SOIL PROFILE AND STRUCTURE FOUNDATION EXPLORATION

PID 91710

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September 2021

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Ohio Department of Transportation

SOIL PROFILE AND

STRUCTURE FOUNDATION EXPLORATION

SUM-8-1.75

(PID #91710)

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Executive Summary

The Ohio Department of Transportation (ODOT) proposes to replace the existing 1,500-ft. long bridge carrying SR8 over the Little Cuyahoga River Valley in Akron, Ohio with parallel NB and SB Bridges. The preferred alternative is a steel girder bridge with six spans. This report also supports the construction of six noise barriers; the realignment of Ramp I and Ramp J at Perkins Street as well as road realignment between Perkins Street at the south end of the project and East Glenwood Avenue at the north end; embankment construction for SR 8 SB; six access roads; crane pad locations; and the two launch pits.

Between June 8th, 2015 and April 13th, 2017, two explorations advanced a total of 93 borings to provide subsurface data for the preliminary design of the project structures and roadway improvements. In adherence with the ODOT Specifications for Geotechnical Exploration (SGE) standards, the borings were designated B-001-0-15 to B-036-0-16, with many offset borings. The depths and intervals of sampling followed ODOT's SGE guidelines for ODOT boring types A, B, D, and E. A geophysical exploration was performed to determine if underground structures were present between stations NB 533+00 (SB 233+00) and NB 538+00 (SB 238+00) and to determine the top of bedrock at the mid-span piers. The geophysical study did not provide good quality data due to vehicle-induced ground vibrations transmitted from SR8 into the ground via the existing bridge supports and because of interference from buried utilities.

The bridge substructures will be supported on a combination of spread footings on bedrock at the Rear Abutments of the NB and SB Bridges; open-ended driven piles at Pier #5 and the Forward Abutments of the NB and SB Bridges, and with drilled shafts at the other substructures.

Embankment construction should not be problematic if the requirements of Section 200 of the ODOT *Construction and Material Specifications* and ODOT Geotechnical Bulletin #2 are followed.

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1.0 INTRODUCTION

The Ohio Department of Transportation (ODOT) proposes to replace the existing 1,500-ft. long bridge carrying SR8 over the Little Cuyahoga River Valley in Akron, Ohio, with parallel NB and SB Bridges. The existing Bridge No. is SUM-8-0199, and the Structure File Number is 7700369. The existing bridge was built in 1953, and the primary feature is a 936-ft long, 3-span deck truss. The deck truss is a critical fracture structure, and both it and the approach spans have undergone numerous repairs in recent years.

The preferred design alternative is a steel girder bridge with five piers and six spans. The existing bridge is to be replaced with parallel NB and SB Bridges. The SB Bridge will be located west of the existing bridge, and the NB Bridge will be constructed along the existing SR8 alignment.

In addition to the bridge replacement recommendations this Structure Foundation Exploration Report provides recommendations for: the construction of six noise barriers; the realignment of Ramp I and Ramp J at Perkins Street; embankment construction for southbound SR8; the realignment of SR 8 between Perkins Street and East Glenwood Avenue at the south and north ends of the project, respectively; the construction of six access roads; crane pads locations; and the NB and SB launch pits. This report includes the combined Soil Profile and Structure Foundation Exploration Sheets for the bridges and noise walls and has been prepared in accordance with ODOT's *Specification for Geotechnical Exploration*, January 2016 & July 2017 (SGE).

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 Geology

The project area is in the center of Summit County in the glaciated portion of northeast Ohio. This project falls within the northern boundary of the Akron-Canton Interlobate Plateau of the Appalachian Plateaus physiographic province and is surrounded by the Killbuck-Glaciated Pittsburgh Plateau. The Akron-Canton Interlobate Plateau is a hummocky area between two converging glacial lobes dominated by kames, kame terraces, eskers, kettles, kettle lakes, and bogs/fens. The region is characterized by deranged drainage paths and includes many natural lakes, with very moderate relief. Bedrock is marked by sandy Wisconsinan-age and older drift over Devonian to Pennsylvanian-age sandstone, conglomerate, and shale.

A search of ODNR's *Mines of Ohio Interactive Mapping* website determined that there are no documented underground mines under the existing or proposed bridges. Industrial materials were surfaced mined approximately 300 feet east of the north abutment under the inactive IM-1027 permit. A search of ODNR's *Ohio Water Wells* website found no wells close enough to the site to provide useful information.

The USDA and NRCS website, *Web Soil Survey*, was reviewed. Selected mapping is presented in Appendix A: Geological Information. The soil units are summarized below.

The Canfield components (map units CfB and CfC) makes up 36.4 percent of the surface area of the defined area of interest. Slopes are generally 2 to 12 percent. These components are on till plains and uplands. The parent material consists of till. Depth to a restrictive root layer, fragipan, is 15 to 30 inches. The natural drainage class is moderately well-drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is low. The shrink-swell potential is low. This soil is generally not prone to flooding or ponding. A seasonal zone of water saturation is at 15 inches during January, February, March, April, November, and December. Organic matter content in the surface horizon is about 3 percent. These soils do not meet hydric criteria. These units are classified as primarily silty loam, falling into AASHTO A-2-4, A-2-6, A-4, A-6, and A-7 series. The plasticity index of cohesive soil is generally lower than 20, and liquid limits range from 22 to 47. These units are identified as "somewhat limited" for road construction with problems due to the shallow depth of saturation and susceptibility to frost action.

The Chili components (map units CuB and CuC) make up 35.1 percent of the surface area of the defined area of interest. Slopes are 2 to 12 percent. These components are on terraces. The parent material consists of loamy outwash. Depth to a restrictive root layer is greater than 60 inches. The natural drainage class is well-drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. The shrink-swell potential is low. These soils are generally not prone to flooding or ponding. The depth of saturation is deeper than 72 inches. Organic matter content in the surface horizon is about 2 percent. These soils do not meet hydric criteria. These units are classified primarily as loam, falling into AASHTO A-1, A-2, and A-4 series. The plasticity index of the cohesive soil is generally lower than 12, and liquid limits range from 15 to 35. These units are identified as "somewhat limited" for road construction with minor problems related to slopes.

The Oshtemo (map unit Rw) component makes up 14.1 percent of the surface area of the defined area of interest. Slopes are 25 to 75 percent. This component is on valley sides on till plains. The parent material consists of sandy outwash. Depth to a restrictive root layer is greater than 60 inches. The natural drainage class is well-drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. The shrink-swell potential is low. This soil is generally not prone to flooding or ponding. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This soil does not meet the hydric criteria. This unit is classified primarily as loam, falling into AASHTO A-2, A-4, and A-6. The plasticity index of cohesive soil is generally lower than 16, and liquid limits range from 12 to 30. The web survey rates this soil as "very limited" for road construction primarily due to problems with slopes and susceptibility to frost action.

The Udorthents (map unit Uf) is a sanitary landfill component that makes up 11.8 percent of the surface area of the defined area of interest. Slopes are varied. Depth to a restrictive root layer is greater than 60 inches. Available water to a depth of 60 inches is very low. The shrink-swell potential is low. This soil is generally not prone to flooding or ponding. There is no zone of water saturation within a depth of 72 inches. This soil does not meet the hydric criteria.

The remaining soils are classified as Urban Land (Ur) and are generally too varied to describe with categorical statements.

Referenced Bibliography

United States Department of Agriculture and Natural Resources Conservation Services, Web Soil Survey, http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Ohio Department of Natural Resources, *Mines of Ohio*, Web Site, https://gis.ohiodnr.gov/website/mrm/OhioMines/

Ohio Department of Natural Resources, *Ohio Water Wells*, Web Site, https://gis.ohiodnr.gov/website/dsw/waterwells/

Ohio Department of Natural Resources, 1998, Physiographic regions of Ohio. Division of Geological Survey, *Ohio Department of Natural Resources Map*. p 2.

Ohio Department of Natural Resources, 2006, Bedrock geologic map of Ohio. Division of Geological Survey, *Ohio Department of Natural Resources Map* BG-1. p 2.

2.2 Site Reconnaissance

The field reconnaissance was performed by Thomas Monaco, P.E. on August 22, 2013. The site varies in elevation by approximately 165 ft. between the SR8 roadway elevation and East North Street at the approximate mid-span of the bridge. The existing slopes were observed to be generally stable but were obscured in many locations due to heavy vegetation. The SUM-8-0175 Bridge is in overall fair condition given its age with some spalling on the bridge deck and piers. Rock outcrops were visible in many locations on the south slope. The outcrops were primarily sandstone, shale, and interbedded sandstone and shale.

Land use adjacent to SR8, north, and south of the bridge, is residential apart from the NE quadrant which is primarily commercial. Land use along East North Street under the bridge is primarily commercial with scattered residential properties. Five railroad corridors, comprising a total of 8 tracks, are situated along the southern valley hillside and generally run parallel to the Little Cuyahoga River.

3.0 EXPLORATION

The explorations conducted for this project were conducted according to specification in ODOT's *Specifications for Subsurface Explorations*, (SGE) for the year of the exploration.

3.1 Historical Exploration

Some historical rod soundings and boring records are available for the existing bridge structures over the Little Cuyahoga River (See Appendix B: Historical Information). The original exploration and bridge construction occurred circa 1948. Bedrock elevations obtained from the historic rod soundings records were taken into consideration in the analysis and recommendations found in Section 5 of this report. A summary of the borings is listed in Table 3.1-1 Historical Exploration Summary.

Table 3.1-1: Historical Exploration Summary

Existing Bridge Substructure	TH No.*	Station	Offset	Ground Elevation	Rock Type	Rock Elevation
Pier #3	B-014-0-48	28+65	14′ LT	960.6	Shale	934.4
Pier #4	B-017-0-48	31+81	54′ RT	861.8	Sandstone	850.0
	B-019-0-48	31+81	36′ LT	857.4	Sandstone	851.4
Pier #5	B-022-0-48	35+38	36′ LT	875.6	Interbedded shale and sandstone	852.6
Pier #6	B-025-0-48	38+18	51′ RT	927.6	-	Not encountered Depth 62.0′
Rear Abutment	R-001-0-48	24+78	48′ RT	1017.2	Sandstone	1009.2
	R-002-0-48	24+78	48′ LT	1016.3	Sandstone	996.3
	R-003-0-48	25+38	48′ LT	1006.5	Sandstone	990.0
	R-004-0-48	25+38	48′ RT	1013.4	Sandstone	1002.9
Pier #1	R-005-0-48	26+10	46′ LT	992.0	Not Identified	982.9
	R-006-0-48	26+14	28′ LT	991.7	Not Identified	984.7
	R-007-0-48	26+16	10′ RT	990.0	Not Identified	990.0
	R-008-0-48	26+23	25′ RT	992.0	Not Identified	988.3
	R-009-0-48	26+26	41′ RT	992.2	Not Identified	987.6
Pier #2	R-010-0-48	27+19	43′ LT	982.7	Not Identified	970.1
	R-011-0-48	27+38	47′ LT	973.0	Not Identified	969.4
	R-012-0-48	27+34	46′ RT	985.2	Not Identified	982.7
	R-013-0-48	27+55	42′ RT	960.9	Not Identified	960.8
Pier #3	R-015-0-48	28+87	52′ RT	949.1	Shale	937.6
	R-016-0-48	28+87	52′ LT	947.0	Shale	937.0
Pier #5	R-021-0-48	35+08	48′ RT	874.5	Shale	857.0
Pier #6	R-023-0-48	38+02	51′ LT	926.8	-	Not encountered Depth 54.0′
	R-024-0-48	38+02	51′ RT	916.0	-	Not encountered Depth 49.5
Pier #7	None					
Forward Abutment	R-026-0-48	39+97	48′ LT	993.5	-	Not encountered Depth 88.0′
	R-027-0-48	40+00	48′ RT	977.4	-	Not encountered Depth 62.0′

Note: * B-014-0-48, B-017-0-48, B-019-0-48, B-022-0-48, and B-025-0-48 refer to historic core borings; and historic drive rod soundings are named as R-001-0-48 through R-022-0-48.

3.2 2013 Project Exploration

Gannett Fleming performed a limited Geotechnical Exploration in 2013 for the Feasibility Study. No borings were advanced, but the historical records were reviewed, and a site visit was performed. The site visit included testing the compressive strength of bedrock outcrops with a Swiss Hammer.

3.3 2015 Project Exploration

The 2015 field exploration was performed for the AER study. The exploration was used to provide subsurface data for the preliminary design of the project structures and roadway improvements. Between June 8th and July 13th of 2015, 47 borings were advanced. In adherence with the ODOT SGE standard, the borings were designated B-001-0-15 to B-032-0-15, with 15 offset borings. The borings included ODOT Type A, B, B1, B2, B4, E1, and E3 borings. With the changing geometry as the project progressed, some of the borings were repurposed. The retaining wall borings were repurposed for Noise Barrier (ODOT type E4) borings once the *Retaining Wall Justification Study* determined that no retaining walls were required. Borings B-008-0-15 and B-009-015 were removed from consideration in the report because of the uncertainty of the as-drilled locations. The logs for these borings are included in Appendix C.

Three rigs were used to advance the borings: a CME-550 ATV rig; a Diedrich D-50 track rig; and a Diedrich D-50 truck rig. Each rig utilized 3-¼ inch diameter hollow stem augers and 2.0 inch outside diameter split spoon samplers. The energy ratio of the hammers of the ATV mounted drill is 81.0%. The energy ratios of the Diedrich D-50 rigs are 80.6% and 80.3%, respectively. The date of calibration of all three hammers was April 4th, 2015. The soil sampling was performed by Ridgeway Drilling Inc., and with some of the rock corings performed by Armstrong Drilling, Inc. under Ridgeway Drilling Inc guidance. All field samples were sealed in glass jars and transported to the Cardno ATC laboratory in Brecksville, Ohio for testing. The borings were backfilled with bentonite chips and auger cuttings.

3.3.1 2015 Geophysical Exploration

A geophysical exploration was performed on November 30th and December 1st, 2015, to determine if underground structures were present between stations NB 533+00 (SB 233+00) and NB 538+00 (SB 238+00), and to determine the top of bedrock at the mid-span piers. This exploration was preferred to avoid complications associated with the drilling of boulder zones and potentially contaminated soils.

On November 30th, 2015 (night 1), an MASW (multichannel analysis of surface waves) investigation was completed on Lines 1, 2 and E shown in Figure 3.3-1. The MASW data was characterized by relatively poor data quality. The data on Line 1 was not usable; about 50% of the data on Line 2 was usable, but less than 50% of the data on Line E was usable. GF believes that this was caused by vehicle-induced ground vibrations transmitted from SR8 into the ground via the bridge supports. The field crew noticed an uptick in truck traffic soon after midnight, and the vibrations were observed as noise on the seismograph's noise monitor. Furthermore, it is unclear whether subsurface conditions such as abrupt lateral changes in density may also be a contributing factor to poor data quality. A representative poor-quality data dispersion curve is shown in Figure 3.3.-2.

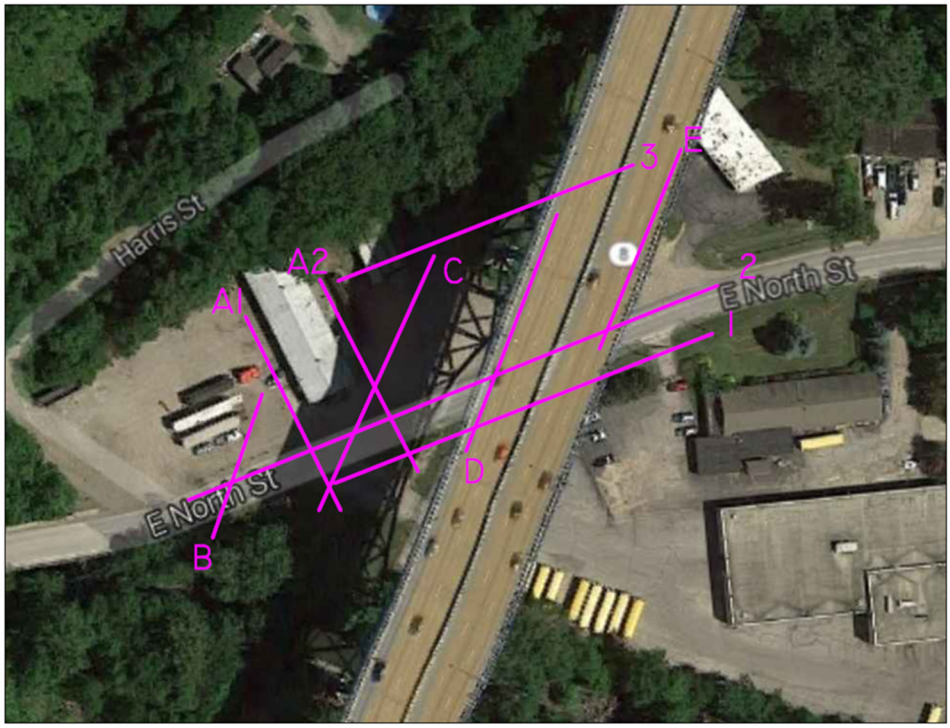

Figure 3.3-1: Proposed Lines of Geophysical Exploration

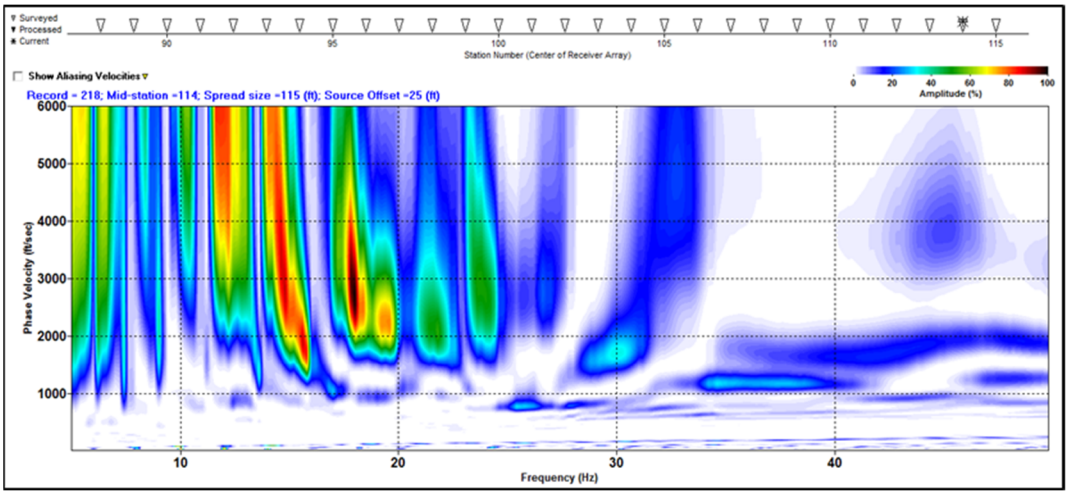

Figure 3.3-2: Poor Quality Data Dispersion Curve

Good data is characterized by a single distinct curve like the one shown in Figure 3.3-3 (not from the SUM-8-1.75 exploration):

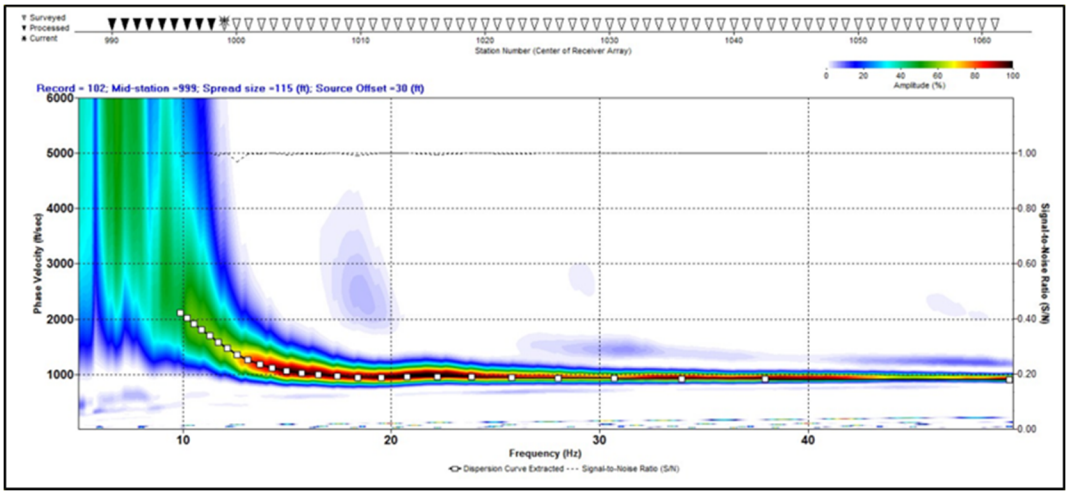

Figure 3.3-3: Good Quality Data Dispersion Curve (not from SUM-8-1.75 exploration.)

After obtaining poor data, GF decided to gather MASW data for a second night, concentrating on lines that were located further away from the overhead bridge. These lines were A1, A2, and B and C, as shown in Figure 3.3-1. Unfortunately, there was no significant improvement in MASW data from the first night.

In addition to the MASW on the second night, 2D electrical resistivity imaging (ERI) was conducted along Line B shown in Figure 3.3-1. The profile graphic along Line B is shown in Figure 3.3-4.

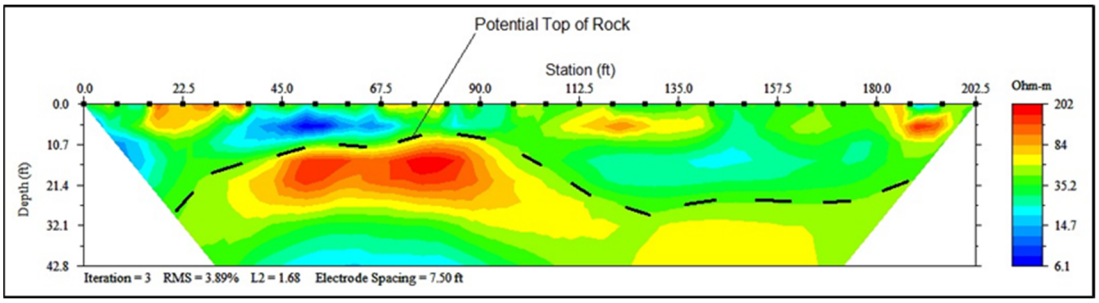

Figure 3.3-4: Top of Rock on Line B

This profile is characterized by good data quality (RMS, a measure of error, is less than 10%, and L2, a measure of the correlation between the model and the observed data, is almost 1). The potential bedrock surface is highlighted in black dashes. Top of rock generally coincides with a laterally continuous horizon characterized by a high gradient (significant change in electrical resistivity over a short depth interval). Line B starts near Boring B-011-0, which reports top of the rock at 19.5 ft. The line trends across East North Street in the direction of boring B-013-1-15 which reports top of the rock at > 60 ft. Line B stops about 275 +/- ft. from B-013-1-15. Potential top of the rock in Line B is a good estimate of the bedrock surface, based upon what is known about the behavior of rock in electrical resistivity data and collaboration with nearby borings.

It was determined, however, that Line B was the only location where reasonably good ERI data could be expected – the remaining, planned geophysical lines were located over apparent buried utilities/piping, which impacts ER data (according to observations by the field crew).

Without sufficient good quality data to work with, a 2D profile of the subsurface to observe the top of the rock surface. Therefore, it was decided that it would not be prudent to continue the geophysical investigation.

3.4 2016 Project Exploration

The primary goal of the 2016 field exploration was to support the Stage I submission. Additional borings were advanced based on the 2015 exploration recommendations to determine the bedrock elevations at the footprint of each substructure where the top of rock varied substantially in the 2015 borings.

The 2016 exploration advanced borings for the design of the six segments of Noise barriers. Borings were also advanced for the proposed storm sewer trunk

line that will be bored under the existing railroad lines to the west of the SB Bridge.

Between December 27, 2016, and April 13, 2017, 46 exploratory borings were advanced. The borings were designated B-001-3-16 to B-036-0-16, with many offset borings. The depths and intervals of sampling followed ODOT's SGE guidelines for boring types D, E1, E3, and E4. There were a total of seven underground utility borings (ODOT type D), 12 bridge borings (ODOT type E1), and 27 noise barrier borings (ODOT type E4). The stations and offsets of the borings can be found on the logs in Appendix C: Boring Logs and Rock Core Photos and Appendix E: Structural Foundation Exploration Sheets.

Four rigs were utilized to advance the borings, a CME 55X Drill rig, CME 55 Drill rig, Dietrich D-50 Drill rig, and a mobile B-57 Drill rig. Each rig utilized 3-¼ inch-diameter hollow stem augers and 2.0 in. outside diameter Split Spoon Samplers. The energy ratio of the hammers of the CME 55X Drill rig, CME 55 Drill rig, Dietrich D-50 Drill rig, and Mobile B-57 Drill rig were 88.1 %, 81.8 %, 81.2 %, and 89.7 %. The date of the calibration of both hammers of CME 55X and CME 55 Drill rigs is December 8th, 2015; and the date of the calibration of both hammers of Dietrich D-50 and Mobile B-57 Drill rigs is May 7th, 2015. The soil sampling of borings was performed by National Engineering & Architectural Services, Inc. (NEAS, Inc.). All field samples were sealed in glass jars and transported to NEAS, Inc. laboratory in Columbus, OH for testing.

3.5 2017 Project Exploration

The 2017 field exploration was performed for the Stage II design of the project structures and roadway. The exploration was used to provide subsurface data for the design of access road and bridge launch pit.

Between March 27th, 2018 and April 5th, 2018, seven (7) exploratory borings were advanced. The borings were designated B-011-6-17, B-015-2-17, B-037-0-17, B-038-0-17, B-017-2-17, B-020-2-17 to B-020-3-17. The depths and intervals of sampling followed ODOT's SGE guidelines for boring types B5 and E1. A total of four B5 borings and three E1 borings were advanced. The stations and offsets of the borings can be found on the logs in Appendix C: Boring Logs, Appendix E: Structural Foundation Exploration Sheets.

ATV CME 550 rig was utilized to advance the borings. The rig utilized 3-¼ in. diameter hollow stem augers and 2.0 in. outside diameter Split Spoon Samplers. The energy ratio of the hammers of the ATV CME 550 rig was 80.3 %. The date

of the calibration of the hammer of CME 550 Drill rigs is January 10th, 2017. The soil sampling of borings was performed by TTL Associates, Inc. All field samples were sealed in glass jars and transported to TTL Associates, Inc. laboratory for testing.

3.6 2019 Project Exploration

The 2019 field exploration was performed for the final design of the project structures. The exploration was used to verify the rock elevation at each drilled shaft location.

Between June 4th, 2019 and July 1st, 2019, six (6) exploratory borings were advanced. The borings were designated B-008-1-19, B-009-5-19, B-009-6-19, B-009-7-19, B-011-7-19, and B-011-8-18. The depths and intervals of sampling for borings B-008-1-19, B-009-5-19 B-008-1-19, B-009-5-19, B-009-6-19, B-009-7-19, B-011-7-19, and B-011-8-19, B-009-6-19, and B-009-7-19 followed ODOT's SGE guidelines for boring types E1. In order to overcome difficult drilling conditions that caused early termination of boring B-011-1-15 in the past, the drilling for borings B-011-7-19 and B-011-8-19 were performed with a sonic drill rig, and no soils were sampled. The stations and offsets of the borings can be found on the logs in Appendix C: Boring Logs, Appendix E: Structural Foundation Exploration Sheets.

A CME 850R tracked rig was utilized to advance the borings B-008-1-19, B-009-5-19, B-009-6-19, and B-009-7-19. The rig utilized 3.75 in. diameter hollow stem augers and 2.0 in. outside diameter Split Spoon Samplers. The energy ratio of the hammer on the rig was 81%. The date of the calibration of the hammer of CME 850R tracked rig is June 1st, 2017. The soil sampling of borings was performed by the Ohio Department of Transportation (ODOT) Exploration and Lab. All field samples were sealed in glass jars and transported to the ODOT laboratory for testing.

Frontz Drilling Inc. utilized a Versa Sonic Rig to advance borings B-011-7-19 and B-011-8-19. The main purpose of these borings was to verify the top of rock elevation. As previously stated, the soil was not sampled.

In addition, a geophysical exploration was performed by ODOT in 2019 to confirm the top of rock elevation encountered in the borings. Results of this exploration are presented in a separate report.

3.7 Laboratory Testing

In the laboratory, all soil samples were visually classified and tested for natural moisture content. Complete classifications (grain size gradations, 2-hour hydrometer, and liquid and plastic limits) were performed on selected fine-grained material. Grain-size analyses were performed on selected non-plastic samples, and sulfate content analyses were performed on selected ODOT type A and type B pavement borings. Hand penetrometer readings were taken in the field. A summary of the laboratory testing samples is presented in Table 3.4.1-1; sulfate testing results can be found in Table 3.4.1-2.

Bedrock samples were selected for unconfined compressive strength, and the results of the testing can be found in Table 3.4.1-3. All testing data can be found on the boring logs in Appendix C: Boring Logs and Rock Core Photos.

Table 3.6-1: Soil Classification Testing

SOIL CLASSIFICATION	AVERAGE GROUP INDEX	MECHANICAL CLASSIFICATION	VISUAL CLASSIFICATION
A-1-a	0	1	11
A-1-b	0	58	152
A-2-4	0	15	37
A-2-6	0	0	19
A-3	0	33	79
A-3a	0	26	56
A-4a	15	69	92
A-4b	23	21	49
A-6a	26	23	28
A-6b	19	21	37
A-7-6	3	8	12

Table 3.6-2: 2015 Sulfate Content Testing

Boring Identification No.	Depth ft.	Sulfate Content PPM
B-001-0-15	1.0-2.5	400
B-003-0-15	6.0-6.3	300
B-021-0-15	1.0-2.5	800
B-022-0-15	1.0-2.5	700
B-024-0-15	1.0-2.5	300
B-029-0-15	1.0-2.5	400
B-030-0-15	1.0-2.5	600
B-031-0-15	1.0-2.5	800
B-032-0-15	2.5-4.0	300
B-001-2-15	1.0-2.5	400
B-004-4-15	3.5-5.0	1000
B-001-1-15	1.0-2.5	400
B-003-3-15	3.5-5.0	500
B-004-3-15	1.0-2.5	300

Table 3.6-3: Rock Testing Summary-1

BORING NO.	SAMPLE	DEPTH	QU (PSI)
B-003-1-15	NX-1	10.1′ – 10.6′	5010
	NX-1	11.9′ – 12.5′	5120
B-003-5-15	NX-1	13.4′ – 13.9′	4230
	NX-1	14.4′ – 15.0′	4830
B-006-0-15	NX-1	19.0′ – 19.5′	5560
B-007-0-15	NX-2	18.8′ – 19.2′	5120
	NX-3	24.6′ – 25.4′	6200
B-010-0-15	NX-3	28.5′ – 29.0′	4380
	NX-6	41.8′ – 42.2′	3840
B-010-1-15	NX-8	41.8′ – 42.4′	3440
B-011-0-15	NX-1	26.3′ – 26.9′	3840
	NX-6	47.2′ – 47.8′	3910
B-012-0-15	NX-5	41.4′ – 41.8′	6300
B-013-0-15	NX-4	51.5′ – 52.1′	6740
	NX-4	55.3′ – 56.0′	5280
B-005-1-16	NQ2-2	37.5′ – 37.9′	4680
B-005-2-16	NQ2-1	25.2′ – 25.6′	4111
B-006-1-16	NQ2-1	16.6′ – 17.0′	4737
	NQ2-2	25.2′ – 25.6′	4635
B-007-2-16	NQ2-3	49.5′ – 49.9′	9344
B-009-1-16	NQ2-3	47.7′ – 48.1′	18462
	NQ2-6	62.4′ – 62.8′	9789
B-009-4-16	NQ2-1	32.3′ – 32.7′	7964
B-011-2-16	NQ2-3	44.1′-44.5′	3331
	NQ2-4	48.1′ – 48.4′	10278
	NQ2-5	52.9′ – 53.2′	8084
B-011-4-16	NX-1	50.0′ – 50.4′	2492
B-011-5-16	NQ-2	48.7′ – 49.1′	1384
	NQ-3	54.8′ – 55.2′	12128
B-013-2-16	NQ2-3	53.4′ – 53.8′	683
	NQ2-4	55.8′ – 56.2′	11709
	NQ2-5	63.4′-63.8′	942
B-013-3-16	NX-2	51.3′ – 51.6′	10916
B-013-4-16	NQ-1	47.8′ – 48.2′	12151
	NQ-3	62.1′ – 62.5′	11803
	NQ-4	68.5′-63.9′	3028
B-013-5-16	NX-1	71.6′ – 72.0′	9267
	NX-3	75.0′ – 75.4′	24283
B-030-1-16	NQ2-1	29.3′ – 29.7′	5184
B-031-3-16	NQ2-1	16.7′ – 17.1′	3826

Table 3.6-3: Rock Testing Summary-1

BEDROCK TEST SUMMARY				
BORING NO.	SAMPLE	DEPTH	QU (PSI)	SI (PSI)
B-008-1-19	NQ2-3	33.1' - 34.6'		1571
	NQ2-4	39.3' - 40.3'		1719
	NQ2-4	41.2' - 41.6'	2800	
	NQ2-5	46.6' - 47.0'	6090	
	NQ2-5	47.4' - 47.7'	808	
	NQ2-6	48.3' - 50.1'		1642
	NQ2-7	54.2' - 54.6'	5320	
	NQ2-7	54.7' - 55.1'	5450	
	NQ2-8	58.1' - 58.5'	1379	
	NQ2-8	59.5' - 59.9'	1587	
B-009-5-19	NQ2-2	14.9' - 15.3'	4630	
	NQ2-3	17.6' - 18.0'	5110	
	NQ2-4	21.8' - 22.7'		627
	NQ2-5	30.6' - 31.4'		1184
	NQ2-6	31.8' - 32.8'		1286
	NQ2-7	38.0' - 39.4'		1028
B-009-6-19	NQ2-2	23.2' - 24.2'		842
	NQ2-3	27.5' - 28.4'		1220
	NQ2-3	30.5' - 30.9'	6387	
	NQ2-3	31.0' - 31.4'	12996	
	NQ2-4	35.2' - 35.6'	1240	
	NQ2-4	35.7' - 36.1'	1656	
	NQ2-5	39.5' - 39.9'	1823	
B-009-7-19	NQ2-2	33.7' – 34.1'	13112	
	NQ2-3	36.3' - 39.0'		1753
	NQ2-3	36.4' - 36.8'	1783	
	NQ2-5	49.4' - 49.9'	1985	
	NQ2-6	51.1' - 51.6'		28950
	NQ2-6	52.5' - 52.9'	2012	
B-011-7-19	NX-1	30.6' - 31.0'	13190	
	NX-1	32.5' - 32.9'	19920	
	NX-2	36.3' - 37.6'		3006
B-011-8-19	NX-1	51.9' - 52.7'	5380	
	NX-2	56.4' - 57.6'	5110	
	NX-3	65.1' - 65.7'	5140	

4.0 FINDINGS

All the boring logs in 8.5" x 11" format and rock core photos can be found in Appendix C: Boring Logs and Rock Core Photos. The boring locations are shown in Appendix E: Soil Profile Sheets. Table 4.0-1 summarizes the purpose of the project borings.

Table 4.0-1: Project Boring Summary

Boring Purpose		Boring ID
Roadway Recommendations (ODOT Type A, B1, B4)		B-001-0-15, B-001-1-15, B-001-2-15, B-002-0-15, B-003-0-15, B-003-2-15, B-003-3-15, B-003-7-15, B-004-0-15, B-004-3-15, B-004-4-15, B-005-0-15, B-018-0-15 B-019-0-15, B-020-0-15, B-021-0-15, B-022-0-15, B-024-0-15, B-027-0-15, B-028-0-15, B-029-0-15, B-030-0-15, B-031-0-15, B-032-0-15
Rear Abutment (South) (ODOT Type E1)	NB SB	B-005-1-16, B-006-0-15 B-005-2-16, B-007-0-15
Pier #1 (ODOT Type E1)	NB SB	B-009-5-19 B-008-1-19, B-009-1-16
Pier #2 (ODOT Type E1)	NB SB	B-009-7-19, B-010-0-15 B-009-6-19, B-011-0-15
Pier #3 (ODOT Type E1)	NB SB	B-010-1-15, B-010-2-15, B-011-2-16, B-011-3-16, B-011-7-19 B-011-1-15, B-011-4-16, B-011-5-16, B-011-8-19
Pier #4 (ODOT Type E1)	NB SB	B-012-0-15, B-013-2-16, B-013-3-16 B-013-0-15, B-013-1-15, B-013-4-16, B-013-5-16
Pier #5 (ODOT Type E1)	NB SB	B-015-0-15 B-014-0-15, B-015-1-16
Forward Abutment (North) (ODOT Type E1)	NB SB	B-017-0-15 B-016-0-15
Bridge Launch Pit (ODOT Type E1)		B-017-2-17, B-020-2-17, B-020-3-17
Noise Barrier 1A & 1B (ODOT Type E4)		B-021-2-16, B-023-0-15, B-025-0-15, B-025-3-16, B-026-0-15, B-030-1-16, B-031-1-16, B-031-3-16, B-033-0-16, B-034-0-16, B-035-0-16, B-036-0-16
Noise Barrier 2A & 2B (ODOT Type E4)		B-021-3-16, B-025-1-16, B-027-0-15, B-029-1-16, B-031-2-16, B-031-4-16, B-032-2-16
Noise Barrier 3 (ODOT Type E4)		B-001-5-16, B-003-4-16, B-003-8-16, B-004-2-16, B-004-6-16, B-005-2-16
Noise Barrier 4 (ODOT Type E1)		B-001-3-16, B-001-4-15, B-003-1-15, B-003-5-15, B-003-6-15, B-004-1-16, B-004-5-16, B-005-1-16
Underground Utility (ODOT Type D)		B-006-1-16, B-007-1-16, B-007-2-16, B-009-2-16, B-009-3-16, B-009-4-16, B-025-2-16
Access Road (ODOT Type B5)		B-011-6-17, B-015-2-17, B-037-0-17, B-038-0-17

Table 4.0-2: Project Boring of Bedrock Summary

Boring ID	TOR. Depth (FT.)	TOR Elev.	Begin Core at Depth (FT.)	Begin Core Elev.	Boring Depth (FT.)	Bottom of Boring Elev.	Rock Type
B-001-0-15	4.5	1029.6			6.2	1027.9	Sandstone
B-001-1-15	8.5	1044.2			11.2	1041.5	Sandstone
B-001-2-15	6.0	1044.5			11.4	1039.1	Sandstone
B-001-3-16	8.5	1045.5	14.0	1040.0	24.0	1030.0	Sandstone
B-001-4-15	6.5	1048.8			13.7	1041.6	Sandstone
B-001-5-16	7.0	1053.1	15.5	1044.6	20.5	1039.6	Sandstone
B-002-0-15	2.0	1033.6			3.7	1031.9	Sandstone
B-003-0-15	3.8	1033.8			6.3	1031.2	Sandstone
B-003-1-15	8.5	1047.9	9.5	1046.9	14.5	1041.9	Sandstone
B-003-2-15	4.0	1049.4			8.6	1044.8	Sandstone
B-003-3-15	7.0	1030.5			8.8	1028.7	Sandstone
B-003-4-16	6.5	1049.5	10.2	1045.8	15.2	1040.8	Sandstone
B-003-5-15	10.0	1042.3	10.0	1042.3	15.0	1037.3	Sandstone
B-003-6-15	2.0	1047.2			9.2	1040.0	Sandstone
B-003-7-15	6.0	1039.5			8.6	1036.9	Sandstone
B-003-8-16	5.5	1043.9	9.0	1040.4	14.0	1035.4	Sandstone
B-004-0-15	2.2	1036.7			3.7	1035.2	Sandstone
B-004-1-16	5.6	1036.4	13.5	1028.5	18.5	1023.5	Sandstone
B-004-2-16	4.9	1037.0	10.0	1031.9	15.0	1026.9	Sandstone
B-004-3-15	4.5	1035.2			6.2	1033.5	Sandstone
B-004-5-16	15.6	1021.2	15.6	1021.2	25.6	1011.2	Sandstone
B-004-6-16	3.7	1018.1	8.5	1013.3	13.5	1008.3	Sandstone
B-005-0-15	6.0	1018.3			8.7	1015.7	Sandstone
B-005-1-16	22.0	1014.6	25.3	1011.3	50.3	986.3	Sandstone
B-005-2-16	12.5	1000.0	15.7	996.8	25.7	986.8	Sandstone
B-006-0-15	16.5	1004.0	19.0	1001.5	29.0	991.5	Sandstone
B-006-1-16	10.5	992.4	15.2	987.7	30.2	972.7	Sandstone
B-007-0-15	14.5	987.4	16.0	985.9	26.0	975.9	Sandstone
B-007-1-16	21.0	972.7	32.0	961.7	37.0	956.7	Sandstone
B-007-2-16	25.5	935.1	25.5	935.1	57.0	903.6	Shale, Siltstone
B-008-1-19	25.3	933.0	24.0	934.3	68.0	890.3	Shale, Sandstone
B-009-1-16	26.0	931.7	37.0	920.7	77.5	880.2	Shale, Siltstone
B-009-3-16	30.3	880.5			36.5	874.3	Shale
B-009-4-16	25.5	857.2	30.2	852.5	40.2	842.5	Shale
B-009-5-19	1.5	958.8	8.5	951.8	41.5	918.8	Shale, Sandstone
B-009-6-19	22.4	858.9	19.5	861.8	42.5	838.8	Shale, Sandstone
B-009-7-19	32.0	853.2	25.0	860.2	55.0	830.2	Shale, Sandstone

Boring ID	TOR. Depth (FT.)	TOR Elev.	Begin Core at Depth (FT.)	Begin Core Elev.	Boring Depth (FT.)	Bottom of Boring Elev.	Rock Type
B-010-0-15	23.5	855.7	21.5	857.7	45.0	834.2	Sandstone, Shale
B-010-1-15	41.4	833.6	18.0	857.0	45.0	830.0	Shale, Sandstone
B-011-0-15	16.5	862.7	25.0	854.2	50.0	829.2	Shale, Sandstone
B-011-2-16	28.0	844.6	31.8	840.8	71.0	801.6	Shale, Siltstone
B-011-3-16	30.0	843.8	35.5	838.3	45.5	828.3	Shale, Siltstone
B-011-4-16	42.8	832.2	45.0	830.0	55.0	820.0	Shale, Siltstone
B-011-5-16	37.5	837.7	40.0	835.2	80.0	795.2	Shale, Siltstone
B-011-7-19	28.7	843.9	30.0	842.6	50.0	822.6	Shale, Siltstone, Limestone
B-011-8-19	40.0	835.0	50.0	825	70.0	805.0	Shale, Siltstone
B-012-0-15	13.5	866.7	21.9	858.3	45.9	834.3	Shale, Sandstone
B-013-0-15	36.0	841.6	39.0	838.6	61.0	816.6	Shale, Sandstone
B-013-2-16	29.0	851.5	15.6	864.9	85.0	795.5	Shale, Siltstone
B-013-3-16	43.5	842.0	46.0	839.5	56.0	829.5	Siltstone, Shale
B-013-4-16	44.4	841.1	45.5	840.0	85.5	800.0	Shale, Siltstone
B-013-5-16	71.5	842.0	71.5	842.0	77.0	836.5	Siltstone, Shale
B-023-0-15	39.0	973.4			43.7	968.7	Sandstone
B-025-0-15	9.5	995.4			18.6	986.3	Sandstone
B-025-3-16	8.0	995.3			21.5	981.8	Sandstone
B-026-0-15	13.5	994.2			13.6	994.1	Sandstone
B-027-0-15	33.5	991.6			38.6	986.5	Sandstone
B-028-0-15	3.5	997.6			8.6	992.5	Sandstone
B-029-1-16	17.5	1007.7			25.3	999.9	Sandstone
B-030-1-16	23.0	1000.1	28.0	995.1	33.0	990.1	Sandstone
B-031-1-16	15.0	1008.1	15.5	1007.6	20.5	1002.6	Sandstone
B-031-2-16	22.0	1003.7			25.3	1000.4	Sandstone
B-031-3-16	5.0	1017.2	15.5	1006.7	20.5	1001.7	Sandstone
B-031-4-16	14.5	1020.6	20.3	1014.8	35.3	999.8	Sandstone
B-032-0-15	5.0	1016.9			5.3	1016.6	Sandstone
B-032-1-16	1.4	1019.5			22.0	998.9	Sandstone
B-032-2-16	7.5	1034.0	10.3	1031.2	20.3	1021.2	Sandstone
B-033-0-16	15.0	1019.4			25.2	1009.2	Sandstone
B-034-0-16	15.0	1021.7			25.2	1011.5	Sandstone
B-035-0-16	12.5	1023.9			25.2	1011.2	Sandstone
B-036-0-16	12.5	1021.8			25.3	1009.0	Sandstone

4.1 Bridge Borings

Borings B-005-1-16, B-005-2-16, B-006-0-15, B-007-0-15, B-008-1-19, B-009-1-16, B-009-5-19, B-009-6-19, B-009-7-19, B-010-0-15, B-010-1-15, B-010-2-15, B-011-0-15, B-011-1-15, B-011-1-16, B-011-2-16, B-011-3-16, B-011-4-16, B-011-5-16, B-011-7-19, B-011-8-19, B-012-0-15, B-013-0-15, B-013-1-15, B-013-2-15, B-013-3-15, B-013-4-15, B-013-5-15, B-014-0-15, B-015-0-15, B-015-1-15, B-016-0-15, B-017-0-15, B-017-2-10, B-020-2-17, and B-020-3-17 were advanced for the proposed bridges carrying SR8 over the Little Cuyahoga River.

4.1.1 Rear (South) Abutments

Borings B-005-1-16 and B-006-0-15 are near the NB Bridge Rear Abutment; B-005-2-16 and B-007-0-15 are near the SB Bridge Rear Abutment. Most of the soil encountered is granular. The relative density of the soil is loose to dense by N_{60} values and is classified as gravel with sand (ODOT A-1-b), coarse and fine sand (ODOT A-3a), and fine sand (ODOT A-3). An exception can be found in Boring B-005-1-16. Although this boring contains some amounts of A-1-b and A-3a soils, most of the material observed is fine-grained, cohesive soil (ODOT A-4a) that is very stiff to hard according to pocket penetrometer readings. Both borings of B-006-0-15 and B-007-0-15 encountered an uncontrolled fill layer at the surface that consisted of boulders, asphalt, and coal fragments.

Weathered sandstone was encountered at elevations 1004.0, 1014.6, 987.4, and 1000 in borings B-006-0-15, B-005-1-16, B-007-0-15, and B-005-2-16, respectively. Competent sandstone was encountered at elevation 1002.0 in boring B-006-0-15 with 98% recovery and an RQD of 72%, at elevation 1006.3 in boring B-005-1-16 with 98% recovery and an RQD of 85%, at elevation 985.9 in boring B-007-0-15 with 90% recovery and an RQD of 80%, and at elevation 996.8 in boring B-007-0-15 with 85% recovery and an RQD of 31%.

4.1.2 Pier Borings

4.1.2.1 Pier #1

B-009-5-19 is located near Pier #1 of the proposed NB Bridge; and borings B-008-1-19 and B-009-1-16 are located near Pier #1 of the proposed SB Bridge. Most of the soil of the borings is non-plastic and/or granular. The relative density of the soil by N_{60} values is medium dense to very dense, and the soil is classified as gravels and/or sand (ODOT A-1, A-2, and A-3 series). Boulder zones are found to exist above the top of the rock.

At the SB Bridge, boring B-008-1-19 finds interbedded siltstone and shale bedrock at elevations 933.0. The bedrock consists of shale with 97% recovery and an RQD of 45%. Boring B-009-1-16 finds weathered bedrock (shale) at elevation 931.7, and competent bedrock at elevation 920.7. The competent bedrock consists of shale and siltstone with 90% recovery and an RQD of 29%.

Boring B-009-5-19 finds weathered bedrock (sandstone) at elevation 958.8, and competent bedrock at elevation 951.8. The competent bedrock consists of sandstone, with 100% recovery and an RQD of 75%, and interbedded shale and sandstone at elevation 941.7 with 90% recovery and an RQD of 37%. The absence of the sandstone at the SB Bridge Pier #1 suggests that the sandstone may have acted to protect the underlying rock from weathering and may explain the difference in the top of the rock observed in B-009-0-15 and B-009-1-16. It is possible, and perhaps likely, that the sandstone is not present across the entire footing area of the NB Bridge.

4.1.2.2 Pier #2

Borings B-009-6-19, B-009-7-19, B-010-0-15, and B-011-0-15, are near Pier #2 of the proposed NB and the SB Bridges. The near-surface soil consists of two to six feet of gravel (ODOT A-1 and A-2 series). At boring B-009-7-19, B-010-0-15, and B-011-0-15, the gravel layer is overlaying medium stiff to hard cohesive soils. At boring B-009-6-19, layers of dense sandy silt (A-4A), and stiff silt and clay (A-6A) were found beneath the gravel layer. Below the cohesive layer, boulder zones are found to exist above the top of the rock.

Near Pier #2 of NB Bridge, Boring B-009-7-19 finds competent bedrock at elevation 853.2. The competent rock consists of sandstone with 100% recovery and an RQD of 79%, and interbedded sandstone (60%) and shale (40%) with 99% recovery and an RQD of 85%. Boring B-010-0-15 finds competent bedrock at elevations 855.7. The competent rock consists of shale with 63% recovery and an RQD of 31%, sandstone with 98% recovery and an RQD of 63%, and shale with 100% recovery and an RQD of 94%.

Near Pier #2 of the SB Bridge, Boring B-009-6-19 finds competent bedrock at elevations 858.9. The competent rock consists of interbedded shale (70%) and sandstone (30%) with 93% recovery and an RQD of 55%, sandstone with 100% recovery and an RQD of 100%, and of interbedded sandstone (60%) and shale (40%) with 97% recovery and an RQD of 45%. Boring B-011-0-15 finds weathered rock (shale) at elevation 862.7, and competent bedrock is at elevations 855.5. The competent bedrock consists of interbedded shale (60%) and sandstone (40%) with 99% recovery and an RQD of 96%.

4.1.2.3 Pier #3

Borings B-011-2-16, B-011-3-16, and B-011-7-19 are located near Pier #3 of the NB Bridge. Most of the soil of the borings is granular. The relative density of the soil by N_{60} values is medium dense to very dense, and the soil is classified as gravels and/or sand (ODOT A-1, A-2, and A-3 series). Boulder zones are found to exist above the top of the rock.

Boring B-011-2-16 finds weathered bedrock (shale) at elevation 844.6 and competent bedrock at elevations 840.8. The competent rock consists of interbedded siltstone (16%) and shale (84%) with 100% recovery and an RQD of 53%.

Boring B-011-3-16 finds weathered bedrock (shale) at elevation 843.8 and competent bedrock at elevations 838.3. The competent rock consists of interbedded shale (69%) and siltstone (31%) with 99% recovery and an RQD of 47%.

Boring B-011-7-19 finds competent bedrock at elevation 843.9. The competent rock consists of interbedded siltstone and shale with 66% recovery and an RQD of 40%, limestone with 66% recovery and an RQD of 40%, and interbedded shale (56%) and siltstone (44%) with 85% recovery and an RQD of 31%.

Borings B-011-4-16, B-011-5-16, and B-011-7-19 are located near Pier #3 of the SB Bridge. Boring B-011-4-16 and B-011-7-19 encounter mostly granular material. The relative density of the soil by N_{60} values is medium dense to very dense, and the soil is classified as gravels and/or sand and/or silt (ODOT A-1, A-2, and A-4 series). Boring B-011-5-16 encounters sandy silt (ODOT A-4 series) and stone fragments with/or sand and/or silt (ODOT A-1 and A-2 series) over silt and clay (ODOT A-6A). The relative density of the soil by N_{60} values is medium dense to very dense, very stiff to hard according to pocket penetrometer readings. Boulder zones are found to exist above the top of the rock.

Boring B-011-4-16 finds weathered bedrock (shale) at elevation 832.2 and competent bedrock at elevations 830.0. The competent rock consists of interbedded siltstone (37%) and shale (63%) with 98% recovery and an RQD of 72%.

Boring B-011-5-16 finds weathered bedrock (shale) at elevation 837.7 and competent bedrock at elevations 835.2. The competent rock consists of interbedded shale (75%) and siltstone (25%) with 99% recovery and an RQD of

71%.

Boring B-011-8-19 finds weathered bedrock (siltstone) at elevation 835.0, and competent bedrock at elevations 825.7 The competent rock consists of interbedded shale (45%), siltstone (40%), and claystone (15%) with 74.5% recovery and an RQD of 22%. Borings B-010-1-15, B-010-2-15, and B-011-1-15, were advanced at previous iterations of the NB and SB Bridge pier locations or terminated early and thus were not used to develop the subsurface conditions at the piers, for the complete logs, see Appendix C.

4.1.2.4 Pier #4

Borings B-013-2-16 and B-013-3-16 are located near Pier #4 of the NB Bridge. Most of the soil of the borings is granular. The relative density of the soil by N_{60} values is very loose to medium dense at boring B-013-2-16 and loose to very dense at boring B-013-3-16. In both borings, relative density generally increased with depth. This soil is classified as gravels and/or sand (ODOT A-1, A-2, and A-3 series).

Boring B-013-2-16 finds weathered bedrock (shale) at elevation 851.5 and competent bedrock at elevations 836.8. The competent rock consists of interbedded siltstone and shale with 95% recovery and an RQD of 64%.

Boring B-013-3-16 finds weathered bedrock (shale) at elevation 842.0 and competent bedrock at elevations 839.5. The upper competent rock stratum is siltstone with a recovery of 99% and RQD 78%. The lower stratum is interbedded shale (69%) and siltstone (31%) with 78% recovery and an RQD of 26%.

Borings B-013-4-16 and B-013-5-16 are located near Pier #4 of the Southbound Bridge. The near-surface soil of Sandy Silt and Silt (ODOT A-4a and A-4b) that is plastic to a depth of 5.5 feet and non-plastic to a depth of 18 feet. The plastic sandy silt has a consistency of stiff to hard, and the non-plastic silt and sandy silt is very loose to medium dense. The strata below the sandy silt strata the soil is composed of loose to very dense gravels (ODOT A-1 and A-2 series) to the top of the rock. Boring B-013-4-16 finds competent interbedded shale (65%) and siltstone (35%) at elevation 841.1 with 98% recovery and an RQD of 76%.

The soil in boring B-013-5-16 consists of 5.5 feet of fill overlaying primarily plastic silts (ODOT A-4b) to the top of the rock. The consistency of the silt is medium stiff to very stiff. There is a 10.5-foot-thick granular stratum at a depth

of 43 feet that has a loose to dense relative density and is composed of ODOT A-2 and A-3 series material. Boring B-013-5-16 finds interbedded shale (85%) and siltstone (15%) at elevation 842.0 with a recovery 76% and RQD 20%.

Borings B-012-0-15, B-013-0-15, B-013-1-15, were advanced at previous iterations of the NB and SB Bridge pier locations and were not used to develop the subsurface conditions at the piers, for complete logs, see Appendix C.

4.1.2.5 Pier #5

Boring B-015-0-15 is located near Pier #5 of the NB Bridge. Very loose to dense, fill consisting of granular soil extends to a depth of 15.3 feet. The underlying natural soils are primarily granular. With the notable exception of very soft to stiff strata of cohesive soil sandy silt and silty clay from a depth of 22 feet to 62.5 feet. The relative density of the granular soils by N_{60} are very loose to very dense with the soil beneath the cohesive stratum being dense to very dense. The boring was terminated at a depth of 95 feet without encountering bedrock.

Boring B-015-1-16 is located near Pier #5 of the SB Bridge. There is 20.5 feet of fill and uncontrolled fill. Based on an Exploratory Environmental Site Assessment (ESA) completed by CTL Engineer of Ohio, Inc., the hillside in the vicinity of, and to the north and west of, proposed Southbound Pier #5 consists of a previously used, unregulated landfill. The natural soils below this are composed of primarily granular soils (ODOT A-1, A-2, and A-3 series) and non-plastic silt. The relative density ranges from loose to dense, with a loose to medium dense silt prominent at a depth of 46 to 87 feet. The boring was terminated at a depth of 115 feet without encountering bedrock.

4.1.3 Forward (North) Abutments

Borings B-016-0-15 and B-017-0-15 are located near the forward abutments for SB and NB Bridges, respectively. Most of the soil in these borings is non-plastic and/or granular. Laboratory testing indicates they fit into classifications in the ODOT A-1 and A-3 series. Several thin layers of fine-grained, cohesive soil are identified in Boring B-016-0-15. These strata are sandy silt (ODOT A-4a) and silty clay (ODOT A-6b). Bedrock was not encountered in either boring.

4.2 Roadway Borings

4.2.1 NB (Station 515+80 to Station 557+44)

Borings B-001-0-15, B-002-0-15, B-021-0-15, B-024-0-15, B-027-0-15, B-030-0-15, and B-032-0-15, were advanced for the NB lanes of SR8. B-004-4-15 is

advanced at the convergence of Ramp J and is also applicable for the NB lanes of SR8.

Borings B-001-0-15 and B-002-0-15 penetrate dense to very dense, fine sand (ODOT A-3) above weathered sandstone bedrock. The elevation of bedrock is 1029.6 and 1033.6, respectively. Boring B-021-0-15 finds the soil to be medium-stiff to stiff silty clay (ODOT A-6b) and medium dense gravel with sand (ODOT A-1-b). Boring B-024-0-15 encounters fine-grained, cohesive soil (ODOT A-6b and A-7-6) that is very stiff to hard according to pocket penetrometer readings. B-027-0-15 identified the soil as dense to very dense sand (ODOT A-3a and A-3) and hard clay (ODOT A-7-6) above the weathered sandstone bedrock at elevations 991.6. Borings B-030-0-15 encounters very stiff silt and clay (ODOT A-6A) over dense, fine sand (ODOT A-3). Boring B-032-0-15 finds granular soil over weathered bedrock at elevation 1016.9. The soil is classified as ODOT A-3 and A-3a and is medium dense to very dense according to N_{60} values. Borings B-004-4-15 encounters non-plastic sandy silt (ODOT A-4a) and fine sand (ODOT A-3) that is very dense according to N_{60} values.

4.2.2 SB (Station 218+00 to Station 254+50)

Borings B-003-0-15, B-004-0-15, B-005-0-15, B-020-0-15, B-022-0-15, B-029-0-15, and B-031-0-15, were advanced for the SB lanes of SR8. Most of the soil is non-plastic and/or granular. Laboratory testing indicates they fit into classifications in the ODOT A-1, A-3, and A-4 series. Notable exceptions can be found in Borings B-022-0-15 and B-031-0-15. Although these two borings contain ODOT A-1 and A-3 soil near the ground surface, the deeper soil is cohesive (ODOT A-6b and A-7-6). Weathered sandstone is encountered at elevations 1033.8, 1036.7, and 1018.3 in Borings B-003-0-15, B-004-0-15, and B-005-0-15, respectively.

4.2.3 Ramp J (NB Entrance Ramp from Perkins Street)

Borings B-001-2-15, B-003-2-15, and B-004-4-15, are applicable for Ramp J. Boring B-001-2-15 identifies medium dense sand (ODOT A-3) and soft clay (ODOT A-6a). Boring B-003-2-15 encounters gravel with sand (ODOT A-1-b) that is medium dense to dense according to N_{60} values. Boring B-004-4-15 encounters non-plastic sandy silt (ODOT A-4a) and fine sand (ODOT A-3) that is very dense according to N_{60} values. Weathered sandstone bedrock is at elevations 1044.5 and 1053.8 in Borings B-001-2-15 and B-003-2-15, respectively.

B-001-4-15, B-003-1-15, B-003-5-15, and B-003-6-15 were originally advanced for a retaining wall that was found to be not justified; however, they are also applicable for Ramp J. Borings B-001-4-15, and B-003-1-15 identified the soil as very stiff or hard silt (ODOT A-4b) and soft or very stiff to hard clay (ODOT A-7-6). Boring B-003-5-15 encountered hard silty clay (ODOT A-6b) and loose to very dense fine sand (ODOT A-3). Boring B-003-6-15 identified sandy silt from auger castings (ODOT A-4a). Weathered sandstone bedrock was encountered at elevations 1048.8, 1047.9, and 1047.2 in Borings B-001-4-15, B-003-1-15, and B-003-6-15, respectively. Competent sandstone was encountered at elevation 1046.9 in boring B-003-1-15 with 100% recovery and an RQD of 62% and at elevations 1042.3 in boring B-003-5-15 with 100% recovery and an RQD of 58%.

4.2.4 Ramp I (SB Exit Ramp to Perkins Street).

Borings B-001-1-15, B-003-3-15, B-003-7-15, and B-004-3-15, are applicable for Ramp I. Most of the soil near Ramp I is granular. The soil is described on the boring logs as gravel with sand, fine sand, or weathered sandstone. Laboratory testing indicates the soil is in the ODOT A-1 and A-3 series. A silt and clay stratum (ODOT A-6a) was encountered in the first few feet of Boring B-003-7-15. Weathered sandstone bedrock is encountered at elevations 1044.2, 1030.5, 1039.5, and 1035.2 in Borings B-001-1-15, B-003-3-15, B-003-7-15, and B-004-3-15, respectively.

4.3 Noise Wall Borings

The boring locations for the six noise barriers are shown on the Soil Profile in Appendix E. A total of 27 borings were advanced for the noise barrier. In accordance with ODOT standards for noise barrier design (BDM Section 802.1.2-A), these borings were typically advanced to depths of 25.0 ft. Bedrock was cored in Boring B-004-6-16 to B-025-3-16.

Borings B-003-1-15, B-003-5-15, B-003-6-15, B-023-0-15, B-025-0-15, B-026-0-15, B-029-0-15, and B-001-4-15, were originally advanced for three potential retaining walls. However the retaining walls were no longer considered an option. These borings are reused for the Noise Wall design.

The applicable borings for each noise barrier are listed in Table 4.0-1. Sections 4.3.1 through 4.3.4 summarize the subsurface conditions found at each noise barrier location.

4.3.1 Noise Barrier No. 1A and 1B

Noise Barriers No. 1A and 1B are located along the west side of Southbound SR 8, south of Glenwood Avenue. Noise Barrier borings B-021-2-16 and B-023-0-15 are granular/non-plastic soils described as gravel with sand (ODOT A-1-b). The typical N_{60} values of these materials range from 22 to 60 (medium dense to very dense).

Borings B-025-0-15, B-025-3-16, and B-031-1-16 encountered primarily encounters fine-grained, cohesive soil (ODOT A-4a, A-6a, and A-6b) that is soft to very stiff according to pocket penetrometer readings. Weathered sandstone bedrock is at elevations 995.4, 995.3, and 1008.1 in Borings B-025-0-15, B-025-3-16, and B-031-1-16, respectively. Competent sandstone was encountered at elevation 1007.6 in boring B-031-1-16 with 100% recovery and an RQD of 75%,

Borings B-026-0-15, B-030-1-16, B-031-3-16, and B-032-1-16 encountered granular/non-plastic soils described as coarse and fine sand (ODOT A-3a) and sandy silt (ODOT A-4a). The typical N_{60} values of these materials range from 4 to 46 (very loose to dense). Weathered sandstone bedrock is at elevations 994.2, 1000.1, 1017.2, and 1019.5 in Borings B-026-0-15, B-030-1-16, B-031-3-16, and B-032-1-16, respectively. Competent sandstone was encountered at elevation 995.1 in boring B-030-1-16 with 88% recovery and an RQD of 66% and at elevations 1006.7 in boring B-031-3-16 with 91% recovery and an RQD of 64%.

Borings B-033-0-16 to B-035-0-16 encountered fine-grained, cohesive soils were identified as the primary soil types above weathered sandstone bedrock in. The soil is classified as ODOT sandy silt (A-4a) and silt and clay (A-6a) and is very stiff to hard according to pocket penetrometer readings. An exception can be found in Boring B-036-0-16. Boring B-036-0-16 finds gravel with sand (ODOT A-1-b) over weathered sandstone bedrock and is medium dense according to N_{60} values. The top of weathered bedrock was encountered in Borings B-033-0-16 to B-036-0-16 at elevations 1019.4, 1021.7, 1023.9, and 1021.8, respectively.

4.3.2 Noise Barrier No. 2A and 2B

Noise Barrier No. 2A and 2B are located along the east side of Northbound SR 8, south of Glenwood Avenue. Borings B-027-0-15, B-029-1-16, and B-031-4-16 encountered primarily granular/non-plastic soils. These soils are described in the logs as gravel with sand; gravel with sand and silt; coarse and fine sand; and fine sand. Lab testing indicates they fit into classifications in A-2 and A-3

series.

Borings B-021-3-16, B-025-1-16, B-031-2-16, and B-032-2-16, encountered primarily fine-grained, cohesive soils. Sandy silt and silt and clay constitute the primary soil types identified on the borings logs. Lab testing has classified these soils as A-4a, and A-6a.

Over the entire length of the noise barriers, the fine-grained soils have pocket penetrometer readings, ranging between 0.5 and 4.5 (medium stiff to hard). For the granular soils, the typical N_{60} values range from 1 to 52 (very loose to very dense).

The top of weathered bedrock was encountered in Borings B-027-0-15, B-029-1-16, B-031-2-16, B-031-4-16, and B-032-2-16, at elevations of 991.6, 1007.7 1003.7, 1020.6, and 1034.0, respectively. Competent bedrock (sandstone) was sampled by NQ-2 coring in Borings B-031-4-16 from a depth of 20.3 ft. (Elevation 1014.8) to a depth of 35.3 ft. (Elevation 999.8) with 88% recovery and an RQD of 60% and B-032-2-16 from a depth of 10.3 ft. (Elevation 1031.2) to a depth of 20.3 ft. (Elevation 1021.2) with 82% recovery and an RQD of 28%.

4.3.3 Noise Barrier No. 3

Noise Barrier No. 3 is located along the west side of Ramp I, north of Perkin Street. Borings B-001-5-16 to B-004-2-16 are fine-grained, cohesive soils. Specifically, these materials are described on the boring logs as sandy silt; or silt and clay. Lab testing classified them as ODOT A-4a and A-6a series.

Borings B-004-6-16 and B-005-2-16 encountered primarily granular/non-plastic soils described as coarse and fine sand. Lab testing indicates these materials are classified as the ODOT A-3a series. Over the entire length of the noise barrier, the fine-grained soils have pocket penetrometer readings, ranging between 0.25 and 4.5+ (soft to hard). For the granular soils, the N_{60} values range from 6 to 91 (loose to very dense).

The weathered sandstone bedrock was encountered in all the borings — the top of rock elevations range from 1018.1 to 1053.1. Five to ten feet of competent bedrock (sandstone) was also sampled by NQ-2 or NX coring in all borings at elevations from 1014.1 to 1045.8. Boring B-001-5-16 has a recovery of 100% and an RQD of 63%; boring B-003-4-16 has a recovery of 86% and an RQD of 45%; boring B-003-8-16 has a recovery of 49% and an RQD of 8%; boring B-004-2-16 has a recovery of 38% and an RQD of 0%; boring B-004-6-16 has a recovery of 80% and an RQD of 0%; and boring B-005-2-16 has a

recovery of 85% and an RQD of 31%.

4.3.4 Noise Barrier No. 4

Noise Barrier No. 4 is located along the east side of Ramp J, north of Perkin Street. Borings B-003-5-15, B-003-6-15, and B-001-3-16 to B-004-5-16 encountered primarily granular/non-plastic soils. These soils are described in the logs as gravel with sand; coarse and fine sand; fine sand; and sandy silt. Lab testing indicates they fit into classifications in the A-2, A-3, and A-4 series.

Borings B-001-4-15, B-003-1-15, and B-001-3-16, encountered primarily fine-grained, cohesive soils. Sandy silt, silt, and clay constitute the primary soil types identified on the borings logs. Lab testing has classified them into A-4, and A-7 series.

Over the entire length of the noise barrier, the fine-grained soils have pocket penetrometer readings, ranging between 0.5 and 4.5+ (medium stiff to hard). For the granular soils, the typical N_{60} values range from 8 to 60 (loose to very dense).

The top of weathered bedrock was encountered in Borings B-001-3-16, B-004-1-16, B-001-4-15, B-003-1-15, B-003-6-15, and B-001-3-16., at elevations of 1045.5, 1036.4, 1048.8, 1047.9, 1047.2, and 1014.6, respectively. Competent bedrock (sandstone) was cored in borings B-001-3-16 from a depth of 14 ft. (Elevation 1040.0) to a depth of 24 ft. (Elevation 1030.0) with 61% recovery and an RQD of 0%; B-004-1-16 from a depth of 13.5 ft. (Elevation 1028.5) to a depth of 18.5 ft. (Elevation 1023.5) with 78% recovery and an RQD of 37%; B-004-5-16 from a depth of 15.6 ft. (Elevation 1021.2) to a depth of 20.6 ft. (Elevation 1011.2) with 77% recovery and an RQD of 37%; B-003-1-15 from a depth of 9.5 ft. (Elevation 1046.9) to a depth of 14.5 ft. (Elevation 1041.9) with 100% recovery and an RQD of 62%; B-003-5-15 from a depth of 10 ft. (Elevation 1042.3) to a depth of 15 ft. (Elevation 1037.3) with 100% recovery and an RQD of 58%; and B-005-1-16 from a depth of 25.3 ft. (Elevation 1011.3) to a depth of 50.3 ft. (Elevation 986.3) with 88% recovery and an RQD of 68%.

4.4 Access Road Borings

The exploration plan for the access road included using borings proposed for other purposes and four additional borings. Borings B-011-6-17, B-015-2-17, B-037-0-17, B-038-0-17, were advanced in support of the access roads. In addition, previously advanced borings near each proposed access road are included where applicable. Sections 4.4.1 through 4.4.5 summarize the subsurface conditions at each access road.

4.4.1 Access Road No. 1 (North Adams Street)

Borings B-005-2-16, B-006-0-15, B-007-0-15, and B-007-1-16, were originally advanced for other structures at the site; however, they have located along, or near Access Road No. 1 and are therefore applicable. Most of the soil is non-plastic and/or granular. Laboratory testing indicates the soil is classified as gravels, sands, and/or silts (ODOT A-1, A-3, and A-4 series). The relative density of the soil with N_{60} values ranging from 6 to 37 is loose to dense. Weathered sandstone is encountered at elevations 1000.0, 1004.0, 987.4, and 972.7 in Borings B-005-2-16, B-006-0-15, B-007-0-15, and B-007-1-16, respectively.

4.4.2 Access Road No. 2A (Furnace Street)

Borings B-009-2-16, B-009-3-16, B-037-0-17, and B-038-0-17, are located along or near Access Road No. 2A. Borings B-009-2-16 and B-009-3-16 were originally advanced for other structures; however, they are also applicable to Access Road No. 2A. Borings B-009-2-16 and B-009-3-16 primarily encountered non-plastic and/or granular soils. Laboratory testing indicates the soil is classified as gravels, sands, and/or silts (ODOT A-1, A-2, A-3, and A-4 series). The relative density of the soil by N_{60} values ranging from 4 to 34 is very loose to dense. Boring B-009-2-16 was terminated at a depth of 41.5 without encountering bedrock. Weathered sandstone is encountered at elevations 880.5 in Boring B-009-3-16.

Borings B-037-0-17 and B-038-0-17 encountered fine-grained, cohesive soils. Boring logs and lab testing indicate the soil is classified as sandy silt, silt, and silty clay (ODOT A-4 and A-6 series). The consistency of the soil based on pocket penetrometer readings is soft to hard. In Boring B-037-0-17, 11 feet of fill was encountered above the cohesive natural soils. Borings B-037-0-17 and B-038-0-17 were terminated at depths of 40 and 27.3 feet. Neither boring encountered bedrock.

4.4.3 Access Road No. 3A (North Arlington Street)

Borings B-006-0-15, B-007-2-16, and B-009-1-16, are located along or near Access Road No. 3A. All three borings were originally advanced for other structures; however, they are also applicable to Access Road No. 3A. Boring B-006-0-15 and B-009-1-16 encountered primarily non-plastic and/or granular. Laboratory testing indicates the soil is classified as gravels, sands, and/or silts (ODOT A-1, A-3, and A-4 series). The relative density of the soil with N_{60} values ranging from 15 to 35 is medium dense to dense. A notable exception of medium stiff to hard strata of cohesive soil sandy silt was encountered in Boring B-007-2-16 from a depth of 5 feet to 17.5 feet and Boring B-009-1-16 from a

depth of 4.5 feet to 17 feet.

Boring B-006-0-15 finds weathered rock (sandstone) at elevation 1004, and competent bedrock is at elevations 1002. The competent bedrock consists of sandstone with 98% recovery and an RQD of 72%.

Boring B-007-2-16 finds weathered rock (shale) at elevation 935.1, and competent bedrock is at elevations 923.6. The competent bedrock consists of shale (76%) and siltstone (24%) with 77% recovery and an RQD of 15%.

Boring B-009-1-16 finds weathered rock (shale) at elevation 922.7, and competent bedrock is at elevations 920.7. The competent bedrock consists of shale (72%) and siltstone (28%) with 90% recovery and an RQD of 29%.

4.4.4 Access Road No. 5A (Harris Street)

Borings B-011-5-16, B-011-6-17, B-013-1-15, B-014-0-15, and B-015-1-16, are located along or near Access Road No. 5A. The 2015 and 2016 borings were Boring B-011-5-16 encounters sandy silt (ODOT A-4 series) and stone fragments with/or sand and/or silt (ODOT A-1 and A-2 series) over silt and clay (ODOT A-6A). The relative density of the granular soil is medium dense to very dense, and the cohesive soils are very stiff to hard according to pocket penetrometer readings. Boring B-011-5-16 finds weathered bedrock (shale) at elevation 837.7 and competent bedrock at elevations 835.2. The competent rock consists of interbedded shale and siltstone with 99% recovery and an RQD of 71%.

Boring B-011-6-17 primarily encounters fine-grained, silt, and clay soils (ODOT A-4 and A-6). The consistency of the soil based on pocket penetrometer readings is stiff to very stiff. The boring was terminated at 30 feet without encountering bedrock.

Borings B-013-1-15 and B-014-0-15 encountered fine-grained, sandy silt and silty clay soils (ODOT A-4 and A-6 series) over non-plastic, granular soil consisting of gravel and sand (ODOT A-1 and A-2 series). The consistency of the fine-grained soil is soft to hard. The relative density of the granular soil is dense to very dense. Borings B-013-1-15 and B-014-0-1 were terminated without encountering bedrock at 60 and 70 feet, respectively.

Boring B-015-1-16 encounters 20.5 feet of fill and uncontrolled fill. The natural soils below the fill are composed of primarily granular soils (ODOT A-1, A-2, and A-3 series) and non-plastic silt (ODOT A-4). The relative density ranges

from loose to dense, with a loose to medium dense silt prominent at a depth of 46 to 87 feet. The boring was terminated at a depth of 115 feet without encountering bedrock.

4.4.5 Access Road No. 6 (SR 8 – Forward Abutment)

Borings B-015-2-17, B-017-2-17, B-018-0-15, B-019-0-15, and B-20-0-15, were advanced along or near Access Road No. 6. Boring B-017-2-17 and the 2015 borings were advanced for use in other structures; however, their location in relation to the proposed access road makes them applicable for Access Road No. 6.

B-015-2-17 encounters fill and uncontrolled fill to a depth of 39 feet where the boring was terminated.

B-017-2-17 encounters non-plastic, granular soils consisting of loose to dense gravel and sand (ODOT A-1 and A-3 series) over medium dense non-plastic silt and sand (ODOT A-4 and A-3). The boring was terminated at 100 feet without encountering bedrock.

Borings B-018-0-15, B-019-0-15, and B-020-0-15 encounter primarily non-plastic, granular soils. These soils were gravel with sand (ODOT A-1 and A-2 series). The relative density based on N_{60} values is very loose to dense. A thin layer of stiff sandy silt (ODOT A-4A series) exists at B-020-0-15 between 6 and 8.5 feet. Borings B-018-0-15 and B-019-0-15 were terminated at 25 feet without encountering bedrock. Boring B-020-0-15 was terminated at 15 feet without encountering bedrock.

4.4.6 Access Road No. 8 (East North Street)

Borings B-009-4-16 and B-011-0-15 were advanced along or near Access Road No. 8. These borings were advanced for use in other structures; however, their location in relation to the proposed access road makes them applicable for Access Road No. 8.

B-009-4-16 finds 10 feet of fill at the surface underlain by fine-grained, cohesive soils (ODOT A-6 series) that is medium-stiff to stiff. The boring finds weathered bedrock (shale) at elevation 866.4 and competent bedrock at elevation 852.5. The competent bedrock consists of shale with a recovery of 94% and an RQD of 75%.

B-011-0-15 finds 2 feet of fill at the surface. The fill is overlaying fine-grained, cohesive soils (ODOT A-6 and A-7-6 series) that is medium-stiff to stiff. Boring B-011-0-15 finds weathered bedrock (shale) at elevation 868.2, and competent bedrock is at elevations 855.5. The competent bedrock consists of interbedded shale (60%) and sandstone (40%) with 99% recovery and an RQD of 96%.

4.5 Launch Pit Borings

Borings B-017-2-17, B-020-2-17 and B-020-3-17, were advanced in support of the launch pits. The borings were advanced according to ODOT SGE Type E1 and terminated between 74.8 feet and 100 feet below ground surface. In addition, previously advanced borings near the proposed launch pits are included where applicable. Sections 4.5.1 and 4.5.2 summarize the subsurface conditions at each launch pit.

4.5.1 NB Launch Pit

Boring B-020-3-17 was advanced in support of the NB Launch Pit. Borings B-017-0-15, B-017-1-16, and B-020-1-16 were advanced in support of other structures; however, their locations also make them applicable for the NB Launch Pit.

The borings find primarily non-plastic, granular soils (ODOT A-1, A-2, A-3, and A-4 series). The relative density of the soils is loose to medium dense to an elevation of approximately 1000. Below elevation 1000, as observed in B-017-0-15 and B-020-3-17 that extended below that elevation, the relative density of the soils is medium dense to very dense. Borings B-017-1-16 and B-020-1-16 were terminated at 26.5 feet (elevation 1002.7) without encountering bedrock. Borings B-017-0-15 and B-020-3-17 were terminated at 70 feet and 74.8 feet, respectively without encountering bedrock.

4.5.2 SB Launch Pit

Borings B-017-2-17 and B-020-2-17 were advanced in support of the SB Launch Pit. Borings B-016-0-15, B-018-0-15, and B-020-0-15 were advanced in support of other structures; however, their locations make them applicable for the SB Launch Pit.

The borings find primarily non-plastic, granular soils (ODOT A-1, A-2, A-3, and A-4A series). The relative density of the soils based on N_{60} values is loose to dense. Notable exceptions are at Boring B-016-0-15 that has several thin layers of fine-grained, cohesive soils (ODOT A-4 and A-6) and at Boring B-017-2-17 that finds non-plastic and slightly plastic silt (ODOT A-4B series) starting at a depth of 33 feet (elevation 970.5) and extending to the bottom of the boring at 100 feet.

Borings B-018-0-15 and B-020-0-15 terminated at 25 feet and 15 feet without encountering bedrock. Borings B-016-0-15 and B-017-2-17 terminated at depths of 100 feet without encountering bedrock. B-020-2-17 encountered auger refusal and was terminated at 85.5 feet.

4.6 Groundwater

During field exploration in 2015, free water was encountered during drilling at depths of 14.0 ft. (elevation 861.0), 15.0 ft. (elevation 860.0), 11.0 ft. (elevation 866.6), 43.5 ft. (elevation 866.0) 23.0 ft. (elevation 900.4), 18.5 ft. (elevation 942.7), 52.0 ft. (elevation 965.6), 58.0 ft. (elevation 966.4), 17.3 ft. (elevation 1007.8) in Borings B-010-1-15, B-010-2-15, B-013-0-15, B-013-1-15, B-014-0-15, B-015-0-15, B-016-0-15, B-017-0-15, and B-027-0-15, respectively. At the completion of drilling, water was observed at depths of 19 ft. (elevation 856) in Boring B-010-2-15. Groundwater was not encountered in the other borings.

During field exploration in 2016, free water was encountered during drilling at depths of 3.5 ft. (elevation 1038.4), 22.0 ft. (elevation 935.7), 14.0 ft. (elevation 868.7), 13.0 ft. (elevation 860.8), 11.0 ft. (elevation 864.0), 8.0 ft. (elevation 867.2), 18.0 ft. (elevation 867.5), 18.0 ft. (elevation 867.5), 27.0 ft. and 45.6 ft. (elevation 886.5 and 867.9), 43.0 ft. (elevation 917.3) in Borings B-004-2-16, B-009-1-16, B-009-4-16, B-011-3-16, B-011-4-16, B-011-5-16, B-013-3-16, B-013-4-16, B-013-5-16, and B-015-1-16, respectively. Another free water level at 23.5' (elevation 862.0) was also encountered in boring B-013-3-16. Groundwater was encountered at the 24 hour at a depth of 16.1 ft. (elevation 857.7), 8.0 ft. (elevation 867.0), 11.3 ft. (elevation 863.9), 15.0 ft. (elevation 870.5), 7.5 ft. (elevation 906.0), 89.5 ft. (elevation 870.8), in Boring B-011-3-16,

B-011-4-16, B-011-5-16, B-013-3-16, B-013-5-16, and B-015-0-16. Groundwater was not encountered in the other borings.

During the field exploration in 2017, free water was encountered during drilling at depths of 63.5 ft. (elevation 965.5) and 11 ft. (elevation 915.8), in Borings B-020-2-17 and B-037-0-17, respectively. At the completion of drilling, water was observed at depths of 67.5 ft. (elevation 961.5) and 17.5 ft. (elevation 909.3), in Borings B-020-2-17 and B-037-0-17. Groundwater was not encountered in the other borings.

During the field exploration in 2019, free water was encountered during drilling at 19.9 ft. (elevation 938.4) in boring B-008-1-19, at 12.4 ft. (elevation 868.8) in boring B009-6-19 and at 12.5 ft. (elevation 872.7) in boring B-009-7-19. Groundwater was not encountered in the other borings.

5.0 ANALYSES AND RECOMMENDATIONS

Below are recommendations pertaining to the construction of the following: the NB and SB bridges foundations, the bridge launching pit, noise wall foundations, embankments, access roads, crane pads, and crane tower foundation, and below-grade walls. The recommendations were made using referencing ODOT's *Specifications For Subsurface Explorations,* July 2019 (SGE); ODOT's *Bridge Design Manual 2007,* updated July 2018 (ODOT BDM); ODOT's *GB1: Plan Subgrades*, July 2018 (GB1) ; *ODOT's GB 2: Special Benching*, April 17 (GB2); ODOT's *GB 5: Geotechnical Submissions Guidelines*, July 2018 (GB5); for geotechnical parameters GF referenced ODOT's *GB 6: Shear Strength of Proposed Embankment* (GB6) now archived ODOT's *GB 7: Drilled Shafts for Land Slide Stabilization*, February 2015 (GB7); ODOT's *Construction Material Specifications*, January 2016 (CMS); FHWA NHI-10-016 *Drilled Shafts: Construction Procedure and LRFD Design Methods*, May 2010 (NHI-10-016); FHWA-NHI-16-009 *Geotechnical Engineering Circular No. 12 – Volume I Design and Construction of Driven Pile Foundations*, July 2016 (NHI-16-009/10); FHWA-NHI-16-010 *Geotechnical Engineering Circular No. 12 – Volume II Design and Construction of Driven Pile Foundations*, July 2016 (NHI-16-009/10), AASHTO *LRFD Bridge Design Specifications*, 8th edition, September 2017 (LRFD); and AASHTO *LRFD Bridge Design Specifications* 2006 (LRFD-2006).

5.1 Summary of Geotechnical Parameters

Based on the project exploration (2019 borings were mainly for drilled shaft axial capacity design, and were not included), the average geotechnical parameters for each stratum are summarized below in Table 5.1-1 to Table 5.1-4. The strata have been divided based on each bridge substructure location. That is, the piers and abutments of the two bridges have different parameters based on the nearby borings for each. Based on the average value, Table 5.1-5 and Table 5.1-6 summarized the design parameter for each bridge. The tabulation and calculation of soil data is presented in Appendix F1. The definition drawing of the subsurface soil profile is presented in Appendix F1.1. Due to the limited spacing, the design parameters for each stratum are not presented here; please refer to Appendix F.1 for details.

Table 5.1-1 Summary Average of SUM-8-0199 NB Bridge Soil Parameters

Structure	Boring No.	Strata No.	Type[1]	N_{60}	$N1_{60}$	γ (pcf)	ϕ' (deg)	C_1 = HP/2 (psf)	C_2 = Su (psf)
Pier 2	B-010-0-15	Strata 1	C	11	15	117.5		1000	1280
		Strata 2	C	69	71	121.5			8007
Pier 3	B-011-2-16	Strata 1	C	7	9	122.5		1500.0	814.7
	B-011-3-16		C	7	9	120.0		2130.0	931.0
	Avg.		C	7	9	120.8		1920	892
	B-011-2-16	Strata 2	G	12	14	125.0	34.0		
	B-011-3-16		G/SL	20	21	130.0	35.3		
	Avg.		G/SL	16	17	127.2	34.6		
	B-011-2-16	Strata 3	G/SL	76	74	137.0	40.5		
	B-011-3-16		G	90	83	138.6	41.7		
	Avg.		G/SL	85	80	138.0	41.2		
Pier 4	B-013-2-16	Strata 1	S	4	6	113.8	30.3		
	B-013-3-16		S	9	12	115.0	34.3		
	Avg.		S	7	10	114.5	32.7		
	B-013-2-16	Strata 2	G	14	14	135.0	34.8		
	B-013-3-16		G	48	42	136.9	39.9		
	Avg.		G	34	31	136.1	37.8		
Pier 5	B-015-0-15	Strata 1	S	6	6	121.7	28.5		
		Strata 2	C	16	13	135.0		686	1914
		Strata 3	S	47	26	145.0	36.4		
F. ABT.	B-017-0-15	Strata 1	G	15	14	128.1	33.5		
		Strata 2	S	43	27	140.5	37.2		

1: S= sand, C=Clay, S/SL=sand and silt, G=gravel, G/SL=Silty Gravel

Table 5.1-2 Summary Average of SUM-8-0199 SB Bridge Soil Parameters

Structure	Boring No.	Strata No.	Type[1]	N_{60}	$N1_{60}$	γ (pcf)	ϕ' (deg)	C_1 = HP/2 (psf)	C_2 = Su (psf)
R. ABT.	B-005-2-16	Strata 1	S	23	31	126.0	37.1		
Pier 1	B-009-1-16	Strata 1	C	18	19	127.1		3550	2056
		Strata 2	G	19	18	131.7	35.9		
		Strata 3	G/SL	90	75	140.0	40.0		
Pier 2	B-011-0-15	Strata 1	C	12	15	123.3		1167	1397
	B-009-4-16		C	14	21	121.7		1000	1591
	Avg.			13	19	122.3		1059	1522
Pier 3	B-011-5-16	Strata 1	C	21	28	125.8		3563	2677
	B-011-4-16	Strata 2	G/SL	76	81	135.4	37.8		
	B-011-5-16		G	65	66	137.5	41.1		
	Avg.			74	78	135.8	38.5		
	B-011-5-16	Strata 3	C	53	48	140.0		4500	6129
Pier 4	B-013-4-16	Strata 1	C	12	19	117.5		2500	1300
	B-013-5-16		C	24	24	134.0		2300	2832
	Avg.			21	23	129.5		2355	2411
	B-013-4-16	Strata 2	S/SL	8	9	120.7	29.6		
	B-013-5-16		S/SL	14	12	132.0	31.0		
	Avg.			11	10	125.9	30.3		
	B-013-4-16	Strata 3	G	57	42	141.1	40.0		
	B-013-5-16		G/SL	35	25	143.0	36.0		
	Avg.			45	33	142.1	37.9		
Pier 5	B-015-1-16	Strata 1	UF	32	39	127.5	34.5		
		Strata 2	S	19	14	134.0	33.2		
		Strata 3	S/SL	12	7	135.0	28.4		
		Strata 4	S/SL	31	15	143.0	31.8		
		Strata 5	G	100	43	145.0	40.5		
F. ABT.	B-016-0-15	Strata 1	G	8	7	124.0	32.1		
		Strata 2	S	38	27	140.7	35.1		
		Strata 3	C	33	19	145.0		3750	4015
		Strata 4	G	48	24	145.0	37.3		
		Strata 5	C	28	12	141.7		1417	3220

1: S= sand, C=Clay, S/SL=sand and silt, G=gravel, G/SL=Silty Gravel

Table 5.1-3 Summary Average of SUM-8-0199 NB Bridge Rock Parameters

Structure	Strata	Boring No.	Type	RQD (%)	Q_u (psi)	GSI
R. ABT	R1	B-006-0-15	Sandstone	20	1500	20
	R2		Sandstone	85	5560	65
	R3		Sandstone	67	3500	55
Pier 2	R1	B-010-0-15	Shale	0	200	5
	R2		Shale	52	1500	15
	R3		Sandstone	63	4380	65
	R4		Shale	94	3840	65
Pier 3	R1	B-011-2-16	Shale	5	200	5
		B-011-3-16	Siltstone	5	360	10
		Avg.	Shale/Siltstone	5	229	6
	R2	B-011-2-16	Shale/Siltstone	42	6062	40
		B-011-3-16	Shale/Siltstone	47	5847	55
		Avg.	Shale/Siltstone	44	5973	46
	R3	B-011-2-16	Shale/Siltstone	60	4969	50
Pier 4	R1	B-013-2-16	Shale	1	360	5
	R2	B-013-2-16	Shale/Siltstone	23	683	45
		B-013-3-16	Shale/Siltstone	24	683	35
		Avg.	Shale/Siltstone	23	683	42
	R3	B-013-2-16	Shale/Siltstone	47	2665	65
		B-013-3-16	Shale/Siltstone	52	3855	60
		Avg.	Shale/Siltstone	47	2767	65

Table 5.1-4 Summary Average of SUM-8-0199 SB Bridge Rock Parameters

Structure	Strata	Boring No.	Type	RQD (%)	Q_u (psi)	GSI
R. ABT	R1	B-005-2-16	Sandstone	10	1000	30
	R2		Sandstone	31	4111	65
Pier 1	R1	B-009-1-16	Shale/Siltstone	12	1125	25
	R2	B-009-1-16	Shale/Siltstone	33	8000	40
	R3	B-009-1-16	Shale/Siltstone	7	750	25
	R4	B-009-1-16	Shale/Siltstone	33	6434	40
Pier 2	R1	B-011-0-15	Shale	10	200	5
		B-009-4-16	Shale	10	200	5
		Avg.	Shale	10	200	5
	R2	B-011-0-15	Shale/Sandstone	97	3875	70
		B-009-4-16	Shale	75	7964	65
		Avg.	Shale/Sandstone	91	5001	69
Pier 3	R1	B-011-4-16	Shale	10	500	5
		B-011-5-16	Shale	30	1125	10
		Avg.	Shale	25	983	9
	R2	B-011-4-16	Shale/Siltstone	76	6057	65
		B-011-5-16	Shale/Siltstone	82	4070	50
		Avg.	Shale/Siltstone	81	4512	53
Pier 4	R1	B-013-4-16	Shale/Siltstone	76	6221	65

Table 5.1-5 SUM-8-0199 N.B. Geotechnical Design Parameters Summary Table

Structure	Foundation Type	Material Type	Bottom of layer Elevation	Y'	γ_{total}	N_{60}	$N1_{60}$	ϕ	C	RQD_L	Q_u	GSI	Subgrade Modulus k	Principal Strain ε_{50}	Intact Modulus E_i	Modulus Ratio E_m/E_i	Mass Modulus E_m	Poisson's Ratio μ	Shear Modulus G_i	Stiffness Constant K_{rm}	Rock: ϕ (RocLab)	Split Tensile Strength	Torsional Shear Stress	Ultimate Pile Tip Resistance
				(pcf)	(pcf)			(deg)	(psf)	(%)	(psi)		(pci)		(ksi)		(ksi)		(ksi)		(deg)	(psf)	(psf)	(kips)
R. ABT.	Spread Footing	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		1001																	
		Sandstone W	999.5	150	150					20	1500	20			135	0.05	7	0.2	56.3	0.00005	24.8	21600	6300	
		Sandstone	992.5	150	150					85	5550	65			499.5	0.85	425	0.2	208.1	0.00005	41.0	79920	34900	
		Sandstone	950	150	150					67	3500	55			315	0.62	195	0.2	131.3	0.00005	37.1	50400	32700	
Pier 1	Drilled Shafts	**Water Elv.=**	Dry			**t. Elv. =**	954.25																	
		Sandstone	950.5	150	150					54	3400	60			306	0.26	80	0.2	127.5	0.00005	38.1	48960	32200	
		Claystone	948	150	150					52	200	30			18	0.21	4	0.1	8.2	0.00036	20.7	2880	7800	
		Shale	938	150	150					11	1500	30			135	0.05	7	0.1	61.4	0.00005	17.8	21600	6300	
		Shale	920	150	150					53	4750	55			427.5	0.23	99	0.1	194.3	0.00005	27.7	68400	34900	
Pier 2	Drilled Shafts	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		878.75		σ_{vs} (ksf) =	2.18														
		C	870.5	117.5	117.5	11	15		1100					0.0097				0.45	2.6				500	
		C	860.5	121.5	121.5	60	60		8000					0.004				0.45	19.2				500	
		Shale W	855.5	150	150					10	200	5			18	0.05	1	0.1	8.2	0.00036	10.2	2880	2300	
		Shale	852.5	150	150					52	1500	15			135	0.21	28	0.1	61.4	0.00005	16.1	21600	21400	
		Sandstone	850	150	150					63	4350	65			391.5	0.51	199	0.2	163.1	0.00005	40.1	62640	34900	
		Shale	830	150	150					94	3800	65			342	0.94	321	0.1	155.5	0.00005	32.9	54720	34100	
Pier 3	Drilled Shafts	**Water Elv.=**	861		**Btm. Ft. Elv. =**		865		σ_{vs} (ksf) =	2.16														
		C	862.5	121	121	7	9		1400					0.0088									500	
		G/SL	861	127	127	16	17	34.5					45					0.325	0.4				1000	
		G/SL	859	69.5	132	16	17	34.5					31					0.325	0.4				1000	
		G/SL	840	80.5	143	60	60	41					125					0.325	2.1				1000	
		Shale/Siltstone W	838	87.5	150					10	200	6			18	0.05	1	0.1	8.2	0.00036	10.5	2880	2300	
		Shale/Siltstone	826.5	87.5	150					44	5950	46			535.5	0.09	48	0.1	243.4	0.00005	25.2	85680	34900	
		Shale/Siltstone	800	87.5	150					60	4950	50			445.5	0.43	189	0.1	202.5	0.00005	26.3	71280	34900	
Pier 4	Drilled Shafts	**Water Elv.=**	870		**Btm. Ft. Elv. =**		872.5		σ_{vs} (ksf) =	2.48														
		S	870	114.5	114.5	7	10	32.5					17					0.325	0.5				1000	
		G	842	78.5	141	34	31	38					73					0.325	1.6				1000	
		Shale W	837	87.5	150					10	350	5			31.5	0.05	2	0.1	14.3	0.00026	10.2	5040	3000	
		Shale/Siltstone	825.5	87.5	150					23	650	42			58.5	0.06	3	0.1	26.6	0.00013	22.6	9360	14100	
		Shale/Siltstone	795	87.5	150					47	2750	65			247.5	0.10	24	0.1	112.5	0.00005	30.4	39600	29000	
Pier 5	Driven Pile	**Water Elv.=**	943		**Btm. Ft. Elv. =**		965.2			Pile Dia. (in.) =	16													
		S	943	121.5	121.5	6	6	28.5					15					0.325	0.3				900	20
		S	939	64	126.5	6	6	28.5					12					0.325	0.3				1000	20
		C	898.5	77.5	140	16	13		1300				220	0.0091				0.45	3.1				1100	140
		S	865	87.5	150	47	26	36.5					115					0.325	1.4				7400	250
F. ABT.	Driven Pile	**Water Elv.=**	966.5		**Btm. Ft. Elv. =**		1011			Pile Dia. (in.) =	14													
		G	992.5	128	128	15	14	33.5					41					0.325	0.7				1200	120
		S	966.5	140.5	140.5	43	27	37					178					0.325	1.4				4500	230
		S	930	83	145.5	43	27	37					102					0.325	1.4				6900	230

Table 5.1-6 SUM-8-0199 S.B. Geotechnical Design Parameters Summary Table

Structure	Foundation Type	Material Type	Bottom of layer Elevation	Υ'	$Υ_{total}$	N_{60}	$N1_{60}$	ϕ	C	RQD_L	Q_u	GSI	Subgrade Modulus k	Principal Strain $ε_{50}$	Intact Modulus E_i	Modulus Ratio E_m/E_i	Mass Modulus E_m	Poisson's Ratio μ	Shear Modulus G_i	Stiffness Constant K_{rm}	Rock: ϕ (RocLab)	Split Tensile Strength	Torsional Shear Stress	Ultimate Pile Tip Resistance
				(pcf)	(pcf)			(deg)	(psf)	(%)	(psi)		(pci)		(ksi)		(ksi)		(ksi)		(deg)	(psf)	(psf)	(kips)
R. ABT.	Spread Footing	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		1001		**$σ_{vs}$** (ksf) =		0.13													
		S	1000	126	126	23	31	37					67					0.325	1.6				1000	
		Sandstone W	996.5	150	150					10	1000	30			90	0.05	5	0.2	37.5	0.000050	27.4	14400	5100	
		Sandstone	950	150	150					31	4100	65			369	0.07	25	0.2	153.8	0.000050	38.5	59040	34900	
Pier 1	Drilled Shafts	**Water Elv.=**	935.5		**Btm. Ft. Elv. =**		952		**$σ_{vs}$** (ksf) =		3.09													
		C	940.5	127	127	19	20		2800					0.0062				0.45	6.7				500	
		G	935.5	131.5	131.5	19	18	36					54					0.325	0.9				1000	
		G	931.5	74	136.5	19	18	36					38					0.325	0.9				1000	
		G/SL	922.5	75.5	138	60	60	40					125					0.325	2.4				1000	
		Shale/Siltstone W	913	87.5	150					12	950	25			85.5	0.05	4	0.1	38.9	0.000060	16.5	13680	5000	
		Shale/Siltstone	903	87.5	150					52	6250	46			562.5	0.19	109	0.1	255.7	0.000050	25.2	90000	34900	
		Shale/Siltstone	898	87.5	150					10	750	25			67.5	0.05	3	0.1	30.7	0.000106	16.5	10800	4400	
		Shale/Siltstone	880	87.5	150					33	6400	40			576	0.07	41	0.1	261.8	0.000050	22.1	92160	34900	
Pier 2	Drilled Shafts	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		874.3		**$σ_{vs}$** (ksf) =		0.95													
		C	866.5	122.5	122.5	13	19		1300					0.0091				0.45	3.1				500	
		Shale W	852.5	150	150					10	200	5			18	0.05	1	0.1	8.2	0.000365	10.2	2880	2300	
		Shale/Sandstone	830	150	150					91	5000	69			450	0.91	409	0.1	204.5	0.000050	34.0	72000	34900	
Pier 3	Drilled Shafts	**Water Elv.=**	867		**Btm. Ft. Elv. =**		866.8		**$σ_{vs}$** (ksf) =		2.73													
		C	867	126	126	21	28		3100					0.0059				0.45	7.4				500	
		C	862.5	68.5	131	21	28		3100				775	0.0059				0.45	7.4				500	
		G/SL	840	78.5	141	60	60	38.5					125					0.325	2.0				1000	
		C	832	82.5	145	53	48		5300				1325	0.00468				0.45	12.7				500	
		Shale W	830	87.5	150					25	950	9			85.5	0.06	5	0.1	38.9	0.000060	12.9	13680	17000	
		Shale/Siltstone	790	87.5	150					81	4500	53			405	0.81	327	0.1	184.1	0.000050	28.4	64800	34900	
Pier 4	Drilled Shafts	**Water Elv.=**	886.5		**Btm. Ft. Elv. =**		886.5		**$σ_{vs}$** (ksf) =		3.48													
		C	886.5	129.5	129.5	21	23		2400					0.0066				0.45	5.7				500	
		C	880	72	134.5	21	23		2400				600	0.0066				0.45	5.7				500	
		S/SL	862.5	68.5	131	11	10	30.5					22					0.325	0.3				1000	
		G/SL	841	84.5	147	45	33	38					110					0.325	0.9				1000	
		Shale/Siltstone	830	87.5	150					76	6200	65			558	0.20	112	0.1	253.6	0.000050	31.8	89280	34900	
Pier 5	Driven Pile	**Water Elv.=**	917.5		**Btm. Ft. Elv. =**		955			Pile Dia. (in.) =	16													
		UF	944	80*	80*	1*	1*	1*					3					0.1	0.03				1*	20
		S	917.5	134	134	19	14	33					51					0.325	0.7				3000	70
		S	914	76.5	139	19	14	33	80				36					0.325	0.7				3100	60
		S/SL	873.5	77.5	140	12	7	28.5					24					0.325	0.2				3200	40
		S/SL	857.5	85.5	148	31	15	32					63					0.325	0.4				5400	350
		G	830	87.5	150	60	43	40.5					125					0.325	2.3				16800	650
F. ABT.	Driven Pile	**Water Elv.=**	965.5		**Btm. Ft. Elv. =**		1011			Pile Dia. (in.) =	14													
		G	988.5	124	124	8	7	32					20					0.325	0.4				1200	80
		S	965.5	140.5	140.5	38	27	35					144					0.325	1.4				3400	120
		S	964	83	145.5	38	27	35					86					0.325	1.4				3500	100
		C	948	87.5	150	33	19		3900				975	0.0051				0.45	9.3				3000	150
		G	929.5	87.5	150	48	24	37.5					119					0.325	1.3				7300	260
		C	910	84	146.5	28	12		2300				575	0.0067				0.45	5.5				1700	140

5.2 Bridge Recommendations

MS structural engineers, GF structural engineers, and geotechnical engineers determined the width of the spread footings and the spacing and diameter of the drilled shafts and friction pile foundation. Using the spacing and diameter, GF and MS structural engineers determined the axial strength and service load on each substructure. Table 5.2-1 presents the Summary of Foundation Recommendations, and Table 5.2-2 presents the Summary of Foundation Loading.

Table 5.2-1: SUM-8-0199 Summary of Foundation Recommendations

Structure	Bottom of Footing	Foundation Type	Diameter[1] or Size	Rows	Spacing[2] (S/D)
			(in.)	(dim)	(dim)
SB Bridge					
Rear Abut.	1001.00	Spread Footing	15'8" Width	NA	NA
Pier #1	952.00	Drilled Shafts	54/48	2	2
Pier #2	874.25	Drilled Shafts	54/48	2	2
Pier #3	866.75	Drilled Shafts	54/48	2	2
Pier #4	886.50	Drilled Shafts	54/48	2	2
Pier #5	955.20	Cast-in-place piles	16	7	3
Forward Abut.	1011.00	Cast-in-place piles	14	3	5
NB Bridge					
Rear Abut.	1001.00	Spread Footing	15'8" Width	NA	NA
Pier #1	954.25	Drilled Shafts	48	2	2
Pier #2	878.75	Drilled Shafts	54/48	2	2
Pier #3	865.00	Drilled Shafts	54/48	2	2
Pier #4	872.50	Drilled Shafts	54/48	2	2
Pier #5	965.20	Cast-in-place piles	16	7	3
Forward Abut.	1011.00	Cast-in-place piles	14	3	5

Note:

1. the diameter for Pier 1 to 4 is formatted as A/B, A indicates diameter above the rock, B refers to a diameter below the bedrock, spread footings are listed in feet and inches;
2. The spacing used in the analyses is based on the smaller spacing in two directions

Table 5.2-2: SUM-8-0199 Summary of Foundation Loading

Structure	Strength					Service		
	Axial Max Compression Load (kip)	Axial Max Uplift Load (kip)	Axial[1] (kip)	Shear[1] (kip)	Moment[1] (kip-ft.)	Axial[1] (kip)	Shear[1] (kip)	Moment[1] (kip-ft.)
SB Bridge								
Rear Abut.								
Pier #1	-4590	500	-3411.66	274.12	2608.42	-3240.14	242.90	2115.57
Pier #2	-4546	0	-4545.48	170.65	1550.44	-3965.66	163.88	1390.13
Pier #3	-4152	0	-2930.98	210.94	1659.82	-3463.36	132.78	893.37
Pier #4	-3749	179	-3369.58	183.97	1242.48	-2964.94	163.29	1056.30
Pier #5	-479	0						
Forward Abut.	-263.5							
NB Bridge								
Rear Abut.								
Pier #1	-5011	453	-4403.45	895.27	2598.39	-3757.56	780.64	2316.58
Pier #2	-4044	0	-4043.44	151.50	1378.37	-3823.68	154.53	1300.69
Pier #3	-4439	267	-4438.19	144.21	1263.24	-3695.01	128.00	1069.37
Pier #4	-4288	52	-4287.81	147.54	1226.19	-3602.66	136.68	1107.54
Pier #5	-446	0						
Forward Abut.	-263.5							

Note:

1. Worst loading case of the combination of axial, shear, and moment is used for bending moment calculation.

5.2.1 Spread Footings

The rear abutments will be supported to bear on spread footings with a width of 15'-8". Based on table C10.6.2.6.1.1 in AASHTO's LRFD, the spread footing for the rear abutment of the NB bridge will bear on hard sound sandstone with a presumptive bearing resistance at the service limit state of 40 kips per square foot (ksf). The rear abutment of the SB bridge will bear on weathered medium-hard bedrock and has a presumptive bearing resistance at the service limit state of 16 ksf. These presumptive values assume one inch or less of settlement.

To determine the bearing resistance at the strength limit state, AASHTO's LRFD-2006, C10.4.6.4 on rock mass quality, Hoek and Brown constants were used with equation 10.8.3.5.4c-2. Based on this analysis, the bearing resistance at the strength limit state is 69.5 ksf and 104.2 ksf for the SB and NB bridges, respectively.

For sliding, the friction angle, δ, shall be taken as 35 degrees ($\tan \delta = 0.70$), the resistance factor for sliding permanent retaining walls is 1.0, according to Table 11.5.7-1 in AASHTO's LRFD. For overturning calculations, the backfill should be considered to have an internal angle of friction of 30 degrees and a moist unit weight of 0.120 kips per cubic foot (kcf).

5.2.2 Friction Pile Design

The friction piles were designed using APILE software. The parameters were developed using the project boring logs and the correlation of $N1_{60}$ values to an internal angle of friction from Sabatini 2002 formula but limited by Table 10.4.6.2.4-1 of the AASHTO's LRFD. The UBV values for the piles of pier 5 are above the recommended value of 450 kips of ODOT BDM 202.2.3.2.b. However, this limit is based on the normal pile wall thickness. The piles have a greater pile wall thickness than normal (the proposed wall thickness is 0.625 inches), GF has preformed a drivability analysis to verify this load does not over stress the steel.

A drivability analysis was performed assuming three diesel hammers due to the differing subsurface conditions loading conditions. The forward abutments of both bridges were less loaded then the pier piles and use a ram with a weight of 4.0 kips and an energy/power 43.240 kip-ft. Due to the heavier section of Pier #5 piles, the longer length, and the need to penetrate the uncontrolled fill these piles use heavier hammers. Both bridges used a ram with a weight of 6.60 kips and an energy/power 75.438 kip-ft. The piles for the forward abutments are close end 14-inch diameter pipe piles with 0.25-inch wall

thickness. The piles at the NB and SB Pier #5 are close end, 16-inch diameter, steel pipe piles. The Pier 5 piles will be specified with 0.625" steel walls. The steel wall is thicker to provide increased capacity, including against unbraced buckling length, after 100 years of section loss in polluted natural soils (degradation loss per Skyline Steel pipe pile literature). The resulting in a pipe wall thickness that can carry the design loads for a design life of 100 years (including the buckling of the unbraced length through landfill). Based on drivability results, Grade 3 steel is required for the NB Pier 5. Therefore, all the piles are recommended to use ASTM D 252 Grade 3 steel; Table 5.1.2-1 presents the results of the analysis. Please refer to Appendix F.2 for detailed calculation.

Table 5.2.2-1: SUM-8-0199 Friction Pile

Sub-structure	Pile Size (inch)	Ultimate Bearing Value (Kips)	Estimated Pile Cutoff EL.	Estimated Pile Tip Elevation (Depth below Footing)	Estimated Pile Length Depth (ft.)	Order Length (ft.)	Recommended Pipe Grade
NB Pier 5	16	658.6	966.2	891.2 (74)	75	80	3
NB Forward Abutment	14	390	1012	978 (33)	35	40	3
SB Pier 5	16	693.3	956.2	871.2 (84)	85	90	3
SB Forward Abutment	14	390	1012	958 (53)	55	60	3

5.2.3 Drilled Shaft Design

The drilled shafts were designed using AASHTO's LRFD. In general, the top of rock varies across the site, significantly in some areas and even in areas with the same surface elevation. The minimum rock socket length should be maintained when the top of rock varies between shafts at each substructure. Since the actual top of rock varies across the pier foundation (Pier 1 to 3), borings B-008-1-19, B-009-5-19, B-009-6-19, B-009-7-19, B-011-7-19, and B-011-8-19 were

advanced to provide detailed rock elevation at each drilled shaft location. At piers with multiple borings, the Top of Rock is assumed at the highest elevation of the borings analyzed and the Top of Competent Rock is assumed at the lowest elevation of the boring analyzed; Between "top of rock elevation" and "top of competent rock elevation", weak rock parameter were used for determining the side resistance of the drilled shaft rock socket based on AASHTO 10.8.3.5.4b-2. The summary for the drilled shaft design for the NB Bridge is presented in Table 5.1.3-1, and the drilled shaft design for the SB Bridge is presented in Table 5.1.3-2. The complete calculations can be found in Appendix F.3.

Table 5.2.3-1: NB Bridge Drilled Shafts

Substructure	Unit	Pier #1	Pier #2	Pier #3	Pier #4
Est. Top of Competent Rock[1]	FT.	951.8	853	838.3	836.8
Est. Top of Rock[1]	FT.	958.8	855.7	844.6	851.5
Design Bearing EL.	FT.	948.25	849.7	836.6	830.5
Rock Socket Diameter, B	FT.	4	4	4	4
Rock Socket Length	FT.	6	6	8	21
Factored Tip Resistance R_p	Kip	11016	6526	6799	3790
Factored Side Resistance R_s	Kip	863	834	404	729
Axial Strength Load/Shaft	Kip	5011	4044	4439	4288
Factored Uplift Resistance	Kip	628	607	294	530
Uplift Strength Load/Shaft	Kip	453	0	267	52

Note: 1. At piers with multiple borings, the Top of Rock is assumed at the highest elevation of the borings analyzed and the Top of Competent Rock is assumed at the lowest elevation of the boring analyze

Table 5.2.3-2: SB Bridge Drilled Shafts

Substructure		Pier #1	Pier #2	Pier #3	Pier #4
Est. Top of Competent Rock[1]	FT.	920.7	855.5	832.2	840
Est. Top of Rock[1]	FT.	933	862.7	837.7	841.1
Design Bearing EL.	FT.	917	855.2	831.2	834.6
Rock Socket Diameter, B	FT.	4	4	4	4
Rock Socket Length	FT.	16	7.5	6.5	6.5
Factored Tip Resistance R_p	Kip	4987	5576	11582	14072
Factored Side Resistance R_s	Kip	728	100	269	1087
Axial Strength Load/Shaft	Kip	4590	4546	4152	3749
Factored Uplift Resistance	Kip	529	73	196	790
Uplift Strength Load/Shaft	Kip	500	0	0	179

Note: 1. At piers with multiple borings, the Top of Rock is assumed at the highest elevation of the borings analyzed and the Top of Competent Rock is assumed at the lowest elevation of the boring analyze

5.2.4 FB-Multiplier Analysis

The reaction of the bridge foundation is calculated via a FB-Multipier global stiffness analysis. The results of FB-Multipier analysis are listed in Appendix F.3.2, and please refer to Table 5.1-5 and Table 5.1-6 for the design input parameters. Below listed a few important assumptions.

Assumptions:

- In FB-Multipier analysis, only 1 p-multiplier is allowed throughout the entire depth, therefore, no p-multiplier is applied for the foundation that is only beared on rock (Northbound Pier 1 and Pier 2). However, a group of p-multipliers (per AASHTO LRFD Table 10.7.2.4-1) is applied throughout the entire depth for other foundation, the bottom of which is in rock, to be conservative in calculation;
- The drain friction angle of granular material was obtained based on $N1_{60}$

according to AASHTO Table 10.4.6.2.4-1 per coarse granular content as listed below;

- The design values of N_{60}= 60, $N1_{60}$ =60 have been assumed for all the soil strata of which N_{60} >60, $N1_{60}$ >60;
- As for the Lateral Resistance analyses, assume Design RQD = 10 for rock strata, of which average RQD < 10.
- the Poisson's ratio for soil is obtained according to AASHTO Table C10.4.6.3-1: for clay μ is assumed to be 0.45, for sand μ is assumed to be 0.325; the Poisson's ratio for rock is obtained according to AASHTO Table C10.4.6.5-2: for sandstone μ is assumed to be 0.2, and for mudstone (including shale, claystone, and interbedded shale and siltstone) μ is assumed to be 0.1;
- Tensile strength of rock is assumed to be Q_u/10;
- The torsional shear stress is assumed to be the same as the ultimate skin friction, and is round to 100 psf:
    - For drilled shaft clay: ΦR_s = 500 psf;
    - For drilled shaft sand or gravel: ΦR_s = 1000 psf;
    - For drilled shaft rock: competent rock (RQD>20): ΦR_s = (Q_uXP_a)^0.5 (AASHTO 10.8.3.5.4b-1); fractured rock (RQD<=20) : ΦR_s = 0.65X0.45X (Q_uXP_a)^0.5 (AASHTO 10.8.3.5.4b-2);
    - For driven pile, maximum skin friction (bottom 1 foot of each layer) obtained from APILE analysis;
- The Pile Bearing Failure Strength for the friction pile is assumed to be the same as the ultimate tip resistance (maximum tip resistance obtained from APILE analysis) of each layer, and is round to 10 kips; and
- Trash zone exists between Elv. 955.2 and Elv. 944 near pier 5 (Stratum 1 for Pier 5). Although the boring logs show a relative high blow count for this layer, however, given the high compressibility nature of trash, this stratum has been modeled as very loose sand with N_{60} and $N1_{60}$ equals to 1, and the Poisson's ratio is assumed to be 0.1. The unit weight of the soil layer is assumed to be 110 pcf, the shear strength of the soil layer is ignored from the calculation (assume φ= 1 degree), and the torsional shear stress is assumed to be 1 psf for calculation purpose.

5.3 Roadway Recommendations

National Engineering and Architectural Services, Inc. (NEAS) prepared a Subgrade Exploration Report. The complete report appears in Appendix G.

5.3.1 Embankment Recommendations

Borings B-018-0-15 and B-019-0-15 were advanced for the fill slope behind the SB Bridge Forward Abutment. A global stability run was performed. The existing cross-section at STA+243 was used to evaluate the overall stability. While a borrow pits has not been identified, it is generally assumed that fill will be composed of soil like the site material. Based on the OGE's recommendation, the embankment material is assumed to be with a short-term shear strength of 1500 pounds per square foot (psf) cohesion (c) and 0 degrees internal angle of friction (φ), and the long-term shear strength of 250 psf effective cohesion (c') and 26 degrees effective internal angle of friction (φ'). The existing soils were granular (ODOT A-1, A-2, and A-3 series) with an average N_{60} value of 18 and $N1_{60}$ value of 20. GF modeled this soil with a long term and effective internal angle of friction of 33 degrees and no cohesion. Groundwater was not encountered in Borings B-018-0-15 and B-019-0-15.

Based on these criteria and the slope geometry, the minimum safety factor is 1.6. Therefore, it is GF's opinion that if construction recommendations from Section 200 of ODOT's CMS and ODOT GB2, are followed, the embankments should be stable. The overall stability run is included in Appendix F.5.1.

This opinion is the result of the following observations and assumptions:

1. It is generally assumed that earthwork projects will utilize soil with similar characteristics to the in-situ soil. With 69% of the soil being classified as granular (ODOT series A-1, A-2, A-3, A-3a) or low plasticity sandy silt (ODOT A-4a), properly compacted embankment may be assumed to have a high shear strength.
2. Shallow groundwater was not encountered at the site, and most of the borings did not encounter the water table.
3. The existing valley slopes were observed to be, in general, stable even though many of the existing valley slopes appear to be more steeply sloped than the standard ODOT two horizontal to one vertical slope.

5.3.2 Access Road Stability Analysis

Overall stability (Global) analyses were performed on the most critical sections through the probable locations of the access road provided by MS structural

engineer group.

Calculations supporting the analysis are presented in Appendix F.5. Below is the summary of the important assumptions and the results of the calculations:

Assumptions:

- The stability analyses were performed on the most critical sections for each Access Road: STA. 13+00 for Access Road 1; STA. 32+00 and STA. 49+00 for Access Road 2A; STA. 52+00 and STA. 56+00 for Access Road 5A; STA. 66+00 for Access Road 6; and STA. 44+00 for Access Road 8. The most critical sections were chosen based on the following factors:
    - The proximity of the road to the slope,
    - Proposed wall height (if any),
    - The steepness of the geometry of the road.
- The Access Road 3A is located along the toe of the existing slope. There is no earthwork proposed for the slope. Therefore, it presents very little risk of overall stability failure, and no stability analysis was performed;
- The Slope Stability of two cases was examined for both the existing condition and the proposed grade after loading. To the extent the slopes could be observed due to vegetation during the field reconnaissance, all the cross-sections were observed to be stable in existing conditions. All the existing models were found to have a Factor of Safety (FoS) equal to or greater than 1.2, based on drained shear strength and soil properties developed for each site, except for STA. 56+00 at Access Road 5A. Here the near-surface material consists of uncontrolled fill (trash), we purposefully reduced the shear strength of the material;
- The shear strength of $c' = 250$ psf and $\phi' = 26$ degrees were assumed for embankment material for the analysis;
- The distributed load was assumed to be 360 psf.

Table 5.3.2-1: Summary of Factor of Safety for the Access Road

Access Road	Factor of Safety	
	Existing Condition	**Finished Grade W/ Load**
Access Road 1		
STA. 13+00	1.5	1.5
Access Road 2A		
STA. 32+00	1.4	1.3
STA. 49+00	1.3	1.5 (Wall)
Access Road 5A.		
STA. 52+00	1.2[1]	1.5 (Road)
		1.2 (Downslope)
		1.3 (Wall_Downslope)
STA. 56+00	1.0[1]	1.6 (Road)
		1.4 (Upslope)
Access Road 6		
STA. 66+00	1.8	1.5
Access Road 8		
STA. 44+00	1.5	1.5 (Wall)
		1.5 (Downslope)
		1.3 (Upslope)
1: Access road 5A soil parameters for the near-surface natural soil and uncontrolled fill were conservatively estimated. They yield a factor of safety of less than the AASHTO required 1.3; however, GF recognizes these parameters are conservation and ran the models to see the access road construction would negatively affect the factor of safety.		

In general, the slopes of the site were observed to be stable where heavy vegetation did not obscure direct observation. Therefore, soil properties were determined based on the index properties, standard blow counts, and pocket penetrometer readings. The effect of the installed access road was compared to the calculated existing slope stability. If there was a reduction in the Factor of Safety, remediation is suggested. If there was no change or an improvement in the stability due to embankment placement, no remediation was suggested. This is due to the inherent uncertainty of calculating an un-failed slope's stability. Embankment placement was not shown with the required special benching to represent a "worst-case" scenario. In all cases of filling on slopes, the ODOT GB2 requirement should be followed.

Access Road (ACR) 1: One critical section was identified. The analysis shows the access road has no net effect on the slope's Factor of Safety (FoS).

ACR 2A: Two critical sections were identified. At station 32+00, due to a slight steepening of the slope above the access road, the FoS drops from 1.5 to 1.4. This is still acceptable by AASHTO and ODOT standards. At station 49+00 a wall is needed to construct the road in the desired location. A soldier pile wall is assumed with a lateral load due to overall stability of 25 kips per pile. The spacing of the soldier piles was assumed to be 8 feet center to center. The load due to active pressure needs to be calculated by the contractor with the greatest of the two loads controlling the design.

ACR 5A: Two critical sections were identified. GF developed the soil parameters for the critical cross-section of STA. 52+00 using the same procedures and correlations used to develop all the subsurface profiles in this report. These parameters resulted in a global FoS of a 1.2. A soldier pile wall is proposed to be constructed in the desired location to achieve an FoS of 1.3 downslope. The soldier pile wall is assumed with a lateral load due to overall stability of 10 kips per pile. The spacing of the soldier piles was assumed to be 8 feet center to center. The analysis also shows that the access road proximity to the slope does not change the FoS. The FoS of a failure through the road is 1.5.

Based on the conservative estimation of soil parameters for the uncontrolled fill, the overall stability analysis of the existing conditions at STA. 56+00 at ACR 5A in equilibrium (FoS equals to 1.0). **This is contrary to what was observed during the field reconnaissance**. The reconnaissance found the slope heavily vegetated. Where it was observable, the slope was stable. However, the near-surface material is uncontrolled fill (trash); therefore, we purposefully assumed a low shear strength for the material. GF recognizes that landfill shear strength can be highly variable, and the actual shear may be significantly higher than the assumed value; therefore, we took a qualitative not a quantitative approach to the slope stability analysis. Our assumption is that if the proximity of the road to the slope did not reduce overall FoS, then no work would be necessary on the landfill material since such work would be costly due to environmental concerns.

According to the analysis, the proposed embankment acts like a toe berm. It increases the factor of safety along the access road to 1.6 or an increase of 60% (1.6/1.0-1). The embankment also increases the upslope stability to 1.4 or by 40%. Given this qualitative increase, GF recommends no improvements be performed up the slope of the access road based on the assumed alignment of the access road. If this alignment changes or these assumptions no longer are justified, **the contractor should perform his own evaluation of the access road for ODOT's review**. When constructing access roads crossing

uncontrolled fill or soft material, GF recommends that the access road utilize geotextile or geogrid. The exact configuration of the geotextile/geogrid should be determined by the contractor based on their estimated traffic and expected service life. The design should be developed with a geogrid/geotextile manufacturer. The contractor should be contractually responsible for maintaining the access road.

ACR 6: One critical section was identified. Due to steepening of the slope below the access road, the FoS drops from 1.8 to 1.5. This is still acceptable by AASHTO and ODOT standards.

ACR 8: One critical section was identified. The walls in this section were suggested by MS. GF evaluated the lateral load on the walls for global stability. Active pressure loads should be determined by the contractor based on the actual configuration of the walls. GF determined that the upslope wall will need to carry a lateral load of 175 kips for acceptable global stability. The downslope stability is unchanged, and the upslope the FoS is 1.3.

5.3.3 Crane Pad and Tower Location allowable bearing capacity

The probable crane pad locations and pad elevations were provided by MS to determine the available bearing resistance at each location. It was assumed that the pad would be 18-inches of crushed aggregate bearing on untreated soil. The crane pad was modeled as a spread footing over with a 30 by 30-foot footing size. Using this assumption, the Strength Bearing Resistance at each crane pad was determined. The Service Bearing Resistance was limited to a load that caused 1.5 inches of settlement. The soil parameters used for the settlement were based on index properties and standard blow counts of the borings nearest to the pads. No consolidation testing was performed. Differential settlement can be assumed to be 0.75 inches. The results of the preliminary analysis are presented below in Table 5.3.3-1.

MS also provided the locations, bearing elevations, and pad sizes for the two proposed crane towers. Crane Tower #1 was assumed to be on a 16 ft. x 16 ft. pad and Crane Tower 12 ft. x 12 ft. pad. The Service Bearing Resistance assumed a settlement of 1.5 inches. The results of this analysis are presented in Table 5.3.3-2.

The locations, soil parameters, bearing capacity, and settlement can be found in Appendix F.6. The contractor should evaluate the allowable settlement threshold, the potential settlement, and the bearing resistance based on the actual load, base size, and allowable settlement.

Table 5.3.3-1: Summary of Allowable Bearing Capacity for Crane Pad Locations

Crane Pad Location	CL1	CL2[1]	CL3	CL4	CL5[2]	CL6[2]
Assumed Bearing Elevation (ft.)	1037	940	930	880	860	860
Strength Bearing Resistance (ksf)	9.6	20.0	5.9	5.9	20.0	20.0
Service Bearing Resistance (ksf)	5.0	20.0	3.0	2.5	20.0	20.0
Crane Pad Location	**CL7**	**CL8**	**CL9**	**CL10**	**CL11**	
Assumed Bearing Elevation (ft.)	880	880	890	890	1037	
Strength Bearing Resistance (ksf)	8.7	14.3	6.2	35.4	24.3	
Service Bearing Resistance (ksf)	5.5	5.5	2.5	3.0	2.5	

Note: 1. CL2 is located in rock outcrop zone; the bearing elevation is therefore assumed to be near the ground elevation 940.

2. For CL5 and CL6, the bearing elevations provided by MS is in Strata 3, which is an lGM stratum.

Table 5.3.3-2: Summary of Allowable Bearing Capacity for Towers Locations

Crane Tower Location	TW1	TW2
Assumed Bearing Elevation (ft.)	872	874
Strength Bearing Resistance (ksf)	18.5	7.3
Service Bearing Resistance (ksf)	7.0	7.0

5.4 Noise barriers

In accordance with Section 800 of the BDM, the design $N1_{60}$ values and predominant soil type (cohesive or granular) for each boring are used in conjunction with the magnitude of the slope of the finished ground surface along the barrier, the barrier design height and the barrier post spacing to determine the depth of the foundations (using Figure 802.1.2-1 or Figure 802.1.2-2, as appropriate). P-Y analyses were performed to determine foundation depth where wall height is over 20 feet. Standard foundations for noise barriers are 30-inch diameter drilled shafts. Tables 5.4-1 to 5.4-6 below presents the recommended depth of the drilled shafts for the six noise barriers. The complete calculations can be found in Appendix F.7.

Table 5.4-1: Noise Barrier No. 1A Design Depth Recommendations

NOISE WALL 1A										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
1	*00+80.00*	*8*	*5.00*	*7.50*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*20*	*7.5' Fill*
2	*00+88.00*	*8*	*9.00*	*7.50*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*20*	
3	*00+96.00*	*8*	*13.00*	*10.00*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*14*	
4	*01+04.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*14*	
5	*01+28.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*14*	
6	*01+52.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*14*	
7	*01+76.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-021-2-16*	*Granular*	*14*	
8	*02+00.00*	*24*	*19.00*	*20.00*	*0.00*	*2:1*	*B-023-0-15*	*Granular*	*4*	** Shaft Length is calculated based on p-y analysis by using LPILE*
9	*02+24.00*	*24*	*19.00*	*20.00*	*0.00*	*2:1*	*B-023-0-15*	*Granular*	*4*	
10	*02+48.00*	*24*	*20.00*	*20.00*	*0.00*	*2:1*	*B-023-0-15*	*Granular*	*4*	
11	*02+72.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-023-0-15*	*Granular*	*NA*	
12	*02+96.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-023-0-15*	*Granular*	*NA*	
13	*03+20.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	
14	*03+44.00*	*16*	*21.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	
15	*03+60.00*	*16*	*21.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	
16	*03+76.00*	*16*	*21.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	
17	*03+92.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	

NOISE WALL 1A										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
18	*04+16.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-025-0-15*	*Granular*	*NA*	
19	*04+40.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-025-3-16*	*Granular*	*NA*	
20	*04+64.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-025-3-16*	*Granular*	*NA*	
21	*04+88.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-025-3-16*	*Granular*	*NA*	
22	*05+12.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
23	*05+36.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
24	*05+60.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
25	*05+84.00*	*24*	*22.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
26	*06+08.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
27	*06+32.00*	*24*	*21.00*	*20.00*	*0.00*	*2:1*	*B-026-0-15*	*Granular*	*NA*	
28	*06+56.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
29	*06+80.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
30	*07+04.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
31	*07+28.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
32	*07+52.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
33	*07+76.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
34	*08+00.00*	*24*	*21.00*	*15.00*	*0.00*	*2:1*	*B-030-1-16*	*Granular*	*NA*	
35	*08+24.00*	*24*	*21.00*	*10.00*	*0.00*	*2:1*	*B-031-1-16*	*Granular*	*NA*	
36	*08+48.00*	*24*	*21.00*	*10.00*	*0.00*	*2:1*	*B-031-1-16*	*Granular*	*NA*	
37	*08+72.00*	*8*	*21.00*	*10.00*	*0.00*	*2:1*	*B-031-1-16*	*Granular*	*NA*	
38	*08+80.00*	*8*	*17.00*	*10.00*	*0.00*	*2:1*	*B-031-1-16*	*Cohesive*	*25*	
39	*08+88.00*	*8*	*13.00*	*6.00*	*0.00*	*2:1*	*B-031-1-16*	*Cohesive*	*20*	*4' Cut*
40	*08+96.00*	*8*	*9.00*	*6.00*	*0.00*	*2:1*	*B-031-1-16*	*Cohesive*	*20*	

Note: ** The Wall height for Shaft No. 8 to 10 is less than or equal to 20 feet, the shaft length can be calculated according to BDM Section 800. However, detailed p-y analysis has been performed for this section (Shaft No. 8 to 12), the shaft length is based on the p-y analysis.*

Table 5.4-2: Noise Barrier No. 1B Design Depth Recommendations

NOISE WALL 1B										
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	Max Barrier Height	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected $N1_{60}$	Remark
1	10+00.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
2	10+24.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
3	10+48.00	24	16.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
4	10+72.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
5	10+96.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
6	11+20.00	24	18.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
7	11+44.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
8	11+68.00	24	17.00	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
9	11+92.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
10	12+16.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
11	12+40.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
12	12+64.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
13	12+88.00	24	18.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
14	13+12.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
15	13+36.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
16	13+60.00	24	16.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
17	13+84.00	24	17.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
18	14+08.00	24	17.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
19	14+32.00	24	17.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
20	14+56.00	24	17.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
21	14+80.00	24	18.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
22	15+04.00	24	18.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
23	15+28.00	24	19.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
24	15+52.00	24	19.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
25	15+76.00	24	20.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
26	16+00.00	24	20.00	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
27	16+24.00	24	21.00	9.00	0.00	3:1	B-033-0-16	Cohesive	NA	Shaft Length is calculated
28	16+48.00	16	22.00	9.00	0.00	3:1	B-033-0-16	Cohesive	NA	

NOISE WALL 1B										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	*Length of Rock Socket (feet)*	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
29	*16+64.00*	*16*	*23.00*	*9.00*	*0.00*	*3:1*	*B-033-0-16*	*Cohesive*	*NA*	*Shaft Length is calculated based on p-y*
30	*16+80.00*	*16*	*24.00*	*9.00*	*0.00*	*3:1*	*B-034-0-16*	*Cohesive*	*NA*	
31	*16+96.00*	*24*	*22.00*	*9.00*	*0.00*	*3:1*	*B-034-0-16*	*Cohesive*	*NA*	
32	*17+20.00*	*24*	*20.00*	*15.00*	*0.00*	*3:1*	*B-034-0-16*	*Cohesive*	*11*	
33	*17+44.00*	*24*	*19.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
34	*17+68.00*	*24*	*19.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
35	*17+92.00*	*24*	*17.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
36	*18+16.00*	*24*	*17.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
37	*18+40.00*	*24*	*17.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
38	*18+64.00*	*24*	*17.00*	*13.00*	*0.00*	*Level*	*B-034-0-16*	*Cohesive*	*11*	
39	*18+88.00*	*24*	*17.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
40	*19+12.00*	*24*	*17.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
41	*19+36.00*	*24*	*17.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
42	*19+60.00*	*24*	*18.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
43	*19+84.00*	*24*	*18.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
44	*20+08.00*	*24*	*18.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
45	*20+32.00*	*24*	*18.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
46	*20+56.00*	*24*	*18.00*	*9.00*	*0.00*	*Level*	*B-035-0-16*	*Cohesive*	*25*	
47	*20+80.00*	*24*	*18.00*	*12.00*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*13*	
48	*21+04.00*	*24*	*19.00*	*12.00*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*13*	
49	*21+28.00*	*8*	*19.00*	*9.50*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*13*	
50	*21+36.00*	*8*	*17.00*	*9.50*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*13*	
51	*21+44.00*	*8*	*13.00*	*8.00*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*13*	
52	*21+52.00*	*8*	*9.00*	*6.50*	*0.00*	*Level*	*B-036-0-16*	*Granular*	*16*	

Table 5.4-3: Noise Barrier No. 2A Design Depth Recommendations

NOISE WALL 2A										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
1	*30+96.00*	*8*	*6.00*	*7.00*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*30*	
2	*31+04.00*	*8*	*10.00*	*7.00*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*30*	
3	*31+12.00*	*8*	*13.00*	*10.00*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*16*	*3.5' Fill*
4	*31+20.00*	*24*	*14.00*	*12.00*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*16*	
5	*31+44.00*	*24*	*14.00*	*12.00*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*16*	
6	*31+68.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*20*	
7	*31+92.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*20*	
8	*32+16.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*20*	
9	*32+40.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-021-3-16*	*Granular*	*20*	
10	*32+64.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
11	*32+88.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
12	*33+12.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	*9' Fill*
13	*33+36.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
14	*33+60.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
15	*33+84.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
16	*34+08.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
17	*34+32.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-025-1-16*	*Granular*	*20*	
18	*34+56.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
19	*34+80.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
20	*35+04.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
21	*35+28.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	*9.5' Fill*
22	*35+52.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
23	*35+76.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
24	*36+00.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-027-0-15*	*Granular*	*20*	
25	*36+24.00*	*24*	*14.00*	*10.00*	*0.00*	*2:1*	*B-029-1-16*	*Granular*	*34*	
26	*36+48.00*	*24*	*15.00*	*16.00*	*0.00*	*2:1*	*B-029-1-16*	*Granular*	*20*	
27	*36+72.00*	*24*	*15.00*	*16.00*	*0.00*	*2:1*	*B-029-1-16*	*Granular*	*20*	*7' Fill*
28	*36+96.00*	*24*	*15.00*	*16.00*	*0.00*	*2:1*	*B-029-1-16*	*Granular*	*20*	

NOISE WALL 2A										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
29	*37+20.00*	*24*	*15.00*	*14.00*	*0.00*	*3:1*	*B-029-1-16*	*Granular*	*20*	
30	*37+44.00*	*24*	*15.00*	*14.00*	*0.00*	*3:1*	*B-029-1-16*	*Granular*	*20*	
31	*37+68.00*	*24*	*16.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
32	*37+92.00*	*24*	*16.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
33	*38+16.00*	*24*	*17.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
34	*38+40.00*	*24*	*17.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	*2.5' Fill*
35	*38+64.00*	*24*	*17.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
36	*38+88.00*	*24*	*17.00*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
37	*39+12.00*	*8*	*17.00*	*10.50*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	
38	*39+20.00*	*8*	*13.00*	*9.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	
39	*39+28.00*	*8*	*9.00*	*7.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	*1.5' Cut*
40	*39+36.00*	*8*	*5.00*	*7.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	

Table 5.4-4: Noise Barrier No. 2B Design Depth Recommendations

NOISE WALL 2B										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	Applicable Boring	Primary Soil Type	Design Depth Corrected $N1_{60}$	*Remark:*
1	*40+48.00*	*24*	*15.00*	*14.00*	*0.00*	*5:1*	*B-031-2-16*	*Cohesive*	*14*	
2	*40+72.00*	*24*	*16.00*	*14.00*	*0.00*	*5:1*	*B-031-2-16*	*Cohesive*	*14*	
3	*40+96.00*	*24*	*15.00*	*14.00*	*0.00*	*5:1*	*B-031-2-16*	*Cohesive*	*14*	
4	*41+20.00*	*24*	*14.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
5	*41+44.00*	*24*	*13.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
6	*41+68.00*	*24*	*12.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
7	*41+92.00*	*24*	*12.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
8	*42+16.00*	*24*	*11.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
9	*42+40.00*	*24*	*11.00*	*10.00*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	

NOISE WALL 2B										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	Applicable Boring	Primary Soil Type	Design Depth Corrected $N1_{60}$	*Remark:*
10	*42+64.00*	*24*	*10.00*	*8.50*	*0.00*	*5:1*	*B-031-4-16*	*Granular*	*10*	
11	*42+88.00*	*16*	*10.00*	*12.50*	*5.00*	*5:1*	*B-032-2-16*	*Granular*	*18*	
12	*43+04.00*	*16*	*12.00*	*12.50*	*5.00*	*2:1*	*B-032-2-16*	*Granular*	*18*	
13	*43+20.00*	*16*	*12.00*	*12.50*	*5.00*	*2:1*	*B-032-2-16*	*Granular*	*18*	
14	*43+36.00*	*16*	*12.00*	*12.50*	*5.00*	*2:1*	*B-032-2-16*	*Granular*	*18*	
15	*43+52.00*	*16*	*12.00*	*12.50*	*5.00*	*2:1*	*B-032-2-16*	*Granular*	*18*	
16	*43+68.00*	*16*	*13.00*	*12.50*	*5.00*	*2:1*	*B-032-2-16*	*Granular*	*18*	
17	*43+84.00*	*16*	*13.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
18	*44+00.00*	*16*	*14.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
19	*44+16.00*	*16*	*14.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
20	*44+32.00*	*16*	*13.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
21	*44+48.00*	*16*	*13.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
22	*44+64.00*	*16*	*14.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
23	*44+80.00*	*16*	*13.00*	*12.50*	*5.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
24	*44+96.00*	*8*	*12.00*	*6.50*	*0.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
25	*45+04.00*	*8*	*9.00*	*6.50*	*0.00*	*Level*	*B-032-2-16*	*Granular*	*18*	
26	*45+12.00*	*8*	*5.00*	*6.50*	*0.00*	*Level*	*B-032-2-16*	*Granular*	*18*	

Table 5.4-5: Noise Barrier No. 3 Design Depth Recommendations

NOISE WALL 3										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
1	*51+04.00*	*8*	*6.00*	*6.00*	*0.00*	*Level*	*B-001-5-16*	*Cohesive*	*26*	
2	*51+12.00*	*8*	*9.00*	*6.00*	*0.00*	*Level*	*B-001-5-16*	*Cohesive*	*26*	
3	*51+20.00*	*24*	*12.00*	*11.50*	*5.00*	*Level*	*B-001-5-16*	*Cohesive*	*26*	*0.5' Cut*
4	*51+44.00*	*24*	*13.00*	*11.50*	*5.00*	*Level*	*B-001-5-16*	*Cohesive*	*26*	
5	*51+68.00*	*24*	*13.00*	*11.50*	*5.00*	*Level*	*B-001-5-16*	*Cohesive*	*26*	

NOISE WALL 3										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
6	*51+92.00*	*24*	*14.00*	*11.50*	*5.00*	*2:1*	*B-001-5-16*	*Cohesive*	*26*	
7	*52+16.00*	*24*	*15.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	*2' Cut*
8	*52+40.00*	*8*	*15.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
9	*52+48.00*	*8*	*15.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
10	*52+56.00*	*8*	*17.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
11	*52+64.00*	*24*	*17.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
12	*52+88.00*	*24*	*16.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
13	*53+12.00*	*24*	*14.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
14	*53+36.00*	*24*	*13.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
15	*53+60.00*	*24*	*13.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
16	*53+84.00*	*24*	*14.00*	*9.50*	*5.00*	*2:1*	*B-003-4-16*	*Cohesive*	*6*	
17	*54+08.00*	*24*	*15.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
18	*54+32.00*	*24*	*15.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
19	*54+56.00*	*24*	*15.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
20	*54+80.00*	*24*	*14.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
21	*55+04.00*	*24*	*14.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
22	*55+28.00*	*24*	*14.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
23	*55+52.00*	*24*	*14.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
24	*55+76.00*	*24*	*13.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
25	*56+00.00*	*24*	*12.00*	*10.50*	*5.00*	*2:1*	*B-003-8-16*	*Cohesive*	*33*	
26	*56+24.00*	*24*	*13.00*	*10.00*	*5.00*	*2:1*	*B-004-2-16*	*Cohesive*	*6*	
27	*56+48.00*	*24*	*14.00*	*10.00*	*5.00*	*2:1*	*B-004-2-16*	*Cohesive*	*6*	
28	*56+72.00*	*24*	*15.00*	*10.00*	*5.00*	*2:1*	*B-004-2-16*	*Cohesive*	*6*	
29	*56+96.00*	*24*	*16.00*	*10.00*	*5.00*	*Level*	*B-004-2-16*	*Cohesive*	*6*	
30	*57+20.00*	*24*	*15.00*	*10.00*	*5.00*	*Level*	*B-004-2-16*	*Cohesive*	*6*	
31	*57+44.00*	*24*	*14.00*	*10.00*	*5.00*	*3:1*	*B-004-2-16*	*Cohesive*	*6*	*4' Fill*
32	*57+68.00*	*24*	*14.00*	*13.00*	*5.00*	*2:1*	*B-004-2-16*	*Cohesive*	*6*	
33	*57+92.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	*20' Fill*
34	*58+16.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	

NOISE WALL 3										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
35	*58+40.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	
36	*58+64.00*	*24*	*14.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	
37	*58+88.00*	*24*	*13.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	
38	*59+12.00*	*24*	*13.00*	*11.50*	*0.00*	*2:1*	*B-005-2-16*	*Granular*	*20*	*29' Fill*
39	*59+36.00*	*24*	*13.00*	*11.50*	*0.00*	*2:1*	*B-005-2-16*	*Granular*	*20*	

Table 5.4-6: Noise Barrier No. 4 Design Depth Recommendations

NOISE WALL 4										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
1	*70+00.00*	*8*	*7.00*	*6.00*	*0.00*	*2:1*	*B-001-3-16*	*Cohesive*	*22*	
2	*70+08.00*	*8*	*9.00*	*6.00*	*0.00*	*2:1*	*B-001-3-16*	*Cohesive*	*22*	
3	*70+16.00*	*8*	*11.00*	*6.00*	*0.00*	*2:1*	*B-001-3-16*	*Cohesive*	*22*	*1' Cut*
4	*70+24.00*	*24*	*12.00*	*7.00*	*0.00*	*2:1*	*B-001-3-16*	*Cohesive*	*22*	
5	*70+48.00*	*24*	*12.00*	*7.00*	*0.00*	*2:1*	*B-001-3-16*	*Cohesive*	*22*	
6	*70+72.00*	*24*	*12.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
7	*70+96.00*	*24*	*12.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
8	*71+20.00*	*24*	*13.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
9	*71+44.00*	*24*	*13.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
10	*71+68.00*	*24*	*13.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
11	*71+92.00*	*24*	*13.00*	*11.50*	*5.00*	*2:1*	*B-001-4-15*	*Cohesive*	*22*	
12	*72+16.00*	*24*	*15.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	
13	*72+40.00*	*24*	*16.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	*8' Cut*
14	*72+64.00*	*24*	*17.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	
15	*72+88.00*	*24*	*19.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	

NOISE WALL 4										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
16	*73+12.00*	*24*	*19.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	
17	*73+36.00*	*24*	*20.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	
18	*73+60.00*	*24*	*20.00*	*5.50*	*5.00*	*2:1*	*B-003-1-15*	*Rock*	*NA*	
19	*73+84.00*	*24*	*21.00*	*8.00*	*5.00*	*2:1*	*B-003-5-15*	*Rock*	*NA*	
20	*74+08.00*	*24*	*20.00*	*8.00*	*5.00*	*2:1*	*B-003-5-15*	*Rock*	*NA*	*7' Cut*
21	*74+32.00*	*24*	*21.00*	*8.00*	*5.00*	*2:1*	*B-003-5-15*	*Rock*	*NA*	
22	*74+56.00*	*24*	*20.00*	*8.00*	*5.00*	*2:1*	*B-003-5-15*	*Rock*	*NA*	
23	*74+80.00*	*24*	*19.00*	*6.00*	*5.00*	*2:1*	*B-003-6-15*	*Rock*	*NA*	
24	*75+04.00*	*24*	*17.00*	*6.00*	*5.00*	*2:1*	*B-003-6-15*	*Rock*	*NA*	
25	*75+28.00*	*24*	*16.00*	*6.00*	*5.00*	*2:1*	*B-003-6-15*	*Rock*	*NA*	*1' Cut*
26	*75+52.00*	*16*	*15.00*	*6.00*	*5.00*	*2:1*	*B-003-6-15*	*Rock*	*NA*	
27	*75+68.00*	*16*	*15.00*	*6.00*	*5.00*	*2:1*	*B-003-6-15*	*Rock*	*NA*	
28	*75+84.00*	*16*	*16.00*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	
29	*76+00.00*	*16*	*16.00*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	
30	*76+16.00*	*16*	*18.00*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	
31	*76+32.00*	*16*	*19.00*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	*3' Cut*
32	*76+48.00*	*16*	*18.00*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	
33	*76+64.00*	*16*	*18.00*	*9.50*	*5.00*	*Level*	*B-004-1-16*	*Rock*	*NA*	
34	*76+80.00*	*16*	*17.00*	*9.50*	*5.00*	*Level*	*B-004-1-16*	*Rock*	*NA*	
35	*76+96.00*	*24*	*17.00*	*12.50*	*5.00*	*Level*	*B-004-1-16*	*Granular*	*14*	
36	*77+20.00*	*24*	*17.00*	*12.50*	*5.00*	*5:1*	*B-004-1-16*	*Granular*	*14*	
37	*77+44.00*	*24*	*17.00*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
38	*77+68.00*	*24*	*17.00*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
39	*77+92.00*	*24*	*17.00*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
40	*78+16.00*	*24*	*18.00*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
41	*78+40.00*	*24*	*18.00*	*15.00*	*0.00*	*3:1*	*B-004-5-16*	*Granular*	*18*	
42	*78+64.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
43	*78+88.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
44	*79+12.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	

NOISE WALL 4										
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*Max Barrier Height*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected $N1_{60}$*	*Remark*
45	*79+36.00*	*24*	*17.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
46	*79+60.00*	*24*	*17.00*	*16.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*20*	*8.5 Fill*

5.5 Below Grade Walls

Significant temporary shoring will be required for the installation of the footing at the SB Bridge at Pier #1 and the NB and SB Bridges at Pier #2. Given the time that excavation is likely to remain open, it is recommended that shoring be designed according to the long term (effective) shear strength. Table 5.4.1-1 presents the recommended design values for the shoring at Pier #1 for the SB Bridge. Table 5.5.1-2 presents the recommended design values for shoring at Pier #2 for the NB and SB Bridges. Section 208.1 of the ODOT Bridge Design Manual requires that details be included in the construction plans for temporary shoring greater than eight feet tall or where excavation will be required adjacent to railroad tracks.

Table 5.5-1: SB Bridge at Pier #1

Elevation	**Stratum**	**Moist Unit Weight γ (kcf)**	**Effective Internal Angle of Friction φ' (degrees)**	**Effective Cohesion c' (ksf)**
Ground to 953	Granular fill	0.125	30	0
953 -940	Very Stiff Cohesive	0.130	28	0.4
940 to top of rock	Medium Dense Granular	0.135	33	0

Table 5.5-2: NB and SB Bridges at Pier #2

Elevation	Stratum	Moist Unit Weight γ (kcf)	Effective Internal Angle of Friction φ' (degrees)	Effective Cohesion c' (ksf)
Ground to Top of the rock	Cohesive Soil	0.125	28	0.4

Table 5.5-3: Launch Pit

Depth (ft.)	Stratum	Moist Unit Weight γ (kcf)	Effective Internal Angle of Friction φ' (degrees)	Effective Cohesion c' (ksf)
0-25	Granular	0.120	30	0
25+	Granular	0.130	35	0

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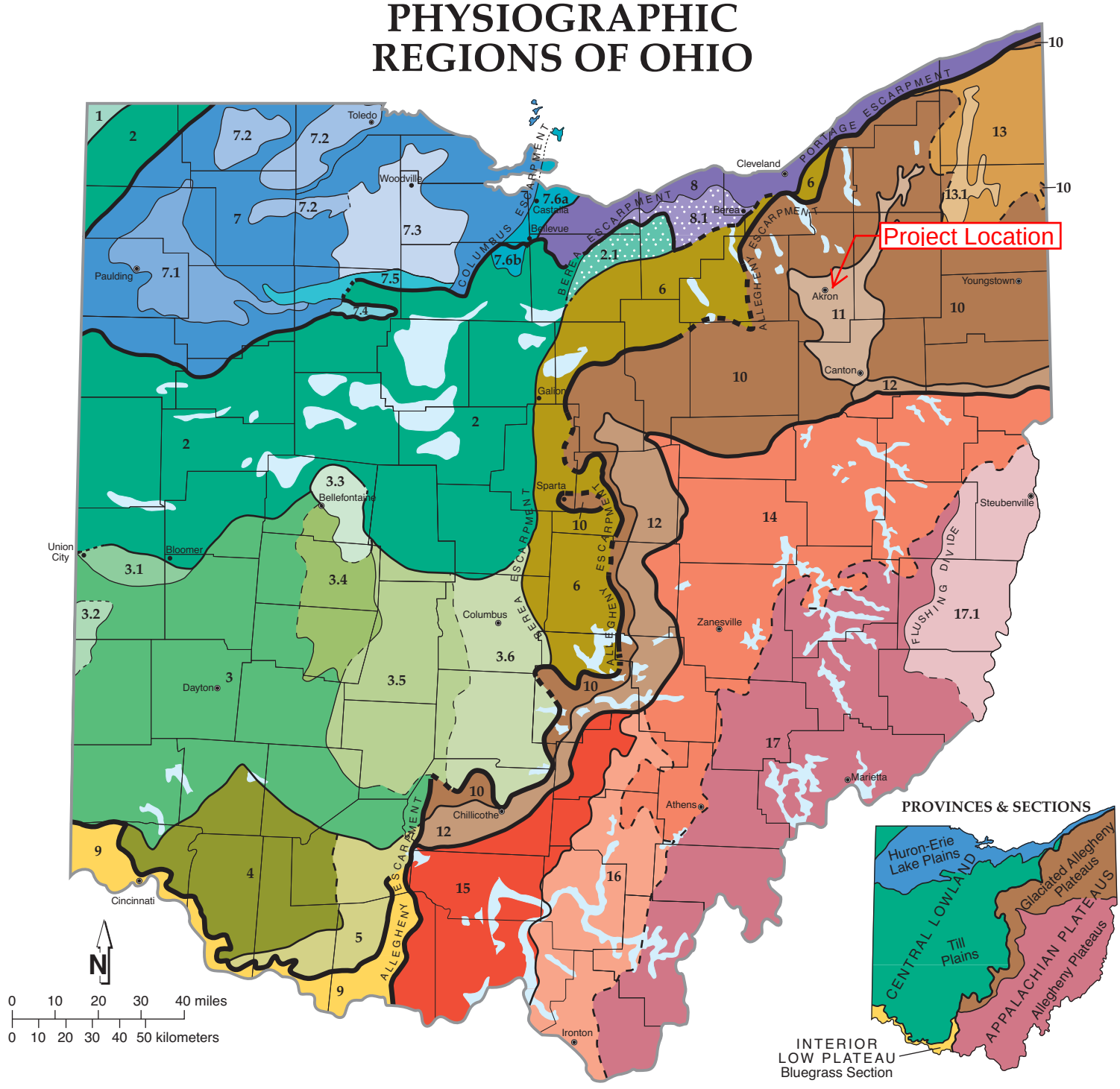
APPENDIX A

Geological Information

PHYSIOGRAPHIC REGIONS OF OHIO



Till Plains

- 1. Steuben Till Plain
- 2. Central Ohio Clayey Till Plain
  - 2.1. Berea Headlands of the Till Plain
- 3. Southern Ohio Loamy Till Plain
  - 3.1. Union City-Bloomer Transitional Terrain
  - 3.2. Whitewater Interlobate Plain
  - 3.3. Bellefontaine Upland
  - 3.4. Mad River Interlobate Plain
  - 3.5. Darby Plain
  - 3.6. Columbus Lowland
- 4. Illinoian Till Plain
- 5. Dissected Illinoian Till Plain
- 6. Galion Glaciated Low Plateau

Transitional boundary

Lake basin/deposits outside Huron-Erie Lake Plains

Huron-Erie Lake Plains

- 7. Maumee Lake Plains
  - 7.1. Paulding Clay Basin
  - 7.2. Maumee Sand Plains
  - 7.3. Woodville Lake-Plain Reefs
  - 7.4. Findlay Embayment
  - 7.5. Fostoria Lake-Plain Shoals
  - 7.6a and 7.6b. Bellevue-Castalia Karst Plain
- 8. Erie Lake Plain
  - 8.1. Berea Headlands of the Erie Lake Plain

Bluegrass Section

- 9. Outer Bluegrass Region

Glaciated Allegheny Plateaus

- 10. Killbuck-Glaciated Pittsburgh Plateau
- 11. Akron-Canton Interlobate Plateau
- 12. Illinoian Glaciated Allegheny Plateau
- 13. Grand River Low Plateau
  - 13.1 Grand River Finger-Lake Plain

Allegheny Plateaus

- 14. Muskingum-Pittsburgh Plateau
- 15. Shawnee-Mississippian Plateau
- 16. Ironton Plateau
- 17. Marietta Plateau
  - 17.1. Little Switzerland Plateau

4/98

Recommended citation: Ohio Division of Geological Survey, 1998, Physiographic regions of Ohio: Ohio Department of Natural Resources, Division of Geological Survey, page-size map with text, 2 p., scale 1:2,100,00.

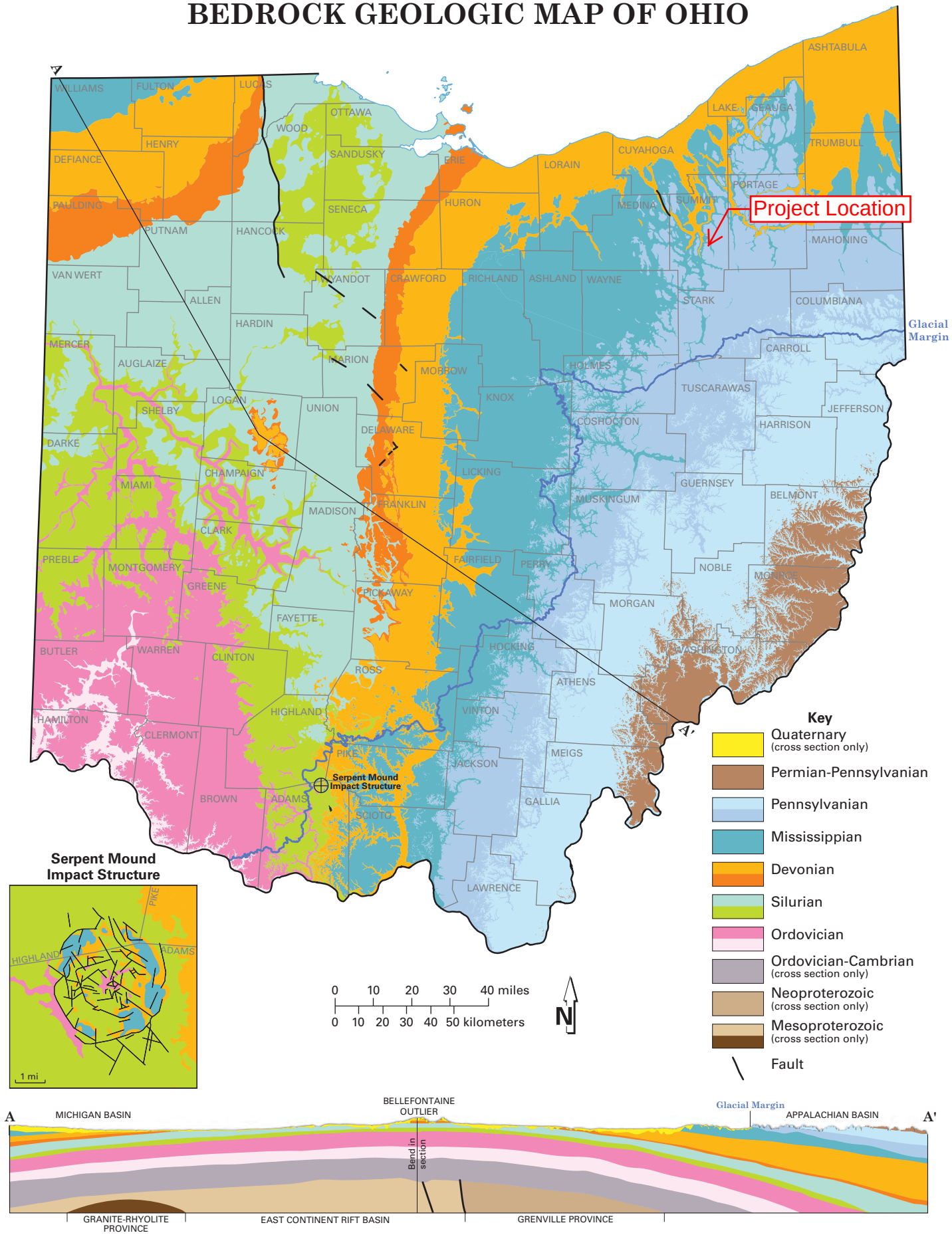
PHYSIOGRAPHIC REGIONS OF OHIO

Major Divisions	Provinces	Sections *	DISTINGUISHING CHARACTERISTICS OF REGIONS & DISTRICTS	GEOLOGY	BOUNDARIES
INTERIOR PLAINS	CENTRAL LOWLAND	Till Plains	**1. Steuben Till Plain.** Hummocky terrain with rolling hills, interspersed flats and closed depressions; wetlands, few streams, deranged drainage; only a small part of the region is in Ohio; elevation 950'-1100', moderately low relief (60')	Wisconsinan-age (latest Ice-Age) loamy till from a northern source (Saginaw glacial lobe) over Mississippian-age Coldwater Shale	Southeast: edge of Wabash Moraine
			2. Central Ohio Clayey Till Plain. Surface of clayey till; well-defined moraines with intervening flat-lying ground moraine and intermorainal lake basins; no boulder belts; about a dozen silt-, clay- and till-filled lake basins range in area from a few to 200 square miles; few large streams; limited sand & gravel outwash; elevation 700'-1150', moderate relief (100')	Clayey, high-lime Wisconsinan-age till from a northeastern source (Erie glacial lobe) and lacustrine materials over Lower Paleozoic-age carbonate rocks and, in the east, shales; loess thin to absent	North: Lake Plain; northeast: limit of Berea Sandstone; east: Berea Escarpment; south: Powell and Union City/Bloomer Moraines; northern segment boundaries: Wabash Moraine and lake plain
			2.1. Berea Headlands of the Till Plain. Gently rolling to flat terrain of thin drift descending to Lake Erie; punctuated by more than 20 streamlined "whalebacks" of Berea Sandstone, 0.5 to 2.5 miles long, 30'-60' high; somewhat poorly drained; elevation 800'-1000', low relief (20')	Thin, clayey, medium-lime Wisconsinan-age till over resistant Mississippian-age Berea Sandstone	South: limit of Berea Sandstone; elsewhere: Berea Escarpment and/or margin of highest Pleistocene lake
			3. Southern Ohio Loamy Till Plain. Surface of loamy till; end and recessional moraines, commonly associated with boulder belts, between relatively flat-lying ground moraine, cut by steep-valleyed large streams; stream valleys filled with outwash and alternate between broad floodplains and narrows; buried valleys common; elevation 530'-1150', moderate relief (200')	Loamy, high-lime Wisconsinan-age till, outwash, and loess over Lower Paleozoic-age carbonate rocks and, in the east, shales	East: Berea and Allegheny Escarpments; north: Powell and Union City/Bloomer Moraines; south: limit of Wisconsinan-age till
			3.1. Union City-Bloomer Transitional Terrain. Well-defined moraines with low-relief, hummocky ground moraine like the Central Ohio Clayey Till Plain to the north; loamy till with loess cap like Southern Ohio Loamy Till Plain to the south; elevation 920'-1075', moderately low relief (30')	Loamy, high-lime Wisconsinan-age till with thin loess cap over Silurian-age dolomites	North: Bloomer Moraine and limit of loamy till; south: Union City Moraine
			3.2. Whitewater Interlobate Plain. An upland between two converging glacial lobes with hummocky moraines, moraine complexes, kames, boulder belts, and broad outwash trains/plains; contains highest elevations in Indiana (1257') and in adjacent Ohio counties (1240'); elevation in Ohio 980'-1240', moderate relief (150')	Loamy, high-lime Wisconsinan-age till and sand and gravel outwash over resistant Silurian-age carbonate rocks (north) and less resistant Ordovician-age shales and limestones (south)	North: limit of Knightstown/Farmersville Moraines and kame fields; east: high, dissected hills draining to Whitewater River
			3.3. Bellefontaine Upland. Moderately high relief (250') dissected topography with moraine complexes, boulder belts, high-gradient major streams, caves and sinkholes; few glacial depressions/kettles compared to surrounding areas; elevation 1100'-1549', includes highest elevation in Ohio (Campbell Hill, 1549')	Loamy, high-lime Wisconsinan-age till over generally deeply buried Silurian- to Devonian-age carbonate rocks and Ohio Shale	North: areas with hilltops above 1200'; elsewhere: hilltops above about 1300'
			3.4. Mad River Interlobate Plain. Area between two major converging glacial lobes with extensive outwash, outwash terraces, and bordering moraines; springs and cool, ground-water-fed surface waters; elevation 800'-1350', moderate relief (200')	Loamy, high-lime Wisconsinan-age till and sand and gravel outwash over Silurian- to Devonian-age carbonate rocks and Ohio Shale	East and north: rear edge of Cable Moraine Complex; south: outwash to Clifton Gorge; west: western edge of Mad River Outwash
			3.5. Darby Plain. Moderately low relief (25'), broadly hummocky ground moraine with several broad, indistinct recessional moraines; between hummocks are broad, poorly drained swales which held wet prairies/meadows in pioneer days; few large streams; elevation 750'-1100'	Loamy, high-lime Wisconsinan-age till and sparse outwash over Silurian- and Devonian-age carbonate rocks and Ohio Shale in the southeast	South and west: front of Reesville and rear of Cable Moraines; north: Powell Moraine; east: increasing eastward slope (see 3.6)
			3.6. Columbus Lowland. Lowland surrounded in all directions by relative uplands, having a broad regional slope toward the Scioto Valley; many larger streams; elevation 600'-850' (950' near Powell Moraine), moderately low relief (25')	Loamy, high-lime (west) to medium-lime (east) Wisconsinan-age till and extensive outwash in Scioto Valley over deep Devonian- to Mississippian-age carbonate rocks, shales, and siltstones	North: Powell Moraine; east and south: Berea and/or Allegheny Escarpments; west: flatter and higher Darby Plain
			4. Illinoian Till Plain. Rolling ground moraine of older till generally lacking ice-constructional features such as moraines, kames, and eskers; many buried valleys; modern valleys alternating between broad floodplains and bedrock gorges; elevation 600'-1100', moderately low relief (50')	Silt-loam, high-lime, Illinoian-age till with loess cap; soils leached several feet; underlain by Ordovician- and Silurian-age carbonate rocks and calcareous shales	North: Wisconsinan glacial margin (Cuba and Hartwell Moraines); elsewhere: limit of common till-covered hillslopes
			5. Dissected Illinoian Till Plain. Hilly former till plain in which glacial deposits have been eroded from many valley sides; relatively high stream density; elevation 600'-1340', moderate relief (200')	Hilltops of high-lime Illinoian-age till with loess cap; slopes of bedrock- and till-derived colluvium and Ordovician- and Silurian-age carbonate rocks and calcareous shales	East: maximum glacial margin; elsewhere: limit of general absence of till on hillslopes
			6. Galion Glaciated Low Plateau. Rolling upland transitional between the gently rolling Till Plain and the hilly Glaciated Allegheny Plateau; mantled with thin to thick drift; elevation 800'-1400', moderate relief (100')	Medium- to low-lime Wisconsinan-age till over Mississippian-age shales and sandstones	North: limit of Berea Sandstone; west: Berea Escarpment; south and east: Allegheny Escarpment
		Huron-Erie Lake Plains	**7. Maumee Lake Plains.** Flat-lying Ice-Age lake basin with beach ridges, bars, dunes, deltas, and clay flats; contained the former Black Swamp; slightly dissected by modern streams; elevation 570'-800', very low relief (5')	Pleistocene-age silt, clay, and wave-planed clayey till over Silurian- and Devonian-age carbonate rocks and shales	Northeast: Lake Erie; elsewhere: margin of highest Pleistocene lake
			7.1. Paulding Clay Basin. Nearly flat lacustrine plain; most clayey of all Lake Plain subregions; low-gradient, highly meandering streams; easily ponded soils; elevation 700'-725', extremely low relief (less than 5')	Pleistocene-age lacustrine clay over clay till and Silurian-age dolomites	Northeast: subdued ("drowned") remnant of Defiance Moraine; elsewhere: limit of lacustrine clay
			7.2. Maumee Sand Plains. Lacustrine plain mantled by sand; includes low dunes, inter-dunal pans, beach ridges, and sand sheets of glacial lakeshores; well to poorly drained; elevation 600'-800', very low relief (10')	Late Wisconsinan-age sand over clay till and lacustrine deposits; Silurian- and Devonian-age carbonate rocks and shales buried deeply.	Limit of sandy deposits and/or low dunes
			7.3. Woodville Lake-Plain Reefs. Very low relief (10') lacustrine plain with low dunes and lake-margin features, punctuated by more than 75 ancient bedrock reefs rising 10' to 40' above the level of the plain and ranging in area from 0.1 to 3.0 square miles; the oblong reefs are thinly draped with drift; elevation 600'-775'	Thin to absent Wisconsinan-age wave-planed clay till, lacustrine deposits, and sand over Silurian-age reefal Lockport Dolomite	Limit of thinly mantled Lockport Dolomite (Bowling Green Fault to the west and the Defiance Moraine to the south)
			7.4. Findlay Embayment. Very low relief (10'), broadly rolling lacustrine plain; embayment of ancestral Lake Erie in which relatively coarse lacustrine sediments collected; elevation 775'-800'	Silty to gravelly Wisconsinan-age lacustrine deposits and wave-planed clayey till over Silurian-age Lockport Dolomite	West: 775' beach ridge; north: Defiance Moraine; south: margin of highest Pleistocene lake level
			7.5. Fostoria Lake-Plain Shoals. Portion of the Defiance Moraine lightly eroded by shallow Lake Maumee with low north-south trending hillocks and shallow, closed depressions; many sandy areas; elevation 750'-825', low relief, decreasing westward (10'-15')	Silty to gravelly Wisconsinan-age lacustrine deposits and wave-planed clay till over deeply covered Silurian-age dolomite	South and east: unmodified Defiance Moraine; elsewhere: very low-relief lake plain
	INT. LOW PLATEAUS	Bluegrass Section	**7.6a and 7.6b. Bellevue-Castalia Karst Plain.** Hummocky plain of rock knobs and numerous sinkholes, large solution features, and caves; large springs; thinly mantled by drift; region straddles both Lake Plain (7.6a) and Till Plain (7.6b); 7.6a has greatest relief of any Lake Plain region (25'); elevation 570'-825'	Columbus and Delaware Limestones overlain by thin clay till in 7.6b, and thin silty and sandy Wisconsinan-age lacustrine deposits and wave-planed clay till in 7.6a	Limit of thinly mantled Columbus and Delaware Limestones, which is marked in the west by the Columbus Escarpment
			8. Erie Lake Plain. Edge of very low-relief (10') Ice-Age lake basin separated from modern Lake Erie by shoreline cliffs; major streams in deep gorges; elevation 570'-800'	Pleistocene-age lacustrine sand, silt, clay, and wave-planed till over Devonian- and Mississippian-age shales and sandstones	North: Lake Erie; south: margin of highest Pleistocene lake
			8.1 Berea Headlands of the Erie Lake Plain. Portion of the Erie Lake Plain underlain by resistant Berea Sandstone; several large sandstone headlands jut into the Ice-Age lake basin; contains several streamlined "whalebacks" of Berea Sandstone, 0.5 to 2.0 miles long, 20'-35' high; poorly drained; elevation 670'-800', very low relief (10')	Thin lacustrine deposits over thin, wave-planed, clayey, medium-lime Wisconsinan-age till; underlain by resistant Berea Sandstone	North: portion of Lake Plain underlain by soft shales; south: margin of highest Pleistocene lake
			9. Outer Bluegrass Region. Moderately high relief (300') dissected plateau of carbonate rocks; in east, caves and other karst features relatively common; in west, thin, early drift caps narrow ridges; elevation 455'-1120'	Ordovician- and Silurian-age dolomites, limestones, and calcareous shales; thin pre-Wisconsinan drift on ridges in west; silt-loam colluvium	Eastern segment: maximum glacial margin and high eastern ridges capped by noncarbonate rocks; connected by Ohio River bluffs to western segment which is bounded by nondissected till plain
APPALACHIAN HIGHLANDS	APPALACHIAN PLATEAUS	Glaciated Allegheny (Southern New York) Plateaus	**10. Killbuck-Glaciated Pittsburgh Plateau.** Ridges and flat uplands generally above 1200', covered with thin drift and dissected by steep valleys; valley segments alternate between broad drift-filled and narrow rock-walled reaches; elevation 600'-1505', moderate relief (200')	Thin to thick Wisconsinan-age clay to loam till over Mississippian- and Pennsylvanian-age shales, sandstones, conglomerates and coals	West and north: resistant sandstones of the Allegheny and Portage Escarpments; south and east: Wisconsinan glacial margin
			11. Akron-Canton Interlobate Plateau. Hummocky area between two converging glacial lobes dominated by kames, kame terraces, eskers, kettles, kettle lakes, and bogs/fens; deranged drainage with many natural lakes; elevation 900'-1200', moderate relief (200')	Sandy Wisconsinan-age and older drift over Devonian- to Pennsylvanian-age sandstones, conglomerates and shales	Limit of common, sandy ice-contact features and deposits
			12. Illinoian Glaciated Allegheny Plateau. Dissected, rugged hills; loess and older drift on ridgetops, but absent on bedrock slopes; dissection similar to unglaciated regions of the Allegheny Plateau; elevation 600'-1400', moderate relief (200')	Colluvium and Illinoian-age till over Devonian- to Pennsylvanian-age shales, siltstones and sandstones	North and west: Wisconsinan glacial margin; south and east: Illinoian (maximum) glacial margin
			13. Grand River Low Plateau. Gently rolling ground and end moraine having thin to thick drift; poorly drained areas and wetlands relatively common; elevation 760'-1200', low relief (20') except near Grand River Valley (200')	Clayey, low-lime Wisconsinan-age till over deeply buried, soft Devonian-age shales and near-surface Mississippian-age sandstones and shales	North: Portage Escarpment; south and west: Defiance Moraine; southeast: increasing relief from proximity of buried Pennsylvanian-age sandstones
			13.1. Grand River Finger-Lake Plain. Very low relief (10') lake deposits in steep-sided troughs (200' relief) within the Grand River Low Plateau; cut by glacial and stream erosion; extensive wetlands; elevation 800'-900'	Surficial lacustrine clay and drift over deeply buried, soft Devonian-age shales	Margins of steeply sloping troughs containing the Grand River and parts of Rock and Mosquito Creeks
		Allegheny (Kanawha) Plateaus	**14. Muskingum-Pittsburgh Plateau.** Moderately high to high relief (300'-600') dissected plateau having broad major valleys that contain outwash terraces, and tributaries with lacustrine terraces; medium-grained bedrock sequences coarser than those in Marietta Plateau (17) but finer than those in Ironton Plateau (16); remnants of ancient Teays-age drainage system uncommon; elevation 650'-1400'	Mississippian and Pennsylvanian-age siltstones, shales, sandstones and economically important coals and claystones; Wisconsinan-age sand, gravel, and lacustrine silt; silt-loam colluvium	North and west: maximum glacial margin; southeast: transition to finer grained bedrock; southwest: transition to coarser grained bedrock
			15. Shawnee-Mississippian Plateau. High relief (400'-800'), highly dissected plateau of coarse and fine grained rock sequences; most rugged area in Ohio; remnants of ancient lacustrine clay-filled Teays drainage system are extensive in lowlands, absent in uplands; elevation 490'-1340'	Devonian- and Mississippian-age shales, siltstones, and locally thick sandstones; Pleistocene-age sandy outwash in Scioto River; Teays-age Minford Clay; silt-loam and channery colluvium	North: Maximum glacial margin; west:: carbonate bedrock; east: limit of Mississippian-age bedrock
			16. Ironton Plateau. Moderately high relief (300') dissected plateau; coarser grained coal-bearing rock sequences more common than in other regions of the Allegheny Plateau; common lacustrine clay-filled Teays Valley remnants; elevation 515'-1060'	Pennsylvanian-age (Pottsville, Allegheny and Conemaugh Groups) cycles of sandstones, siltstones, shales and economically important coals; Pleistocene (Teays)-age Minford Clay; silt-loam and channery colluvium	West: limit of common Pennsylvanian-age bedrock; north and east: gradation to finer rock sequences
			17. Marietta Plateau. Dissected, high-relief (generally 350', to 600' near Ohio River) plateau; mostly fine-grained rocks; red shales and red soils relatively common; landslides common; remnants of ancient lacustrine clay-filled Teays drainage system common; elevation 515'-1400'	Pennsylvanian-age Upper Conemaugh Group through Permian-age Dunkard Group cyclic sequences of red and gray shales, and siltstones, sandstones, limestones and coals; Pleistocene (Teays)-age Minford Clay; red and brown silty-clay loam colluvium; landslide deposits	North and west: transition to medium-grained Lower Conemaugh rocks; east: Flushing Divide
			17.1. Little Switzerland Plateau. Highly dissected, high-relief (generally 450', to 750' along Ohio River) plateau; mostly fine-grained rocks; red shales and red soils relatively common; landslides common; high-gradient shale-bottomed streams subject to flash flooding; no remnants of ancient Teays drainage system; elevation 540'-1400'	Similar to Marietta Plateau but lacking Pleistocene (Teays)-age Minford Clay	North: transition to medium-grained rocks; west and south: Flushing Divide; east: Ohio River

* Section names modified from Fenneman (1938, 1946).

STATE OF OHIO • DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY

BEDROCK GEOLOGIC MAP OF OHIO



Serpent Mound Impact Structure

Recommended citation: Ohio Division of Geological Survey, 2006, Bedrock geologic map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-1, generalized page-size version with text, 2 p., scale 1:2,000,000.

This map is a generalization of the Bedrock Geologic Map of Ohio (Slucher and others, 2006)—the first statewide 1:500,000-scale bedrock-geology map compiled by the Ohio Division of Geological Survey since 1920 and the first to properly portray the bedrock geology that exists beneath the extensive deposits of Quaternary sediments that cover much of the bedrock in the state. Overall, the bedrock geology of Ohio consists of flat lying to gently dipping carbonate, siliciclastic, evaporite, and organoclastic strata of sedimentary origin that range in age from Upper Ordovician to Upper Carboniferous-Lower Permian. At depth, as illustrated in the cross section, older sedimentary, igneous, and metamorphic rocks that range from Lower Ordovician to Mesoproterozoic in age occur. At the surface, an irregular veneer of mainly unconsolidated Quaternary sediments conceal most bedrock units occurring northward and westward of the glacial margin.

Strata of the Ordovician System are the oldest exposed rocks in Ohio and consist mainly of alternating shale and limestone sequences. Silurian System strata are mostly dolomites with lesser amounts of shale. Rocks of the Devonian System consist of two contrasting types. Lower and Middle Devonian-age strata are mainly carbonate rocks whereas Upper Devonian-age rocks consist mostly of clastic rocks. In Champaign and Logan Counties, Devonian rocks occur on a small erosional remnant referred to as the Bellefontaine Outlier by geologists. Coincidentally, the highest topographic point in Ohio (Campbell Hill–1,549 feet above sea level) occurs also in this area.

The Carboniferous System is divided into two Subsystems, the Mississippian and Pennsylvanian. Mississippian strata are mostly shales and sandstones that occur locally in various proportions. Pennsylvanian strata consist mainly of a diverse array of alternating sandstones, siltstones, shales, mudstones, limestones, and underclays; economic coal beds occur also in portions of this sequence. The youngest interval of sedimentary rocks in Ohio, the Dunkard Group, occurs only in southeastern Ohio and consists of strata similar in composition to the underlying Upper Pennsylvanian-age rocks; however, the age of the Dunkard Group has been debated since the late 1800s. Dunkard strata contain a well-studied late Pennsylvanian-age assemblage of plant fossils with infrequent early Permian-age forms. Yet, fossil plant spores found in coal beds in the interval only support a late, but not latest Pennsylvanian age. Thus, until more definitive fossils are found, geologist are unable to determine the exact age of the Dunkard Group beyond a combined Permian-Pennsylvanian age assignment.

In west-central Ohio, the ancient Teays River system extended across much of Ohio during the late Neogene to early Quaternary Periods and sculptured an extensive network of deeply dissected valleys into the bedrock surface. The spatial configuration of many geologic units on this map clearly reflects the major channel networks of these former drainage systems. Also, four major regional structural geology elements affect the spatial distribution of rocks in Ohio: the Appalachian and Michigan basins, and the Cincinnati and Findlay arches which occur between the two basins. Locally, several high-angle normal faults displace rocks in the state.

The Serpent Mound Impact Structure in southern Ohio is a circular area of deformed and broken rocks that is approximately four and one-half miles in diameter. Recent investigations indicate the feature is the result of a meteorite impact believed to have occurred between 256 and 330 million years ago.

Cross section A-A' traverses Ohio from the northwest to the southeast and intersects the southern portion of the Michigan Basin, the area between the Cincinnati and Findlay arches, and the western Appalachian Basin, respectively. The stratigraphic units shown in this profile illustrate the broad, arching geometric distortion to the bedrock in Ohio created mainly by periods of tectonic subsidence within these regional structural basins. For specific details on the various rock units, economic commodities, and geologic hazards within Ohio, see either the printed or digital version of the Bedrock Geologic Map of Ohio (Slucher and others, 2006). Both products are available for purchase by contacting the ODNR Geologic Records Center by calling 614-265-6576 or emailing: geo.survey@dnr.state.oh.us.

Quaternary (about 1.8 million years ago to present)—Unconsolidated sediments: till, gravel, sand, silt, clay, and organic debris. Continental origin. (Shown in cross section only)

Period of widespread erosion

Permian and Pennsylvanian (about 298 to 302 million years ago)—Sedimentary rocks: mainly shale, sandstone, siltstone, mudstone, and minor coal. Continental origin.

Pennsylvanian (about 302 to 307 million years ago) Sedimentary rocks: mainly shale, sandstone, siltstone, mudstone, limestone, and some coal. Continental and marine origin.

Pennsylvanian (about 307 to 318 million years ago)—Sedimentary rocks: mainly sandstone, siltstone, shale, and conglomerate, with some coal and limestone. Deltaic and marine origin.

Period of widespread erosion

Mississippian (about 322 to 359 million years ago)—Sedimentary rocks: sandstone, shale, siltstone, conglomerate, and minor limestone. Marine to marginal marine origin.

Devonian (about 359 to 385 million years ago)—Sedimentary rocks: mainly shale and siltstone with some sandstone. Marine to marginal marine origin.

Devonian (about 385 to 407 million years ago)—Sedimentary rocks: mainly limestone and dolomite with some shale, and minor sandstone. Marine and eolian origin.

Period of widespread erosion

Silurian (about 416 to 423 million years ago)—Sedimentary rocks: dolomite, anhydrite, gypsum, salt, and shale. Marine and restricted marine origin.

Silurian (about 423 to 435 million years ago)—Sedimentary rocks: dolomite and shale with some limestone. Marine origin.

Period of widespread erosion

Ordovician (about 446 to 450 million years ago)—Sedimentary rocks: shale and limestone. Marine origin.

Ordovician (about 450 to 460 million years ago)—Sedimentary rocks: limestone and shale. Marine origin.

Period of widespread erosion

Ordovician and Cambrian (about 486 to 510 million years ago)—Sedimentary rocks: mainly dolomite, sandstone, shale, with minor limestone. Marine origin. (Shown in cross section only)

Period of widespread erosion

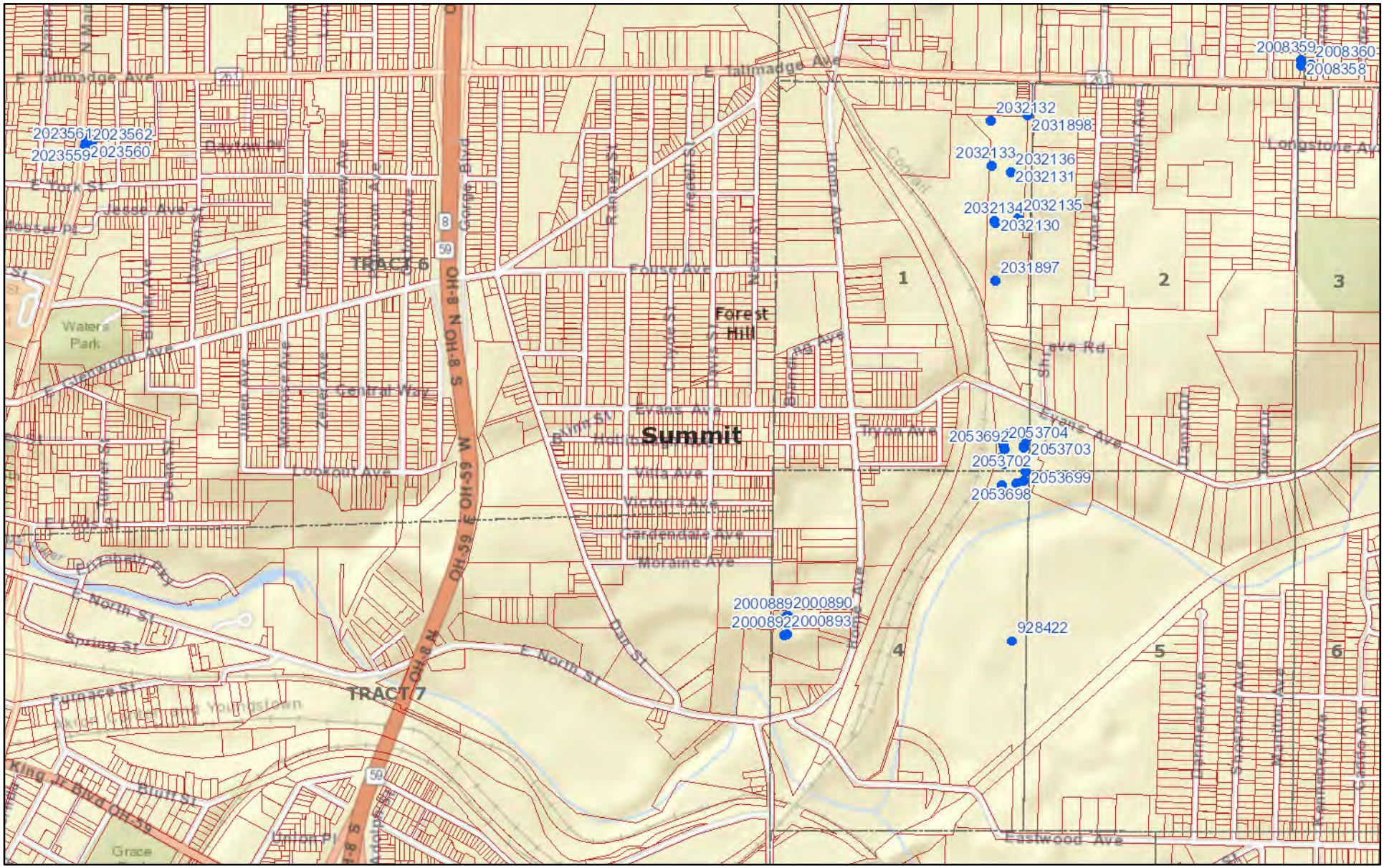
Neoproterozoic (between 900 million and 1 billion years ago)—Metamorphic rocks: gneiss, schist, amphibolite, and marble; and igneous rocks: granite. Form during collision of tectonic plates. (Shown in cross section only)

Mesoproterozoic (between 1.0 and 1.2 billion years ago)—Sedimentary rocks: sandstone and siltstone; and igneous rocks: basalt and rhyolite. Form during rifting of continental landmass. (Shown in cross section only)

Period of widespread erosion

Mesoproterozoic (between 1.45 and 1.52 billion years ago)—Igneous rocks: granite and rhyolite. Formed during crustal evolution and differentiation. (Shown in cross section only)

Ohio Water Wells



December 10, 2015

- Water Wells
- Counties
- Current Township
- Land Subdivision
- Statewide Parcels

1:18,056

0 0.15 0.3 0.6 mi

0 0.25 0.5 1 km

Division Of Soil & Water

Soil Map—Summit County, Ohio
(SUM-8-1.75)

Map Scale: 1:8,790 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County, Ohio
Survey Area Data: Version 12, Sep 29, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 3, 2012—Mar 11, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Summit County, Ohio (OH153)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CfB	Canfield-Urban land complex, 2 to 6 percent slopes	8.4	7.8%
CfC	Canfield-Urban land complex, 6 to 12 percent slopes	30.5	28.6%
CuB	Chili-Urban land complex, undulating	16.4	15.4%
CuC	Chili-Urban land complex, rolling	21.0	19.7%
Rw	Oshtemo-Glenford complex, 25 to 75 percent slopes	15.0	14.1%
Uf	Udorthents, sanitary landfill	12.6	11.8%
Ur	Urban land	2.8	2.6%
Totals for Area of Interest		**106.7**	**100.0%**

AASHTO Group Classification (Surface)—Summit County, Ohio
(SUM-8-1.75)

Map Scale: 1:8,790 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Soil Rating Lines
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Soil Rating Points
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County, Ohio
Survey Area Data: Version 12, Sep 29, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 3, 2012—Mar 11, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

AASHTO Group Classification (Surface)

AASHTO Group Classification (Surface)— Summary by Map Unit — Summit County, Ohio (OH153)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CfB	Canfield-Urban land complex, 2 to 6 percent slopes	A-4	8.4	7.8%
CfC	Canfield-Urban land complex, 6 to 12 percent slopes	A-4	30.5	28.6%
CuB	Chili-Urban land complex, undulating	A-4	16.4	15.4%
CuC	Chili-Urban land complex, rolling	A-4	21.0	19.7%
Rw	Oshtemo-Glenford complex, 25 to 75 percent slopes	A-2	15.0	14.1%
Uf	Udorthents, sanitary landfill		12.6	11.8%
Ur	Urban land		2.8	2.6%
Totals for Area of Interest			**106.7**	**100.0%**

Description

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba).

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
CfB—Canfield-Urban land complex, 2 to 6 percent slopes														
Canfield	45	C/D	0-6	Silt loam, gravelly silt loam	ML, CL, SC-SM	A-4, A-7-5	0- 0- 0	0- 0- 0	76-98-100	51-96-100	45-90-99	37-78-88	23-31-47	6-9 -14
			6-9	Silt loam, loam, gravelly loam	CL, SC-SM	A-6, A-4	0- 0- 0	0- 0- 0	76-98-100	51-96-100	45-91-99	37-79-87	22-30-35	6-12-15
			9-15	Silt loam, loam, gravelly loam	SC, CL	A-6	0- 0- 0	0- 0- 0	76-98-100	52-96-100	45-90-98	37-76-85	28-34-38	12-16-19
			15-21	Silt loam, loam, gravelly loam	CL, SC	A-6, A-2-6	0- 0- 0	0- 0- 0	76-96-100	52-91-100	44-84-97	34-68-81	28-33-38	12-15-18
			21-26	Silt loam, loam, gravelly loam	SC, CL	A-6, A-2-6	0- 0- 0	0- 0- 0	76-92-100	52-83-100	43-76-96	32-58-77	28-36-38	12-18-18
			26-38	Silt loam, loam, sandy loam, gravelly loam	SC, CL	A-6, A-2-4	0- 0- 0	0- 1- 2	74-94-97	51-87-97	41-79-95	30-61-76	25-30-36	9-14-18
			38-45	Silt loam, loam, sandy loam, gravelly loam	SC, CL	A-2-4, A-6	0- 0- 0	0- 1- 2	74-94-97	51-87-97	40-77-93	28-58-74	25-29-36	9-13-18
			45-62	Silt loam, loam, sandy loam, gravelly sandy loam	SC-SM, CL	A-6, A-1-b	0- 0- 0	0- 1- 2	69-97-97	39-94-97	30-83-92	20-60-72	20-27-35	6-11-17

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			62-80	Silt loam, loam, sandy loam, gravelly sandy loam	SM, CL	A-4, A-6, A-1-b	0- 0- 0	0- 1- 2	69-94-97	39-87-97	29-76-92	19-53-70	16-25-35	2-9 -17
Ravenna	10	D	0-8	Silt loam, loam	CL, SC-SM, ML	A-4, A-7-6	0- 0- 0	0- 0- 0	81-98-100	62-96-100	52-88-99	43-76-88	25-32-42	6-10-15
			8-12	Silt loam, loam	CL, SC	A-6, A-4	0- 0- 0	0- 0- 0	82-98-100	63-95-100	55-89-100	45-77-90	25-32-38	9-14-18
			12-22	Loam, silt loam	CL, SC	A-6	0- 0- 0	0- 0- 0	82-97-100	63-91-100	55-86-100	45-74-89	28-36-38	12-18-18
			22-48	Loam, silt loam, gravelly sandy loam	CL, SC	A-6, A-2-6	0- 0- 0	0- 1- 2	74-95-97	50-89-97	41-81-94	31-65-78	27-31-36	12-15-18
			48-53	Loam, silt loam, gravelly sandy loam	CL, SC	A-6, A-2-4	0- 0- 0	0- 1- 2	74-94-97	49-86-97	40-78-94	30-62-78	25-32-37	9-15-19
			53-74	Loam, silt loam, gravelly sandy loam	CL, SC-SM	A-6, A-2-4	0- 0- 0	0- 1- 2	74-94-97	49-86-97	40-78-94	29-63-77	23-30-36	7-13-17

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
CfC—Canfield-Urban land complex, 6 to 12 percent slopes														
Canfield	50	C/D	0-6	Silt loam, gravelly silt loam	ML, CL, SC-SM	A-4, A-7-5	0- 0- 0	0- 0- 0	76-98-100	51-96-100	45-90-99	37-78-88	23-31-47	6-9 -14
			6-9	Silt loam, loam, gravelly loam	CL, SC-SM	A-6, A-4	0- 0- 0	0- 0- 0	76-98-100	51-96-100	45-91-99	37-79-87	22-30-35	6-12-15
			9-15	Silt loam, loam, gravelly loam	SC, CL	A-6	0- 0- 0	0- 0- 0	76-98-100	52-96-100	45-90-98	37-76-85	28-34-38	12-16-19
			15-21	Silt loam, loam, gravelly loam	CL, SC	A-6, A-2-6	0- 0- 0	0- 0- 0	76-96-100	52-91-100	44-84-97	34-68-81	28-33-38	12-15-18
			21-26	Silt loam, loam, gravelly loam	SC, CL	A-6, A-2-6	0- 0- 0	0- 0- 0	76-92-100	52-83-100	43-76-96	32-58-77	28-36-38	12-18-18
			26-38	Silt loam, loam, sandy loam, gravelly loam	SC, CL	A-6, A-2-4	0- 0- 0	0- 1- 2	74-94-97	51-87-97	41-79-95	30-61-76	25-30-36	9-14-18
			38-45	Silt loam, loam, sandy loam, gravelly loam	SC, CL	A-2-4, A-6	0- 0- 0	0- 1- 2	74-94-97	51-87-97	40-77-93	28-58-74	25-29-36	9-13-18
			45-62	Silt loam, loam, sandy loam, gravelly sandy loam	SC-SM, CL	A-6, A-1-b	0- 0- 0	0- 1- 2	69-97-97	39-94-97	30-83-92	20-60-72	20-27-35	6-11-17
			62-80	Silt loam, loam, sandy loam, gravelly sandy loam	SM, CL	A-4, A-6, A-1-b	0- 0- 0	0- 1- 2	69-94-97	39-87-97	29-76-92	19-53-70	16-25-35	2-9 -17

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
CuB—Chili-Urban land complex, undulating														
Chili	70	A	0-9	Loam	ML, SM	A-4	0- 0- 0	0- 0- 0	90-95-100	70-80-90	50-63-75	40-55-70	25-30 -35	4-7 -10
			9-42	Gravelly sandy loam	SM	A-2, A-4	0- 0- 0	1- 5- 10	70-80-90	45-60-75	30-45-60	25-35-45	15-23 -30	NP-6 -12
			42-60	Gravelly sand	SW-SM, SM	A-2, A-1	0- 0- 0	1- 5- 10	70-80-90	45-60-75	25-35-45	5-15- 25	—	NP
CuC—Chili-Urban land complex, rolling														
Chili	70	A	0-9	Loam	ML, SM	A-4	0- 0- 0	0- 0- 0	90-95-100	70-80-90	50-63-75	40-55-70	25-30 -35	4-7 -10
			9-42	Gravelly sandy loam	SM	A-2, A-4	0- 0- 0	1- 5- 10	70-80-90	45-60-75	30-45-60	25-35-45	15-23 -30	NP-6 -12
			42-60	Gravelly sand	SW-SM, SM	A-2, A-1	0- 0- 0	1- 5- 10	70-80-90	45-60-75	25-35-45	5-15- 25	—	NP

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
Rw—Oshtemo-Glenford complex, 25 to 75 percent slopes														
Oshtemo	55	A	0-8	Sandy loam	SC-SM, SM	A-4, A-2	0- 0- 0	0- 0- 0	95-98-100	60-78-95	60-65-70	25-33-40	15-20 -25	2-5 -7
			8-39	Sandy loam, sandy clay loam, gravelly sandy loam	SC-SM, SM, SC	A-2, A-4, A-6	0- 0- 0	0- 0- 0	95-98-100	60-78-95	60-73-85	25-35-45	12-21 -30	2-9 -16
			39-47	Loamy sand, sandy loam	SM, SP-SM	A-2	0- 0- 0	0- 0- 0	85-90-95	60-78-95	55-63-70	10-13-15	0-17 -27	NP

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			47-80	Stratified gravel to gravelly coarse sand	GP, SP, SP-SM, GP-GM	A-2, A-3, A-1	0- 0- 0	0- 3- 5	40-65-90	35-60-85	20-40-60	0- 5- 10	0-15 -27	NP
Glenford	30	C/D	0-2	Slightly decomposed plant material	PT	A-8	—	—	—	—	—	—	—	—
			2-5	Silt loam	OL, OH, ML	A-4, A-7-5	0- 0- 0	0- 0- 0	100-100-100	100-100-100	92-97-100	84-92-100	32-47-58	6-12-16
			5-10	Silt loam	CL-ML, CL	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	92-97-100	84-92-100	22-28-38	6-10-17
			10-13	Silt loam	CL, CL-ML	A-6, A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	93-98-100	85-93-100	21-29-42	6-11-18
			13-39	Silt loam, silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	93-99-100	86-96-100	28-37-45	12-18-24
			39-45	Silt loam, silty clay loam, stratified fine sandy loam to silt loam to silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	98-100-100	95-100-100	82-99-100	71-96-100	28-30-45	12-13-24
			45-72	Silt loam, silty clay loam, stratified fine sandy loam to silt	CL, ML	A-6, A-4, A-7-6	0- 0- 0	0- 0- 0	93-100-100	84-100-100	71-99-100	61-96-100	0-25 -41	NP-13-21
Cardinal	5	C/D	0-4	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-80-90	25-33-40	4-12-20
			4-13	Silt loam	CL, CL-ML	A-6, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	70-80-90	25-33-40	4-12-20
			13-22	Silty clay loam, silt loam	CL	A-7, A-6	0- 0- 0	0- 0- 0	95-98-100	95-98-100	85-93-100	65-78-90	25-38-50	10-18-25
			22-34	Silty clay loam, silty clay	CL, CH	A-6, A-7-6	0- 0- 0	0- 0- 0	95-98-100	95-98-100	90-95-100	80-88-95	35-45-55	12-20-28
			34-43	Silty clay loam, silty clay	CL, CH	A-7-6, A-6	0- 0- 0	0- 0- 0	95-98-100	95-98-100	90-95-100	80-88-95	35-45-55	12-20-28

Engineering Properties–Summit County, Ohio														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			43-80	Silty clay loam, silty clay	CH, CL	A-6, A-7	0- 0- 0	0- 0- 0	90-95-100	90-95-100	85-93-100	75-85-95	35-50-55	12-18-28
Ellsworth	5	D	0-2	Slightly decomposed plant material	PT	A-8	—	—	—	—	—	—	—	—
			2-5	Silt loam	OH, SM	A-7-5, A-4	0- 0- 0	0- 0- 0	83-98-100	65-95-100	57-90-100	48-76-89	36-51-57	9-13-16
			5-8	Silt loam	CL	A-4, A-7-6	0- 0- 0	0- 0- 0	85-98-100	70-96-100	61-89-99	50-73-86	27-27-41	9-9 -17
			8-11	Silt loam, silty clay loam	CL	A-4, A-7-6	0- 0- 0	0- 0- 0	85-98-100	70-96-100	64-96-100	54-87-100	27-41-49	9-21-24
			11-16	Silty clay, silty clay loam, clay, clay loam	CL, CH	A-7-6, A-6	0- 0- 0	0- 0- 0	87-98-98	75-97-97	66-93-97	58-85-95	39-45-55	21-25-32
			16-25	Clay loam, silty clay loam, silty clay, clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	88-98-98	75-97-97	68-94-97	59-85-93	44-48-54	25-28-32
			25-37	Silty clay loam, silty clay, clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	88-98-98	76-95-97	68-92-97	60-84-93	44-48-55	25-28-32
			37-60	Silty clay loam, clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	88-99-99	77-96-97	71-95-97	63-88-96	38-43-49	21-24-28
Mentor	5	C	0-2	Slightly decomposed plant material	PT	A-8	—	—	—	—	—	—	—	—
			2-5	Silt loam	OL, OH, ML	A-4, A-7-5	0- 0- 0	0- 0- 0	96-100-100	91-100-100	84-97-100	79-92-100	32-47-58	6-12-16
			5-9	Silt loam	CL-ML, CL	A-4, A-6	0- 0- 0	0- 0- 0	96-100-100	92-100-100	84-97-100	79-92-100	22-28-38	6-10-17
			9-13	Silt loam	CL, CL-ML	A-6, A-4, A-7-6	0- 0- 0	0- 0- 0	97-100-100	93-100-100	84-98-100	79-93-100	21-29-41	6-11-18
			13-42	Silt loam, silty clay loam	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	97-100-100	93-100-100	83-99-100	80-96-100	28-38-45	12-19-24

Engineering Properties–Summit County, Ohio													
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			42-47	Silty clay loam, stratified fine sandy loam to loam, silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	97-100-100	93-100-100	91-99-100	86-94-100	28-30-44	12-14-24
			47-72	Silty clay loam, loam, stratified fine sandy loam to loam, silt loam	CL, SM	A-6, A-4	0- 0- 0	0- 0- 0	86-95-100	72-95-100	60-91-100	48-75-94	0-26 -40	NP-14-21

Data Source Information

Soil Survey Area: Summit County, Ohio
Survey Area Data: Version 12, Sep 29, 2015

Local Roads and Streets (OH)—Summit County, Ohio
(SUM-8-1.75)

Map Scale: 1:8,790 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Background
- Aerial Photography

Soils

Soil Rating Polygons
- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Lines
- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Points
- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County, Ohio
Survey Area Data: Version 12, Sep 29, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 3, 2012—Mar 11, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Local Roads and Streets (OH)

Local Roads and Streets (OH)— Summary by Map Unit — Summit County, Ohio (OH153)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
CfB	Canfield-Urban land complex, 2 to 6 percent slopes	Somewhat limited	Canfield (45%)	Depth to saturated zone (0.94)	8.4	7.8%
				Frost action (0.50)		
				Low strength (0.05)		
CfC	Canfield-Urban land complex, 6 to 12 percent slopes	Somewhat limited	Canfield (50%)	Depth to saturated zone (0.94)	30.5	28.6%
				Frost action (0.50)		
				Low strength (0.05)		
				Slope (0.04)		
CuB	Chili-Urban land complex, undulating	Not limited	Chili (70%)		16.4	15.4%
CuC	Chili-Urban land complex, rolling	Somewhat limited	Chili (70%)	Slope (0.04)	21.0	19.7%
Rw	Oshtemo-Glenford complex, 25 to 75 percent slopes	Very limited	Oshtemo (55%)	Slope (1.00)	15.0	14.1%
				Frost action (0.50)		
			Glenford (30%)	Slope (1.00)		
				Frost action (1.00)		
				Low strength (1.00)		
				Depth to saturated zone (0.81)		
			Ellsworth (5%)	Slope (1.00)		
				Depth to saturated zone (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		

Local Roads and Streets (OH)— Summary by Map Unit — Summit County, Ohio (OH153)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
				Shrink-swell (0.08)		
			Mentor (5%)	Slope (1.00)		
				Frost action (1.00)		
				Low strength (1.00)		
			Cardinal (5%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
				Depth to saturated zone (0.35)		
Uf	Udorthents, sanitary landfill	Not rated	Udorthents, sanitary landfill (100%)		12.6	11.8%
Ur	Urban land	Not rated	Urban Land (100%)		2.8	2.6%
Totals for Area of Interest					**106.7**	**100.0%**

Local Roads and Streets (OH)— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Somewhat limited	59.9	56.1%
Not limited	16.4	15.4%
Very limited	15.0	14.1%
Null or Not Rated	15.3	14.4%
Totals for Area of Interest	**106.7**	**100.0%**

Description

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock, hardness of bedrock, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, slippage, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Differences between this interpretation for Ohio and the national intepretation: The Ohio interpretation does not consider cemented pan in the ratings and uses different AASHTO Group Index and shrink-swell breaks. It also considers soil slippage potential in the ratings.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Corrosion of Concrete—Summit County, Ohio
(SUM-8-1.75)

Map Scale: 1:8,790 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- High
- Moderate
- Low
- Not rated or not available

Soil Rating Lines
- High
- Moderate
- Low
- Not rated or not available

Soil Rating Points
- High
- Moderate
- Low
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County, Ohio
Survey Area Data: Version 12, Sep 29, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 3, 2012—Mar 11, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Corrosion of Concrete

Corrosion of Concrete— Summary by Map Unit — Summit County, Ohio (OH153)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CfB	Canfield-Urban land complex, 2 to 6 percent slopes	Moderate	8.4	7.8%
CfC	Canfield-Urban land complex, 6 to 12 percent slopes	Moderate	30.5	28.6%
CuB	Chili-Urban land complex, undulating	High	16.4	15.4%
CuC	Chili-Urban land complex, rolling	High	21.0	19.7%
Rw	Oshtemo-Glenford complex, 25 to 75 percent slopes	High	15.0	14.1%
Uf	Udorthents, sanitary landfill		12.6	11.8%
Ur	Urban land		2.8	2.6%
Totals for Area of Interest			**106.7**	**100.0%**

Description

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Rating Options

Aggregation Method: Dominant Condition

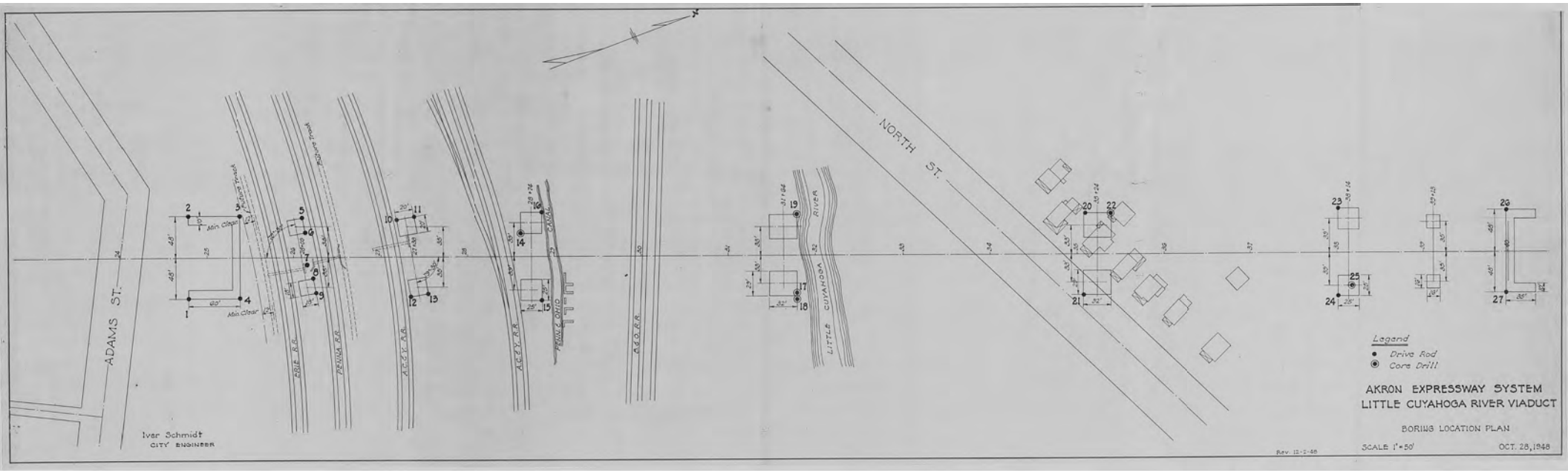
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Gannett Fleming
Engineers and Architects, P.C.
Excellence Delivered **As Promised**

APPENDIX B

Historical Information



Iver Schmidt
CITY ENGINEER

AKRON EXPRESSWAY SYSTEM
LITTLE CUYAHOGA RIVER VIADUCT

BORING LOCATION PLAN

Rev. 12-2-48

SCALE 1"=50'

OCT. 28, 1948

PILE PENETRATION CURVES

#3 ~~Abut~~ - Pier
T.H. 14 Date _____
Sta. 28+64 Offset 26' Lt.
Water Elev. _____

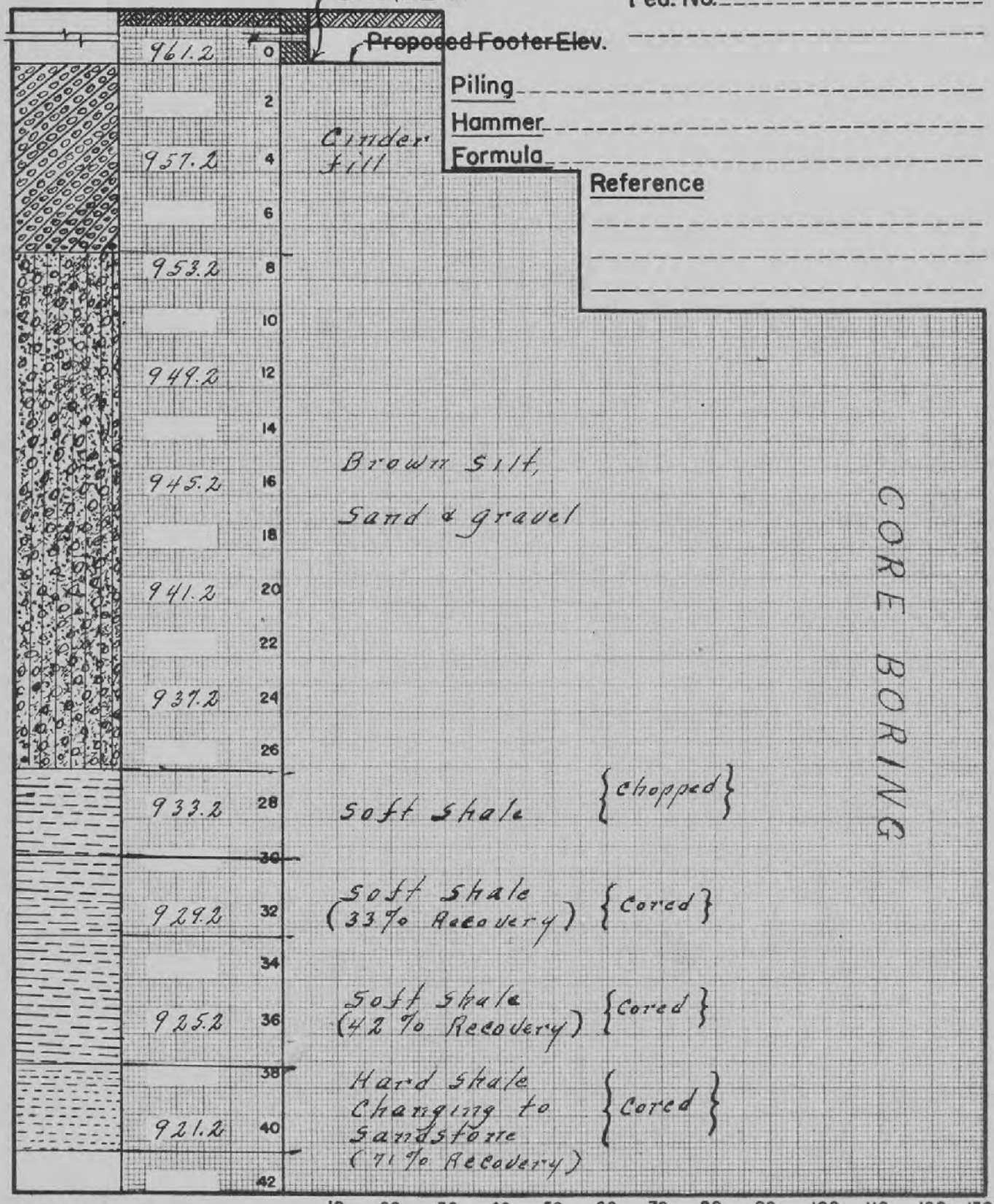
County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG ELEV. DEPTH

Ground Line
~~Proposed Footer Elev.~~

Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____



10 20 30 40 50 60 70 80 90 100 110 120 130
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

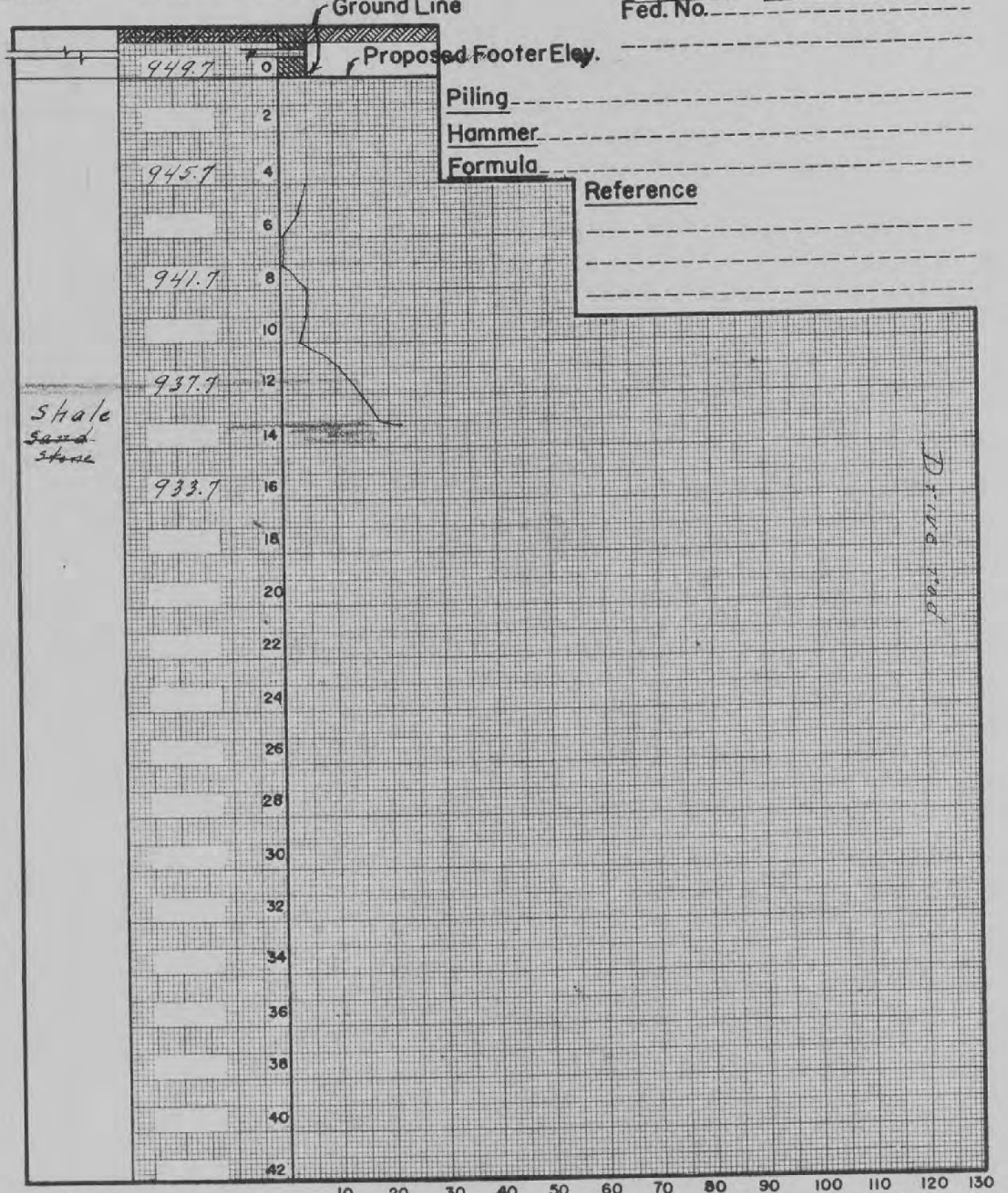
By W.G.T.
Date _____

PILE PENETRATION CURVES

#3 ~~Abut~~ - Pier
T.H. 15 Date _____
Sta. 28+86.5 Offset 51.5' Rt.
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St Viaduct Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG ELEV. DEPTH



Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date _____

PILE PENETRATION CURVES

#3 Abut.- Pier
T.H. 16 Date _____
Sta. 28+86.5 Offset 51.5' Lt.
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG ELEV. DEPTH

Ground Line
~~Proposed Footer Elev.~~

947.6 0
943.6 4
939.6 8
935.6 12

~~Sand-stone~~ Shale

Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

Drive Tod

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

10 20 30 40 50 60 70 80 90 100 110 120 130

Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date _____

Section

PILE PENETRATION CURVES

#5 Abut. - Pier
T.H. 22 Date
Sta. 35+37 Offset 47.5' Lt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Piling
Hammer
Formula
Reference

SOIL LOG	ELEV.	DEPTH
	876.2	Ground Line / ~~Proposed Footer~~ Elev.
		2
	872.2	4 Brown silt
		6 and small amount
	868.2	8 of gravel
		10
	864.2	12 Fine grey sand and
		14 small amount of silt
	860.2	16
		18 Hardpan
	856.2	20 Sand and gravel
		22
	852.2	24
		26 Soft shale
	848.2	28
		30
	844.2	32 Thin layers of
		34 sandstone and
	840.2	36 soft shale
		38
	836.2	40 Hard shale
		42
	832.2	44 Layers shale
		46 and sandstone
	828.2	48
		50
		52
		54
		56
		58
		60
		62
		64
		66
		68
		70

CORE BORING

0 10 20 30 40 50 60 70 80 90 100 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. F.
Date

PILE PENETRATION CURVES

#6 Abut.- Pier
T.H. 23 Date
Sta. 38+01.5 Offset 51.5' Lt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Piling
Hammer
Formula
Reference

SOIL LOG	ELEV.	DEPTH
	927.4	
		2
Fine Brown Sand & Silt	923.4	4
		6
	919.4	8
		10
	915.4	12
		14
	911.4	16
		18
Grey Sand Silt & Clay	907.4	20
		22
	903.4	24
		26
	899.4	28
		30
	895.4	32
		34
	891.4	36
		38
Dense grey Silt & Clay	887.4	40
		42
	883.4	44
		46
	879.4	48
		50
	875.4	52
		54
	871.4	56
		58
	867.4	60
		62
	863.4	64
		66
	859.4	68
		70

Ground Line
~~Proposed Footer Elev.~~

Drive Rod

0 10 20 30 40 50 60 70 80 90 100 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.E.I.
Date

PILE PENETRATION CURVES

#6 ~~Abut.~~ - Pier
T.H. 24 Date
Sta. 38+01.5 Offset 51.5' Rt.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Water Elev.

SOIL LOG	ELEV.	DEPTH
	916.6	
Fine Brown Sand & Silt		2
	912.6	4
		6
	908.6	8
Grey Sand Silt & Clay		10
	904.6	12
		14
	900.6	16
		18
	896.6	20
		22
	892.6	24
		26
	888.6	28
Fine Grey Sand & Silt		30
	884.6	32
		34
	880.6	36
		38
Gravel Sand & Silt	876.6	40
		42
	872.6	44
Dense Grey Sand & Silt		46
	868.6	48
		50
	864.6	52
		54
		56
		58
		60
		62
		64
		66
		68
		70

Ground Line

~~Proposed~~ Footer Elev.

Piling
Hammer
Formula
Reference

Drive Rod

0 10 20 30 40 50 60 70 80 90 100 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. F.
Date

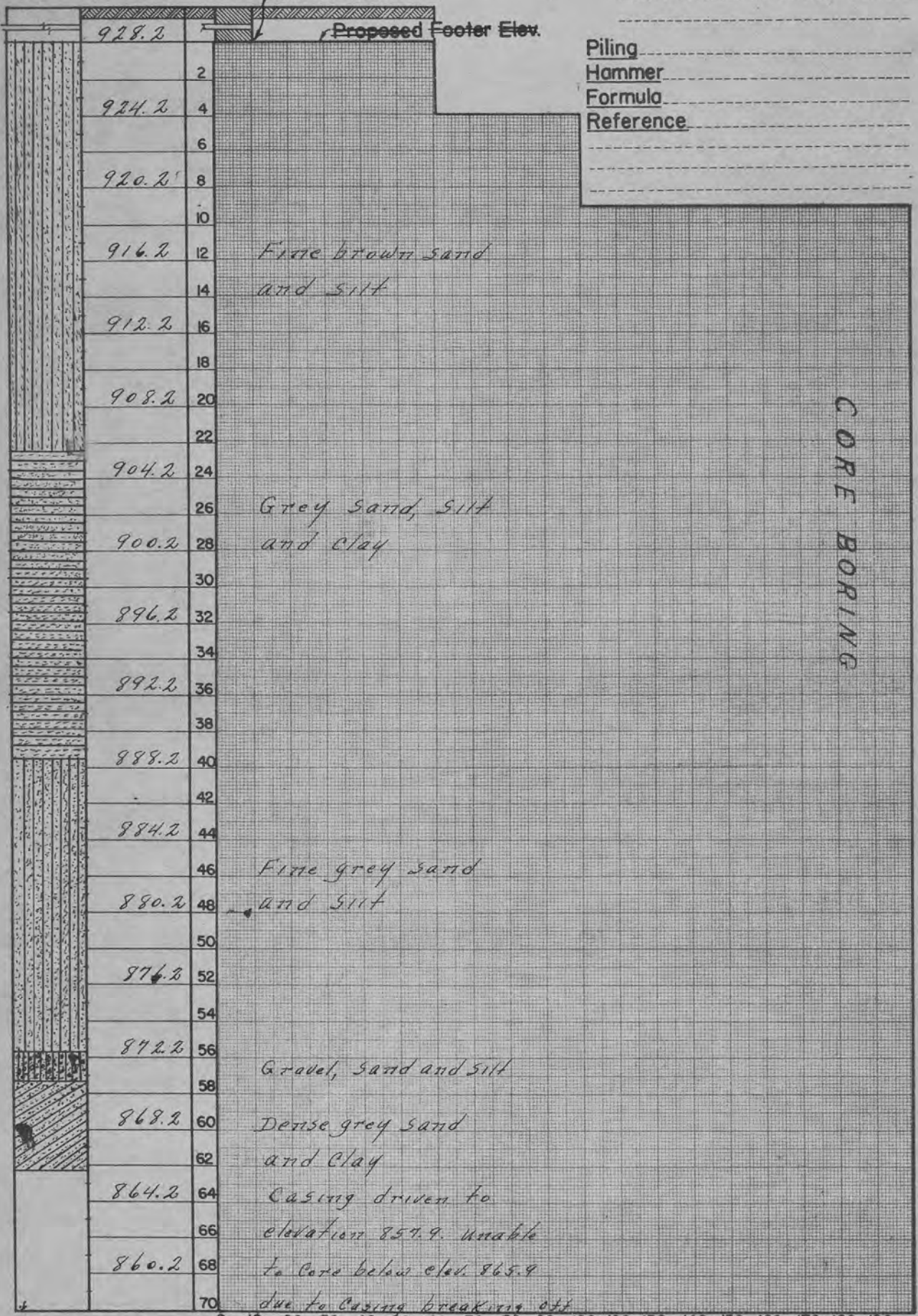
PILE PENETRATION CURVES

#6 Abut. - Pier
T.H. 25 Date
Sta. 38+17 Offset 39' Rt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Piling
Hammer
Formula
Reference

SOIL LOG ELEV. DEPTH



0 10 20 30 40 50 60 70 80 90 100 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.G.L.
Date

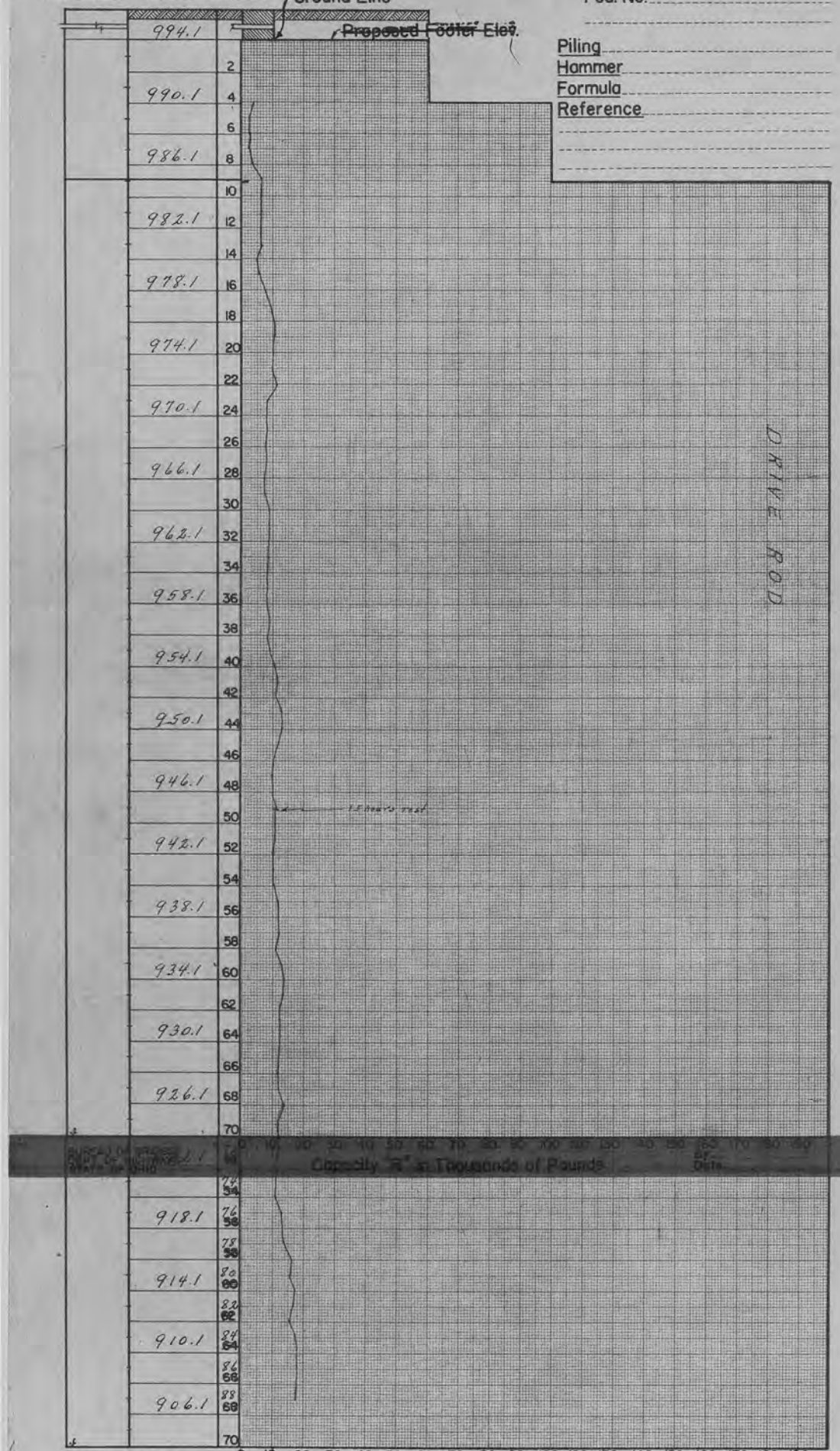
PILE PENETRATION CURVES

Forward Abut. - ~~Pier~~
T.H. 26 Date Nov. 4, 1948
Sta. 39+97 Offset 48' Lt.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Water Elev.

Piling
Hammer
Formula
Reference



BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date

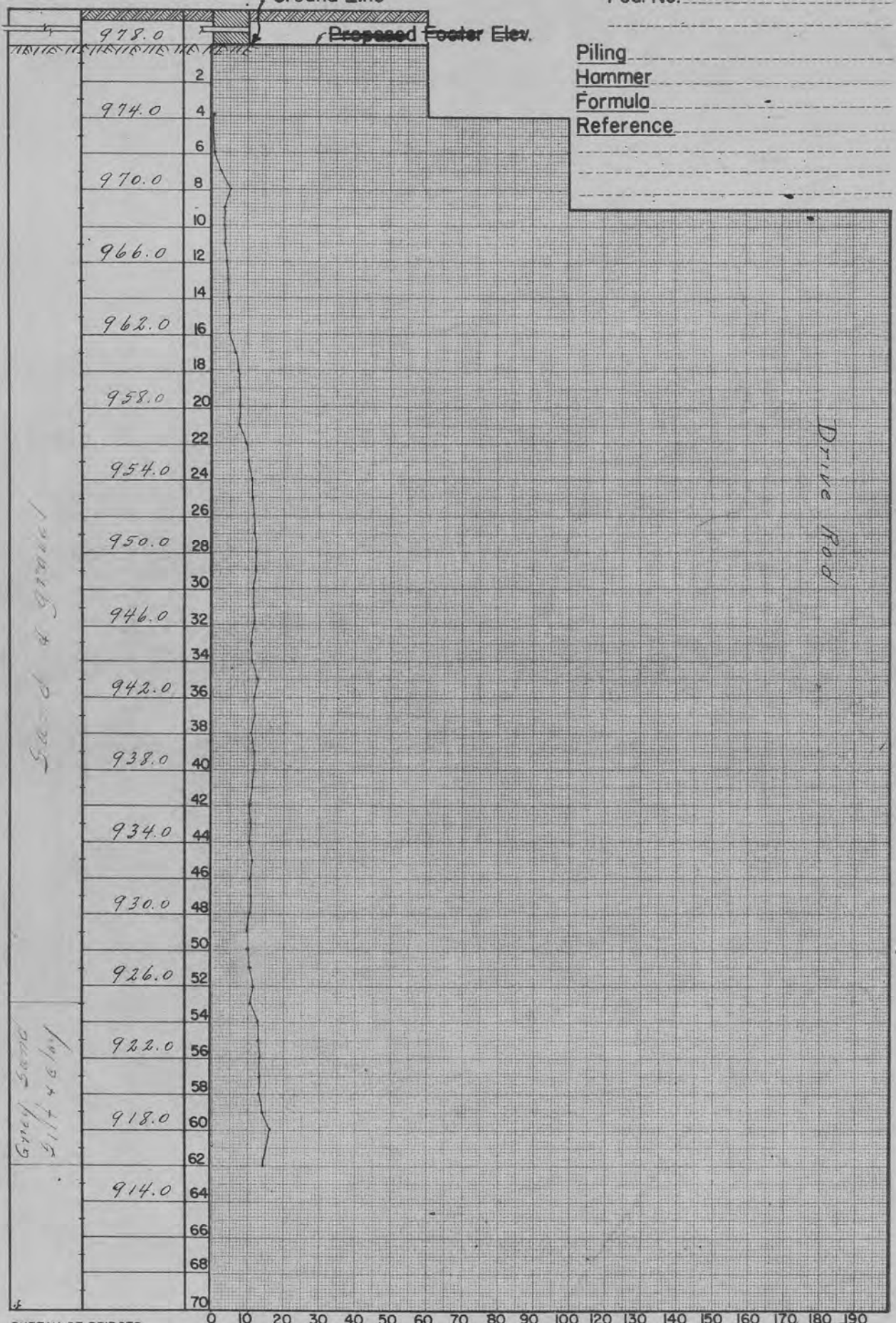
PILE PENETRATION CURVES

Forward Abut. - ~~Pier~~
T.H. 27 Date
Sta. 40+00 Offset 48' Rt.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct over Little Cuyahoga River AKRON EXPRESSWAY
Fed. No.

Water Elev.

SOIL LOG ELEV. DEPTH



Piling
Hammer
Formula
Reference

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. E. L.
Date

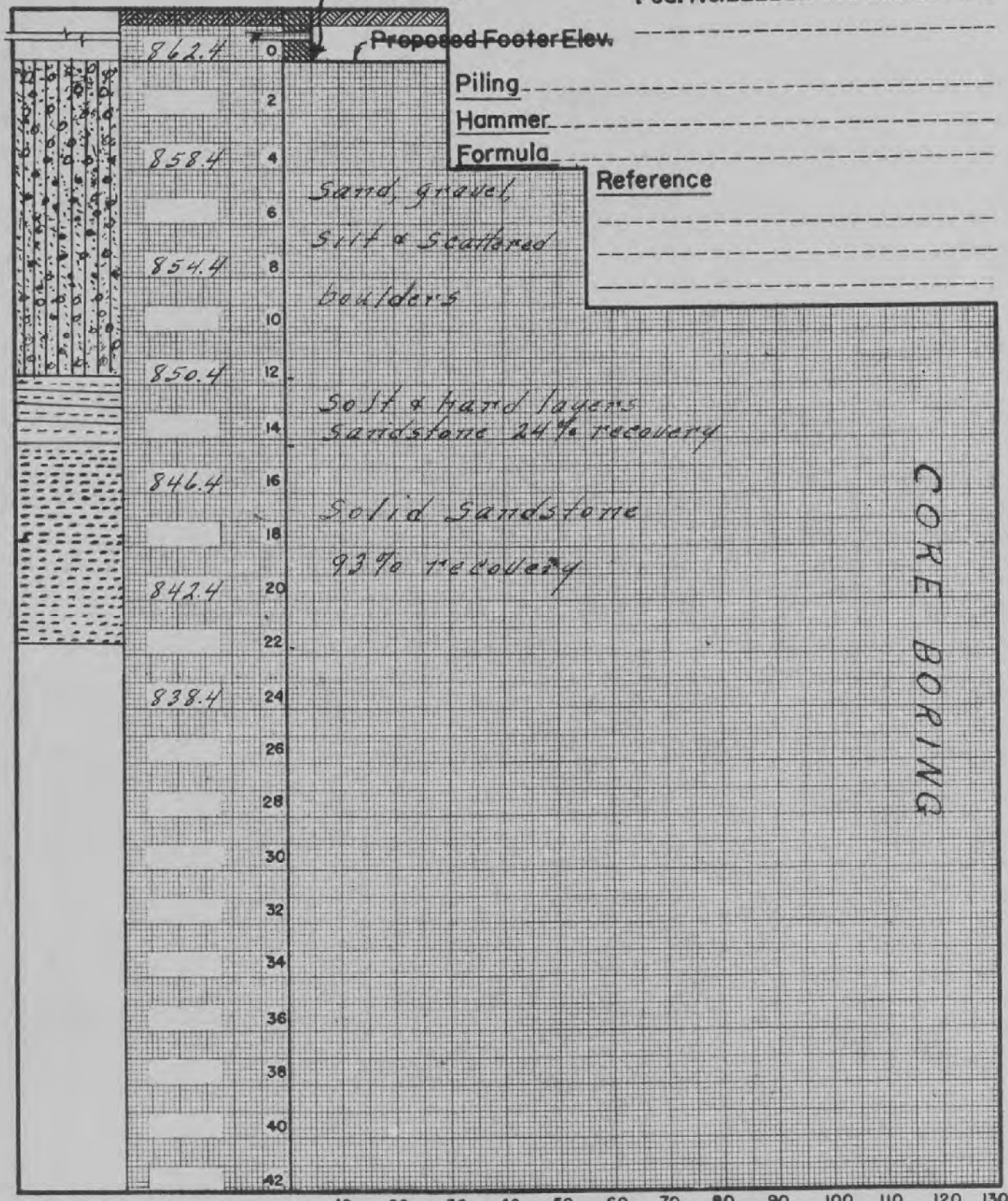
PILE PENETRATION CURVES

#4 Abut. - Pier
T.H. 17 Date _____
Sta. 31+80 Offset 43' Rt.

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St Viaduct over Little Cuyahoga River AKRON EXPRESSWAY
Fed. No. _____

Water Elev. _____

SOIL LOG ELEV. DEPTH



Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

10 20 30 40 50 60 70 80 90 100 110 120 130

Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.C.T.
Date _____

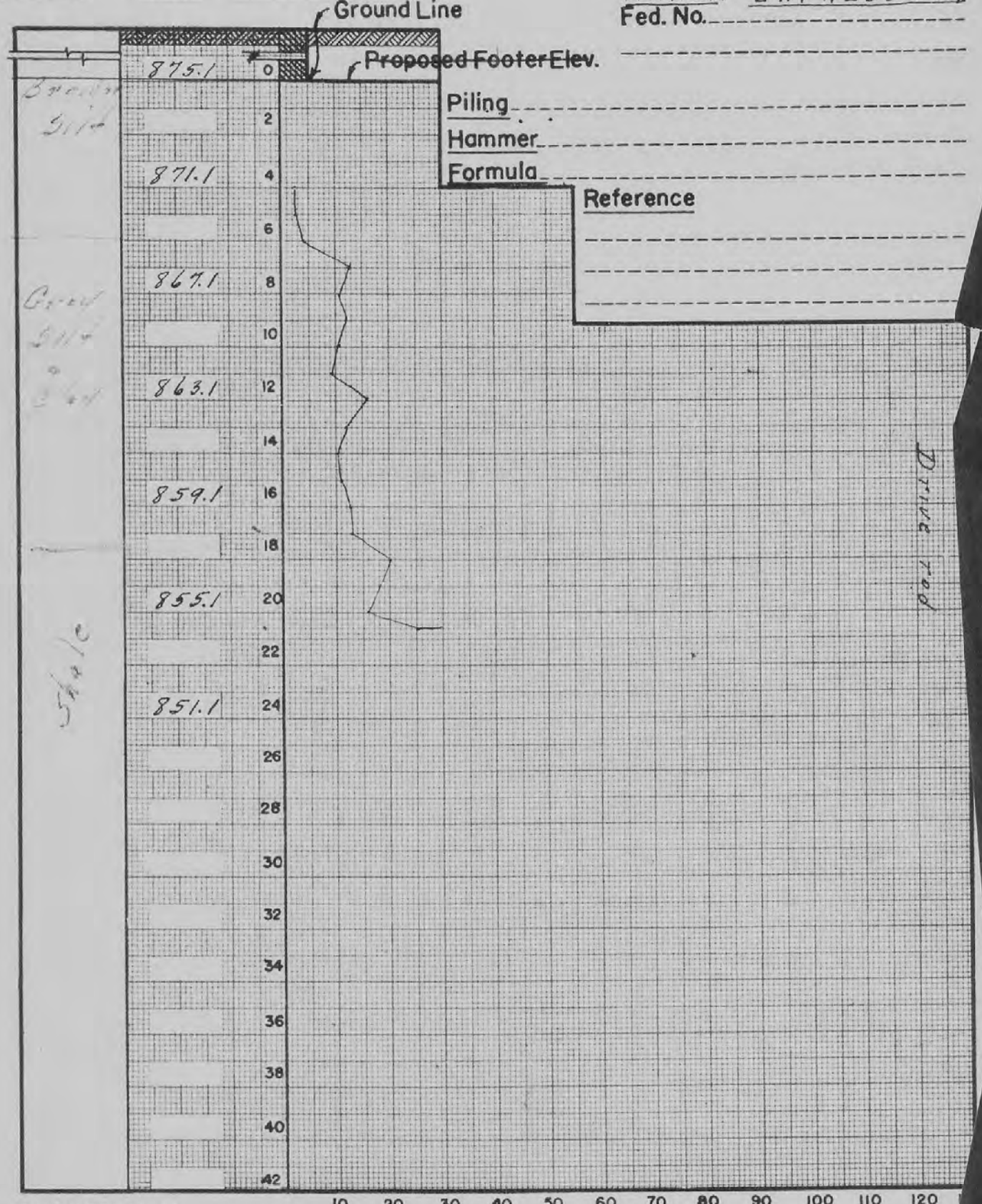
PILE PENETRATION CURVES

#5 ~~Abut.~~ - Pier
T.H. 21 Date _____
Sta. 35+08 Offset 47.5' Rt.

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

Water Elev. _____

SOIL LOG ELEV. DEPTH



Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

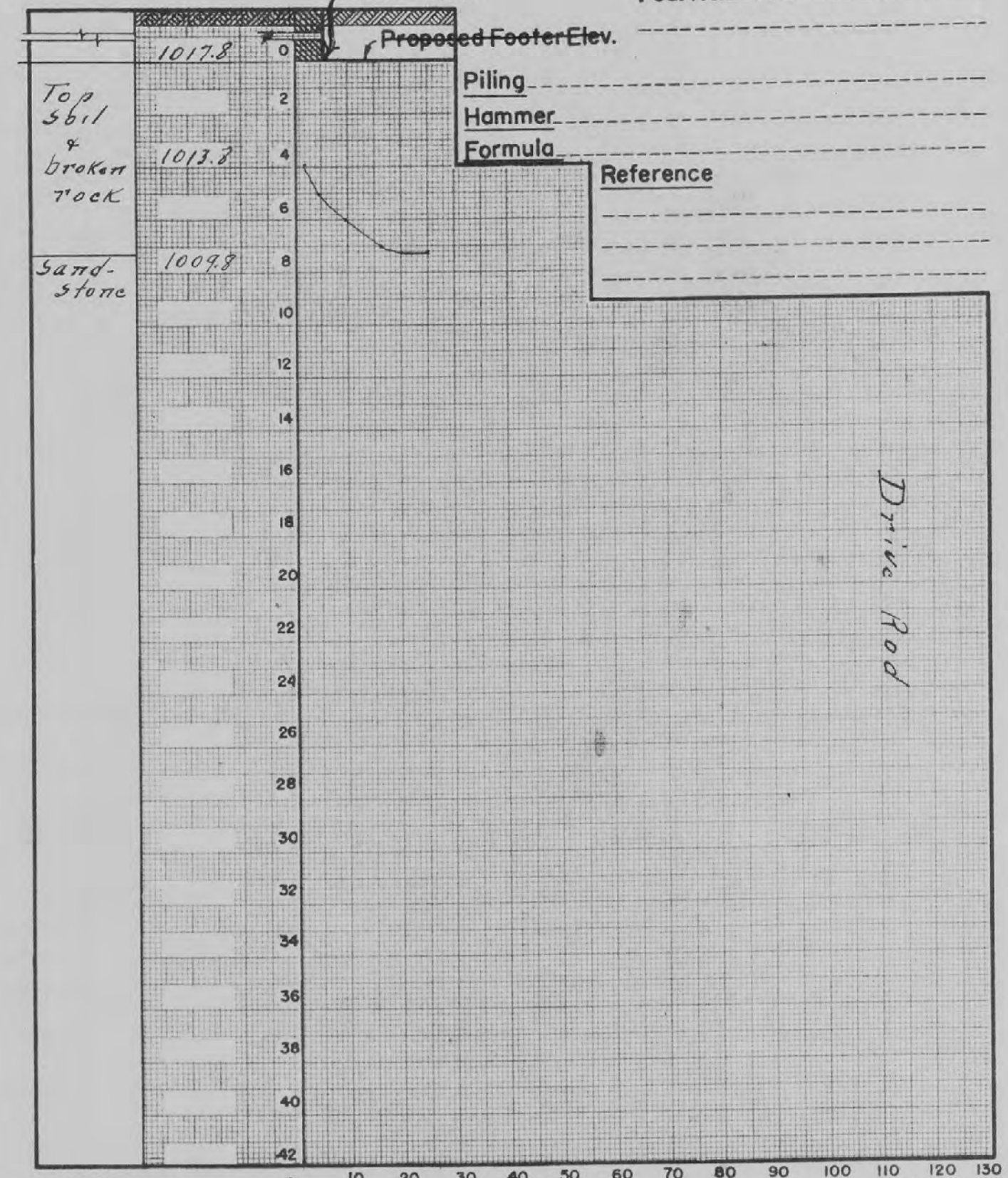
By W. G.
Date _____

PILE PENETRATION CURVES

Rear Abut. - ~~Pier~~
T.H. 1 Date _____
Sta. 24+78 Offset 48' Rt.
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St. Viaduct over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

Piling _____
Hammer _____
Formula _____
Reference _____



BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date _____

PILE PENETRATION CURVES

Rear Abut. - Pier

T.H. 2 Date _____

Sta. 24+78 Offset 48' Lt.

County Summit

S.H. _____ Sec. City of Akron

Bridge No. Union St. Viaduct

Over Little Cuyahoga River

AKRON EXPRESSWAY

Fed. No. _____

Water Elev. _____

SOIL LOG ELEV. DEPTH

Ground Line

Proposed Footer Elev.

Piling _____

Hammer _____

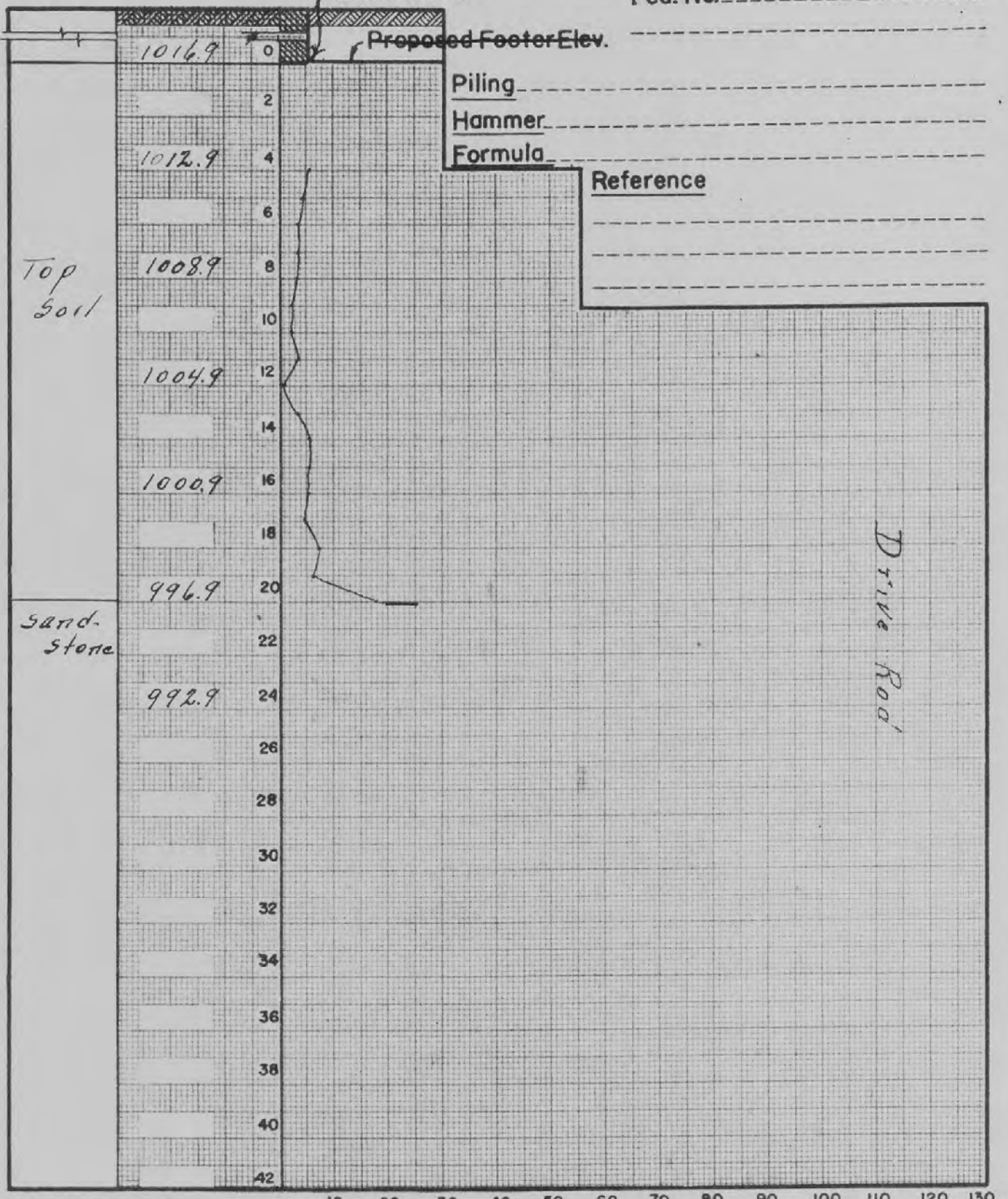
Formula _____

Reference

_____

_____

_____



BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.

Date _____

PILE PENETRATION CURVES

#4 ~~Abut.~~ - Pier
T.H. 19 Date _____
Sta. 31+80 Offset 47.5' Lt.

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

Water Elev. _____

SOIL LOG	ELEV.	DEPTH
Ground Line		
~~Proposed Footer Elev.~~		
	858.0	0
Silt Changing to clay		2
	854.0	4
		6
Grey Sandstone 50% Recovery	850.0	8
		10
Grey Sandstone 70% Recovery	846.0	12
		14
Grey Sandstone 94% Recovery	842.0	16
		18
	838.0	20
		22
	834.0	24
		26
		28
		30
		32
		34
		36
		38
		40
		42

Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

10 20 30 40 50 60 70 80 90 100 110 120 130
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date _____

PILE PENETRATION CURVES

Rear Abut. - ~~Pier~~

T.H. 3 Date _____

Sta. 25+38 Offset 48' Lt.

Water Elev. _____

County Summit

S.H. _____ Sec. City of Akron

Bridge No. Union St. Viaduct over Little Cuyahoga River

AKRON EXPRESSWAY

Fed. No. _____

_____

SOIL LOG ELEV. DEPTH

Ground Line

~~Proposed Footer Elev.~~

Piling _____

Hammer _____

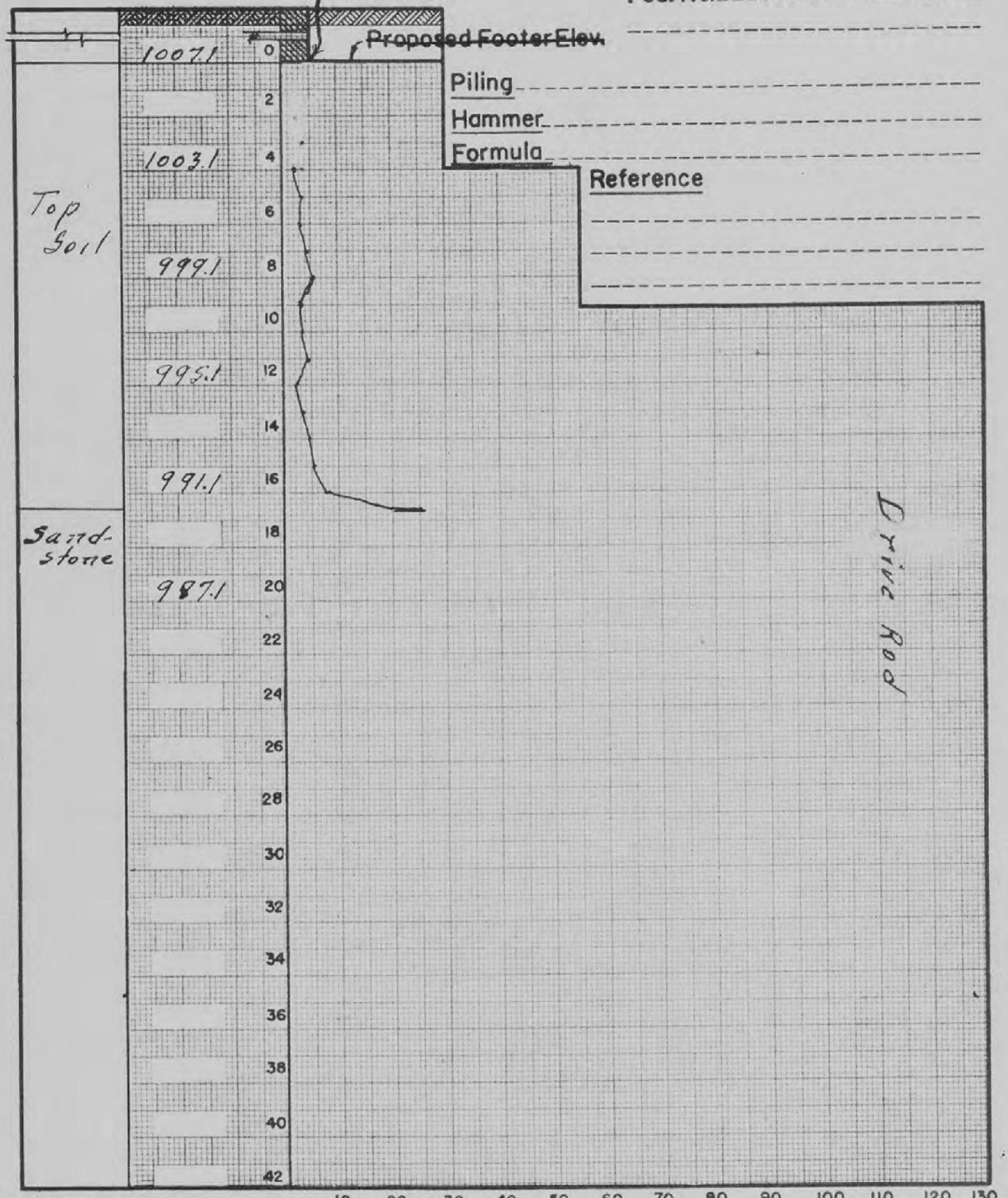
Formula _____

Reference

_____

_____

_____



BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.

Date _____

PILE PENETRATION CURVES

Rear Abut. - ~~Pier~~

T.H. 4 Date _____

Sta. 25+38 Offset 48' Rt.

Water Elev. _____

County Summit

S.H. _____ Sec. City of Akron

Bridge No. Union St. Viaduct Over Little Cuyahoga River AKRON EXPRESSWAY

Fed. No. _____

_____

Piling _____

Hammer _____

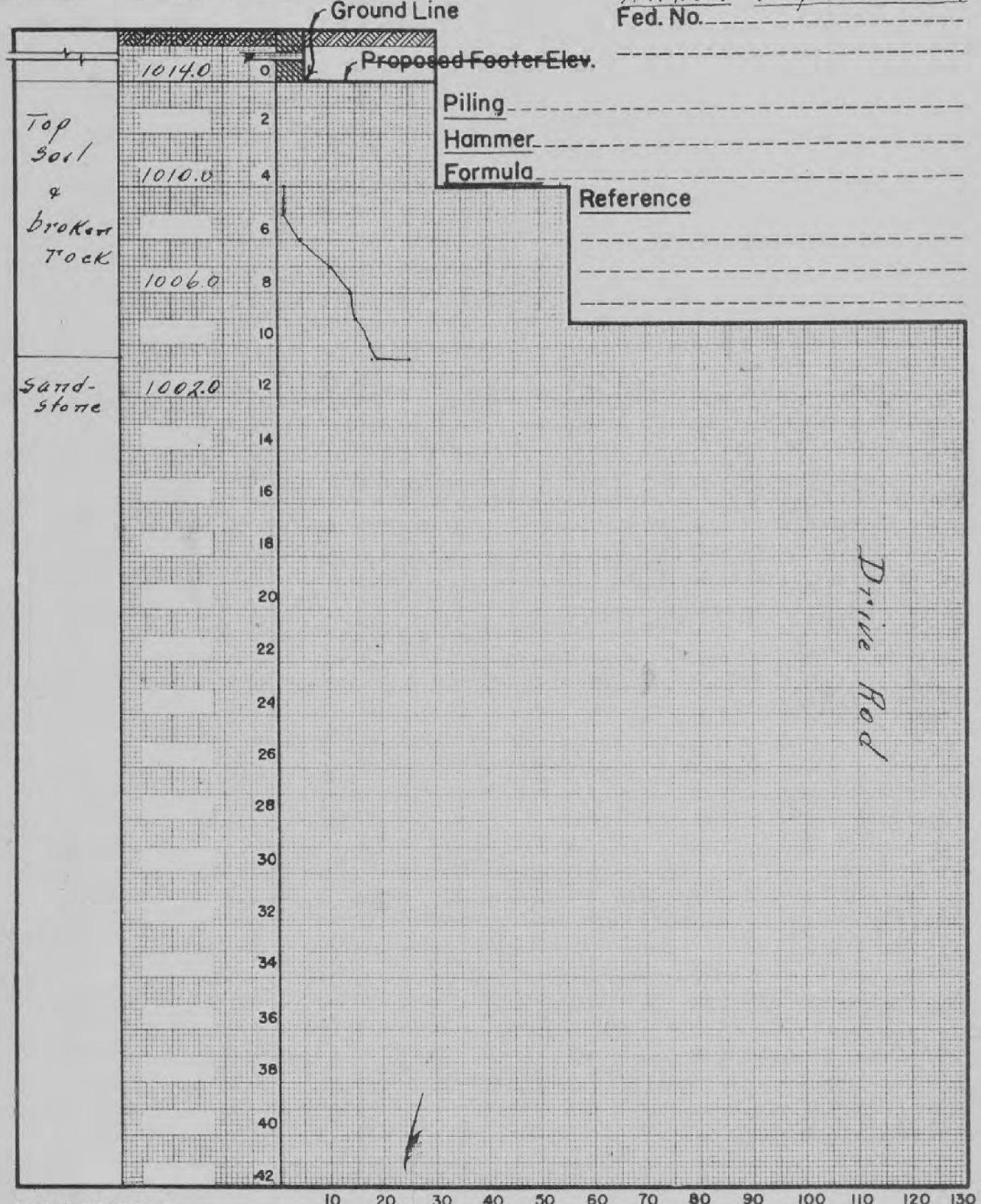
Formula _____

Reference

_____

_____

_____



BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. F.

Date _____

PILE PENETRATION CURVES

#1 ~~Abut.~~ - Pier

T.H. _____ Date _____

Sta. _____ Offset _____

Water Elev. _____

County Summit

S.H. _____ Sec. City of Akron

Bridge No. Union St. Viaduct Over Little Cuyahoga River AKRON EXPRESSWAY

Fed. No. _____

SOIL LOG ELEV. DEPTH

Ground Line

Proposed Footer Elev.

Piling _____

Hammer _____

Formula _____

Reference

_____

_____

_____

T.H. No.	Station	Offset	Ground Elevation	Rock Elevation
5	26+10	46' Lt.	992.6	983.5
6	26+14	28' Lt.	992.3	985.3
7	26+16	10' Rt.	990.6	990.6
8	26+23	25' Rt.	992.6	988.9
9	26+26	41' Rt.	992.8	988.2

ROD SOUNDINGS

(Taken with Steel rod and Sledge hammer)

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

10 20 30 40 50 60 70 80 90 100 110 120 130

Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.

Date _____

PILE PENETRATION CURVES

#2 Abut. - Pier
T.H. _____ Date _____
Sta. _____ Offset _____
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG ELEV. DEPTH

Ground Line
Proposed Footer Elev.

Piling _____
Hammer _____
Formula _____

Reference
_____
_____
_____

T.H. No.	Station	Offset	Ground Elevation	Rock Elevation
10	27+19	43' Lt.	983.3	970.1
11	27+38	47' Lt.	993.6	970.0
12	27+34	46' Rt.	985.8	983.3
13	27+55	42' Rt.	961.5	961.4

ROD SOUNDINGS

(Taken with steel rod and sledge hammer)

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

10 20 30 40 50 60 70 80 90 100 110 120 130

Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W. G. T.
Date _____

Gannett Fleming
Engineers and Architects, P.C.
Excellence Delivered **As Promised**

APPENDIX C

Boring Logs and Rock Core Photos

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 515+84, 45' RT.	EXPLORATION ID B-001-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1034.1 (MSL) EOB: 6.2 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084210, -81.502841	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1034.1	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
12" ASPHALT (DRILLER'S DESCRIPTION)	1033.1																	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, (WEATHERED SANDSTONE), DRY		1 2 3 4	9 11 15	35	67	SS-1	-	12	21	61	- 6 -		NP	NP	NP	6	A-3 (0)	
	1029.6	TR	19 26 50/3"	-	80	SS-2	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1027.9	5 EOB 6	50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 314+55, 40' LT.	EXPLORATION ID B-001-1-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1052.7 (MSL) EOB: 11.2 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084061, -81.503949	

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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1052.7																	
	1051.7																	
LOOSE TO MEDIUM DENSE, BROWN TO GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, (FILL), DRY		1	6 7 10	23	56	SS-1	-	43	22	30	-	5 -	NP	NP	NP	5	A-1-b (0)	
		2																
		3																
		4	2 2 2	5	28	SS-2	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		5																
		6																
		7	4 7 10	23	22	SS-3	-	49	6	39	-	6 -	NP	NP	NP	7	A-1-b (0)	
	1044.2	8																
		TR																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		9	50/4"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1041.5	10																
		EOB 11	50/2"	-	0	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: *BORING MOVED UP HILL FROM SURVEYED LOCATION

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 415+52, 2' RT.	EXPLORATION ID B-001-2-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1050.5 (MSL) EOB: 11.4 ft.	PAGE 1 OF 1
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.084049, -81.502558	

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
12" ASPHALT (DRILLER'S DESCRIPTION)	1050.5																	
MEDIUM DENSE, REDDISH BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, TRACE SILT AND CLAY, DAMP	1049.5	1	7 5 4	12	44	SS-1	-	21	29	22	27	1	NP	NP	NP	18	A-3a (0)	
SOFT, DARK BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, MOIST	1048.0	2																
		3																
		4	1 1 14	20	44	SS-2	0.25	15	18	12	27	28	35	24	11	25	A-6a (4)	
	1044.5	5																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 6	50/2"	-	80	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		7																
		8																
		9	50/3"	-	62	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		10																
	1039.1	EOB 11	50/5"	-	89	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: CAVE @ 8.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 12 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 419+81, 36' RT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1054.0 (MSL) EOB: 24.0 ft.
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.084037, -81.502378

EXPLORATION ID B-001-3-16

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	1054.0							GRADATION (%)					ATTERBERG					
TOPSOIL (6.0")	1053.5		7			SS-1A	2.75 - 3.25	-	-	-	-	-	-	-	-	19		
DENSE, GRAYISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS CONCRETE FRAGMENTS, DAMP **(FILL)**	1052.0	1	23 6	43	89	SS-1B	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
STIFF, GRAYISH BROWN WITH ORANGISH BROWN AND GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, CONTAINS CINDERS, SLAG, AND MANY BRICK FRAGMENTS, MOIST **(FILL)**	1049.5	2 3	4 4 7	16	100	SS-2	1.25	8	15	26	33	18	30	19	11	19	A-6a (4)	
DENSE, LIGHT GRAYISH BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**	1048.2	4 5	8 9 13	32	100	SS-3A	-	34	17	20	18	11	23	17	6	12	A-2-4 (0)	
		6				SS-3B	2.9 - 4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	1045.5	7 8	4 7 34	60	100	SS-4A	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	
		TR				SS-4B	-	-	-	-	-	-	-	-	-	2	Rock (V)	
SANDSTONE, PINKISH BROWN, MODERATELY WEATHERED, MODERATELY FRIABLE, EASILY AUGERED.		9 10	4 50/5"	-	100	SS-5	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		11 12																
		13	4 50/5"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	Rock (V)	
	1040.0	14																
SANDSTONE, LIGHT BROWN, MAROONISH BROWN AND LIGHT GRAY, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, MEDIUM GRAINED, THIN BEDDED, FINE GRAINED TO 14.5', JOINT DISCONTINUITIES: LOW ANGLE FRACTURES WITH VERTICAL FRACTURES 14.0' TO 14.5', FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, DISINTEGRATED, FAIR SURFACE CONDITION; RQD 0%, REC 61%.		15 16 17 18	0		34	NQ2-1											CORE	
		19 20 21 22 23	0		88	NQ2-2											CORE	
	1030.0	EOB 24																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 25 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 416+81, 50' RT.
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1055.3 (MSL) EOB: 13.7 ft.
START: 6/8/15 END: 6/8/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084395, -81.502357

EXPLORATION ID B-001-4-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
12" TOPSOIL (DRILLER'S DESCRIPTION)	1055.3																	
	1054.3																	
SOFT, BROWN, **CLAY**, "AND" SILT, TRACE SAND AND GRAVEL, DAMP		1	3	5	67	SS-1	0.50	5	2	4	54	35	44	20	24	22	A-7-6 (14)	
	1052.3	2	2 2															
VERY STIFF, BROWN, **SILT**, SOME CLAY, LITTLE GRAVEL, TRACE SAND, DRY		3																
		4	6	25	83	SS-2	4.00	13	2	7	50	28	24	22	2	25	A-4b (8)	
		5	8 11															
	1048.8	6	6	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		TR	50/2"															
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		7																
		8																
		9	50/2"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		10																
		11	50/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		12																
	1041.6	13	50/2"	-	67	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 316+58, 75' LT.	EXPLORATION ID B-001-5-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1060.1 (MSL) EOB: 20.5 ft.	PAGE 1 OF 1
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.084620, -81.503801	

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
TOPSOIL (4.0")	1060.1																	
VERY STIFF TO HARD, BROWN WITH DARK GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL (SANDSTONE), CONTAIN CINDERS, AND FEW ROOT HAIRS, @0.3' TO 1.5'; CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**	1059.8	1	4 5 6	16	83	SS-1	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
		2																
		3	7 9 6	22	100	SS-2	4.00	13	8	38	26	15	20	14	6	13	A-4a (1)	
		4																
		5																
		6	3 7 8	22	67	SS-3	2.0 - 2.5	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1053.1	7																
SANDSTONE, ORANGISH BROWN TO WHITE AND ORANGISH BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 8	17 50/5"	-	9	SS-4	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		9																
		10	22 50/4"	-	60	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		11																
@12.5' TO 15.3'; BECOMES LIGHT AND DARK ORANGISH BROWN		12																
		13	50/3"	-	100	SS-6	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		14																
	1044.6	15	50/3"	-	100	SS-7	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, BROWN WITH LIGHT GRAY AND MAROONISH BROWN, SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MEDIUM TO COARSE GRAINED, VERY THIN BEDDED, JOINT DISCONTINUITIES: LOW ANGLE FRACTURES, DIAGONAL FRACTURE AT 16.0-16.2', FRACTURED TO MODERATELY FRACTURED, TIGHT, SLIGHTLY ROUGH, VERY BLOCKY STRUCTURE, GOOD SURFACE CONDITION; RQD 63%, REC 100%.		16																
		17																
		18	63		100	NQ2-1											CORE	
		19																
	1039.6	20 EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 517+48, 50' RT.	EXPLORATION ID B-002-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1035.6 (MSL) EOB: 3.7 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084653, -81.502740	

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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1035.6																	
	1034.6	1	5															
VERY DENSE, BROWN TO RED, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVE, TRACE SILT AND CLAY, DRY	1033.6	TR 2	7 50/2"	-	86	SS-1	-	11	20	62	-	7 -	NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1031.9	3 EOB	50/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 218+05, 38' LT.	EXPLORATION ID B-003-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.5 (MSL) EOB: 6.3 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084847, -81.503109	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1037.5	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
10" ASPHALT (DRILLER'S DESCRIPTION)	1036.7																	
DENSE, BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY		1	16 16 15	41	72	SS-1	-	20	19	53	- 8 -		NP	NP	NP	6	A-3 (0)	
	1033.8	2 3 TR																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		4	50/3"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1031.2	5 6 EOB	50/4"	-	75	SS-3	-	-	-	-	—	—	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 418+31, 44' RT.
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1056.4 (MSL) EOB: 14.5 ft.
START: 6/9/15 END: 6/9/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084807, -81.502349

EXPLORATION ID B-003-1-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	1056.4																	
12" TOPSOIL (DRILLER'S DESCRIPTION)	1055.4																	
HARD, BROWN, **SILT**, SOME CLAY, LITTLE SAND AND GRAVEL, DRY	1053.1	1 2 3	4 6 5	15	83	SS-1	4.5+	11	1	9	55	24	25	20	5	15	A-4b (8)	
VERY STIFF TO HARD, BROWN, **CLAY**, SOME SAND LITTLE GRAVEL, DRY	1047.9	4 5 6 7 8	3 4 4	11	72	SS-2	4.00	12	3	14	41	30	-	-	-	15	A-7-6 (V)	
			4 6 8	19	89	SS-3	4.5+	-	-	-	-	-	38	21	17	17	A-7-6 (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1046.9	TR 9	50/4"	-	50	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, REDDISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, FINE TO COARSE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY FRACTURED; RQD 62%, REC 100%. @ 10.1' TO 10.6'; Qu = 5,010 PSI @ 10.7' TO 10.9'; VERTICAL FRACTURE @ 11.9' TO 12.5'; Qu = 5,120 PSI	1041.9	10 11 12 13 14 EOB	62		100	NX-1											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 418+52, 9' RT.	EXPLORATION ID B-003-2-15	
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J		
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1053.4 (MSL) EOB: 8.6 ft.	PAGE 1 OF 1	
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.084870, -81.502470		

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
18" TOPSOIL (BROWN, COARSE AND FINE SAND, DRY)	1053.4																	
MEDIUM DENSE TO VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	1051.9	1	4 9 9	24	53	SS-1	-	12	53	27	-	8 -	NP	NP	NP	7	A-1-b (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1049.4	2																
		3																
		TR 4	50/3"	-	117	SS-2	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		5																
		6	50/2"	-	67	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		7																
	1044.8	EOB 8	50/1"	-	-	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 318+54, 2' LT.	EXPLORATION ID B-003-3-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.5 (MSL) EOB: 8.8 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085051, -81.503313	

MATERIAL DESCRIPTION AND NOTES		ELEV. 1037.5	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
12" TOPSOIL (DRILLER'S DESCRIPTION)		1036.5																	
MEDIUM DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY	F-S	1034.0	1 2 3	7 8 5	17	83	SS-1	-	10	22	63	- 5 -		NP	NP	NP	5	A-3 (0)	
LOOSE, BROWN, **FINE SAND**, SOME GRAVEL, TRACE COARSE SAND, SILT AND CLAY, DRY	F-S	1030.5	4 5 6	2 2 2	5	72	SS-2	-	22	7	69	- 2 -		NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		1028.7	TR 7 8 EOB	9 20 50/3"	-	93	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
				50/3"	-	67	SS-4	-	-	-	-	—	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 318+54, 2' LT.	EXPLORATION ID B-003-4-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1056.0 (MSL) EOB: 15.2 ft.	PAGE 1 OF 1
START: 1/4/17 END: 1/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.085107, -81.503568	

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
1056.0																		
TOPSOIL (3.5")	1055.7																	
LOOSE, DARK GRAYISH BROWN, BROWN, AND ORANGISH BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS ROOTS, IRON STAINING AND CINDERS, MOIST **(FILL)**	1054.0	1	1 2 2	6	89	SS-1	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
SOFT TO MEDIUM STIFF, DARK GRAYISH BROWN AND BROWN, **SILT AND CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, @2.5' TO 4.0'; CONTAINS DECAYED LEAVES AND MANY ROOTS, DAMP TO MOIST		2 3	WOH 1 2	4	78	SS-2	0.25 - 1.0	4	9	26	35	26	28	17	11	20	A-6a (6)	
@5.0' TO 6.5'; BECOMES VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, CONTAINS ROOTS	1049.5	4 5 6	6 8 9	25	100	SS-3	3.25 - 4.5+	11	6	20	39	24	29	18	11	15	A-6a (6)	
SANDSTONE, BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 7 8 9	50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	7	Rock (V)	
@10.0' TO 10.2'; BECOMES ORANGISH BROWN WITH MAROONISH BROWN, CONTAINS IRON STAINING	1045.8	10	50/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, STRONG, FINE TO COARSE GRAINED, VERY THIN TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 12.7' - 12.9', MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, VERY BLOCKY, FAIR TO GOOD SURFACE CONDITION; RQD 45%, REC 86%.	1040.8	11 12 13 14 15 EOB	45		86	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 30 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 419+81, 36' RT.
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1052.3 (MSL) EOB: 15.0 ft.
START: 6/9/15 END: 6/9/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085220, -81.502345

EXPLORATION ID B-003-5-15

PAGE 1 OF 1

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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1052.3																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY	1051.3	1	5 6 21	36	67	SS-1	4.5+	18	11	3	37	31	38	18	20	15	A-6b (11)	
	1048.8	3																
LOOSE TO DENSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY BRICK FRAGMENTS THROUGH (POSSIBLE OLD FOUNDATION)	FS	4	6 9 15	32	22	SS-2	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		6	3 3 3	8	22	SS-3	-	21	11	62	- 6 -		NP	NP	NP	7	A-3 (0)	
	1042.3	8	9 50/5"	-	73	SS-4	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
SANDSTONE, REDDISH BROWN, MODERATELY TO HIGHLY WEATHERED, SLIGHTLY STRONG, FINE TO COARSE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY FRACTURED; RQD 58%, REC 100%.		TR 10																
@ 13.4' TO 13.9'; Qu = 4,230 PSI		12	58		100	NX-1											CORE	
@ 14.4' TO 15.0'; Qu = 4,830 PSI	1037.3	EOB 15																
@ 14.7' TO 15.0'; VERTICAL FRACTURE																		

NOTES: *ESTIMATED ELEVATION 1057', ACTUAL ELEVATION 1025', BORING ADVANCED TO 1037, 5' BELOW PROPOSED ELEVATION

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 420+39, 52' RT.	EXPLORATION ID B-003-6-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1049.2 (MSL) EOB: 9.2 ft.	PAGE 1 OF 1
START: 6/9/15 END: 6/9/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085375, -81.502274	

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
	1049.2																	
12" CONCRETE (DRILLER'S DESCRIPTION)	1048.2																	
BROWN, **SANDY SILT**, (IDENTIFIED FROM AUGER), DRY	1047.2	TR	6 14 50/3"	-	67	SS-1	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		1 2 3 4 5 6 7 8 9	50/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1040.0	EOB	50/2"	-	50	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: *BORING MOVED 5' NORTH DUE TO EXISTING SEWER LINE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 12 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 320+34, 14' RT.	EXPLORATION ID B-003-7-15	
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I		
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1045.5 (MSL) EOB: 8.6 ft.	PAGE 1 OF 1	
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.085519, -81.503094		

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
	1045.5																	
14" TOPSOIL (DRILLER'S DESCRIPTION)	1044.3																	
MEDIUM STIFF TO VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND AND GRAVEL, DRY TO DAMP		1	2 2 3	7	67	SS-1	1.60	-	-	-	-	-	-	-	-	19	A-6a (V)	
	1040.6	2																
		3																
		4	4 6 11	23	94	SS-2	2.75	14	5	6	29	46	37	22	15	24	A-6a (10)	
VERY DENSE, BROWN, **FINE SAND**, LITTLE GRAVEL AND COARSE SAND, TRACE SILT AND CLAY, DRY	1039.5	5																
		TR 6	50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1036.9	7																
		EOB 8	50/1"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 320+66, 36' LT.	EXPLORATION ID B-003-8-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1049.4 (MSL) EOB: 14.0 ft.	PAGE 1 OF 1
START: 12/29/16 END: 12/29/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.085635, -81.503239	

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
	1049.4																	
TOPSOIL (2.0")	1049.2																	
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW ROOT HAIRS, MOIST	1047.4	1	3 3 4	10	67	SS-1	1.25 - 1.75	-	-	-	-	-	-	-	-	19	A-4a (V)	
STIFF TO VERY STIFF, BROWN TO BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, DAMP TO MOIST	1043.9	2 3 4 5	8 10 14	35	100	SS-2	2.0 - 2.25	10	9	33	29	19	26	15	11	15	A-6a (3)	
SANDSTONE, LIGHT BROWN TO BROWN WITH GRAY, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1041.6	TR 6 7	12 50/3"	-	100	SS-3A SS-3B	1.5 - 1.75 -	6 -	9 -	28 -	34 -	23 -	28 -	17 -	11 -	16 6	A-6a (5) Rock (V)	
SANDSTONE, LIGHT BROWN AND ORANGISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, FRACTURED TO HIGHLY FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; RQD 8%, REC 49%.	1035.4	8 9 10 11 12 13 EOB 14	50/3" 8	-	100 49	SS-4 NQ2-1	-	-	-	-	-	-	-	-	-	5 CORE	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 222+05, 3' LT.	EXPLORATION ID B-004-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1038.9 (MSL) EOB: 3.7 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085921, -81.502778	

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
6" ASPHALT (DRILLER'S DESCRIPTION)	1038.9																	
	1038.4																	
VERY DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY		1	28	-	59	SS-1	-	44	24	26	- 6 -		NP	NP	NP	7	A-1-b (0)	
	1036.7	TR 2	14 50/5"															
SANDSTONE, REDDISH BROWN, SEVERELY TO HIGHLY WEATHERED.		3																
	1035.2	EOB	60/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 420+39, 52' RT.	EXPLORATION ID B-004-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1042.0 (MSL) EOB: 18.5 ft.	PAGE 1 OF 1
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.085810, -81.502220	

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
TOPSOIL (2.0")	1042.0																	
LOOSE TO MEDIUM DENSE, DARK GRAY CHANGING TO DARK GRAY WITH BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, CONTAIN SLAG AND ROOTS, @0.0' TO 1.5'; CONTAINS ORGANICS AND BRICK FRAGMENTS, MOIST **(FILL)**	1041.8		2 5 3	12	61	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
		1																
		2																
		3	2 3 4	10	89	SS-2	-	12	19	30	27	12	NP	NP	NP	20	A-4a (1)	
		4																
	1036.4	5																
SANDSTONE, BROWN TO LIGHT BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY FRIABLE, EASILY AUGERED.		TR	10 5 4	13	83	SS-3	-	16	7	54	15	8	NP	NP	NP	4	Rock (V)	
		6																
		7																
		8	15 26 47	107	100	SS-4	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		9																
		10																
		11	16 29 48	113	100	SS-5	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		12																
	1028.5	13	21 50/2"	-	88	SS-6	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, LIGHT GRAY AND ORANGISH BROWN, SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO MEDIUM GRAINED, VERY THIN TO THIN BEDDED, CONTAINS A PLANT FOSSIL, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES WITH DIAGONAL AT 17.0' TO 17.3', FRACTURED , NARROW, VERY ROUGH, BLOCKY STRUCTURE, GOOD SURFACE CONDITION; RQD 37%, REC 78%.		14																
		15																
		16	37		78	NQ2-1											CORE	
		17																
	1023.5	18																
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 27 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 322+46, 14' LT.	EXPLORATION ID B-004-2-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 1041.9 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 4/5/17 END: 4/5/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.086097, -81.502980	

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
12.0" TOPSOIL (DRILLER'S DESCRIPTION)	1041.9																	
	1040.9																	
MEDIUM STIFF, DARK BROWN AND LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, TRACE TO LITTLE GRAVEL, 1.0' TO 2.5' CONTAINS FEW ROOTS, MOIST **(FILL)**		1	2 1 2	4	78	SS-1	0.60	4	15	32	34	15	24	17	7	20	A-4a (3)	
		W 1038.4																
		4	2 2 50/5"	-	44	SS-2	0.60	-	-	-	-	-	-	-	-	20	A-4a (V)	
	1037.0																	
SANDSTONE, LIGHT BROWN, HIGHLY WEATHERED, FRIABLE.		TR 5 6	50/5"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		8 9	50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1031.9																	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, VERY THIN TO LAMINATED, CONGLOMERITIC, FRIABLE, FERRIFEROUS, CROSS BEDDED, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, HIGHLY FRACTURED TO FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY/DISTURBED/SEAMY, FAIR SURFACE CONDITION; RQD 0%, REC 38%.		10 11 12 13 14	0		38	NX-1											CORE	
	1026.9	EOB 15																

NOTES: GROUNDWATER ENCOUNTERED AT 3.5' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 20 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 323+04, 8' LT.	EXPLORATION ID B-004-3-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1039.7 (MSL) EOB: 6.15 ft.	PAGE 1 OF 1
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.086245, -81.502898	

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
24" TOPSOIL (DRILLER'S DESCRIPTION)	1039.7																	
VERY DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, GRAVEL, SILT AND CLAY, DRY	1037.7	1	2 4 4	11	67	SS-1	-	-	-	-	-	-	-	-	-	20	A-3 (V)	
		2																
		3																
		4	14 18 50/3"	-	67	SS-2	-	7	5	82	-	6 -	NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1035.2	TR																
	1033.5	5																
		EOB 6	50/2"	-	86	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 423+06, 14' RT.	EXPLORATION ID B-004-4-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.3 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.086084, -81.502209	

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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1037.3																	
	1036.3																	
LOOSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY		1	3	5	67	SS-1	-	22	17	55	- 6 -		NP	NP	NP	7	A-3 (0)	
		2	2 2															
	1033.8	3																
VERY STIFF, BROWN TO GRAY, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY		4	10 6 6	16	94	SS-2	3.00	-	-	-	-	-	-	-	-	16	A-6b (V)	
		5																
		6	6															
		7	6 2	11	100	SS-3	3.00	16	5	7	42	30	39	22	17	17	A-6b (10)	
	1028.3	8																
DENSE, REDDISH BROWN, **FINE SAND**, LITTLE COARSE SAND AND GRAVEL, TRACE SILT AND CLAY, DRY		9	4															
	1027.3	EOB 10	15 16	42	89	SS-4	-	12	18	61	- 9 -		NP	NP	NP	9	A-3 (0)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 423+45, 3' RT.	EXPLORATION ID B-004-5-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.8 (MSL) EOB: 25.6 ft.	PAGE 1 OF 1
START: 1/21/17 END: 1/21/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086194, -81.502201	

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
ASPHALT (8.0") & GRANULAR BASE (4.0")	1036.8																	
	1035.8																	
VERY DENSE, LIGHT GRAYISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS ASPHALT FRAGMENTS (3/8" TO 1.0" EXCLUDED FROM GRADATION), DRY **(FILL)**		1 2 3 4	50/6"	-	67	SS-1	-	26	34	17	18	5	NP	NP	NP	1	A-1-b (0)	
	1032.3																	
MEDIUM DENSE TO DENSE, BROWN BECOMING BROWN AND BLACK, **COARSE AND FINE SAND**, SOME TO LITTLE SILT, TRACE TO LITTLE GRAVEL, TRACE TO LITTLE CLAY, CONTAINS PLASTIC FRAGMENTS AND CINDERS, DAMP **(FILL)**		5 6 7	19 10 8	26	39	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	1028.3	8	9 7 14	31	78	SS-3A	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
VERY STIFF TO HARD, BROWN TO BLACK WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS CINDERS, @8.5' TO 9.0'; SLIGHTLY ORGANIC, DAMP TO MOIST **(FILL)**		9 10 11				SS-3B	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
	1024.8		10 7 4	16	100	SS-4	3.25 - 4.5+	9	11	32	30	18	23	14	9	14	A-4a (3)	
DENSE TO VERY DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP **(FILL)**		12 13 14	21 17 16	48	100	SS-5	-	7	19	55	11	8	NP	NP	NP	10	A-3a (0)	
@15.0' TO 15.8'; CHANGES TO BROWN WITH LIGHT BROWN, CONTAINS FEW CINDERS	1021.2	TR 15 16	19 50/4"	-	50	SS-6	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
SANDSTONE, BROWN AND GRAY BECOMING ORANGISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, SLIGHTLY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY TO VERY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 37%, REC 77%.		17 18 19 20	17		53	NQ2-1											CORE	
		21 22 23 24	57		100	NQ2-2											CORE	
	1011.2	EOB 25																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 323+89, 17' LT.	EXPLORATION ID B-004-6-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1021.8 (MSL) EOB: 13.5 ft.	PAGE 1 OF 1
START: 12/27/16 END: 12/27/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086476, -81.502828	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1021.8	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
ASPHALT (8.5")	1021.1																	
VERY DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS SLAG AND BRICK FRAGMENTS, DAMP **(FILL)**			14 18 44	91	100	SS-1A	-	21	20	32	17	10	NP	NP	NP	12	A-3a (0)	
@3.5'; CONTAINS BROWN SILTY CLAY LENSE	1018.1	TR				SS-1B	-	-	-	-	-	-	-	-	-	7	Rock (V)	
SANDSTONE, BROWN BECOMING LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.			16 50/5"	-	27	SS-2	-	-	-	-	-	-	-	-	-	6	Rock (V)	
@7.5' TO 7.7'; BECOMES ORANGISH BROWN, CONTAINS IRON STAINING	1014.1		50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, ORANGISH BROWN WITH LIGHT BROWN AND GRAY, MODERATELY TO HIGHLY WEATHERED, STRONG, MEDIUM TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, FERRIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; RQD 0%, REC 80%.	1008.3	EOB	0		80	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 40 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75
TYPE: ROADWAY
PID: 91710 SFN: 7700370/7700371 (P)
START: 6/25/15 END: 6/25/15

DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.
SAMPLING FIRM / LOGGER: GF / M. HILTY
DRILLING METHOD: 4.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: D-50 TRUCK (RW)
HAMMER: DIEDRICH AUTOMATIC
CALIBRATION DATE: 4/4/15
ENERGY RATIO (%): 80.25

STATION / OFFSET: 224+04, 8' LT.
ALIGNMENT: SR 8 SB
ELEVATION: 1024.3 (MSL) EOB: 8.65 ft.
LAT / LONG: 41.086455, -81.502610

EXPLORATION ID B-005-0-15

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
	1024.3																	
12" ASPHALT (DRILLER'S DESCRIPTION)	1023.3																	
MEDIUM DENSE, BROWN, **SANDY SILT**, SOME GRAVEL AND CLAY, DAMP (FILL)	1021.3	1	5 5 7	16	72	SS-1	-	28	6	15	27	24	NP	NP	NP	14	A-4a (3)	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, SILT AND CLAY, DAMP	1018.3	2 3 4 5	2 1 3	5	78	SS-2	-	21	23	29	- 27 -		NP	NP	NP	15	A-3a (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 6	50/3"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1015.7	EOB 7 8	50/2"	-	57	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 12 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 524+32, 64' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.6 (MSL) EOB: 50.3 ft.
START: 1/21/17 END: 1/21/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086418, -81.502086

EXPLORATION ID B-005-1-16

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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
ASPHALT (8.0") & GRANULAR BASE (8.5")	1036.6																	
	1035.2	1																
DENSE, BROWN AND LIGHT GRAY BECOMING BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, DAMP		2																
		3	38 15 11	38	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
		4																
		5	22 18 15	48	100	SS-2	-	19	8	53	12	8	NP	NP	NP	10	A-3a (0)	
	1029.6	6																
STIFF TO HARD, BROWN AND BLACK BECOMING BROWNISH GRAY AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN TRACE ANTHRACITE COAL FRAGMENTS, DAMP		7																
		8	23 8 7	22	100	SS-3	2.5 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		9																
		10																
		11	11 8 6	21	100	SS-4	1.25 - 1.75	9	10	29	33	19	26	16	10	16	A-4a (3)	
		12																
		13	11 6 7	19	78	SS-5	3.75 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		14																
@15.0' TO 17.0'; BECOMES BLACK AND DARK BROWN, CONTAINS IRON STAINING AND FUEL ODOR		15																
		16	12 20 15	51	100	SS-6	2.0 - 4.5+	7	14	39	28	12	22	16	6	13	A-4a (1)	
	1019.6	17																
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP		18	9 10 5	22	100	SS-7	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	1017.1	19																
MEDIUM DENSE, BROWN, **SANDY SILT**, LITTLE STONE FRAGMENTS, LITTLE CLAY, CONTAINS IRON STAINING, DAMP		20																
@20.0'; NO HP, SAMPLE IS NON COHESIVE		21	9 7 6	19	100	SS-8	-	-	-	-	-	-	-	-	-	16	A-4a (V)	
	1014.6	22																
SANDSTONE, ORANGISH BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		23	32 50/4"	-	100	SS-9	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	1011.3	24																
		25	50/3"	-	67	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		26																
		27																
		28	0		47	NQ2-1											CORE	
		29																

TR

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 524+32, 64' RT.	START: 1/21/17	END: 1/21/17	PG 2 OF 2	B-005-1-16

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
SANDSTONE, BROWN AND ORANGISH BROWN, BECOMES DARK BROWN AND GRAY FROM 38.6' - 39.5', SLIGHTLY TO HIGHLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, TRACE QUARTZITE PEBBLES THROUGHOUT, CONTAINS FEW VUGS FROM 36.5' - 36.8', SLIGHTLY MICACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO SLIGHTLY FRACTURED, OPEN TO TIGHT, BLOCKY/DISTURBED/SEAMY TO INTACT, DISINTEGRATED FROM 25.3' - 26.1', GOOD TO FAIR SURFACE CONDITION; RQD 68%, REC 88%. *(continued)* @37.5'; Qu = 4680 PSI	1006.6	31 32 33 34 35 36 37 38 39 40	85		98	NQ2-2											CORE	
	986.3	EOB 41 42 43 44 45 46 47 48 49 50	85		98	NQ2-3											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 40 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 225+00, 78' LT.	EXPLORATION ID B-005-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1012.5 (MSL) EOB: 25.7 ft.	PAGE 1 OF 1
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086773, -81.502733	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1012.5	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
TOPSOIL (4.0")	1012.2		4 4 5	13	83	SS-1	-	11	21	37	18	13	NP	NP	NP	21	A-3a (0)	
MEDIUM DENSE, DARK GRAY AND DARK BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE CLAY, LITTLE GRAVEL, CONTAIN FEW ROOTS, @0.3' TO 1.5'; CONTAINS SLAG AND CINDERS, WET																		
(FILL)	1009.2		4 5 8	19	67	SS-2A	-	-	-	-	-	-	-	-	-	27	A-3a (V)	
						SS-2B	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
MEDIUM DENSE TO DENSE, BROWN AND LIGHT BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, DRY TO DAMP			18 10 7	25	100	SS-3	-	13	21	49	11	6	NP	NP	NP	4	A-3a (0)	
			9 9 8	25	83	SS-4	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
@10.0' TO 11.5'; BECOMES SOME GRAVEL			9 12 10	32	67	SS-5	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
	1000.0	TR																
SANDSTONE, BROWN TO PINKISH BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.			24 50/3"	-	78	SS-6	-	-	-	-	-	-	-	-	-	3	Rock (V)	
	996.8		34 50/2"	-	75	SS-7	-	-	-	-	-	-	-	-	-	2	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, VERY THIN TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY TO SLIGHTLY FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, GOOD SURFACE CONDITION; RQD 31%, REC 85%.			31		85	NQ2-1											CORE	
@25.2'; Qu = 4111 PSI	986.8	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 525+07, 40' LT.	EXPLORATION ID B-006-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1020.5 (MSL) EOB: 29.0 ft.	PAGE 1 OF 1
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.086712, -81.502336	

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
UNCONTROLLED FILL (BOULDER ASPHALT AND COAL)	1020.5																	
	1018.5																	
MEDIUM DENSE, BLACK, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, AND SLAG, TRACE SILT AND CLAY, DAMP	1015.5		6 9 11	27	72	SS-1	-	19	30	45	- 6 -		NP	NP	NP	11	A-1-b (0)	
MEDIUM DENSE, BROWN, **FINE SAND**, SOME COARSE SAND AND GRAVEL, TRACE SILT AND CLAY, DAMP			8 9 9	24	78	SS-2	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
			7 9 13	29	78	SS-3	-	20	20	52	- 8 -		NP	NP	NP	10	A-3 (0)	
			6 7 8	20	83	SS-4	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
	1007.0																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DAMP			5 6 8	19	78	SS-5	4.50	13	8	11	45	23	36	20	16	24	A-6b (9)	
	1004.0	TR	50/6"	-	83	SS-6	-	-	-	-	-	-	-	-	-	26	A-6b (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1002.0		50/1"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, MODERATELY WEATHERED, SLIGHTLY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 72%, REC 98%. @ 19.0' TO 19.5'; Qu = 5,560 PSI			29		100	NX-1											CORE	
			92		100	NX-2											CORE	
	992.5		67		92	NX-3											CORE	
SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 67%, REC 92%.	991.5	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 21 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 225+38, 92' LT.
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1002.9 (MSL) EOB: 30.2 ft.
START: 1/4/17 END: 1/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086887, -81.502727

EXPLORATION ID: B-006-1-16

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, DARK GRAY, GRAY AND DARK BROWN, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS CINDERS, DAMP **(FILL)**	1002.9	1	6 13 19	47	83	SS-1	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	997.9	5																
STIFF, BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, DAMP		6	11 5 4	13	78	SS-2	1.0 - 1.5	12	26	14	27	21	30	18	12	15	A-6a (3)	
SS-3A RECOVERY TOO LOW FOR HP READING.	992.4	10	9			SS-3A	-	-	-	-	-	-	-	-	-	9	A-6a (V)	
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 11	17 39	82	100	SS-3B	-	-	-	-	-	-	-	-	-	3	Rock (V)	
@15.0' TO 15.2'; BECOMES LIGHT ORANGISH BROWN	987.7	15	50/2"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, FEW VUGS FROM 19.4' - 19.8', BEDDING DISCONTINUITIES: LOW ANGLE, SLIGHTLY FRACTURED TO FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 72%, REC 87%. @16.6'; Qu = 4737 PSI		16	46		63	NQ2-1												CORE	
@25.2'; Qu = 4635 PSI		25	85		98	NQ2-2												CORE	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 225+38, 92' LT.	START: 1/4/17	END: 1/4/17	PG 2 OF 2	B-006-1-16

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
	972.9																	
	972.7	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 50 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 225+54, 49' LT.	EXPLORATION ID B-007-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1001.9 (MSL) EOB: 26.0 ft.	PAGE 1 OF 1
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.086881, -81.502563	

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
UNCONTROLLED FILL (LARGE ROCK AND BOULDER)	1001.9																	
	997.4	4	8 16 12	37	72	SS-1	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		7	5 7 7	19	67	SS-2	-	15	42	35	8	-	NP	NP	NP	9	A-1-b (0)	
	990.9	9	6 8 8	21	67	SS-3	-	32	33	31	4	-	NP	NP	NP	7	A-1-b (0)	
LOOSE, BROWN, **FINE SAND**, AND COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, MOIST		12	3 3 3	8	72	SS-4	-	10	39	42	9	-	NP	NP	NP	7	A-3 (0)	
	987.4	14	8 15 50/5"	-	47	SS-5	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR																
AUGER REFUSAL @ 16'	985.9	16	50/1"	-	-	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, MODERATELY WEATHERED, MODERATELY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 80%, REC 90%.		17	48		48	NX-1											CORE	
@ 18.8' TO 19.2'; Qu = 5,120 PSI		20	85		100	NX-2											CORE	
@ 24.6' TO 25.35'; Qu = 6,200 PSI	975.9	25	94		100	NX-3											CORE	
		EOB 26																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 20 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 226+26, 95' LT.
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 993.7 (MSL) EOB: 37.0 ft.
START: 4/13/17 END: 4/13/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087115, -81.502620

EXPLORATION ID B-007-1-16

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MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
LOOSE TO MEDIUM DENSE, BLACK BECOMING LIGHT BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST	993.7	1	1 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	20	A-1-b (V)	
	987.9	5	3 4 3	10	100	SS-2A	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
LOOSE, GRAY, **SANDY SILT**, TRACE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, MOIST						SS-2B	-	-	-	-	-	-	-	-	-	15	A-4a (V)	
@10.0' TO 11.5'; BECOMES ORANGISH BROWN AND GRAY, CONTAINS IRON STAINING		10	3 2 2	6	56	SS-3	-	5	8	37	40	10	NP	NP	NP	15	A-4a (3)	
	978.2	15	4 4 6	15	100	SS-4A	-	-	-	-	-	-	-	-	-	15	A-4a (V)	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST	975.4					SS-4B	-	38	26	14	16	6	NP	NP	NP	11	A-1-b (0)	
HARD, BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	972.7	20	3 10 50/2"	-	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
SANDSTONE, LIGHT BROWN BECOMING ORANGISH BROWN WITH BROWN, HIGHLY WEATHERED, FINE TO COARSE GRAINED, FRIABLE.	TR	25	50/3"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 226+26, 95' LT.	START: 4/13/17	END: 4/13/17	PG 2 OF 2	B-007-1-16

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
SANDSTONE, LIGHT BROWN BECOMING ORANGISH BROWN WITH BROWN, HIGHLY WEATHERED, FINE TO COARSE GRAINED, FRIABLE. *(continued)*	963.7	31	50/2"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	961.7	32																
@32.0' TO 37.0'; NO RECOVERY, POSSIBLE SANDSTONE		33	0		0	NQ2-1											CORE	
		34																
		35																
		36																
	956.7	EOB 37																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 14.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 60 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+29, 97' LT.	EXPLORATION ID B-007-2-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 960.6 (MSL) EOB: 57.0 ft.	PAGE 1 OF 2
START: 4/6/17 END: 4/6/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087379, -81.502491	

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, DARK BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP	960.6	1	2 4 14	26	44	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
MEDIUM STIFF TO VERY STIFF, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP	955.6	5	4 4 11	22	89	SS-2	3.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
		10	5 6 7	19	89	SS-3	2.5 - 3.75	21	13	19	32	15	19	15	4	10	A-4a (2)	
		15	7 50/3"	-	78	SS-4	0.6 - 1.25	-	-	-	-	-	-	-	-	12	A-4a (V)	
VERY DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, WET	943.1	20	60/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
VERY STIFF, GRAY AND BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP	939.1	25	4 38 50/2"	-	71	SS-6A SS-6B	3.0 - 3.2 -	12 -	11 -	9 -	32 -	36 -	39 -	22 -	17 -	14 12	A-6b (9) Rock (V)	
SHALE, GRAY AND DARK GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE.	935.1	TR																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+29, 97' LT.	START: 4/6/17	END: 4/6/17	PG 2 OF 2	B-007-2-16

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, GRAY AND DARK GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE. *(continued)*	930.6	31	5 50/5"	-	82	SS-7	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		32																
		33																
		34																
		35	49 50/1"	-	86	SS-8	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		36																
	923.6	37																
INTERBEDDED SHALE (76%) AND SILTSTONE (24%), RQD 15%, REC. 77%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 44.8' - 45.1' AND 52.8' - 53.1', MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.		38																	
		39	0		34	NQ2-1											CORE	
		40																
		41																
		42																
		43	7		85	NQ2-2											CORE	
		44																
		45																
		46																
		47																
@49.5'; Qu = 9344 PSI (SILTSTONE)		48	35		95	NQ2-3											CORE	
		49																
		50																
		51																
		52																
		53	16		93	NQ2-4											CORE	
		54																
		55																
		56																
	903.6	EOB 57																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 60 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:42 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 227+43, 33' LT.	EXPLORATION ID B-008-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 960.3 (MSL) EOB: 52.0 ft.	PAGE 1 OF 2
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.087352, -81.502255	

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 AND STONE FRAGMENTS WITH SAND**, DRY	960.3	1	10 12 16	37	100	SS-1	-	31	21	40	- 8 -		NP	NP	NP	4	A-1-b (0)	
		2																
		3																
		4	12 12 7	25	83	SS-2	2.50	10	5	10	42	33	44	19	25	16	A-7-6 (15)	
VERY STIFF, GRAY, **CLAY**, SOME GRAVEL, DRY	955.7	5																
	954.3	6	50/6"	-	50	SS-3	-	-	-	-	-	-	-	-	-	-	A-2-7 (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, (WEATHERED SHALE), DRY		7																
		8																
		9	0		13	NX-1											CORE	
		10																
		11	0		58	NX-2											CORE	
@ 12.0'; SILTSTONE BOULDER		12																
		13	0		25	NX-3											CORE	
		14																
		15																
		16																
		17	0		25	NX-4											CORE	
		18																
STARTING @ 18.3'; MANY SANDSTONE COBBLES AND GRAVEL		19	0		25	NX-5											CORE	
		20																
		21																
		22																
		23																
		24																
		25																
		26																
		27																
		28																
	931.3	29 TR	0		42	NX-6											CORE	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+43, 33' LT.	START: 6/25/15	END: 6/25/15	PG 2 OF 2	B-008-0-15

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, GRAY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY FINE GRAINED, LAMINATED; RQD 45%, REC 100%. *(continued)*	930.3	31	0		100	NX-7											CORE	
		32																
		33																
		34	17		100	NX-8											CORE	
		35																
		36																
		37																
		38																
		39	62		100	NX-9											CORE	
		40																
		41																
		42																
		43																
		44	62		100	NX-10											CORE	
@44.7' TO 45.5'; Qu = 5,130 PSI		45																
		46																
		47																
		48																
		49	68		100	NX-11											CORE	
		50																
		51																
	908.3	EOB 52																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 88 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 18:02 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 227+64, 24' LT.	EXPLORATION ID B-008-1-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 958.3 (MSL) EOB: 68.0 ft.	PAGE 1 OF 3
START: 6/24/19 END: 6/25/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087395, -81.502198	

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, BLACK, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WITH WOOD FRAGMENTS, MOIST	958.3																	
		1																
		2	9 19 28	70	78	SS-1	-	41	19	23	13	4	NP	NP	NP	29	A-1-b (0)	
	954.8	3																
HARD, GRAY, **SILT AND CLAY**, "AND" STONE FRAGMENTS, LITTLE SAND, WITH WOOD FRAGMENTS, (NOT ENOUGH MATERIAL TO TEST), DAMP		4	9 9 11	30	33	SS-2	4.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
		5																
		6																
		7	8 10 14	36	33	SS-3	4.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
		8																
@8.5'; STIFF		9	6 9 11	30	22	SS-4	1.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
		10																
@11.0'; VERY STIFF		11																
		12	7 8 11	28	17	SS-5	2.00	-	-	-	-	-	-	-	-	8	A-6a (V)	
	944.8	13																
MEDIUM DENSE TO DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, MOIST		14	10 10 11	31	78	SS-6	-	34	14	19	21	12	NP	NP	NP	16	A-2-4 (0)	
		15																
		16																
@16.0'; WITH WOOD FRAGMENTS		17	7 7 7	21	17	SS-7	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	939.8	18																
MEDIUM DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS BOULDERS, WET		19	3 5 6	16	56	SS-8	-	22	44	15	13	6	18	14	4	17	A-1-b (0)	
W 938.4		20																
		21																
		22	11 16 24	59	33	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		23																
		24	60	-	100	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	933.0	25																
TR		26	0		83	NQ2-1											CORE	
		27																
		28																
		29																

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
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 97%; **SHALE**, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10". *(continued)*	928.3	31	0		90	NQ2-2											CORE	
		32																
		33																
		34																
		35	30		97	NQ2-3											CORE	
		36																
		37																
		38																
		39																
@39.3' - 40.3'; SHALE Sc = 1719 psi		40	18		100	NQ2-4											CORE	
@40.6' - 41.2'; HIGH ANGLE FRACTURE @41.2' - 41.6'; SANDSTONE γ = 160 pcf; Qu = 2,800 psi		41																
		42																
		43																
		44																
@44.8' - 47.3'; SANDSTONE @45.4'; VERY THIN CLAY SEAM		45	70		97	NQ2-5											CORE	
		46																
@46.6' - 47.0'; SANDSTONE γ = 161 pcf; Qu = 6,090 psi @47.4' - 47.7'; SHALE γ = 161 pcf; Qu = 808 psi		47																
		48																
@48.3' - 50.1'; SHALE Sc = 1642 psi		49																
		50	52		95	NQ2-6											CORE	
@51.2' - 52.2'; HIGH ANGLE FRACTURE		51																
		52																
@52.4' - 53.4'; HIGH ANGLE FRACTURE		53																
		54																
@54.2' - 54.6'; SANDSTONE γ = 159 pcf; Qu = 6,320 ps @54.7' - 55.1'; SANDSTONE γ = 159 pcf; Qu = 5,450 psi		55	68		95	NQ2-7											CORE	
		56																
		57																
		58																
@58.1' - 58.5'; SHALE γ = 160 pcf; Qu = 1,379 psi @58.6' - 59.1'; HIGH ANGLE FRACTURE @59.5' - 59.9'; SHALE γ = 161 pcf; Qu = 1,587 psi		59																
		60	77		97	NQ2-8											CORE	
		61																

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 227+64, 24' LT.	START: 6/24/19	END: 6/25/19	PG 3 OF 3	B-008-1-19

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
@61.9'; VERY THIN CLAY SEAM **INTERBEDDED SHALE (70%) AND SANDSTONE (30%)**, RQD 45%, REC. 97%; **SHALE**, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10". *(continued)*	896.2 890.3	63 64 65 66 67 EOB 68	75		93	NQ2-9										CORE	

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 2 BAGS BENTONITE GROUT; TREMIED 3 BAGS CEMENT; TREMIED 120 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 527+57, 13' RT.	EXPLORATION ID B-009-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 968.9 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.087297, -81.501823	

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, **FINE SAND**, SOME COARSE SAND, TRACE SILT CLAY AND GRAVEL, DRY	968.9	1	11 21 50/4"	-	69	SS-1	-	5	33	57	- 5 -		NP	NP	NP	4	A-3 (0)	
	966.4	2																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	965.3	TR 3																
SANDSTONE, REDDISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC, BEDDING SLIGHTLY FRACTURED TO FRACTURED; RQD 62%, REC 85%.		4	50/1"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		5																
		6	50		83	NX-1											CORE	
@ 8.2' TO 8.9'; Qu = 3,440 PSI		7																
		8																
		9	65		87	NX-2											CORE	
		10																
		11																
@ 12.0' TO 15.4'; IRON STAINING		12																
		13																
		14	68		88	NX-3											CORE	
		15																
		16																
	950.4	17																
		18																
CLAYSTONE, GRAY, HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, SOME QUARTZ ROCK FRAGMENTS; RQD 52%, REC 67%.	948.3	19	52		67	NX-4											CORE	
		20																
SHALE, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 40%, REC 98%.		21																
		22																
		23	12		92	NX-5											CORE	
		24																
		25																
		26																
		27																
		28	10		100	NX-6											CORE	
		29																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 527+57, 13' RT.	START: 6/25/15	END: 6/25/15	PG 2 OF 2	B-009-0-15

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, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 40%, REC 98%. *(continued)* @ 31.4' TO 31.9'; Qu = 4,770 PSI	938.9	31																
		32																
		33	37		97	NX-7											CORE	
		34																
		35																
		36																
		37																
		38	57		100	NX-8											CORE	
		39																
		40																
		41																
		42																
		43	67		100	NX-9											CORE	
		44																
	923.9	EOB 45																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 83 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+80, 6' LT.	EXPLORATION ID B-009-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 957.7 (MSL) EOB: 77.5 ft.	PAGE 1 OF 3
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087417, -81.502115	

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, BROWN, DARK GRAYISH BLACK, AND REDDISH BROWN, **SANDY SILT**, SOME GRAVEL (SANDSTONE FRAGMENTS), TRACE CLAY, CONTAINS FEW ROOT HAIRS AND TRACE COAL FRAGMENTS, DAMP NO HP SAMPLE FELL APART **(FILL)**	957.7	1	5 11 4	22	50	SS-1	-	-	-	-	-	-	-	-	-	14	A-4a (V)	
	955.7	2																
		3	12 14 10	35	72	SS-2	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
DENSE, BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT , TRACE TO LITTLE CLAY, LITTLE GRAVEL, DAMP **(FILL)**	953.2	4																
		5	2 6 7	19	100	SS-3	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
VERY STIFF TO HARD, GRAY WITH ORANGISH BROWN AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		6																
		7																
		8	2 3 4	10	44	SS-4	2.6 - 3.5	18	14	18	30	20	23	15	8	11	A-4a (3)	
		9																
@10.0' to 17.0'; BECOMES SOME GRAVEL		10																
		11	3 5 6	16	56	SS-5	3.1 - 4.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
		12																
@12.5' to 17.0'; BECOMES GRAY		13	2 5 6	16	50	SS-6	2.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		14																
		15																
		16	3 4 12	23	78	SS-7	3.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	940.7	17																
MEDIUM DENSE, ORANGISH BROWN BECOMING BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, 17.5' TO 21.5' CONTAINS 1.0" TO 1.5" SILTY CLAY LENSES, MOIST TO WET		18	5 7 5	18	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		19																
		20	3 4 6	15	89	SS-9	-	51	16	10	14	9	NP	NP	NP	15	A-1-b (0)	
W 935.7		21																
		22																
		23	9 7 10	25	50	SS-10	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		24																
		25	9			SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	931.7	26	20 50/5"	-	82	SS-11	-	-	-	-	-	-	-	-	-	11	Rock (V)	
TR																		
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK, FRAGMENTED.		27																
		28	15 50/4"	-	100	SS-12	-	-	-	-	-	-	-	-	-	9	Rock (V)	
		29																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 2 OF 3	B-009-1-16

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, GRAY, HIGHLY WEATHERED, VERY WEAK, FRAGMENTED. *(continued)*	927.7	31	50/3"	-	78	SS-13	-	-	-	-	-	-	-	-	-	14	Rock (V)	
		35	50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
	920.7	37																
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.		37	13		38	NQ2-1												CORE	
		41	16		92	NQ2-2												CORE
@47.7'; Qu = 18462 PSI (SILTSTONE)		47	36		99	NQ2-3												CORE
		51	30		100	NQ2-4												CORE
		57	7		78	NQ2-5												CORE
		61																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 3 OF 3	B-009-1-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS. *(continued)* @62.4'; Qu = 9789 PSI (SILTSTONE)	895.6	63 64 65	39		97	NQ2-6												CORE	
		66 67 68 69	49		100	NQ2-7												CORE	
		70 71 72 73 74	46		98	NQ2-8												CORE	
		75 76 77	15		83	NQ2-9												CORE	
	880.2	EOB																	

NOTES: GROUNDWATER ENCOUNTERED AT 22.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 65 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 228+74, 105' LT.	EXPLORATION ID B-009-2-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 949.2 (MSL) EOB: 41.5 ft.	PAGE 1 OF 2
START: 4/10/17 END: 4/10/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087759, -81.502323	

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 LOOSE, DARK BROWN AND BLACK, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAINS WOOD FRAGMENTS AND ROOTS, WET	949.2	1	WOH 1 2	4	44	SS-1	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
	945.9	2																
LOOSE, BROWN BECOMING BLACK, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, MOIST TO WET @5.0' TO 6.5'; IRON STAINING		3																
		4	4 3 2	7	100	SS-2	-	15	21	36	20	8	NP	NP	NP	13	A-3a (0)	
		5																
		6																
		7																
		8																
		9																
		10	3 1 3	6	11	SS-3	-	-	-	-	-	-	-	-	-	21	A-3a (V)	
	935.9	11																
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, CONTAINS IRON STAINING, WET		12																
		13																
		14																
		15	5 5 6	16	100	SS-4	-	3	8	20	55	14	NP	NP	NP	23	A-4b (7)	
	930.9	16																
STIFF TO VERY STIFF, GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL AND STONE FRAGMENTS, DAMP		17																
		18																
		19																
		20	5 7 7	21	11	SS-5	1.75 - 3.75	-	-	-	-	-	-	-	-	13	A-4a (V)	
	925.9	21																
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		22																
		23																
		24																
		25	4 12 11	34	100	SS-6	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		26																
		27																
		28																
		29																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 228+74, 105' LT.	START: 4/10/17	END: 4/10/17	PG 2 OF 2	B-009-2-16

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, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)* @30.0' TO 41.5'; GRAY	919.2	31	4 6 11	25	89	SS-7	-	40	14	23	16	7	NP	NP	NP	9	A-1-b (0)	
		32																
		33																
		34																
		35																
		36	7 12 11	34	56	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		37																
		38																
		39																
		40																
	907.7	41	3 6 6	18	50	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 15.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 65 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 229+64, 106' LT.	EXPLORATION ID B-009-3-16	
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB		
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 910.8 (MSL) EOB: 36.5 ft.	PAGE 1 OF 2	
START: 4/11/17 END: 4/11/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087988, -81.502206		

MATERIAL DESCRIPTION AND NOTES	ELEV. 910.8	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
LOOSE, ORANGISH BROWN AND BLACK, **FINE SAND**, LITTLE COARSE SAND, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING AND ROOT HAIRS, MOIST	907.5	1	1 3 2	7	100	SS-1	-	-	-	-	-	-	-	-	-	17	A-3 (V)	
MEDIUM DENSE, ORANGISH BROWN AND BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE TO LITTLE CLAY, CONTAINS ANTHRACITE COAL FRAGMENTS AND IRON STAINING, MOIST	902.5	5	4 5 4	13	89	SS-2	-	-	-	-	-	-	-	-	-	15	A-2-4 (V)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE GRAVEL, WET		10	4 3 4	10	100	SS-3	-	1	1	64	24	10	NP	NP	NP	21	A-3a (0)	
@15.0' TO 16.5'; IRON STAINING	892.5	15	3 4 5	13	89	SS-4	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN BECOMING GRAY AND ORANGISH BROWN, **SANDY SILT**, LITTLE GRAVEL AND STONE FRAGMENTS, TRACE TO LITTLE CLAY, CONTAINS IRON STAINING, DAMP TO MOIST		20	3 4 5	13	89	SS-5	1.25 - 2.25	-	-	-	-	-	-	-	-	21	A-4a (V)	
@25.0'; 1.25" ORANGISH BROWN SILT SEAM	882.5	25	2 4 4	12	100	SS-6	2.75 - 4.0	16	14	19	36	15	NP	NP	NP	13	A-4a (3)	
VERY LOOSE, GRAY, **SILT**, TRACE SAND, TRACE CLAY, SAMPLE IS NP, NO HP, DAMP		29																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 229+64, 106' LT.	START: 4/11/17	END: 4/11/17	PG 2 OF 2	B-009-3-16

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
	880.8																	
SHALE, GRAY, SEVERELY WEATHERED.	880.5	TR	3	-	88	SS-7A	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
		31	24 50/4"			SS-7B	-	-	-	-	-	-	-	-	-	13	Rock (V)	
		32																
		33																
		34																
		35																
		36	37 42 50/6"	-	83	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	874.3	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 19.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 57 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 231+15, 100' LT.
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 882.7 (MSL) EOB: 40.2 ft.
START: 2/1/17 END: 2/1/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.088367, -81.501986

EXPLORATION ID: B-009-4-16

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 VERY STIFF, BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, @0.0' TO 1.5'; CONTAIN ROOTS AND BRICK FRAGMENTS, DAMP TO MOIST **(FILL)**	882.7		1 2 7	13	78	SS-1	1.25 - 1.5	-	-	-	-	-	-	-	-	22	A-4a (V)	
			5 6 8	21	100	SS-2	2.25 - 2.75	17	14	30	26	13	19	16	3	13	A-4a (1)	
	872.7																	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL AND STONE FRAGMENTS, DAMP TO MOIST		W 868.7	1 2 3	7	56	SS-3	0.5 - 1.0	-	-	-	-	-	-	-	-	11	A-6b (V)	
	866.4		2 6 50/3"	-	60	SS-4	0.75 - 1.25	-	-	-	-	-	-	-	-	15	A-6b (V)	
VERY DENSE, GRAY, **SILTY CLAY**, (BOULDER ZONE, SHALE), DAMP			6 11 48	87	100	SS-5	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
	857.2	TR	18 50/5"	-	73	SS-6A SS-6B	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	A-6b (V) Rock (V)	
SHALE, GRAY, MODERATELY WEATHERED, EASILY AUGERED.																		

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 231+15, 100' LT.	START: 2/1/17	END: 2/1/17	PG 2 OF 2	B-009-4-16

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
852.7																		
@30.0' to 30.2'; NO RECOVERY	852.5		50/2"	-	0	SS-7	-	-	-	-	-	-	-	-	-	-		
SHALE, GRAY AND DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, LAMINATED TO THIN BEDDED, MODERATELY FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 34.1' - 34.3' AND 36.9' - 37.1', SLIGHTLY TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 94%. @32.3'; Qu = 7964 PSI (SHALE)		31 32 33 34 35 36 37 38 39	75		94	NQ2-1										CORE	
	842.5	EOB 40																

NOTES: GROUNDWATER ENCOUNTERED AT 14.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 45 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 18:02 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 527+89, 29' RT.	EXPLORATION ID B-009-5-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 960.3 (MSL) EOB: 41.5 ft.	PAGE 1 OF 2
START: 6/26/19 END: 7/1/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087362, -81.501727	

MATERIAL DESCRIPTION AND NOTES	ELEV. 960.3	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
BROWN, **SILT AND CLAY**, SOME STONE FRAGMENT, SOME SAND, DAMP	958.8	TR																
SANDSTONE, BROWNISH GRAY AND LIGHT GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, MEDIUM TO COARSE GRAINED. NOTE: AUGERS ADVANCED TO SET CORE BARREL		1	60/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	3	Rock (V)	
@6.0' - 8.5'; FINE TO MEDIUM GRAINED		6	60/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	2	Rock (V)	
	951.8	8	60/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG, MEDIUM TO GRAVEL GRAINED, THIN BEDDED, SLIGHTLY FRIABLE, OCCASSIONAL RUST STAINING, CONTAINS LAYERS OF MEDIUM TO COARSE GRAINED, BLOCKY, GOOD; RQD 75%, REC 100%.		9	-				-	-	-	-	-	-	-	-	-	7		
		10	56		100	NQ2-1											CORE	
@14.9' - 15.3'; γ = 142 pcf; Qu = 4,630 psi		14	78		100	NQ2-2											CORE	
@16.4'; LIGHT GRAY WITH BROWN, MEDIUM TO COARSE GRAINED WITH OCCASIONAL GRAVEL																		
@17.6' - 18.0'; γ = 142 pcf; Qu = 5,110 psi																		
@18.4'; GRAY	941.7	19	40		87	NQ2-3											CORE	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 37%, REC. 90%; **SHALE**, GRAYISH BLACK, HIGHLY TO MODERATELY WEATHERED, VERY WEAK TO WEAK, LAMINATED TO VERY THIN BEDDED, CONTAINS SLIGHTLY ARENACESOUS LAYERS, RANGES IN THICKNESS 0.5" TO 10", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 4". @21.3' - 21.9'; HIGH ANGLE FRACTURE @21.8' - 22.7'; SHALE Sc = 627 psi @22.6' - 24.6'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS @26.1' - 27.8'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS @27.5'; MODERATELY WEATHERED, BLOCKY, GOOD		24	10		75	NQ2-4											CORE	
		29	37		95	NQ2-5											CORE	

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 527+89, 29' RT.	START: 6/26/19	END: 7/1/19	PG 2 OF 2	B-009-5-19

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
@29.6' - 30.6'; HIGH ANGLE FRACTURE **INTERBEDDED SHALE (70%) AND SANDSTONE (30%)**, RQD 37%, REC. 90%; **SHALE**, GRAYISH BLACK, HIGHLY TO MODERATELY WEATHERED, VERY WEAK TO WEAK, LAMINATED TO VERY THIN BEDDED, CONTAINS SLIGHTLY ARENACESOUS LAYERS, RANGES IN THICKNESS 0.5" TO 10", BLOCKY, POOR TO FAIR;	930.3	31 32 33 34	52		98	NQ2-6											CORE	
SANDSTONE, LIGHT GRAY AND BROWNISH GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 4". *(continued)* @30.6'; SLIGHTLY WEATHERED @30.6' - 31.4'; SHALE Sc = 1,184 psi @31.8' - 32.8'; SHALE Sc = 1,286 psi @32.8' - 33.4'; HIGH ANGLE FRACTURE @36.8' - 37.5'; HIGH ANGLE FRACTURE @38.0' - 39.4'; SHALE Sc = 1,028 psi		35 36 37 38 39	72		100	NQ2-7											CORE	
	918.8	EOB 41																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 1 BAG BENTONITE GROUT; TREMIED 1 BAG CEMENT; TREMIED 50 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 18:02 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 230+96, 20' LT.	EXPLORATION ID B-009-6-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / MCINTOSH	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 881.3 (MSL) EOB: 42.5 ft.	PAGE 1 OF 2
START: 6/5/19 END: 6/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088239, -81.501739	

MATERIAL DESCRIPTION AND NOTES	ELEV. 881.3	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
BROWN, **SILT AND CLAY**, CONTAINS COBBLES AND BOULDERS	879.8																	
MEDIUM DENSE, GRAY AND BLACK, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	875.3		6 4 7	15	44	SS-1	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
			4 5 4	12	44	SS-2	-	44	17	25	10	4	NP	NP	NP	16	A-1-b (0)	
DENSE, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGEMENTS, LITTLE CLAY, MODERATELY ORGANIC (LOI=4.1%), WET @8.5'; VERY LOOSE, GRAYISH BROWN, NO ORGANICS	870.3		0 18 24	57	56	SS-3	-	30	8	19	30	13	NP	NP	NP	43	A-4a (2)	
			1 1 2	4	67	SS-4	-	-	-	-	-	-	-	-	-	18	A-4a (V)	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, LITTLE STONE FRAGMENTS, MOIST	867.8	W 868.9	6 6 9	20	67	SS-5	1.00	10	7	26	30	27	29	18	11	20	A-6a (5)	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, DAMP	865.3		10 7 9	22	33	SS-6	4.5+	30	5	8	32	25	27	17	10	14	A-4a (4)	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP	858.9		37 41 40	109	56	SS-7	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
			48 63	-	83	SS-8	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
		TR	0		22	NQ2-1											CORE	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 88%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, VERY WEAK TO WEAK, LAMINATED, SLIGHTLY ARENACEOUS, RANGES IN THICKNESS 0.5" TO 4", BLOCKY, GOOD; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 1.5". @23.2' - 24.2'; SHALE, Sc = 842 psi @24.7' 25.3'; BROKEN, HIGHLY TO MODERATELY WEATHERED WITH CORE LOSS			43		88	NQ2-2											CORE	

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 230+96, 20' LT.	START: 6/5/19	END: 6/6/19	PG 2 OF 2	B-009-6-19

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
	851.3																	
@27.5' - 28.4'; SHALE, Sc = 1,220 psi @30.5' - 30.9'; SANDSTONE γ = 159 pcf; Qu = 6,387 psi	850.4		72		100	NQ2-3											CORE	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, INTACT, VERY GOOD; RQD 100%, REC 100%. @31.0' - 31.4'; SANDSTONE γ = 152 pcf; Qu = 12,996 psi	848.5	31 32 33 34																
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 91%, REC. 100%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 11", BLOCKY, GOOD; **SHALE**, DARK GRAY AND GRAYISH BLACK, SLIGHTLY WEATHERED, WEAK, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5". @35.2' - 35.6'; γ = 160 pcf; Qu = 1,240 psi @35.7' - 36.1'; γ = 161 pcf; Qu = 1,656 psi @39.5' - 39.9'; γ = 161 pcf; Qu = 1,823 psi		35 36 37	92		100	NQ2-4											CORE	
	838.8	38 39 40 41 42 EOB	90		100	NQ2-5											CORE	

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; PLACED 120 IN. TRIM PIPE; TREMIED 30 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 18:02 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 530+84, 30' RT.	EXPLORATION ID B-009-7-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 885.2 (MSL) EOB: 55.0 ft.	PAGE 1 OF 2
START: 6/4/19 END: 6/5/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088116, -81.501328	

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
Topsoil - 5"	885.2																	
LOOSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	884.9		4 3 2	7	56	SS-1	-	35	16	17	19	13	21	16	5	11	A-2-4 (0)	
MEDIUM STIFF, GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP	881.7		2 2 3	7	39	SS-2	0.50	29	12	16	24	19	25	17	8	14	A-4a (2)	
LOOSE, BLACK WITH BROWN, **STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET	879.2		2 2 3	7	39	SS-3	-	59	13	16	8	4	NP	NP	NP	20	A-1-a (0)	
@8.5'; MEDIUM DENSE, CONTAINS COBBLES AND BOULDERS	874.2		2 7 3	14	22	SS-4	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
MEDIUM DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS ROOTS, MODERATELY ORGANIC (LOI=7.5%), WET	871.7	W 872.7	6 6 3	12	50	SS-5	-	48	5	15	12	20	NP	NP	NP	55	A-2-4 (0)	
DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP	869.2		4 12 19	42	11	SS-6	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, DAMP	866.7		11 15 15	41	67	SS-7	3.50	48	7	8	22	15	27	18	9	11	A-4a (0)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS) @ 18.5' - 25.0'; ENCOUNTERED COBBLES AND BOULDERS	860.2		13 39 50	120	72	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
			31 33 33	89	100	SS-9	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
			43 48 60	146	39	SS-10	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP			0		68	SS-11	-	60	3	6	17	14	24	15	9	12	A-2-4 (0)	
						NQ2-1	-	-	-	-	-	-	-	-	-	-	CORE	

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 530+84, 30' RT.	START: 6/4/19	END: 6/5/19	PG 2 OF 2	B-009-7-19

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, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP *(continued)*	855.2																	
	853.2	TR																
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, BLOCKY, GOOD; RQD 79%, REC 100%.		31	43		55	NQ2-2											CORE	
@ 33.7' - 34.1'; SANDSTONE γ = 150 pcf; Qu = 13,112 psi	850.1	32																
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 85%, REC. 99%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 1" TO 6", BLOCKY, GOOD; **SHALE**, DARK GRAY, SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5".		33																
@36.3' - 39.0'; SHALE Sc = 1,753 psi		34																
@36.4' - 36.8'; γ = 163 pcf; Qu = 1,783 psi		35																
@39.0' - 39..2'; MODERATELY WEATHERED		36	90		100	NQ2-3											CORE	
		37																
		38																
		39																
@43.8' - 44.0'; MODERATELY WEATHERED		40																
		41																
		42																
		43	83		100	NQ2-4											CORE	
		44																
		45																
		46																
		47																
@47.7'; VERY THIN CLAY SEAM		48	87		100	NQ2-5											CORE	
		49																
@49.4' - 49.9'; γ = 158 pcf; Qu = 1,985 psi		50																
@50.4' - 50.9'; MODERATELY WEATHERED, WITH LOSS		51																
@51.1' - 51.6'; LIMESTONE, VERY STRONG, THIN BEDDED		52																
@51.1' - 51.6'; LIMESTONE Sc = 28,950 psi		53	80		97	NQ2-6											CORE	
@52.5' - 52.9'; γ = 162 pcf; Qu = 2,012 psi		54																
		55																
@54.7' - 55.0'; LIMESTONE, VERY STRONG, THIN BEDDED	830.2	EOB																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; TREMIED 30 GAL. WATER

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PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 531+07, 13' LT.	EXPLORATION ID B-010-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088190, -81.501356	

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
LOOSE, GRAVEL, DAMP (FILL)	879.2																	
	875.2	4	3 2 2	5	44	SS-1	1.00	10	6	6	40	38	45	21	24	26	A-7-6 (15)	
MEDIUM STIFF, BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL AND SAND, MOIST	874.2	5																
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, CONTAINS SHALE FRAGMENTS, (SEVERELY WEATHERED SHALE), MOIST		6	6 6 7	17	78	SS-2	-	-	-	-	-	-	-	-	-	10	A-6b (V)	
		9	7 7 25	43	67	SS-3	-	5	7	7	53	28	39	19	20	9	A-6b (12)	
		12	13 14 20	45	72	SS-4	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
		14	22 28 30	78	78	SS-5	-	-	-	-	-	-	-	-	-	13	A-6b (V)	
		17	25 28 30	78	100	SS-6	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
	860.7	18																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, (BOULDER ZONE), DAMP		19	26 50/5"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		21	50/4"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	855.7	22	0		33	NX-1											CORE	
TR		24	46		75	NX-2											CORE	
SHALE, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, ARGILLACEOUS; RQD 31%, REC 63%.	852.8	26																
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, INTACT; RQD 63%, REC 98%.		28	63		98	NX-3											CORE	
@ 28.5' TO 29.0'; Qu = 4,380 PSI	850.2	29																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 531+07, 13' LT.	START: 6/26/15	END: 6/26/15	PG 2 OF 2	B-010-0-15

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, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, LAMINATED, ARGILLACEOUS; RQD 94%, REC 100%. *(continued)*	849.2	31																
		32																
		33	94		100	NX-4											CORE	
		34																
		35																
		36																
		37	98		100	NX-5											CORE	
		38																
		39																
		40																
		41																
@ 41.8' TO 42.2'; Qu = 3,840 PSI		42	100		100	NX-6											CORE	
		43																
		44																
	834.2	EOB 45																

NOTES: CAVE @ 14'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 534+14, 19' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 875.0 (MSL) EOB: 45.0 ft.
START: 6/24/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088968, -81.500925

EXPLORATION ID B-010-1-15

PAGE 1 OF 2

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, BROWN, **SILT AND CLAY**, LITTLE SAND AND ROCK FRAGMENT, DAMP	875.0		6 6 9	20	89	SS-1	4.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
			6 6 8	19	56	SS-2	4.00	-	-	-	-	-	-	-	-	26	A-6a (V)	
			7 4 3	9	72	SS-3	4.00	12	4	9	46	29	37	23	14	26	A-6a (9)	
	866.5																	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, SOME CLAY, MOIST TO WET			3 4 4	11	100	SS-4	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
			2 3 3	8	100	SS-5	-	7	48	44	-	1 -	NP	NP	NP	17	A-1-b (0)	
	861.4	W 861.0																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, DAMP			11 17 21	51	83	SS-6	-	43	22	29	-	6 -	NP	NP	NP	9	A-1-b (0)	
	858.7																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, (FILL), DRY			33 50/4"	-	100	SS-7	-	16	39	38	-	7 -	NP	NP	NP	9	A-1-b (0)	
@ 18.0' TO 22.0'; SILTSTONE BOULDER FRAGMENT			0		42	NX-1											CORE	
			0		17	NX-2											CORE	
@ 22.0' TO 25.0'; AUGERED THROUGH WITHOUT SAMPLING.																		
			0		17	NX-3											CORE	
@ 27.0' TO 31.0'; LIMESTONE BOULDER			54		96	NX-4											CORE	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 534+14, 19' RT.	START: 6/24/15	END: 6/26/15	PG 2 OF 2	B-010-1-15

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, GRAY, **GRAVEL AND STONE FRAGMENTS**, (FILL), DRY *(continued)*	845.0	31	40		57	NX-5											CORE	
		34	0		83	NX-6											CORE	
		36	0		22	NX-7											CORE	
	833.6	41 TR																
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 38%, REC. 57%; **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 41.8' TO 42.35'; Qu = 3,440 PSI		42	75		100	NX-8											CORE	
		44	0		13	NX-9											CORE	
	830.0	45 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 90 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 534+13, 15' RT.	EXPLORATION ID B-010-2-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 875.0 (MSL) EOB: 23.6 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088970, -81.500941	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST	875.0		13 15 9	32	72	SS-1	-	8	47	38	7	-	NP	NP	NP	12	A-1-b (0)	
			50/4"	-	100	SS-2	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	869.0																	
VERY STIFF TO HARD, BROWN AND GRAY, **CLAY**, "AND" SILT, LITTLE SAND AND GRAVEL, MOIST TO WET			6 8 4	16	83	SS-3	2.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
			6 11 12	31	83	SS-4	3.00	-	-	-	-	-	-	-	-	30	A-7-6 (V)	
			4 6 7	17	72	SS-5	3.00	-	-	-	-	-	-	-	-	32	A-7-6 (V)	
		W 860.0	6 7 37	59	67	SS-6	4.50	12	2	8	40	38	42	20	22	33	A-7-6 (13)	
			9 11 12	31	72	SS-7	3.50	-	-	-	-	-	-	-	-	33	A-7-6 (V)	
		▼	8 11 11	29	67	SS-8	4.00	-	-	-	-	-	-	-	-	37	A-7-6 (V)	
	853.5		22 50/3"	-	71	SS-9	4.00	-	-	-	-	-	-	-	-	38	A-7-6 (V)	
AUGER REFUSAL IN CLAY STONE BOULDERS	851.4	EOB	50/1"	-	-	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: CAVE @ 16; ADD WATER @ 22'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47.2 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 231+23, 36' LT.	EXPLORATION ID B-011-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 50.0 ft.	PAGE 1 OF 2
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089047, -81.501288	

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
UNCONTROLLED FILL (ROCK AND BOULDERS)	879.2																	
	877.2																	
MEDIUM STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND AND GRAVEL, MOIST TO WET			2 3 31	45	72	SS-1	1.00	14	7	12	36	31	41	20	21	36	A-7-6 (11)	
	873.7																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK AND GRAVEL, WET @ 6.0' TO 7.0'; HARSH PETROLEUM SMELL			2 3 2	7	78	SS-2	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
			5 7 6	17	67	SS-3	1.25	14	7	19	33	27	35	24	11	29	A-6a (5)	
	868.2																	
VERY DENSE, GRAY, **SILT AND CLAY**, (BOULDER ZONE, SHALE), DAMP			11 13 23	48	72	SS-4	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
			15 9 13	29	78	SS-5	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
	862.7	TR	42 50/6"	-	83	SS-6A	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
						SS-6B	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.			38 50/6"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	855.5																	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 26.3' TO 26.9'; Qu = 3,840 PSI (SANDSTONE)			50/3"	-	-	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			96		100	NX-1											CORE	
			93		97	NX-2											CORE	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 231+23, 36' LT.	START: 6/26/15	END: 6/26/15	PG 2 OF 2	B-011-0-15

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
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. *(continued)*	849.2	31																
		32																
		33																
		34	93		100	NX-3											CORE	
		35																
		36																
		37																
		38																
		39	98		98	NX-4											CORE	
		40																
		41																
		42																
		43																
		44	100		100	NX-5											CORE	
		45																
		46																
		47																
@ 47.2' TO 47.8'; Qu = 3,910 PSI (SHALE)		48																
		49	100		100	NX-6											CORE	
	829.2	EOB 50																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 50 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 234+16, 13' LT.	EXPLORATION ID B-011-1-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 875.1 (MSL) EOB: 5.2 ft.	PAGE 1 OF 1
START: 6/24/15 END: 6/24/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089035, -81.501286	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	875.1	1	8															
		2	14 14	37	89	SS-1	-	44	13	34	9	-	NP	NP	NP	5	A-1-b (0)	
		3																
	870.1	4	17 15 16	41	50	SS-2	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
@ 5.0' TO 5.2'; AUGER REFUSED UNKNOWN MATERIAL, BORING TERMINATED.	869.9	EOB 5	50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-		

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 533+38, 43' RT.	EXPLORATION ID B-011-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 872.6 (MSL) EOB: 71.0 ft.	PAGE 1 OF 3
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.088750, -81.500946	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.6	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
ASPHALT (4.0") & BASE (7.0")	871.7																	
VERY STIFF TO HARD, GRAYISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**		1 2 3 4	12 11 8	26	100	SS-1	2.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@5.0' TO 6.5'; CHANGES TO MEDIUM STIFF TO VERY STIFF, GREENISH BROWN AND GRAYISH BROWN, CONTAINS CINDERS	865.1	5 6 7	3 2 3	7	100	SS-2	0.75 - 2.75	24	15	21	27	13	24	17	7	15	A-4a (1)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP	862.6	8 9 10	7 5 3	11	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
MEDIUM DENSE, ORANGISH BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST	860.6	11 12	3 4 5	12	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
HARD, GRAYISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	858.1	13 14	15 50/4"	-	80	SS-5	4.0 - 4.25	30	16	16	24	14	25	17	8	11	A-4a (1)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, (SILTSTONE), DAMP	855.1	15 16 17	50/5"	-	80	SS-6	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	853.1	18 19	9 21 50/5"	-	59	SS-7	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTSTONE), WET	850.6	20 21 22	19 7 18	34	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	847.6	23 24 25	6 27 28	75	67	SS-9	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE, SHALE), DAMP	844.6	26 27	39 17 28	61	100	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FISSILE.	843.1	TR 28 29	20 50/4"	-	90	SS-11A SS-11B	- -	- -	- -	- -	- -	- -	- -	- -	- -	12 -	A-2-6 (V) Rock (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+38, 43' RT.	START: 4/3/17	END: 4/4/17	PG 2 OF 3	B-011-2-16

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
SILTSTONE, GRAY, HIGHLY WEATHERED. *(continued)*	842.6	31	50/3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	16	Rock (V)	
	840.8	32																
INTERBEDDED SILTSTONE (54%) AND SHALE (46%), RQD 42%, REC. 100%; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, CONTAINS CLAY SEAMS, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 37.4' - 37.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; **SHALE**, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, FISSILE.		33	38		100	NQ2-1											CORE	
		34																
		35																
		36																
		37	47		100	NQ2-2											CORE	
		38																
		39																
		40																
		41																
	830.6	42																
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. @44.1'; Qu = 3331 PSI (SHALE) @48.1'; Qu = 10278 PSI (SILTSTONE) @52.9'; Qu = 8084 PSI (SILTSTONE)		43	39		99	NQ2-3											CORE	
		44																
		45																
		46																
		47	60		100	NQ2-4											CORE	
		48																
		49																
		50																
		51																
		52	55		100	NQ2-5											CORE	
		53																
		54																
		55																
		56																
		57	73		100	NQ2-6											CORE	
		58																
		59																
		60																
		61																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+38, 43' RT.	START: 4/3/17	END: 4/4/17	PG 3 OF 3	B-011-2-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. *(continued)*	810.5	63 64 65 66	42		100	NQ2-7											CORE	
		67 68 69 70	72		100	NQ2-8											CORE	
	801.6	EOB 71																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 1 BAG ASPHALT PATCH; PUMPED 65 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 533+69, 6' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 873.8 (MSL) EOB: 45.5 ft.
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.088868, -81.501030

EXPLORATION ID B-011-3-16

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
ASPHALT (6.0")	873.8																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW CINDERS, MOIST **(FILL)**	873.3		4 6 10	22	39	SS-1A	2.0 - 4.5+	-	-	-	-	-	-	-	-	19	A-4a (V)	
	872.2					SS-1B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	870.8		3 3 4	9	72	SS-2	1.5 - 3.5	25	13	19	28	15	25	18	7	14	A-4a (2)	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, DAMP **(FILL)**	868.3		2 2 2	5	61	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW CINDERS, DAMP **(FILL)**	865.8		2 2 3	7	72	SS-4	1.1 - 2.75	-	-	-	-	-	-	-	-	14	A-4a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST **(FILL)**	862.8		3 5 9	19	56	SS-5	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS CINDERS, MOIST **(FILL)**	860.8	W 860.8	1 1 14	20	83	SS-6A	-	-	-	-	-	-	-	-	-	29	A-3a (V)	
VERY LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET	859.4					SS-6B	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
MEDIUM DENSE TO VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE AND SHALE), DAMP			13 17 20	50	67	SS-7	-	48	13	14	17	8	21	16	5	10	A-1-b (0)	
			31 50/5"	-	73	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			50/3"	-	67	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	851.3																	
HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP	849.3		18 28 50/5"	-	88	SS-10A	4.3 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST						SS-10B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	846.3																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, CONTAINS 1.0" BY 2.0" COARSE GRAVEL PIECE, MOIST	843.8		36 50/5"	-	82	SS-12	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+69, 6' RT.	START: 4/3/17	END: 4/4/17	PG 2 OF 2	B-011-3-16

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
SILTSTONE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK.	843.8	TR 31 32 33																
		34	50/6"	-	67	SS-13	-	-	-	-	-	-	-	-	-	10	Rock (V)	
	838.3	35																
INTERBEDDED SHALE (57%) AND SILTSTONE (43%), RQD 47%, REC. 99%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, DISINTEGRATED FROM 36.3' - 36.5', GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG, JOINT DISCONTINUITY: HIGH ANGLE FROM 38.8' - 39.0'.		36 37 38 39 40 41 42 43 44 45	47		99	NX-1											CORE	
	828.3	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 13.0' DURING DRILLING, 16.1' AFTER DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 55 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:43 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 234+26, 15' LT.	EXPLORATION ID B-011-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 875.0 (MSL) EOB: 55.0 ft.	PAGE 1 OF 2
START: 3/31/17 END: 4/3/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089076, -81.501281	

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, GRAYISH BROWN AND BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING (STONE FRAGMENTS ARE SILTSTONE), DAMP **(FILL)**	875.0		14 13 14	37	67	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
MEDIUM DENSE, GRAYISH BROWN AND BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**	872.0		6 9 12	28	78	SS-2	-	-	-	-	-	-	-	-	-	12	A-2-4 (V)	
@6.0' TO 7.5'; CHANGES TO VERY DENSE, GRAY AND ORANGISH BROWN	867.0	▼	9 27 38	88	78	SS-3	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		W 864.0	10 13 44	77	61	SS-4	-	51	10	5	21	13	28	19	9	7	A-2-4 (0)	
	862.0		19 22 22	60	89	SS-5	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), DRY	861.0		50/6"	-	67	SS-6	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP	857.0		10 24 50/2"	-	79	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP	854.5		13 22 50/4"	-	94	SS-8	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP	852.5		15 29 50	107	78	SS-9	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP @23.5' TO 24.4'; NO HP, SAMPLE CRUMBLED	849.0		10 50/5"	-	91	SS-10	-	37	17	8	21	17	30	20	10	10	A-4a (1)	
VERY DENSE, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC			20 36 32	92	78	SS-11	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
			31 23 14	50	89	SS-12	-	-	-	-	-	-	-	-	-	16	A-4a (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+26, 15' LT.	START: 3/31/17	END: 4/3/17	PG 2 OF 2	B-011-4-16

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, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC *(continued)*	845.0	31 32 33																
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), MOIST	842.0	34	50/5"	-	80	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, (SILTSTONE COBBLE), DRY	840.0	35 36 37 38 39	0		18	NX-1										1	CORE	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	835.0	40 41 42	26 29 32	83	67	SS-14	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
SHALE, GRAY, SEVERELY WEATHERED.	832.2 TR	43 44	50/3"	-	33	SS-15	-	-	-	-	-	-	-	-	-	14	Rock (V)	
INTERBEDDED SHALE (63%) AND SILTSTONE (37%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO SLICKENSIDED, INTACT TO BLOCKY, GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG. @50.0'; Qu = 2492 PSI (SHALE)	830.0	45 46 47 48 49 50 51 52 53 54	76		98	NX-2											CORE	
	820.0 EOB	55																

NOTES: GROUNDWATER ENCOUNTERED AT 11.0' BEFORE DRILLING ON 4/3/2017, 8.0' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 66 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 234+65, 60' LT.	EXPLORATION ID B-011-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 875.2 (MSL) EOB: 80.0 ft.	PAGE 1 OF 3
START: 4/3/17 END: 4/3/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089221, -81.501383	

MATERIAL DESCRIPTION AND NOTES	ELEV. 875.2	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
DARK BROWN AND BLACK, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	874.2																	
VERY STIFF TO HARD, DARK GRAY AND GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS COAL AND BRICK FRAGMENTS, FEW ROOTS AND MANY WOOD FRAGMENTS, MOIST **(FILL)**	872.2	1	4 7 8	22	100	SS-1	3.9 - 4.5+	-	-	-	-	-	-	-	-	22	A-4a (V)	
STIFF TO VERY STIFF, GRAYISH BROWN MOTTLED WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS DECAYED ROOT, MOIST	869.7	2	1 2 2	6	83	SS-2	1.9 - 2.9	-	-	-	-	-	-	-	-	19	A-4a (V)	
MEDIUM DENSE, GRAY MOTTLED WITH BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW IRON STAINS, WET	867.2	3	5 3 6	13	67	SS-3	-	2	4	24	56	14	NP	NP	NP	25	A-4b (7)	
MEDIUM DENSE, GRAY WITH BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST	865.2	W 867.2	5 5 4	13	78	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL AND STONE FRAGMENTS (SHALE), LITTLE CLAY, DAMP		4	4 14 13	40	44	SS-5	3.9 - 4.5+	31	11	10	36	12	23	18	5	13	A-4a (3)	
@13.5' to 15.0'; BECOMES "AND" GRAVEL AND STONE FRAGMENTS	860.2	5	6 11 12	34	50	SS-6	3.4 - 4.5+	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	857.2	6	11 18 18	54	78	SS-7	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS**, (SHALE), DAMP	854.7	7	11 14 15	43	83	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE CLAY, TRACE SILT, DAMP	852.2	8	14 18 31	73	100	SS-9	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	850.2	9	11 23 38	91	78	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP		10	10 15 19	51	33	SS-11	4.5+	22	17	7	27	27	32	20	12	9	A-6a (5)	
		11	9 15 18	49	78	SS-12	4.5+	-	-	-	-	-	-	-	-	9	A-6a (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 2 OF 3	B-011-5-16

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, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP *(continued)*	845.2	31 32 33																
		34	11 14 25	58	89	SS-13	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
		35 36 37																
SHALE, GRAY, HIGHLY WEATHERED, FRAGMENTED.	837.7	TR 38																
		39	50/3"	-	33	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. @48.7'; Qu = 1384 PSI (SHALE)	835.2	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61	40		99	NQ-1											CORE	
			61		96	NQ-2											CORE	
@54.8'; Qu = 12128 PSI (SILTSTONE)			79		100	NQ-3											CORE	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 3 OF 3	B-011-5-16

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
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. *(continued)*	813.1	63 64 65 66 67 68 69 70	80		98	NQ-4											CORE	
SHALE, DARK GRAY, UNWEATHERED, WEAK TO MODERATELY STRONG, THINLY LAMINATED TO LAMINATED, FISSILE, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, INTACT, GOOD TO VERY GOOD SURFACE CONDITION; RQD 100%, REC 100%.	802.6	71 72 73 74 75 76 77 78 79	97		100	NQ-5											CORE	
	795.2	EOB 80																

NOTES: GROUNDWATER ENCOUNTERED AT 8.0' DURING DRILLING, 11.3' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 54 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 234+91, 174' LT.	EXPLORATION ID B-011-6-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 901.6 (MSL) EOB: 30.0 ft.	PAGE 1 OF 2
START: 4/3/18 END: 4/3/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.089401, -81.501735	

MATERIAL DESCRIPTION AND NOTES	ELEV. 901.6	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
STIFF, BROWN AND GRAY, **SILTY CLAY**, TRACE GRAVEL, MOIST		1	4 4 8	16	94	SS-1	1.50	-	-	-	-	-	-	-	-	21	A-6b (V)	
		2																
		3	3 8 9	23	100	SS-2	1.50	-	-	-	-	-	-	-	-	24	A-6b (V)	
	895.6	4																
STIFF, BROWN AND GRAY, **SILT**, SOME CLAY AND LITTLE SAND, DAMP		5																
	893.6	6	7 9 14	31	100	SS-3	1.75	0	4	8	58	30	23	21	2	18	A-4b (8)	
DENSE, BROWN AND GRAY, **SILT**, LITTLE CLAY AND SAND, TRACE GRAVEL, MOIST		7																
	891.6	8			88	ST-1	NP	0	3	8	77	12	NP	NP	NP	19	A-4b (8)	
VERY STIFF, BROWN AND GRAY, **SILT**, "AND" CLAY, TRACE SAND AND GRAVEL, DAMP		9																
		10																
		11	6 13 18	41	89	SS-4	NI	0	1	5	52	42	28	21	7	16	A-4b (8)	
		12																
		13	6 12 19	41	100	SS-5	NI	-	-	-	-	-	-	-	-	18	A-4b (V)	
		14																
		15																
		16	7 9 8	23	100	SS-6	2.50	-	-	-	-	-	-	-	-	26	A-4b (V)	
	883.1	17																
STIFF, BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, DAMP		18																
	881.6	19	5 10 12	29	100	SS-7	1.50	0	3	14	25	58	28	16	12	16	A-6a (9)	
STIFF, GRAY, **SANDY SILT**, DAMP TO MOIST		20																
		21																
		22	6 7 9	21	100	SS-8	1.25	-	-	-	-	-	-	-	-	16	A-4a (V)	
		23																
		24	5 5 9	19	100	SS-9	1.75	-	-	-	-	-	-	-	-	21	A-4a (V)	
	876.6	25																
STIFF, GRAY, **SILTY CLAY**, MOIST		26																
	874.1	27	4 5 6	15	100	SS-10	2.00	-	-	-	-	-	-	-	-	26	A-6b (V)	
STIFF, GRAY, **SANDY SILT**, TRACE CLAY, MOIST		28																
	872.0	29	9 12 15	36	94	SS-11	1.50	-	-	-	-	-	-	-	-	21	A-4a (V)	
P.S.		EOB				SS-11	-	-	-	-	-	-	-	-	-	19	A-3 (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+91, 174' LT.	START: 4/3/18	END: 4/3/18	PG 2 OF 2	B-011-6-17

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
	871.6																	
DENSE, BROWN, **FINE SAND**, MOIST	871.6																	

NOTES: CAVE IN AT 27.4'. NI - NOT INTACT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 533+54, 26' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 NB
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 872.6 (MSL) EOB: 50.0 ft.
START: 6/28/19 END: 6/28/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.088809, -81.500980

EXPLORATION ID B-011-7-19

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
MOIST ASPHALT (3.0") & BASE (9.0")	872.6																	
	871.6																	
LIGHT BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	871.1	1					-	-	-	-	-	-	-	-	-	-	A-3a (V)	
	870.6	2					-	-	-	-	-	-	-	-	-	-	A-4a (V)	
LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	869.9	3			100		-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
BLACK, **COARSE AND FINE SAND**, BRICK FRAGMENTS, (FILL), MOIST		4					1.00	-	-	-	-	-	-	-	-	-	A-4a (V)	
STIFF, GREY, **SANDY SILT**, SOME CLAY, SOME ROCK FRAGMENTS, COAL FRAGMENTS, (FILL), MOIST @ 5.0'; GREY TO BROWN, LITTLE GRAVEL, TRACE TERRACOTTA PIPE		5																
	863.6	6			100		1.50	-	-	-	-	-	-	-	-	-	A-4a (V)	
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, BRICK FRAGMENTS, LITTLE SILT, TRACE CLAY, (FILL), MOIST TO WET @ 10.0' TO 12.0'; WET		7																
	860.1	8																
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, MOIST TO DAMP		9					-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		10																
@ 15.0'; BROWN AND ORANGE MOTTLING		11			70		-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		12																
		13					-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		14																
		15																
		16																
		17			92		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		18																
		19																
		20																
	851.0	21					-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, (BOULDER ZONE), MOIST TO DAMP @ 21.6'; 5" (DIA.) WELL ROUNDED COBBLE @ 23.5'; "AND" CLAY		22																
		23			88		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		24																
	847.6	25																
HARD, GREY, **SILT AND CLAY**, LITTLE GRAVEL, (BOULDER ZONE), DAMP TO MOIST	846.8						-	-	-	-	-	-	-	-	-	-	A-6a (V)	
GREY, **STONE FRAGMENTS**, SOME SILT, (BOULDER ZONE: SILTSTONE AND SHALE), DRY		26																
		27			92		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	843.9	28																
		TR																
INTERBEDDED SILTSTONE (80%) AND SHALE (20%); **SILTSTONE**, LIGHT GREY, HIGHLY WEATHERED,	842.6	29					-	-	-	-	-	-	-	-	-	-	Rock (V)	

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 533+54, 26' RT.	START: 6/28/19	END: 6/28/19	PG 2 OF 2	B-011-7-19

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
WEAK; **SHALE**, GREY, HIGHLY WEATHERED, WEAK.	842.6	31																
INTERBEDDED SILTSTONE (67%) AND SHALE (33%), RQD 40%, REC. 66%; **SILTSTONE**, LIGHT GREY, UNWEATHERED, MODERATELY STRONG TO STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED TO MODERATELY FRACTURED; **SHALE**, DARK GREY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS. @ 30.6' TO 31.0'; QU = 13,190 PSI (SILTSTONE)	840.1 839.4	32 33 34 35	40		66	NX-1											CORE	
LIMESTONE, LIGHT GREY, UNWEATHERED, VERY STRONG, THIN BEDDED; RQD 40%, REC 66%. @ 32.5' TO 32.9'; QU = 19,920 PSI (LIMESTONE) **INTERBEDDED SHALE (56%) AND SILTSTONE (44%)**, RQD 31%, REC. 85%; **SHALE**, DARK GREY, MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, FRACTURED TO MODERATELY FRACTURED. @ 36.3' TO 37.6'; AVG SC VALUE = 3006 PSI (SHALE AND SILTSTONE) @ 42.9' TO 43.3'; GREY CLAY INFILLING @ 44.1' TO 44.2'; GREY CLAY INFILLING @ 46.0' TO 49.0'; SANDSTONE INTERBEDS		36 37 38 39 40 41 42 43 44 45 46 47 48 49	14		76	NX-2											CORE	
			23		88	NX-3											CORE	
			54		98	NX-4											CORE	
@ 49.0'; 70 DEGREE, HIGH ANGLE FRACTURE @ 49.6' TO 50.0'; HIGHLY FRACTURED, GREY CLAY INFILLING	822.6	EOB 50																

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE PELLETS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 18:02 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 234+36, 19' LT.	EXPLORATION ID B-011-8-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 875.0 (MSL) EOB: 70.0 ft.	PAGE 1 OF 3
START: 6/28/19 END: 7/1/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.089106, -81.501282	

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
	875.0																	
GRAVEL BASE (12") @ 0.6'; "AND" SAND	874.0	1																
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, DRY @ 2.5'; GREY AND BROWN ROCK FRAGMENTS @ 3.0'; SOME VERY STIFF SANDY SILT, LITTLE CLAY	871.0	2 3 4			100		-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP		5					-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
@ 6.3'; COLOR CHANGE TO GREY, BOULDERS		6 7 8 9 10			94		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	859.0	11 12 13 14 15			92		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE), DAMP @ 16.6'; HARD SILT AND CLAY WITH ROCK FRAGMENTS @ 16.9'; ROCK FRAGMENTS, SAND AND SILT; SILTSTONE (BOULDER) @ 17.2'; SILTSTONE (BOULDER) @ 17.6'; SILTSTONE (BOULDER)		16 17 18 19 20			100		-	-	-	-	-	-	-	-	-	A-2-6 (V)	
@ 19.0'; GREY SILT AND CLAY WITH ROCK FRAGMENTS	854.0	21			75		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
GREY, **GRAVEL**, (BOULDER ZONE), MOIST		22 23 24 25			16		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
@ 26.0'; ROCK FRAGMENTS, LITTLE SAND, TRACE SILT AND CLAY, WET @ 26.0' TO 28.4'; WET	847.0	26 27					-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
GREY, **STONE FRAGMENTS WITH SAND AND SILT**, (BOULDER ZONE), WET TO MOIST @ 29.0'; 5" (DIA.) SILTSTONE COBBLE		28 29			100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	

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
GREY, **STONE FRAGMENTS WITH SAND AND SILT**, (BOULDER ZONE), WET TO MOIST *(continued)*	845.0	31			100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
		36			96		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	835.0	TR 40																
SILTSTONE, GREY, HIGHLY WEATHERED, WEAK, VERY THIN BEDDED.		41			100		-	-	-	-	-	-	-	-	-	-	Rock (V)	
		46			96		-	-	-	-	-	-	-	-	-	-	Rock (V)	
	825.7	49																
INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%), RQD 22%, REC. 74.5%; **SHALE**, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. @ 51.9' TO 52.7'; QU = 5,380 PSI (SHALE AND SILTSTONE) @ 54.9'; MECHANICAL BREAK @ 55.0'; VERY WEAK SHALE @ 55.2' TO 55.9'; 8" GREY CLAY @ 55.9' TO 59.6'; MODERATELY STRONG @ 56.4' TO 57.6'; QU = 5,110 PSI (SHALE AND SILTSTONE) @ 59.6'; HIGHLY WEATHERED, VERY WEAK, VERY BLOCKY WITH CLAY INFILLING @ 60.1' TO 61.2'; CLAY INFILLED SHALE, HIGHLY WEATHERED, VERY WEAK, HIGHLY FRACTURED		51	32		74	NX-1											CORE	
		56	30		92	NX-2											CORE	
		61																

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 234+36, 19' LT.	START: 6/28/19	END: 7/1/19	PG 3 OF 3	B-011-8-19

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
@ 61.2' TO 65.0'; FRACTURED TO VERY FRACTURED **INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%)**, RQD 22%, REC. 74.5%;	812.9	63	0		58	NX-3											CORE	
SHALE, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED;		64																
SILTSTONE, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. *(continued)*		65																
@ 65.0' TO 66.1'; SLIGHTLY STRONG		66																
@ 65.1' TO 65.7'; QU = 5140 PSI (SHALE AND SILTSTONE)		67	26		74	NX-4											CORE	
@ 66.1' TO 69.6'; WEAK, HIGHLY FRACTURED.		68																
@ 69.6' TO 69.9'; VERY STRONG		69																
	805.0	EOB 70																

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 6 BAGS BENTONITE PELLETS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 535+57, 13' RT.	EXPLORATION ID B-012-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 880.2 (MSL) EOB: 45.9 ft.	PAGE 1 OF 2
START: 6/16/15 END: 6/16/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.58	LAT / LONG: 41.089338, -81.500755	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY TO DAMP	880.2	1	4 6 9	20	17	SS-1	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		2																
		3																
		4	9 9 6	20	83	SS-2	-	41	22	29	-	8 -	NP	NP	NP	6	A-1-b (0)	
@ 6.0'; VERY LOOSE		5																
		6																
		7	3 2 1	4	72	SS-3	-	39	26	28	-	7 -	NP	NP	NP	13	A-1-b (0)	
	870.7	8																
STIFF, GRAY TO BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET TO MOIST		9	6 12 9	28	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		10																
		11																
		12	9 14 10	32	61	SS-5	2.00	6	13	19	33	29	28	21	7	30	A-4a (5)	
	866.7	13																
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.		14	18 23 19	56	67	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		15																
		16																
		17	15 16 15	42	89	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		18																
		19	10 19 22	55	100	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		20																
		21																
	858.3	22	38 50/5"	-	91	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 14%, REC. 90%; **SHALE**, DARK GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, ARGILLACEOUS; **SANDSTONE**, GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE GRAINED, VERY THIN BEDDED.		23	13		92	NX-1												CORE	
		24																
		25																
		26	18		80	NX-2												CORE
		27																
		28																
		29																

TR

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 535+57, 13' RT.	START: 6/16/15	END: 6/16/15	PG 2 OF 2	B-012-0-15

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
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 14%, REC. 90%; **SHALE**, DARK GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, ARGILLACEOUS; **SANDSTONE**, GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE GRAINED, VERY THIN BEDDED. *(continued)*	850.2	31	8		87	NX-3											CORE	
		36	15		100	NX-4											CORE	
INTERBEDDED SHALE (55%) AND SANDSTONE (45%), RQD 33%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, MODERATELY STRONG, VERY FINE GRAINED, LAMINATED TO THIN BEDDED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 41.4' TO 41.8'; Qu = 6,300 PSI	839.3	41	33		100	NX-5											CORE	
	834.3	EOB 45																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 48 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 235+78, 12' LT.	EXPLORATION ID B-013-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 877.6 (MSL) EOB: 61.0 ft.	PAGE 1 OF 2
START: 6/16/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.58	LAT / LONG: 41.089461, -81.501070	

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, BROWN TO GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST TO DAMP	877.6	1	13 8 5	17	39	SS-1	-	43	35	17	- 5 -		NP	NP	NP	8	A-1-b (0)	
		2																
		3																
		4	4 5 6	15	67	SS-2	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		5																
	871.1	6																
MEDIUM STIFF, BROWN TO GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST TO DAMP		7	4 2 3	7	72	SS-3	1.00	-	-	-	-	-	-	-	-	15	A-4a (V)	
		8																
		9	2 3 3	8	78	SS-4	1.00	9	14	18	33	26	25	20	5	27	A-4a (5)	
	866.6	10																
LOOSE TO MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET	W 866.6	11	3 3 4	9	100	SS-5	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		12																
		13																
		14	9 6 10	21	83	SS-6	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
	862.6	15																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET		16	14 12 15	36	83	SS-7	-	45	23	29	- 3 -		NP	NP	NP	18	A-1-b (0)	
		17																
		18																
		19	8 11 11	30	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		20																
		21																
		22	6 12 14	35	83	SS-9	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		23																
		24	6 12 12	32	78	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		25																
		26																
		27	12 18 24	56	89	SS-11	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		28																
		29	14 15 15	40	78	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 235+78, 12' LT.	START: 6/16/15	END: 6/26/15	PG 2 OF 2	B-013-0-15

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
	847.6																	
	846.6																	
HARD, GRAY, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, (FILL), WET		31	18 25 50	101	83	SS-13	4.50	-	-	-	-	-	-	-	-	27	A-4b (V)	
		32																
		33																
		34	14 20 31	68	78	SS-14	4.50	7	13	12	50	18	29	22	7	27	A-4b (7)	
		35																
	841.6	36 TR																
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.		37	23 50/2"	-	75	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		38																
	838.8	39	50/3"	-	100	SS-16	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 66%, REC. 97%; **SHALE**, DARK GRAY, MODERATELY TO HIGHLY WEATHERED, WEAK TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, FINE GRAINED, THIN BEDDED. @ 42.5' TO 42.9'; VERTICAL FRACTURE		40	83		100	NX-1											CORE	
		41																
		42																
		43	45		100	NX-2											CORE	
		44																
		45																
@ 45.6' TO 45.9'; VERTICAL FRACTURE		46																
		47																
		48	63		100	NX-3											CORE	
		49																
		50																
		51																
@ 51.5' TO 52.1'; Qu = 6,740 PSI (SHALE)		52																
		53	58		87	NX-4											CORE	
		54																
		55																
@ 55.3' TO 56.0'; Qu = 5,280 PSI (SANDSTONE)		56																
		57																
		58	92		100	NX-5											CORE	
		59																
		60																
	816.6	61 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 122 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 236+50, 123' LT.	EXPLORATION ID B-013-1-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 909.5 (MSL) EOB: 60.0 ft.	PAGE 1 OF 2
START: 6/24/15 END: 6/24/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089756, -81.501347	

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, DARK BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DRY	909.5	1	5 3 4	9	94	SS-1	4.00	14	2	7	44	33	25	22	3	16	A-4a (8)	
	905.8	2																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	903.5	3	3 3 5	11	83	SS-2	-	48	17	30	- 5 -		NP	NP	NP	18	A-1-b (0)	
VERY STIFF TO HARD, BROWN, **SILT**, SOME CLAY, TRACE SAND AND GRAVEL, DRY		4	4 5 7	16	100	SS-3	3.00	-	-	-	-	-	-	-	-	18	A-4b (V)	
		5	5 7 11	24	100	SS-4	3.00	-	-	-	-	-	-	-	-	16	A-4b (V)	
		6	6 8 16	32	100	SS-5	4.50	5	1	5	53	36	26	21	5	18	A-4b (8)	
	893.7	7	4 4 5	12	100	SS-6	4.50	-	-	-	-	-	-	-	-	17	A-4b (V)	
VERY STIFF TO HARD, BROWN TO GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DRY		8	4 5 7	16	100	SS-7	4.5+	-	-	-	-	-	-	-	-	15	A-4a (V)	
		9	4 5 12	23	100	SS-8	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
		10	8 15 20	47	100	SS-9	4.5+	-	-	-	-	-	-	-	-	18	A-4a (V)	
		11	7 9 11	27	100	SS-10	4.00	7	3	22	34	34	26	22	4	16	A-4a (7)	
		12	8 8 14	29	100	SS-11	3.00	-	-	-	-	-	-	-	-	19	A-4a (V)	
	881.2	13																
DENSE TO VERY DENSE, BROWN TO GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY		14	19 25 34	79	83	SS-12	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 236+50, 123' LT. | START: 6/24/15 | END: 6/24/15 | PG 2 OF 2 | B-013-1-15

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
DENSE TO VERY DENSE, BROWN TO GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY *(continued)*	879.5	31	15 12 15	36	100	SS-13	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		32																
		33																
		34	9 12 15	36	100	SS-14	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		35																
		36																
		37																
		38																
		39	7 8 15	31	89	15	-	41	20	36	-	3 -	NP	NP	NP	5	A-1-b (0)	
		40																
		41																
		42																
	W 866.0	43																
@ 43.5'; WATER		44	8 20 24	59	100	SS-16	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		45																
		46																
		47																
		48																
		49	12 16 23	52	100	SS-17	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
		50																
		51																
		52																
		53																
		54	26 31 36	90	100	SS-18	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
@ 45'; WATER ADDED		55																
		56																
		57																
		58																
	849.5	59	8 15 23	51	89	SS-19	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		EOB 60																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 120 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 536+16, 44' RT.	EXPLORATION ID B-013-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/7/15	ELEVATION: 880.5 (MSL) EOB: 85.0 ft.	PAGE 1 OF 3
START: 3/30/17 END: 3/31/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089458, -81.500570	

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, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW PORCELAIN FRAGMENTS, DAMP **(FILL)**	880.5	1–2	4 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	877.5	3																
VERY LOOSE, DARK BROWN AND BLACK, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS TRACE BLACK ORGANICS, LOI = 1.8% ASH, MOIST **(FILL)**		4–5	1 2 1	4	39	SS-2	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	875.0																	
VERY LOOSE TO LOOSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST **(FILL)** @6.0' TO 7.5'; CONTAINS 2.0" SILTY CLAY SEAM		6–7	2 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
		8																
		9–10	1 1 1	3	39	SS-4	-	-	-	-	-	-	-	-	-	19	A-3a (V)	
	870.0																	
LOOSE TO MEDIUM DENSE, GRAY AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST TO WET		11–12	2 3 3	9	83	SS-5	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		13																
		14–15	6 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		16–17	3 4 4	12	100	SS-7	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		18																
		19–20	3 3 2	7	100	SS-8	-	38	31	12	14	5	NP	NP	NP	17	A-1-b (0)	
	860.0																	
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		21–22	3 5 14	28	100	SS-9	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
	856.8	23																
VERY STIFF TO HARD, GRAY, **SILT AND CLAY**, SOME GRAVEL, SOME SAND, RELIC SHALE STRUCTURE, DAMP		24–25	7 13 15	42	100	SS-10	3.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
		26–27	10 23 27	75	100	SS-11	4.5+	28	16	8	27	21	30	17	13	11	A-6a (4)	
		28																
	851.5	TR 29	20 30 45	112	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 2 OF 3	B-013-2-16

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, GRAY, SEVERELY WEATHERED, VERY WEAK TO WEAK, BECOMES MORE INDURATED WITH DEPTH. *(continued)*	850.5	31																
		32																
		33																
		34	15 34 50/5"	-	100	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		35																
		36																
		37																
		38																
		39	18 20 34	81	100	SS-14	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		40																
		41																
		42																
		43																
	836.8	44	60/3"	-	100	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS.		44	29		100	NQ2-1												CORE	
		45																
		46																
		47	16		77	NQ2-2											CORE	
		48																
		49																
		50																
		51																
		52	29		84	NQ2-3											CORE	
		53																
		54																
		55																
		56																
		57	61		100	NQ2-4											CORE	
		58																
		59																
		60																
		61																

@53.4'; Qu = 683 PSI (SHALE INTERBEDDED WITH SILTSTONE)

@55.8'; Qu = 11709 PSI (SILTSTONE)

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 3 OF 3	B-013-2-16

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
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS. *(continued)* @63.4'; Qu = 942 PSI (SHALE)	818.4	63	79		100	NQ2-5											CORE	
		65	55		100	NQ2-6											CORE	
		70	87		98	NQ2-7											CORE	
		75	95		100	NQ2-8											CORE	
		80	98		100	NQ2-9											CORE	
	795.5	EOB 85																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 85 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 536+52, 6' RT.	EXPLORATION ID B-013-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 56.0 ft.	PAGE 1 OF 2
START: 3/27/17 END: 3/28/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089588, -81.500652	

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, DARK BROWN CHANGING TO BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST **FILL** @1.0' TO 2.5'; CONTAINS CONCRETE AND ANTHRACITE COAL FRAGMENTS	885.5		7 6 6	16	89	SS-1	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	881.6		7			SS-2A	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, DAMP **FILL** @6.0' TO 7.5'; CONTAINS 1.0" GRAY SILTY CLAY SEAM			7 5	16	61	SS-2B	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
			6 11 13	32	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	877.5																	
LOOSE, DARK BROWN CHANGING TO DARK BROWN WITH BLACK AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE TO SOME SILT, TRACE CLAY, STONE FRAGMENTS ARE SANDSTONE, DAMP TO WET **FILL** @8.5' TO 10.0'; CONTAINS TRACE ANTHRACITE COAL FRAGMENTS @11.0' TO 12.5'; CONTAINS TRACE BLACK ROOTS			3 3 4	9	78	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			6 3 3	8	56	SS-5	-	-	-	-	-	-	-	-	-	26	A-1-b (V)	
	872.0																	
MEDIUM STIFF TO STIFF, BLACK AND GRAY, **SILT AND CLAY**, "AND" SAND, ORGANIC, CONTAINS TRACE BLACK ROOTS, LOI = 7.2% ASH, MOIST	870.0	▼ 1 days	3 2 1	4	72	SS-6	0.75 - 1.7	0	6	42	38	14	38	24	14	32	A-6a (5)	
MEDIUM DENSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST	867.5	W 867.5	5 3 5	11	67	SS-7	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, TRACE TO LITTLE SAND, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE SILTSTONE, WET	865.0		9 11 7	24	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-a (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET			20 20 20	54	72	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		W 862.0	20 16 16	43	72	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			12 18 20	51	67	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
@28.5' TO 30.0'; GRAVEL IS ROUNDED TO SUBROUNDED			9 14 14	38	61	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+52, 6' RT.	START: 3/27/17	END: 3/28/17	PG 2 OF 2	B-013-3-16

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, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET *(continued)*	855.5	31 32 33 34 35 36 37 38 39 40 41 42 43	12 22 24	62	67	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			8 43 33	103	72	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
SILTSTONE, GRAY, SEVERLY WEATHERED, MODERATELY ARGILLACEOUS.	842.0	TR 44 45	84/6"	-	33	SS-15	-	-	-	-	-	-	-	-	-	13	Rock (V)	
SILTSTONE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, PYRITIC, MODERATELY ARGILLACEOUS, CONTAINS FEW THIN SHALE SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 47.1' - 47.5', FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD TO VERY GOOD SURFACE CONDITION; RQD 78.4%, REC 99.3%.	839.5	46 47 48	65		92	NX-1											CORE	
INTERBEDDED SHALE (69%) AND SILTSTONE (31%), RQD 26.1%, REC. 77.7%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BECOMES FISSILE AT 53.0', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURES FROM 50.8' - 51.0', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, POOR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG. @51.3'; Qu = 10916 PSI (SILTSTONE)	836.9	49 50 51	11		72	NX-2											CORE	
		52 53 54	52		91	NX-3											CORE	
	829.5	EOB 55 56																

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING, 23.5' BEFORE CORING, 15.0' UPON COMPLETION. CAVE DEPTH 29.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 80 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 236+44, 2' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 85.5 ft.
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089616, -81.500934

EXPLORATION ID B-013-4-16

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 WITH DARK GRAY AND GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, CONTAINS FEW ROOTS, DAMP **(FILL)**	885.5		4 6 5	16	67	SS-1	3.2 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
	883.0																	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST			3 3 2	7	100	SS-2	1.25 - 2.2	-	-	-	-	-	-	-	-	16	A-4a (V)	
	880.0																	
VERY LOOSE TO LOOSE, ORANGISH BROWN BECOMING ORANGISH BROWN WITH LIGHT GRAY, **SILT**, SOME SAND, LITTLE CLAY, LITTLE GRAVEL, MOIST TO WET			1 1 1	3	97	SS-3	-	12	12	12	51	13	NP	NP	NP	17	A-4b (6)	
	875.0		2 2 3	7	100	SS-4	-	-	-	-	-	-	-	-	-	22	A-4b (V)	
VERY LOOSE TO MEDIUM DENSE, YELLOWISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, 11.0' TO 15.0' CONTAINS FEW ROOTS, MOIST TO WET @11.0' TO 17.5'; NO HP, NON PLASTIC			2 1 2	4	100	SS-5	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@13.5' TO 15.0'; BECOMES GRAYISH BROWN WITH ORANGISH BROWN, TRACE CLAY			2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@16.0' TO 17.5'; BECOMES ORANGISH BROWN			3 5 5	15	94	SS-7	-	0	12	47	23	18	NP	NP	NP	23	A-4a (1)	
	867.5	W 867.5																
LOOSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, LITTLE CLAY, WET			3 3 3	9	72	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
	865.0																	
MEDIUM DENSE, GRAY, **SANDY SILT**, TRACE CLAY, WET @21.0' TO 22.5'; NO HP, NON PLASTIC			4 4 6	15	100	SS-9	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
	862.5																	
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP			6 10 7	25	67	SS-10	-	47	11	9	24	9	NP	NP	NP	14	A-2-4 (0)	
	860.0																	
DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST			11 15 15	45	83	SS-11	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			6 11 11	33	83	SS-12	-	37	28	18	13	4	NP	NP	NP	12	A-1-b (0)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 2 OF 3	B-013-4-16

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, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	855.5	31																
		32	10 10 15	37	78	SS-13	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		33																
		34	10 18 18	54	78	SS-14	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		35																
		36																
		37	10 21 15	54	94	SS-15	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		38																
		39	19 19 25	66	83	SS-16	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	844.5	40																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP		41																
		42																
		43																
	841.1	44	17 50/5"	-	100	SS-17	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
INTERBEDDED SHALE (65%) AND SILTSTONE (35%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. @47.8'; Qu = 12151 PSI (SILTSTONE)		TR 45																
		46																
		47																
		48	64		95	NQ-1											CORE	
		49																
		50																
		51																
		52																
		53	70		99	NQ-2											CORE	
		54																
		55																
		56																
		57																
		58																
		59																
		60	62		99	NQ-3											CORE	
		61																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 3 OF 3	B-013-4-16

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
@62.1'; Qu = 11803 PSI (SILTSTONE) **INTERBEDDED SHALE (65%) AND SILTSTONE (35%)**, RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. *(continued)* @68.5'; Qu = 3028 PSI (SHALE)	823.3	63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85	88		99	NQ-4											CORE	
	800.0	EOB	89		100	NQ-5											CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 75 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 236+87, 43' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 913.5 (MSL) EOB: 77.0 ft.
START: 3/29/17 END: 3/30/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089770, -81.501026

EXPLORATION ID B-013-5-16

MATERIAL DESCRIPTION AND NOTES	ELEV. 913.5	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
MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**			4 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
@3.5' TO 5.0'; CHANGES TO VERY LOOSE			2 1 1	3	72	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	908.0																	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE), CONTAINS IRON STAINING, DAMP **(FILL)**	906.0	▼ 1 days	5 5 5	14	61	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
STIFF TO HARD, ORANGISH BROWN BECOMING ORANGISH BROWN MOTTLED WITH GRAY, **SILT**, TRACE SAND, TRACE CLAY, CONTAINS IRON STAINING, WET			3 3 5	11	78	SS-4	1.1 - 2.6	-	-	-	-	-	-	-	-	27	A-4b (V)	
			3 4 8	16	100	SS-5	1.0 - 2.6	0	2	8	80	10	27	24	3	29	A-4b (8)	
			3 7 9	22	89	SS-6	1.25 - 3.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
			2 7 9	22	100	SS-7	2.0 - 3.6	-	-	-	-	-	-	-	-	29	A-4b (V)	
			5 8 11	26	100	SS-8	1.25 - 4.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
			5 6 9	20	89	SS-9	2.0 - 4.5+	-	-	-	-	-	-	-	-	32	A-4b (V)	
			3 5 7	16	100	SS-10	1.75 - 3.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
	888.0																	
MEDIUM STIFF TO VERY STIFF, ORANGISH BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, WET	886.0	W 886.5	3 8 11	26	100	SS-11	0.5 - 3.2	-	-	-	-	-	-	-	-	30	A-6a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET			8 10 11	28	100	SS-12	1.25 - 3.9	-	-	-	-	-	-	-	-	31	A-4b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+87, 43' LT.	START: 3/29/17	END: 3/30/17	PG 2 OF 3	B-013-5-16

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 VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET *(continued)*	883.5																	
@31.0' TO 32.5'; BROWN WITH ORANGISH BROWN AND GRAY, NO HP, NO SOIL PLUG	880.5	31	2 11 11	30	56	SS-13	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE GRAVEL, TRACE CLAY, DAMP	878.0	32																
		33																
		34	6 8 10	24	89	SS-14	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
		35																
MEDIUM STIFF, GRAY, **SILT**, TRACE TO LITTLE SAND, TRACE TO LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, WET		36																
		37	1 2 3	7	83	SS-15	0.5 - 0.8	-	-	-	-	-	-	-	-	39	A-4b (V)	
		38																
@38.5' TO 39.3'; STIFF TO VERY STIFF, ORANGISH BROWN,	874.2	39	5 10 11	28	100	SS-16A	1.8 - 3.5	-	-	-	-	-	-	-	-	33	A-4b (V)	
MEDIUM DENSE, DARK BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP	873.0					SS-16B	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		40																
VERY SOFT TO SOFT, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, WET		41																
@41.0' TO 42.5'; NO HP, NO SOIL PLUG	870.5	42	1 1 1	3	100	SS-17	-	0	0	14	75	11	18	16	2	29	A-4b (8)	
		43																
LOOSE TO MEDIUM DENSE, GRAY, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, TRACE GRAVEL, WET		44	3 3 4	9	100	SS-18	-	-	-	-	-	-	-	-	-	26	A-3 (V)	
W 868.0		45																
		46																
		47	1 2 6	11	89	SS-19	-	-	-	-	-	-	-	-	-	24	A-3 (V)	
	865.5	48																
DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST		49	6 9 14	31	78	SS-20	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
		50																
		51																
		52	13 16 17	45	78	SS-21	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
	860.0	53																
MEDIUM STIFF TO STIFF, GRAY, **SILT**, TRACE SAND, TRACE CLAY, TRACE GRAVEL, WET		54	5 8 10	24	89	SS-22	0.75 - 1.7	-	-	-	-	-	-	-	-	31	A-4b (V)	
		55																
		56																
		57																
	855.0	58																
MEDIUM DENSE TO DENSE, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET		59	6 6 8	19	100	SS-23	-	0	1	19	66	14	NP	NP	NP	25	A-4b (8)	
		60																
		61																

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 236+87, 43' LT. | START: 3/29/17 | END: 3/30/17 | PG 3 OF 3 | B-013-5-16

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, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET *(continued)*	851.4	63																
		64	4 7 19	35	94	SS-24	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
	848.6	65																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTY SHALE AND GRANITE), MOIST		66																
		67																
		68																
		69	12 23 17	54	50	SS-25	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		70																
		71																
@71.0'; ENCOUNTERED GRANITE BOULDER (GLACIAL ERRATIC)	842.0	TR																
INTERBEDDED SILTSTONE (85%) AND SHALE (15%), RQD 20%, REC. 76%; **SILTSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THINLY LAMINATED, MODERATELY ARGILLACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 75.4' - 75.6', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO VERY BLOCKY, DISINTEGRATED FROM 73.9' - 74.8', FAIR TO GOOD SURFACE CONDITION; **SHALE**, GRAY, MODERATELY STRONG, SILTY, PYRITIC. @71.6'; Qu = 9267 PSI (SILTSTONE) @75.0'; Qu = 24283 PSI (SILTSTONE)		72	31		67	NX-1												CORE	
		73																
		74	0		81	NX-2												CORE
		75																
		76	25		81	NX-3												CORE
	836.5	EOB 77																

NOTES: GROUNDWATER ENCOUNTERED AT 45.5' DURING DRILLING, 27.0' BEFORE CORING, 7.5' AFTER DRILLING. CAVE DEPTHS 7.7' AND 70.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 100 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:44 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 238+53, 60' LT.	EXPLORATION ID B-014-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 923.4 (MSL) EOB: 70.0 ft.	PAGE 1 OF 3
START: 7/7/15 END: 7/7/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090211, -81.500864	

MATERIAL DESCRIPTION AND NOTES	ELEV. 923.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM STIFF, BLACK, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP		1	1 2 2	5	72	SS-1	-	10	10	18	39	23	28	21	7	26	A-4a (5)	
	919.4	2																
SOFT, BLACKISH BROWN, **CLAY**, SOME SAND, LITTLE GRAVEL AND SILT, MOIST		3																
	917.4	4	1/12" 1	-	78	SS-2	0.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, MOIST		5																
	914.9	6	7 5 5	13	17	SS-3	-	29	7	36	12	16	NP	NP	NP	29	A-2-4 (0)	
SOFT TO MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST TO WET		7																
		8	7 8 6	19	17	SS-4	0.40	8	7	7	55	23	40	19	21	30	A-6b (12)	
@ 11.0' TO 16.0'; STIFF TO VERY STIFF		9																
		10																
		11	4 7 7	19	83	SS-5	2.25	-	-	-	-	-	-	-	-	34	A-6b (V)	
		12																
		13																
		14	5 6 6	16	78	SS-6	2.00	-	-	-	-	-	-	-	-	35	A-6b (V)	
		15																
		16																
		17	4 4 5	12	89	SS-7	1.00	-	-	-	-	-	-	-	-	33	A-6b (V)	
		18																
		19	4 5 6	15	83	SS-8	0.50	-	-	-	-	-	-	-	-	36	A-6b (V)	
		20																
		21																
		22	4 7 8	20	83	SS-9	0.50	7	7	9	55	22	36	20	16	34	A-6b (10)	
	W 900.4	23																
		24	3 5 6	15	89	SS-10	0.75	-	-	-	-	-	-	-	-	36	A-6b (V)	
		25																
		26																
		27																
		28																
		29	5 9 11	27	94	SS-11	0.50	9	5	9	50	27	37	21	16	37	A-6b (10)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 238+53, 60' LT.	START: 7/7/15	END: 7/7/15	PG 2 OF 3	B-014-0-15

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
SOFT TO MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST TO WET *(continued)*	893.4	31 32 33 34 35 36 37 38 39	9 10 13	31	94	SS-12	0.40	-	-	-	-	-	-	-	-	38	A-6b (V)	
			15 15 18	44	39	SS-13	0.25	-	-	-	-	-	-	-	-	33	A-6b (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET	883.9	40 41 42 43 44 45 46 47 48	11 18 17	47	67	SS-14	-	29	21	44	-	6 -	NP	NP	NP	15	A-1-b (0)	
@ 48.5'; LITTLE SILT AND CLAY		49 50 51 52 53	25 21 25	62	67	SS-15	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET	868.9	54 55 56 57 58 59 60 61	21 18 24	56	67	SS-16	1.50	29	25	19	11	16	NP	NP	NP	37	A-2-4 (0)	
			18 26 33	79	61	SS-17	-	-	-	-	-	-	-	-	-	20	A-2-4 (V)	

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, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET *(continued)*	861.2	63																
		64	21 23 27	67	61	SS-18	-	32	23	10	16	19	NP	NP	NP	21	A-2-4 (0)	
		65																
		66																
		67																
		68																
		69	12 32 42	99	33	SS-19	-	-	-	-	-	-	-	-	-	22	A-2-4 (V)	
	853.4	EOB 70																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 140 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 538+82, 13' RT.	EXPLORATION ID B-015-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 961.2 (MSL) EOB: 95.0 ft.	PAGE 1 OF 4
START: 7/10/15 END: 7/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090167, -81.500322	

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
UNCONTROLLED FILL (ROCK FRAGMENTS)	961.2		7 12 12	32	50	SS-1	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
MEDIUM DENSE, BLACK, RED, GRAY, AND BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY TO DAMP (POSSIBLE FILL)	958.9		9 13 9	30	56	SS-2	-	55	12	29	4	-	NP	NP	NP	8	A-1-b (0)	
			6 9 11	27	94	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST (POSSIBLE FILL)	952.7		6 4 4	11	94	SS-4	0.75	9	11	21	30	29	28	21	7	28	A-4a (5)	
VERY LOOSE TO LOOSE, BLACKISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP (POSSIBLE FILL)	951.2		3 1 2	4	61	SS-5	-	10	22	60	8	-	NP	NP	NP	12	A-3 (0)	
			3 2 3	7	61	SS-6	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
VERY LOOSE TO LOOSE, BROWN, **FINE SAND**, TRACE GRAVEL, COARSE SAND, SILT AND CLAY, DAMP TO WET	945.7		2 2 2	5	56	SS-7	-	5	5	85	5	-	NP	NP	NP	18	A-3 (0)	
		W 942.7	3 2 2	5	50	SS-8	-	-	-	-	-	-	-	-	-	21	A-3 (V)	
	939.0		1 1 2	4	72	SS-9A	-	-	-	-	-	-	-	-	-	30	A-3 (V)	
						SS-9B	0.40	5	5	34	24	32	27	20	7	34	A-4a (4)	
VERY SOFT TO MEDIUM STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET @ 23.5'; BECOMES GRAY. @ 23.5' To 25.5'; Stiff			3 3 3	8	100	SS-10	1.25	-	-	-	-	-	-	-	-	38	A-4a (V)	
	934.2		4 9 8	23	78	SS-11A	0.10	7	8	25	28	32	31	22	9	36	A-4a (5)	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET						SS-11B	0.30	-	-	-	-	-	-	-	-	30	A-6b (V)	
			2 5 7	16	78	SS-12	0.75	4	4	12	54	26	37	20	17	40	A-6b (11)	

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 STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET *(continued)*	931.2	31																
		32																
		33																
		34	3 4 6	13	72	SS-13	0.70	-	-	-	-	-	-	-	-	38	A-6b (V)	
		35																
		36																
		37																
		38																
		39	2 5 5	13	89	SS-14	1.25	-	-	-	-	-	-	-	-	42	A-6b (V)	
		40																
		41																
		42																
		43																
		44	4 5 9	19	89	SS-15	1.00	7	2	9	56	26	38	21	17	44	A-6b (11)	
		45																
		46																
		47																
		48																
		49	5 6 9	20	92	SS-16	0.65	-	-	-	-	-	-	-	-	46	A-6b (V)	
		50																
		51																
		52																
		53																
		54	4 5 9	19	89	SS-17	0.65	-	-	-	-	-	-	-	-	43	A-6b (V)	
		55																
		56																
		57																
		58																
		59	4 6 7	17	78	SS-18	0.25	-	-	-	-	-	-	-	-	41	A-6b (V)	
		60																
		61																

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, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET	899.1 898.7	63																
		64	12 12 13	34	58	SS-19	-	27	6	36	27	4	NP	NP	NP	21	A-2-4 (0)	
		65																
		66																
DENSE, BROWN TO GRAY, **COARSE AND FINE SAND**, SOME SILT, TRACE GRAVEL AND CLAY, WET	894.7	67																
		68																
		69	6 9 18	36	56	SS-20	-	-	-	-	-	-	-	-	-	22	A-3a (V)	
@ 69.7'; BECOMES GRAY.		70																
		71																
		72																
		73																
		74	9 10 15	34	100	SS-21	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
		75																
		76																
		77																
		78																
		79	5 11 14	34	100	SS-22	-	8	28	33	26	5	NP	NP	NP	25	A-3a (0)	
		80																
		81																
		82																
	878.7	83																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		84	15 22 26	64	100	SS-23	-	-	-	-	-	-	-	-	-	38	A-2-4 (V)	
		85																
		86																
		87																
		88																
		89	32 27 34	82	100	SS-24	-	-	-	-	-	-	-	-	-	35	A-2-4 (V)	
		90																
		91																
		92																
		93																
		94	24															

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 538+82, 13' RT.	START: 7/10/15	END: 7/10/15	PG 4 OF 4	B-015-0-15

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
	866.9																	
	866.2	EOB 95	17 16	44	78	SS-25	-	-	-	-	-	-	-	-	-	34	A-2-4 (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 190 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 239+12, 11' LT.	EXPLORATION ID B-015-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/7/15	ELEVATION: 960.3 (MSL) EOB: 115.0 ft.	PAGE 1 OF 4
START: 4/5/17 END: 4/5/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89.7	LAT / LONG: 41.090310, -81.500620	

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
LOOSE, DARK BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, CONTAINS WOOD AND PLASTIC, DAMP **(FILL)** @1.0' TO 3.0'; NO HP, NON PLASTIC	960.3	1	2 2 2	6	39	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
	957.3	2																
UNCONTROLLED FILL, CONTAINING RUBBER TIRE FRAGMENTS, PLASTIC, PAPER, FIBERGLASS, AND WOOD, MOISTURE CONTENT MAY REFLECT INNACCURATE RESULTS DUE TO LACK OF SOIL IN SAMPLES **(FILL)**		3																
		4	4 5 6	16	72	SS-2	-	-	-	-	-	-	-	-	-	103	UCF (V)	
		5																
		6																
		7	4 7 27	51	44	SS-3	-	-	-	-	-	-	-	-	-	19	UCF (V)	
		8																
		9	4 6 28	51	50	SS-4	-	-	-	-	-	-	-	-	-	96	UCF (V)	
		10																
		11																
		12	4 4 5	13	39	SS-5	-	-	-	-	-	-	-	-	-	30	UCF (V)	
		13																
@13.5' TO 15.5' MIXED WITH SANDY SILT		14	3 4 5	13	72	SS-6	-	-	-	-	-	-	-	-	-	20	UCF (V)	
	944.8	15																
LOOSE TO MEDIUM DENSE, ORANGISH BROWN AND BLACK CHANGING TO BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS DECAYED WOOD FRAGMENTS, DAMP TO MOIST **(FILL)** @16.0' TO 17.5'; CONTAINS METAL FRAGMENTS		16																
		17	21 11 6	25	61	SS-7	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
		18																
		19	2 3 3	9	11	SS-8	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
	939.8	20																
LOOSE TO VERY DENSE, BROWN, **FINE SAND**, LITTLE TO SOME COARSE SAND, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, TRACE SILT, TRACE CLAY, DAMP		21																
		22	2 2 2	6	72	SS-9	-	20	23	48	6	3	NP	NP	NP	8	A-3 (0)	
		23																
		24	1 4 6	15	50	SS-10	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
		25																
		26																
@26.0' TO 27.5'; BECOMES BROWN AND BLACK		27	3 5 12	25	83	SS-11	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		28																
@28.5' TO 32.5'; BECOMES ORANGISH BROWN		29	19 22 16	57	83	SS-12	-	-	-	-	-	-	-	-	-	7	A-3 (V)	

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
LOOSE TO VERY DENSE, BROWN, **FINE SAND**, LITTLE TO SOME COARSE SAND, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, TRACE SILT, TRACE CLAY, DAMP *(continued)*	930.3																	
33.5' TO 37.5'; BECOMES BROWN		31	4 4 5	13	83	SS-13	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
		32																
		33																
		34	5 8 9	25	67	SS-14	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
		35																
		36	7 8 10	27	89	SS-15	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
	922.3	37																
MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, CONTAINS A 1.5" GRAVEL PIECE, DAMP		38																
	919.8	39	7 10 10	30	17	SS-16	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, LITTLE COARSE SAND, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP		40																
	917.3	41	4 4 5	13	72	SS-17	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
	W 917.3	42																
MEDIUM DENSE, DARK BROWN AND LIGHT BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET		43																
	914.3	44	4 6 8	21	56	SS-18	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
LOOSE TO MEDIUM DENSE, BROWN, **SILT**, LITTLE TO SOME CLAY, TRACE SAND, MOIST TO WET		45																
		46	3 4 5	13	72	SS-19	-	-	-	-	-	-	-	-	-	31	A-4b (V)	
		47																
		48																
		49	2 4 4	12	100	SS-20	-	0	1	2	83	14	NP	NP	NP	33	A-4b (8)	
		50																
@51.0' TO 85.0'; BECOMES GRAY		51																
		52	3 3 3	9	61	SS-21	-	-	-	-	-	-	-	-	-	29	A-4b (V)	
		53																
		54	2 3 3	9	100	SS-22	-	-	-	-	-	-	-	-	-	28	A-4b (V)	
		55																
		56																
		57																
		58																
		59	4 5 5	15	100	SS-23	-	-	-	-	-	-	-	-	-	25	A-4b (V)	
		60																
		61																

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 239+12, 11' LT.	START: 4/5/17	END: 4/5/17	PG 3 OF 4	B-015-1-16

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
LOOSE TO MEDIUM DENSE, BROWN, **SILT**, LITTLE TO SOME CLAY, TRACE SAND, MOIST TO WET *(continued)*	898.2	63																
		64	1 2 3	7	100	SS-24	-	-	-	-	-	-	-	-	-	31	A-4b (V)	
		65																
		66																
		67																
		68																
		69	1 2 3	7	100	SS-25	-	-	-	-	-	-	-	-	-	33	A-4b (V)	
		70																
		71																
		72																
		73																
		74	1 2 3	7	100	SS-26	-	-	-	-	-	-	-	-	-	33	A-4b (V)	
		75																
		76																
		77																
		78																
		79	4 5 6	16	100	SS-27A	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
						SS-27B	-	-	-	-	-	-	-	-	-	30	A-4b (V)	
		80																
		81																
		82																
		83																
		84	3 7 8	22	100	SS-28	-	-	-	-	-	-	-	-	-	27	A-4b (V)	
		85																
		86																
		87																
		88																
DENSE, GRAY, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, MOIST	873.3	89	4 9 12	31	89	SS-29	-	-	-	-	-	-	-	-	-	20	A-3 (V)	
		90																
		91																
		92																
		93																
	866.3	94	10			SS-30A	-	-	-	-	-	-	-	-	-	15	A-3 (V)	

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 239+12, 11' LT. | START: 4/5/17 | END: 4/5/17 | PG 4 OF 4 | B-015-1-16

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, GRAY, **SILT**, TRACE TO LITTLE CLAY, SOME TO "AND" SAND, SS-30B IS INTERBEDDED WITH CLAY, WET *(continued)*	866.1	95	9 12	31	100	SS-30B	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
		96																
		97																
		98																
		99	5 8 12	30	78	SS-31	-	0	1	39	53	7	NP	NP	NP	21	A-4b (5)	
		100																
		101																
	857.8	102																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST		103																
	854.8	104	28 25 20	67	44	SS-32	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP		105																
		106																
		107																
		108																
		109	18 29 25	81	61	SS-33	2.25 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	848.3	110																
		111																
		112																
		113																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (FINE GRAINED SANDSTONE), MOIST		114	56 45 57	152	39	SS-34	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	845.3	115																
		EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 43.0' DURING DRILLING, 89.5' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 170 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 240+34, 116' LT.	EXPLORATION ID B-015-2-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 993.5 (MSL) EOB: 39.0 ft.	PAGE 1 OF 2
START: 3/28/18 END: 3/28/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.090728, -81.500813	

MATERIAL DESCRIPTION AND NOTES	ELEV. 993.5	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
17" TOPSOIL(DRILLER'S DESCRIPTION)	992.0	1	13 11 4	20	67	SS-1	NP	0	6	72	21	1	NP	NP	NP	3	A-3a (0)	
MEDIUM DENSE, GRAY, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE ORGANICS, DRY TO DAMP (FILL)	990.5	2																
LOOSE TO MEDIUM DENSE, BROWN/BLACK, **FINE SAND**, SOME GARBAGE(SOME SPONGE), LITTLE GRAVEL, MOIST TO WET (FILL)		3																
		4	6 2 4	8	0	SS-2	NR	-	-	-	-	-	-	-	-	-	A-3 (V)	
		5																
		6	10 5 5	13	11	SS-3	NP	-	-	-	-	-	-	-	-	36	A-3 (V)	
	985.0	7																
LOOSE, BROWN/BLUE, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, SOME GARBAGE(SOME PLASTIC), MOIST TO WET (FILL)		8																
	982.5	9	10 5 2	9	6	SS-4	NP	-	-	-	-	-	-	-	-	21	A-2-6 (V)	
MEDIUM DENSE TO DENSE, GRAY/BLUE/BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, SOME GARBAGE (PAPER, FIBERS, GLASS FRAGMENTS, PLASTIC, WOOD FRAGMENTS, AND PETROLEUM ODOR), WET (FILL)		10																
		11	4 6 9	20	0	SS-5	NR	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		12																
		13	16 14 23	50	22	SS-6	NP	-	-	-	-	-	-	-	-	35	A-1-b (V)	
		14																
		15																
		16	7 9 11	27	67	SS-7	NP	52	17	15	15	1	NP	NP	NP	21	A-1-b (0)	
	975.5	17																
STIFF, BLACK, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, SOME GARBAGE (BRICK FRAGMENTS, PLASTIC, WOOD AND ORGANICS), MOIST (FILL) (PETROLEUM ODOR NOTED IN JAR)		18																
		19	10 4 5	12	44	SS-8	1.25	22	15	9	44	10	33	26	7	28	A-4a (4)	
	972.5	20																
DENSE, BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, SOME GARBAGE (FIBERS, PLASTICS, WOOD AND ORGANICS), WET (FILL)		21																
		22	10 11 15	35	17	SS-9	NP	-	-	-	-	-	-	-	-	47	A-1-b (V)	
	970.0	23																
DENSE TO VERY DENSE, BLACK, **FINE SAND**, TRACE SILT, SOME GARBAGE (FIBERS, PLASTICS, WOOD AND ORGANICS), MOIST TO WET (FILL) (PETROLEUM ODOR NOTED IN JAR)		24	32 50/2"	-	0	SS-10	NP	-	-	-	-	-	-	-	-	35	A-3 (V)	
@26'; DENSE, BLACK/BROWN, SOME GRAVEL, (PETROLEUM ODOR NOTED IN JAR)		25																
		26																
		27	9 13 18	41	89	SS-11	NP	-	-	-	-	-	-	-	-	12	A-3 (V)	
	965.0	28																
		29	6 8 6	19	100	SS-12	NP	-	-	-	-	-	-	-	-	8	A-3a (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 240+34, 116' LT.	START: 3/28/18	END: 3/28/18	PG 2 OF 2	B-015-2-17

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, **COARSE AND FINE SAND**, LITTLE GRAVEL, SOME SILT, TRACE CLAY, DAMP TO MOIST (FILL) *(continued)*	963.5																	
@31'; BLACK/GRAY, SOME GARBAGE(WOOD AND PLASTIC), GRAVEL, TRACE CLAY		31	5 4 22	35	100	SS-13	NP	20	23	33	23	1	NP	NP	NP	12	A-3a (0)	
@32.4'; DARK BROWN, TRACE GRAVEL		32																
		33																
		34	6 5 7	16	11	SS-14	NP	-	-	-	-	-	-	-	-	15	A-3a (V)	
		35																
	957.5	36																
VERY DENSE, GRAY/DARK BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE WOOD, MOIST (FILL)		37	11 50/3"	-	11	SS-15	NP	-	-	-	-	-	-	-	-	20	A-1-b (V)	
	955.5	38																
VERY DENSE, BLACK, **FINE SAND**, SOME GARBAGE(WOOD AND PLASTIC), TRACE GRAVEL, MOIST TO WET (FILL) (PETROLEUM ODOR NOTED IN JAR)	954.5	EOB 39	16 50/0"	-	17	SS-16	NP	-	-	-	-	-	-	-	-	26	A-3 (V)	

NOTES: NP - NON PLASTIC. NR - NO RECOVERY

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 241+03, 42' LT.	EXPLORATION ID B-016-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1017.6 (MSL) EOB: 100.0 ft.	PAGE 1 OF 4
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090831, -81.500470	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1017.6	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
MEDIUM DENSE TO DENSE, BROWN AND GRAY AND RED, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY SLAG (FILL)		1	8 12 9	28	61	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		2																
		3																
		4	24 50/5"	-	64	SS-2	-	53	16	27	-	4 -	NP	NP	NP	8	A-1-b (0)	
		5																
@ 6.0'; BRICK FRAGMENTS		6	24 14 8	30	39	SS-3	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
	1009.1	7																
VERY LOOSE TO LOOSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, TRACE SLAG, DRY		8																
		9	2 2 2	5	28	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		10																
		11	1 1 1	3	61	SS-5	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		12																
@ 13.5'; MEDIUM DENSE		13	5 8 9	23	53	SS-6	-	10	54	30	-	6 -	NP	NP	NP	12	A-1-b (0)	
		14																
		15	2 3 4	9	83	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		16																
		17	4 3 3	8	61	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		18																
		19	2 2 2	5	83	SS-9	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		20																
		21	3 3 3	8	67	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		22																
	990.6	23	5 6 5	15	78	SS-11	1.50	8	15	22	27	28	26	23	3	20	A-4a (4)	
STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	988.6	24																
		25																
		26																
		27																
		28																
		29	12 9 8	23	56	SS-12	-	-	-	-	-	-	-	-	-	12	A-3 (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

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, BROWNISH GRAY, **FINE SAND**, SOME GRAVE, LITTLE COARSE SAND, TRACE SILT AND CLAY, DAMP *(continued)*	987.6	31	12 12 17	39	67	SS-13	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		32																
		33																
		34	14 13 18	42	78	SS-14	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		35																
		36	30 20 21	55	72	SS-15	-	29	16	47	8	-	NP	NP	NP	10	A-3 (0)	
		37																
		38																
		39	12 13 20	44	72	SS-16	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		40																
		41																
		42																
		43																
		44	12 13 11	32	78	SS-17	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		45																
		46																
		47																
		48																
MEDIUM DENSE, BROWNISH GRAY, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP	969.6	49	12 11 13	32	83	SS-18	-	11	34	52	3	-	NP	NP	NP	17	A-3 (0)	
		50																
		51																
W 965.6		52																
		53																
VERY STIFF, BROWNISH GRAY, **SILTY CLAY**, SOME GRAVEL, TRACE SAND, MOIST	963.9	54	10 12 14	35	89	SS-19	3.00	-	-	-	-	-	-	-	-	29	A-6b (V)	
		55																
		56																
		57																
		58																
DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST	959.6	59	9 11 12	31	67	SS-20	-	6	44	43	7	-	NP	NP	NP	16	A-1-b (0)	
		60																
		61																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 241+03, 42' LT.	START: 7/6/15	END: 7/6/15	PG 3 OF 4	B-016-0-15

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
	955.5																	
	954.4	63																
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET		64	9 13 12	34	67	SS-21	4.5+	1	27	13	19	40	28	22	6	27	A-4a (5)	
	949.6	65																
MEDIUM STIFF, BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST	948.1	66																
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET		67																
		68																
		69	17 18 22	54	61	SS-22	0.50	8	8	21	36	27	37	20	17	29	A-6b (8)	
		70																
		71																
		72																
		73																
		74	19 22 28	67	61	SS-23	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		75																
		76																
		77																
		78																
		79	10 12 16	38	56	SS-24	-	23	32	39	-	6 -	NP	NP	NP	18	A-1-b (0)	
		80																
		81																
		82																
		83																
		84	10 12 16	38	44	SS-25	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		85																
		86																
		87																
	929.6	88																
SOFT, BROWN, **SANDY SILT**, TRACE GRAVEL, WET		89	4 5 5	13	67	SS-26	0.25	-	-	-	-	-	-	-	-	26	A-4a (V)	
		90																
		91																
		92																
		93																
	924.1	94	9															

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 STIFF TO VERY STIFF, BROWN, **CLAY**, LITTLE SAND, TRACE GRAVEL, WET *(continued)*	923.3	95	10 14	32	89	SS-27	0.75	8	8	11	50	23	39	20	19	37	A-6b (11)	
		96																
		97																
		98																
		99	10 12 16	38	94	SS-28	3.25	7	7	7	52	27	40	20	20	38	A-6b (12)	
	917.6	EOB 100																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 200 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 541+07, 87' RT.	EXPLORATION ID B-017-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1024.4 (MSL) EOB: 70.0 ft.	PAGE 1 OF 3
START: 7/8/15 END: 7/8/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090666, -81.499769	

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
5" TOPSOIL (DRILLER'S DESCRIPTION)	1024.4																	
LOOSE TO MEDIUM DENSE, BROWN AND BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP	1023.9	1	5 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		2																
		3																
		4	2 2 3	7	100	SS-2	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		5																
		6																
		7	2 3 2	7	83	SS-3	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		8																
		9	3 2 3	7	61	SS-4	-	15	41	36	-	8 -	NP	NP	NP	14	A-1-b (0)	
		10																
		11																
		12	2 2 3	7	83	SS-5	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		13																
		14	2 2 3	7	25	SS-6	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
@ 0.5' TO 15.0'; FILL		15																
		16																
		17	3 3 4	9	83	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		18																
		19	3 3 3	8	67	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		20																
		21																
		22	3 4 7	15	72	SS-9	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	1001.4	23																
MEDIUM DENSE TO DENSE, BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, SILT AND CLAY, MOIST		24	7 9 15	32	72	SS-10	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
		25																
		26																
		27	10 11 13	32	94	SS-11	-	-	-	-	-	-	-	-	-	15	A-3 (V)	
		28																
		29	5 4 4	11	89	SS-12	-	7	17	73	-	3 -	NP	NP	NP	17	A-3 (0)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 541+07, 87' RT.	START: 7/8/15	END: 7/8/15	PG 2 OF 3	B-017-0-15

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
MEDIUM DENSE TO DENSE, BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, SILT AND CLAY, MOIST *(continued)*	994.4	31																
	992.9	32	10 20 21	55	78	SS-13	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		33																
		34	14 16 24	54	61	SS-14	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		35																
		36	19 15 18	44	67	SS-15	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	986.4	37																
DENSE, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP		38																
		39	10 11 14	34	78	SS-16	-	12	20	60	- 8 -		NP	NP	NP	15	A-3 (0)	
		40																
		41																
		42																
	980.9	43																
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP		44	12 41 29	94	39	SS-17	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		45																
		46																
		47																
		48																
		49	9 12 12	32	78	SS-18	-	30	36	32	- 2 -		NP	NP	NP	12	A-1-b (0)	
		50																
		51																
		52																
		53																
	969.9	54	12 12 14	35	94	SS-19	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
						SS-20	4.25	11	22	16	28	23	28	22	6	24	A-4a (3)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP		55																
		56																
		57																
	966.4	58																
	W 966.4																	
DENSE, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, WET		59	11 12 16	38	78	SS-21	-	10	22	60	- 8 -		NP	NP	NP	14	A-3 (0)	
		60																
@ 61.0'; BECOMES GRAY.		61																

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, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, WET *(continued)*	962.3	63																
		64	10 12 14	35	89	SS-22	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
		65																
		66																
		67																
	956.4	68																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET	954.4	69	12 20 24	59	83	23	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		EOB 70																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 140 LB. BENTONITE CHIPS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 542+28, 56' RT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.091013, -81.499713

EXPLORATION ID B-017-1-16

PAGE 1 OF 1

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
	1029.2																	
ASPHALT (8.0") & GRANULAR BASE (7.5")	1027.9																	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			8 16 15	46	50	SS-1	-	12	52	29	4	3	NP	NP	NP	9	A-1-b (0)	
	1023.5		9 7 7	21	72	SS-2A	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
VERY STIFF, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS 1/8" GRAY CLAY LENSE, MOIST	1022.2					SS-2B	2.0 - 2.5	5	12	32	31	20	22	14	8	15	A-4a (3)	
LOOSE TO MEDIUM DENSE, BROWN AND DARK BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, DAMP TO MOIST			7 4 5	13	100	SS-3	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			7 3 5	12	100	SS-4	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			2 3 4	10	100	SS-5	-	30	40	25	3	2	NP	NP	NP	6	A-1-b (0)	
@15.0' TO 19.0'; BECOMES DARK BROWN			1 2 4	9	78	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			1 2 3	7	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@20.0' TO 21.5'; BECOME GRAYISH BROWN AND ORANGISH BROWN	1007.2		2 5 6	16	100	SS-8	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
MEDIUM DENSE, BROWNISH GRAY AND ORANGISH BROWN, **COARSE AND FINE SAND**, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP			2 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
	1002.7	EOB	2 5 6	16	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 8.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 244+01, 86' LT.	EXPLORATION ID B-017-2-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1004.0 (MSL) EOB: 100.0 ft.	PAGE 1 OF 4
START: 4/4/18 END: 4/4/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.091624, -81.500238	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1004.0	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
LOOSE TO MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE GRAVEL, TRACE CLAY, MOIST		1	2 1 2	4	61	SS-1	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
		2																
		3	2 3 3	8	89	SS-2	-	2	19	46	32	1	NP	NP	NP	13	A-3a (0)	
		4																
		5	3 4 4	11	61	SS-3	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
		6																
		7	3 6 7	17	72	SS-4	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	994.0	8																
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, DAMP		9																
	991.5	10	5 5 7	16	61	SS-5	-	47	23	17	13	0	NP	NP	NP	9	A-1-b (0)	
MEDIUM DENSE, BROWN AND WHITE, **FINE SAND**, SOME GRAVEL, DAMP		11																
		12	11 9 10	25	67	SS-6	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
		13																
@ SS-7; HIT A GRAVEL		14	10 11 11	29	0	SS-7	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
		15																
		16	4 5 5	13	67	SS-8	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
	983.0	17																
MEDIUM DENSE TO DENSE, BROWN AND WHITE, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE WOOD, DAMP		18	5 6 6	16	61	SS-9	-	42	26	17	15	0	NP	NP	NP	8	A-1-b (0)	
		19																
		20	7 4 4	11	61	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		21																
		22																
		23																
		24																
		25																
		26																
		27																
		28																
		29	15 16 17	44	67	SS-11	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 244+01, 86' LT.	START: 4/4/18	END: 4/4/18	PG 2 OF 4	B-017-2-17

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 AND WHITE, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE WOOD, DAMP *(continued)*	974.0	31 32 33																
	970.5																	
VERY STIFF, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, MOIST TO WET @ 34.3'; SAND SEAM		34 35 36 37 38	5 5 7	16	89	SS-12	4.00	-	-	-	-	-	-	-	-	14	A-4b (V)	
		39 40 41 42 43	5 6 8	19	100	SS-13	2.50	-	-	-	-	-	-	-	-	25	A-4b (V)	
	962.0																	
MEDIUM DENSE, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, MOIST TO WET		44 45 46 47 48	7 9 7	21	89	SS-14	1.25	0	2	31	54	13	NP	NP	NP	24	A-4b (6)	
	957.0																	
VERY STIFF, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, DAMP		49 50 51 52 53	3 8 7	20	67	SS-15	2.00	-	-	-	-	-	-	-	-	9	A-4b (V)	
	954.0																	
MEDIUM DENSE, BROWN, TAN AND WHITE, **FINE SAND**, SOME GRAVEL, DAMP TO MOIST		54 55 56 57 58	4 11 8	25	72	SS-16	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
	949.0																	
VERY STIFF, BROWN, **SANDY SILT**, MOIST		59 60 61	7 11 15	35	100	SS-17	2.00	-	-	-	-	-	-	-	-	23	A-4a (V)	
	944.0																	
MEDIUM STIFF TO STIFF, GRAY, **SILT**, "AND" CLAY, TRACE SAND, MOIST TO WET																		

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 244+01, 86' LT.	START: 4/4/18	END: 4/4/18	PG 3 OF 4	B-017-2-17

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 STIFF TO STIFF, GRAY, **SILT**, "AND" CLAY, TRACE SAND, MOIST TO WET *(continued)*	941.9	63																
		64	4 4 5	12	89	SS-18	1.00	-	-	-	-	-	-	-	-	27	A-4b (V)	
		65																
		66																
		67																
		68																
		69	4 5 4	12	100	SS-19	0.75	0	1	4	58	37	27	25	2	25	A-4b (8)	
		70																
		71																
		72																
		73																
		74	7 9 7	21	100	SS-20	1.00	-	-	-	-	-	-	-	-	23	A-4b (V)	
		75																
		76																
		77																
		78																
		79	4 5 5	13	100	SS-21	1.00	-	-	-	-	-	-	-	-	25	A-4b (V)	
		80																
		81																
		82																
		83																
		84	4 5 6	15	100	SS-22	0.50	-	-	-	-	-	-	-	-	26	A-4b (V)	
		85																
		86																
		87																
		88																
		89	5 5 6	15	100	SS-23	1.00	-	-	-	-	-	-	-	-	22	A-4b (V)	
		90																
		91																
		92																
		93																
		94	5															

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 244+01, 86' LT.	START: 4/4/18	END: 4/4/18	PG 4 OF 4	B-017-2-17

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 STIFF TO STIFF, GRAY, **SILT**, "AND" CLAY, TRACE SAND, MOIST TO WET *(continued)*	909.8	95	6 6	16	100	SS-24	0.75	0	1	1	61	37	27	24	3	30	A-4b (8)	
		96																
		97																
		98																
		99	4 5 8	17	100	SS-25	1.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
	904.0	EOB 100																

NOTES: CAVE IN AT 25.7'; SITE CONDITION RESTRICTS OPERATIONS OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / D. S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 243+13, 97' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1002.9 (MSL) EOB: 25.0 ft.
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.091416, -81.500379

EXPLORATION ID B-018-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1002.9	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
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		1	3 6 5	15	56	SS-1	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		2																
		3																
		4	8 8 11	26	67	SS-2	-	17	49	26	-	8 -	NP	NP	NP	14	A-1-b (0)	
	996.9	5																
DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, SOME CLAY, MOIST		6	2 10 22	43	56	SS-3	-	33	12	20	12	23	NP	NP	NP	18	A-2-4 (0)	
	994.4	7																
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		8																
		9	2 5 5	14	33	SS-4	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		10																
		11	2 7 4	15	67	SS-5	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		12																
		13																
		14	4 4 5	12	78	SS-6	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		15																
		16																
		17	5 3 4	9	78	SS-7	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		18																
		19	3 4 5	12	83	SS-8	-	16	45	30	-	9 -	NP	NP	NP	13	A-1-b (0)	
		20																
		21																
		22	9 6 9	20	89	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		23																
		24	6 9 11	27	-	SS-10	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
	977.9 EOB	25																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / D. S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 243+18, 147' LT.	EXPLORATION ID B-019-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 996.6 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.091478, -81.500542	

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
11" TOPSOIL (DRILLER'S DESCRIPTION)	996.6																	
	995.6																	
LOOSE TO MEDIUM DENSE, BLACK AND BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, SOME CLAY, WITH PLANT FIBERS, WOOD FIBERS, BRICK FRAGMENTS, PLASTIC CLOTH, PAPER, BOTTLE CAP, MOIST TO WET (TRASH FILL)		1	3 50/1"	-	71	SS-1	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
		2																
		3																
		4	2 2 3	7	22	SS-2	-	-	-	-	-	-	-	-	-	23	A-2-4 (V)	
		5																
		6	3 4 7	15	28	SS-3	-	-	-	-	-	-	-	-	-	20	A-2-4 (V)	
		7																
		8	8 8 8	22	39	SS-4	-	29	14	25	8	24	NP	NP	NP	21	A-2-4 (0)	
		9																
		10																
		11	3 3 6	12	44	SS-5	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
		12																
		13																
		14																
		15																
		16																
		17																
		18																
		19	9 3 4	9	39	SS-6	-	-	-	-	-	-	-	-	-	15	A-2-4 (V)	
		20																
		21																
		22																
		23																
		24	5 9 11	27	56	SS-7	-	-	-	-	-	-	-	-	-	24	A-2-4 (V)	
	971.6	EOB 25																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / D. S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 244+04, 11' LT.	EXPLORATION ID B-020-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1015.3 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.091569, -81.499977	

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
6" TOPSOIL (DRILLER'S DESCRIPTION)	1015.3																	
VERY LOOSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST	1014.8	1																
		2	WOH	-	0		-	-	-	-	-	-	-	-	-	-		
		3																
		4	1 2 1	4	56	SS-1	-	9	53	31	-	7 -	NP	NP	NP	14	A-1-b (0)	
	1009.3	5																
STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET		6	5 6 5	15	100	SS-2	2.00	5	7	30	28	30	26	21	5	27	A-4a (5)	
	1006.8	7																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		8																
		9	6 5 6	15	100	SS-3	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		10																
		11																
		12	3 4 7	15	100	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		13																
		14	2 2 6	11	100	SS-5	-	9	45	37	-	9 -	NP	NP	NP	15	A-1-b (0)	
	1000.3	15 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 544+04, 52' RT.	EXPLORATION ID B-020-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.091487, -81.499523	

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
ASPHALT (8.0") & GRANULAR BASE (6.5")	1029.2																	
	1028.0																	
STIFF TO VERY STIFF, BROWN AND GRAY BECOMING BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST		1																
		2																
		3	13 7 6	19	56	SS-1	1.0 - 2.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
		4																
		5	5 3 4	10	89	SS-2	1.0 - 2.25	-	-	-	-	-	-	-	-	15	A-4a (V)	
		6																
@7.5' TO 13.3'; CONTAINS IRON STAINING		7																
		8	5 3 3	9	100	SS-3	1.0 - 2.25	7	9	26	34	24	27	17	10	16	A-4a (5)	
		9																
		10	3 2 3	7	100	SS-4	1.0 - 1.75	-	-	-	-	-	-	-	-	17	A-4a (V)	
		11																
		12																
	1015.9	13	3 3 5	12	100	SS-5A	1.25 - 2.25	-	-	-	-	-	-	-	-	16	A-4a (V)	
						SS-5B	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, 13.3' TO 16.5'; CONTAINS IRON STAINING, DAMP		14																
		15																
		16	2 3 4	10	100	SS-6	-	19	34	39	3	5	NP	NP	NP	7	A-1-b (0)	
		17																
@17.5' TO 19.0'; BECOMES BROWN AND DARK BROWN		18	6 3 2	7	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
	1009.7	19																
LOOSE TO MEDIUM DENSE, BROWN AND LIGHT BROWN, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE GRAVEL, DAMP		20																
		21	4 4 5	13	100	SS-8	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		22																
@22.5' TO 26.5'; BECOME TRACE SILT, DRY		23	2 1 3	6	100	SS-9	-	1	9	88	1	1	NP	NP	NP	4	A-3 (0)	
		24																
		25																
		26	1 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 6.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:45 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 246+12, 46' LT.	EXPLORATION ID B-020-2-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1029.0 (MSL) EOB: 85.5 ft.	PAGE 1 OF 3
START: 4/4/18 END: 4/5/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.092137, -81.499899	

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, **SANDY SILT**, TRACE GRAVEL, TRACE CLAY, DAMP TO MOIST	1029.0	1	3 5 5	13	61	SS-1	2.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
		4	7 8 9	23	72	SS-2	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		7	9 13 14	36	89	SS-3	3.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
		9	6 8 7	20	61	SS-4	4.5+	2	15	34	47	2	21	14	7	11	A-4a (3)	
		12	6 8 8	21	83	SS-5	4.5+	-	-	-	-	-	-	-	-	15	A-4a (V)	
	1014.0	14	5 5 7	16	100	SS-6	4.00	-	-	-	-	-	-	-	-	13	A-4a (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP	1011.5	17	5 8 8	21	83	SS-7	-	4	34	50	11	1	NP	NP	NP	4	A-3a (0)	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP		19	5 5 6	15	72	SS-8	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
@21' to 23'; LOOSE		22	3 3 4	9	56	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
		24	8 11 18	39	28	SS-10	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
		29	8 12 18	40	61	SS-11	-	36	31	23	9	1	NP	NP	NP	3	A-1-b (0)	

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 246+12, 46' LT. | START: 4/4/18 | END: 4/5/18 | PG 2 OF 3 | B-020-2-17

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, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP *(continued)*	999.0	31–34																
		34–35	4 7 9	21	94	SS-12	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		35–39																
	989.0	39–40	9 11 14	33	72	SS-13	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP		40–44																
	984.0	44–45	6 8 16	32	100	SS-14	4.5+	8	5	19	46	22	24	16	8	15	A-4a (7)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP		45–49																
		49–50	14 19 15	46	83	SS-15	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
		50–54																
		54–55	10 13 18	41	100	SS-16	-	-	-	-	-	-	-	-	-	6	A-3a (V)	
		55–59																
		59–60	7 10 11	28	100	SS-17	-	4	15	68	12	1	NP	NP	NP	9	A-3a (0)	
		60–61																

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 246+12, 46' LT.	START: 4/4/18	END: 4/5/18	PG 3 OF 3	B-020-2-17

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, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP *(continued)* @63.5' to 69.5'; WET	966.9	W 965.5	4 7 10	23	100	SS-18	-	-	-	-	-	-	-	-	-	28	A-3a (V)	
		▼ 0 hrs																
VERY STIFF, BROWN, **SANDY SILT**, "AND" CLAY, LITTLE GRAVEL, WET	959.5		10 7 8	20	100	SS-19	2.00	10	4	8	34	44	NP	NP	NP	26	A-4a (8)	
VERY DENSE, BROWN, **FINE SAND**, SOME CLAY, WET	957.0		25 34 26	80	100	SS-20	-	-	-	-	-	-	-	-	-	18	A-3 (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG TO VERY STRONG.	949.5		11 17 29	62	100	SS-21	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
@ 85.5'; BORING TERMINATED DUE TO AUGER REFUSAL	943.5	EOB	50/5"	-	100	SS-22	-	-	-	-	-	-	-	-	-	14	Rock (V)	

NOTES: CAVE IN AT 48.9'; AUGUR REFUSAL AT 85.5'; SITE CONDITION RESTRICTS OPERATION OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 300 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 545+66, 90' RT.	EXPLORATION ID B-020-3-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1029.1 (MSL) EOB: 74.8 ft.	PAGE 1 OF 3
START: 4/5/18 END: 4/5/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.091904, -81.499250	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1029.1	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
6" TOPSOIL(DRILLER'S DESCRIPTION)	1028.6																	
LOOSE, BROWN, **FINE SAND**, LITTLE GRAVEL, LITTLE CLAY, MOIST		1	1 2 3	7	72	SS-1	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
	1025.6	3																
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST		4	3 3 3	8	67	SS-2	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		6	4 4 5	12	11	SS-3	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
		9	2 3 3	8	72	SS-4	-	10	48	35	6	1	NP	NP	NP	6	A-1-b (0)	
		11	3 3 4	9	72	SS-5	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	1015.6																	
LOOSE TO MEDIUM DENSE, BROWN, **FINE SAND**, TRACE SILT, TRACE CLAY, DAMP		14	3 3 5	11	83	SS-6	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
		16	3 3 5	11	61	SS-7	-	-	-	-	-	-	-	-	-	3	A-3 (V)	
		19	4 4 5	12	100	SS-8	-	-	-	-	-	-	-	-	-	3	A-3 (V)	
		21	3 3 4	9	72	SS-9	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
		24	3 4 4	11	83	SS-10	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
		29	3 3 4	9	100	SS-11	-	0	29	62	8	1	NP	NP	NP	9	A-3 (0)	

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
LOOSE TO MEDIUM DENSE, BROWN, **FINE SAND**, TRACE SILT, TRACE CLAY, DAMP *(continued)*	999.1	31																
		32																
		33																
	995.1	34	8 14 17	41	83	SS-12	-	-	-	-	-	-	-	-	-	6	A-3a (V)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, DAMP		35																
		36																
		37																
		38																
		39	4 4 5	12	94	SS-13	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
		40																
		41																
		42																
		43																
		44	6 6 8	19	94	SS-14	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
		45																
		46																
		47																
		48																
		49	8 10 13	31	100	SS-15	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
		50																
		51																
		52																
		53																
		54	12 21 20	55	89	SS-16	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
		55																
		56																
		57																
		58																
	969.8	59	8 17 19	48	83	SS-17	4.5+	14	9	23	45	9	21	14	7	10	A-4a (4)	
HARD, BROWN, **SANDY SILT**, LITTLE GRAVEL, TRACE CLAY, DAMP		60																
		61																

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 545+66, 90' RT.	START: 4/5/18	END: 4/5/18	PG 3 OF 3	B-020-3-17

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
	967.0																	
	966.1																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP TO MOIST		63																
		64	16 33 44	103	100	SS-18	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
		65																
		66																
		67																
		68																
		69	21 45 50	127	100	SS-19	-	27	14	25	28	6	NP	NP	NP	10	A-2-4 (0)	
		70																
		71																
		72																
		73																
	954.3	74 EOB	9 11 50/4"	-	100	SS-20	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	

NOTES: CAVE IN AT 57.2'; SITE CONDITION RESTRICTS OPERATION OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 100 LB. BENTONITE CHIPS; BACKFILLED WITH 100 LB. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 545+06, 66' RT.	EXPLORATION ID B-021-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1028.1 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.091752, -81.499381	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1028.1	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
6" ASPHALT, 12" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1026.6	1	7 4 5	12	72	SS-1	2.50	-	-	-	-	-	-	-	-	25	A-6b (V)	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, MOIST		2																
		3	5 5 3	11	89	SS-2	3.00	16	5	6	51	22	39	21	18	25	A-6b (11)	
	1022.8	4																
		5	3 3 7	13	89	SS-3	3.00	-	-	-	-	-	-	-	-	19	A-6b (V)	
MEDIUM DENSE, REDDISH BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	1021.1	6	6 7 5	16	94	SS-4	-	33	18	40	- 9 -		NP	NP	NP	6	A-1-b (0)	
		EOB 7																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 546+03, 50' RT.	EXPLORATION ID B-021-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1028.8 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.092030, -81.499363	

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
ASPHALT (9.0") & GRANULAR BASE (6.0")	1028.8																	
	1027.5																	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			9 6 6	18	83	SS-1	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	1021.8		5 3 4	10	100	SS-2	-	21	37	36	4	2	NP	NP	NP	8	A-1-b (0)	
LOOSE TO MEDIUM DENSE, LIGHT BROWN AND BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP TO MOIST			2 3 3	9	100	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			3 2 3	7	100	SS-4	-	2	13	82	2	1	NP	NP	NP	5	A-3 (0)	
			4 3 3	9	100	SS-5	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
			3 3 5	12	100	SS-6	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
			1 2 2	6	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
@20.0' TO 21.5'; BECOMES VERY LOOSE			2 2 1	4	100	SS-8	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
			1 2 2	6	100	SS-9	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
	1002.3	EOB	2 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 12.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 247+14, 57' LT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1016.7 (MSL) EOB: 26.5 ft.
START: 1/6/17 END: 1/6/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.092416, -81.499862

EXPLORATION ID B-021-2-16

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	1016.7							GRADATION (%)					ATTERBERG					
MEDIUM STIFF, BROWN AND DARK BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAIN ROOTS, MOIST		1	1 2 4	9	83	SS-1	0.5 - 1.0	2	13	34	30	21	23	15	8	19	A-4a (3)	
		2																
		3	4 5 6	16	100	SS-2	0.5 - 0.75	9	10	28	31	22	20	13	7	15	A-4a (4)	
		4																
@5.0' TO 5.8'; BECOMES STIFF TO VERY STIFF	1010.9	5	5 10 11	31	100	SS-3A	1.5 - 2.25	-	-	-	-	-	-	-	-	17	A-4a (V)	
DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, TRACE SILT, TRACE GRAVEL (SANDSTONE), TRACE CLAY, DAMP	1009.7	6				SS-3B	-	8	29	48	8	7	NP	NP	NP	8	A-3a (0)	
		7																
DENSE TO VERY DENSE, BROWN BECOMING ORANGISH BROWN WITH BROWN, **GRAVEL WITH SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE CLAY, GRAVEL IS FRIABLE SANDSTONE, DAMP		8	6 11 22	48	100	SS-4	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@7.5' TO 9.0'; CONTAINS 1.5" SILT AND CLAY SEAM		9																
		10	5 13 16	43	100	SS-5	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		11																
@12.5' TO 14.0'; CONTAINS 1.5" SILT AND CLAY SEAM		12																
		13	9 18 23	60	100	SS-6	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		14																
		15	5 14 15	43	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		16																
@17.5' to 20.0'; BECOMES ORANGISH BROWN WITH REDDISH BROWN		17																
		18	9 11 13	35	100	SS-8	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	997.2	19																
MEDIUM DENSE, ORANGISH BROWN WITH BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, MOIST		20																
		21	6 11 8	28	100	SS-9	-	-	-	-	-	-	-	-	-	15	A-2-4 (V)	
	994.7	22																
STIFF TO VERY STIFF, BROWN MOTTLED WITH GRAY BECOMING BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST		23	6 3 5	12	100	SS-10	1.0 - 2.25	7	10	32	30	21	23	14	9	15	A-4a (3)	
		24																
@25.0' to 26.5'; CONTAINS IRON STAINING		25																
	990.2	26	4 4 5	13	100	SS-11	1.0 - 1.5	-	-	-	-	-	-	-	-	15	A-4a (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 547+95, 48' RT.	EXPLORATION ID B-021-3-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1027.7 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.092565, -81.499265	

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
ASPHALT (8.0") & GRANULAR BASE (9.0")	1027.7																	
	1026.3																	
MEDIUM STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @5.0' TO 6.5'; CONTAINS A 1.25" GRAVEL PIECE, DAMP TO MOIST **(FILL)** @2.5' TO 4.0'; NO RECOVERY		1 2 3 4 5 6	12 9 11	29	0	SS-1	-	-	-	-	-	-	-	-	-	-		
			8 5 4	13	78	SS-2	0.5 - 1.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
@7.5' TO 9.0'; CHANGES TO BROWN, GRAY AND DARK GRAY, CONTAINS FEW PORCELAIN AND ASPHALT FRAGMENTS, AND IRON STAINING	1018.2	7 8 9	5 6 6	18	100	SS-3	1.75 - 3.0	6	11	30	32	21	25	16	9	16	A-4a (4)	
VERY STIFF TO HARD, BROWN WITH BROWNISH GRAY AND DARK GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, DAMP	1015.7	10 11 12	7 7 7	21	100	SS-4	3.25 - 4.5+	5	10	28	35	22	25	15	10	15	A-4a (4)	
VERY LOOSE, BROWN WITH ORANGISH BROWN AND DARK GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, SS-5 NO HP, SAMPLE IS NON COHESIVE	1013.2	13 14	3 1 1	3	39	SS-5	-	-	-	-	-	-	-	-	-	12	A-4a (V)	
VERY LOOSE, ORANGISH BROWN, **FINE SAND**, SOME COARSE SAND, TRACE TO LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP @15.0' TO 16.5'; CONTAINS DECAYED WOOD FRAGMENTS AND IRON STAINING		15 16 17	1 WOH 1	1	50	SS-6	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@17.5' TO 26.5'; BECOMES LOOSE TO MEDIUM DENSE, BROWN		18 19	2 3 2	7	100	SS-7	-	6	32	58	2	2	NP	NP	NP	4	A-3 (0)	
		20 21 22	2 3 3	9	100	SS-8	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
		23 24	3 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
		EOB 25 26	3 4 4	12	100	SS-10	-	-	-	-	-	-	-	-	-	7	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 248+06, 7' LT.	EXPLORATION ID B-022-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1024.7 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.092634, -81.499630	

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
8" ASPHALT, 16" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1024.7																	
DENSE, REDDISH BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY	1022.7	1	8 11 14	33	78	SS-1	-	10	17	65	- 8 -		NP	NP	NP	7	A-3 (0)	
VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE GRAVEL, TRACE SAND (FILL), DRY	1021.2	2 3 4	4 5 6	15	100	SS-2	3.50	14	4	7	49	26	41	20	21	14	A-7-6 (12)	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY	1018.7	5 6 7	4 3 4	9	100	SS-3	3.50	16	7	5	45	27	39	21	18	13	A-6b (11)	
	1014.7	EOB 8 9 10	3 3 3	8	6	SS-4	4.00	-	-	-	-	-	-	-	-	15	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / D. S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 248+45, 75' LT.	EXPLORATION ID B-023-0-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1012.4 (MSL) EOB: 43.7 ft.	PAGE 1 OF 2
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.092765, -81.499854	

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
2" TOPSOIL (DRILLER'S DESCRIPTION)	1012.4																	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP (FILL)	1012.2	1	4 7 9	22	67	SS-1	-	44	33	17	- 6 -		NP	NP	NP	9	A-1-b (0)	
	1008.8	2																
SOFT, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK FRAGMENTS AND GRAVEL, MOIST		3	2 2 1	4	56	SS-2	0.30	12	4	16	40	28	36	21	15	26	A-6a (9)	
	1006.4	4																
VERY SOFT TO SOFT, BROWN, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL, MOIST		5	3 1 1	3	94	SS-3	0.25	11	5	23	39	22	38	20	18	28	A-6b (8)	
@ 8.5'; VERY STIFF	1002.9	6																
MEDIUM DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		7	4 7 8	20	72	SS-4	2.25	-	-	-	-	-	-	-	-	25	A-6b (V)	
		8																
		9																
		10	7 16 22	51	78	SS-5	-	11	40	40	- 9 -		NP	NP	NP	11	A-1-b (0)	
		11																
		12																
		13	11 15 22	50	89	SS-6	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		14																
		15																
		16	11 11 22	45	67	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		17																
		18																
		19	7 8 8	22	78	SS-8	-	41	25	27	- 7 -		NP	NP	NP	10	A-1-b (0)	
		20																
		21																
		22																
		23																
	988.7	24	6 4 5	12	72	SS-9	0.60	-	-	-	-	-	-	-	-	27	A-6b (V)	
SOFT TO STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		25																
		26																
		27																
		28																
@ 28.5' TO 30.0'; STIFF		29	5 11 16	36	67	SS-10	1.80	-	-	-	-	-	-	-	-	28	A-6b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 248+45, 75' LT.	START: 7/6/15	END: 7/6/15	PG 2 OF 2	B-023-0-15

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
SOFT TO STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST *(continued)*	982.4	31 32 33																
@ 33.5'; VERY SOFT		34 35	7 6 7	18	67	SS-11	0.25	9	7	7	50	27	35	19	16	25	A-6b (10)	
	973.4	TR 36 37 38 39	50/5"	-	120	SS-12	0.50	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	968.7	EOB 40 41 42 43	50/2"	-	89	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 549+04, 55' RT.	EXPLORATION ID B-024-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1026.3 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.092867, -81.499208	

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
8" ASPHALT, 10" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1026.3																	
	1024.8	1																
VERY STIFF, BROWN TO GRAY, **CLAY**, "AND" SILT, LITTLE SAND AND GRAVEL, (FILL), DRY		2	6 6 7	17	83	SS-1	3.50	11	4	9	55	21	42	19	23	15	A-7-6 (14)	
	1022.3	3	4 5 7	16	78	SS-2	4.00	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DRY		4	5 4 6	13	89	SS-3	4.00	9	7	14	37	33	39	21	18	13	A-6b (10)	
	1019.3	5	5 6 8	19	100	SS-4	4.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
		EOB 6 7																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 8 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 249+72, 77' LT.	EXPLORATION ID B-025-0-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1004.9 (MSL) EOB: 18.58 ft.	PAGE 1 OF 1
START: 6/30/15 END: 6/30/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.093100, -81.499820	

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
11" TOPSOIL (DRILLER'S DESCRIPTION)	1004.9																	
	1003.9																	
SOFT TO STIFF, BROWN, **SILT AND CLAY**, LITTLE CLAY AND GRAVEL, DAMP		1	3 4 4	11	78	SS-1	0.25	-	-	-	-	-	-	-	-	25	A-6a (V)	
		2																
		3																
		4	4 2 2	5	83	SS-2	1.50	15	3	14	39	29	35	22	13	28	A-6a (8)	
	998.9	5																
LOOSE, BROWN, **SILTY CLAY**, LITTLE GRAVEL, TRACE SAND, MOIST		6																
		7	2 3 2	7	56	SS-3	0.50	14	2	6	50	28	38	19	19	29	A-6b (12)	
	995.9	8																
VERY DENSE, BROWN, **FINE SAND**, SOME COARSE SAN AND GRAVEL, TRACE SILT AND CLAY, DAMP	P.S. 995.4	9	18 21 50/3"	-	87	SS-4	-	20	23	50	-	7 -	NP	NP	NP	14	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		10																
		11	50/2"	-	50	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		12																
		13																
		14	18 31 42	98	61	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		15																
		16	50/4"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		17																
	986.3	18																
	EOB		50/1"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 549+84, 46' RT.	EXPLORATION ID B-025-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1026.7 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093093, -81.499228	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (7.0") & GRANULAR BASE (13.0")	1026.7																	
	1025.0																	
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, @1.7' TO 6.5'; CONTAIN FEW ROOT HAIRS, DAMP		1 2 3 4	5 6 8	21	100	SS-1	4.0 - 4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	
@5.0' TO 6.5'; CONTAINS FEW BLACK ORGANICS @5.0' TO 8.0'; BECOME BROWN WITH BROWNISH GRAY AND DARK GRAY		5 6 7	10 6 8	21	100	SS-2	2.5 - 4.0	8	9	27	34	22	27	15	12	15	A-6a (5)	
	1018.7	8	4 7 12	28	100	SS-3A	2.0 - 3.25	-	-	-	-	-	-	-	-	15	A-6a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL (FRIABLE SANDSTONE), TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, CONTAINS IRON STAINING, DAMP		9				SS-3B	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
	1014.7	10 11 12	3 4 7	16	100	SS-4	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL (FRIABLE SANDSTONE), CONTAINS IRON STAINING, NO HP, SAMPLE IS NON COHESIVE, DAMP	1012.2	13 14	2 4 7	16	100	SS-5	-	8	15	39	24	14	17	12	5	11	A-4a (1)	
MEDIUM DENSE, ORANGISH BROWN AND BROWNISH GRAY, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1009.7	15 16 17	2 4 15	28	100	SS-6	-	12	19	40	18	11	NP	NP	NP	9	A-3a (0)	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP		18 19	3 5 9	21	100	SS-7	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@20.0' TO 21.5'; BECOMES BROWN WITH ORANGISH BROWN AND MAROONISH BROWN, GRAVEL IS FRIABLE SANDSTONE	1004.7	20 21 22	3 7 11	26	100	SS-8	2.5 - 4.0	6	10	36	31	17	19	12	7	11	A-4a (3)	
DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, (FRIABLE SANDSTONE), TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP	1002.2	23 24	6 14 15	43	100	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1000.2	25 26 EOB	6 9 8	25	78	SS-10	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 248+45, 75' LT.	EXPLORATION ID B-025-2-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1004.9 (MSL) EOB: 15.8 ft.	PAGE 1 OF 1
START: 1/19/17 END: 1/19/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093232, -81.498981	

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
TOPSOIL (4.0")	1004.9																	
	1004.6																	
MEDIUM STIFF TO STIFF, DARK BROWN AND LIGHT BROWN, **SANDY SILT**, TRACE GRAVEL, LITTLE CLAY, SS-1 AND SS-2 NO HP DUE TO SAMPLE DISTURBANCE DURING RECOVERY, DAMP TO MOIST @0.3' TO 3.0'; CONTAINS ROOTS		1	3 5 3	12	33	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
		2	2 3 4	10	100	SS-2	-	6	18	38	27	11	24	20	4	19	A-4a (1)	
	1001.0	3	3 6 5	16	100	SS-3A	0.75 - 1.25	-	-	-	-	-	-	-	-	18	A-4a (V)	
		4				SS-3B	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
MEDIUM DENSE TO DENSE, ORANGISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP		5	3 5 4	13	100	SS-4	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
		6	5 6 6	18	100	SS-5	-	18	28	46	5	3	NP	NP	NP	7	A-3 (0)	
		7																
		8	6 11 21	47	56	SS-6	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
		9																
		10	5 9 10	28	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@10.5' TO 12.0'; BECOMES BROWN AND LIGHT BROWN, SOME GRAVEL, CONTAINS SANDY SILT SEAM		11	9 11 18	43	67	SS-8	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@12.0' TO 13.5'; BECOMES VERY DENSE, BROWN	991.4	12	10 21 36	84	50	SS-9	-	-	-	-	-	-	-	-	-	4	A-3 (V)	
VERY DENSE, BROWN AND LIGHT BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP	989.9	13																
		14	11 26 38	94	83	SS-10	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
VERY DENSE, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, NO HP, SAMPLE IS NON COHESIVE, DRY	989.1	15	11 50/4"	-	60	SS-11	-	4	19	40	23	14	17	13	4	5	A-4a (0)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 250+93, 89' LT.	EXPLORATION ID B-025-3-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1003.3 (MSL) EOB: 21.5 ft.	PAGE 1 OF 1
START: 1/18/17 END: 1/18/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093422, -81.499843	

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
	1003.3																	
TOPSOIL (2.0")	1003.1																	
VERY STIFF, DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS ROOTS AND IRON STAINING, DAMP	1001.3	1	1 3 5	12	100	SS-1	2.0 - 2.5	-	-	-	-	-	-	-	-	14	A-4a (V)	
SOFT, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW ROOT HAIRS, DAMP		2																
		3	3 3 1	6	100	SS-2	0.25 - 0.5	13	19	30	24	14	20	15	5	15	A-4a (1)	
	998.8	4																
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAINS IRON STAINING, MOIST		5	1 3 4	10	100	SS-3	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
	995.3	6																
SANDSTONE, BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		7																
		8	TR 9 50/5"	-	64	SS-4	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
		9																
		10																
		11	15 38 50/4"	-	88	SS-5	-	-	-	-	-	-	-	-	-	8	Rock (V)	
		12																
		13	6 15 50/5"	-	71	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		14																
		15	17 50/5"	-	55	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		16																
		17																
@17.5' TO 21.5'; BECOMES DARK BROWN		18	50/5"	-	100	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19																
		20																
	981.8	21	EOB 15 7 14	31	100	SS-9	-	-	-	-	-	-	-	-	-	8	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 251+32, 70' LT.	EXPLORATION ID B-026-0-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1007.7 (MSL) EOB: 13.6 ft.	PAGE 1 OF 1
START: 6/30/15 END: 6/30/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.093524, -81.499772	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1007.7	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
13" TOPSOIL (DRILLER'S DESCRIPTION)	1006.7																	
VERY LOOSE TO LOOSE, BROWN, **SANDY SILT**, LITTLE GRAVEL AND CLAY, MOIST TO DAMP		1	3 4 3	9	89	SS-1	0.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
		2																
		3																
		4	2 1 2	4	44	SS-2	-	22	11	28	29	10	NP	NP	NP	15	A-4a (1)	
		5																
@ 6.4'; DENSE, ROCK FRAGMENTS AND GRAVEL		6	5 8 15	31	78	SS-3	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
	999.2	7																
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP TO MOIST		8																
		9	18 21 26	63	72	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		10																
		11																
		12	7 8 7	20	72	SS-5	-	22	33	37	- 8	-	NP	NP	NP	14	A-1-b (0)	
	994.2	13																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	994.1	TR3	60/1"	-	-		-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 551+79, 52' RT.	EXPLORATION ID B-027-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1025.1 (MSL) EOB: 38.6 ft.	PAGE 1 OF 2
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.093637, -81.499221	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1025.1	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
6" ASPHALT, 10" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1023.6																	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, SILT AND CLAY, TRACE SILT AND CLAY (FILL), DRY		1	8 11 14	33	78	SS-1	-	19	23	55	- 3 -		NP	NP	NP	12	A-3 (0)	
@ 4.5'; SANDSTONE FRAGMENT IN FILL.		2																
		3																
		4	3 8 15	31	67	SS-2	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		5																
@ 6.5' TO 6.9'; LEAN CLAY SEAM.		6																
		7	6 18 21	52	78	SS-3	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
	1016.6	8																
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, MOIST		9	12 21 17	51	78	SS-4	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
		10																
@ 11.6' TO 11.9'; LEAN CLAY SEAM.		11	12 10 22	43	89	SS-5	-	9	13	67	- 11 -		NP	NP	NP	7	A-3a (0)	
		12																
		13																
		14	12 15 19	45	100	SS-6	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
	1008.8	15																
HARD, BROWN TO GRAY, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, (RESIDUAL), DRY		16																
	W 1007.8	17	6 5 5	13	100	SS-7	4.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		18																
		19	4 7 10	23	100	SS-8	4.50	9	3	16	39	33	41	21	20	17	A-7-6 (12)	
		20																
		21																
		22																
		23																
		24	8 10 12	29	100	SS-9	4.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
	996.6	25																
		26																
		27																
		28																
		29	8 9 21	40	89	SS-10	-	8	21	65	- 6 -		NP	NP	NP	8	A-3 (0)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 551+79, 52' RT.	START: 6/10/15	END: 6/10/15	PG 2 OF 2	B-027-0-15

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
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY *(continued)*	995.1	31 32 33																
	991.6	TR	50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		34 35 36 37 38																
	986.5	EOB	50/1"	-	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 552+13, 111' RT.	EXPLORATION ID B-028-0-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1001.1 (MSL) EOB: 8.6 ft.	PAGE 1 OF 1
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.093747, -81.499015	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1001.1	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
15" TOPSOIL (DRILLER'S DESCRIPTION)	999.9																	
MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DAMP TO MOIST	997.6	1 2 3	2 2 3	7	56	SS-1	1.00	19	7	7	41	26	36	20	16	29	A-6b (9)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 4 5 6 7 8	50/4"	-	86	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	992.5	EOB	50/1"	-	50	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 252+07, 38' LT.	EXPLORATION ID B-029-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1022.7 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.093726, -81.499660	

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
7" ASPHALT, 11" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1022.7																	
	1021.2																	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND AND GRAVEL, TRACE SILT AND CLAY (WEATHERED SANDSTONE), DRY		1	7 8 7	20	83	SS-1	-	23	30	44	- 3 -		NP	NP	NP	11	A-1-b (0)	
		2																
		3																
		4	7 14 10	32	89	SS-2	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		5																
		6	20 23 24	63	78	SS-3	-	20	23	53	- 4 -		NP	NP	NP	9	A-3 (0)	
		7																
		8																
		9	20 30 31	82	89	SS-4	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
	1012.7	EOB 10																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 7 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 249+72, 77' LT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1025.2 (MSL) EOB: 25.3 ft.
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093990, -81.499291

EXPLORATION ID B-029-1-16

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (8.0") & GRANULAR BASE (11.0")	1025.2																	
	1023.6																	
MEDIUM DENSE TO DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP		1																
		2																
		3	15 9 14	34	100	SS-1	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
		4																
		5																
		6	7 9 10	28	100	SS-2	-	11	37	41	6	5	NP	NP	NP	7	A-3a (0)	
		7																
		8	7 10 10	29	100	SS-3	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	1015.7	9																
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST		10																
		11	4 6 8	21	100	SS-4	3.25 - 4.5+	5	9	33	32	21	22	13	9	12	A-4a (4)	
		12																
@12.5' TO 14.0'; BECOMES BROWN WITH BROWNISH GRAY AND BLACK, CONTAINS FEW BLACK ORGANICS, ROOT HAIRS, AND IRON STAINS		13	4 9 11	29	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1010.7	14																
DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST		15																
		16	4 12 13	37	100	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	1007.7	17																
SANDSTONE, LIGHT BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR 18	4 12 18	44	100	SS-7	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		19																
@20.0' TO 23.0'; BECOMES MAROONISH BROWN		20																
		21	27 24 31	81	100	SS-8	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		22																
		23	50/5"	-	80	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		24																
	999.9	EOB 25	50/4"	-	75	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 11.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 553+19, 74' RT.	EXPLORATION ID B-030-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1024.9 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.094028, -81.499275	

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
6" ASPHALT (DRILLER'S DESCRIPTION)	1024.4																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND AND GRAVEL, DRY	1022.9	1	5 7 8	20	89	SS-1	4.00	24	9	9	39	19	37	22	15	15	A-6a (7)	
DENSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY (FILL), DRY		2 3	7 15 13	37	72	SS-2	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
F.S.		4 5	7 11 17	37	89	SS-3	-	22	10	63	- 5 -		NP	NP	NP	7	A-3 (0)	
@ 6.0' TO 6.5'; LEAN CLAY SEAM	1017.9	6	7 11 19	40	78	SS-4	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		EOB 7																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 251+32, 70' LT.	EXPLORATION ID B-030-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1023.1 (MSL) EOB: 33.0 ft.	PAGE 1 OF 2
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094081, -81.499698	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1023.1	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
ASPHALT (3.0") OVER CONCRETE (10.0")	1022.0	1																
MEDIUM DENSE, ORANGISH BROWN AND BROWN BECOMING ORANGISH BROWN AND REDDISH BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, DAMP		2																
		3	5 5 6	15	56	SS-1	-	21	17	40	14	8	NP	NP	NP	8	A-3a (0)	
		4																
		5																
		6	5 8 12	27	33	SS-2	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	1016.1	7																
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, TRACE BLACK ORGANICS, MOIST		8	6 3 3	8	100	SS-3	0.5 - 0.75	6	11	29	34	20	25	15	10	16	A-4a (4)	
	1013.6	9																
LOOSE TO MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST		10																
		11	3 3 4	10	100	SS-4	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	1010.1	12																
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @15.0' TO 16.5'; CONTAINS IRON STAINING AND TRACE BLACK ORGANICS, DAMP TO MOIST		13	5	12	100	SS-5A	-	-	-	-	-	-	-	-	-	15	A-3a (V)	
		14	5 4			SS-5B	1.75 - 2.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
		15																
		16	3 5 8	18	100	SS-6	1.75 - 2.0	4	5	18	49	24	26	17	9	18	A-4a (8)	
	1006.1	17																
DENSE, BROWN WITH ORANGISH BROWN AND DARK, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS IRON STAINING, MOIST		18	6 10 17	37	100	SS-7	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
	1003.6	19																
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, LITTLE CLAY, MOIST		20																
		21	5 10 14	33	100	SS-8	-	15	8	44	21	12	NP	NP	NP	11	A-3a (0)	
	1000.1	22																
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 23	18 50/3"	-	78	SS-9	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
		24																
		25																
		26	18 24 28	71	67	SS-10	-	-	-	-	-	-	-	-	-	6	Rock (V)	
	995.1	27																
@29.3'; Qu = 5184 PSI		28																
		29																

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
SANDSTONE, LIGHT GRAY AND ORANGISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO VERY THIN BEDDED, FRIABLE, MICACEOUS, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY, FAIR TO GOOD SURFACE CONDITION; RQD 66%, REC 88%. *(continued)*	993.1	31	66		88	NQ2-1											CORE	
	990.1	EOB 33																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 254+57, 55' LT.	EXPLORATION ID B-031-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1023.1 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.094392, -81.499798	

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
6" ASPHALT, 18" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1023.1																	
STIFF TO VERY STIFF, BROWN, **CLAY**, SOME SAND, LITTLE GRAVEL, (FILL), DRY	1021.1	1	6 3 2	7	56	SS-1	-	32	33	29	- 6 -		NP	NP	NP	10	A-1-b (0)	
		2																
		3																
		4	1 2 2	5	100	SS-2	1.00	-	-	-	-	-	-	-	-	15	A-6b (V)	
		5																
		6	2 3 4	9	100	SS-3	2.50	13	4	16	35	32	39	19	20	18	A-6b (10)	
		7																
		8																
	1013.1	9	11 10 9	25	89	SS-4	2.50	-	-	-	-	-	-	-	-	12	A-6b (V)	
	EOB	10																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 254+88, 47' LT.	EXPLORATION ID B-031-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1023.1 (MSL) EOB: 20.5 ft.	PAGE 1 OF 1
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094480, -81.499786	

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
ASPHALT (6.0") & GRANULAR BASE (18.0")	1023.1																	
	1021.1																	
MEDIUM STIFF TO VERY STIFF, BROWNISH GRAY WITH BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST		1 2 3 4	5 4 4	11	100	SS-1	0.75 - 1.0	4	10	28	38	20	25	16	9	18	A-4a (5)	
@5.0' TO 6.5'; BECOMES BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, CONTAINS IRON STAINING		5 6	4 4 7	15	100	SS-2	1.75 - 3.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
	1016.1																	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, MOIST		7 8 9	7 8 10	25	100	SS-3	-	-	-	-	-	-	-	-	-	14	A-2-6 (V)	
	1013.6																	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, SS-4 NO HP DUE TO SAMPLE DISTURBANCE DURING RECOVERY, DAMP		10 11 12	6 8 11	26	100	SS-4	-	7	8	28	42	15	20	16	4	15	A-4a (4)	
		13	7 11 14	34	100	SS-5	1.75 - 3.25	8	12	30	34	16	19	14	5	13	A-4a (3)	
	1008.1	14																
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1007.6	TR 15	50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY WEATHERED, STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, MEDIUM TO COARSE GRAINED FROM 19.8' - 20.5', FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, SLIGHTLY FRACTURED TO HIGHLY FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 100%.	1002.6	16 17 18 19 20 EOB	75		100	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:46 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 554+47, 97' RT.	EXPLORATION ID B-031-2-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1025.7 (MSL) EOB: 25.3 ft.	PAGE 1 OF 1
START: 1/20/17 END: 1/20/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.094397, -81.499169	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1025.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (3.0")	1025.4																	
MEDIUM STIFF TO VERY STIFF, BROWN BECOMING BROWN AND GRAYISH BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, FEW ROOT HAIRS, DAMP		1	1 2 4	9	72	SS-1	0.5 - 2.0	-	-	-	-	-	-	-	-	14	A-6a (V)	
		2																
		3	2 5 6	16	89	SS-2	1.25 - 2.25	14	12	31	24	19	25	14	11	14	A-6a (2)	
		4																
		5	2 4 7	16	83	SS-3	0.75 - 1.5	-	-	-	-	-	-	-	-	14	A-6a (V)	
	1018.7	6																
MEDIUM STIFF, BROWN AND BROWNISH GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		7	2 5 5	15	100	SS-4	0.75 - 1.0	13	11	35	28	13	21	15	6	15	A-4a (1)	
	1016.2	8																
STIFF TO VERY STIFF, BROWN WITH ORANGISH BROWN AND BROWNISH GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, @10.0' TO 11.5'; CONTAIN IRON STAINING, DAMP TO MOIST		9	3 7 8	22	100	SS-5	1.5 - 3.0	-	-	-	-	-	-	-	-	15	A-6a (V)	
		10																
@12.5' TO 16.5'; BECOME BROWN AND GRAY, INTERBEDDED SILT AND CLAY		11	6 8 9	25	100	SS-6	2.25 - 2.5	4	5	18	47	26	28	16	12	17	A-6a (8)	
		12																
	1008.7	13	8 10 11	31	100	SS-7	2.0 - 2.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
STIFF TO VERY STIFF, BROWN AND LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		14																
		15																
		16	8 13 36	72	100	SS-8	1.25 - 1.75	11	4	33	32	20	21	13	8	13	A-4a (3)	
		17																
		18																
		19																
		20	13 15 48	93	44	SS-9	2.25 - 3.0	-	-	-	-	-	-	-	-	11	A-4a (V)	
	1003.7	21																
		TR 22																
SANDSTONE, BROWN AND ORANGISH BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		23	36 50/5"	-	73	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1000.4	24																
		EOB 25	50/4"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:47 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 256+63, 53' LT.	EXPLORATION ID B-031-3-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1022.2 (MSL) EOB: 20.5 ft.	PAGE 1 OF 1
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094952, -81.499890	

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
1022.2																		
ASPHALT (6.0")	1021.7																	
DENSE TO VERY DENSE, LIGHT BROWN BECOMING BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, TRACE SILT, TRACE CLAY, (GRAVEL IS QUARTZITE PEBBLES AND FRIABLE SANDSTONE), DAMP		1 2 3 4	14 18 16	46	100	SS-1	-	34	1	52	8	5	NP	NP	NP	8	A-3a (0)	
	1017.2	TR 5																
SANDSTONE, BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		6	19 21 34	75	100	SS-2	-	-	-	-	-	-	-	-	-	5	Rock (V)	
@7.5' TO 8.4'; BECOME LIGHT BROWN AND ORANGISH BROWN		7 8	29 50/5"	-	36	SS-3	-	-	-	-	-	-	-	-	-	5	Rock (V)	
@10.0' TO 13.2'; CONTAINS FUEL ODOR		9 10 11 12	17 30 38	93	67	SS-4	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		13	26 50/2"	-	50	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
	1006.7	14 15	50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND MAROONISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, HIGH ANGLE JOINT DISCONTINUITY FROM 15.8' - 16.0', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 64%, REC 91%. @16.7'; Qu = 3826 PSI	1001.7	16 17 18 19 20 EOB	64		91	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 555+84, 113' RT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1035.1 (MSL) EOB: 35.3 ft.
START: 1/19/17 END: 1/19/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.094775, -81.499178

EXPLORATION ID B-031-4-16

PAGE 1 OF 2

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
TOPSOIL (5.0")	1035.1 / 1034.7		1 2 2	6	100	SS-1	0.5 - 1.0	-	-	-	-	-	-	-	-	16	A-4a (V)	
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS ROOT HAIRS, MOIST	1033.1																	
MEDIUM DENSE, BROWN BECOMING BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, LITTLE CLAY, TRACE GRAVEL, CONTAIN ROOT HAIRS, MOIST			5 6 7	19	100	SS-2	-	5	16	44	20	15	18	12	6	12	A-3a (0)	
	1028.1		3 3 8	16	67	SS-3	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
SOFT TO VERY STIFF, BROWN WITH GRAY AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST			2 4 5	13	100	SS-4	0.25 - 2.5	-	-	-	-	-	-	-	-	15	A-4a (V)	
	1025.6																	
VERY STIFF, LIGHT BROWN AND GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS ROOTS, MOIST			4 5 7	18	100	SS-5	2.5 - 3.25	2	4	16	58	20	28	18	10	19	A-4b (8)	
	1023.1																	
MEDIUM DENSE, BROWN WITH ORANGISH BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, CONTAINS IRON STAINING, MOIST			8 9 10	28	100	SS-6	-	9	6	59	16	10	NP	NP	NP	13	A-3a (0)	
	1020.6	TR																
SANDSTONE, LIGHT BROWN TO ORANGISH BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.			8 14 11	37	100	SS-7	-	-	-	-	-	-	-	-	-	9	Rock (V)	
			50/5"	-	60	SS-8	-	-	-	-	-	-	-	-	-	9	Rock (V)	
	1014.8		60/2"	-	100	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN WITH MAROONISH BROWN AND LIGHT BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, MODERATELY FRIABLE, CONTAINS CLAY LENSES BETWEEN SOME DISCONTINUITIES, MODERATELY MICACEOUS, TRACE QUARTZITE PEBBLES FROM 28.4 - 35.3', CROSS BEDDED, CONTAINS ONE CLAY FILLED VUG AT 28.5', BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, TIGHT TO OPEN, SLIGHTLY TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 34.7 - 35.3' GOOD TO FAIR SURFACE CONDITION; RQD 60%, REC 88%.			28		71	NQ2-1											CORE	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:47 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 555+84, 113' RT.	START: 1/19/17	END: 1/19/17	PG 2 OF 2	B-031-4-16

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
(Continued)	1005.1	31 32 33 34 35	76		96	NQ2-2											CORE	
	999.8	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 35 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 557+48, 53' RT.	EXPLORATION ID B-032-0-15
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1021.9 (MSL) EOB: 5.33 ft.	PAGE 1 OF 1
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.095197, -81.499473	

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
6" ASPHALT (DRILLER'S DESCRIPTION)	1021.9																	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT AND CLAY, LITTLE GRAVEL, DRY	1021.4	1	5 7 10	23	83	SS-1	-	17	6	56	14	7	NP	NP	NP	7	A-3a (0)	
VERY DENSE, REDDISH BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, (WEATHERED SANDSTONE), DRY	1019.7	2 3 4	7 15 50	87	89	SS-2	-	18	4	70	- 8	-	NP	NP	NP	8	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1016.9 TR 1016.6 EOB	5	50/4"	-	100	SS-3	-	-	-	-	-		-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 259+26, 62' LT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1020.9 (MSL) EOB: 22.0 ft.
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.095666, -81.500051

EXPLORATION ID B-032-1-16

PAGE 1 OF 1

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
ASPHALT (7.0") & GRANULAR BASE (10.0")	1020.9																	
	1019.5	TR																
SANDSTONE, LIGHT PINKISH BROWN, SEVERLY WEATHERED, FRIABLE, EASILY AUGERED.		1																
		2																
		3	14 19 23	62	89	SS-1	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		4																
		5	16 50/4"	-	50	SS-2	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		6																
		7																
		8	50/5"	-	100	SS-3	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		9																
		10	50	-	50	SS-4	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		11																
		12																
@12.5' TO 15.4'; BECOMES BROWN		13	48 50/5"	-	64	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		14																
		15	50/5"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		16																
		17																
@17.5' TO 20.2'; BECOMES BROWN AND LIGHT BROWN		18	50/4"	-	75	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19																
		20	50/2"	-	50	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		21																
	998.9	EOB																
		22																

@22.0'; AUGER REFUSAL.

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 9.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 24 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:47 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:47 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 558+07, 140' RT.	EXPLORATION ID B-032-2-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1041.5 (MSL) EOB: 20.3 ft.	PAGE 1 OF 1
START: 1/18/17 END: 1/18/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.095394, -81.499193	

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
ASPHALT (4.0") & GRANULAR BASE (5.0")	1041.5																	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE GRAVEL, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, GRAVEL IS FRIABLE SANDSTONE, DAMP	1040.8		8 4 4	12	72	SS-1	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
			5 6 5	16	100	SS-2	-	7	3	82	5	3	NP	NP	NP	10	A-3 (0)	
SANDSTONE, BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1034.0	TR	12 50/5"	-	82	SS-3	-	-	-	-	-	-	-	-	-	10	Rock (V)	
	1031.2		50/4"	-	100	SS-4	-	-	-	-	-	-	-	-	-	10	Rock (V)	
SANDSTONE, BROWN AND MAROONISH BROWN, DARK BROWN FROM 16.6 - 18.5', SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, CONTAINS TRACE QUARTZ PEBBLES THROUGHOUT, MEDIUM TO COARSE GRAINED FROM 16.6 - 20.3', CONTAINS A 0.5" CEMENTED QUARTZITE GRAVEL SEAM AT 19.0', BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY TO VERY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 28%, REC 82%.			17		63	NQ2-1											CORE	
	1021.2	EOB	39		100	NQ2-2											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 21 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 415+52, 2' RT.
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1034.4 (MSL) EOB: 25.2 ft.
START: 1/16/17 END: 1/16/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.095726, -81.500208

EXPLORATION ID B-033-0-16

PAGE 1 OF 1

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
	1034.4																	
TOPSOIL (4.0")	1034.1																	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @2.5' TO 4.0'; CONTAINS FEW ROOTS, DAMP @0.0' TO 1.5'; ONLY RECOVERED 4.0" OF SAMPLE (TOPSOIL)		1	9 9 4	19	22	SS-1	-	-	-	-	-	-	-	-	-	34	Topsoil (V)	
		2																
		3	6 10 15	37	89	SS-2	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
		4																
		5	9 16 15	46	100	SS-3	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		6																
		7																
		8	12 20 21	60	100	SS-4	4.5+	4	4	19	47	26	26	16	10	10	A-4a (8)	
		9																
	1024.1	10				SS-5A	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE GRAVEL, DAMP		11	7 10 11	31	100	SS-5B	-	6	13	48	26	7	NP	NP	NP	7	A-3a (0)	
	1022.4	12																
VERY STIFF, BROWN AND MAROONISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP		13	4 6 14	29	100	SS-6	3.0 - 4.0	13	14	16	35	22	26	16	10	15	A-4a (4)	
	1019.4	14																
		TR 15	10 10 10	29	100	SS-7	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, LIGHT BROWN AND PINKISH BROWN BECOMING BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		16																
		17																
		18	7 10 5	22	100	SS-8	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		19																
		20	50/5"	-	40	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		21																
		22																
		23	50/4"	-	50	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		24																
	1009.2	EOB 25	50/2"	-	50	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 416+81, 50' RT.	EXPLORATION ID B-034-0-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.7 (MSL) EOB: 25.2 ft.	PAGE 1 OF 1
START: 1/17/17 END: 1/17/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.096376, -81.500399	

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
TOPSOIL (5.0")	1036.7																	
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, @0.4' TO 1.5'; CONTAINS ROOTS AND WOOD FRAGMENTS, DAMP TO MOIST	1036.3		1 2 3	7	89	SS-1	0.5 - 1.5	-	-	-	-	-	-	-	-	21	A-6a (V)	
@2.5' to 4.0'; BECOMES HARD, BROWN MOTTLED WITH GRAY, CONTAINS SILT AND ROOT FILLED DESSICATION CRACKS			4 10 17	40	100	SS-2	4.5+	15	7	22	34	22	27	16	11	9	A-6a (5)	
@5.0' to 7.0'; BECOMES HARD, BROWN , TRACE GRAVEL			11 18 20	56	100	SS-3	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
HARD, BROWN AND ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, DAMP	1029.7		11 15 13	41	100	SS-4	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
			5 10 12	32	100	SS-5	4.5+	9	8	31	37	15	21	15	6	11	A-4a (3)	
			7 9 11	29	100	SS-6	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
SANDSTONE, LIGHT ORANGISH BROWN TO LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, FINE TO MEDIUM GRAINED, FRIABLE, EASILY AUGERED.	1021.7	TR	6 14 12	38	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
			4 10 7	25	100	SS-8	-	-	-	-	-	-	-	-	-	3	Rock (V)	
			42 50/5"	-	45	SS-9	-	-	-	-	-	-	-	-	-	3	Rock (V)	
			50/5"	-	60	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
@25.0' to 25.2'; BECOMES ORANGISH BROWN WITH REDDISH BROWN	1011.5	EOB	60/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 418+31, 44' RT.	EXPLORATION ID B-035-0-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.4 (MSL) EOB: 25.2 ft.	PAGE 1 OF 1
START: 1/16/17 END: 1/16/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.096815, -81.500529	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	1036.4							GRADATION (%)					ATTERBERG					
TOPSOIL (4.0")	1036.1																	
STIFF TO HARD, DARK BROWN AND LIGHT BROWN, **SILT AND CLAY**, LITTLE TO SOME SAND, TRACE GRAVEL, DAMP TO MOIST @0.3' TO 4.0'; CONTAIN FEW ROOTS		1	2 1 3	6	83	SS-1	1.5 - 2.0	-	-	-	-	-	-	-	-	23	A-6a (V)	
@2.5' TO 4.0'; BECOMES VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, CONTAINS FEW IRON STAINS		2 3	3 3 8	16	100	SS-2	3.25 - 4.5+	5	5	20	41	29	29	17	12	16	A-6a (8)	
		4 5	4 8 10	26	100	SS-3	4.25	-	-	-	-	-	-	-	-	13	A-6a (V)	
@7.5' TO 9.0'; BECOMES LITTLE GRAVEL		6 7 8	5 11 13	35	100	SS-4	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
	1026.9	9																
VERY STIFF, BROWN MOTTLED WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP		10 11	4 11 13	35	100	SS-5	3.5 - 4.0	23	13	26	25	13	24	17	7	11	A-4a (1)	
	1023.9	12																
SANDSTONE, LIGHT ORANGISH BROWN, HIGHLY WEATHERED, FINE TO MEDIUM GRAINED, FRIABLE, EASILY AUGERED.		TR 13 14 15 16	6 14 21	51	89	SS-6	-	-	-	-	-	-	-	-	-	2	Rock (V)	
			4 13 19	47	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		17 18	50/6"	-	50	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19 20	50/5"	-	100	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		21 22																
		23	50/3"	-	67	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1011.2	24																
@25.0' TO 26.2'; NO RECOVERY		EOB 25	50/2"	-	0	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 27 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 418+20, 9' RT.	EXPLORATION ID B-036-0-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1034.3 (MSL) EOB: 25.3 ft.	PAGE 1 OF 1
START: 1/18/17 END: 1/18/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.097400, -81.500718	

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
TOPSOIL (4.0")	1034.3																	
MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, SOME SILT, LITTLE CLAY, CONTAINS A 2.5" SILT AND CLAY SEAM, DAMP	1034.0	1	1 4 5	13	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	1032.3	2																
VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS 0.25" DIAMETER ROOTS, DAMP		3	4 5 5	15	100	SS-2	2.75	12	15	34	26	13	17	13	4	12	A-4a (1)	
	1029.8	4																
MEDIUM DENSE, BROWN BECOMING LIGHT BROWN AND MAROONISH BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP		5	5 4 5	13	100	SS-3	-	27	22	41	7	3	NP	NP	NP	8	A-1-b (0)	
		6																
		7																
		8	4 4 4	12	72	SS-4	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		9																
		10																
		11	4 4 11	22	67	SS-5	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	1021.8	12																
SANDSTONE, MAROONISH BROWN AND BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR 13	13 19 23	62	100	SS-6	-	3	64	26	4	3	NP	NP	NP	2	Rock (V)	
		14																
		15																
		16	10 16 21	54	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		17																
		18	50/5"	-	80	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19																
		20	36 50/4"	-	60	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		21																
		22																
		23	50/5"	-	60	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		24																
	1009.0	EOB 25	50/3"	-	67	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 17:47 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\COMBINE BORING\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 34+72, 21' RT.	EXPLORATION ID B-037-0-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: AR2A	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 926.8 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2
START: 3/27/18 END: 3/28/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.087955, -81.506639	

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
3" TOPSOIL(DRILLER'S DESCRIPTION)	926.8 / 926.5																	
MEDIUM DENSE, DARK BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, SOME GARBAGE, TRACE CLAY, TRACE BRICK FRAGMENTS, DAMP (FILL)	923.8	1	6 4 8	16	78	SS-1	NI	21	27	19	32	1	19	16	3	14	A-2-4 (0)	
LOOSE, BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE ORGANICS, TRACE ROOT HAIRS, MOIST (FILL)		4	3 3 4	9	78	SS-2	NP	-	-	-	-	-	-	-	-	18	A-1-b (V)	
@6'; BROWN/BLACK, TRACE BRICK FRAGMENTS	918.8	7	4 2 3	7	89	SS-3	NP	-	-	-	-	-	-	-	-	16	A-1-b (V)	
MEDIUM DENSE, DARK BROWN/GRAY, **FINE SAND**, SOME GARBAGE, TRACE GRAVEL, TRACE CLAY, SOME ASPHALT FRAGMENTS, TRACE CONCRETE FRAGMENTS, DAMP TO MOIST (FILL)	915.8	10	22 12 3	20	67	SS-4	NP	-	-	-	-	-	-	-	-	10	A-3 (V)	
VERY LOOSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, WET (FREE WATER NOTED IN JAR)	913.8	W 915.8 12	WOH	-	100	SS-5	NI	2	1	42	40	15	NP	NP	NP	26	A-4a (4)	
MEDIUM STIFF, BROWN/GRAY, **SILT**, LITTLE CLAY, TRACE SAND, MOIST TO WET	910.8	14	2 4 4	11	100	SS-6	0.75	-	-	-	-	-	-	-	-	26	A-4b (V)	
SOFT, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST TO WET	908.8	17	2 2 4	8	100	SS-7	0.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
SOFT TO MEDIUM STIFF, GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET		19	2 2 1	4	33	SS-8	0.50	0	1	10	56	33	25	19	6	28	A-4b (8)	
@21'; TRACE GRAVEL, MOIST		22	1 1 2	4	100	SS-9	0.25	-	-	-	-	-	-	-	-	19	A-4b (V)	
		24	1 1 2	4	78	SS-10	0.50	-	-	-	-	-	-	-	-	28	A-4b (V)	
	898.8	27	2 3 5	11	67	SS-11	0.75	-	-	-	-	-	-	-	-	26	A-4b (V)	
STIFF TO VERY STIFF, GRAY, **SILT**, TRACE SAND, MOIST TO WET		29	4 6 7	17	67	SS-12	1.25	-	-	-	-	-	-	-	-	22	A-4b (V)	

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 34+72, 21' RT.	START: 3/27/18	END: 3/28/18	PG 2 OF 2	B-037-0-17

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 VERY STIFF, GRAY, **SILT**, TRACE SAND, MOIST TO WET *(continued)*	896.8	31																
		32	5 8 11	25	78	SS-13	1.75	-	-	-	-	-	-	-	-	24	A-4b (V)	
		33																
		34	5 7 11	24	100	SS-14	2.00	0	1	7	55	37	25	21	4	24	A-4b (8)	
		35																
		36	6 8 12	27	89	SS-15	2.75	-	-	-	-	-	-	-	-	22	A-4b (V)	
	888.8	37																
HARD, GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, MOIST		38																
		39	5 9 11	27	100	SS-16	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
	886.8	EOB 40																

NOTES: CAVE IN AT 17.9'. NP - NON PLASTIC

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 3 BAG BENTONITE CHIPS

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 37+90, 113' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: AR2A
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 933.5 (MSL) EOB: 27.25 ft.
START: 3/27/18 END: 3/27/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.088265, -81.505426

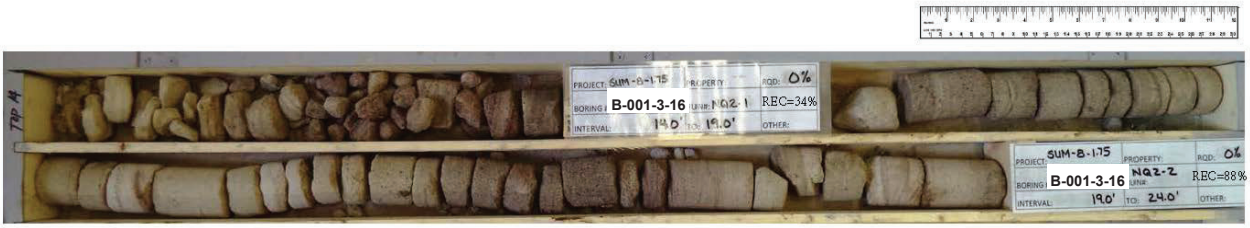
EXPLORATION ID B-038-0-17

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 933.5	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
6" TOPSOIL(DRILLER'S DESCRIPTION)	933.0																	
MEDIUM DENSE, DARK BROWN, **SANDY SILT**, TRACE GRAVEL, CLAY, ORGANICS, MOIST	930.0	1	6 5 4	12	78	SS-1	NI	6	19	35	36	4	NP	NP	NP	19	A-4a (1)	
VERY LOOSE, DARK BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT, ORGANICS, TRACE ROOT HAIRS, DAMP TO MOIST	927.5	2	2 1 2	4	83	SS-2	NP	-	-	-	-	-	-	-	-	9	A-3 (V)	
STIFF, GRAY/BROWN, **SILT**, LITTLE CLAY, TRACE SAND, ORGANICS, MOIST TO WET	922.5	3	2 2 3	7	78	SS-3	1.25	-	-	-	-	-	-	-	-	30	A-4b (V)	
		4	3 5 7	16	100	SS-4	1.50	-	-	-	-	-	-	-	-	25	A-4b (V)	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST @13'; GRAY, LITTLE CLAY, GRAVEL @13.2'; LITTLE LIMESTONE FRAGMENTS @14.9'; 1" SAND SEAM @16.8'; 2" SAND SEAM	910.0	5	8 13 17	40	89	SS-5	2.25	2	8	16	43	31	28	19	9	21	A-4a (8)	
		6	6 7 17	32	78	SS-6	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
		7	16 32 50/5"	-	76	SS-7	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
		8	32 50/3"	-	89	SS-8	NI	-	-	-	-	-	-	-	-	7	A-4a (V)	
		9	13 23 36	79	94	SS-9	3.00	21	11	11	34	23	21	13	8	8	A-4a (4)	
HARD, GRAY, **SILTY CLAY**, TRACE SAND AND GRAVEL, DAMP TO MOIST	907.5	10	16 28 32	80	11	SS-10	NI	-	-	-	-	-	-	-	-	16	A-6b (V)	
HARD, GRAY, **SANDY SILT**, LITTLE CLAY AND GRAVEL, DAMP	906.3	11 EOB	16 35 50/3"	-	87	SS-11	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	

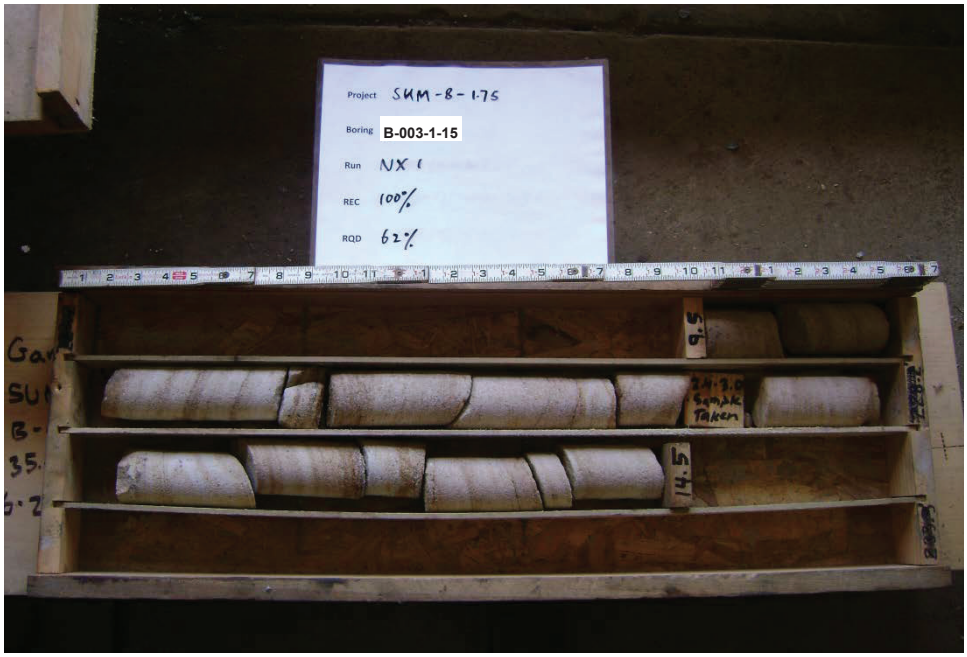
NOTES: CAVE IN AT 11.2'. NP - NON PLASTIC. NI - NOT INTACT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS



Photograph: B-001-3-16 Run 1 & 2

Photograph: B-001-5-16 Run 1



Photograph: B-003-1-15 Run 1

Photograph: B-003-4-16 Run 1

Photograph: B-003-5-15 Run 1

Photograph: B-003-8-16 Run 1

Photograph: B-004-1-16 Run 1

Photograph: B-004-2-16 Run 1

Photograph: B-004-5-16 Run 1 & 2

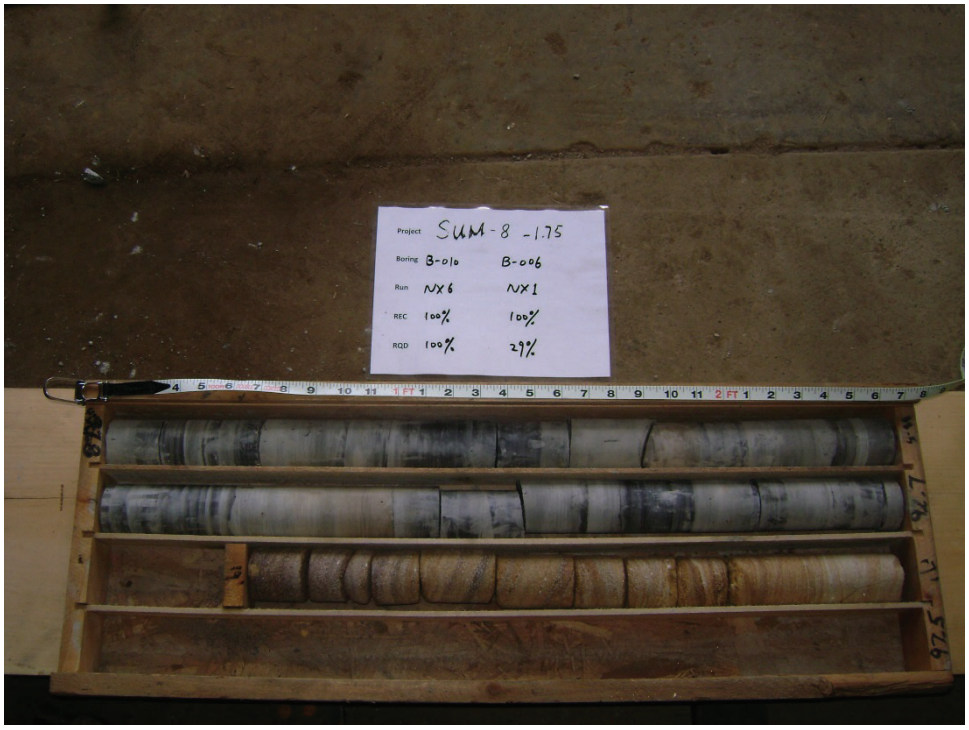
Photograph: B-004-6-16 Run 1

Photograph: B-005-1-16 Run 1

Photograph: B-005-1-16 Run 2

Photograph: B-005-1-16 Run 3

Photograph: B-005-2-16 Run 1



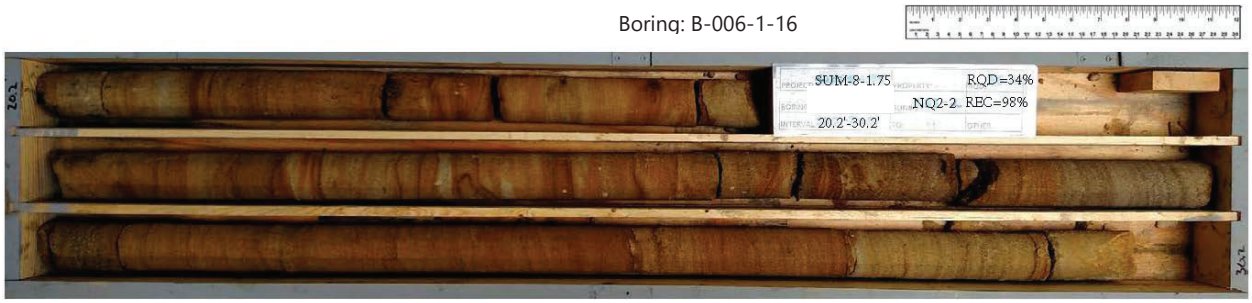
Photograph: B-006-0-15 Run 1

Photograph: B-006-0-15 Run 2-3

B-006-1-16

Photograph: B-006-1-16 Run 1

Boring: B-006-1-16



Photograph: B-006-1-16 Run 2

Photograph: B-007-0-15 Run 1-2

Photograph: B-007-0-15 Run 3

Photograph: B-007-2-16 Run 1 to 3

Photograph: B-007-2-16 Run 4

Photograph: B-008-0-15 Run 1-8

Photograph: B-008-0-15 Run 8-11

Photograph: B-008-0-15 Run 11

B-008-1-19

Run #:	Depth		Recovery		RQD	
NQ2-1	24.0'	28.0'	40/48	83%	0/48	0%
NQ2-2	28.0'	33.0'	54/60	90%	0/60	0%
SUM-8-1.75 PID 91710						

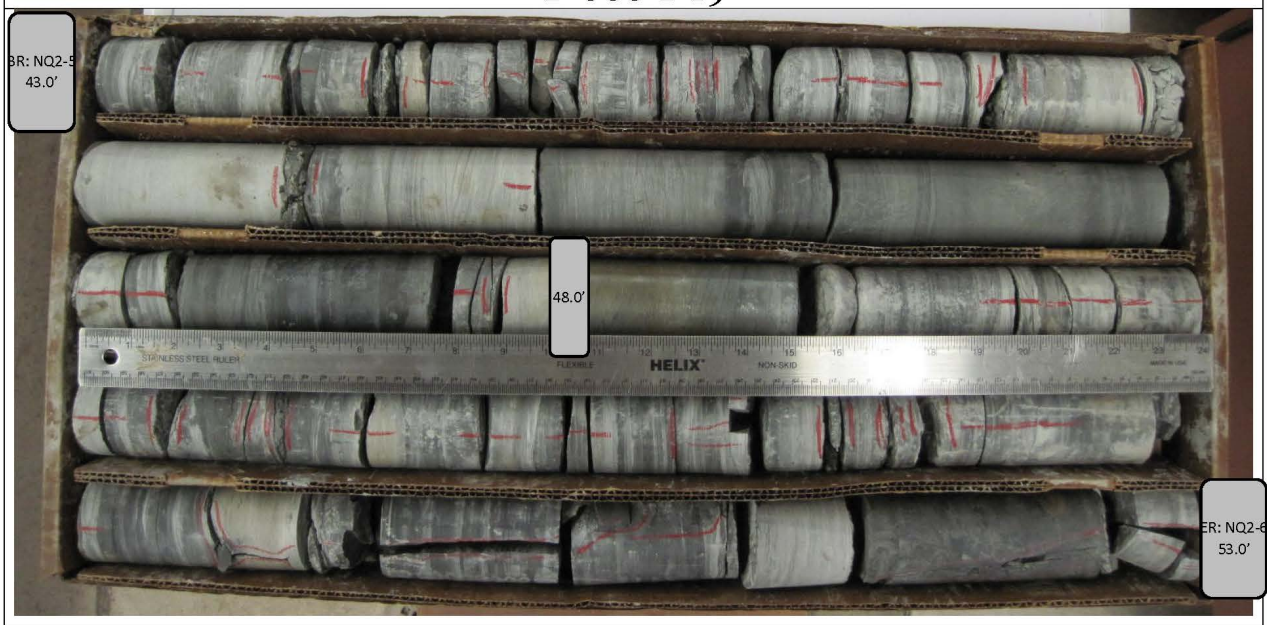
Photograph: B-008-1-19 Run 1-2

B-008-1-19

Run #:	Depth		Recovery		RQD	
NQ2-3	33.0'	38.0	58/60	97%	18/60	30%
NQ2-4	38.0'	43.0	60/60	100%	11/16	18%
SUM-8-1.75 PID 91710						

Photograph: B-008-1-19 Run 3-4

B-008-1-19



Run #:	Depth		Recovery		RQD	
NQ2-5	43.0'	48.0'	58/60	97%	42/60	70%
NQ2-6	48.0'	53.0'	57/60	95%	31/60	52%
SUM-8-1.75 PID 91710						

Photograph: B-008-1-19 Run 5-6

B-008-1-19

Run #:	Depth		Recovery		RQD	
NQ2-7	53.0'	58.0'	57/60	95%	41/60	68%
NQ2-8	58.0'	63.0'	58/60	67%	46/60	77%
SUM-8-1.75 PID 91710						

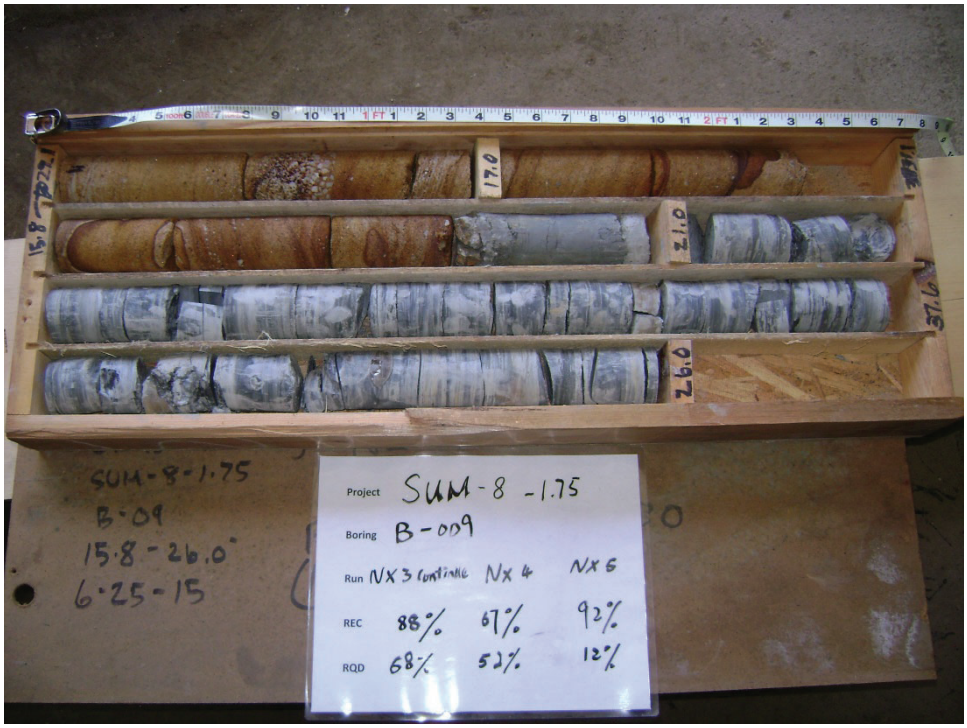
Photograph: B-008-1-19 Run 7-8

B-008-1-19

Run #:	Depth		Recovery		RQD	
NQ2-9	63.0'	68.0'	56/60	93%	45/60	75%
SUM-8-1.75 PID 91710						

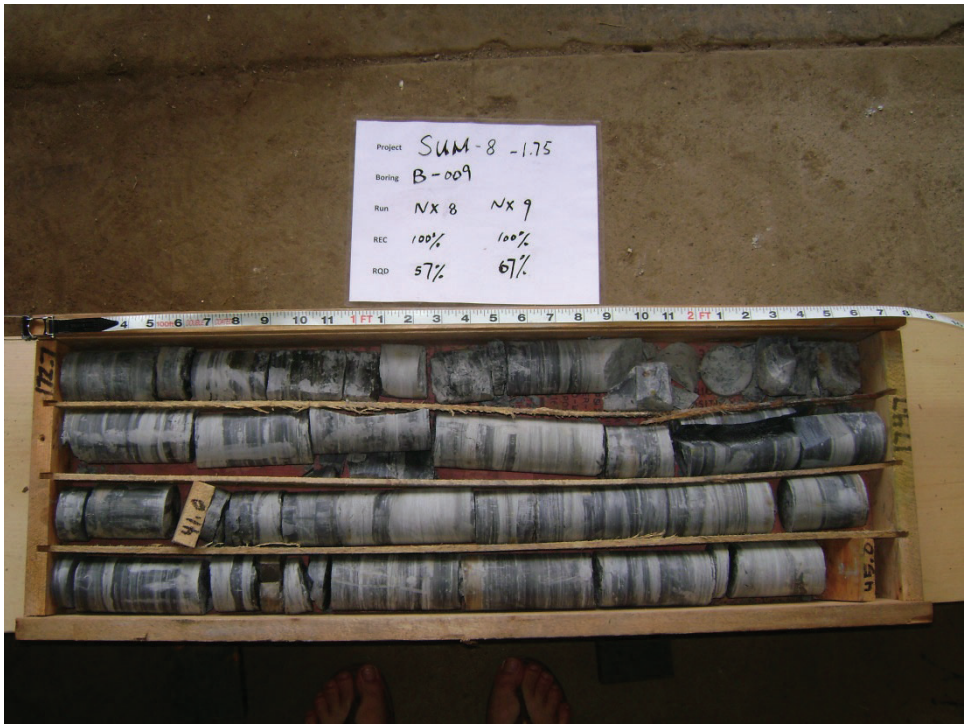
Photograph: B-008-1-19 Run 9

Photograph: B-009-0-15 Run 1-3



Photograph: B-009-0-15 Run 3-5

Photograph: B-009-0-15 Run 6-7



Photograph: B-009-0-15 Run 8-9

Photograph: B-009-1-16 Run 1 to 3

Photograph: B-009-1-16 Run 4 and 5

Photograph: B-009-1-16 Run 6 and 7

Photograph: B-009-1-16 Run 8 and 9

Photograph: B-009-4-16 Run 1

B-009-5-19

Run #:	Depth		Recovery		RQD	
NQ2-1	8.3'	11.5'	39/39	100%	22/39	56%
SUM-8-1.75 PID 91710						

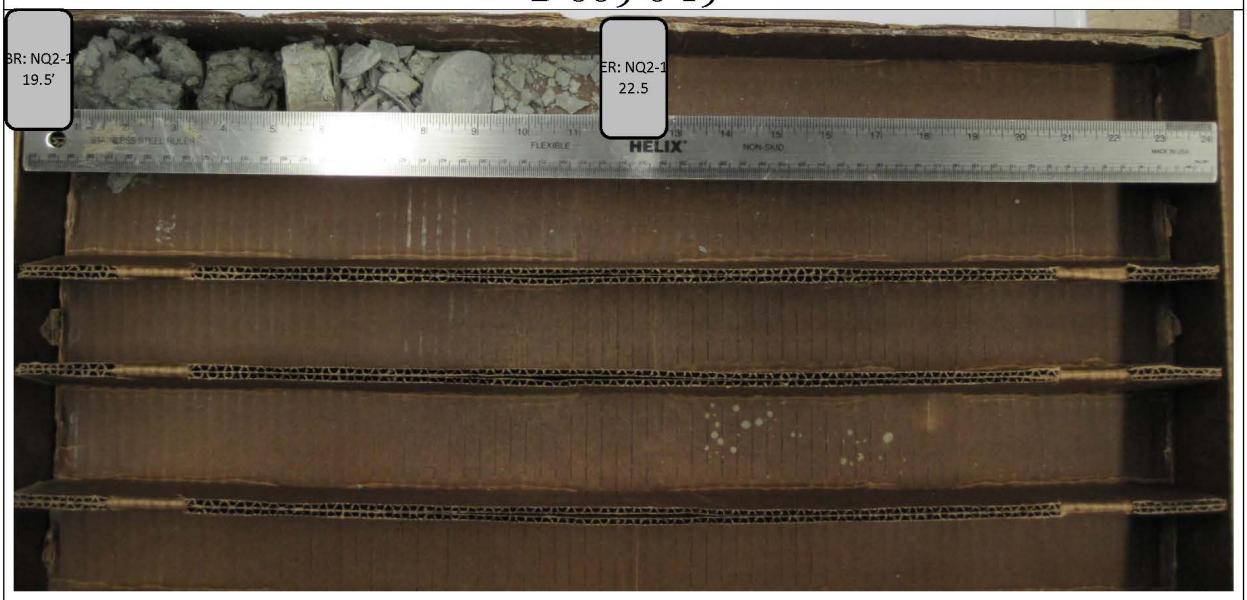
Photograph: B-009-5-19 Run 1

B-009-5-19

Run #:	Depth		Recovery		RQD	
NQ2-2	11.5'	16.5"	60/60	100%	47/48	98%
NQ2-3	16.5'	21.5'	52/60	87%	24/60	40%
SUM-8-1.75 PID 91710						

Photograph: B-009-5-19 Run 2-3

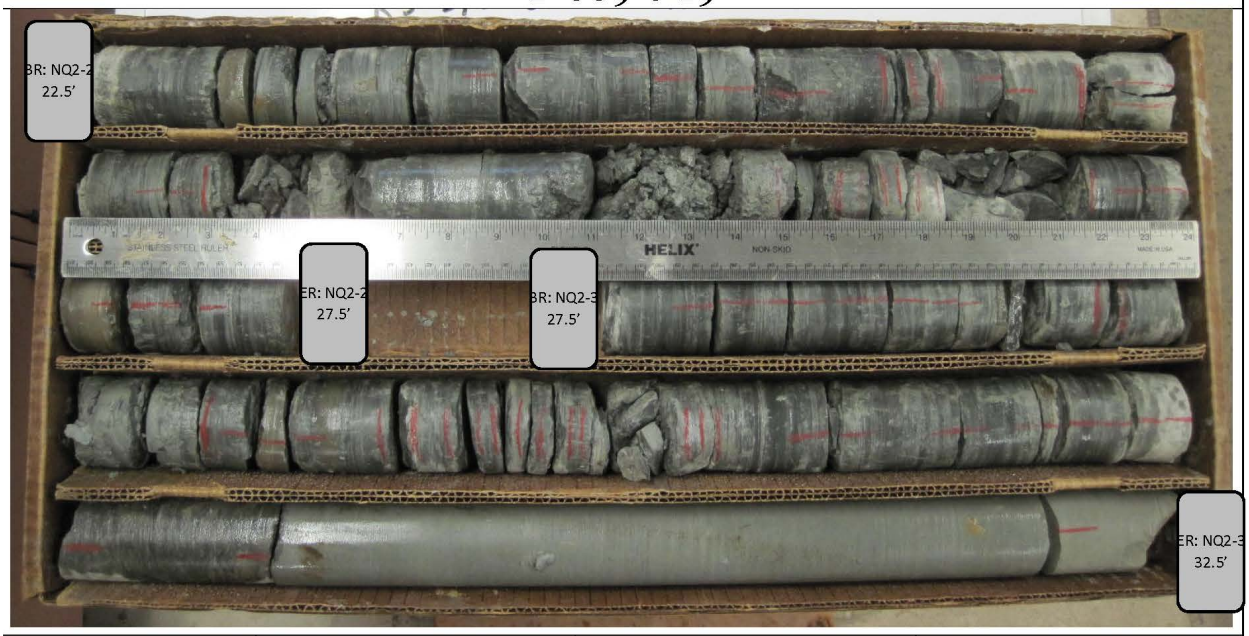
B-009-6-19



Run #:	Depth		Recovery		RQD	
NQ2-1	19.5'	21.5'	8/36	22%	0/36	0%
SUM-8-1.75 PID 91710						

Photograph: B-009-6-19 Run 1

B-009-6-19



Run #:	Depth		Recovery		RQD	
NQ2-2	22.5'	27.5'	53/60	88%	22/60	37%
NQ2-3	27.5'	32.5'	60/60	100%	43/60	72%
SUM-8-1.75 PID 91710						

Photograph: B-009-6-19 Run 2-3

B-009-6-19

Run #:	Depth		Recovery		RQD	
NQ2-4	32.5'	37.5'	60/60	100%	55/48	92%
NQ2-5	37.5'	42.5'	60/60	100%	54/60	90%
SUM-8-1.75 PID 91710						

Photograph: B-009-6-19 Run 4-5

B-009-7-19

Run #:	Depth		Recovery		RQD	
NQ2-1	25.0'	30.0'	41/60	68%	0/48	0%
NQ2-2	30.0'	35.0'	33/60	55%	26/60	43%
SUM-8-1.75 PID 91710						

Photograph: B-009-7-19 Run 1-2

B-009-7-19

Run #:	Depth		Recovery		RQD	
NQ2-3	35.0'	40.0'	60/60	100%	54/48	90%
NQ2-4	40.0'	45.0'	60/60	100%	50/60	83%
SUM-8-1.75 PID 91710						

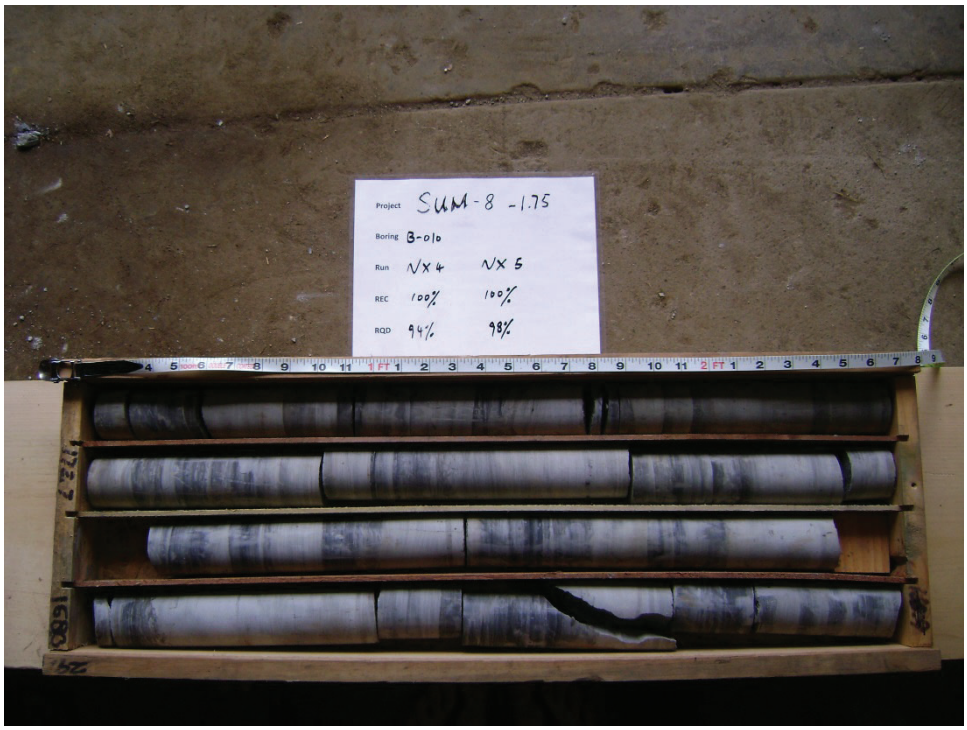
Photograph: B-009-7-19 Run 3-4

B-009-7-19

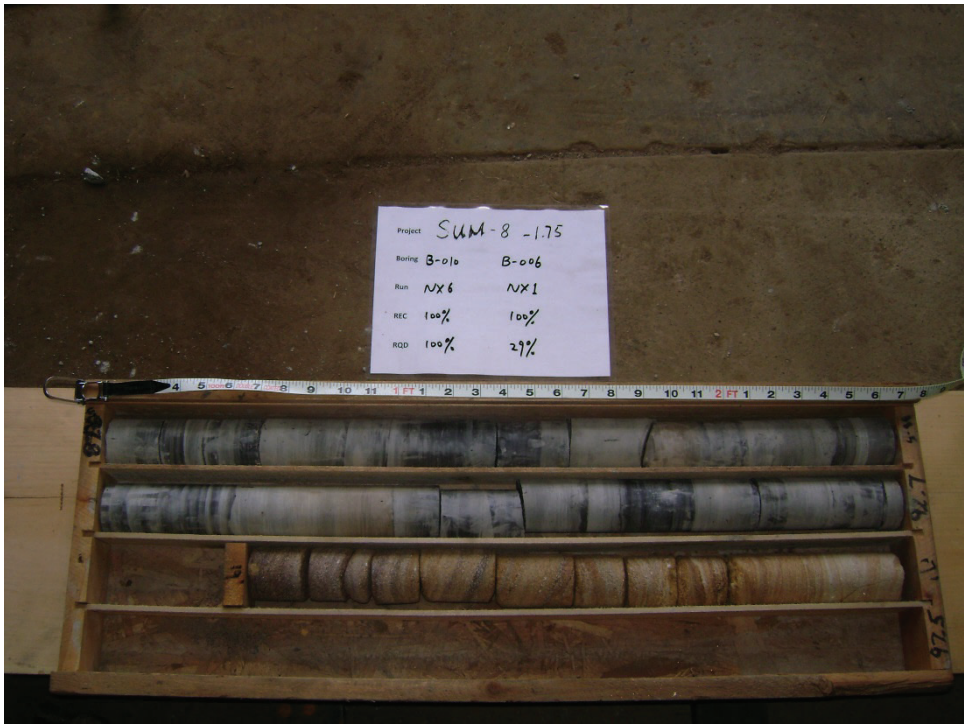
Run #:	Depth		Recovery		RQD	
NQ2-5	45.0'	50.0'	60/60	100%	52/60	87%
NQ2-6	50.0'	55.0'	58/60	97%	48/60	80%
SUM-8-1.75 PID 91710						

Photograph: B-009-7-19 Run 5-6

Photograph: B-010-0-15 Run 1-3



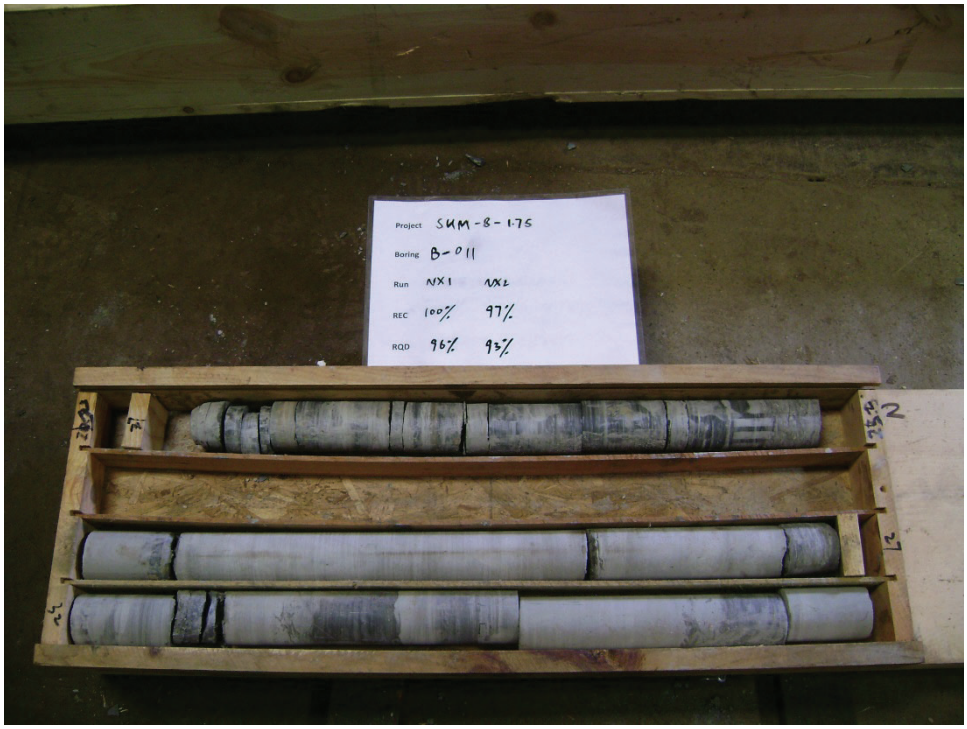
Photograph: B-010-0-15 Run 4-5



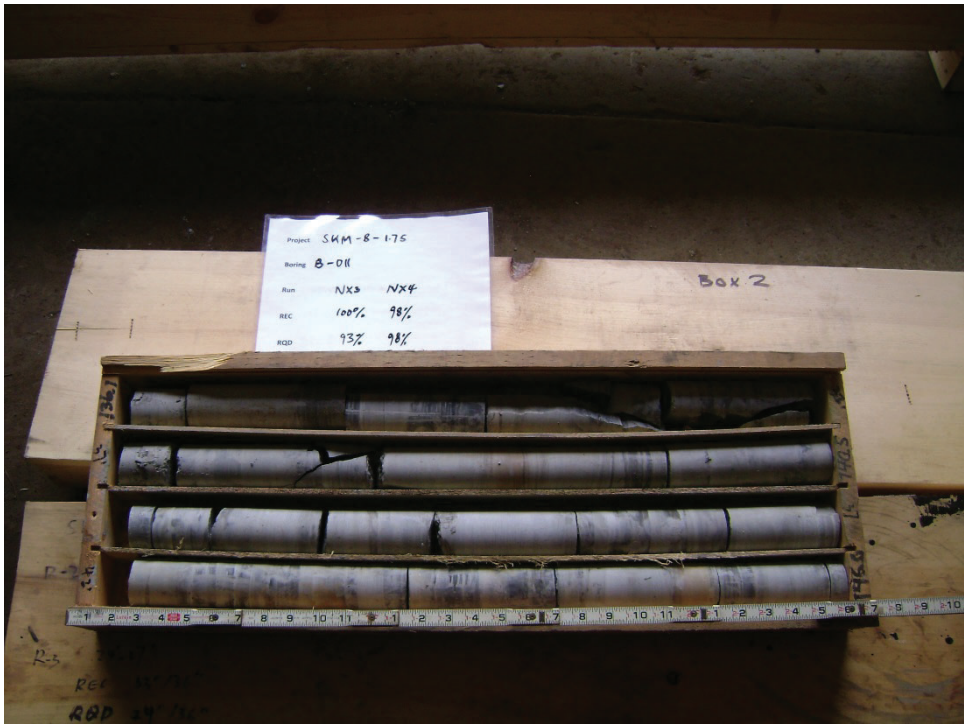
Photograph: B-010-0-15 Run 6

Photograph: B-010-1-15 Run 1-7

Photograph B-010-1-15 Run 8-9



Photograph: B-011-0-15 Run 1-2



Photograph: B-011-0-15 Run 3-4

Photograph: B-011-0-15 Run 5-6

Photograph: B-011-2-16 Run 1 to 3

Photograph: B-011-2-16 Run 4 to 6

Photograph: B-011-2-16 Run 7 and 8

Photograph: B-011-3-16 Run 1

Photograph: B-011-4-16 Run 1

Photograph: B-011-5-16 Run 1 and 2

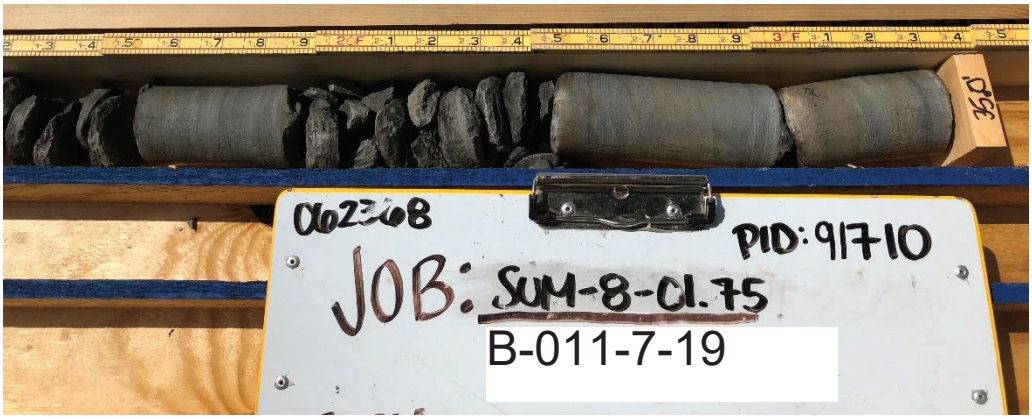
Photograph: B-011-5-16 Run 3

Photograph: B-011-5-16 Run 4

Photograph: B-011-5-16 Run 5

Photograph: B-011-7-19, R-1 (photo 1 of 3)

Photograph: B-011-7-19, R-1 (photo 2 of 3)



Photograph: B-011-7-19, R-1 (photo 3 of 3)

Photograph: B-011-7-19, R-2 (photo 1 of 4)

Photograph: B-011-7-19, R-2 (photo 2 of 4)

Photograph: B-011-7-19, R-2 (photo 3 of 4)

Photograph: B-011-7-19, R-2 (photo 4 of 4)

Photograph: B-011-7-19, R-3 (photo 1 of 4)

Photograph: B-011-7-19, R-3 (photo 2 of 4)

Photograph: B-011-7-19, R-3 (photo 3 of 4)

Photograph: B-011-7-19, R-3 (photo 4 of 4)

Photograph: B-011-7-19, R-4 (photo 1 of 4)

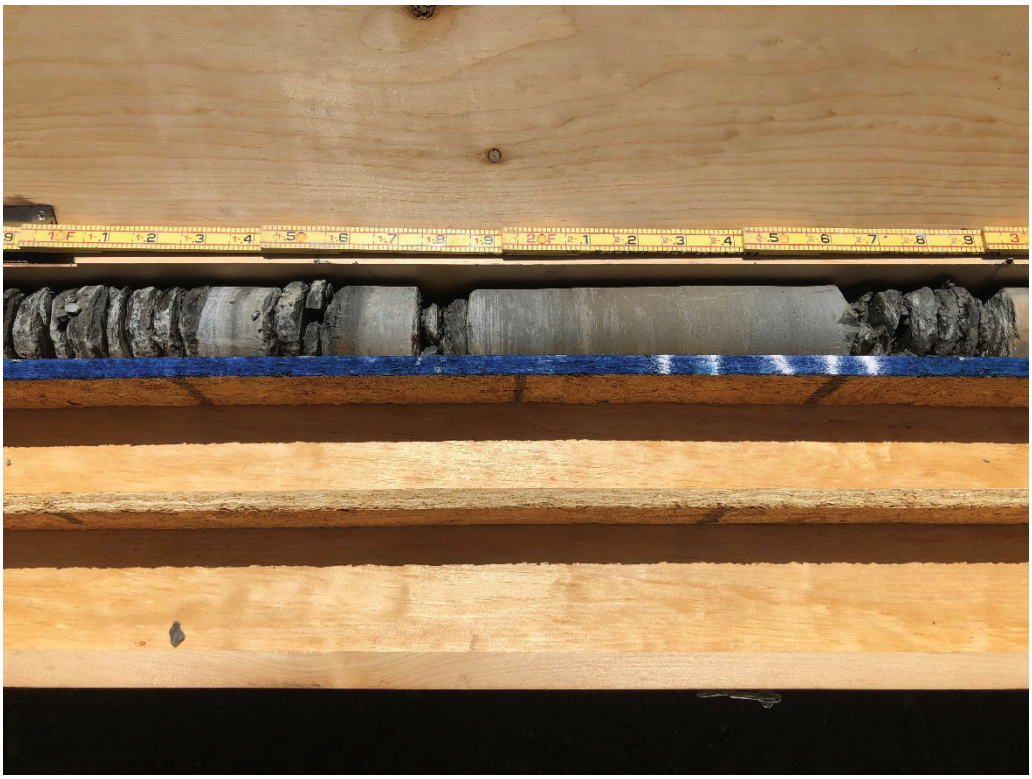
Photograph: B-011-7-19, R-4 (photo 2 of 4)

Photograph: B-011-7-19, R-4 (photo 3 of 4)

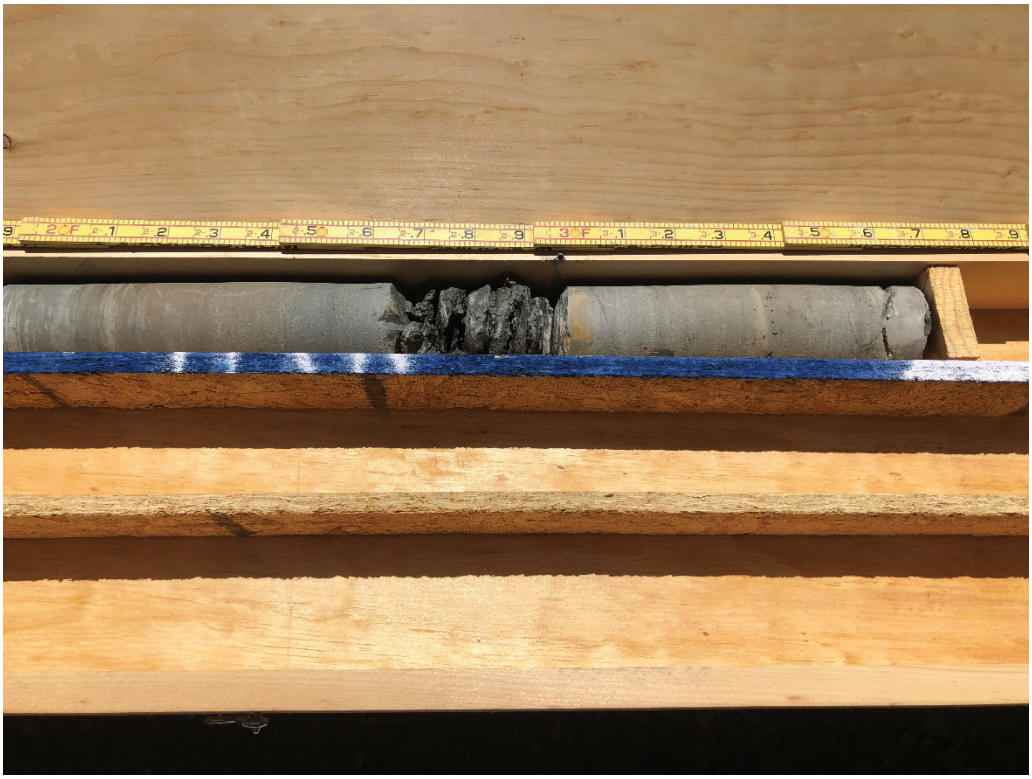
Photograph: B-011-7-19, R-4 (photo 4 of 4)

Photograph: B-011-8-19, R-1 (photo 1 of 4)

Photograph: B-011-8-19, R-1 (photo 2 of 4)



Photograph: B-011-8-19, R-1 (photo 3 of 4)



Photograph: B-011-8-19, R-1 (photo 4 of 4)

Photograph: B-011-8-19, R-2 (photo 1 of 4)

Photograph: B-011-8-19, R-2 (photo 2 of 4)

Photograph: B-011-8-19, R-2 (photo 3 of 4)

Photograph: B-011-8-19, R-2 (photo 4 of 4)

Photograph: B-011-8-19, R-3 (photo 1 of 4)

Photograph: B-011-8-19, R-3 (photo 2 of 4)

Photograph: B-011-8-19, R-3 (photo 3 of 4)

Photograph: B-011-8-19, R-3 (photo 4 of 4)

Photograph: B-011-8-19, R-4 (photo 1 of 4)

Photograph: B-011-8-19, R-4 (photo 2 of 4)

Photograph: B-011-8-19, R-4 (photo 3 of 4)

Photograph: B-011-8-19, R-4 (photo 4 of 4)

Photograph: B-012-0-15 Run 1-3

Photograph: B-012-0-15 Run 3-4

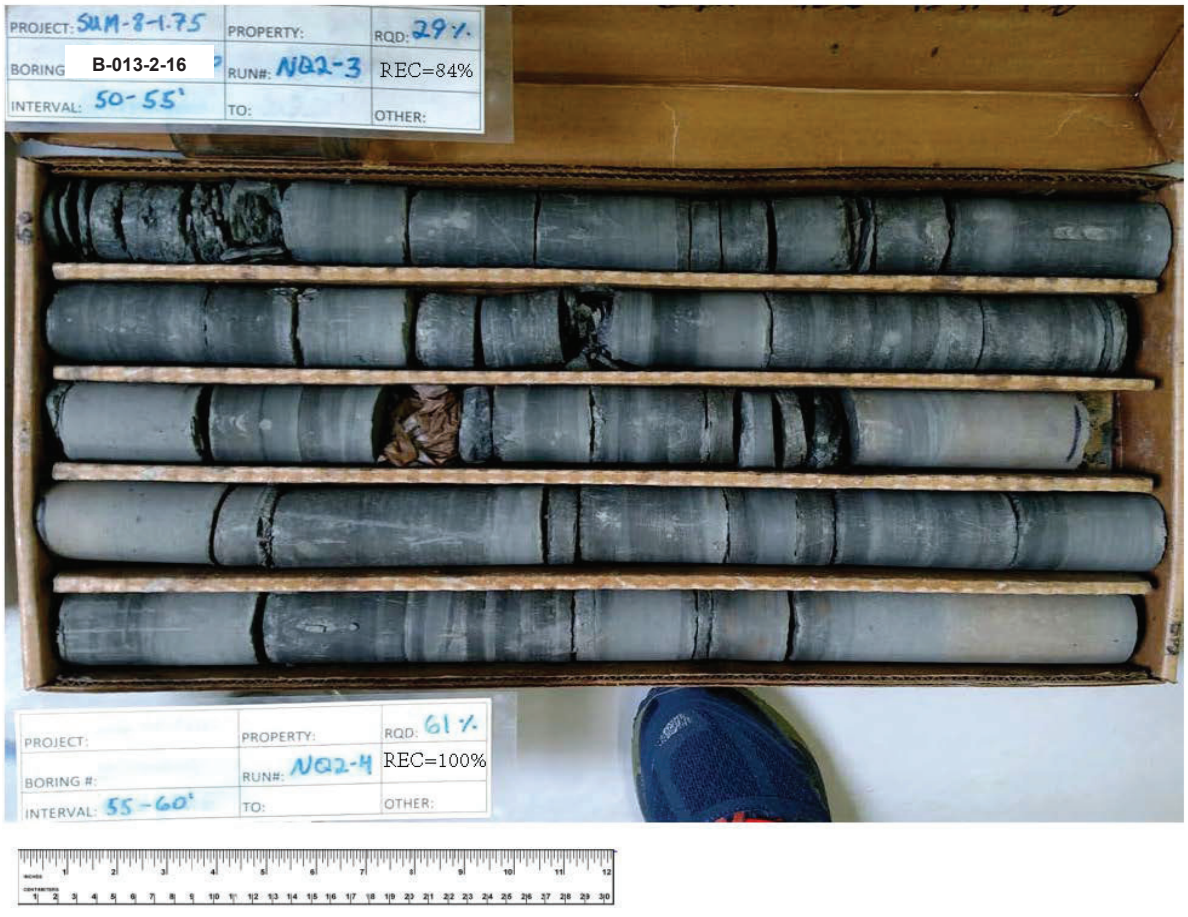
Photograph: B-012-0-15 Run 5

Photograph: B-013-0-15 Run 1-3

Photograph: B-013-0-15 Run 3-5

Photograph: B-013-0-15 Run 5

Photograph: B-013-2-16 Run 1 and 2



Photograph: B-013-2-16 Run 3 and 4

Photograph: B-013-2-16 Run 5

Photograph: B-013-2-16 Run 6 and 7

Photograph: B-013-2-16 Run 8 and 9

Photograph: B-013-3-16 Run 1 to 3

Photograph: B-013-4-16 Run 1 and 2

Photograph: B-013-4-16 Run 3

Photograph: B-013-4-16 Run 4

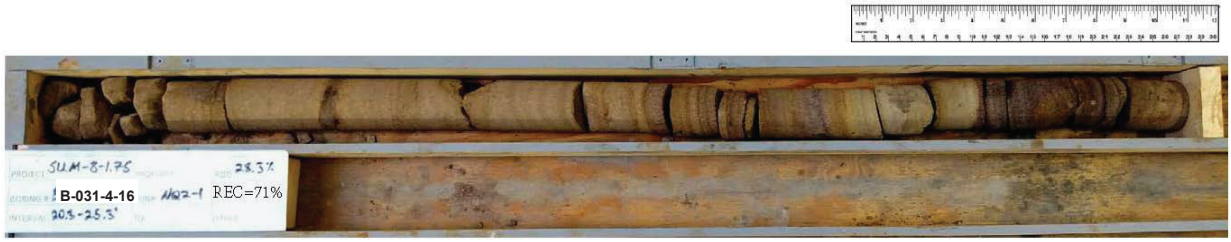
Photograph: B-013-4-16 Run 5

Photograph: B-013-5-16 Run 1 to 3

Photograph: B-030-1-16 Run 1

Photograph: B-031-1-16 Run 1

Photograph: B-031-3-16 Run 1



Photograph: B-031-4-16 Run 1

Photograph: B-031-4-16 Run 2

Photograph: B-032-2-16 Run 1 & 2

Gannett Fleming
Engineers and Architects, P.C.
Excellence Delivered **As Promised**

APPENDIX D

Lab Testing Results

8/1/2015

Compressive Strength of Rock
ASTM 7012

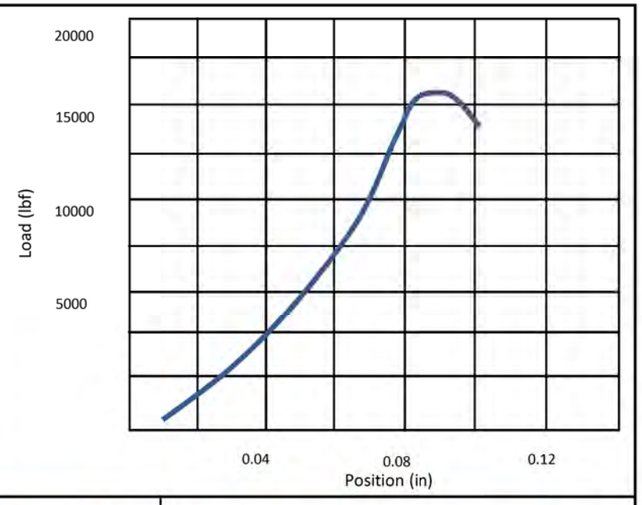
BORING NUMBER	B-003-1-15	TOP DEPTH	10.1'	BOTTOM DEPTH	10.6'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	418+31	OFFSET	44'	OFFSET DIRECTION	RIGHT

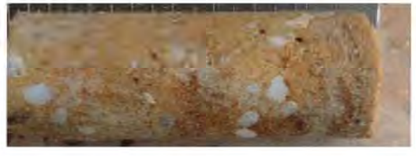
FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.545	1.993
2	4.333	1.997
3	4.541	1.995
AVERAGE	4.473	1.995

LENGTH/DIA.	2.242
AREA (in2)	3.124
MASS (GRAMS)	434.3

MAXIMUM LOAD (LBS)
15,650
COMPRESSIVE STRENGTH (PSI)
5,010
TIME OF TEST (MINUTES)
1:54
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt





BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

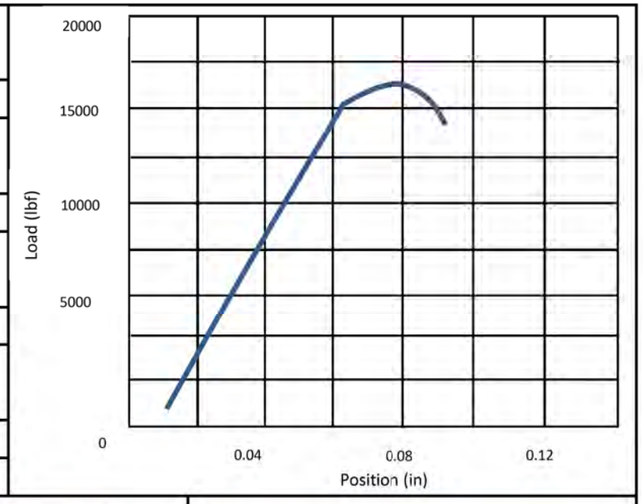
BORING NUMBER	B-003-1-15	TOP DEPTH	11.9'	BOTTOM DEPTH	12.5'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	418+31	OFFSET	44'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.283	1.994
2	4.233	1.993
3	4.238	1.999
AVERAGE	4.251	1.995

LENGTH/DIA.	2.131
AREA (in2)	3.125
MASS (GRAMS)	433.13

MAXIMUM LOAD (LBS)
16,000
COMPRESSIVE STRENGTH (PSI)
5,120
TIME OF TEST (MINUTES)
1:35
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Cardno ATC
Shaping the Future

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-003-5-15	TOP DEPTH	13.4'	BOTTOM DEPTH	13.9'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	419+81	OFFSET	36'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.998	1.993
2	3.994	1.987
3	3.989	1.988
AVERAGE	3.994	1.989

LENGTH/DIA.	2.008
AREA (in2)	3.107
MASS (GRAMS)	444.24

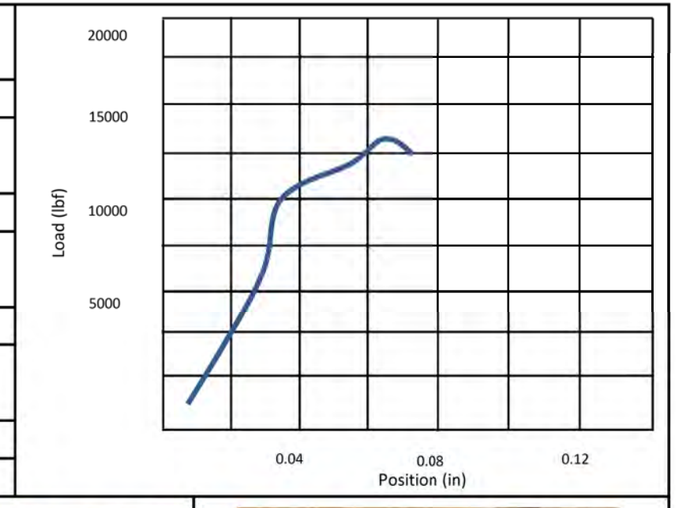
MAXIMUM LOAD (LBS)
13,140

COMPRESSIVE STRENGTH (PSI)
4,230

TIME OF TEST (MINUTES)
1:39

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

Cardno ATC
Shaping the Future

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-003-5-15	TOP DEPTH	14.4'	BOTTOM DEPTH	15.0'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	419+81	OFFSET	36'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.493	1.994
2	4.339	1.994
3	4.533	1.994
AVERAGE	4.455	1.994

LENGTH/DIA.	2.234
AREA (in2)	3.121
MASS (GRAMS)	428.34

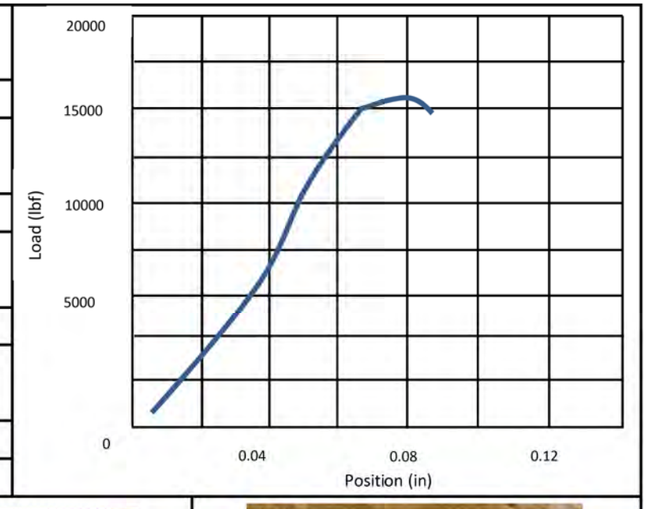
MAXIMUM LOAD (LBS)
15,070

COMPRESSIVE STRENGTH (PSI)
4,830

TIME OF TEST (MINUTES)
1:45

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

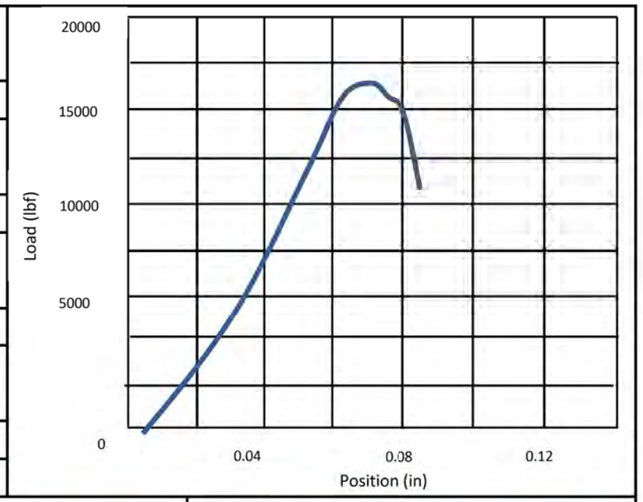
BORING NUMBER	B-006-0-15	TOP DEPTH	19.0'	BOTTOM DEPTH	19.5'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	525+07	OFFSET	40'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Light Brown, Slightly Weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.778	1.994
2	3.796	1.993
3	3.733	1.993
AVERAGE	3.769	1.993

LENGTH/DIA.	1.891
AREA (in2)	3.119
MASS (GRAMS)	420.34

MAXIMUM LOAD (LBS)
17,341
COMPRESSIVE STRENGTH (PSI)
5,560
TIME OF TEST (MINUTES)
2:33
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

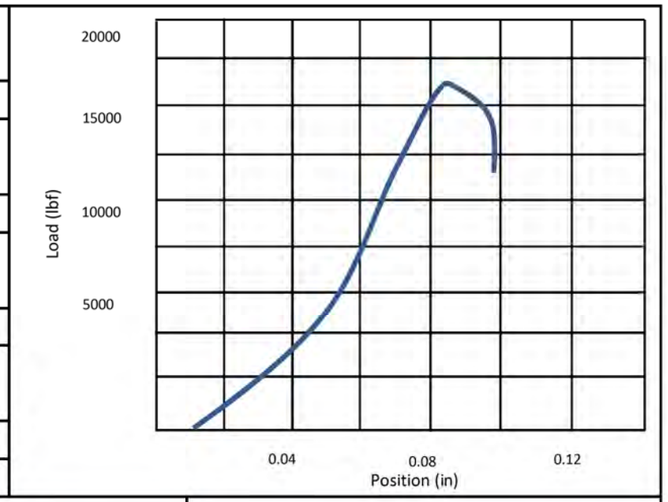
BORING NUMBER	B-007-0-15	TOP DEPTH	18.8'	BOTTOM DEPTH	19.2'
SAMPLE NUMBER	NX-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	225+54	OFFSET	49'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Light Brown, Slightly Weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	5.123	1.993
2	5.102	1.993
3	5.121	1.992
AVERAGE	5.115	1.993

LENGTH/DIA.	2.567
AREA (in2)	3.117
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
15,960
COMPRESSIVE STRENGTH (PSI)
5,120
TIME OF TEST (MINUTES)
2:19
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-007-0-15	TOP DEPTH	24.6'	BOTTOM DEPTH	25.35'
SAMPLE NUMBER	NX-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	225+54	OFFSET	49'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, brown, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.112	1.994
2	4.182	1.993
3	4.143	1.992
AVERAGE	4.146	1.993

LENGTH/DIA.	2.080
AREA (in2)	3.118
MASS (GRAMS)	433.13

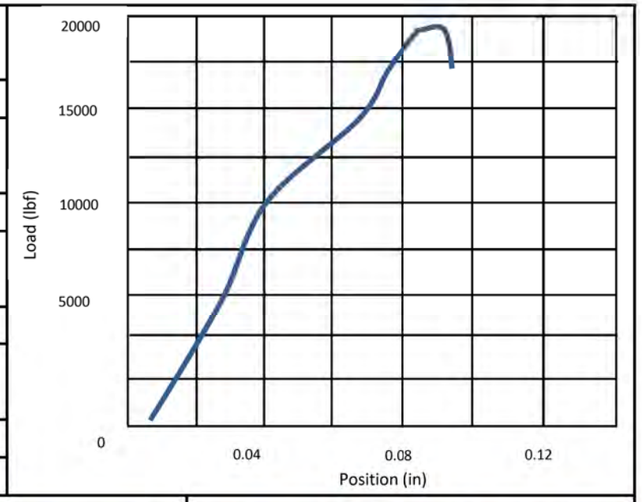
MAXIMUM LOAD (LBS)
19,330

COMPRESSIVE STRENGTH (PSI)
6,200

TIME OF TEST (MINUTES)
1:49

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-008-0-15	TOP DEPTH	44.7'	BOTTOM DEPTH	45.5'
SAMPLE NUMBER	NX-10	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	227+43	OFFSET	33'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.022	1.994
2	4.026	1.993
3	4.024	1.991
AVERAGE	4.024	1.993

LENGTH/DIA.	2.019
AREA (in2)	3.117
MASS (GRAMS)	433.13

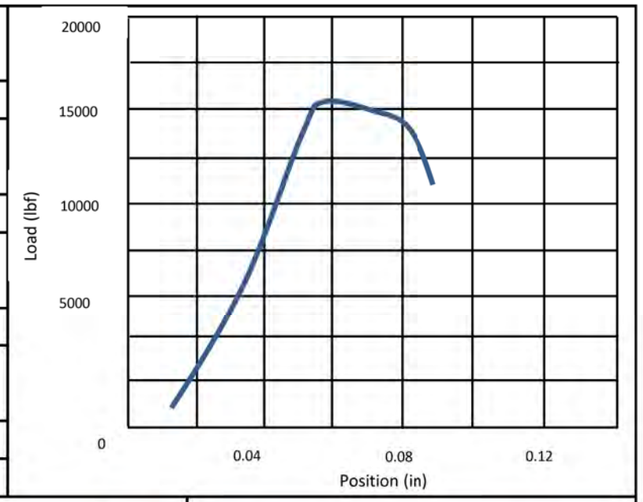
MAXIMUM LOAD (LBS)
15,990

COMPRESSIVE STRENGTH (PSI)
5,130

TIME OF TEST (MINUTES)
2:45

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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Cardno ATC
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7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-009-0-15	TOP DEPTH	8.2'	BOTTOM DEPTH	8.9'
SAMPLE NUMBER	NX-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	527+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered, slightly strong

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.998	1.993
2	3.994	1.987
3	3.989	1.988
AVERAGE	3.994	1.989

LENGTH/DIA.	2.008
AREA (in2)	3.107
MASS (GRAMS)	467.28

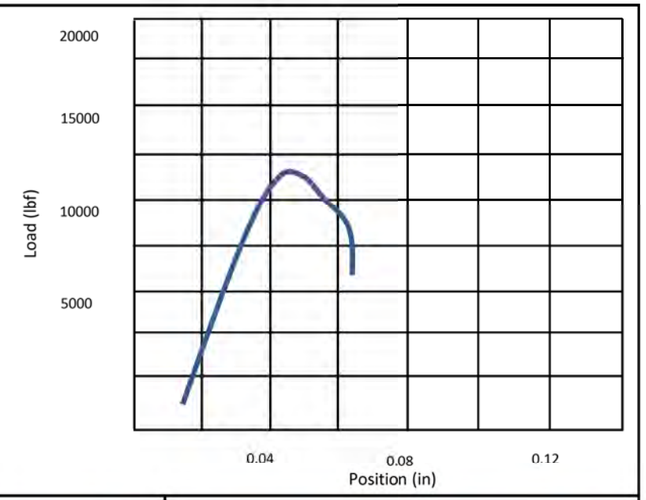
MAXIMUM LOAD (LBS)
10,690

COMPRESSIVE STRENGTH (PSI)
3,440

TIME OF TEST (MINUTES)
1:22

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

Cardno ATC
Shaping the Future

7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-009-0-15	TOP DEPTH	31.4'	BOTTOM DEPTH	31.9'
SAMPLE NUMBER	NX-7	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	527+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.439	1.993
2	4.431	1.993
3	4.433	1.993
AVERAGE	4.434	1.993

LENGTH/DIA.	2.225
AREA (in2)	3.118
MASS (GRAMS)	433.13

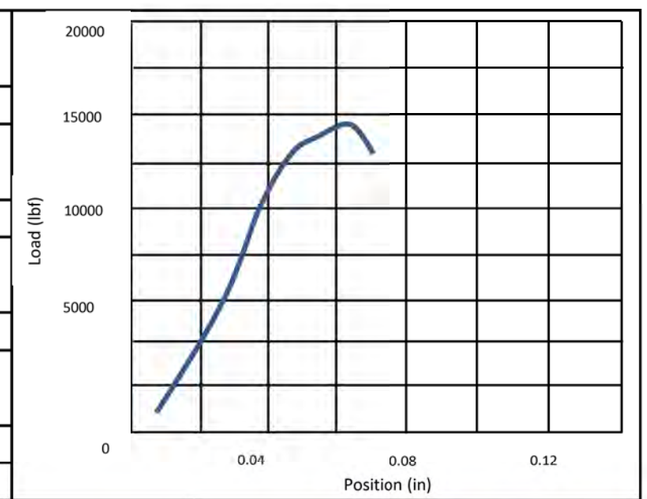
MAXIMUM LOAD (LBS)
14,870

COMPRESSIVE STRENGTH (PSI)
4,770

TIME OF TEST (MINUTES)
2:10

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-0-15	TOP DEPTH	28.5'	BOTTOM DEPTH	29.0'
SAMPLE NUMBER	NX-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	513+07	OFFSET	13'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.129	1.992
2	4.291	1.992
3	4.222	1.992
AVERAGE	4.214	1.992

LENGTH/DIA.	2.115
AREA (in2)	3.115
MASS (GRAMS)	467.28

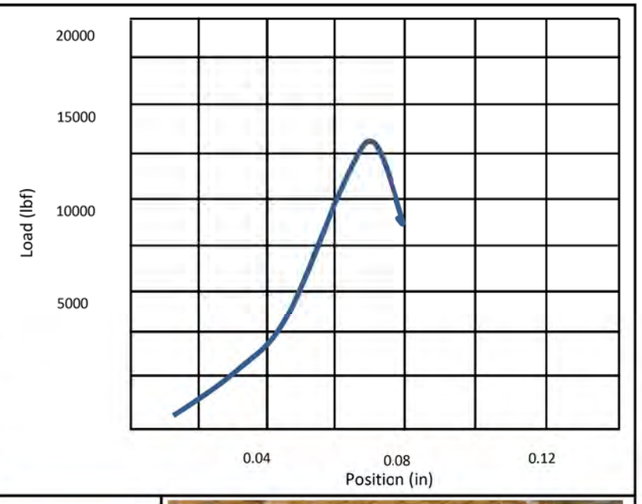
MAXIMUM LOAD (LBS)
13,640

COMPRESSIVE STRENGTH (PSI)
4,380

TIME OF TEST (MINUTES)
2:02

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-0-15	TOP DEPTH	41.8'	BOTTOM DEPTH	42.2'
SAMPLE NUMBER	NX-6	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	513+07	OFFSET	13'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.045	1.994
2	4.044	1.993
3	4.034	1.994
AVERAGE	4.041	1.994

LENGTH/DIA.	2.027
AREA (in2)	3.120
MASS (GRAMS)	433.13

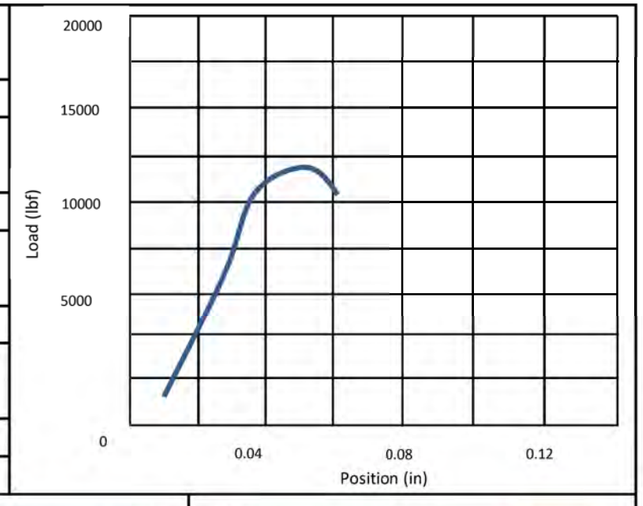
MAXIMUM LOAD (LBS)
11,980

COMPRESSIVE STRENGTH (PSI)
3,840

TIME OF TEST (MINUTES)
1:54

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

DRAWN YLZ
CHECKED TLM

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-1-15	TOP DEPTH	41.8'	BOTTOM DEPTH	42.35'
SAMPLE NUMBER	NX-8	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	534+14	OFFSET	19'	OFFSET DIRECTION	RIGHT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	2.783	1.993
2	2.777	1.994
3	2.739	1.988
AVERAGE	2.766	1.992

LENGTH/DIA.	1.389
AREA (in2)	3.114
MASS (GRAMS)	467.28

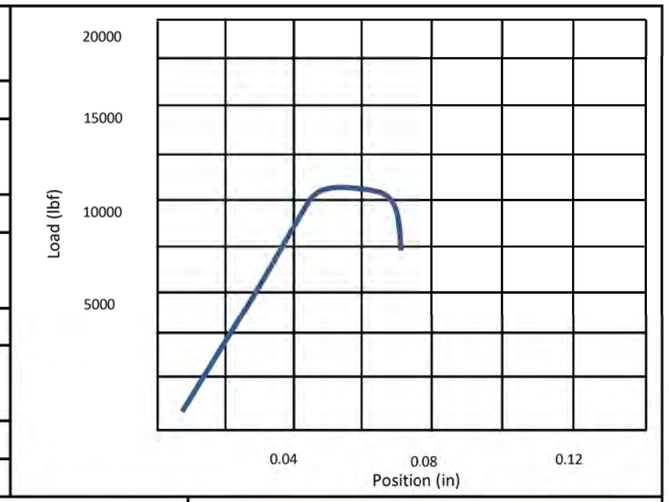
MAXIMUM LOAD (LBS)
10,710

COMPRESSIVE STRENGTH (PSI)
3,440

TIME OF TEST (MINUTES)
1:22

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-011-0-15	TOP DEPTH	26.3'	BOTTOM DEPTH	26.9'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	231+23	OFFSET	36'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.121	1.994
2	4.238	1.993
3	4.233	1.991
AVERAGE	4.197	1.993

LENGTH/DIA.	2.106
AREA (in2)	3.117
MASS (GRAMS)	433.13

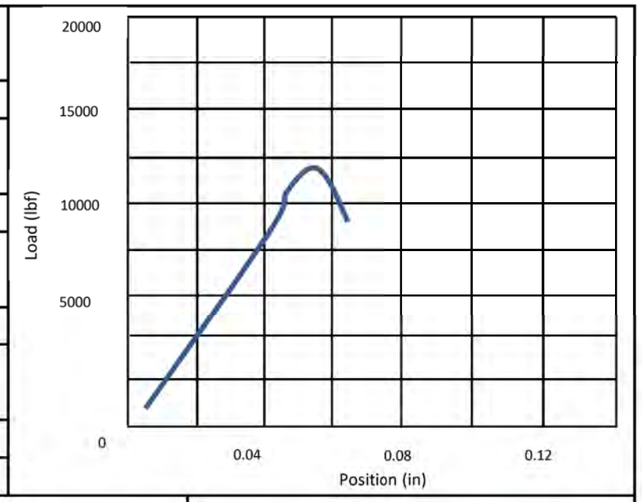
MAXIMUM LOAD (LBS)
11,970

COMPRESSIVE STRENGTH (PSI)
3,840

TIME OF TEST (MINUTES)
2:04

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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8/1/2015

Compressive Strength of Rock
ASTM 7012

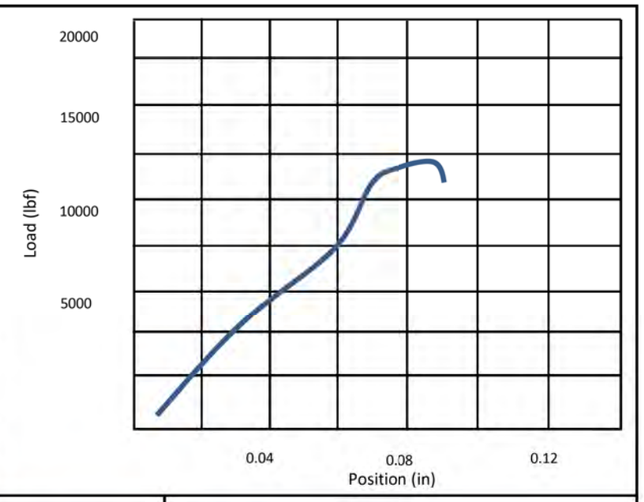
BORING NUMBER	B-011-0-15	TOP DEPTH	47.2'	BOTTOM DEPTH	47.8'
SAMPLE NUMBER	NX-6	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	231+23	OFFSET	36'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Sandstone, light brown, slightly weathered, slightly strong

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.093	1.869
2	4.088	1.987
3	4.039	1.988
AVERAGE	4.073	1.948

LENGTH/DIA.	2.091
AREA (in2)	2.979
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
11,650
COMPRESSIVE STRENGTH (PSI)
3,910
TIME OF TEST (MINUTES)
2:34
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

7/13/2015

Compressive Strength of Rock
ASTM 7012

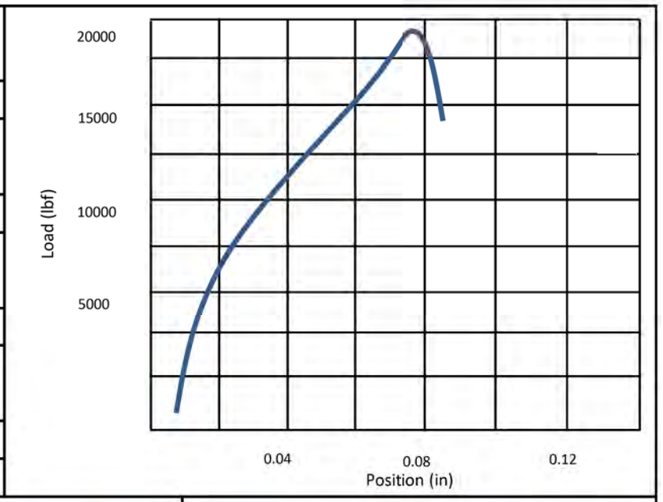
BORING NUMBER	B-012-0-15	TOP DEPTH	41.4'	BOTTOM DEPTH	41.8'
SAMPLE NUMBER	NX-5	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	535+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.329	1.988
2	4.331	1.984
3	4.327	1.988
AVERAGE	4.329	1.987

LENGTH/DIA.	2.179
AREA (in2)	3.098
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
19,460
COMPRESSIVE STRENGTH (PSI)
6,300
TIME OF TEST (MINUTES)
2:58
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Cardno ATC
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7/13/2015

Compressive Strength of Rock
ASTM 7012

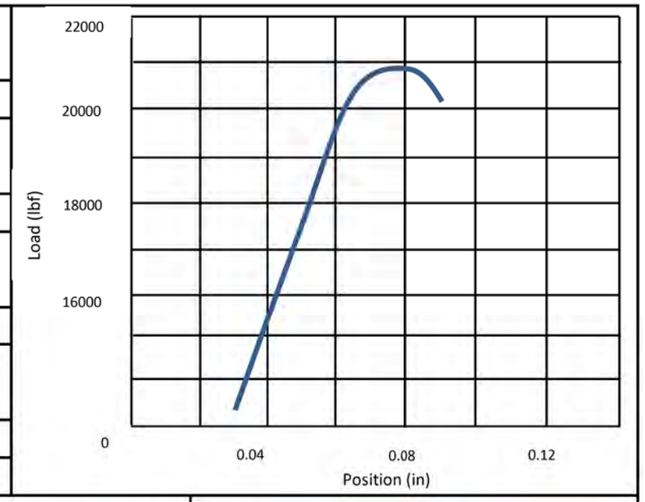
BORING NUMBER	B-013-0-15	TOP DEPTH	51.5'	BOTTOM DEPTH	55.1'
SAMPLE NUMBER	NX-4	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	235+78	OFFSET	12'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.981	1.995
2	3.991	1.995
3	3.987	1.993
AVERAGE	3.986	1.994

LENGTH/DIA.	1.999
AREA (in2)	3.122
MASS (GRAMS)	433.13

MAXIMUM LOAD (LBS)
20,970
COMPRESSIVE STRENGTH (PSI)
6,740
TIME OF TEST (MINUTES)
2:19
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

Cardno ATC
Shaping the Future

8/1/2015

Compressive Strength of Rock
ASTM 7012

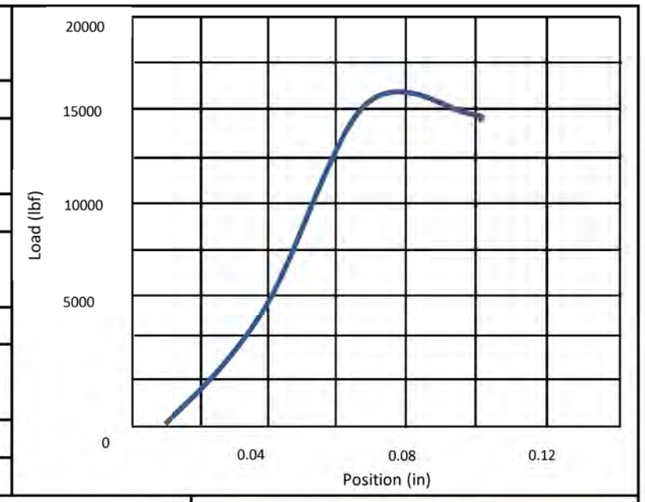
BORING NUMBER	B-013-0-15	TOP DEPTH	55.3'	BOTTOM DEPTH	56.0'
SAMPLE NUMBER	NX-4	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	235+78	OFFSET	12'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.022	1.994
2	4.026	1.993
3	4.024	1.888
AVERAGE	4.024	1.958

LENGTH/DIA.	2.055
AREA (in2)	3.011
MASS (GRAMS)	412.81

MAXIMUM LOAD (LBS)
15,900
COMPRESSIVE STRENGTH (PSI)
5,280
TIME OF TEST (MINUTES)
2:08
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-005-1-16, NQ2-2, Depth: 37.5 - 37.9 ft)

Tested Date: 1/31/2017

Specimen Properties

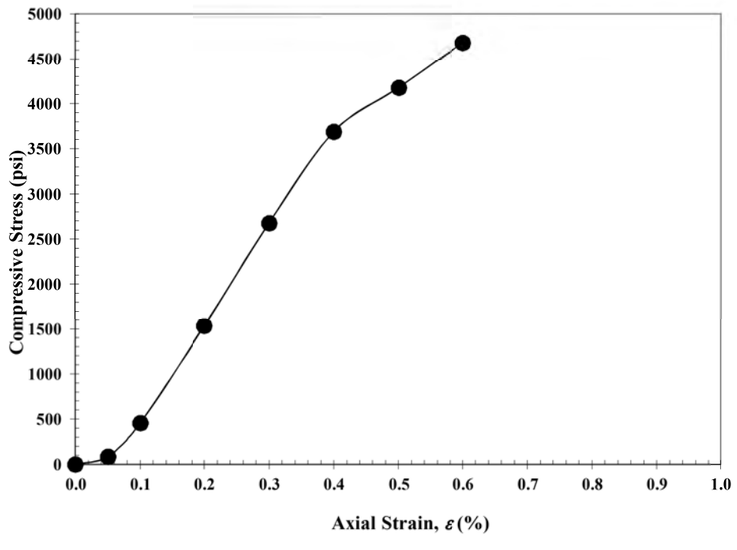
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.55
Length to Diameter Ratio:	2.29
Area, A (in^2):	3.09
Volume, V (in^3):	14.08
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	4.4
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	135.4
Dry Unit Weight, γ_d (lb/ft^3):	129.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4680** **32** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-005-2-16, NQ2-1, Depth: 25.2 - 25.6 ft)

Tested Date: 1/13/2017

Specimen Properties

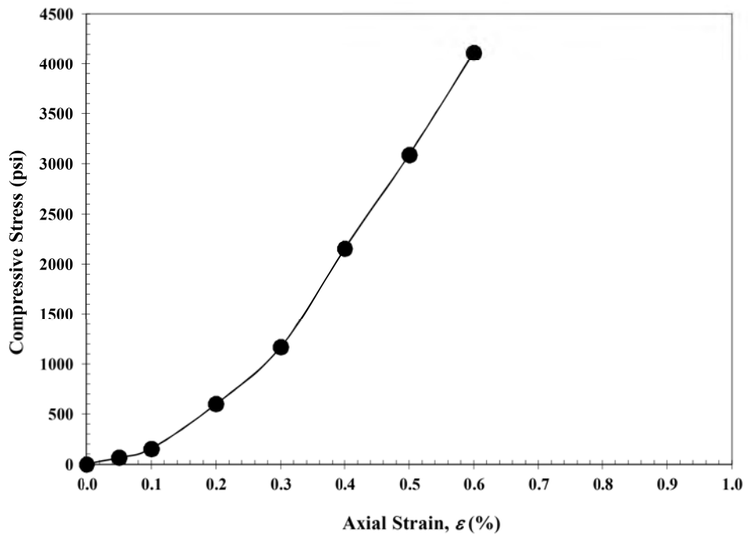
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.50
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.07
Volume, V (in^3):	13.82
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	2.9
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	132.2
Dry Unit Weight, γ_d (lb/ft^3):	128.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4111** **28** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, orangish brown, fine to medium grained, SANDSTONE, ferriferous, friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-006-1-16, NQ2-1, Depth: 16.6 - 17.0 ft)

Tested Date: 1/13/2017

Specimen Properties

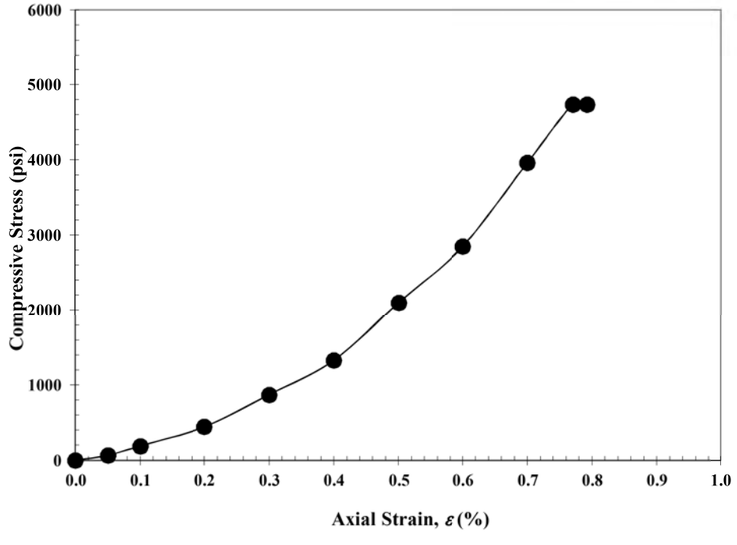
Average Dia., D_{avg} (in):	1.96
Average Height, H_{avg} (in):	4.54
Length to Diameter Ratio:	2.32
Area, A (in^2):	3.02
Volume, V (in^3):	13.71
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	6.3
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	137.8
Dry Unit Weight, γ_d (lb/ft^3):	129.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4737** **33** (MPa)

Strain (%): **0.8**



Notes: Moderately strong, orangish brown and light brown, fine to coarse grained, SANDSTONE, ferriferous, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-006-1-16, NQ2-2, Depth: 25.2 - 25.6 ft)

Tested Date: 1/13/2017

Specimen Properties

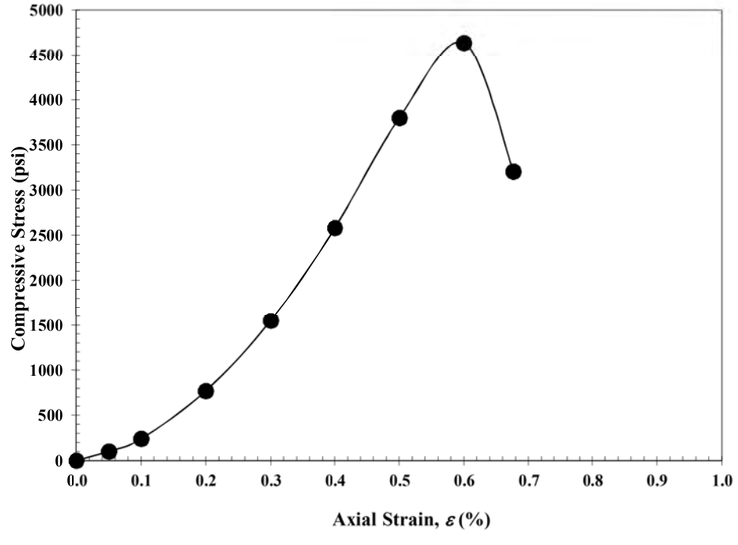
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.29
Length to Diameter Ratio:	2.16
Area, A (in^2):	3.08
Volume, V (in^3):	13.21
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	5.6
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	139.3
Dry Unit Weight, γ_d (lb/ft^3):	131.8

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4635** **32** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, slightly ferriferous, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-007-2-16, NQ2-3, Depth: 49.5 - 49.9 ft)

Tested Date: 4/19/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.34
Length to Diameter Ratio:	2.19
Area, A (in^2):	3.08
Volume, V (in^3):	13.34
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.2
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	158.0
Dry Unit Weight, γ_d (lb/ft^3):	156.2

Final Specimen Figure

64 (MPa)

Results

Unconfined Compressive Strength (psi): **9344**

Strain (%): **1.5**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-009-1-16, NQ2-3, Depth: 47.7 - 48.1 ft)

Tested Date: 4/12/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.54
Length to Diameter Ratio:	2.29
Area, A (in^2):	3.09
Volume, V (in^3):	14.02
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	0.6
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	170.6
Dry Unit Weight, γ_d (lb/ft^3):	169.6

Final Specimen Figure

127 (MPa)

Results

Unconfined Compressive Strength (psi): **18462**

Strain (%): **1.0**

Notes: Very strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-009-1-16, NQ2-6, Depth: 62.4 - 62.8 ft)

Tested Date: 4/12/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.46
Length to Diameter Ratio:	2.26
Area, A (in^2):	3.07
Volume, V (in^3):	13.67
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.8
Dry Mass of Specimen (lb):	1.3
Wet Unit Weight, γ (lb/ft^3):	162.0
Dry Unit Weight, γ_d (lb/ft^3):	159.2

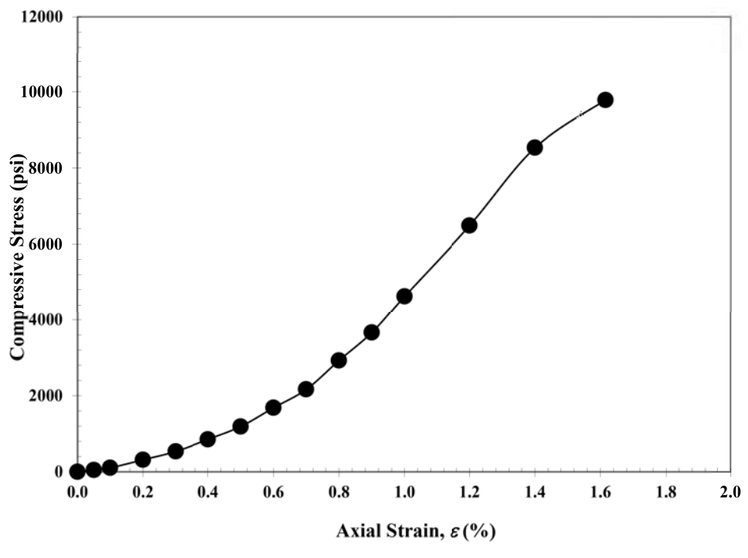
Final Specimen Figure

67 (MPa)

Results

Unconfined Compressive Strength (psi): **9789**

Strain (%): **1.6**



Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
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Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-009-4-16, NQ2-1, Depth: 32.3 - 32.7 ft)

Tested Date: 3/6/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.49
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.08
Volume, V (in^3):	13.84
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.1
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	153.7
Dry Unit Weight, γ_d (lb/ft^3):	152.0

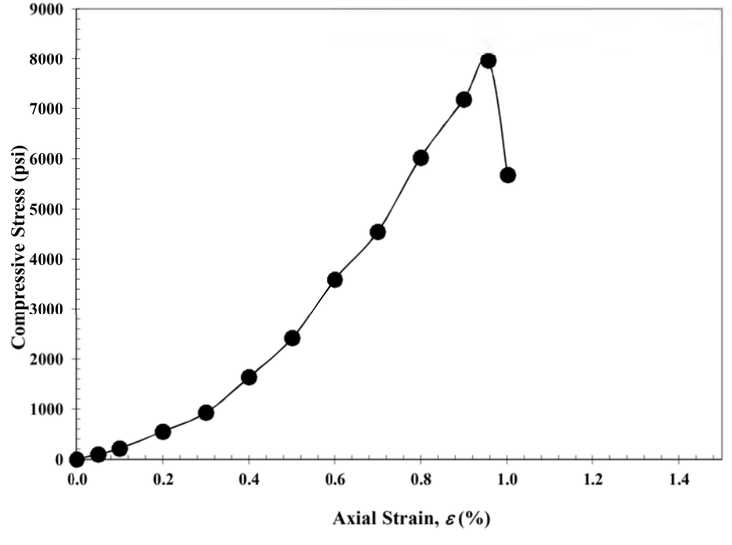
Final Specimen Figure

55 (MPa)

Results

Unconfined Compressive Strength (psi): **7964**

Strain (%): **1.0**



Notes: Strong, gray, SHALE, moderately silty.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-3, Depth: 44.1 - 44.5 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.97
Average Height, H_{avg} (in):	4.15
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.06
Volume, V (in^3):	12.69
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.9
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	158.7
Dry Unit Weight, γ_d (lb/ft^3):	155.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**3331**	**23** (MPa)
Strain (%):	**3.8**	

Notes: Slightly strong, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-4, Depth: 48.1 - 48.4 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.20
Length to Diameter Ratio:	2.13
Area, A (in^2):	3.07
Volume, V (in^3):	12.88
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.7
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	155.0
Dry Unit Weight, γ_d (lb/ft^3):	152.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**10278**	**71** (MPa)
Strain (%):	**1.0**	

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-5, Depth: 52.9 - 53.2 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.15
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.08
Volume, V (in^3):	12.77
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	3.9
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	159.5
Dry Unit Weight, γ_d (lb/ft^3):	153.5

Final Specimen Figure

56 (MPa)

Results

Unconfined Compressive Strength (psi): **8084**

Strain (%): **1.4**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-4-16, NX-1, Depth: 50.0 - 50.4 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.04
Average Height, H_{avg} (in):	4.65
Length to Diameter Ratio:	2.28
Area, A (in^2):	3.28
Volume, V (in^3):	15.22
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	2.8
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	160.7
Dry Unit Weight, γ_d (lb/ft^3):	156.3

Final Specimen Figure

17 (MPa)

Results

Unconfined Compressive Strength (psi): **2492**

Strain (%): **1.3**

Notes: Slightly strong, dark gray, SHALE interbedded with gray siltstone.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-5-16, NQ-2, Depth: 48.7 - 49.1 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.41
Length to Diameter Ratio:	2.23
Area, A (in^2):	3.08
Volume, V (in^3):	13.58
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	3.4
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	159.6
Dry Unit Weight, γ_d (lb/ft^3):	154.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **1384**

10 (MPa)

Strain (%): **2.0**

Notes: Weak, gray, SHALE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-5-16, NQ-3, Depth: 54.8 - 55.2 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.43
Length to Diameter Ratio:	2.22
Area, A (in^2):	3.11
Volume, V (in^3):	13.79
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	3.9
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	160.7
Dry Unit Weight, γ_d (lb/ft^3):	154.8

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **12128**

84 (MPa)

Strain (%): **1.0**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-3, Depth: 53.4 - 53.8 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.24
Length to Diameter Ratio:	2.13
Area, A (in^2):	3.11
Volume, V (in^3):	13.17
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	4.0
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	156.4
Dry Unit Weight, γ_d (lb/ft^3):	150.3

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**683**	**5** (MPa)
Strain (%):	**2.3**	

Notes: Very weak, gray, SHALE INTERBEDDED WITH SILTSTONE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-4, Depth: 55.8 - 56.2 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.28
Length to Diameter Ratio:	2.16
Area, A (in^2):	3.10
Volume, V (in^3):	13.28
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	155.9
Dry Unit Weight, γ_d (lb/ft^3):	153.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**11709**	**81** (MPa)
Strain (%):	**1.3**	

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-5, Depth: 63.4 - 63.8 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.08
Length to Diameter Ratio:	2.06
Area, A (in^2):	3.09
Volume, V (in^3):	12.61
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	3.6
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	157.1
Dry Unit Weight, γ_d (lb/ft^3):	151.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **942** **6** (MPa)

Strain (%): **2.8**

Notes: Weak, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-3-16, NX-2, Depth: 51.3 - 51.6 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.01
Length to Diameter Ratio:	1.96
Area, A (in^2):	3.29
Volume, V (in^3):	13.20
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	152.8
Dry Unit Weight, γ_d (lb/ft^3):	150.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **10916** **75** (MPa)

Strain (%): **1.3**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-1, Depth: 47.8 - 48.2 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.47
Length to Diameter Ratio:	2.24
Area, A (in^2):	3.12
Volume, V (in^3):	13.96
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.5
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	154.9
Dry Unit Weight, γ_d (lb/ft^3):	152.6

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **12151**

84 (MPa)

Strain (%): **1.4**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-3, Depth: 62.1 - 62.5 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.47
Length to Diameter Ratio:	2.25
Area, A (in^2):	3.11
Volume, V (in^3):	13.90
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	157.6
Dry Unit Weight, γ_d (lb/ft^3):	155.2

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **11803**

81 (MPa)

Strain (%): **1.3**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-4, Depth: 68.5 - 68.9 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.26
Length to Diameter Ratio:	2.15
Area, A (in^2):	3.09
Volume, V (in^3):	13.15
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	2.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	163.1
Dry Unit Weight, γ_d (lb/ft^3):	159.0

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **3028**

21 (MPa)

Strain (%): **2.2**

Notes: Slightly strong, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
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614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-5-16, NX-1, Depth: 71.6 - 72.0 ft)

Tested Date: 4/7/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.29
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.29
Volume, V (in^3):	14.11
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	2.2
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	153.0
Dry Unit Weight, γ_d (lb/ft^3):	149.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **9267**

64 (MPa)

Strain (%): **1.1**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-5-16, NX-3, Depth: 75.0 - 75.4 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.58
Length to Diameter Ratio:	2.24
Area, A (in^2):	3.29
Volume, V (in^3):	15.09
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	0.6
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	165.7
Dry Unit Weight, γ_d (lb/ft^3):	164.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **24283**

167 (MPa)

Strain (%): **0.9**

Notes: Very strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-030-1-16, NQ2-1, Depth: 29.3 - 29.7 ft)

Tested Date: 1/18/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.97
Average Height, H_{avg} (in):	4.38
Length to Diameter Ratio:	2.22
Area, A (in^2):	3.06
Volume, V (in^3):	13.39
Wet Mass of Specimen (lb):	1.0
Moisture Content (%):	4.6
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	134.3
Dry Unit Weight, γ_d (lb/ft^3):	128.4

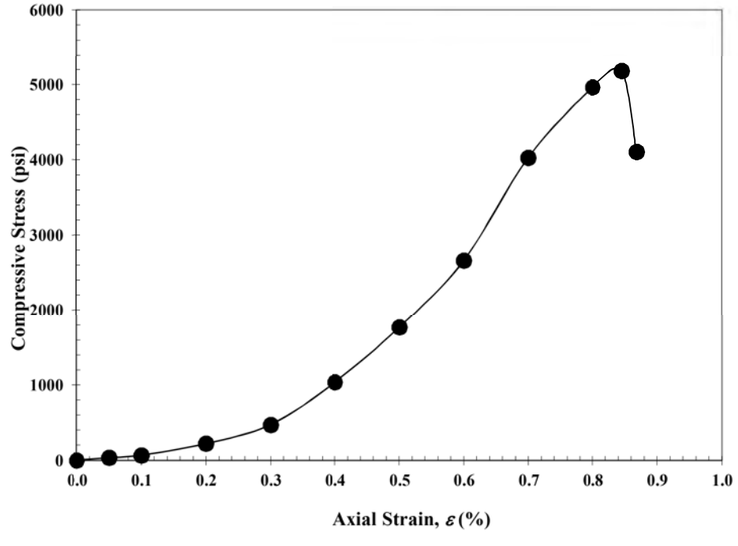
Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **5184**

36 (MPa)

Strain (%): **0.8**



Notes: Moderately strong, light brown interbedded with orangish brown, fine to medium grained, SANDSTONE, friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-031-3-16, NQ2-1, Depth: 16.7 - 17.1 ft)

Tested Date: 1/18/2017

Specimen Properties

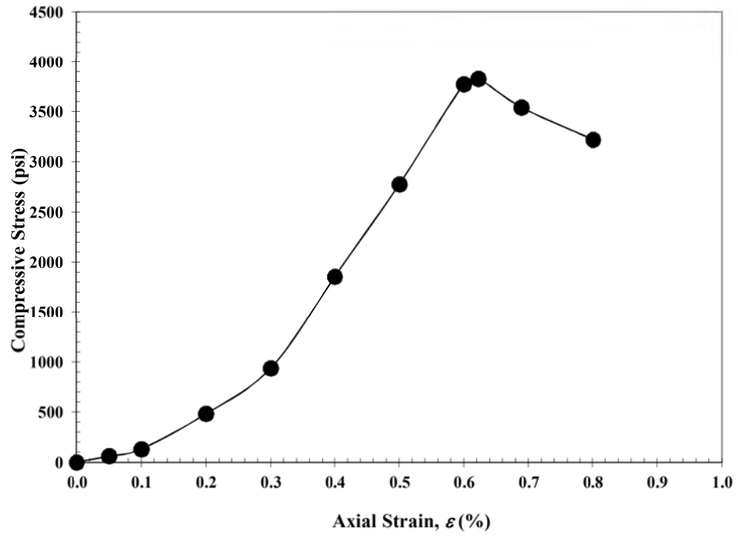
Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.50
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.10
Volume, V (in^3):	13.92
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	4.4
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	134.7
Dry Unit Weight, γ_d (lb/ft^3):	129.1

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **3826** **26** (MPa)

Strain (%): **0.6**



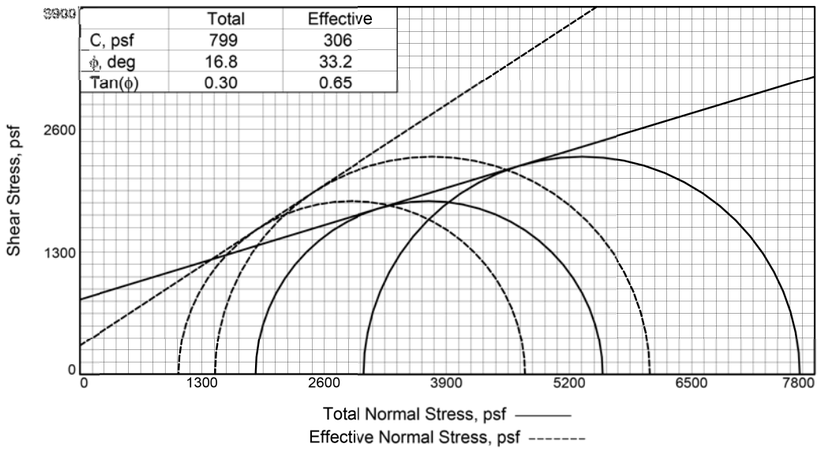
Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, friable, contains quartzite pebble.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

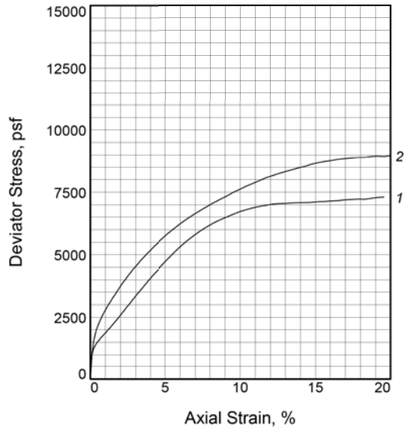
DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75



	Total	Effective
C, psf	799	306
ϕ, deg	16.8	33.2
Tan(ϕ)	0.30	0.65



	Sample No.	1	2
Initial	Water Content, %	23.6	28.1
	Dry Density, pcf	96.0	92.9
	Saturation, %	84.5	93.0
	Void Ratio	0.7554	0.8148
	Diameter, in.	2.79	2.79
	Height, in.	5.57	5.55
At Test	Water Content, %	25.1	28.9
	Dry Density, pcf	100.5	94.7
	Saturation, %	100.0	100.0
	Void Ratio	0.6770	0.7791
	Diameter, in.	2.75	2.77
	Height, in.	5.49	5.51
Strain rate, in./min.		0.012	0.012
Back Pressure, psi		56.00	56.00
Cell Pressure, psi		69.00	77.00
Fail. Stress, psf		3680	4619
Total Pore Pr., psf		8885	9649
Ult. Stress, psf		3680	4619
Total Pore Pr., psf		8885	9649
σ_1 Failure, psf		4731	6058
σ_3 Failure, psf		1051	1439

Type of Test:
CU with Pore Pressures
Sample Type: Intact
Description: silt

LL= NP **PI=** NP
Assumed Specific Gravity= 2.7
Remarks:

Figure _____

Client: TTL

Project: TTL Project No. 1635502

Source of Sample: B-038-0-17 Offset **Depth:** 8.0'-10.0'
Sample Number: ST-1
Proj. No.: 1821-4616.00 **Date Sampled:** 4-17-18

DLZ

Tested By: Tony McCune **Checked By:** Steve Robinson

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
TRIAXIAL CONSOLIDATED UNDRAINED TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-108
Date:	7/9/19

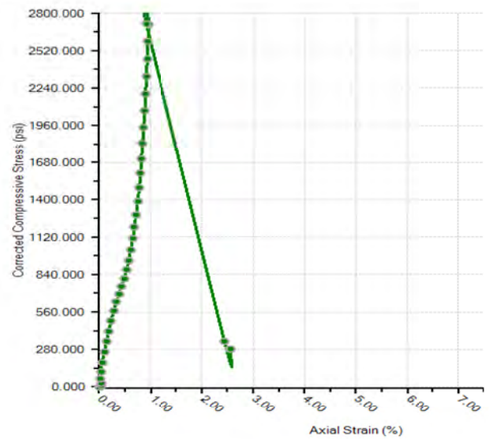
Boring Number	B-008-1-19	Top Depth (ft)	41.2	Bottom Depth (ft)	41.55
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

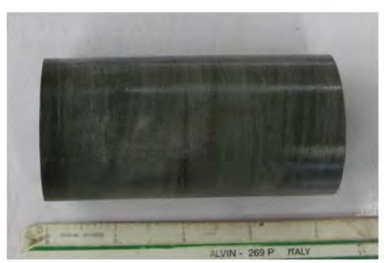
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.005	1.982
2	4.004	1.980
3	4.006	1.979
Average	4.005	1.980

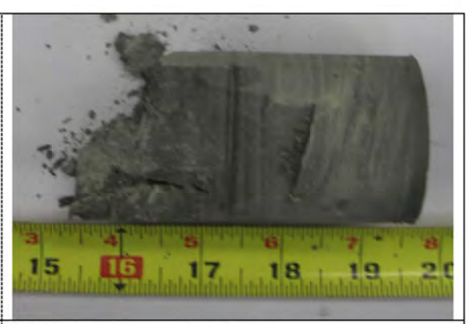
Length / Diameter	2.022
Correction Factor	1.000
Area (in^2)	3.063
Mass (grams)	518.14
Unit Weight (lbs/ft^3)	160.01

Maximum Load (lbs)
8706
Compressive Strength (psi)
2800
Time of Test (minutes)
6:02
Loading Direction
Perp. to Bedding
Technician
AOW





Before Testing



After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-104
Date:	7/9/19

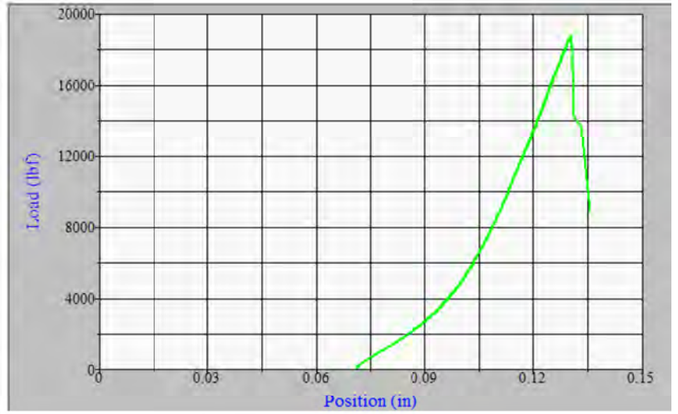
Boring Number	B-008-1-19	Top Depth (ft)	46.6	Bottom Depth (ft)	46.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.199	1.983
2	4.194	1.982
3	4.200	1.982
Average	4.198	1.982

Length / Diameter	2.12
Correction Factor	1.000
Area (in^2)	3.086
Mass (grams)	546.25
Unit Weight (lbs/ft^3)	160.63

Maximum Load (lbs)
18,780
Compressive Strength (psi)
6,090
Time of Test (minutes)
3:00
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

30/181

DRAWN YLZ
CHECKED TLM

Lab No.	19-107
Date:	7/9/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

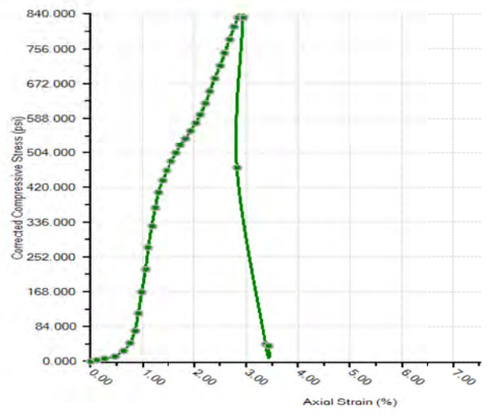
Boring Number	B-008-1-19	Top Depth (ft)	47.4	Bottom Depth (ft)	47.65
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

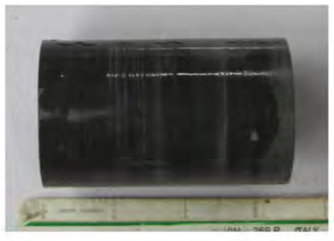
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	3.227	1.975
2	3.228	1.974
3	3.224	1.975
Average	3.226	1.975

Length / Diameter	1.634
Correction Factor	0.971
Area (in^2)	3.0625
Mass (grams)	416.46
Unit Weight (lbs/ft^3)	160.57

Maximum Load (lbs)
2622
Compressive Strength (psi)
808
Time of Test (minutes)
5:38
Loading Direction
Perp. to Bedding
Technician
AOW





Before Testing

After Failure

Lab No.	19-102
Date:	7/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

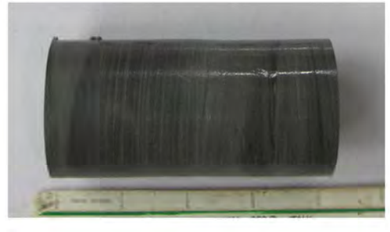
Boring Number	B-008-1-19	Top Depth (ft)	54.2	Bottom Depth (ft)	54.6
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.009	1.983
2	4.011	1.984
3	4.003	1.982
Average	4.008	1.983

Length / Diameter	2.02
Correction Factor	1.000
Area (in^2)	3.088
Mass (grams)	516.83
Unit Weight (lbs/ft^3)	159.07

Maximum Load (lbs)
19,520
Compressive Strength (psi)
6,320
Time of Test (minutes)
3:40
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

31/181

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-102
Date:	7/11/19

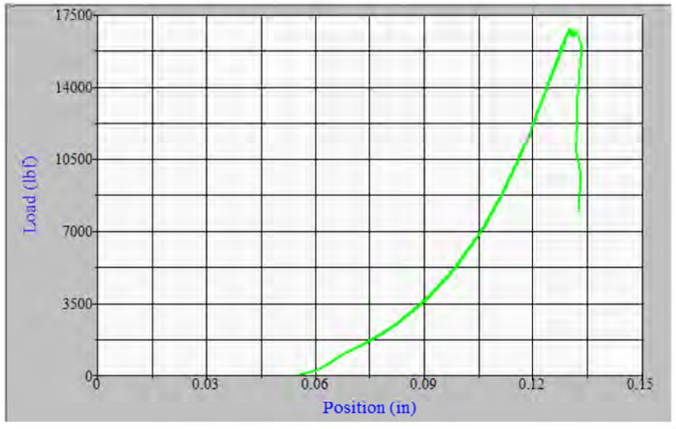
Boring Number	B-008-1-19	Top Depth (ft)	54.7	Bottom Depth (ft)	55.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

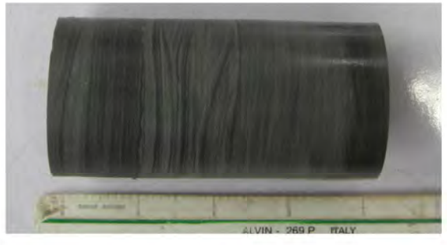
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.979	1.987
2	3.980	1.981
3	3.981	1.984
Average	3.980	1.984

Length / Diameter	2.006
Correction Factor	1.000
Area (in^2)	3.092
Mass (grams)	514.76
Unit Weight (lbs/ft^3)	159.38

Maximum Load (lbs)
16,840
Compressive Strength (psi)
5,450
Time of Test (minutes)
3:47
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-106
Date:	7/10/19

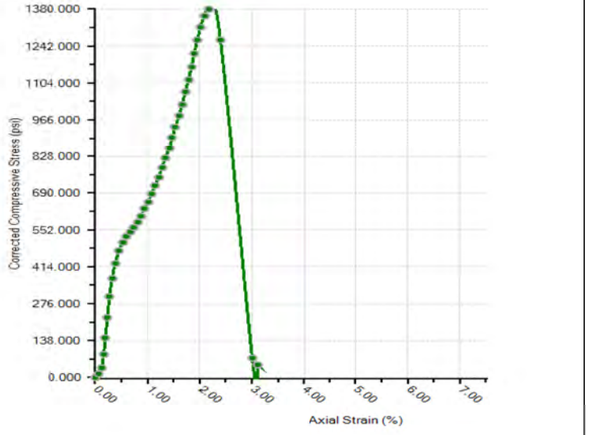
Boring Number	B-008-1-19	Top Depth (ft)	58.1	Bottom Depth (ft)	58.5
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

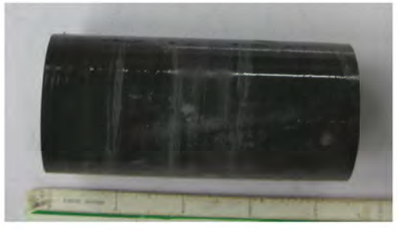
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, grayish black, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.184	1.975
2	4.183	1.977
3	4.186	1.976
Average	4.184	1.976

Length / Diameter	2.118
Correction Factor	1.000
Area (in^2)	3.067
Mass (grams)	540.21
Unit Weight (lbs/ft^3)	160.78

Maximum Load (lbs)
4,324
Compressive Strength (psi)
1,379
Time of Test (minutes)
6:20
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-106
Date:	7/10/19

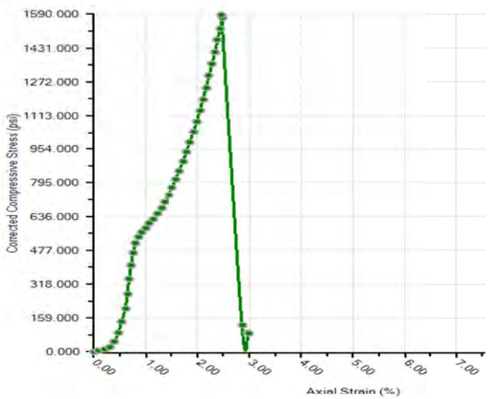
Boring Number	B-008-1-19	Top Depth (ft)	59.5	Bottom Depth (ft)	59.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, grayish black, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.180	1.973
2	4.184	1.972
3	4.186	1.972
Average	4.183	1.972

Length / Diameter	2.121
Correction Factor	1.000
Area (in^2)	3.055
Mass (grams)	540.09
Unit Weight (lbs/ft^3)	160.98

Maximum Load (lbs)
4,970
Compressive Strength (psi)
1,587
Time of Test (minutes)
6:53
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-100
Date:	7/11/19

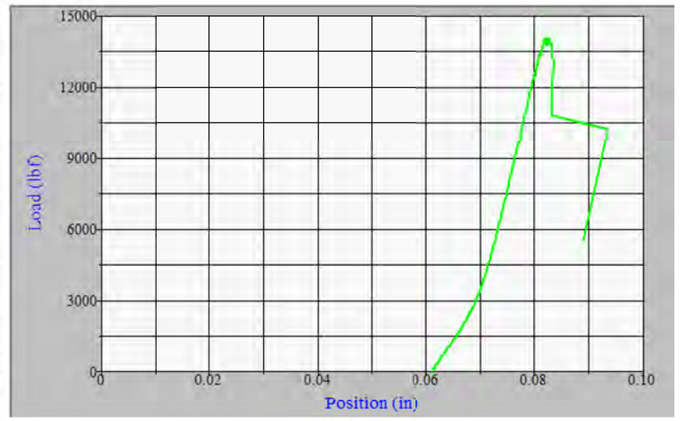
Boring Number	B-009-5-19	Top Depth (ft)	14.9	Bottom Depth (ft)	15.3
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, brown and light brown, medium to gravel, thin bedded

Measurement	Length (inches)	Diameter (inches)
1	3.960	1.968
2	3.955	1.969
3	3.956	1.975
Average	3.957	1.971

Length / Diameter	2.008
Correction Factor	1.000
Area (in^2)	3.050
Mass (grams)	449.13
Unit Weight (lbs/ft^3)	141.76

Maximum Load (lbs)
14,110
Compressive Strength (psi)
4,630
Time of Test (minutes)
1:55
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

33 / 181

DRAWN YLZ CHECKED TLM

Lab No.	19-101
Date:	7/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

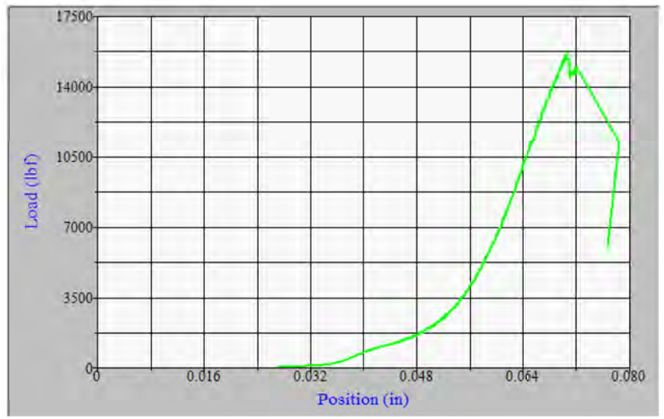
Boring Number	B-009-5-19	Top Depth (ft)	17.6	Bottom Depth (ft)	18.0
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

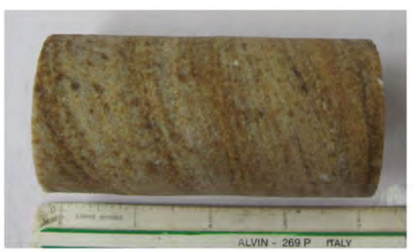
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray and brown, medium to coarse grained, thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.006	1.984
2	4.019	1.979
3	4.002	1.975
Average	4.009	1.979

Length / Diameter	2.025
Correction Factor	1.000
Area (in^2)	3.077
Mass (grams)	460.29
Unit Weight (lbs/ft^3)	142.15

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
15,700	5,110	2:14	Perp. to Bedding	PPP





Before Testing

After Failure

Lab No.	19-94
Date:	6/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

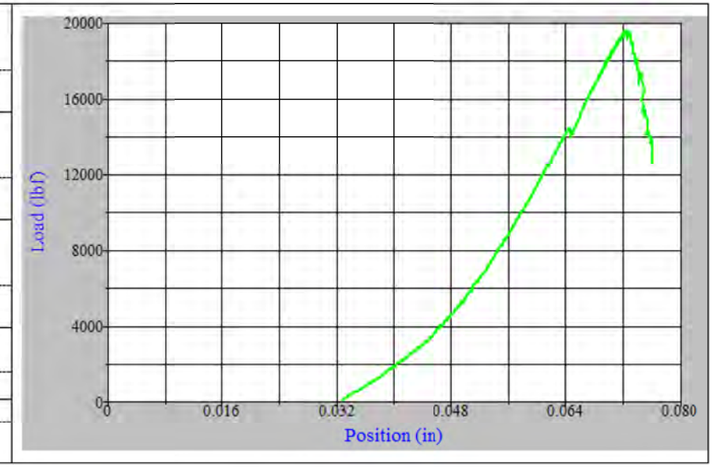
Boring Number	B-009-6-19	Top Depth (ft)	30.5	Bottom Depth (ft)	30.85
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

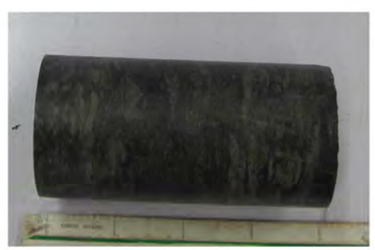
Formation	MC – Cuyahoga Formation
Description	Sandstone, very fine to fine grained

Measurement	Length (inches)	Diameter (inches)
1	3.912	1.977
2	3.911	1.977
3	3.913	1.977
Average	3.912	1.977

Length / Diameter	1.979
Correction Factor	0.998
Area (in^2)	3.0697
Mass (grams)	499.66
Unit Weight (lbs/ft^3)	158.5

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
19,640	6,387	2:10	Perp. to Bedding	PPP





Before Testing

After Failure

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Lab No.	19-95
Date:	6/12/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

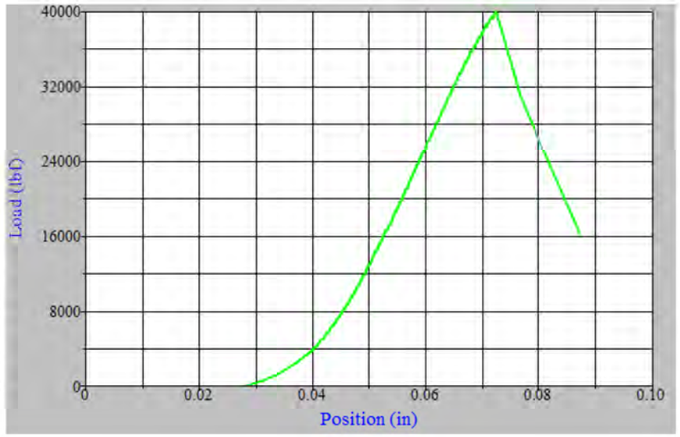
Boring Number	B-009-6-19	Top Depth (ft)	31.0	Bottom Depth (ft)	31.4
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	Mc – Cuyahoga Formation
Description	Sandstone, very fine to fine grained

Measurement	Length (inches)	Diameter (inches)
1	4.266	1.977
2	4.267	1.980
3	4.265	1.981
Average	4.266	1.979

Length / Diameter	2.155
Correction Factor	1.000
Area (in^2)	3.077
Mass (grams)	523.82
Unit Weight (lbs/ft^3)	152.02

Maximum Load (lbs)
39,990
Compressive Strength (psi)
12,996
Time of Test (minutes)
2:12
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Lab No.	19-91
Date:	6/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

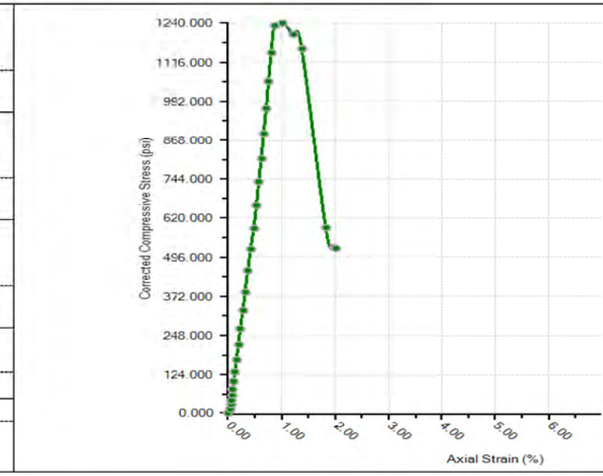
Boring Number	B-009-6-19	Top Depth (ft)	35.2	Bottom Depth (ft)	35.6
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	Mc – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

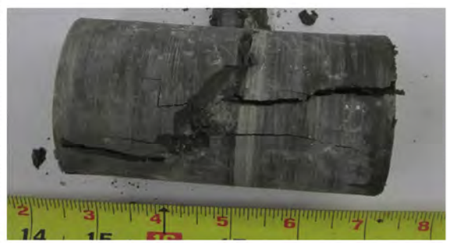
Measurement	Length (inches)	Diameter (inches)
1	4.119	1.979
2	4.120	1.977
3	4.128	1.976
Average	4.122	1.977

Length / Diameter	2.0848
Correction Factor	1.000
Area (in^2)	3.0708
Mass (grams)	531.90
Unit Weight (lbs/ft^3)	159.90

Maximum Load (lbs)
3845.5
Compressive Strength (psi)
1,240
Time of Test (minutes)
4:43
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing



After Failure

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-92
Date:	6/11/19

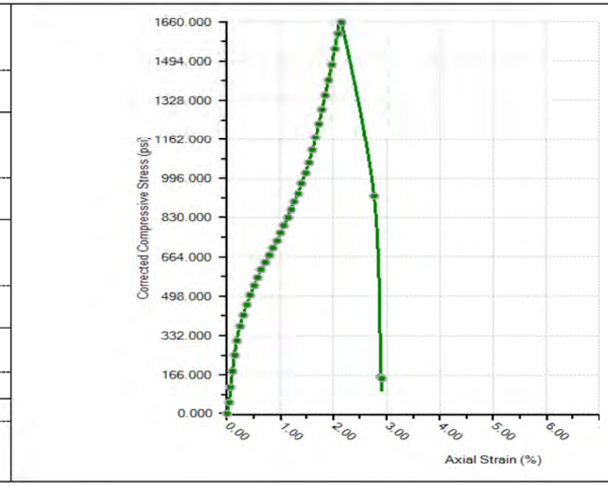
Boring Number	B-009-6-19	Top Depth (ft)	35.7	Bottom Depth (ft)	36.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.264	1.978
2	4.264	1.980
3	4.262	1.981
Average	4.263	1.980

Length / Diameter	2.1536
Correction Factor	1.000
Area (in^2)	3.0780
Mass (grams)	555.99
Unit Weight (lbs/ft^3)	161.41

Maximum Load (lbs)
5,210.7
Compressive Strength (psi)
1,656
Time of Test (minutes)
6:13
Loading Direction
Perp. to Bedding
Technician
PPP




Before Testing


After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-93
Date:	6/11/19

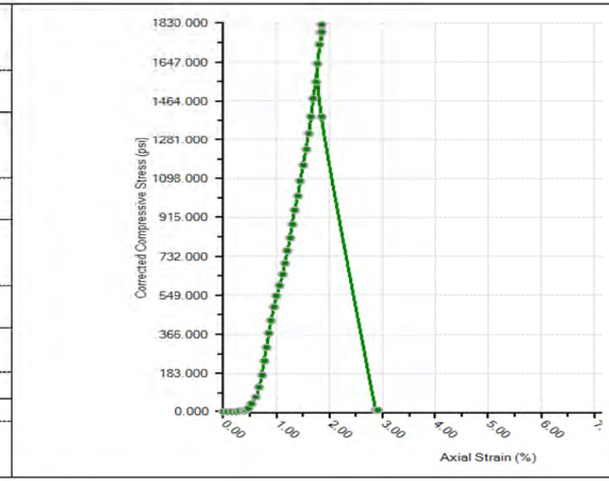
Boring Number	B-009-6-19	Top Depth (ft)	39.5	Bottom Depth (ft)	39.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

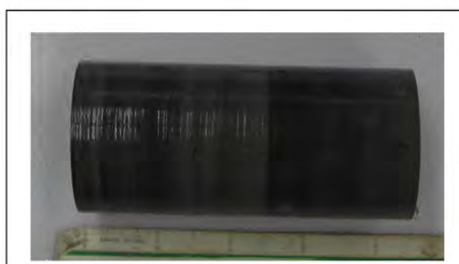
Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.341	1.982
2	4.431	1.982
3	4.339	1.984
Average	4.370	1.983

Length / Diameter	2.189
Correction Factor	1.000
Area (in^2)	3.0874
Mass (grams)	566.73
Unit Weight (lbs/ft^3)	161.12

Maximum Load (lbs)
5735.5
Compressive Strength (psi)
1,823
Time of Test (minutes)
6:36
Loading Direction
Perp. to Bedding
Technician
PPP




Before Testing


After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ CHECKED TLM

36/181

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-96
Date:	6/12/19

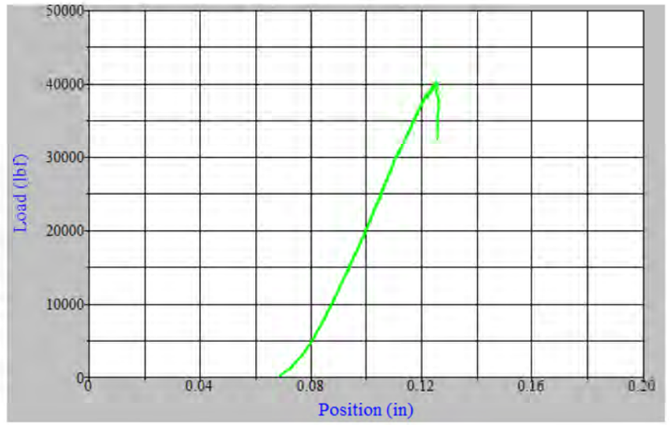
Boring Number	B-009-7-19	Top Depth (ft)	33.7	Bottom Depth (ft)	34.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

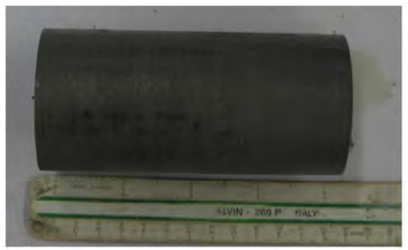
Formation	MC – Cuyahoga Formation
Description	Sandstone, very fine to fine grained, very thin to thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.190	1.983
2	4.188	1.982
3	4.189	1.980
Average	4.189	1.982

Length / Diameter	2.114
Correction Factor	1.000
Area (in^2)	3.084
Mass (grams)	510.22
Unit Weight (lbs/ft^3)	150.44

Maximum Load (lbs)
40,440
Compressive Strength (psi)
13,112
Time of Test (minutes)
2:51
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-88
Date:	6/11/19

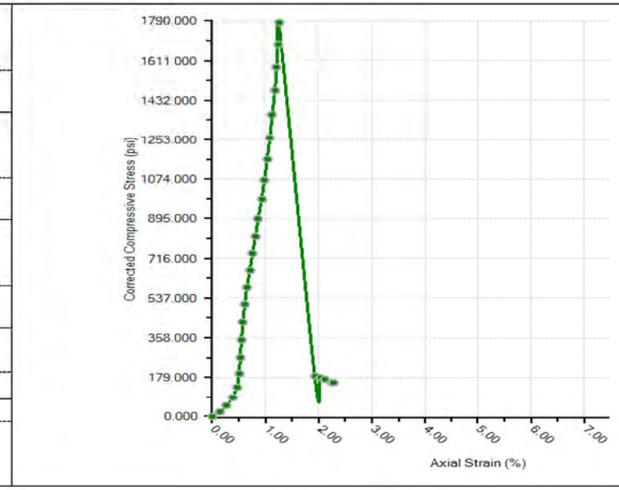
Boring Number	B-009-7-19	Top Depth (ft)	36.4	Bottom Depth (ft)	36.8
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

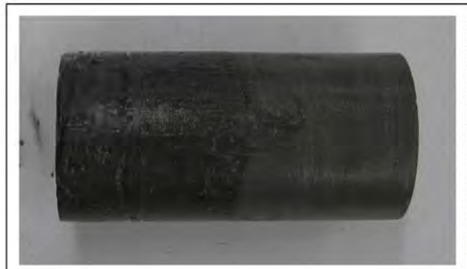
Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.988	1.971
2	3.992	1.972
3	3.988	1.971
Average	3.989	1.971

Length / Diameter	2.024
Correction Factor	1.000
Area (in^2)	3.0522
Mass (grams)	520.11
Unit Weight (lbs/ft^3)	162.73

Maximum Load (lbs)
5,510.7
Compressive Strength (psi)
1,783
Time of Test (minutes)
4:53
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

37 / 181

DRAWN YLZ CHECKED TLM

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-89
Date:	6/11/19

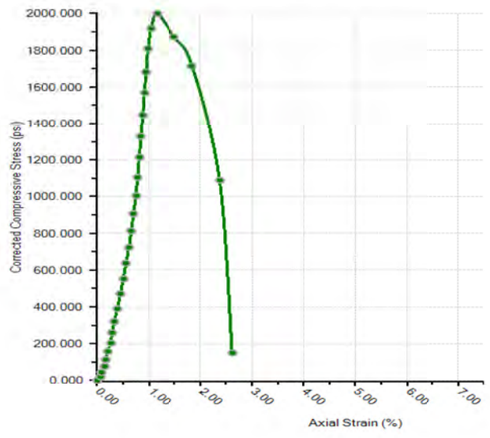
Boring Number	B-009-7-19	Top Depth (ft)	49.5	Bottom Depth (ft)	49.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.774	1.977
2	3.778	1.977
3	3.800	1.980
Average	3.784	1.978

Length / Diameter	1.913
Correction Factor	0.993
Area (in^2)	3.0729
Mass (grams)	482.58
Unit Weight (lbs/ft^3)	158.11

Maximum Load (lbs)
6200.0
Compressive Strength (psi)
1,985
Time of Test (minutes)
4:49
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-90
Date:	6/11/19

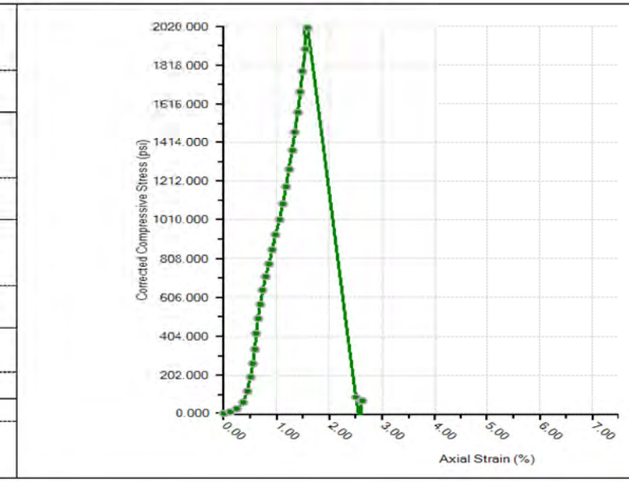
Boring Number	B-009-7-19	Top Depth (ft)	52.5	Bottom Depth (ft)	52.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.019	1.978
2	4.020	1.977
3	4.021	1.965
Average	4.020	1.973

Length / Diameter	2.037
Correction Factor	1.000
Area (in^2)	3.0584
Mass (grams)	522.07
Unit Weight (lbs/ft^3)	161.77

Maximum Load (lbs)
6253.7
Compressive Strength (psi)
2,012
Time of Test (minutes)
4:43
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

Lab No.	19-98
Date:	7/1/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

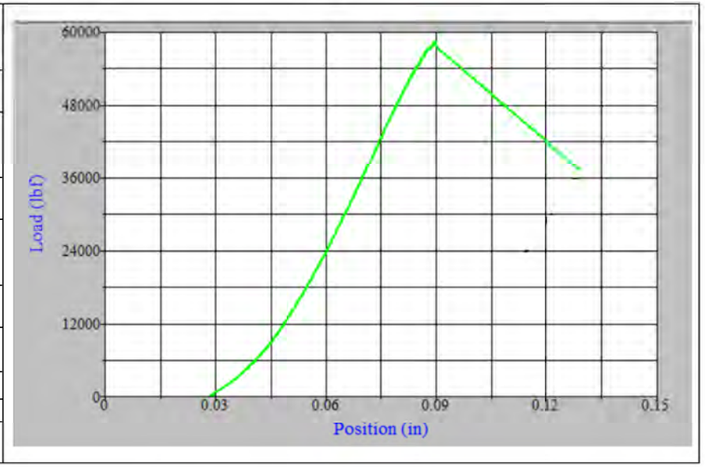
Boring Number	B-011-7-19	Top Depth (ft)	30.6	Bottom Depth (ft)	31.0
Sample Number	OGE 19-98	District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Siltstone, gray

Measurement	Length (inches)	Diameter (inches)
1	5.194	2.377
2	5.194	2.376
3	5.193	2.375
Average	5.194	2.376

Length / Diameter	2.376
Correction Factor	1.000
Area (in^2)	4.4339
Mass (grams)	945.9669
Unit Weight (lbs/ft^3)	143.25

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
58500	13,190	3:02	Perp. to Bedding	PPP



Before Testing

After Failure

Lab No.	19-99
Date:	7/1/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

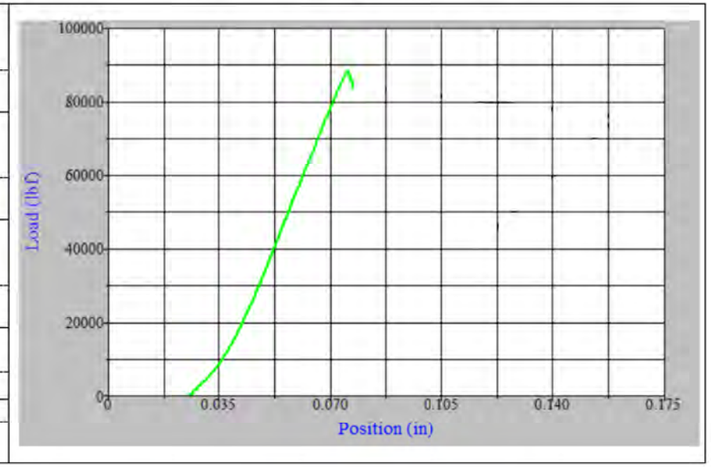
Boring Number	B-011-7-19	Top Depth (ft)	32.5	Bottom Depth (ft)	32.9
Sample Number	OGE 19-99	District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Limestone, gray

Measurement	Length (inches)	Diameter (inches)
1	5.137	2.383
2	5.137	2.384
3	5.136	2.384
Average	5.137	2.384

Length / Diameter	2.384
Correction Factor	1.000
Area (in^2)	4.4625
Mass (grams)	1001.078
Unit Weight (lbs/ft^3)	166.37

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
88620	19,920	2:33	Perp. to Bedding	PPP



Before Testing

After Failure

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

ATC GROUP SERVICES LLC

7/8/2019

Compressive Strength of Rock
ASTM 7012

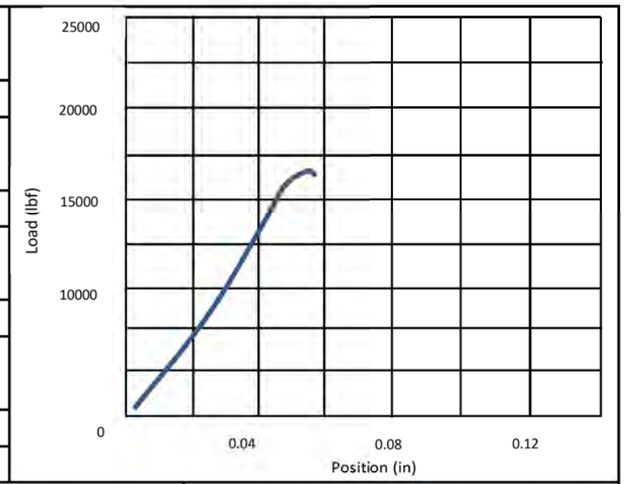
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	51.85'	BOTTOM DEPTH	52.70'
SAMPLE NUMBER	RC-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.308
1	4.255	1.834	AREA (in2)	2.665
2	4.246	1.844	MASS (GRAMS)	239.1
3	4.259	1.850		
AVERAGE	4.253	1.843		

MAXIMUM LOAD (LBS)
16,770
COMPRESSIVE STRENGTH (PSI)
5,380
TIME OF TEST (MINUTES)
0:44
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

ATC GROUP SERVICES LLC

7/8/2019

Compressive Strength of Rock
ASTM 7012

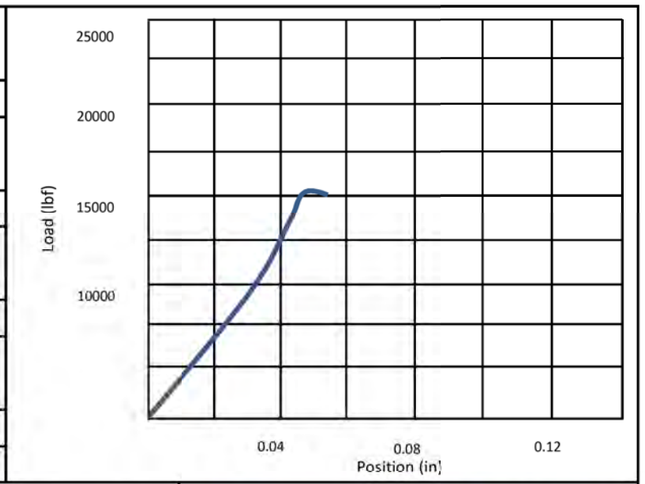
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	56.40'	BOTTOM DEPTH	57.60'
SAMPLE NUMBER	RC-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.415
1	4.356	1.799	AREA (in2)	2.556
2	4.367	1.803	MASS (GRAMS)	244.9
3	4.351	1.811		
AVERAGE	4.358	1.804		

MAXIMUM LOAD (LBS)
15,930
COMPRESSIVE STRENGTH (PSI)
5,110
TIME OF TEST (MINUTES)
1:05
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

7/8/2019

Compressive Strength of Rock
ASTM 7012

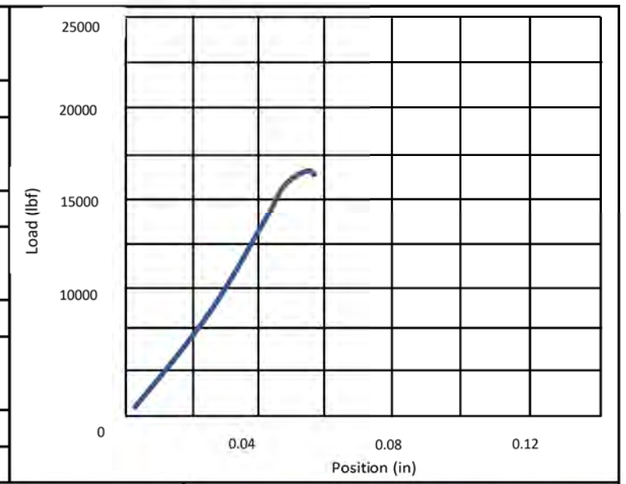
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	65.10'	BOTTOM DEPTH	65.70'
SAMPLE NUMBER	RC-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.387
1	4.419	1.855	AREA (in2)	2.681
2	4.403	1.848	MASS (GRAMS)	267.4
3	4.412	1.841		
AVERAGE	4.411	1.848		

MAXIMUM LOAD (LBS)
16,005
COMPRESSIVE STRENGTH (PSI)
5,140
TIME OF TEST (MINUTES)
0:49
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	33.1-34.6	Shale	1.9685	50	1.12204	30.0	27.0	28.50	0.570	1.745	0.96	139	12	1673
			1.9685	50	0.60039	16.0	14.5	15.25	0.305	1.485	1.53	222	18	2661
			1.9685	50	0.98425	26.0	24.0	25.00	0.500	0.764	0.48	70	6	835
			1.9685	50	1.08267	29.0	26.0	27.50	0.550	1.196	0.68	99	8	1189
			1.9685	50	1.17126	31.0	28.5	29.75	0.595	1.412	0.75	108	9	1297
			1.9685	50	0.69882	19.5	16.0	17.75	0.355	2.137	1.89	274	23	3291
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	0.99	0.94	137	11	1640
			1.9685	50	0.68897	19.0	16.0	17.50	0.350	0.941	0.84	122	10	1470
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.186	1.26	183	15	2198
			1.9685	50	0.88582	24.0	21.0	22.50	0.450	1.157	0.81	117	10	1405
			1.9685	50	0.62008	17.5	14.0	15.75	0.315	0.755	0.75	109	9	1310
												Average Strength (Sc)		**1571**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	39.3-40.3	Shale	1.9685	50	0.86614	23.5	20.5	22.00	0.440	1.127	0.80	117	10	1400
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.284	1.37	198	16	2379
			1.9685	50	0.72834	20.0	17.0	18.50	0.370	2.147	1.82	264	22	3172
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.176	1.25	182	15	2179
			1.9685	50	0.62992	17.0	15.0	16.00	0.320	0.882	0.87	126	10	1507
			1.9685	50	0.7185	19.5	17.0	18.25	0.365	1.265	1.09	158	13	1895
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	1.265	1.20	175	14	2095
			1.9685	50	0.86614	24.0	20.0	22.00	0.440	1.421	1.01	147	12	1765
			2.0079	51	0.61023	17.0	14.0	15.50	0.304	1.52	1.51	219	18	2628
			1.9685	50	1.20078	32.0	29.0	30.50	0.610	1.686	0.87	126	10	1511
												Average Strength (Sc)		**1719**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	48.3-50.1	Shale	1.9685	50	0.73819	20.0	17.5	18.75	0.375	1.019	0.85	124	10	1485
			1.9685	50	0.53149	15.0	12.0	13.50	0.270	0.637	0.74	107	9	1290
			1.9685	50	0.54134	15.0	12.5	13.75	0.275	0.892	1.02	148	12	1773
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	1.304	1.24	180	15	2160
			1.9685	50	0.60039	16.5	14.0	15.25	0.305	1.549	1.60	231	19	2776
			1.9685	50	0.61023	17.0	14.0	15.50	0.310	1.431	1.45	210	17	2523
			1.9685	50	0.72834	20.0	17.0	18.50	0.370	1.412	1.20	174	14	2086
			1.9685	50	0.60039	16.5	14.0	15.25	0.305	1.284	1.32	192	16	2301
			2.0079	51	0.68897	19.0	16.0	17.50	0.343	0.872	0.77	111	9	1335
			1.9685	50	0.7874	21.0	19.0	20.00	0.400	1.235	0.97	141	12	1688
			1.9685	50	0.63976	17.5	15.0	16.25	0.325	0.862	0.83	121	10	1450
												Average Strength (Sc)		**1642**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	21.8-22.7	Shale	1.9685	50	1.13189	30.5	27	28.75	0.575	0.647	0.35	51	4	615
			1.9685	50	0.68897	19	16	17.5	0.350	0.313	0.28	41	3	489
			1.9685	50	0.57086	15.5	13.5	14.5	0.290	0.362	0.39	57	5	682
			1.9685	50	0.51181	14	12	13	0.260	0.264	0.32	46	4	555
			1.9685	50	0.56102	15.5	13	14.25	0.285	0.382	0.42	61	5	733
			1.9685	50	1.27952	34	31	32.5	0.650	1.147	0.55	80	7	965
			1.9685	50	0.65945	18	15.5	16.75	0.335	0.372	0.35	51	4	607
			1.9685	50	0.60039	16	14.5	15.25	0.305	0.382	0.39	57	5	685
			1.9685	50	0.55118	15	13	14	0.280	0.264	0.30	43	4	515
			2.0079	51	1.25	33.5	30	31.75	0.623	0.892	0.43	63	5	753
			1.9685	50	0.51181	14	12	13	0.260	0.188	0.23	33	3	395
												Average Strength (Sc)		**627**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	30.6-31.4	Shale	1.9685	50	0.91535	24.5	22	23.25	0.465	0.882	0.60	86	7	1037
			1.9685	50	0.77756	21.5	18	19.75	0.395	1.265	1.01	146	12	1751
			1.9685	50	0.76771	21	18	19.5	0.390	0.735	0.59	86	7	1030
			1.9685	50	0.67913	18.5	16	17.25	0.345	0.686	0.62	91	7	1087
			1.9685	50	0.88582	24	21	22.5	0.450	0.725	0.51	73	6	881
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.617	0.60	86	7	1038
			1.9685	50	0.80708	22	19	20.5	0.410	1.206	0.92	134	11	1608
			1.9685	50	0.59055	16	14	15	0.300	0.46	0.48	70	6	838
			1.9685	50	0.66929	18	16	17	0.340	0.813	0.75	109	9	1307
			1.9685	50	0.94488	30	18	24	0.480	1.461	0.96	139	11	1664
												Average Strength (Sc)		**1184**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	31.8-32.8	Shale	1.9685	50	0.86614	23	21	22	0.440	0.813	0.58	84	7	1010
			1.9685	50	0.98425	26.5	23.5	25	0.500	1.256	0.79	114	9	1373
			1.9685	50	0.68897	19	16	17.5	0.350	1.098	0.99	143	12	1715
			1.9685	50	1.33858	36	32	34	0.680	1.039	0.48	70	6	835
			1.9685	50	1.25984	34	30	32	0.640	1.304	0.64	93	8	1114
			1.9685	50	0.83661	23	19.5	21.25	0.425	0.833	0.62	89	7	1071
			1.9685	50	1.29921	35	31	33	0.660	2.147	1.02	148	12	1778
			1.9685	50	0.94488	25	23	24	0.480	1.363	0.89	129	11	1552
			1.9685	50	0.79724	21.5	19	20.25	0.405	0.99	0.77	111	9	1336
			1.9685	50	0.74803	21	17	19	0.380	0.882	0.73	106	9	1269
												Average Strength (Sc)		**1286**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	38.0-39.4	Shale	1.9685	50	1.33858	35.5	32.5	34	0.680	0.912	0.42	61	5	733
			1.9685	50	0.83661	22.5	20	21.25	0.425	0.674	0.50	72	6	867
			1.9685	50	1.10236	29	27	28	0.560	1.176	0.66	96	8	1148
			1.9685	50	0.94488	26	22	24	0.480	0.98	0.64	93	8	1116
			1.9685	50	0.79724	21.5	19	20.25	0.405	0.696	0.54	78	6	939
			1.9685	50	1.20078	32	29	30.5	0.610	2.353	1.21	176	15	2109
			1.9685	50	1.19094	32	28.5	30.25	0.605	0.862	0.45	65	5	779
			1.9685	50	1.00393	27	24	25.5	0.510	1.333	0.82	119	10	1429
			1.9685	50	1.02362	27.5	24.5	26	0.520	1.117	0.67	98	8	1174
			1.9685	50	0.92519	25	22	23.5	0.470	0.715	0.48	69	6	832
			1.9685	50	0.82677	22	20	21	0.420	0.862	0.64	93	8	1122
												Average Strength (Sc)		**1028**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-6-19	23.2-24.2	Shale	1.9685	50	0.99409	27	23.5	25.25	0.505	0.578	0.36	52	4	626
			1.9685	50	0.7185	19.5	17	18.25	0.365	0.667	0.57	83	7	999
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.421	0.41	59	5	708
			1.9685	50	0.84645	23	20	21.5	0.430	0.598	0.44	63	5	760
			1.9685	50	0.87598	23.5	21	22.25	0.445	0.529	0.37	54	4	650
			1.9685	50	0.67913	18.5	16	17.25	0.345	0.853	0.78	113	9	1352
			1.9685	50	0.55118	15	13	14	0.280	0.715	0.80	116	10	1396
			1.9685	50	0.90551	24	22	23	0.460	0.715	0.49	71	6	850
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.568	0.55	80	7	955
			1.9685	50	0.82677	22	20	21	0.420	0.598	0.45	65	5	778
												Average Strength (Sc)		**842**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-6-19	27.5-28.4	Shale	1.9685	50	0.89567	24	21.5	22.75	0.455	0.657	0.45	66	5	789
			1.9685	50	0.7874	21.5	18.5	20	0.400	0.774	0.61	88	7	1058
			1.9685	50	0.59055	16	14	15	0.300	0.853	0.89	130	11	1554
			1.9685	50	0.7874	21	19	20	0.400	1.01	0.79	115	10	1380
			1.9685	50	0.57086	15.5	13.5	14.5	0.290	0.509	0.55	80	7	959
			1.9685	50	0.80708	22	19	20.5	0.410	0.892	0.68	99	8	1189
			1.9685	50	0.7874	21	19	20	0.400	1	0.79	114	9	1367
			1.9685	50	0.68897	19	16	17.5	0.350	1.176	1.06	153	13	1837
			1.9685	50	0.55118	15	13	14	0.280	0.529	0.59	86	7	1033
			2.0079	51	0.58071	16	13.5	14.75	0.289	0.451	0.47	68	6	819
			1.9685	50	0.59055	16	14	15	0.300	0.872	0.91	132	11	1589
												Average Strength (Sc)		**1220**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-7-19	36.3-39.0	Shale	1.9685	50	0.8563	23.5	20	21.75	0.435	0.961	0.69	101	8	1208
			1.9685	50	0.61023	17	14	15.5	0.310	0.813	0.82	119	10	1434
			1.9685	50	0.87598	24	20.5	22.25	0.445	2.481	1.75	254	21	3048
			1.9685	50	0.89567	25	20.5	22.75	0.455	1.676	1.16	168	14	2014
			1.9685	50	0.68897	19	16	17.5	0.350	0.99	0.89	129	11	1546
			1.9685	50	0.76771	21	18	19.5	0.390	1.637	1.32	191	16	2294
			1.9685	50	0.76771	21	18	19.5	0.390	0.931	0.75	109	9	1305
			1.9685	50	0.69882	19	16.5	17.75	0.355	0.788	0.70	101	8	1213
			1.9685	50	0.7874	21	19	20	0.400	1.157	0.91	132	11	1581
			1.9685	50	0.58071	16	13.5	14.75	0.295	1.186	1.26	183	15	2198
			1.9685	50	0.66929	19	15	17	0.340	1.029	0.95	138	11	1654
			1.9685	50	0.54134	15	12.5	13.75	0.275	1.186	1.35	196	16	2357
												Average Strength (Sc)		**1753**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 24

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-7-19	51.1-51.6	Limestone	1.9685	50	0.72834	21	16	18.5	0.370	10.954	9.30	1349	223	32367
			1.9685	50	0.48228	14	10.5	12.25	0.245	5.668	7.27	1054	174	25293
			1.9685	50	0.73819	21	16.5	18.75	0.375	3.785	3.17	460	76	11035
			1.9685	50	0.50197	14.5	11	12.75	0.255	6.707	8.26	1198	198	28755
			1.9685	50	0.29527	9	6	7.5	0.150	4.118	8.62	1251	207	30014
			1.9685	50	0.6496	18	15	16.5	0.330	7.821	7.45	1080	179	25911
			1.9685	50	0.53149	15	12	13.5	0.270	7.796	9.07	1315	218	31567
			1.9685	50	0.42323	12	9.5	10.75	0.215	5.913	8.64	1253	207	30068
			1.9685	50	0.43307	12.5	9.5	11	0.220	5.511	7.87	1141	189	27386
			1.9685	50	0.45275	13	10	11.5	0.230	6.982	9.54	1383	229	33188
												Average Strength (Sc)		**28950**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** JB

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ $F = (De/50)^{0.45}$ Is50 = Is*F Strength = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is (Mpa)	F	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-011-7-19	36.3'-37.6'	Shale	2.3819	60.501	1.102	30.0	26.0	28.00	0.463	5.785	2.68	0.97	2.59	376	31	4514
			2.3819	60.501	1.132	31.5	26.0	28.75	0.475	2.157	0.97	0.97	0.95	137	11	1649
			2.3819	60.501	1.112	30.0	26.5	28.25	0.467	1.225	0.56	0.97	0.55	79	7	949
			2.3819	60.501	0.965	27.0	22.0	24.50	0.405	1.078	0.57	0.94	0.54	78	6	933
			2.3819	60.501	1.053	29.0	24.5	26.75	0.442	6.335	3.07	0.96	2.94	427	35	5122
			2.3819	60.501	0.817	23.5	18.0	20.75	0.343	3.442	2.15	0.90	1.95	282	23	3388
			2.3819	60.501	0.709	21.0	15.0	18.00	0.298	4.050	2.92	0.88	2.56	371	31	4451
			2.3819	60.501	0.994	26.5	24.0	25.25	0.417	2.020	1.04	0.95	0.98	142	12	1708
			2.3819	60.501	0.738	21.0	16.5	18.75	0.310	3.069	2.12	0.88	1.88	272	23	3268
			2.3819	60.501	0.768	22.0	17.0	19.50	0.322	3.461	2.30	0.89	2.05	298	25	3575
														Avg. S_c Value		3006

Comments: Red highlights excluded in S_c calculation

Gannett Fleming
Engineers and Architects, P.C.
Excellence Delivered As Promised

APPENDIX E

Soil Profile Sheets

PROJECT DESCRIPTION

THIS EXPLORATION SUPPORTS THE PROPOSED REPLACEMENT OF THE EXISTING 1,500-FT. LONG BRIDGE CARRYING SR8 OVER THE LITTLE CUYAHOGA RIVER VALLEY IN AKRON, OHIO WITH PARALLEL NORTHBOUND AND SOUTHBOUND BRIDGES. THIS REPORT ALSO SUPPORTS THE CONSTRUCTION OF SIX NOISE BARRIERS, AND THE REALIGNMENT OF RAMP I AND RAMP J AT PERKINS STREET AS WELL AS ROAD REALIGNMENT BETWEEN PERKINS STREET AT THE SOUTH END OF THE PROJECT AND EAST GLENWOOD AVENUE AT THE NORTH END.

HISTORIC RECORDS

FIVE CORE BORINGS AND 20 DRIVE ROD SOUNDINGS WERE PERFORMED IN 1948 FOR THE EXPLORATION FOR THE EXISTING BRIDGE.
THE FINDINGS OF THE CORE BORINGS ARE PRESENTED. THE RESULTS OF THE DRIVE ROD SOUNDINGS ARE AVAILABLE FOR REVIEW AT THE OFFICE OF GEOTECHNICAL ENGINEERING AT 1980 WEST BROAD STREET.

GEOLOGY

THE PROJECT AREA IS LOCATED IN THE CENTER OF SUMMIT COUNTY IN THE GLACIATED PORTION OF NORTHEAST OHIO. THIS PROJECT FALLS WITHIN THE NORTHERN BOUNDARY OF THE AKRON-CANTON INTERLOBATE PLATEAU OF THE APPALACHIAN PLATEAUS PHYSIOGRAPHIC PROVINCE, AND IS SURROUNDED BY THE KILLBUCK-GLACIATED PITTSBURGH PLATEAU. THE PLATEAU IS A HUMMOCKY AREA BETWEEN TWO CONVERGING GLACIAL LOBES DOMINATED BY KAMES, KAME TERRACES, ESKERS, KETTLES, KETTLE LAKES, AND BOGS/FENS. THE REGION IS CHARACTERIZED BY DERANGED DRAINAGE PATHS AND INCLUDES MANY NATURAL LAKES, WITH VERY MODERATE RELIEF. BEDROCK IS MARKED BY SANDY WISCONSINAN-AGE AND OLDER DRIFT OVER DEVONIAN TO PENNSYLVANIAN AGE SANDSTONE, CONGLOMERATE AND SHALE.

RECONNAISSANCE

THE FIELD RECONNAISSANCE WAS PERFORMED BY THOMAS MONACO, P.E. ON AUGUST 22, 2013. THE SITE VARIES IN ELEVATION BY APPROXIMATELY 165 FT. BETWEEN THE SR8 ROADWAY ELEVATION AND EAST NORTH STREET AT THE APPROXIMATE MID-SPAN OF THE BRIDGE. THE EXISTING SLOPES WERE OBSERVED TO BE GENERALLY STABLE BUT WERE OBSCURED IN MANY LOCATIONS DUE TO HEAVY VEGETATION. THE SUM-8-0175 BRIDGE IS IN OVERALL FAIR CONDITION GIVEN ITS AGE WITH SOME SPALLING ON THE BRIDGE DECK AND PIERS. ROCK OUTCROPS WERE VISIBLE IN MANY LOCATIONS ON THE SOUTH SLOPE. THE OUTCROPS ARE PRIMARILY SANDSTONE, SHALE, AND INTERBEDDED SANDSTONE AND SHALE.

LAND USE NORTH AND SOUTH OF THE BRIDGE IS RESIDENTIAL WITH THE EXCEPTION OF THE NORTHEAST QUADRANT WHICH IS PRIMARILY COMMERCIAL. LAND USE UNDER THE BRIDGE IS PRIMARILY COMMERCIAL WITH SCATTERED RESIDENTIAL PROPERTIES.

SUBSURFACE EXPLORATION

2013 EXPLORATION

GANNETT FLEMING PERFORMED A LIMITED GEOTECHNICAL EXPLORATION IN 2013 FOR THE FEASIBILITY STUDY. NO BORINGS WERE ADVANCED, BUT THE HISTORICAL RECORDS WERE REVIEWED, AND A SITE VISIT WAS PERFORMED. THE SITE VISIT INCLUDED TESTING THE COMPRESSIVE STRENGTH OF BEDROCK OUTCROPS WITH A SWISS HAMMER.

2015 EXPLORATION

THE 2015 FIELD EXPLORATION WAS PERFORMED FOR THE AER STUDY. THE EXPLORATION WAS USED TO PROVIDE SUBSURFACE DATA FOR THE PRELIMINARY DESIGN OF THE PROJECT STRUCTURES AND ROADWAY IMPROVEMENTS. BETWEEN JUNE 8TH AND JULY 13TH OF 2015, 47 BORINGS WERE ADVANCED. IN ADHERENCE WITH THE ODOT SGE STANDARD, THE BORINGS WERE DESIGNATED B-001-0-15 TO B-032-0-15, WITH OFFSET BORINGS. THE BORINGS INCLUDED ODOT TYPE A, B, B1, B2, B4, E1, AND E3 BORINGS. BORINGS B-008-0-15 AND B-009-015 WERE REMOVED FROM CONSIDERATION IN THE REPORT BECAUSE OF THE UNCERTAINTY OF THE AS-DRILLED LOCATIONS.

THREE RIGS WERE USED TO ADVANCE THE BORINGS: A CME-550 ATV RIG, A DIEDRICH D-50 TRACK RIG, AND A DIEDRICH D-50 TRUCK RIG. EACH RIG UTILIZED 3.25-INCH DIAMETER HOLLOW STEM AUGERS AND 2.0 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLERS. THE ENERGY RATIO OF THE HAMMERS OF THE ATV MOUNTED DRILL IS 81.0%. THE ENERGY RATIOS OF THE DIEDRICH D-50 RIGS ARE 80.6% AND 80.3%, RESPECTIVELY. THE DATE OF CALIBRATION OF ALL THREE HAMMERS WAS APRIL 4, 2015. THE SOIL SAMPLING WAS PERFORMED BY RIDGEWAY DRILLING INC., AND SOME OF THE ROCK CORING WAS PERFORMED BY ARMSTRONG DRILLING, INC. ALL FIELD SAMPLES WERE SEALED IN GLASS JARS AND TRANSPORTED TO THE CARDNO ATC LABORATORY IN BRECKSVILLE, OHIO FOR TESTING. THE BORINGS WERE BACKFILLED WITH BENTONITE CHIPS AND AUGER CUTTINGS.

2016 EXPLORATION

THE PRIMARY GOAL OF THE 2016 FIELD EXPLORATION WAS TO SUPPORT THE STAGE I SUBMISSION. ADDITIONAL BORINGS WERE ADVANCED BASED ON THE 2015 EXPLORATION RECOMMENDATIONS TO DETERMINE THE BEDROCK ELEVATIONS AT THE FOOTPRINT OF EACH SUBSTRUCTURE WHERE TOP OF ROCK VARIED SUBSTANTIALLY IN THE 2015 BORINGS.

THE 2016 EXPLORATION ADVANCED BORINGS FOR THE DESIGN OF THE FOUR SEGMENTS OF NOISE BARRIERS. BORINGS WERE ALSO ADVANCED FOR THE PROPOSED STORM SEWER TRUNK LINE THAT WILL BE BORED UNDER THE EXISTING RAILROAD LINES TO THE WEST OF THE SOUTHBOUND BRIDGE.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS	A-1-a	1	11
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	58	152
GRAVEL AND/OR STONE FRAG. WITH SAND AND SILT	A-2-4	15	37
GRAVEL AND/OR STONE FRAG. WITH SAND, SILT, AND CLAY	A-2-6	0	19
FINE SAND	A-3	33	79
FINE AND COARSE SAND	A-3a	26	56
SANDY SILT	A-4a	69	92
SILT	A-4b	21	49
SILT AND CLAY	A-6a	23	28
SILTY CLAY	A-6b	21	37
CLAY	A-7-6	8	12
	TOTAL	275	572
BOULDER ZONE	VISUAL		
UNCONTROLLED FILL (UCF)	VISUAL		
CLAYSTONE	VISUAL		
SANDSTONE	VISUAL		
SHALE	VISUAL		
SILTSTONE	VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		
SOD AND TOPSOIL = X = APPROXIMATE THICKNESS	VISUAL		
ROCK OUTCROP - PLAN VIEW.	VISUAL		

PROJECT BORING LOCATION - PLAN VIEW.

HISTORIC BORING LOCATION - PLAN VIEW.

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

WC INDICATES WATER CONTENT IN PERCENT.

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

W— INDICATES FREE WATER ELEVATION.

TR INDICATES TOP OF ROCK.

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

⊖ INDICATES A NON-PLASTIC MATERIAL WITH A MOISTURE CONTENT GREATER THAN 25 % OR GREATER THAN 19 % WITH A WET APPEARANCE.

* INDICATES A SAMPLE TAKEN WITHIN 3 FT OF PROPOSED GRADE.

SS INDICATES A SPLIT SPOON SAMPLE.

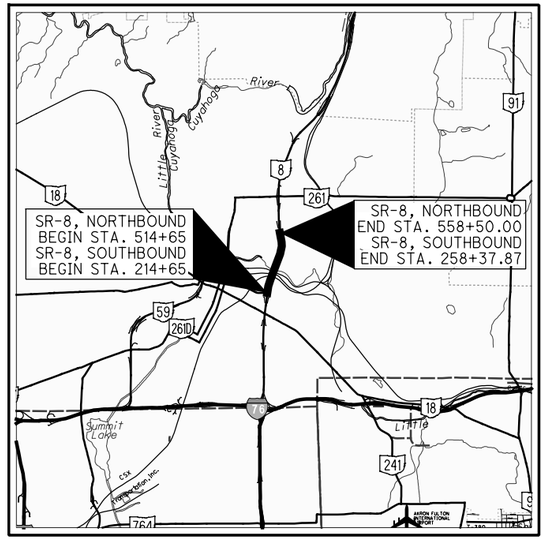
NP INDICATES A NON-PLASTIC SAMPLE.

RECON. - TLM 8/22/2013

DRILLING - RIDGEWAY 6/08/2015 - 7/13/2015
NEAS 12/27/2016 - 4/13/2017
TTL 3/27/2018 - 4/5/2018
ODOT 6/4/2019 - 6/26/2019
FRONTZ 6/28/2019 -7/1/2019

DRAWN - YLZ 8/30/2019

REVIEWED - JAY 9/12/2019



LOCATION MAP
SCALE IN MILES
0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

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

SUBSURFACE EXPLORATION (CONT.)

BETWEEN DECEMBER 27, 2016 AND APRIL 13, 2017, 46 EXPLORATORY BORINGS WERE ADVANCED. THE BORINGS WERE DESIGNATED B-001-3-16 TO B-036-0-16, WITH MANY OFFSET BORINGS. THE DEPTHS AND INTERVALS OF SAMPLING FOLLOWED ODOT'S SGE GUIDELINES FOR BORING TYPES D, E1, E3, AND E4. THERE WERE A TOTAL OF SEVEN UNDERGROUND UTILITY BORINGS (ODOT TYPE D), 12 BRIDGE BORINGS (ODOT TYPE E1), AND 27 NOISE BARRIER BORINGS (ODOT TYPE E4).

FOUR RIGS WERE UTILIZED TO ADVANCE THE BORINGS, A CME 55X DRILL RIG, CME 55 DRILL RIG, DIETRICH D-50 DRILL RIG, AND A MOBILE B-57 DRILL RIG. EACH RIG UTILIZED 3.25-INCH DIAMETER HOLLOW STEM AUGERS AND 2.0 IN. OUTSIDE DIAMETER SPLIT SPOON SAMPLERS. THE ENERGY RATIO OF THE HAMMERS OF THE CME 55X DRILL RIG, CME 55 DRILL RIG, DIETRICH D-50 DRILL RIG, AND MOBILE B-57 DRILL RIG WERE 88.1 %, 81.8 %, 81.2 % AND 89.7 %. THE DATE OF THE CALIBRATION OF BOTH HAMMERS OF CME 55X AND CME 55 DRILL RIGS IS DECEMBER 8, 2015; AND THE DATE OF THE CALIBRATION OF BOTH HAMMERS OF DIETRICH D-50 AND MOBILE B-57 DRILL RIGS IS MAY 7, 2015. THE SOIL SAMPLING OF BORINGS WAS PERFORMED BY NATIONAL ENGINEERING & ARCHITECTURAL SERVICES, INC. (NEAS, INC.). ALL FIELD SAMPLES WERE SEALED IN GLASS JARS AND TRANSPORTED TO NEAS, INC. LABORATORY IN COLUMBUS, OH FOR TESTING.

2017 EXPLORATION

THE 2017 FIELD EXPLORATION WAS PERFORMED FOR THE FINAL DESIGN OF THE PROJECT STRUCTURES AND ROADWAY. THE EXPLORATION WAS USED TO PROVIDE SUBSURFACE DATA FOR THE DESIGN OF ACCESS ROAD AND BRIDGE LAUNCH PIT.

BETWEEN MARCH 27TH, 2018 AND APRIL 5TH, 2018, 7 EXPLORATORY BORINGS WERE ADVANCED. THE BORINGS WERE DESIGNATED B-011-6-17, B-015-2-17, B-037-0-17, B-038-0-17, B-017-2-17, B-020-2-17 TO B-020-3-17. THE DEPTHS AND INTERVALS OF SAMPLING FOLLOWED ODOT'S SGE GUIDELINES FOR BORING TYPES B5 AND E1. A TOTAL OF FOUR B5 BORINGS AND THREE E1 BORINGS WERE ADVANCED.

ATV CME 550 RIG WAS UTILIZED TO ADVANCE THE BORINGS. THE RIG UTILIZED 3.25 IN. DIAMETER HOLLOW STEM AUGERS AND 2.0 IN. OUTSIDE DIAMETER SPLIT SPOON SAMPLERS. THE ENERGY RATIO OF THE HAMMERS OF THE ATV CME 550 RIG WAS 80.3 %. THE DATE OF THE CALIBRATION OF THE HAMMER OF CME 550 DRILL RIGS IS JANUARY 10TH, 2017. THE SOIL SAMPLING OF BORINGS WAS PERFORMED BY TTL ASSOCIATES, INC.

DESIGN AGENCY
GANNETT FLEMING
300 N. CLEVELAND-MASSILLON ROAD
SUITE 104, AKRON, OHIO 44333-2484

PID NO. 91710

SOIL PROFILE

SUM-8-1.75

2019 PROJECT EXPLORATION

THE 2019 FIELD EXPLORATION WAS PERFORMED FOR THE FINAL DESIGN OF THE PROJECT STRUCTURES. THE EXPLORATION WAS USED TO VERIFY ROCK ELEVATION AT EACH DRILLED SHAFT LOCATION.

BETWEEN JUNE 4TH, 2019 AND JULY 1ST, 2019, SIX (6) EXPLORATORY BORINGS WERE ADVANCED. THE BORINGS WERE DESIGNATED B-008-1-19, B-009-5-19, B-009-6-19, B-009-7-19, B-011-7-19, AND B-011-8-19. THE DEPTH INTERVALS OF SAMPLING FOR BORINGS B-008-1-19, B-009-5-19, B-009-6-19 AND B-009-7-19 FOLLOWED ODOT'S SGE GUIDELINES FOR BORING TYPES E1. IN ORDER TO OVERCOME DIFFICULT DRILLING CONDITIONS THAT CAUSED EARLY TERMINATION OF BORING B-011-1-15 IN THE PAST, THE DRILLING FOR BORINGS B-011-7-19 AND B-011-8-19 WAS PERFORMED WITH A SONIC DRILL RIG AND NO SOILS WERE SAMPLED.

A CME 850R TRACKED RIG WAS UTILIZED TO ADVANCE THE BORINGS B-008-1-19, B-009-5-19, B-009-6-19, AND B-009-7-19. THE RIG UTILIZED 3.75 IN. DIAMETER HOLLOW STEM AUGERS AND 2.0 IN. OUTSIDE DIAMETER SPLIT SPOON SAMPLERS. THE ENERGY RATIO OF THE HAMMER ON THE RIG WAS 81%. THE DATE OF THE CALIBRATION OF THE HAMMER OF THE CME 850R TRACKED RIG IS JUNE 1ST, 2017. THE SOIL SAMPLING OF THE BORINGS WAS PERFORMED BY OHIO DEPARTMENT OF TRANSPORTATION (ODOT) EXPLORATION AND LAB. ALL FIELD SAMPLES WERE SEALED IN GLASS JARS AND TRANSPORTED TO THE ODOT LABORATORY FOR TESTING.

FRONTZ DRILLING INC. UTILIZED A VERSA SONIC RIG TO ADVANCE BORINGS B-011-7-19 AND B-011-8-19. THE MAIN PURPOSE OF THESE BORINGS WAS TO VERIFY THE TOP OF ROCK ELEVATION. AS PREVIOUSLY STATED, NO SOIL WAS SAMPLED FOR THOSE TWO BORINGS.

IN ADDITION, A GEOPHYSICAL EXPLORATION WAS PERFORMED BY ODOT IN 2019 TO CONFIRM THE TOP OF ROCK ELEVATION ENCOUNTERED IN THE BORINGS. RESULTS OF THIS EXPLORATION ARE PRESENTED IN A SEPARATE REPORT.

EXPLORATION FINDINGS

BRIDGE BORINGS

BORINGS B-005-1-16, B-005-2-16, B-006-0-15, B-007-0-15, B-B-008-1-19, B-009-1-16, B-009-5-19, B-009-6-19, B-009-7-19, B-010-0-15, B-010-1-15, B-010-2-15, B-011-0-15, B-011-1-15, B-011-1-16, B-011-2-16, B-011-3-16, B-011-4-16, B-011-5-16, B-011-7-19, B-011-8-19, B-012-0-15, B-013-0-15, B-013-1-15, B-013-2-15, B-013-3-15, B-013-4-15, B-013-5-15, B-014-0-15, B-015-0-15, B-015-1-15, B-016-0-15, B-017-0-15, B-017-2-10, B-020-2-17, AND B-020-3-17 WERE ADVANCED FOR THE PROPOSED BRIDGES CARRYING SR8 OVER THE LITTLE CUYAHOGA RIVER.

REAR ABUTMENT

BORINGS B-005-1-16 AND B-006-0-15 ARE NEAR THE NORTHBOUND BRIDGE REAR ABUTMENT; B-005-2-16 AND B-007-0-15 ARE NEAR THE SOUTHBOUND BRIDGE REAR ABUTMENT. MOST OF THE SOIL ENCOUNTERED IS GRANULAR. THE RELATIVE DENSITY OF THE SOIL IS LOOSE TO DENSE BY N60 VALUES AND IS CLASSIFIED AS GRAVEL WITH SAND (ODOT A-1-B), COARSE AND FINE SAND (ODOT A-3A), AND FINE SAND (ODOT A-3). AN EXCEPTION CAN BE FOUND IN BORING B-005-1-16. ALTHOUGH THIS BORING CONTAINS SOME AMOUNTS OF A-1-B AND A-3A SOILS, MOST OF THE MATERIAL OBSERVED IS FINE-GRAINED, COHESIVE SOIL (ODOT A-4A) THAT IS VERY STIFF TO HARD ACCORDING TO POCKET PENETROMETER READINGS. BOTH BORINGS OF B-006-0-15 AND B-007-0-15 ENCOUNTERED AN UNCONTROLLED FILL LAYER AT THE SURFACE THAT CONSISTED OF BOULDERS, ASPHALT, AND COAL FRAGMENTS.

WEATHERED SANDSTONE WAS ENCOUNTERED AT ELEVATIONS 1004.0, 1014.6, 987.4, AND 1000.0 IN BORINGS B-006-0-15, B-005-1-16, B-007-0-15, AND B-005-2-16, RESPECTIVELY. COMPETENT SANDSTONE WAS ENCOUNTERED AT ELEVATION 1002.0 IN BORING B-006-0-15 WITH 98% RECOVERY AND AN RQD OF 72%, AT ELEVATION 1006.3 IN BORING B-005-1-16 WITH 98% RECOVERY AND AN RQD OF 85%, AT ELEVATION 985.9 IN BORING B-007-0-15 WITH 90% RECOVERY AND AN RQD OF 80%, AND AT ELEVATION 996.8 IN BORING B-007-0-15 WITH 85% RECOVERY AND AN RQD OF 31%.

PIER 1

BORING B-009-5-19 ARE LOCATED NEAR PIER #1 OF THE PROPOSED NORTHBOUND BRIDGE; AND BORINGS B-008-1-19 AND B-009-1-16 ARE LOCATED NEAR PIER #1 OF THE PROPOSED SOUTHBOUND BRIDGE. MOST OF THE SOIL OF THE BORINGS IS NON-PLASTIC AND/OR GRANULAR. THE RELATIVE DENSITY OF THE SOIL BY N60 VALUES IS MEDIUM DENSE TO VERY DENSE, AND THE SOIL IS CLASSIFIED AS GRAVEL AND/OR SAND (ODOT A-1, A-2, AND A-3 SERIES). BOULDER ZONES ARE FOUND TO EXIST ABOVE TOP OF ROCK.

AT THE SOUTHBOUND BRIDGE, BORING B-008-1-19 FINDS INTERBEDDED SILTSTONE AND SHALE BEDROCK AT ELEVATIONS 933.0. THE BEDROCK CONSISTS OF SHALE WITH 97% RECOVER AND AN RQD OF 45%. BORING B-009-1-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 931.7, AND COMPETENT BEDROCK AT ELEVATION 920.7. THE COMPETENT BEDROCK CONSISTS OF SHALE AND SILTSTONE WITH 90% RECOVERY AND AN RQD OF 29%.

BORING B-009-5-19 FINDS WEATHERED BEDROCK (SANDSTONE) AT ELEVATION 958.8, AND COMPETENT BEDROCK AT ELEVATION 951.8. THE COMPETENT BEDROCK CONSISTS OF SANDSTONE, WITH 100% RECOVERY AND AN RQD OF 75%, AND INTERBEDDED SHALE AND SANDSTONE AT ELEVATION 941.7 WITH 90% RECOVERY AND AN RQD OF 37%. THE ABSENCE OF THE SANDSTONE AT THE SOUTHBOUND BRIDGE PIER #1 SUGGESTS THAT THE SANDSTONE MAY HAVE ACTED TO PROTECT UNDERLYING ROCK FROM WEATHERING AND MAY EXPLAIN THE DIFFERENCE IN TOP OF ROCK OF 43.7 FEET BETWEEN B-009-0-15 AND B-009-1-16. IT IS POSSIBLE, AND PERHAPS LIKELY, THAT THE SANDSTONE IS NOT PRESENT ACROSS THE ENTIRE FOOTING AREA OF THE NORTHBOUND BRIDGE.

PIER 2

BORINGS B-009-6-19, B-009-7-19, B-010-0-15 AND B-011-0-15 ARE NEAR PIER #2 OF THE PROPOSED NORTHBOUND AND THE SOUTHBOUND BRIDGES. THE NEAR SURFACE SOIL CONSISTS OF TWO TO SIX FEET OF GRAVEL (ODOT A-1 AND A-2 SERIES). AT BORING B-009-7-19, B-010-0-15, AND B-011-0-15, THE GRAVEL LAYER IS OVERLAYING MEDIUM STIFF TO HARD COHESIVE SOILS. AT BORING B-009-6-19, LAYERS OF DENSE SANDY SILT (A-4A) AND STIFF SILT AND CLAY (A-6A) WERE FOUND BENEATH THE GRAVEL LAYER. BELOW THE COHESIVE LATER, BOULDER ZONES ARE FOUND TO EXIST ABOVE THE TOP OF ROCK.

NEAR PIER #2 OF THE NORTHBOUND BRIDGE, BORING -009-19 FINDS COMPETENT BEDROCK AT ELEVATION 853.2. THE COMPETENT ROCK CONSISTS OF SANDSTONE WITH 100% RECOVERY AND AN RQD OF 79%, AND AN INTERBEDDED SANDSTONE (60%) AND SHALE (40%) WITH 99% RECOVERY AND AN RQD OF 85%. BORING B-010-0-15 FINDS COMPETENT BEDROCK AT ELEVATIONS 855.7. THE COMPETENT ROCK CONSISTS OF SHALE WITH 63% RECOVERY AND AN RQD OF 31%, SANDSTONE WITH 98% RECOVERY AND AN RQD OF 63%, AND SHALE WITH 100% RECOVERY AND AN RQD OF 94%.

NEAR PIER #2 OF THE SOUTHBOUND BRIDGE, BORING B-009-6-19 FINDS COMPETENT BEDROCK AT ELEVATIONS 858.9. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SHALE (70%) AND SANDSTONE (30%) WITH 93% RECOVERY AND AN RQD OF 55%, SANDSTONE WITH 100% RECOVERY AND AN RQD OF 100%, AND OF INTERBEDDED SANDSTONE (60%) AND SHALE (40%) WITH 97% RECOVERY AND AN RQD OF 45%. BORING B-011-0-15 FINDS WEATHERED ROCK (SHALE) AT ELEVATION 862.7 AND COMPETENT BEDROCK IS AT ELEVATIONS 855.5. THE COMPETENT BEDROCK CONSISTS OF INTERBEDDED SHALE (60%) AND SANDSTONE (40%) WITH 99% RECOVERY AND AN RQD OF 96%.

PIER 3

BORINGS B-011-2-16, B-011-3-16 AND B-011-7-19 ARE LOCATED NEAR PIER #3 OF THE NORTHBOUND BRIDGE. MOST OF THE SOIL OF THE BORINGS IS GRANULAR. THE RELATIVE DENSITY OF THE SOIL BY N60 VALUES IS MEDIUM DENSE TO VERY DENSE, AND THE SOIL IS CLASSIFIED AS GRAVELS AND/OR SAND (ODOT A-1, A-2 AND A-3 SERIES). BOULDER ZONES ARE FOUND TO EXIST ABOVE THE TOP OF ROCK.

BORING B-011-2-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 844.6 AND COMPETENT BEDROCK AT ELEVATIONS 840.8. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SILTSTONE (16%) AND SHALE (84%) WITH 100% RECOVERY AND AN RQD OF 53%.

BORING B-011-3-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 843.8 AND COMPETENT BEDROCK AT ELEVATIONS 838.3. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SHALE (69%) AND SILTSTONE (31%) WITH 99% RECOVERY AND AN RQD OF 47%.

BORING B-011-7-19 FINDS COMPETENT BEDROCK AT ELEVATION 843.9. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SILTSTONE AND SHALE WIH 66% RECOVERY AND AN RQD OF 40%, LIMESTONE WITH 66% RECOVERY AND AN RQD OF 40%, AND INTERBEDDED SHALE (56%) AND SILTSTONE (44%) WITH 85% RECOVER AND AN RQD OF 31%.

BORINGS B-011-4-16, B-011-5-16 AND B-011-7-19 ARE LOCATED NEAR PIER #3 OF THE SOUTHBOUND BRIDGE. BORING B-011-4-16 AND B-011-7-19 ENCOUNTER MOSTLY GRANULAR MATERIAL. THE RELATIVE DENSITY OF THE SOIL BY N60 VALUES IS MEDIUM DENSE TO VERY DENSE, AND THE SOIL IS CLASSIFIED AS GRAVELS AND/OR SAND AND/OR SILT (ODOT A-1, A-2 AND A-4 SERIES). BORING B-011-5-16 ENCOUNTERS SANDY SILT (ODOT A-4 SERIES) AND STONE FRAGMENTS WITH/OR SAND AND/OR SILT (ODOT A-1 AND A-2 SERIES) OVER SILT AND CLAY (ODOT A-6A). THE RELATIVE DENSITY OF THE SOIL BY N60 VALUES IS MEDIUM DENSE TO VERY DENSE, VERY STIFF TO HARD ACCORDING TO POCKET PENETROMETER READINGS. BOULDER ZONES ARE FOUND TO EXIST ABOVE THE TOP OF ROCK.

BORING B-011-4-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 832.2 AND COMPETENT BEDROCK AT ELEVATIONS 830.0. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SILTSTONE (37%) AND SHALE (63%) WITH 98% RECOVERY AND AN RQD OF 72%.

BORING B-011-5-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 837.7 AND COMPETENT BEDROCK AT ELEVATIONS 835.2. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SHALE (75%) AND SILTSTONE (25%) WITH 99% RECOVERY AND AN RQD OF 71%.

BORING B-011-8-19 FINDS WEATHERED BEDROCK (SILTSTONE) AT ELEVATION 835.0 AND COMPETENT BEDROCK AT ELEVATION 825.7. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SHALE (45%), SILTSTONE (40%), AND CLAYSTONE (15%) WITH 74.5% RECOVERY AND AN RQD OF 22%.

BORINGS B-010-1-15, B-010-2-15, AND B-011-1-15 WERE ADVANCED AT PREVIOUS ITERATIONS OF THE NORTHBOUND AND SOUTHBOUND BRIDGE PIER LOCATIONS OR TERMNINATED EARLY AND THUS WERE NOT USED TO DEVELOP THE SUBSURFACE CONDITIONS AT THE PIERS.

PIER 4

BORINGS B-013-2-16 AND B-013-3-16 ARE LOCATED NEAR PIER #4 OF THE NORTHBOUND BRIDGE. THE MAJORITY OF THE SOIL OF THE BORINGS IS GRANULAR. THE RELATIVE DENSITY OF THE SOIL BY N60 VALUES IS VERY LOOSE TO MEDIUM DENSE AT BORING B-013-2-16 AND LOOSE TO VERY DENSE AT BORING B-013-3-16. IN BOTH BORINGS RELATIVE DENSITY GENERALLY INCREASED WITH DEPTH. THIS SOIL IS CLASSIFIED AS GRAVELS AND/OR SAND (ODOT A-1, A-2 AND A-3 SERIES).

BORING B-013-2-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 851.5 AND COMPETENT BEDROCK AT ELEVATIONS 836.8. THE COMPETENT ROCK CONSISTS OF INTERBEDDED SILTSTONE AND SHALE WITH 95% RECOVERY AND AN RQD OF 64%.

BORING B-013-3-16 FINDS WEATHERED BEDROCK (SHALE) AT ELEVATION 842.0 AND COMPETENT BEDROCK AT ELEVATIONS 839.5. THE UPPER COMPETENT ROCK STRATUM IS SILTSTONE WITH A RECOVERY 99% AND RQD 78%. THE LOWER STRATUM IS INTERBEDDED SHALE (69%) AND SILTSTONE (31%) WITH 78% RECOVERY AND AN RQD OF 26%.

BORINGS B-013-4-16 AND B-013-5-16 ARE LOCATED NEAR PIER #4 OF THE SOUTHBOUND BRIDGE. THE NEAR SURFACE SOIL OF SANDY SILT AND SILT (ODOT A-4A AND A-4B) THAT IS PLASTIC TO A DEPTH OF 5.5 FEET AND NON-PLASTIC TO A DEPTH OF 18 FEET. THE PLASTIC SANDY SILT HAS A CONSISTENCY OF STIFF TO HARD, AND THE NON-PLASTIC SILT AND SANDY SILT IS VERY LOOSE TO MEDIUM DENSE. THE STRATA BELOW THE SANDY SILT STRATA THE SOIL IS COMPOSED OF LOOSE TO VERY DENSE GRAVELS (ODOT A-1 AND A-2 SERIES) TO THE TOP OF ROCK. BORING B-013-4-16 FINDS COMPETENT INTERBEDDED SHALE (65%) AND SILTSTONE (35%) AT ELEVATION 841.1 WITH 98% RECOVERY AND A RQD OF 76%.

THE SOIL IN BORING B-013-5-16 CONSISTS OF 5.5 FEET OF FILL OVERLAYING PRIMARILY PLASTIC SILTS (ODOT A-4B) TO THE TOP OF ROCK. THE CONSISTENCY OF THE SILT IS MEDIUM STIFF TO VERY STIFF. THERE IS A 10.5-FOOT-THICK GRANULAR STRATUM AT A DEPTH OF 43 FEET THAT HAS A LOOSE TO DENSE RELATIVE DENSITY AND IS COMPOSED OF ODOT A-2 AND A-3 SERIES MATERIAL. BORING B-013-5-16 FINDS INTERBEDDED SHALE (85%) AND SILTSTONE (15%) AT ELEVATION 842.0 WITH A RECOVERY 76% AND RQD 20%.

BORINGS B-012-0-15, B-013-0-15, AND B-013-1-15 WERE ADVANCED AT PREVIOUS ITERATIONS OF THE NORTHBOUND AND SOUTHBOUND BRIDGE PIER LOCATIONS AND WERE NOT USED TO DEVELOP SUBSURFACE CONDITIONS AT THE PIERS.

PIER 5

BORING B-015-0-15 IS LOCATED NEAR PIER #5 OF THE NORTHBOUND BRIDGE. VERY LOOSE TO DENSE, FILL CONSISTING OF GRANULAR SOIL EXTENDS TO A DEPTH OF 15.3 FEET. THE UNDERLYING NATURAL SOILS ARE PRIMARILY GRANULAR WITH THE NOTABLE EXCEPTION OF VERY SOFT TO STIFF STRATA OF COHESIVE SOIL SANDY SILT AND SILTY CLAY FROM A DEPTH OF 22 FEET TO 62.5 FEET. THE RELATIVE DENSITY OF THE GRANULAR SOILS BY N60 ARE VERY LOOSE TO VERY DENSE WITH THE SOIL BENEATH THE COHESIVE STRATUM BEING DENSE TO VERY DENSE. THE BORING WAS TERMINATED AT A DEPTH OF 95 FEET WITHOUT ENCOUNTERING BEDROCK.

BORING B-015-1-16 IS LOCATED NEAR PIER #5 OF THE SOUTHBOUND BRIDGE. THERE IS 20.5 FEET OF FILL AND UNCONTROLLED FILL. BASED ON AN EXPLORATORY ENVIRONMENTAL SITE ASSESSMENT (ESA) COMPLETED BY CTL ENGINEER OF OHIO, INC., THE HILLSIDE IN THE VICINITY OF, AND TO THE NORTH AND WEST OF, PROPOSED SOUTHBOUND PIER #5 CONSISTS OF PREVIOUSLY USED, UNREGULATED LANDFILL. THE NATURAL SOILS BELOW THIS ARE COMPOSED OF PRIMARILY GRANULAR SOILS (ODOT A-1, A-2, AND A-3 SERIES) AND NON-PLASTIC SILT. THE RELATIVE DENSITY RANGES FROM LOOSE TO DENSE, WITH A LOOSE TO MEDIUM DENSE SILT PROMINENT AT A DEPTH OF 46 TO 87 FEET. THE BORING WAS TERMINATED AT A DEPTH OF 115 FEET WITHOUT ENCOUNTERING BEDROCK.

FORWARD (NORTH) ABUTMENTS

BORINGS B-016-0-15 AND B-017-0-15 ARE LOCATED NEAR THE FORWARD ABUTMENTS FOR SOUTHBOUND AND NORTHBOUND BRIDGES, RESPECTIVELY. MOST OF THE SOIL IN THESE BORINGS IS NON-PLASTIC AND/OR GRANULAR. LABORATORY TESTING INDICATES THEY FIT INTO CLASSIFICATIONS IN THE ODOT A-1 AND A-3 SERIES. SEVERAL THIN LAYERS OF FINE GRAINED, COHESIVE SOIL ARE IDENTIFIED IN BORING B-016-0-15. THESE STRATA ARE SANDY SILT (ODOT A-4A) AND SILTY CLAY (ODOT A-6B). BEDROCK WAS NOT ENCOUNTERED IN EITHER BORING.

ROADWAY BORINGS

BORINGS B-001-0-15, B-002-0-15, B-021-0-15, B-024-0-15, B-027-0-15, B-030-0-15, AND B-032-0-15 WERE ADVANCED FOR THE NORTHBOUND LANES OF SR8. B-004-4-15 WAS ADVANCED AT THE CONVERGENCE OF RAMP J, AND IS ALSO APPLICABLE FOR THE NORTHBOUND LANES OF SR8.

BORINGS B-001-0-15 AND B-002-0-15 PENETRATE DENSE TO VERY DENSE, FINE SAND (ODOT A-3) ABOVE WEATHERED SANDSTONE BEDROCK. THE ELEVATION OF BEDROCK IS 1029.6 AND 1033.6, RESPECTIVELY. BORING B-021-0-15 FINDS THE SOIL TO BE MEDIUM STIFF TO STIFF SILTY CLAY (ODOT A-6B) AND MEDIUM DENSE GRAVEL WITH SAND (ODOT A-1-B). BORING B-024-0-15 ENCOUNTERS FINE-GRAINED, COHESIVE SOIL (ODOT A-6B AND A-7-6) THAT IS VERY STIFF TO HARD ACCORDING TO POCKET PENETROMETER READINGS. B-027-0-15 IDENTIFIED THE SOIL AS DENSE TO VERY DENSE SAND (ODOT A-3A AND A-3) AND HARD CLAY (ODOT A-7-6) ABOVE THE WEATHERED SANDSTONE BEDROCK AT ELEVATIONS 991.6. BORINGS B-030-0-15 ENCOUNTERS VERY STIFF SILT AND CLAY (ODOT A-6A) OVER DENSE FINE SAND (ODOT A-3). BORING B-032-0-15 FINDS GRANULAR SOIL OVER WEATHERED BEDROCK AT ELEVATION 1016.9. BORINGS B-001-0-15 AND B-002-0-15 PENETRATE DENSE TO VERY DENSE, FINE SAND (ODOT A-3) ABOVE WEATHERED SANDSTONE BEDROCK. THE ELEVATION OF BEDROCK IS 1029.6 AND 1033.6, RESPECTIVELY. BORING B-021-0-15 FINDS THE SOIL TO BE MEDIUM STIFF TO STIFF SILTY CLAY (ODOT A-6B) AND MEDIUM DENSE GRAVEL WITH SAND (ODOT A-1-B). BORING B-024-0-15 ENCOUNTERS FINE-GRAINED, COHESIVE SOIL (ODOT A-6B AND A-7-6) THAT IS VERY STIFF TO HARD ACCORDING TO POCKET PENETROMETER READINGS. B-027-0-15 CLASSIFIED AS ODOT A-3 AND A-3A AND IS MEDIUM DENSE TO VERY DENSE ACCORDING TO N60 VALUES. BORINGS B-004-4-15 ENCOUNTERS NON-PLASTIC SANDY SILT (ODOT A-4A) AND FINE SAND (ODOT A-3) THAT IS VERY DENSE ACCORDING TO N60 VALUES.

BORINGS B-003-0-15, B-004-0-15, B-005-0-15, B-020-0-15, B-022-0-15, B-029-0-15, AND B-031-0-15 WERE ADVANCED FOR THE SOUTHBOUND LANES OF SR8. THE MAJORITY OF THE SOIL IS NON-PLASTIC AND/OR GRANULAR. LABORATORY TESTING INDICATES THEY FIT INTO CLASSIFICATIONS IN THE ODOT A-1, A-3, AND A-4 SERIES. NOTABLE EXCEPTIONS CAN BE FOUND IN BORINGS B-022-0-15 AND B-031-0-15. ALTHOUGH THESE TWO BORINGS CONTAIN ODOT A-1 AND A-3 SOIL NEAR THE GROUND SURFACE, THE DEEPER SOIL IS COHESIVE (ODOT A-6B AND A-7-6). WEATHERED SANDSTONE IS ENCOUNTERED AT ELEVATIONS 1033.8, 1036.7, AND 1018.3 IN BORINGS B-003-0-15, B-004-0-15, AND B-005-0-15, RESPECTIVELY.

DRAWN YLZ | CHECKED TLM

SOIL PROFILE

SUM-8-1.75

BORINGS B-001-2-15, B-003-2-15, AND B-004-4-15 ARE APPLICABLE FOR RAMP J. BORING B-001-2-15 IDENTIFIES MEDIUM DENSE SAND (ODOT A-3) AND SOFT CLAY (ODOT A-6A). BORING B-003-2-15 ENCOUNTERS GRAVEL WITH SAND (ODOT A-1-B) THAT IS MEDIUM DENSE TO DENSE ACCORDING TO N60 VALUES. BORING B-004-4-15 ENCOUNTERS NON-PLASTIC SANDY SILT (ODOT A-4A) AND FINE SAND (ODOT A-3) THAT IS VERY DENSE ACCORDING TO N60 VALUES. WEATHERED SANDSTONE BEDROCK IS AT ELEVATIONS 1044.5 AND 1053.8 IN BORINGS B-001-2-15 AND B-003-2-15, RESPECTIVELY.

B-001-4-15, B-003-1-15, B-003-5-15, AND B-003-6-15 WERE ORIGINALLY ADVANCED FOR A RETAINING WALL THAT WAS FOUND TO BE NOT JUSTIFIED; HOWEVER, THEY ARE ALSO APPLICABLE FOR RAMP J. BORINGS B-001-4-15 AND B-003-1-15 IDENTIFIED THE SOIL AS VERY STIFF OR HARD SILT (ODOT A-4B) AND SOFT OR VERY STIFF TO HARD CLAY (ODOT A-7-6). BORING B-003-5-15 ENCOUNTERED HARD SILTY CLAY (ODOT A-6B) AND LOOSE TO VERY DENSE FINE SAND (ODOT A-3). BORING B-003-6-15 IDENTIFIED SANDY SILT FROM AUGER CASTINGS (ODOT A-4A). WEATHERED SANDSTONE BEDROCK WAS ENCOUNTERED AT ELEVATIONS 1048.8, 1047.9, AND 1047.2 IN BORINGS B-001-4-15, B-003-1-15, AND B-003-6-15, RESPECTIVELY. COMPETENT SANDSTONE WAS ENCOUNTERED AT ELEVATION 1046.9 IN BORING B-003-1-15 WITH 100% RECOVERY AND A RQD OF 62%, AND AT ELEVATIONS 1042.3 IN BORING B-003-5-15 WITH 100% RECOVERY AND A RQD OF 58%.

BORINGS B-001-1-15, B-003-3-15, B-003-7-15, AND B-004-3-15 ARE APPLICABLE FOR RAMP I. THE MAJORITY OF THE SOIL NEAR RAMP I IS GRANULAR. THE SOIL IS DESCRIBED ON THE BORING LOGS AS GRAVEL WITH SAND, FINE SAND, OR WEATHERED SANDSTONE. LABORATORY TESTING INDICATES THE SOIL IS IN THE ODOT A-1 AND A-3 SERIES. A SILT AND CLAY STRATUM (ODOT A-6A) WAS ENCOUNTERED IN THE FIRST FEW FEET OF BORING B-003-7-15. WEATHERED SANDSTONE BEDROCK IS ENCOUNTERED AT ELEVATIONS 1044.2, 1030.5, 1039.5, AND 1035.2 IN BORINGS B-001-1-15, B-003-3-15, B-003-7-15, AND B-004-3-15, RESPECTIVELY.

NOISE BARRIER BORINGS

A TOTAL OF 27 BORINGS WERE ADVANCED FOR THE NOISE BARRIER. IN ACCORDANCE WITH ODOT STANDARDS FOR NOISE BARRIER DESIGN (BDM SECTION 802.1.2-A), THESE BORINGS WERE TYPICALLY ADVANCED TO DEPTHS OF 25.0 FT. BEDROCK WAS CORED IN BORING B-004-6-16 TO B-025-3-16.

ACCESS ROAD BORING

BORINGS B-011-6-17, B-015-2-17, B-037-0-17, B-038-0-17 WERE ADVANCED IN SUPPORT OF THE ACCESS ROADS. IN ADDITION, PREVIOUSLY ADVANCED BORINGS NEAR EACH PROPOSED ACCESS ROAD ARE INCLUDED WHERE APPLICABLE.

LAUNCH PIT

BORINGS B-017-2-17 AND B-020-2-17 WERE ADVANCED IN SUPPORT OF THE SOUTHBOUND LAUNCH PIT. BORINGS B-016-0-15, B-018-0-15, AND B-020-0-15 WERE ADVANCED IN SUPPORT OF OTHER STRUCTURES; HOWEVER, THEIR LOCATIONS MAKE THEM APPLICABLE FOR THE SOUTHBOUND LAUNCH PIT.

WATER

DURING THE FIELD EXPLORATION IN 2015, FREE WATER WAS ENCOUNTERED DURING DRILLING AT DEPTHS OF 14.0 FT. (ELEVATION 861.0), 15.0 FT. (ELEVATION 860.0), 11.0 FT. (ELEVATION 866.6), 43.5 FT. (ELEVATION 866.0) 23.0 FT. (ELEVATION 900.4), 18.5 FT. (ELEVATION 942.7), 52.0 FT. (ELEVATION 965.6), 58.0 FT. (ELEVATION 966.4), 17.3 FT. (ELEVATION 1007.8) IN BORINGS B-010-1-15, B-010-2-15, B-013-0-15, B-013-1-15, B-014-0-15, B-015-0-15, B-016-0-15, B-017-0-15, AND B-027-0-15, RESPECTIVELY. AT THE COMPLETION OF DRILLING, WATER WAS OBSERVED AT DEPTHS OF 19 FT. (ELEVATION 856) IN BORING B-010-2-15. GROUNDWATER WAS NOT ENCOUNTERED IN THE OTHER BORINGS.

DURING THE FIELD EXPLORATION IN 2016, FREE WATER WAS ENCOUNTERED DURING DRILLING AT DEPTHS OF 3.5 FT. (ELEVATION 1038.4), 22.0 FT. (ELEVATION 935.7), 14.0 FT. (ELEVATION 868.7), 13.0 FT. (ELEVATION 860.8), 11.0 FT. (ELEVATION 864.0), 8.0 FT. (ELEVATION 867.2), 18.0 FT. (ELEVATION 867.5), 18.0 FT. (ELEVATION 867.5), 27.0 FT. AND 45.6 FT. (ELEVATION 886.5 AND 867.9), 43.0 FT. (ELEVATION 917.3) IN BORINGS B-004-2-16, B-009-1-16, B-009-4-16, B-011-3-16, B-011-4-16, B-011-5-16, B-013-3-16, B-013-4-16, B-013-5-16, AND B-015-1-16, RESPECTIVELY. ANOTHER FREE WATER LEVEL AT 23.5 FT. (ELEVATION 862.0) WAS ALSO ENCOUNTERED IN BORING B-013-3-16. GROUNDWATER WAS ENCOUNTERED AT THE 24 HOUR AT A DEPTH OF 16.1 FT. (ELEVATION 857.7), 8.0 FT. (ELEVATION 867.0), 11.3 FT. (ELEVATION 863.9), 15.0 FT. (ELEVATION 870.5), 7.5 FT. (ELEVATION 906.0), 89.5 FT. (ELEVATION 870.8), IN BORING B-011-3-16, B-011-4-16, B-011-5-16, B-013-3-16, B-013-5-16, AND B-015-0-16. GROUNDWATER WAS NOT ENCOUNTERED IN THE OTHER BORINGS.

DURING THE FIELD EXPLORATION IN 2017, FREE WATER WAS ENCOUNTERED DURING DRILLING AT DEPTHS OF 63.5 FT. (ELEVATION 965.5) AND 11 FT. (ELEVATION 915.8), IN BORINGS B-020-2-17 AND B-037-0-17, RESPECTIVELY. AT THE COMPLETION OF DRILLING, WATER WAS OBSERVED AT DEPTHS OF 67.5 FT. (ELEVATION 961.5) AND 17.5 FT. (ELEVATION 909.3), IN BORINGS B-020-2-17 AND B-037-0-17. GROUNDWATER WAS NOT ENCOUNTERED IN THE OTHER BORINGS.

DURING THE FIELD EXPLORATION IN 2019, FREE WATER WAS ENCOUNTERED DURING DRILLING AT 19.9 FT. (ELEVATION 938.4) IN BORING B-008-1-19, AT 12.4 FT. (ELEVATION 868.8) IN BORING B-009-6-19 AND AT 12.5 FT. (ELEVATION 872.7) IN BORING B-009-7-19. GROUNDWATER WAS NOT ENCOUNTERED IN THE OTHER BORINGS.

INDEX OF SHEETS

SUMMARY OF SOIL AND ROCK TEST DATA, SHEETS 5 TO 47

LOCATION FROM STA.	TO STA.	PLAN VIEW SHEET	PROFILE SHEET	CUT MAX.	FILL EMB. MAX.	STRUCTURES INCLUDED BRIDGE NO.	STRUCTURES INCLUDED SFN
S.R. 8 S.B.							
211+00	224+11.84	48	49	-	12.5 FT		
224+11.84	228+00	50	51	-	15.5 FT	SUM-8-0199	7700371
228+00	233+00	53	54	-	-	SUM-8-0199	7700371
233+00	238+00	56	57	-	-	SUM-8-0199	7700371
238+00	242+12	59	60	-	-	SUM-8-0199	7700371
242+12	253+87.86	62	63	-	10.5 FT		
			64	-	10.5 FT		
253+87.86	262+86.80	66	67	-	-		
S.R. 8 N.B.							
511+00	524+00	48	49	-	2.5 FT		
524+00	528+00	50	52	-	-	SUM-8-0199	7700370
528+00	533+00	53	55	-	-	SUM-8-0199	7700370
533+00	538+00	56	58	-	-	SUM-8-0199	7700370
538+00	542+00	59	61	-	-	SUM-8-0199	7700370
542+00	554+00	62	63	-	1 FT		
			65	-	1 FT		
554+00	562+94.93	66	67	-	-		
RAMP I							
314+53.04	325+32.77	68	68	4.5 FT	29.5 FT		
RAMP J							
415+09.61	424+25.80	69	69	11.5FT	3 FT		
NOISE BARRIER NO. 1A							
0+80	6+20	70	70	-	14 FT		
6+20	8+96	71	71	4.5 FT	6.5 FT		
NOISE BARRIER NO. 1B							
10+00	15+40	72	72	-	-		
15+40	20+80	73	73	-	-		
20+80	21+52	74	74	-	-		
NOISE BARRIER NO. 2A							
30+80	35+80	75	75	-	10 FT		
35+80	39+36	76	76	3.5 FT	10 FT		
NOISE BARRIER NO. 2B							
40+48	45+12	77	77	-	-		
NOISE BARRIER NO. 3							
51+04	56+10	78	78	3 FT	-		
56+10	59+36	79	79	-	30 FT		
NOISE BARRIER NO. 4							
70+00	75+00	80	80	9.5 FT	-		
75+00	79+60	81	81	4.5 FT	9 FT		
ACCESS ROAD 1							
10+00	18+50	82		-	-		
ACCESS ROAD 2A							
30+00	44+00	83	83	-	-		
44+00	53+08.96	84		-	-		
ACCESS ROAD 3A							
34+50	47+25.95	82		-	-		
ACCESS ROAD 5A							
51+00	59+63.74	85		-	-		
ACCESS ROAD 6							
60+00	78+26.50	85		-	-		
ACCESS ROAD 8							
40+00	49+58.57	84		-	-		

INDEX OF SHEETS

LOCATION FROM STA.	TO STA.	CROSS SETION SHEET	CUT MAX.	FILL EMB. MAX.	STRUCTURES INCLUDED BRIDGE NO.	STRUCTURES INCLUDED SFN
CROSS SECTION						
SR. 8 S.B. 224+00.00		86	-	-		
SR. 8 S.B. 225+00.00		86	-	20.5 FT		
SR. 8 S.B. 243+00.00		87	-	17.5 FT		
SR. 8 N.B. 525+00.00		87	-	-		
RAMP I 320+50.00		88	19.5 FT	-		
RAMP J 418+50.00		88	10.6 FT	-		
ACR 1 13+00.00		89	-	-		
ACR 2A 49+00.00		90	-	-		
ACR 5A 52+00.00		91	-	-		
ACR 5A 56+00.00		92	-	-		
ACR 6 66+00.00		93	-	-		
ACR 8 44+00.00		94	-	-		
ROCK OUTCROPPING PROFILES, SHEETS 95 TO 96						
BORING LOGS, SHEETS 97 TO 181						

SPECIFICATIONS

THIS THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATE JULY 2015, JULY 2016 AND JANUARY 2019.

AVAILABLE INFORMATION

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

DRAWN YLZ CHECKED TLM

SOIL PROFILE

SUM-8-1.75

INDEX OF SHEETS

BORING NO.	PROFILE SHEET NO.	BORING NO.	PROFILE SHEET NO.	BORING NO.	PROFILE SHEET NO.
B-001-0-15	49	B-001-3-16	80	B-033-0-16	73
B-001-1-15	68	B-001-5-16	78	B-034-0-16	73
B-001-2-15	69	B-003-4-16	78	B-035-0-16	73
B-001-4-15	80		88	B-036-0-16	74
B-002-0-15	49	B-003-8-16	78		
B-003-0-15	49		88		
B-003-1-15	80	B-004-1-16	81	B-011-6-17	57
	88	B-004-2-16	79		91
B-003-2-15	69	B-004-5-16	81	B-015-2-17	60
	68	B-004-6-16	79	B-017-2-17	64
	88		86	B-020-2-17	64
B-003-3-15	68	B-005-1-16	52	B-020-3-17	65
B-003-5-15	69		81	B-037-0-17	83
	80		87	B-038-0-17	83
B-003-6-15	80	B-005-2-16	51		
B-003-7-15	68		79		
B-004-0-15	49		86		
B-004-3-15	68		89	B-008-1-19	51
B-004-4-15	69	B-006-1-16	51	B-009-5-19	52
B-005-0-15	49		89	B-009-6-19	54
	86	B-007-1-16	51	B-009-7-19	55
B-006-0-15	52		89	B-011-7-19	58
	86	B-007-2-16	51	B-011-8-19	57
	87	B-009-1-16	51		
	89	B-009-2-16	54		
B-007-0-15	51		90	B-014-0-48	55
	89	B-009-3-16	54	B-017-0-48	55
B-010-0-15	55		90	B-019-0-48	55
B-010-1-15	58	B-009-4-16	54	B-022-0-48	58
B-010-2-15	58		94	B-025-0-48	61
B-011-0-15	54	B-011-2-16	58		
	94	B-011-3-16	58		
B-011-1-15	57	B-011-4-16	57		
B-012-0-15	58	B-011-5-16	57		
B-013-0-15	57		91		
B-013-1-15	57	B-013-2-16	58		
B-014-0-15	60	B-013-3-16	58		
	92	B-013-4-16	57		
B-015-0-15	61	B-013-5-16	57		
B-016-0-15	60	B-015-1-16	60		
B-017-0-15	61		92		
B-018-0-15	87	B-017-1-16	63		
	93	B-020-1-16	63		
B-019-0-15	87	B-021-1-16	63		
	93	B-021-2-16	63		
B-020-0-15	63		70		
	93	B-021-3-16	63		
B-021-0-15	63		75		
B-022-0-15	63	B-025-1-16	63		
B-023-0-15	70		75		
B-024-0-15	63	B-025-2-16	75		
B-025-0-15	70	B-025-3-16	70		
B-026-0-15	70	B-029-1-16	76		
B-027-0-15	63	B-030-1-16	71		
	75	B-031-1-16	71		
B-030-0-15	63		72		
B-029-0-15	63	B-031-2-16	76		
B-030-0-15	63		77		
B-031-0-15	67	B-031-3-16	72		
B-032-0-15	67	B-031-4-16	76		
			77		
		B-032-1-16	72		
		B-032-2-16	75		

BEDROCK TEST SUMMARY

BORING NO.	SAMPLE	DEPTH	QU (PSI)
B-003-1-15	NX-1	10.1′ - 10.6′	5010
	NX-1	11.9′ - 12.5′	5120
B-003-5-15	NX-1	13.4′ - 13.9′	4230
	NX-1	14.4′ - 15.0′	4830
B-006-0-15	NX-1	19.0′ - 19.5′	5560
B-007-0-15	NX-2	18.8′ - 19.2′	5120
	NX-3	24.6′ - 25.4′	6200
B-010-0-15	NX-3	28.5′ - 29.0′	4380
	NX-6	41.8′ - 42.2′	3840
B-010-1-15	NX-8	41.8′ - 42.4′	3440
B-011-0-15	NX-1	26.3′ - 26.9′	3840
	NX-6	47.2′ - 47.8′	3910
B-012-0-15	NX-5	41.4′ - 41.8′	6300
B-013-0-15	NX-4	51.5′ - 52.1′	6740
	NX-4	55.3′ - 56.0′	5280
B-005-1-16	NQ2-2	37.5′ - 37.9′	4680
B-005-2-16	NQ2-1	25.2′ - 25.6′	4111
B-006-1-16	NQ2-1	16.6′ - 17.0′	4737
	NQ2-2	25.2′ - 25.6′	4635
B-007-2-16	NQ2-3	49.5′ - 49.9′	9344
B-009-1-16	NQ2-3	47.7′ - 48.1′	18462
	NQ2-6	62.4′ - 62.8′	9789
B-009-4-16	NQ2-1	32.3′ - 32.7′	7964
B-011-2-16	NQ2-3	44.1′ - 44.5′	3331
	NQ2-4	48.1′ - 48.4′	10278
	NQ2-5	52.9′ - 53.2′	8084
B-011-4-16	NX-1	50.0′ - 50.4′	2492
B-011-5-16	NQ-2	48.7′ - 49.1′	1384
	NQ-3	54.8′ - 55.2′	12128
B-013-2-16	NQ2-3	53.4′ - 53.8′	683
	NQ2-4	55.8′ - 56.2′	11709
	NQ2-5	63.4′ - 63.8′	942
B-013-3-16	NX-2	51.3′ - 51.6′	10916
B-013-4-16	NQ-1	47.8′ - 48.2′	12151
	NQ-3	62.1′ - 62.5′	11803
	NQ-4	68.5′ - 63.9′	3028
B-013-5-16	NX-1	71.6′ - 72.0′	9267
	NX-3	75.0′ - 75.4′	24283
B-030-1-16	NQ2-1	29.3′ - 29.7′	5184
B-031-3-16	NQ2-1	16.7′ - 17.1′	3826

BEDROCK TEST SUMMARY

BORING NO.	SAMPLE	DEPTH	QU (PSI)	SI (PSI)
B-008-1-19	NQ2-3	33.1′ - 34.6′		1571
	NQ2-4	39.3′ - 40.3′		1719
	NQ2-4	41.2′ - 41.6′	2800	
	NQ2-5	46.6′ - 47.0′	6090	
	NQ2-5	47.4′ - 47.7′	808	
	NQ2-6	48.3′ - 50.1′		1642
	NQ2-7	54.2′ - 54.6′	5320	
	NQ2-7	54.7′ - 55.1′	5450	
	NQ2-8	58.1′ - 58.5′	1379	
	NQ2-8	59.5′ - 59.9′	1587	
B-009-5-19	NQ2-2	14.9′ - 15.3′	4630	
	NQ2-3	17.6′ - 18.0′	5110	
	NQ2-4	21.8′ - 22.7′		627
	NQ2-5	30.6′ - 31.4′		1184
	NQ2-6	31.8′ - 32.8′		1286
	NQ2-7	38.0′ - 39.4′		1028
B-009-6-19	NQ2-2	23.2′ - 24.2′		842
	NQ2-3	27.5′ - 28.4′		1220
	NQ2-3	30.5′ - 30.9′	6387	
	NQ2-3	31.0′ - 31.4′	12996	
	NQ2-4	35.2′ - 35.6′	1240	
	NQ2-4	35.7′ - 36.1′	1656	
	NQ2-5	39.5′ - 39.9′	1823	
B-009-7-19	NQ2-2	33.7′ - 34.1′	13112	
	NQ2-3	36.3′ - 39.0′		1753
	NQ2-3	36.4′ - 36.8′	1783	
	NQ2-5	49.4′ - 49.9′	1985	
	NQ2-6	51.1′ - 51.6′		28950
	NQ2-6	52.5′ - 52.9′	2012	
B-011-7-19	NX-1	30.6′ - 31.0′	13190	
	NX-1	32.5′ - 32.9′	19920	
	NX-2	36.3′ - 37.6′		3006
B-011-8-19	NX-1	51.9′ - 52.7′	5380	
	NX-2	56.4′ - 57.6′	5110	
	NX-3	65.1′ - 65.7′	5140	

DRAWN YLZ
CHECKED TLM

SOIL PROFILE

SUM-8-1.75

SUMMARY OF SOIL TEST DATA
S.R. 8 S.B.

STATION & OFFSET	FROM TO	SAMPLE ID	N60	% REC	HP †sf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS	ppm SO4
B-003-0-15	01.00-02.50	SS-1	41	72	-	20	19	53	- 8 -		NP	NP	NP	6	A-3 (0) *	
STA., 218+05, 38.0' LT.	03.50-03.75	SS-2	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LATITUDE = 41.08485296	06.00-06.33	SS-3	-	75	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	300
LONGITUDE = -81.503074																
B-004-0-15	01.00-02.42	SS-1	-	59	-	44	24	26	- 6 -		NP	NP	NP	7	A-1-b (0)	
STA., 222+05, 3.0' LT.	03.50-03.67	SS-2	-	100	SANDSTONE, REDDISH BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LATITUDE = 41.08592719																
LONGITUDE = -81.50274212																
B-005-0-15	01.00-02.50	SS-1	16	72	-	28	6	15	27	24	NP	NP	NP	14	A-4a (3)	
STA., 224+04, 8.0' LT.	03.50-05.00	SS-2	5	78	-	21	23	29	- 27 -		NP	NP	NP	15	A-3a (0)	
LATITUDE = 41.08646114	06.00-06.25	SS-3	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.50257501	08.50-08.65	SS-4	-	57	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	

FOR BORINGS B-006-0-15 THROUGH B-017-0-15 SEE THE BORING LOGS ON SHEETS 61 TO 79.

B-018-0-15	01.00-02.50	SS-1	15	56	-	SAME AS SS-2								16	A-1-b (VISUAL)	
STA., 243+13, 97.0' LT.	03.50-05.00	SS-2	26	67	-	17	49	26	- 8 -		NP	NP	NP	14	A-1-b (0)	
LATITUDE = 41.0914222	06.00-07.50	SS-3	43	56	-	33	12	20	12	23	NP	NP	NP	18	A-2-4 (0)	
LONGITUDE = -81.50034356	08.50-10.00	SS-4	14	33	-	SAME AS SS-8								15	A-1-b (VISUAL)	
	11.00-12.50	SS-5	15	67	-	SAME AS SS-8								14	A-1-b (VISUAL)	
	13.50-15.00	SS-6	12	78	-	SAME AS SS-8								13	A-1-b (VISUAL)	
	16.00-17.50	SS-7	9	78	-	SAME AS SS-8								15	A-1-b (VISUAL)	
	18.50-20.00	SS-8	12	83	-	16	45	30	- 9 -		NP	NP	NP	13	A-1-b (0)	
	21.00-22.50	SS-9	20	89	-	SAME AS SS-8								13	A-1-b (VISUAL)	
	23.50-25.00	SS-10	27		-	SAME AS SS-8								13	A-1-b (VISUAL)	
B-019-0-15	01.00-01.121	SS-1	-	71	-	SAME AS SS-4								17	A-2-4 (VISUAL)	
STA., 243+18, 147.0' LT.	03.50-05.00	SS-2	7	22	-	SAME AS SS-4								23	A-2-4 (VISUAL)	
LATITUDE = 41.09148361	06.00-07.50	SS-3	15	28	-	SAME AS SS-4								20	A-2-4 (VISUAL)	
LONGITUDE = -81.50050654	08.50-10.00	SS-4	22	39	-	29	14	25	8	24	NP	NP	NP	21	A-2-4 (0)	
	11.00-12.50	SS-5	12	44	-	SAME AS SS-4								21	A-2-4 (VISUAL)	
	18.50-20.00	SS-6	9	39	-	SAME AS SS-4								15	A-2-4 (VISUAL)	
	23.50-25.00	SS-7	27	56	-	SAME AS SS-4								24	A-2-4 (VISUAL)	
B-020-0-15	03.50-05.00	SS-1	4	56	-	9	53	31	- 7 -		NP	NP	NP	14	A-1-b (0)	
STA., 244+04, 11.0' LT.	06.00-07.50	SS-2	15	100	2	5	7	30	28	30	26	21	5	27	A-4a (5)	
LATITUDE = 41.09157502	08.50-10.00	SS-3	15	100	-	SAME AS SS-5								14	A-1-b (VISUAL)	
LONGITUDE = -81.49994198	11.00-12.50	SS-4	15	100	-	SAME AS SS-5								13	A-1-b (VISUAL)	
	13.50-15.00	SS-5	11	100	-	9	45	37	- 9 -		NP	NP	NP	15	A-1-b (0)	
B-022-0-15	01.00-02.50	SS-1	33	78	-	10	17	65	- 8 -		NP	NP	NP	7	A-3 (0)	700
STA., 248+06, 7.0' LT.	03.50-05.00	SS-2	15	100	3.5	14	4	7	49	26	41	20	21	14	A-7-6 (12)	
LATITUDE = 41.0926397	06.00-07.50	SS-3	9	100	3.5	16	7	5	45	27	39	21	18	13	A-6b (11)	
LONGITUDE = -81.49959494	08.50-10.00	SS-4	8	6	4	SAME AS SS-3								15	A-6b (VISUAL)	

FOR BORINGS B-023-0-15, B-025-0-15, AND B-026-0-15 SEE THE BORING LOGS ON SHEETS 80 TO 81.

B-029-0-15	01.00-02.50	SS-1	20	83	-	23	30	44	- 3 -		NP	NP	NP	11	A-1-b (0) *	400
STA., 252+07, 38.0' LT.	03.50-05.00	SS-2	32	89	-	SAME AS SS-3								10	A-3 (VISUAL)	
LATITUDE = 41.09373163	06.00-07.50	SS-3	63	78	-	20	23	53	- 4 -		NP	NP	NP	9	A-3 (0)	
LONGITUDE = -81.49962435	08.50-10.00	SS-4	82	89	-	SAME AS SS-3								10	A-3 (VISUAL)	
B-031-0-15	01.00-02.50	SS-1	7	56	-	32	33	29	- 6 -		NP	NP	NP	10	A-1-b (0) *	800
STA., 254+57, 55.0' LT.	03.50-05.00	SS-2	5	100	1	SAME AS SS-3								15	A-6b (VISUAL)	
LATITUDE = 41.09439806	06.00-07.50	SS-3	9	100	2.5	13	4	16	35	32	39	19	20	18	A-6b (10)	
LONGITUDE = -81.4997625	08.50-10.00	SS-4	25	89	2.5	SAME AS SS-3								12	A-6b (VISUAL)	

SUMMARY OF SOIL TEST DATA
S.R. 8 N.B.

STATION & OFFSET	FROM TO	SAMPLE ID	N60	% REC	HP †sf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS	ppm SO4
B-001-0-15	01.00-02.50	SS-1	35	67	-	12	21	61	- 6 -		NP	NP	NP	6	A-3 (0) *	400
STA., 515+84, 45.0' RT.	03.50-04.75	SS-2	-	80	-	SAME AS SS-1								5	A-3 (VISUAL)	
LATITUDE = 41.08421557	06.00-06.20	SS-3	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.502806																
B-002-0-15	01.00-02.17	SS-1	-	86	-	11	20	62	- 7 -		NP	NP	NP	4	A-3 (0) *	
STA., 517+48, 50.0' RT.	03.50-03.67	SS-2	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LATITUDE = 41.084612193																
LONGITUDE = -81.50270473																
B-021-0-15	01.00-02.50	SS-1	12	72	2.5	SAME AS SS-2								25	A-6b (VISUAL)*	800
STA., 545+06, 66.0' RT.	02.50-04.00	SS-2	11	89	3	16	5	6	51	22	39	21	18	25	A-6b (11)	
LATITUDE = 41.091712129	04.00-05.50	SS-3	13	89	3	SAME AS SS-2								19	A-6b (VISUAL)	
LONGITUDE = -81.49934551	05.50-07.00	SS-4	16	94	-	33	18	40	- 9 -		NP	NP	NP	6	A-1-b (0)	
B-024-0-15	01.00-02.50	SS-1	17	83	3.5	11	4	9	55	21	42	19	23	15	A-7-6 (14) *	300
STA., 549+04, 55.0' RT.	02.50-04.00	SS-2	16	78	4	SAME AS SS-1								16	A-7-6 (VISUAL)	
LATITUDE = 41.0928729	04.00-05.50	SS-3	13	89	4	9	7	14	37	33	39	21	18	13	A-6b (10)	
LONGITUDE = -81.49917221	05.50-07.00	SS-4	19	100	4.5	SAME AS SS-3								13	A-6b (VISUAL)	
B-027-0-15	01.00-02.50	SS-1	33	78	-	19	23	55	- 3 -		NP	NP	NP	12	A-3 (0) *	
STA., 551+79, 52.0' RT.	03.50-05.00	SS-2	31	67	-	SAME AS SS-1								10	A-3 (VISUAL)	
LATITUDE = 41.0936433	06.00-07.50	SS-3	52	78	-	SAME AS SS-1								9	A-3 (VISUAL)	
LONGITUDE = -81.49918594	08.50-10.00	SS-4	51	78	-	SAME AS SS-5								8	A-3a (VISUAL)	
	11.00-12.50	SS-5	43	89	-	9	13	67	- 11 -		NP	NP	NP	7	A-3a (0)	
	13.50-15.00	SS-6	45	100	-	SAME AS SS-5								9	A-3a (VISUAL)	
	16.00-17.50	SS-7	13	100	4.5	SAME AS SS-8								15	A-7-6 (VISUAL)	
	18.50-20.00	SS-8	23	100	4.5	9	3	16	39	33	41	21	20	17	A-7-6 (12)	
	23.50-25.00	SS-9	29	100	4.5	SAME AS SS-8								25	A-7-6 (VISUAL)	
	28.50-30.00	SS-10	40	89	-	8	21	65	- 6 -		NP	NP	NP	8	A-3 (0)	
	33.50-33.67	SS-11	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
	38.50-38.121	SS-12	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	

SUMMARY OF SOIL TEST DATA
S.R. 8 N.B. (CONT.)

STATION & OFFSET	FROM TO	SAMPLE ID	N60	% REC	HP †sf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS	ppm SO4
B-028-0-15	01.00-02.50	SS-1	7	56	1	19	7	7	41	26	36	20	16	29	A-6b (9)	-
STA., 552+13, 111.0' RT.	03.50-03.79	SS-2	-	86	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	-
LATITUDE = 41.09375308	06.00-06.19	SS-3	-	89	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.49897926	08.50-08.121	SS-4	-	50	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
B-030-0-15	01.00-02.50	SS-1	20	89	4	24	9	9	39	19	37	22	15	15	A-6a (7) *	600
STA., 553+19, 74.0' RT.	02.50-04.00	SS-2	37	72	-			SAME AS SS-3						8	A-3 (VISUAL)	
LATITUDE = 41.09403381	04.00-05.50	SS-3	37	89	-	22	10	63	-5-		NP	NP	NP	7	A-3 (0)	
LONGITUDE = -81.49923991	05.50-07.00	SS-4	40	78	-			SAME AS SS-3						10	A-3 (VISUAL)	
B-032-0-15	01.00-02.50	SS-1	23	83	-	17	6	56	14	7	NP	NP	NP	7	A-3a (0) *	
STA., 557+48, 53.0' RT.	02.50-04.00	SS-2	87	89	-	18	4	70	-8-		NP	NP	NP	8	A-3 (0)	300
LATITUDE = 41.09520276	05.00-05.33	SS-3	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.49943789																

SUMMARY OF SOIL TEST DATA
RAMP I

STATION & OFFSET	FROM TO	SAMPLE ID	N60	% REC	HP †sf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS	ppm SO4
B-001-1-15	01.00-02.50	SS-1	23	56	-	43	22	30	- 5 -		NP	NP	NP	5	A-1-b (0) *	400
STA., 314+55, 40.0' LT.	03.50-05.00	SS-2	5	28	-			SAME AS SS-1						5	A-1-b (VISUAL)	
LATITUDE = 41.08406685	06.00-07.50	SS-3	23	22	-	49	6	39	- 6 -		NP	NP	NP	7	A-1-b (0)	
LONGITUDE = -81.502806	08.50-08.83	SS-4	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
	11.00-11.17	SS-5	-	0	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
B-003-3-15	01.00-02.50	SS-1	17	83	-	10	22	63	- 5 -		NP	NP	NP	5	A-3 (0)	
STA., 318+54, 2.0' LT.	03.50-05.00	SS-2	5	72	-	22	7	69	- 2 -		NP	NP	NP	4	A-3 (0)	500
LATITUDE = 41.08505693	06.00-07.25	SS-3	-	93	-			SAME AS SS-2						6	A-3 (VISUAL)	
LONGITUDE = -81.50327802	08.50-08.75	SS-4	-	67	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
B-003-7-15	01.00-02.50	SS-1	7	67	1.6			SAME AS SS-2						19	A-6a (VISUAL)	
STA., 320+34, 14.0' RT.	03.50-05.00	SS-2	23	94	2.75	14	5	6	29		37	22	15	24	A-6a (10)	
LATITUDE = 41.08552522	06.00-06.13	SS-3	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.503012139	08.50-08.60	SS-4	-	100	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
B-004-3-15	01.00-02.50	SS-1	11	67	-			SAME AS SS-2						20	A-3 (VISUAL)	300
STA., 323+04, 8.0' LT.	03.50-04.75	SS-2	-	67	-	7	5	82	- 6 -		NP	NP	NP	4	A-3 (0)	
LATITUDE = 41.08625105	06.00-06.15	SS-3	-	86	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.50286254																

SUMMARY OF SOIL TEST DATA
RAMP J

STATION & OFFSET	FROM TO	SAMPLE ID	N60	% REC	HP †sf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS	ppm SO4
B-001-2-15	01.00-02.50	SS-1	12	44	-	21	29	22	27	1	NP	NP	NP	18	A-3a (0)	400
STA., 415+52, 2.0' RT.	03.50-05.00	SS-2	20	44	0.25	15	18	12	27	28	35	24	11	25	A-6a (4)	
LATITUDE = 41.08405471	06.00-06.13	SS-3	-	80	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.50252237	08.50-08.77	SS-4	-	62	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
	11.00-11.38	SS-5	-	89	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	

FOR BORINGS B-001-4-15 AND B-003-1-15 SEE THE BORING LOGS ON SHEET 59.

B-003-2-15	01.00-02.50	SS-1	24	53	-	12	53	27	-8-		NP	NP	NP	7	A-1-b (0)	
STA., 418+52, 9.0' RT.	04.00-04.25	SS-2	-	117	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									3	VISUAL	
LATITUDE = 41.08487552	06.00-06.13	SS-3	-	67	- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	
LONGITUDE = -81.50243497	08.50-08.60	SS-4	-		- SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED									-	VISUAL	

FOR BORINGS B-003-5-15 AND B-003-6-15 SEE THE BORING LOGS ON SHEET 60.

B-004-4-15	01.00-02.50	SS-1	5	67	-	22	17	55	-6-		NP	NP	NP	7	A-3 (0)	
STA., 423+06, 14.0' RT.	03.50-05.00	SS-2	16	94	3			SAME AS SS-3						16	A-6b (VISUAL)	1000
LATITUDE = 41.08608999	06.00-07.50	SS-3	11	100	3	16	5	7	42	30	39	22	17	17	A-6b (10)	
LONGITUDE = -81.5021735	08.50-10.00	SS-4	42	89	-	12	18	61	-9-		NP	NP	NP	9	A-3 (0)	

8/1/2015

Compressive Strength of Rock
ASTM 7012

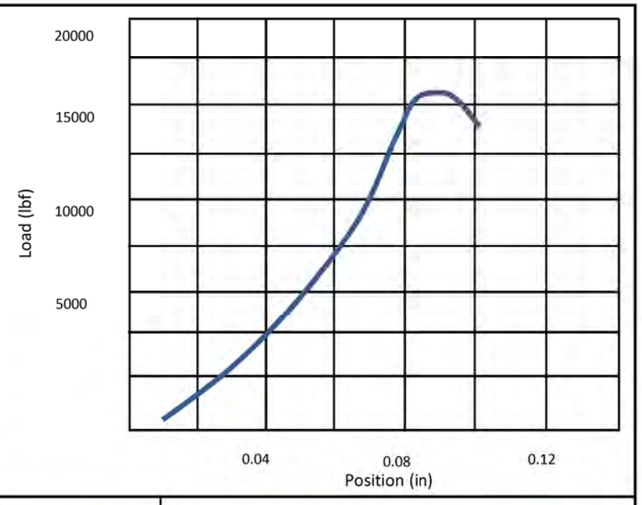
BORING NUMBER	B-003-1-15	TOP DEPTH	10.1'	BOTTOM DEPTH	10.6'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	418+31	OFFSET	44'	OFFSET DIRECTION	RIGHT

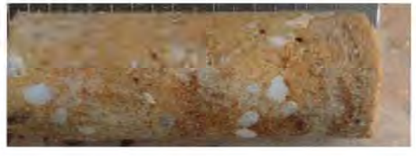
FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.545	1.993
2	4.333	1.997
3	4.541	1.995
AVERAGE	4.473	1.995

LENGTH/DIA.	2.242
AREA (in2)	3.124
MASS (GRAMS)	434.3

MAXIMUM LOAD (LBS)
15,650
COMPRESSIVE STRENGTH (PSI)
5,010
TIME OF TEST (MINUTES)
1:54
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt





BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

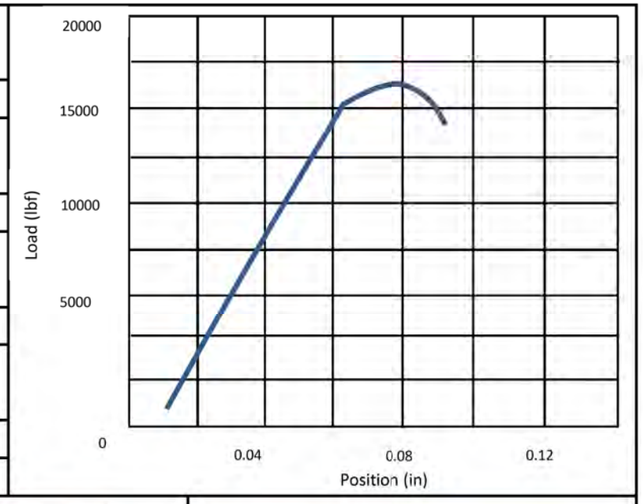
BORING NUMBER	B-003-1-15	TOP DEPTH	11.9'	BOTTOM DEPTH	12.5'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	418+31	OFFSET	44'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.283	1.994
2	4.233	1.993
3	4.238	1.999
AVERAGE	4.251	1.995

LENGTH/DIA.	2.131
AREA (in2)	3.125
MASS (GRAMS)	433.13

MAXIMUM LOAD (LBS)
16,000
COMPRESSIVE STRENGTH (PSI)
5,120
TIME OF TEST (MINUTES)
1:35
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-003-5-15	TOP DEPTH	13.4'	BOTTOM DEPTH	13.9'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	419+81	OFFSET	36'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.998	1.993
2	3.994	1.987
3	3.989	1.988
AVERAGE	3.994	1.989

LENGTH/DIA.	2.008
AREA (in2)	3.107
MASS (GRAMS)	444.24

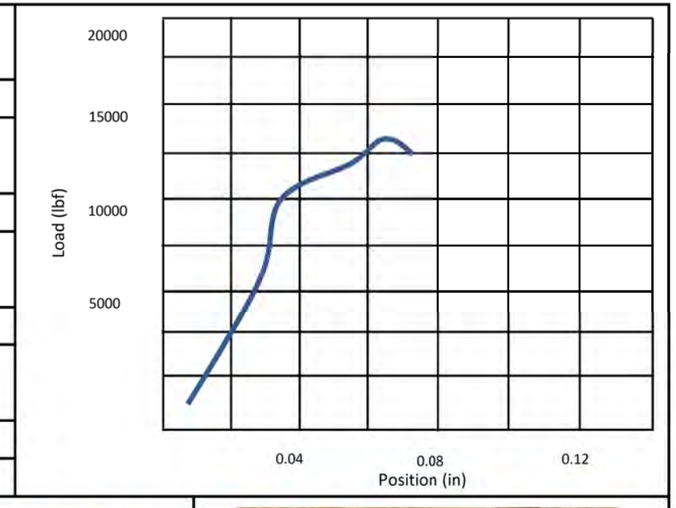
MAXIMUM LOAD (LBS)
13,140

COMPRESSIVE STRENGTH (PSI)
4,230

TIME OF TEST (MINUTES)
1:39

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-003-5-15	TOP DEPTH	14.4'	BOTTOM DEPTH	15.0'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	419+81	OFFSET	36'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.493	1.994
2	4.339	1.994
3	4.533	1.994
AVERAGE	4.455	1.994

LENGTH/DIA.	2.234
AREA (in2)	3.121
MASS (GRAMS)	428.34

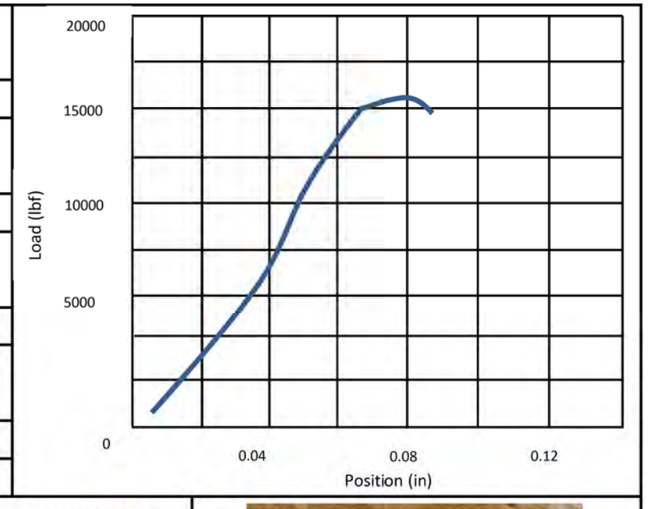
MAXIMUM LOAD (LBS)
15,070

COMPRESSIVE STRENGTH (PSI)
4,830

TIME OF TEST (MINUTES)
1:45

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

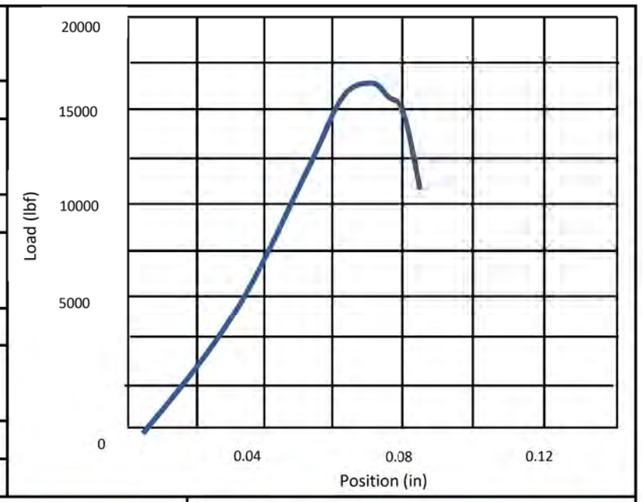
BORING NUMBER	B-006-0-15	TOP DEPTH	19.0'	BOTTOM DEPTH	19.5'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	525+07	OFFSET	40'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Light Brown, Slightly Weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.778	1.994
2	3.796	1.993
3	3.733	1.993
AVERAGE	3.769	1.993

LENGTH/DIA.	1.891
AREA (in2)	3.119
MASS (GRAMS)	420.34

MAXIMUM LOAD (LBS)
17,341
COMPRESSIVE STRENGTH (PSI)
5,560
TIME OF TEST (MINUTES)
2:33
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

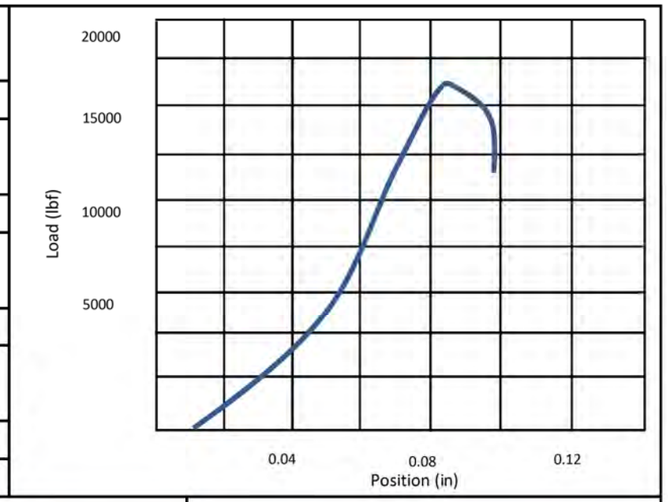
BORING NUMBER	B-007-0-15	TOP DEPTH	18.8'	BOTTOM DEPTH	19.2'
SAMPLE NUMBER	NX-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	225+54	OFFSET	49'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, Light Brown, Slightly Weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	5.123	1.993
2	5.102	1.993
3	5.121	1.992
AVERAGE	5.115	1.993

LENGTH/DIA.	2.567
AREA (in2)	3.117
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
15,960
COMPRESSIVE STRENGTH (PSI)
5,120
TIME OF TEST (MINUTES)
2:19
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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DRAWN YLZ CHECKED TLM

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8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-007-0-15	TOP DEPTH	24.6'	BOTTOM DEPTH	25.35'
SAMPLE NUMBER	NX-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	225+54	OFFSET	49'	OFFSET DIRECTION	LEFT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, brown, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.112	1.994
2	4.182	1.993
3	4.143	1.992
AVERAGE	4.146	1.993

LENGTH/DIA.	2.080
AREA (in2)	3.118
MASS (GRAMS)	433.13

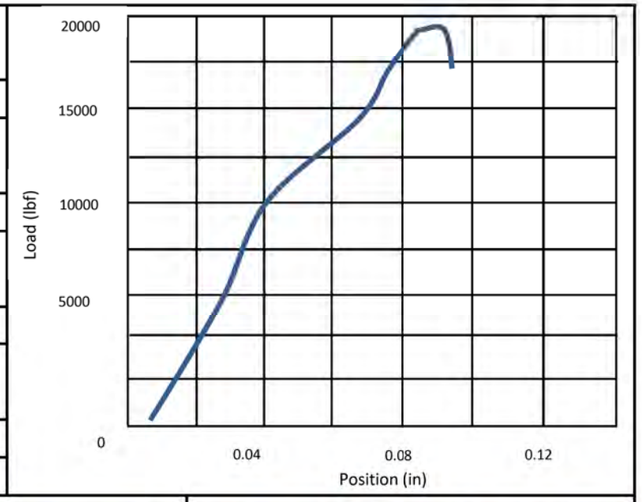
MAXIMUM LOAD (LBS)
19,330

COMPRESSIVE STRENGTH (PSI)
6,200

TIME OF TEST (MINUTES)
1:49

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-008-0-15	TOP DEPTH	44.7'	BOTTOM DEPTH	45.5'
SAMPLE NUMBER	NX-10	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	227+43	OFFSET	33'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.022	1.994
2	4.026	1.993
3	4.024	1.991
AVERAGE	4.024	1.993

LENGTH/DIA.	2.019
AREA (in2)	3.117
MASS (GRAMS)	433.13

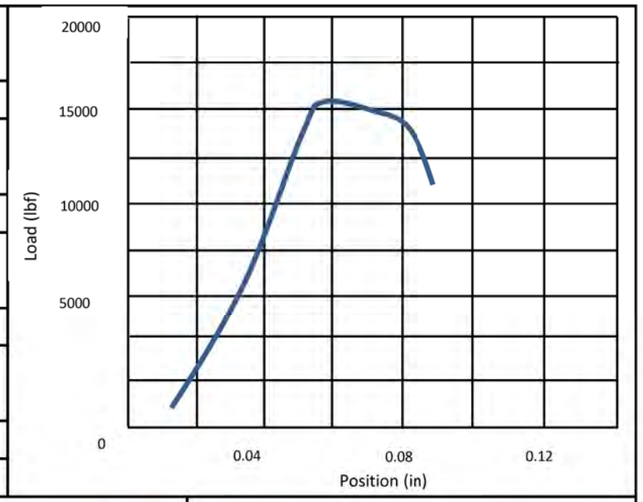
MAXIMUM LOAD (LBS)
15,990

COMPRESSIVE STRENGTH (PSI)
5,130

TIME OF TEST (MINUTES)
2:45

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-009-0-15	TOP DEPTH	8.2'	BOTTOM DEPTH	8.9'
SAMPLE NUMBER	NX-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	527+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Sandstone, light brown, slightly weathered, slightly strong

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.998	1.993
2	3.994	1.987
3	3.989	1.988
AVERAGE	3.994	1.989

LENGTH/DIA.	2.008
AREA (in2)	3.107
MASS (GRAMS)	467.28

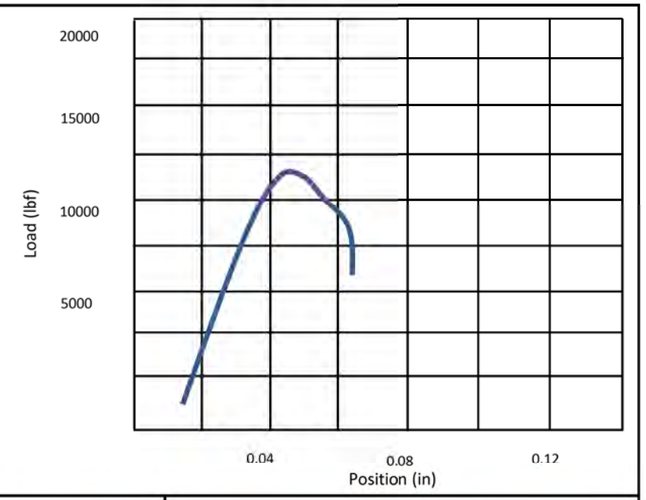
MAXIMUM LOAD (LBS)
10,690

COMPRESSIVE STRENGTH (PSI)
3,440

TIME OF TEST (MINUTES)
1:22

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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7/13/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-009-0-15	TOP DEPTH	31.4'	BOTTOM DEPTH	31.9'
SAMPLE NUMBER	NX-7	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	527+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Sharon Formation (Pennsylvanian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.439	1.993
2	4.431	1.993
3	4.433	1.993
AVERAGE	4.434	1.993

LENGTH/DIA.	2.225
AREA (in2)	3.118
MASS (GRAMS)	433.13

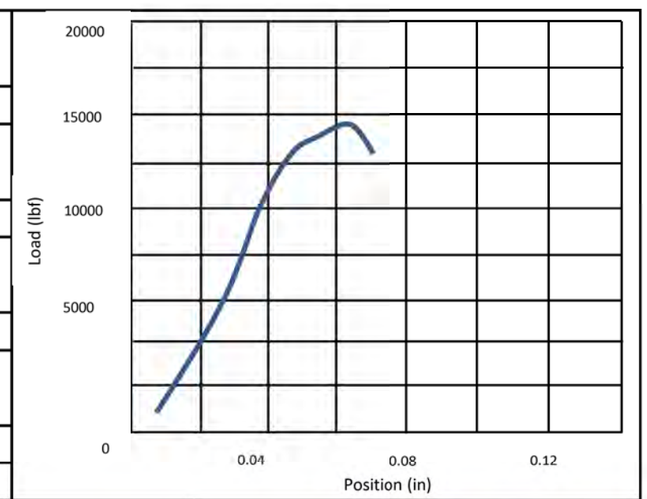
MAXIMUM LOAD (LBS)
14,870

COMPRESSIVE STRENGTH (PSI)
4,770

TIME OF TEST (MINUTES)
2:10

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

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STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-0-15	TOP DEPTH	28.5'	BOTTOM DEPTH	29.0'
SAMPLE NUMBER	NX-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	513+07	OFFSET	13'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Sandstone, light brown, slightly weathered

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.129	1.992
2	4.291	1.992
3	4.222	1.992
AVERAGE	4.214	1.992

LENGTH/DIA.	2.115
AREA (in2)	3.115
MASS (GRAMS)	467.28

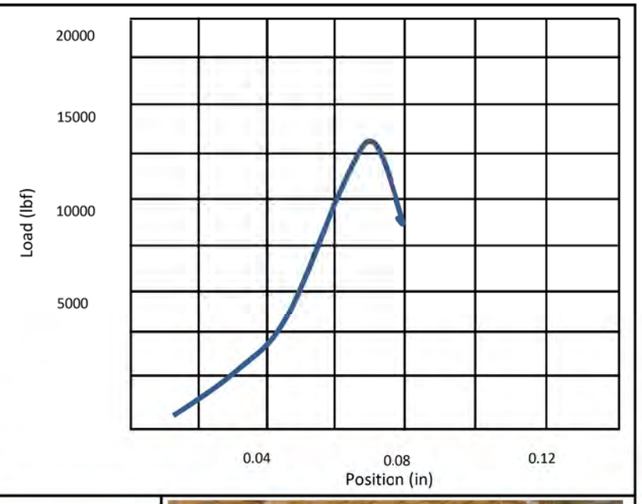
MAXIMUM LOAD (LBS)
13,640

COMPRESSIVE STRENGTH (PSI)
4,380

TIME OF TEST (MINUTES)
2:02

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-0-15	TOP DEPTH	41.8'	BOTTOM DEPTH	42.2'
SAMPLE NUMBER	NX-6	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	513+07	OFFSET	13'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.045	1.994
2	4.044	1.993
3	4.034	1.994
AVERAGE	4.041	1.994

LENGTH/DIA.	2.027
AREA (in2)	3.120
MASS (GRAMS)	433.13

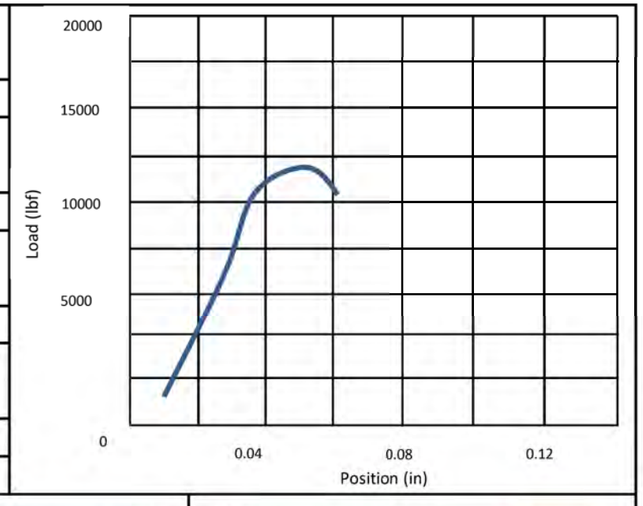
MAXIMUM LOAD (LBS)
11,980

COMPRESSIVE STRENGTH (PSI)
3,840

TIME OF TEST (MINUTES)
1:54

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

DRAWN YLZ
CHECKED TLM

SUM-8-1.75

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-010-1-15	TOP DEPTH	41.8'	BOTTOM DEPTH	42.35'
SAMPLE NUMBER	NX-8	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	534+14	OFFSET	19'	OFFSET DIRECTION	RIGHT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	2.783	1.993
2	2.777	1.994
3	2.739	1.988
AVERAGE	2.766	1.992

LENGTH/DIA.	1.389
AREA (in2)	3.114
MASS (GRAMS)	467.28

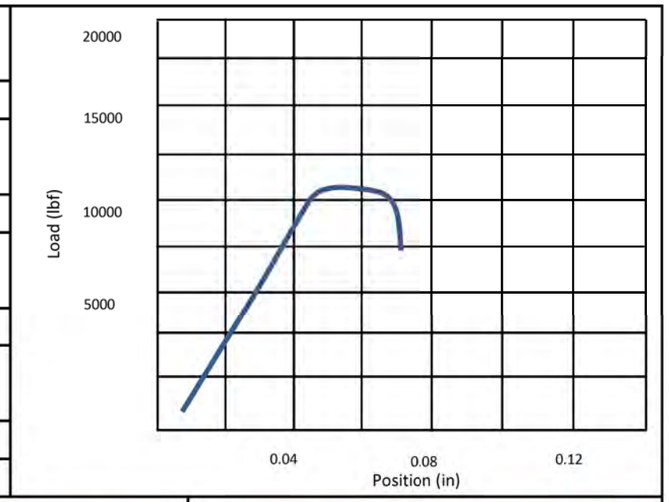
MAXIMUM LOAD (LBS)
10,710

COMPRESSIVE STRENGTH (PSI)
3,440

TIME OF TEST (MINUTES)
1:22

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

8/1/2015

Compressive Strength of Rock
ASTM 7012

BORING NUMBER	B-011-0-15	TOP DEPTH	26.3'	BOTTOM DEPTH	26.9'
SAMPLE NUMBER	NX-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	231+23	OFFSET	36'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.121	1.994
2	4.238	1.993
3	4.233	1.991
AVERAGE	4.197	1.993

LENGTH/DIA.	2.106
AREA (in2)	3.117
MASS (GRAMS)	433.13

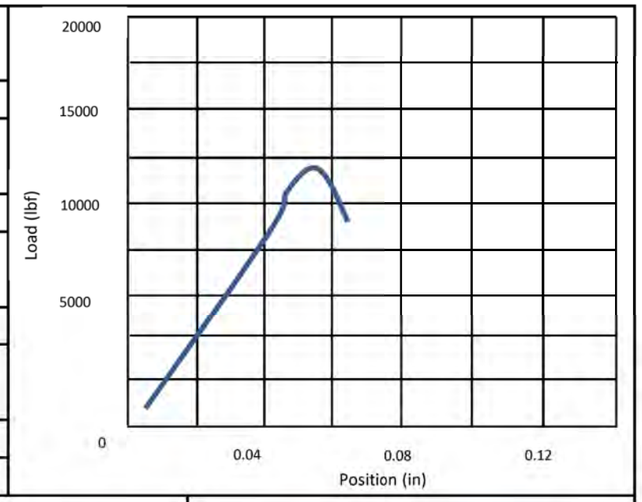
MAXIMUM LOAD (LBS)
11,970

COMPRESSIVE STRENGTH (PSI)
3,840

TIME OF TEST (MINUTES)
2:04

LOADING DIRECTION
Perp. To Bedding

TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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8/1/2015

Compressive Strength of Rock
ASTM 7012

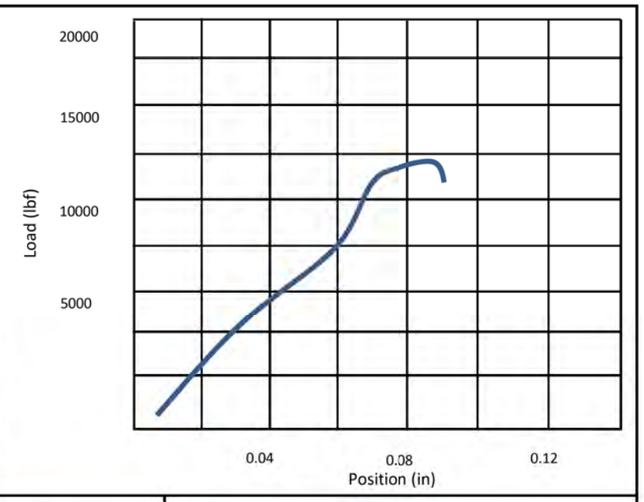
BORING NUMBER	B-011-0-15	TOP DEPTH	47.2'	BOTTOM DEPTH	47.8'
SAMPLE NUMBER	NX-6	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	231+23	OFFSET	36'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Sandstone, light brown, slightly weathered, slightly strong

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.093	1.869
2	4.088	1.987
3	4.039	1.988
AVERAGE	4.073	1.948

LENGTH/DIA.	2.091
AREA (in2)	2.979
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
11,650
COMPRESSIVE STRENGTH (PSI)
3,910
TIME OF TEST (MINUTES)
2:34
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

7/13/2015

Compressive Strength of Rock
ASTM 7012

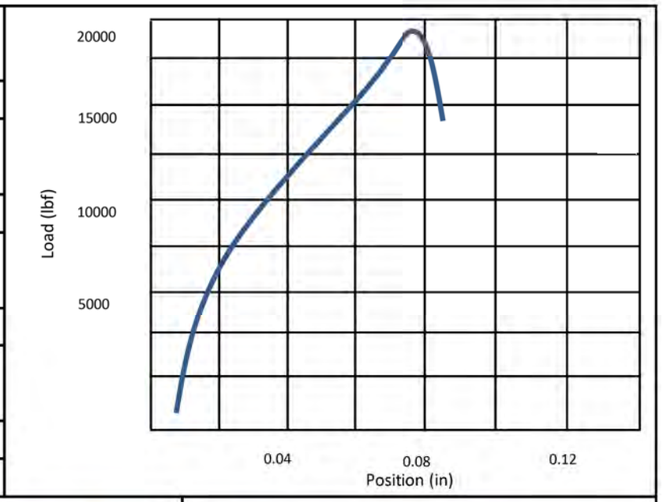
BORING NUMBER	B-012-0-15	TOP DEPTH	41.4'	BOTTOM DEPTH	41.8'
SAMPLE NUMBER	NX-5	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	535+57	OFFSET	13'	OFFSET DIRECTION	RIGHT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.329	1.988
2	4.331	1.984
3	4.327	1.988
AVERAGE	4.329	1.987

LENGTH/DIA.	2.179
AREA (in2)	3.098
MASS (GRAMS)	467.28

MAXIMUM LOAD (LBS)
19,460
COMPRESSIVE STRENGTH (PSI)
6,300
TIME OF TEST (MINUTES)
2:58
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Cardno ATC
Shaping the Future

7/13/2015

Compressive Strength of Rock
ASTM 7012

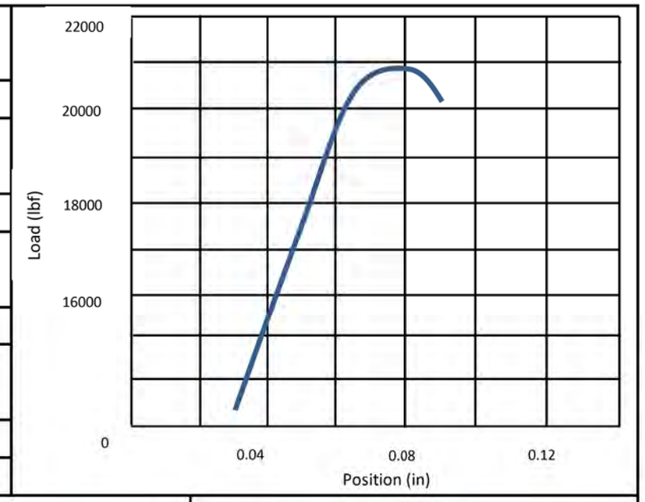
BORING NUMBER	B-013-0-15	TOP DEPTH	51.5'	BOTTOM DEPTH	55.1'
SAMPLE NUMBER	NX-4	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	235+78	OFFSET	12'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, moderately strong, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	3.981	1.995
2	3.991	1.995
3	3.987	1.993
AVERAGE	3.986	1.994

LENGTH/DIA.	1.999
AREA (in2)	3.122
MASS (GRAMS)	433.13

MAXIMUM LOAD (LBS)
20,970
COMPRESSIVE STRENGTH (PSI)
6,740
TIME OF TEST (MINUTES)
2:19
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

Cardno ATC
Shaping the Future

8/1/2015

Compressive Strength of Rock
ASTM 7012

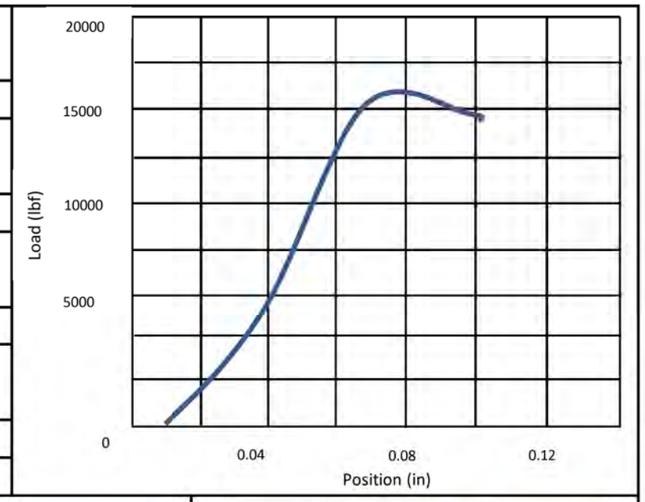
BORING NUMBER	B-013-0-15	TOP DEPTH	55.3'	BOTTOM DEPTH	56.0'
SAMPLE NUMBER	NX-4	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	235+78	OFFSET	12'	OFFSET DIRECTION	LEFT

FORMATION	Cuyahoga Formation (Mississippian)
DESCRIPTION	Shale, gray, slightly weathered, medium bedded

MEASUREMENT	LENGTH (in.)	DIAMETER (in.)
1	4.022	1.994
2	4.026	1.993
3	4.024	1.888
AVERAGE	4.024	1.958

LENGTH/DIA.	2.055
AREA (in2)	3.011
MASS (GRAMS)	412.81

MAXIMUM LOAD (LBS)
15,900
COMPRESSIVE STRENGTH (PSI)
5,280
TIME OF TEST (MINUTES)
2:08
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

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NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-005-1-16, NQ2-2, Depth: 37.5 - 37.9 ft)

Tested Date: 1/31/2017

Specimen Properties

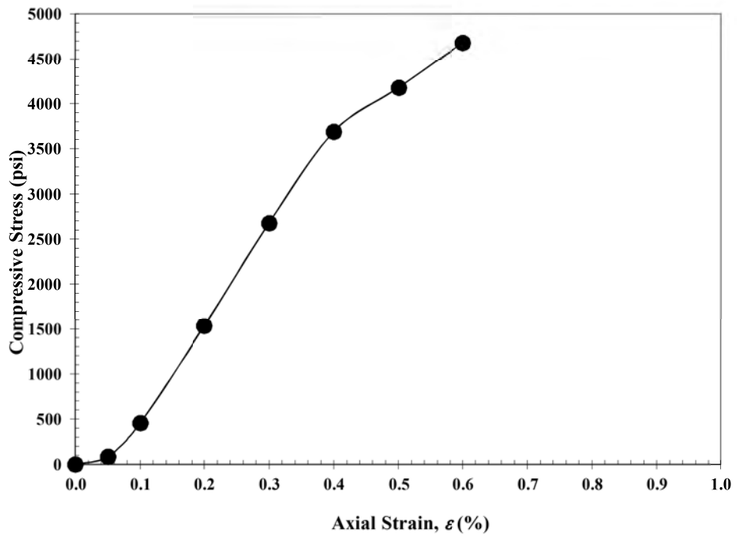
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.55
Length to Diameter Ratio:	2.29
Area, A (in^2):	3.09
Volume, V (in^3):	14.08
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	4.4
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	135.4
Dry Unit Weight, γ_d (lb/ft^3):	129.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4680** **32** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-005-2-16, NQ2-1, Depth: 25.2 - 25.6 ft)

Tested Date: 1/13/2017

Specimen Properties

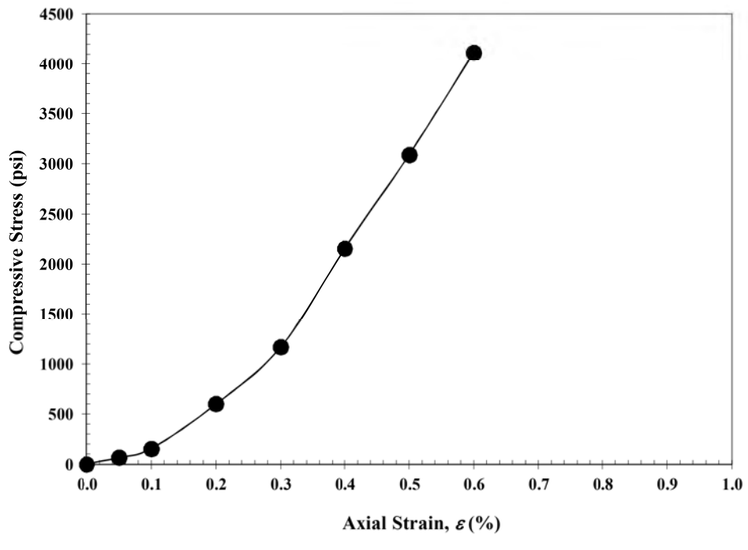
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.50
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.07
Volume, V (in^3):	13.82
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	2.9
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	132.2
Dry Unit Weight, γ_d (lb/ft^3):	128.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4111** **28** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, orangish brown, fine to medium grained, SANDSTONE, ferriferous, friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-006-1-16, NQ2-1, Depth: 16.6 - 17.0 ft)

Tested Date: 1/13/2017

Specimen Properties

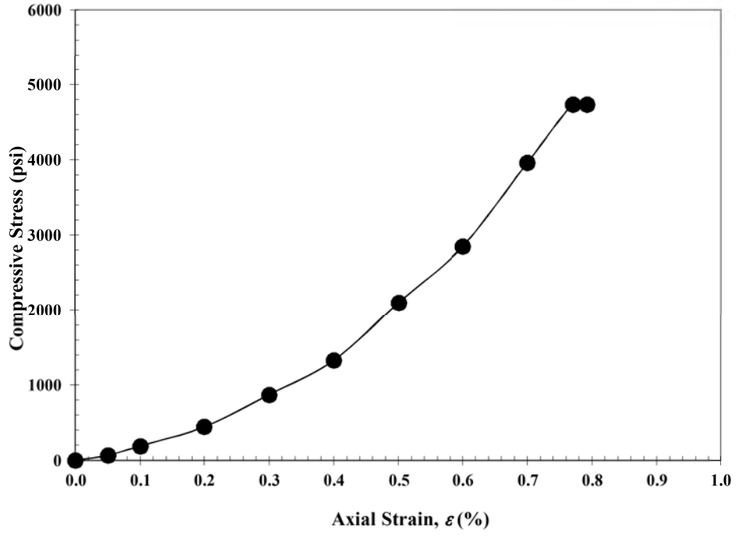
Average Dia., D_{avg} (in):	1.96
Average Height, H_{avg} (in):	4.54
Length to Diameter Ratio:	2.32
Area, A (in^2):	3.02
Volume, V (in^3):	13.71
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	6.3
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	137.8
Dry Unit Weight, γ_d (lb/ft^3):	129.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4737** **33** (MPa)

Strain (%): **0.8**



Notes: Moderately strong, orangish brown and light brown, fine to coarse grained, SANDSTONE, ferriferous, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
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5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-006-1-16, NQ2-2, Depth: 25.2 - 25.6 ft)

Tested Date: 1/13/2017

Specimen Properties

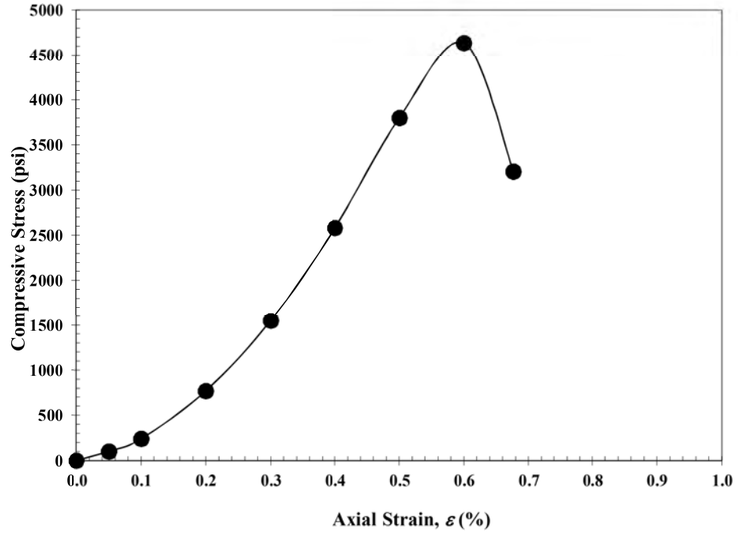
Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.29
Length to Diameter Ratio:	2.16
Area, A (in^2):	3.08
Volume, V (in^3):	13.21
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	5.6
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	139.3
Dry Unit Weight, γ_d (lb/ft^3):	131.8

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **4635** **32** (MPa)

Strain (%): **0.6**



Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, slightly ferriferous, moderately friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-007-2-16, NQ2-3, Depth: 49.5 - 49.9 ft)

Tested Date: 4/19/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.34
Length to Diameter Ratio:	2.19
Area, A (in^2):	3.08
Volume, V (in^3):	13.34
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.2
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	158.0
Dry Unit Weight, γ_d (lb/ft^3):	156.2

Final Specimen Figure

64 (MPa)

Results

Unconfined Compressive Strength (psi): **9344**

Strain (%): **1.5**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-009-1-16, NQ2-3, Depth: 47.7 - 48.1 ft)

Tested Date: 4/12/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.54
Length to Diameter Ratio:	2.29
Area, A (in^2):	3.09
Volume, V (in^3):	14.02
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	0.6
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	170.6
Dry Unit Weight, γ_d (lb/ft^3):	169.6

Final Specimen Figure

127 (MPa)

Results

Unconfined Compressive Strength (psi): **18462**

Strain (%): **1.0**

Notes: Very strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-009-1-16, NQ2-6, Depth: 62.4 - 62.8 ft)

Tested Date: 4/12/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.46
Length to Diameter Ratio:	2.26
Area, A (in^2):	3.07
Volume, V (in^3):	13.67
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.8
Dry Mass of Specimen (lb):	1.3
Wet Unit Weight, γ (lb/ft^3):	162.0
Dry Unit Weight, γ_d (lb/ft^3):	159.2

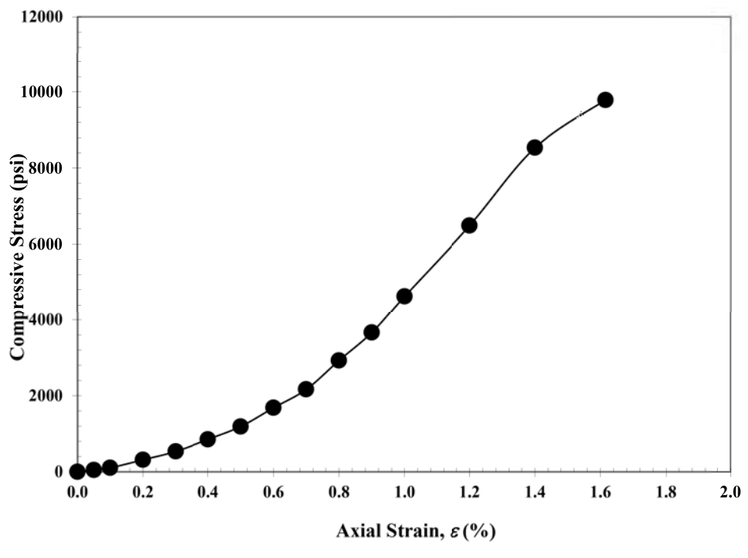
Final Specimen Figure

67 (MPa)

Results

Unconfined Compressive Strength (psi): **9789**

Strain (%): **1.6**



Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-009-4-16, NQ2-1, Depth: 32.3 - 32.7 ft)

Tested Date: 3/6/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.49
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.08
Volume, V (in^3):	13.84
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.1
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	153.7
Dry Unit Weight, γ_d (lb/ft^3):	152.0

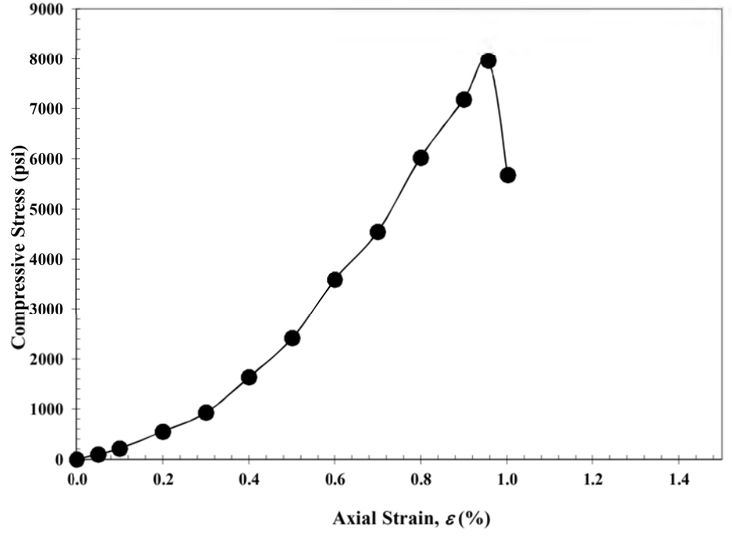
Final Specimen Figure

55 (MPa)

Results

Unconfined Compressive Strength (psi): **7964**

Strain (%): **1.0**



Notes: Strong, gray, SHALE, moderately silty.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-3, Depth: 44.1 - 44.5 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.97
Average Height, H_{avg} (in):	4.15
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.06
Volume, V (in^3):	12.69
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.9
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	158.7
Dry Unit Weight, γ_d (lb/ft^3):	155.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**3331**	**23** (MPa)
Strain (%):	**3.8**	

Notes: Slightly strong, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-4, Depth: 48.1 - 48.4 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.20
Length to Diameter Ratio:	2.13
Area, A (in^2):	3.07
Volume, V (in^3):	12.88
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.7
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	155.0
Dry Unit Weight, γ_d (lb/ft^3):	152.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**10278**	**71** (MPa)
Strain (%):	**1.0**	

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

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NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-011-2-16, NQ2-5, Depth: 52.9 - 53.2 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.15
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.08
Volume, V (in^3):	12.77
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	3.9
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	159.5
Dry Unit Weight, γ_d (lb/ft^3):	153.5

Final Specimen Figure

56 (MPa)

Results

Unconfined Compressive Strength (psi): **8084**

Strain (%): **1.4**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-4-16, NX-1, Depth: 50.0 - 50.4 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.04
Average Height, H_{avg} (in):	4.65
Length to Diameter Ratio:	2.28
Area, A (in^2):	3.28
Volume, V (in^3):	15.22
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	2.8
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	160.7
Dry Unit Weight, γ_d (lb/ft^3):	156.3

Final Specimen Figure

17 (MPa)

Results

Unconfined Compressive Strength (psi): **2492**

Strain (%): **1.3**

Notes: Slightly strong, dark gray, SHALE interbedded with gray siltstone.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-5-16, NQ-2, Depth: 48.7 - 49.1 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.41
Length to Diameter Ratio:	2.23
Area, A (in^2):	3.08
Volume, V (in^3):	13.58
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	3.4
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	159.6
Dry Unit Weight, γ_d (lb/ft^3):	154.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **1384**

10 (MPa)

Strain (%): **2.0**

Notes: Weak, gray, SHALE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-011-5-16, NQ-3, Depth: 54.8 - 55.2 ft)

Tested Date: 4/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.43
Length to Diameter Ratio:	2.22
Area, A (in^2):	3.11
Volume, V (in^3):	13.79
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	3.9
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	160.7
Dry Unit Weight, γ_d (lb/ft^3):	154.8

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **12128**

84 (MPa)

Strain (%): **1.0**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-3, Depth: 53.4 - 53.8 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.24
Length to Diameter Ratio:	2.13
Area, A (in^2):	3.11
Volume, V (in^3):	13.17
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	4.0
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	156.4
Dry Unit Weight, γ_d (lb/ft^3):	150.3

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**683**	**5** (MPa)
Strain (%):	**2.3**	

Notes: Very weak, gray, SHALE INTERBEDDED WITH SILTSTONE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-4, Depth: 55.8 - 56.2 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.28
Length to Diameter Ratio:	2.16
Area, A (in^2):	3.10
Volume, V (in^3):	13.28
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	155.9
Dry Unit Weight, γ_d (lb/ft^3):	153.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi):	**11709**	**81** (MPa)
Strain (%):	**1.3**	

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-2-16, NQ2-5, Depth: 63.4 - 63.8 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.08
Length to Diameter Ratio:	2.06
Area, A (in^2):	3.09
Volume, V (in^3):	12.61
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	3.6
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	157.1
Dry Unit Weight, γ_d (lb/ft^3):	151.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **942** **6** (MPa)

Strain (%): **2.8**

Notes: Weak, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-3-16, NX-2, Depth: 51.3 - 51.6 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.01
Length to Diameter Ratio:	1.96
Area, A (in^2):	3.29
Volume, V (in^3):	13.20
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.1
Wet Unit Weight, γ (lb/ft^3):	152.8
Dry Unit Weight, γ_d (lb/ft^3):	150.4

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **10916** **75** (MPa)

Strain (%): **1.3**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ CHECKED TLM

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-1, Depth: 47.8 - 48.2 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.47
Length to Diameter Ratio:	2.24
Area, A (in^2):	3.12
Volume, V (in^3):	13.96
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.5
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	154.9
Dry Unit Weight, γ_d (lb/ft^3):	152.6

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **12151**

84 (MPa)

Strain (%): **1.4**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-3, Depth: 62.1 - 62.5 ft)

Tested Date: 4/14/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.47
Length to Diameter Ratio:	2.25
Area, A (in^2):	3.11
Volume, V (in^3):	13.90
Wet Mass of Specimen (lb):	1.3
Moisture Content (%):	1.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	157.6
Dry Unit Weight, γ_d (lb/ft^3):	155.2

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **11803**

81 (MPa)

Strain (%): **1.3**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-4-16, NQ-4, Depth: 68.5 - 68.9 ft)

Tested Date: 5/11/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.98
Average Height, H_{avg} (in):	4.26
Length to Diameter Ratio:	2.15
Area, A (in^2):	3.09
Volume, V (in^3):	13.15
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	2.6
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	163.1
Dry Unit Weight, γ_d (lb/ft^3):	159.0

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **3028**

21 (MPa)

Strain (%): **2.2**

Notes: Slightly strong, dark gray, SHALE, fissile, fossiliferous.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-5-16, NX-1, Depth: 71.6 - 72.0 ft)

Tested Date: 4/7/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.29
Length to Diameter Ratio:	2.10
Area, A (in^2):	3.29
Volume, V (in^3):	14.11
Wet Mass of Specimen (lb):	1.2
Moisture Content (%):	2.2
Dry Mass of Specimen (lb):	1.2
Wet Unit Weight, γ (lb/ft^3):	153.0
Dry Unit Weight, γ_d (lb/ft^3):	149.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **9267**

64 (MPa)

Strain (%): **1.1**

Notes: Strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core (ASTM D7012)

(Project: SUM-8-1.75, Boring Location: B-013-5-16, NX-3, Depth: 75.0 - 75.4 ft)

Tested Date: 4/4/2017

Specimen Properties

Average Dia., D_{avg} (in):	2.05
Average Height, H_{avg} (in):	4.58
Length to Diameter Ratio:	2.24
Area, A (in^2):	3.29
Volume, V (in^3):	15.09
Wet Mass of Specimen (lb):	1.4
Moisture Content (%):	0.6
Dry Mass of Specimen (lb):	1.4
Wet Unit Weight, γ (lb/ft^3):	165.7
Dry Unit Weight, γ_d (lb/ft^3):	164.7

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **24283**

167 (MPa)

Strain (%): **0.9**

Notes: Very strong, gray, SILTSTONE.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

NEAS Inc.
National Engineering & Architectural Services Inc.
5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-030-1-16, NQ2-1, Depth: 29.3 - 29.7 ft)

Tested Date: 1/18/2017

Specimen Properties

Average Dia., D_{avg} (in):	1.97
Average Height, H_{avg} (in):	4.38
Length to Diameter Ratio:	2.22
Area, A (in^2):	3.06
Volume, V (in^3):	13.39
Wet Mass of Specimen (lb):	1.0
Moisture Content (%):	4.6
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	134.3
Dry Unit Weight, γ_d (lb/ft^3):	128.4

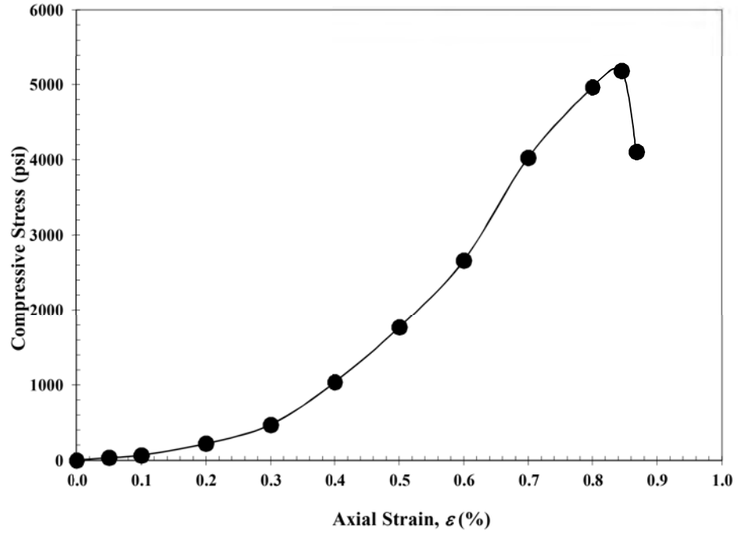
Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **5184**

36 (MPa)

Strain (%): **0.8**



Notes: Moderately strong, light brown interbedded with orangish brown, fine to medium grained, SANDSTONE, friable.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

NEAS Inc.
National Engineering & Architectural Services Inc.

5710 Westbourne Avenue
Columbus, OH 43213
614-892-0162

Unconfined Compressive Strength of Rock Core

(Project: SUM-8-1.75, Boring Location: B-031-3-16, NQ2-1, Depth: 16.7 - 17.1 ft)

Tested Date: 1/18/2017

Specimen Properties

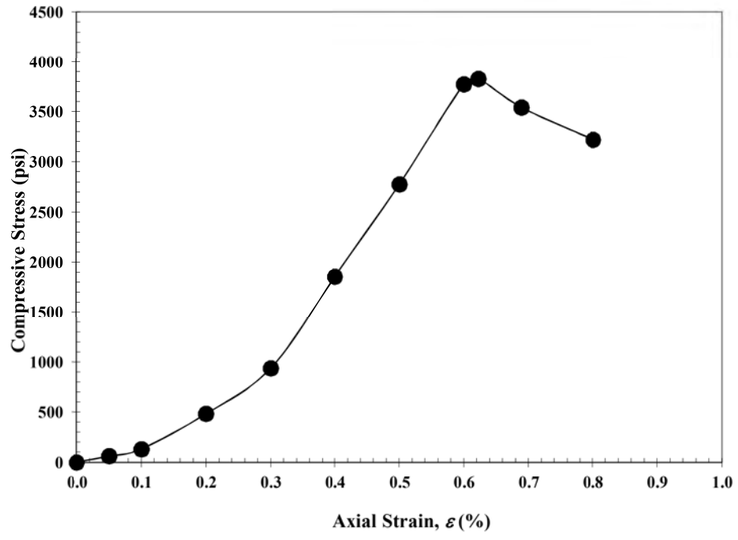
Average Dia., D_{avg} (in):	1.99
Average Height, H_{avg} (in):	4.50
Length to Diameter Ratio:	2.27
Area, A (in^2):	3.10
Volume, V (in^3):	13.92
Wet Mass of Specimen (lb):	1.1
Moisture Content (%):	4.4
Dry Mass of Specimen (lb):	1.0
Wet Unit Weight, γ (lb/ft^3):	134.7
Dry Unit Weight, γ_d (lb/ft^3):	129.1

Final Specimen Figure

Results

Unconfined Compressive Strength (psi): **3826** **26** (MPa)

Strain (%): **0.6**



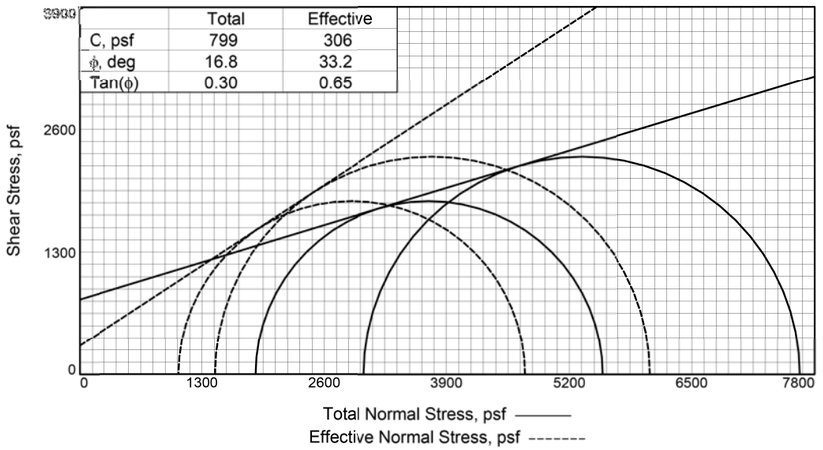
Notes: Moderately strong, brown, fine to coarse grained, SANDSTONE, friable, contains quartzite pebble.

Sample trimming procedure does not conform to ASTM D4543 and the results reported may differ from the results obtained from a test specimen that meets the requirements of Practice D4543.

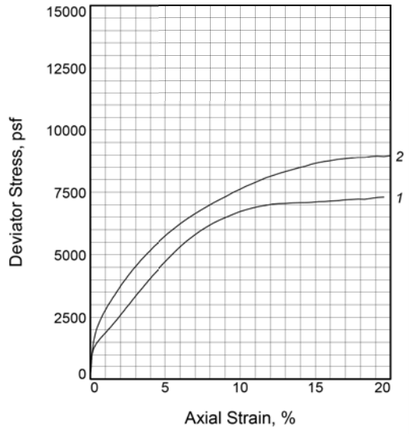
DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75



	Total	Effective
C, psf	799	306
ϕ, deg	16.8	33.2
Tan(ϕ)	0.30	0.65



	Sample No.	1	2
Initial	Water Content, %	23.6	28.1
	Dry Density, pcf	96.0	92.9
	Saturation, %	84.5	93.0
	Void Ratio	0.7554	0.8148
	Diameter, in.	2.79	2.79
	Height, in.	5.57	5.55
At Test	Water Content, %	25.1	28.9
	Dry Density, pcf	100.5	94.7
	Saturation, %	100.0	100.0
	Void Ratio	0.6770	0.7791
	Diameter, in.	2.75	2.77
	Height, in.	5.49	5.51
Strain rate, in./min.		0.012	0.012
Back Pressure, psi		56.00	56.00
Cell Pressure, psi		69.00	77.00
Fail. Stress, psf		3680	4619
Total Pore Pr., psf		8885	9649
Ult. Stress, psf		3680	4619
Total Pore Pr., psf		8885	9649
σ_1 Failure, psf		4731	6058
σ_3 Failure, psf		1051	1439

Type of Test:
CU with Pore Pressures
Sample Type: Intact
Description: silt

LL= NP **PI=** NP
Assumed Specific Gravity= 2.7
Remarks:

Figure _____

Client: TTL

Project: TTL Project No. 1635502

Source of Sample: B-038-0-17 Offset **Depth:** 8.0'-10.0'
Sample Number: ST-1
Proj. No.: 1821-4616.00 **Date Sampled:** 4-17-18

DLZ

Tested By: Tony McCune **Checked By:** Steve Robinson

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
TRIAXIAL CONSOLIDATED UNDRAINED TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-108
Date:	7/9/19

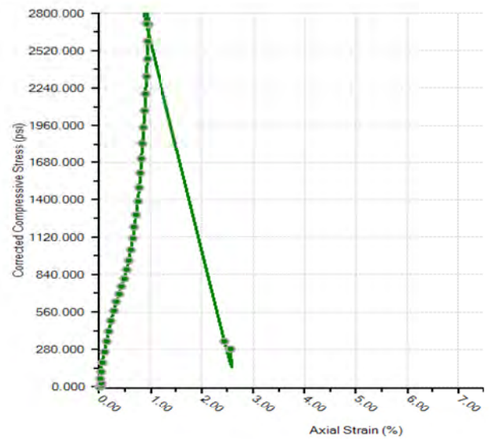
Boring Number	B-008-1-19	Top Depth (ft)	41.2	Bottom Depth (ft)	41.55
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

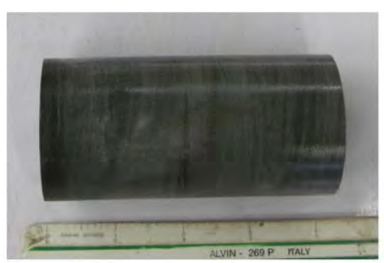
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.005	1.982
2	4.004	1.980
3	4.006	1.979
Average	4.005	1.980

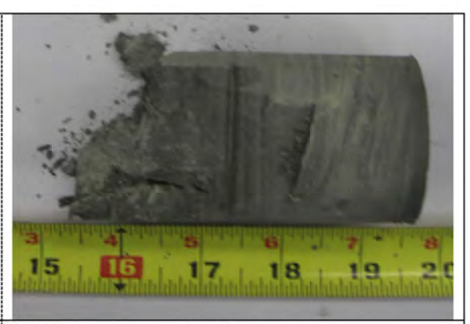
Length / Diameter	2.022
Correction Factor	1.000
Area (in^2)	3.063
Mass (grams)	518.14
Unit Weight (lbs/ft^3)	160.01

Maximum Load (lbs)
8706
Compressive Strength (psi)
2800
Time of Test (minutes)
6:02
Loading Direction
Perp. to Bedding
Technician
AOW





Before Testing



After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-104
Date:	7/9/19

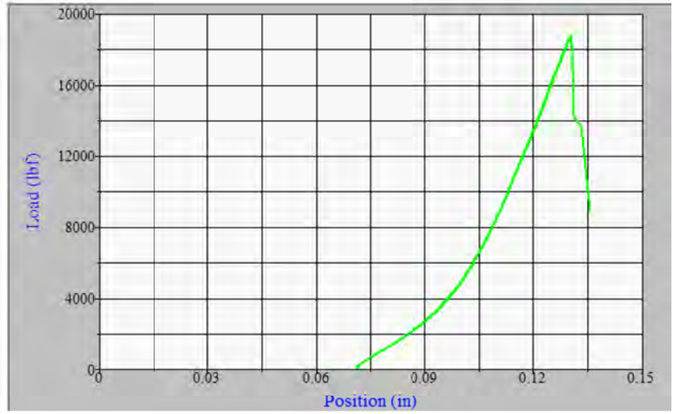
Boring Number	B-008-1-19	Top Depth (ft)	46.6	Bottom Depth (ft)	46.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.199	1.983
2	4.194	1.982
3	4.200	1.982
Average	4.198	1.982

Length / Diameter	2.12
Correction Factor	1.000
Area (in^2)	3.086
Mass (grams)	546.25
Unit Weight (lbs/ft^3)	160.63

Maximum Load (lbs)
18,780
Compressive Strength (psi)
6,090
Time of Test (minutes)
3:00
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

30/181

DRAWN YLZ
CHECKED TLM

Lab No.	19-107
Date:	7/9/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

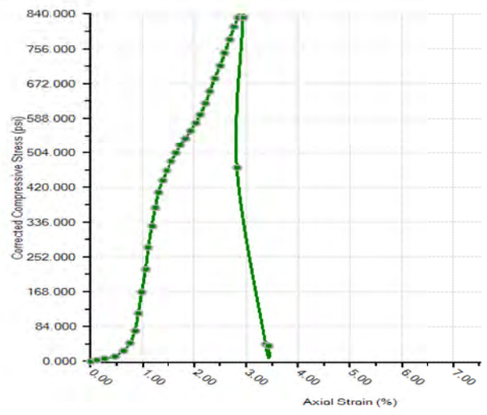
Boring Number	B-008-1-19	Top Depth (ft)	47.4	Bottom Depth (ft)	47.65
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

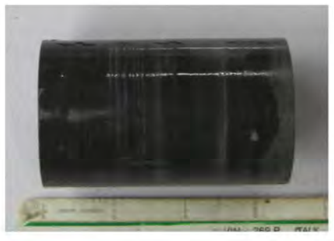
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	3.227	1.975
2	3.228	1.974
3	3.224	1.975
Average	3.226	1.975

Length / Diameter	1.634
Correction Factor	0.971
Area (in^2)	3.0625
Mass (grams)	416.46
Unit Weight (lbs/ft^3)	160.57

Maximum Load (lbs)
2622
Compressive Strength (psi)
808
Time of Test (minutes)
5:38
Loading Direction
Perp. to Bedding
Technician
AOW





Before Testing

After Failure

Lab No.	19-102
Date:	7/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

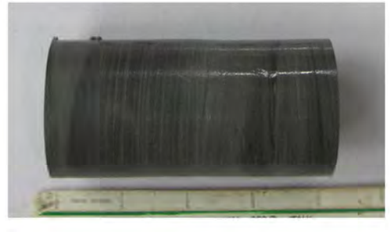
Boring Number	B-008-1-19	Top Depth (ft)	54.2	Bottom Depth (ft)	54.6
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.009	1.983
2	4.011	1.984
3	4.003	1.982
Average	4.008	1.983

Length / Diameter	2.02
Correction Factor	1.000
Area (in^2)	3.088
Mass (grams)	516.83
Unit Weight (lbs/ft^3)	159.07

Maximum Load (lbs)
19,520
Compressive Strength (psi)
6,320
Time of Test (minutes)
3:40
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

31/181

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-102
Date:	7/11/19

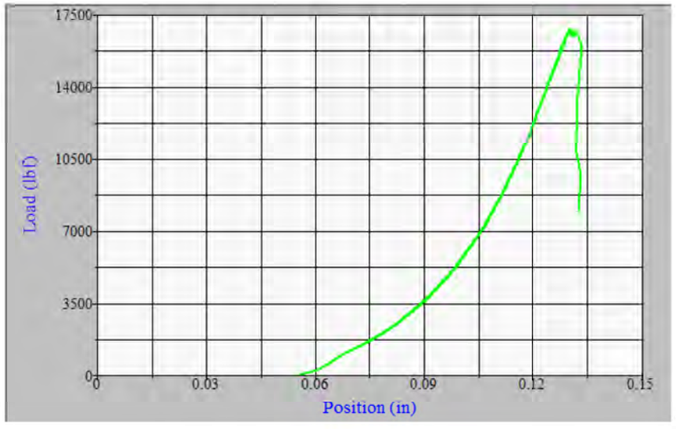
Boring Number	B-008-1-19	Top Depth (ft)	54.7	Bottom Depth (ft)	55.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

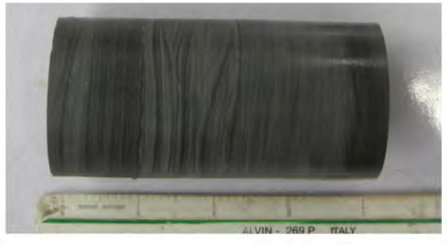
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray, very fine to fine grained, very thin to thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.979	1.987
2	3.980	1.981
3	3.981	1.984
Average	3.980	1.984

Length / Diameter	2.006
Correction Factor	1.000
Area (in^2)	3.092
Mass (grams)	514.76
Unit Weight (lbs/ft^3)	159.38

Maximum Load (lbs)
16,840
Compressive Strength (psi)
5,450
Time of Test (minutes)
3:47
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-106
Date:	7/10/19

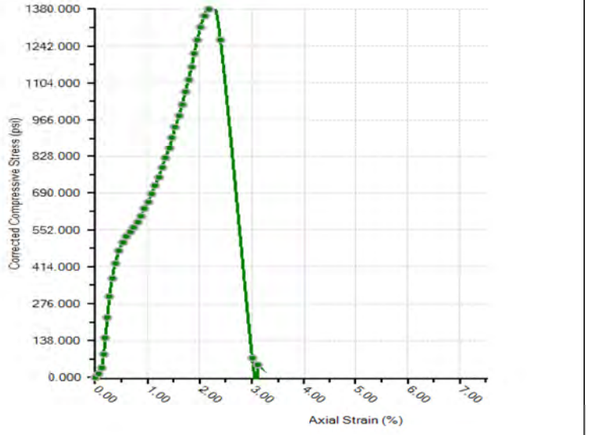
Boring Number	B-008-1-19	Top Depth (ft)	58.1	Bottom Depth (ft)	58.5
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

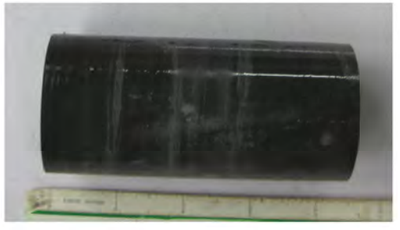
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, grayish black, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.184	1.975
2	4.183	1.977
3	4.186	1.976
Average	4.184	1.976

Length / Diameter	2.118
Correction Factor	1.000
Area (in^2)	3.067
Mass (grams)	540.21
Unit Weight (lbs/ft^3)	160.78

Maximum Load (lbs)
4,324
Compressive Strength (psi)
1,379
Time of Test (minutes)
6:20
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-106
Date:	7/10/19

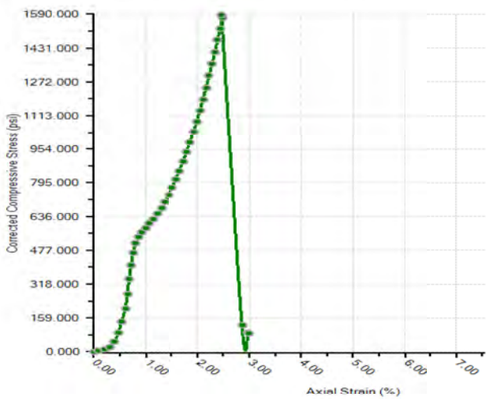
Boring Number	B-008-1-19	Top Depth (ft)	59.5	Bottom Depth (ft)	59.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Shale, grayish black, laminated to very thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.180	1.973
2	4.184	1.972
3	4.186	1.972
Average	4.183	1.972

Length / Diameter	2.121
Correction Factor	1.000
Area (in^2)	3.055
Mass (grams)	540.09
Unit Weight (lbs/ft^3)	160.98

Maximum Load (lbs)
4,970
Compressive Strength (psi)
1,587
Time of Test (minutes)
6:53
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-100
Date:	7/11/19

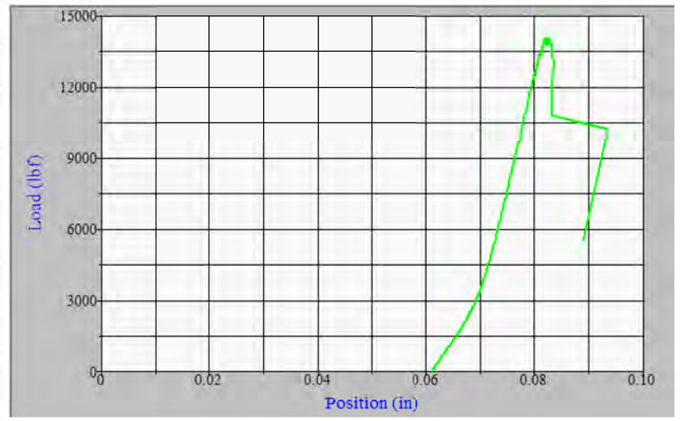
Boring Number	B-009-5-19	Top Depth (ft)	14.9	Bottom Depth (ft)	15.3
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, brown and light brown, medium to gravel, thin bedded

Measurement	Length (inches)	Diameter (inches)
1	3.960	1.968
2	3.955	1.969
3	3.956	1.975
Average	3.957	1.971

Length / Diameter	2.008
Correction Factor	1.000
Area (in^2)	3.050
Mass (grams)	449.13
Unit Weight (lbs/ft^3)	141.76

Maximum Load (lbs)
14,110
Compressive Strength (psi)
4,630
Time of Test (minutes)
1:55
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

33 / 181

DRAWN YLZ CHECKED TLM

Lab No.	19-101
Date:	7/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

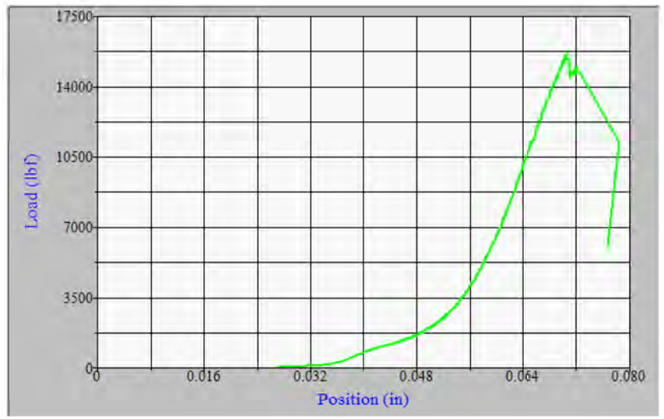
Boring Number	B-009-5-19	Top Depth (ft)	17.6	Bottom Depth (ft)	18.0
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

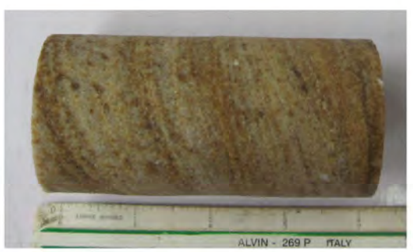
Formation	IP ap – Allegheny and Pottsville Groups Undivided
Description	Sandstone, light gray and brown, medium to coarse grained, thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.006	1.984
2	4.019	1.979
3	4.002	1.975
Average	4.009	1.979

Length / Diameter	2.025
Correction Factor	1.000
Area (in^2)	3.077
Mass (grams)	460.29
Unit Weight (lbs/ft^3)	142.15

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
15,700	5,110	2:14	Perp. to Bedding	PPP





Before Testing

After Failure

Lab No.	19-94
Date:	6/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

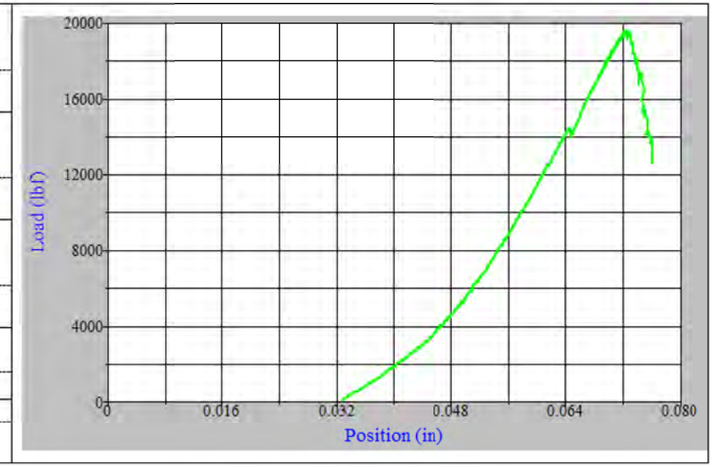
Boring Number	B-009-6-19	Top Depth (ft)	30.5	Bottom Depth (ft)	30.85
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

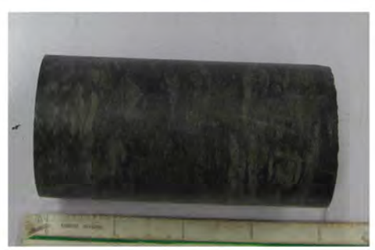
Formation	MC – Cuyahoga Formation
Description	Sandstone, very fine to fine grained

Measurement	Length (inches)	Diameter (inches)
1	3.912	1.977
2	3.911	1.977
3	3.913	1.977
Average	3.912	1.977

Length / Diameter	1.979
Correction Factor	0.998
Area (in^2)	3.0697
Mass (grams)	499.66
Unit Weight (lbs/ft^3)	158.5

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
19,640	6,387	2:10	Perp. to Bedding	PPP





Before Testing

After Failure

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Lab No.	19-95
Date:	6/12/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

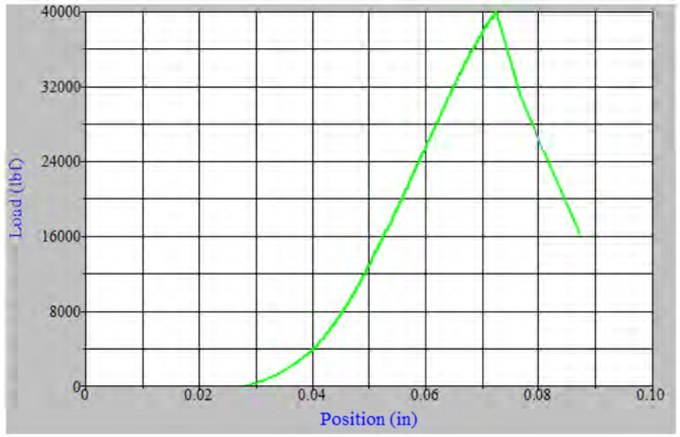
Boring Number	B-009-6-19	Top Depth (ft)	31.0	Bottom Depth (ft)	31.4
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	Mc – Cuyahoga Formation
Description	Sandstone, very fine to fine grained

Measurement	Length (inches)	Diameter (inches)
1	4.266	1.977
2	4.267	1.980
3	4.265	1.981
Average	4.266	1.979

Length / Diameter	2.155
Correction Factor	1.000
Area (in^2)	3.077
Mass (grams)	523.82
Unit Weight (lbs/ft^3)	152.02

Maximum Load (lbs)
39,990
Compressive Strength (psi)
12,996
Time of Test (minutes)
2:12
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Lab No.	19-91
Date:	6/11/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

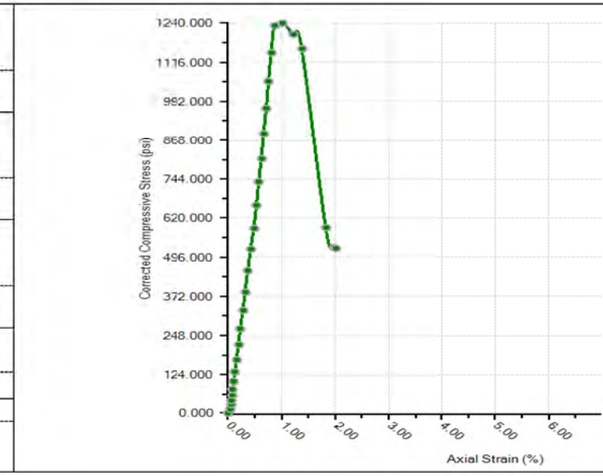
Boring Number	B-009-6-19	Top Depth (ft)	35.2	Bottom Depth (ft)	35.6
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	Mc – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

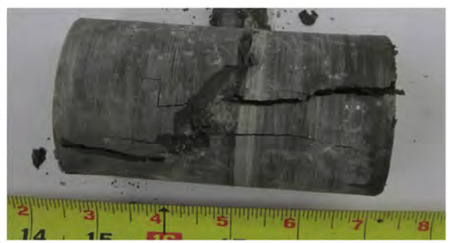
Measurement	Length (inches)	Diameter (inches)
1	4.119	1.979
2	4.120	1.977
3	4.128	1.976
Average	4.122	1.977

Length / Diameter	2.0848
Correction Factor	1.000
Area (in^2)	3.0708
Mass (grams)	531.90
Unit Weight (lbs/ft^3)	159.90

Maximum Load (lbs)
3845.5
Compressive Strength (psi)
1,240
Time of Test (minutes)
4:43
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing



After Failure

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-92
Date:	6/11/19

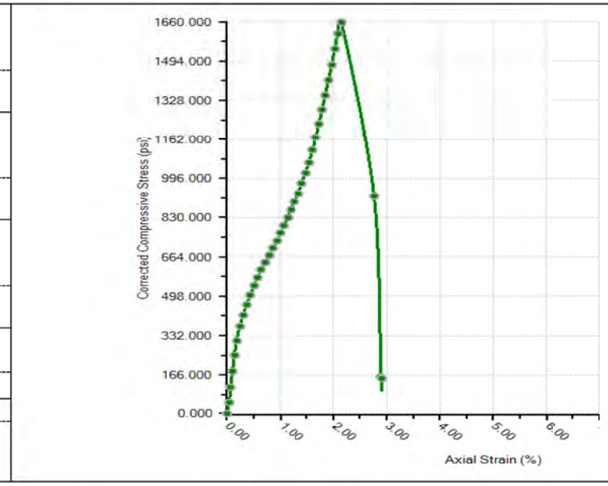
Boring Number	B-009-6-19	Top Depth (ft)	35.7	Bottom Depth (ft)	36.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.264	1.978
2	4.264	1.980
3	4.262	1.981
Average	4.263	1.980

Length / Diameter	2.1536
Correction Factor	1.000
Area (in^2)	3.0780
Mass (grams)	555.99
Unit Weight (lbs/ft^3)	161.41

Maximum Load (lbs)
5,210.7
Compressive Strength (psi)
1,656
Time of Test (minutes)
6:13
Loading Direction
Perp. to Bedding
Technician
PPP




Before Testing


After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-93
Date:	6/11/19

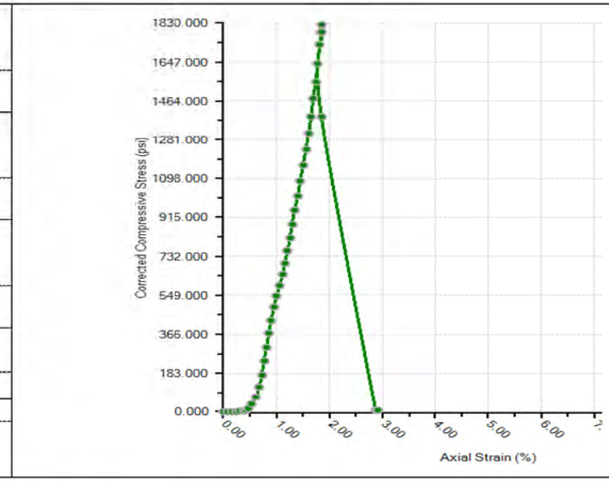
Boring Number	B-009-6-19	Top Depth (ft)	39.5	Bottom Depth (ft)	39.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

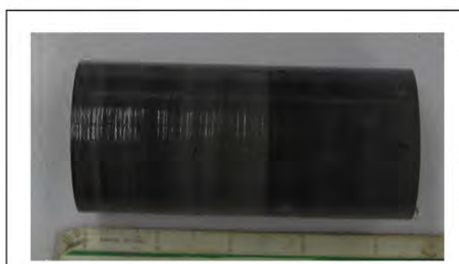
Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.341	1.982
2	4.431	1.982
3	4.339	1.984
Average	4.370	1.983

Length / Diameter	2.189
Correction Factor	1.000
Area (in^2)	3.0874
Mass (grams)	566.73
Unit Weight (lbs/ft^3)	161.12

Maximum Load (lbs)
5735.5
Compressive Strength (psi)
1,823
Time of Test (minutes)
6:36
Loading Direction
Perp. to Bedding
Technician
PPP




Before Testing


After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ CHECKED TLM

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Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-96
Date:	6/12/19

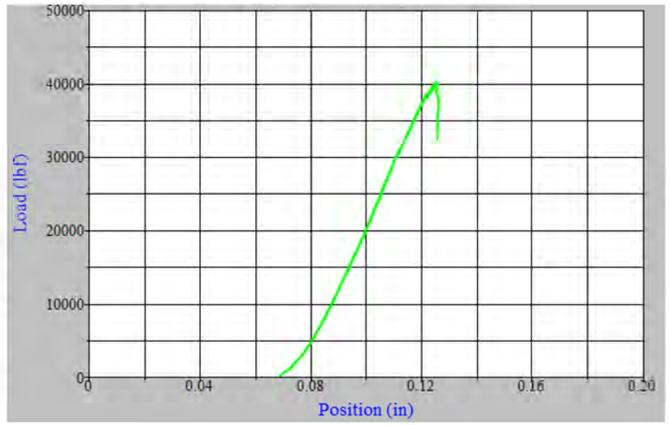
Boring Number	B-009-7-19	Top Depth (ft)	33.7	Bottom Depth (ft)	34.1
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

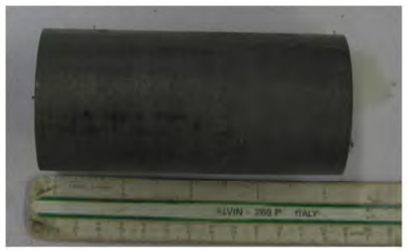
Formation	MC – Cuyahoga Formation
Description	Sandstone, very fine to fine grained, very thin to thin bedded

Measurement	Length (inches)	Diameter (inches)
1	4.190	1.983
2	4.188	1.982
3	4.189	1.980
Average	4.189	1.982

Length / Diameter	2.114
Correction Factor	1.000
Area (in^2)	3.084
Mass (grams)	510.22
Unit Weight (lbs/ft^3)	150.44

Maximum Load (lbs)
40,440
Compressive Strength (psi)
13,112
Time of Test (minutes)
2:51
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-88
Date:	6/11/19

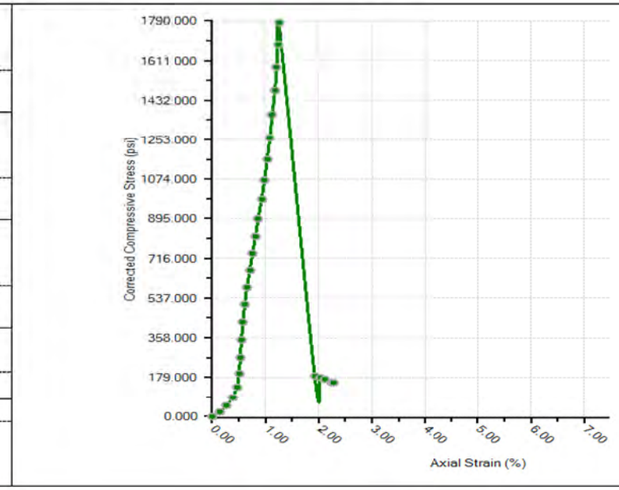
Boring Number	B-009-7-19	Top Depth (ft)	36.4	Bottom Depth (ft)	36.8
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

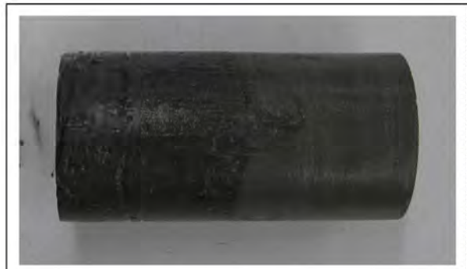
Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.988	1.971
2	3.992	1.972
3	3.988	1.971
Average	3.989	1.971

Length / Diameter	2.024
Correction Factor	1.000
Area (in^2)	3.0522
Mass (grams)	520.11
Unit Weight (lbs/ft^3)	162.73

Maximum Load (lbs)
5,510.7
Compressive Strength (psi)
1,783
Time of Test (minutes)
4:53
Loading Direction
Perp. to Bedding
Technician
PPP





Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

37 / 181

DRAWN YLZ CHECKED TLM

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-89
Date:	6/11/19

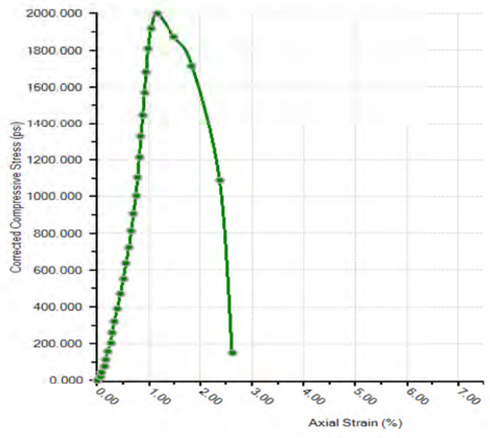
Boring Number	B-009-7-19	Top Depth (ft)	49.5	Bottom Depth (ft)	49.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	3.774	1.977
2	3.778	1.977
3	3.800	1.980
Average	3.784	1.978

Length / Diameter	1.913
Correction Factor	0.993
Area (in^2)	3.0729
Mass (grams)	482.58
Unit Weight (lbs/ft^3)	158.11

Maximum Load (lbs)
6200.0
Compressive Strength (psi)
1,985
Time of Test (minutes)
4:49
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

Lab No.	19-90
Date:	6/11/19

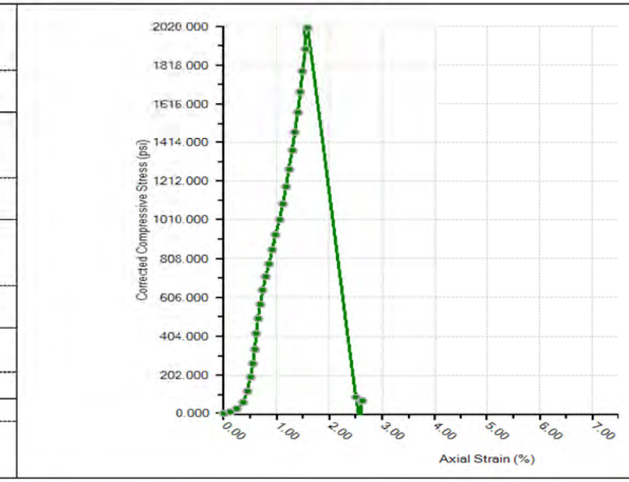
Boring Number	B-009-7-19	Top Depth (ft)	52.5	Bottom Depth (ft)	52.9
Sample Number		District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Interbedded Sandstone, very fine to fine grained and Shale, laminated to very thin bedded.

Measurement	Length (inches)	Diameter (inches)
1	4.019	1.978
2	4.020	1.977
3	4.021	1.965
Average	4.020	1.973

Length / Diameter	2.037
Correction Factor	1.000
Area (in^2)	3.0584
Mass (grams)	522.07
Unit Weight (lbs/ft^3)	161.77

Maximum Load (lbs)
6253.7
Compressive Strength (psi)
2,012
Time of Test (minutes)
4:43
Loading Direction
Perp. to Bedding
Technician
PPP



Before Testing

After Failure

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

DRAWN YLZ
CHECKED TLM

Lab No.	19-98
Date:	7/1/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

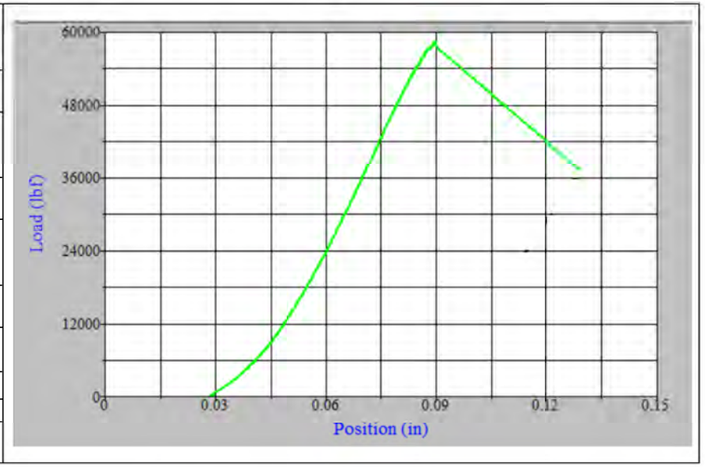
Boring Number	B-011-7-19	Top Depth (ft)	30.6	Bottom Depth (ft)	31.0
Sample Number	OGE 19-98	District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Siltstone, gray

Measurement	Length (inches)	Diameter (inches)
1	5.194	2.377
2	5.194	2.376
3	5.193	2.375
Average	5.194	2.376

Length / Diameter	2.376
Correction Factor	1.000
Area (in^2)	4.4339
Mass (grams)	945.9669
Unit Weight (lbs/ft^3)	143.25

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
58500	13,190	3:02	Perp. to Bedding	PPP



Before Testing

After Failure

Lab No.	19-99
Date:	7/1/19

Compressive Strength of Rock
ASTM 7012
ODOT - Office of Geotechnical Engineering

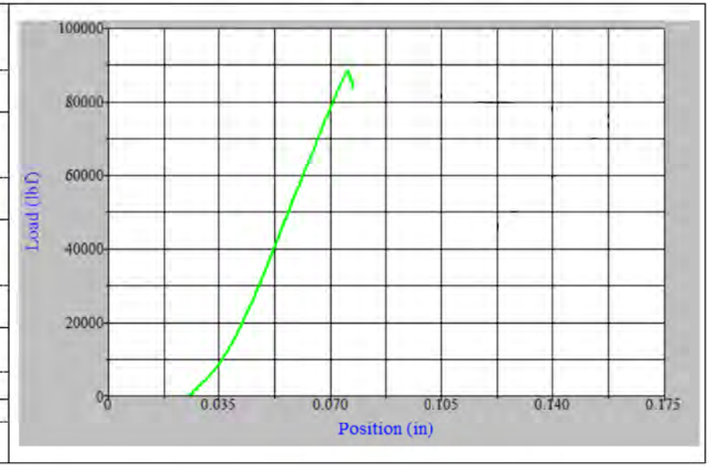
Boring Number	B-011-7-19	Top Depth (ft)	32.5	Bottom Depth (ft)	32.9
Sample Number	OGE 19-99	District	4	PID	91710
County	SUM	Route	8	Secton	1.75
Station		Offset		Offset Direction	

Formation	MC – Cuyahoga Formation
Description	Limestone, gray

Measurement	Length (inches)	Diameter (inches)
1	5.137	2.383
2	5.137	2.384
3	5.136	2.384
Average	5.137	2.384

Length / Diameter	2.384
Correction Factor	1.000
Area (in^2)	4.4625
Mass (grams)	1001.078
Unit Weight (lbs/ft^3)	166.37

Maximum Load (lbs)	Compressive Strength (psi)	Time of Test (minutes)	Loading Direction	Technician
88620	19,920	2:33	Perp. to Bedding	PPP



Before Testing

After Failure

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

ATC GROUP SERVICES LLC

7/8/2019

Compressive Strength of Rock
ASTM 7012

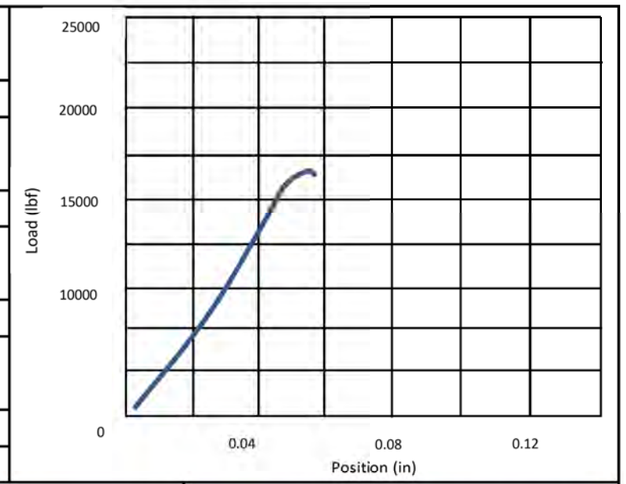
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	51.85'	BOTTOM DEPTH	52.70'
SAMPLE NUMBER	RC-1	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.308
1	4.255	1.834	AREA (in2)	2.665
2	4.246	1.844	MASS (GRAMS)	239.1
3	4.259	1.850		
AVERAGE	4.253	1.843		

MAXIMUM LOAD (LBS)
16,770
COMPRESSIVE STRENGTH (PSI)
5,380
TIME OF TEST (MINUTES)
0:44
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

ATC GROUP SERVICES LLC

7/8/2019

Compressive Strength of Rock
ASTM 7012

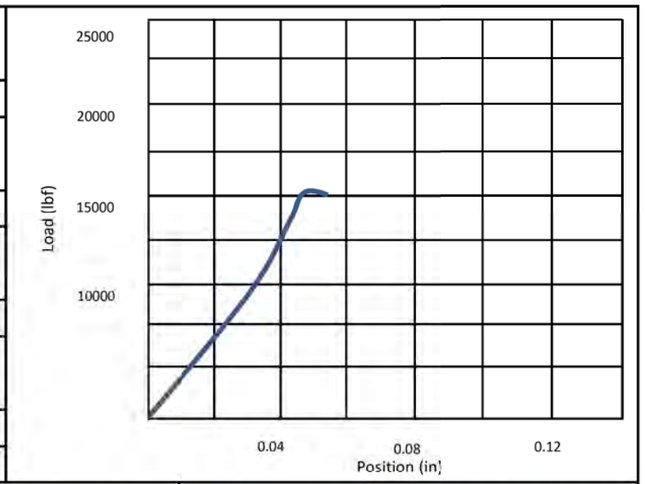
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	56.40'	BOTTOM DEPTH	57.60'
SAMPLE NUMBER	RC-2	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.415
1	4.356	1.799	AREA (in2)	2.556
2	4.367	1.803	MASS (GRAMS)	244.9
3	4.351	1.811		
AVERAGE	4.358	1.804		

MAXIMUM LOAD (LBS)
15,930
COMPRESSIVE STRENGTH (PSI)
5,110
TIME OF TEST (MINUTES)
1:05
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

7/8/2019

Compressive Strength of Rock
ASTM 7012

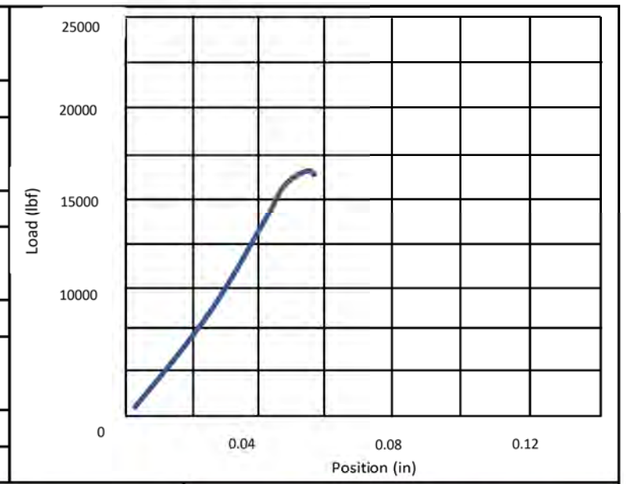
PROJECT: SUM-8-01.75

Performed By: Jeff Strobelt — Checked By: Richard Sullivan

BORING NUMBER	011-8-19	TOP DEPTH	65.10'	BOTTOM DEPTH	65.70'
SAMPLE NUMBER	RC-3	DISTRICT	4	PID	91710
COUNTY	SUMMIT	ROUTE	8	SECTION	1.75
STATION	234+36	OFFSET	19	OFFSET DIRECTION	LT

DESCRIPTION	Gray, Shale and Siltstone, Moderately Weathered, Moderately Strong			
MEASUREMENT	LENGTH (in.)	DIAMETER (in.)	LENGTH/DIA.	2.387
1	4.419	1.855	AREA (in2)	2.681
2	4.403	1.848	MASS (GRAMS)	267.4
3	4.412	1.841		
AVERAGE	4.411	1.848		

MAXIMUM LOAD (LBS)
16,005
COMPRESSIVE STRENGTH (PSI)
5,140
TIME OF TEST (MINUTES)
0:49
LOADING DIRECTION
Perp. To Bedding
TESTED BY: Jeff Strobelt



BEFORE TESTING

AFTER TESTING

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULTS

SUM-8-1.75

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	33.1-34.6	Shale	1.9685	50	1.12204	30.0	27.0	28.50	0.570	1.745	0.96	139	12	1673
			1.9685	50	0.60039	16.0	14.5	15.25	0.305	1.485	1.53	222	18	2661
			1.9685	50	0.98425	26.0	24.0	25.00	0.500	0.764	0.48	70	6	835
			1.9685	50	1.08267	29.0	26.0	27.50	0.550	1.196	0.68	99	8	1189
			1.9685	50	1.17126	31.0	28.5	29.75	0.595	1.412	0.75	108	9	1297
			1.9685	50	0.69882	19.5	16.0	17.75	0.355	2.137	1.89	274	23	3291
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	0.99	0.94	137	11	1640
			1.9685	50	0.68897	19.0	16.0	17.50	0.350	0.941	0.84	122	10	1470
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.186	1.26	183	15	2198
			1.9685	50	0.88582	24.0	21.0	22.50	0.450	1.157	0.81	117	10	1405
			1.9685	50	0.62008	17.5	14.0	15.75	0.315	0.755	0.75	109	9	1310
												Average Strength (Sc)		**1571**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	39.3-40.3	Shale	1.9685	50	0.86614	23.5	20.5	22.00	0.440	1.127	0.80	117	10	1400
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.284	1.37	198	16	2379
			1.9685	50	0.72834	20.0	17.0	18.50	0.370	2.147	1.82	264	22	3172
			1.9685	50	0.58071	16.0	13.5	14.75	0.295	1.176	1.25	182	15	2179
			1.9685	50	0.62992	17.0	15.0	16.00	0.320	0.882	0.87	126	10	1507
			1.9685	50	0.7185	19.5	17.0	18.25	0.365	1.265	1.09	158	13	1895
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	1.265	1.20	175	14	2095
			1.9685	50	0.86614	24.0	20.0	22.00	0.440	1.421	1.01	147	12	1765
			2.0079	51	0.61023	17.0	14.0	15.50	0.304	1.52	1.51	219	18	2628
			1.9685	50	1.20078	32.0	29.0	30.50	0.610	1.686	0.87	126	10	1511
												Average Strength (Sc)		**1719**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-008-1-19	48.3-50.1	Shale	1.9685	50	0.73819	20.0	17.5	18.75	0.375	1.019	0.85	124	10	1485
			1.9685	50	0.53149	15.0	12.0	13.50	0.270	0.637	0.74	107	9	1290
			1.9685	50	0.54134	15.0	12.5	13.75	0.275	0.892	1.02	148	12	1773
			1.9685	50	0.6496	18.0	15.0	16.50	0.330	1.304	1.24	180	15	2160
			1.9685	50	0.60039	16.5	14.0	15.25	0.305	1.549	1.60	231	19	2776
			1.9685	50	0.61023	17.0	14.0	15.50	0.310	1.431	1.45	210	17	2523
			1.9685	50	0.72834	20.0	17.0	18.50	0.370	1.412	1.20	174	14	2086
			1.9685	50	0.60039	16.5	14.0	15.25	0.305	1.284	1.32	192	16	2301
			2.0079	51	0.68897	19.0	16.0	17.50	0.343	0.872	0.77	111	9	1335
			1.9685	50	0.7874	21.0	19.0	20.00	0.400	1.235	0.97	141	12	1688
			1.9685	50	0.63976	17.5	15.0	16.25	0.325	0.862	0.83	121	10	1450
												Average Strength (Sc)		**1642**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	21.8-22.7	Shale	1.9685	50	1.13189	30.5	27	28.75	0.575	0.647	0.35	51	4	615
			1.9685	50	0.68897	19	16	17.5	0.350	0.313	0.28	41	3	489
			1.9685	50	0.57086	15.5	13.5	14.5	0.290	0.362	0.39	57	5	682
			1.9685	50	0.51181	14	12	13	0.260	0.264	0.32	46	4	555
			1.9685	50	0.56102	15.5	13	14.25	0.285	0.382	0.42	61	5	733
			1.9685	50	1.27952	34	31	32.5	0.650	1.147	0.55	80	7	965
			1.9685	50	0.65945	18	15.5	16.75	0.335	0.372	0.35	51	4	607
			1.9685	50	0.60039	16	14.5	15.25	0.305	0.382	0.39	57	5	685
			1.9685	50	0.55118	15	13	14	0.280	0.264	0.30	43	4	515
			2.0079	51	1.25	33.5	30	31.75	0.623	0.892	0.43	63	5	753
			1.9685	50	0.51181	14	12	13	0.260	0.188	0.23	33	3	395
												Average Strength (Sc)		**627**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	30.6-31.4	Shale	1.9685	50	0.91535	24.5	22	23.25	0.465	0.882	0.60	86	7	1037
			1.9685	50	0.77756	21.5	18	19.75	0.395	1.265	1.01	146	12	1751
			1.9685	50	0.76771	21	18	19.5	0.390	0.735	0.59	86	7	1030
			1.9685	50	0.67913	18.5	16	17.25	0.345	0.686	0.62	91	7	1087
			1.9685	50	0.88582	24	21	22.5	0.450	0.725	0.51	73	6	881
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.617	0.60	86	7	1038
			1.9685	50	0.80708	22	19	20.5	0.410	1.206	0.92	134	11	1608
			1.9685	50	0.59055	16	14	15	0.300	0.46	0.48	70	6	838
			1.9685	50	0.66929	18	16	17	0.340	0.813	0.75	109	9	1307
			1.9685	50	0.94488	30	18	24	0.480	1.461	0.96	139	11	1664
												Average Strength (Sc)		**1184**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: Is = P / (D_e^2) D_e^2 = 4A/π A = (WD) Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	31.8-32.8	Shale	1.9685	50	0.86614	23	21	22	0.440	0.813	0.58	84	7	1010
			1.9685	50	0.98425	26.5	23.5	25	0.500	1.256	0.79	114	9	1373
			1.9685	50	0.68897	19	16	17.5	0.350	1.098	0.99	143	12	1715
			1.9685	50	1.33858	36	32	34	0.680	1.039	0.48	70	6	835
			1.9685	50	1.25984	34	30	32	0.640	1.304	0.64	93	8	1114
			1.9685	50	0.83661	23	19.5	21.25	0.425	0.833	0.62	89	7	1071
			1.9685	50	1.29921	35	31	33	0.660	2.147	1.02	148	12	1778
			1.9685	50	0.94488	25	23	24	0.480	1.363	0.89	129	11	1552
			1.9685	50	0.79724	21.5	19	20.25	0.405	0.99	0.77	111	9	1336
			1.9685	50	0.74803	21	17	19	0.380	0.882	0.73	106	9	1269
												Average Strength (Sc)		**1286**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-5-19	38.0-39.4	Shale	1.9685	50	1.33858	35.5	32.5	34	0.680	0.912	0.42	61	5	733
			1.9685	50	0.83661	22.5	20	21.25	0.425	0.674	0.50	72	6	867
			1.9685	50	1.10236	29	27	28	0.560	1.176	0.66	96	8	1148
			1.9685	50	0.94488	26	22	24	0.480	0.98	0.64	93	8	1116
			1.9685	50	0.79724	21.5	19	20.25	0.405	0.696	0.54	78	6	939
			1.9685	50	1.20078	32	29	30.5	0.610	2.353	1.21	176	15	2109
			1.9685	50	1.19094	32	28.5	30.25	0.605	0.862	0.45	65	5	779
			1.9685	50	1.00393	27	24	25.5	0.510	1.333	0.82	119	10	1429
			1.9685	50	1.02362	27.5	24.5	26	0.520	1.117	0.67	98	8	1174
			1.9685	50	0.92519	25	22	23.5	0.470	0.715	0.48	69	6	832
			1.9685	50	0.82677	22	20	21	0.420	0.862	0.64	93	8	1122
												Average Strength (Sc)		**1028**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-6-19	23.2-24.2	Shale	1.9685	50	0.99409	27	23.5	25.25	0.505	0.578	0.36	52	4	626
			1.9685	50	0.7185	19.5	17	18.25	0.365	0.667	0.57	83	7	999
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.421	0.41	59	5	708
			1.9685	50	0.84645	23	20	21.5	0.430	0.598	0.44	63	5	760
			1.9685	50	0.87598	23.5	21	22.25	0.445	0.529	0.37	54	4	650
			1.9685	50	0.67913	18.5	16	17.25	0.345	0.853	0.78	113	9	1352
			1.9685	50	0.55118	15	13	14	0.280	0.715	0.80	116	10	1396
			1.9685	50	0.90551	24	22	23	0.460	0.715	0.49	71	6	850
			1.9685	50	0.63976	17.5	15	16.25	0.325	0.568	0.55	80	7	955
			1.9685	50	0.82677	22	20	21	0.420	0.598	0.45	65	5	778
												Average Strength (Sc)		**842**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-6-19	27.5-28.4	Shale	1.9685	50	0.89567	24	21.5	22.75	0.455	0.657	0.45	66	5	789
			1.9685	50	0.7874	21.5	18.5	20	0.400	0.774	0.61	88	7	1058
			1.9685	50	0.59055	16	14	15	0.300	0.853	0.89	130	11	1554
			1.9685	50	0.7874	21	19	20	0.400	1.01	0.79	115	10	1380
			1.9685	50	0.57086	15.5	13.5	14.5	0.290	0.509	0.55	80	7	959
			1.9685	50	0.80708	22	19	20.5	0.410	0.892	0.68	99	8	1189
			1.9685	50	0.7874	21	19	20	0.400	1	0.79	114	9	1367
			1.9685	50	0.68897	19	16	17.5	0.350	1.176	1.06	153	13	1837
			1.9685	50	0.55118	15	13	14	0.280	0.529	0.59	86	7	1033
			2.0079	51	0.58071	16	13.5	14.75	0.289	0.451	0.47	68	6	819
			1.9685	50	0.59055	16	14	15	0.300	0.872	0.91	132	11	1589
												Average Strength (Sc)		**1220**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT:	SUM-8-1.75	DISTRICT No.:	4	PID No.	91710	Tech:	PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 12

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-7-19	36.3-39.0	Shale	1.9685	50	0.8563	23.5	20	21.75	0.435	0.961	0.69	101	8	1208
			1.9685	50	0.61023	17	14	15.5	0.310	0.813	0.82	119	10	1434
			1.9685	50	0.87598	24	20.5	22.25	0.445	2.481	1.75	254	21	3048
			1.9685	50	0.89567	25	20.5	22.75	0.455	1.676	1.16	168	14	2014
			1.9685	50	0.68897	19	16	17.5	0.350	0.99	0.89	129	11	1546
			1.9685	50	0.76771	21	18	19.5	0.390	1.637	1.32	191	16	2294
			1.9685	50	0.76771	21	18	19.5	0.390	0.931	0.75	109	9	1305
			1.9685	50	0.69882	19	16.5	17.75	0.355	0.788	0.70	101	8	1213
			1.9685	50	0.7874	21	19	20	0.400	1.157	0.91	132	11	1581
			1.9685	50	0.58071	16	13.5	14.75	0.295	1.186	1.26	183	15	2198
			1.9685	50	0.66929	19	15	17	0.340	1.029	0.95	138	11	1654
			1.9685	50	0.54134	15	12.5	13.75	0.275	1.186	1.35	196	16	2357
												Average Strength (Sc)		**1753**

Comments: Red highlights excluded in Sc calculation

The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** PPP

Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ Stregnth = Is * K K = 24

Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-009-7-19	51.1-51.6	Limestone	1.9685	50	0.72834	21	16	18.5	0.370	10.954	9.30	1349	223	32367
			1.9685	50	0.48228	14	10.5	12.25	0.245	5.668	7.27	1054	174	25293
			1.9685	50	0.73819	21	16.5	18.75	0.375	3.785	3.17	460	76	11035
			1.9685	50	0.50197	14.5	11	12.75	0.255	6.707	8.26	1198	198	28755
			1.9685	50	0.29527	9	6	7.5	0.150	4.118	8.62	1251	207	30014
			1.9685	50	0.6496	18	15	16.5	0.330	7.821	7.45	1080	179	25911
			1.9685	50	0.53149	15	12	13.5	0.270	7.796	9.07	1315	218	31567
			1.9685	50	0.42323	12	9.5	10.75	0.215	5.913	8.64	1253	207	30068
			1.9685	50	0.43307	12.5	9.5	11	0.220	5.511	7.87	1141	189	27386
			1.9685	50	0.45275	13	10	11.5	0.230	6.982	9.54	1383	229	33188
												Average Strength (Sc)		**28950**

Comments: Red highlights excluded in Sc calculation

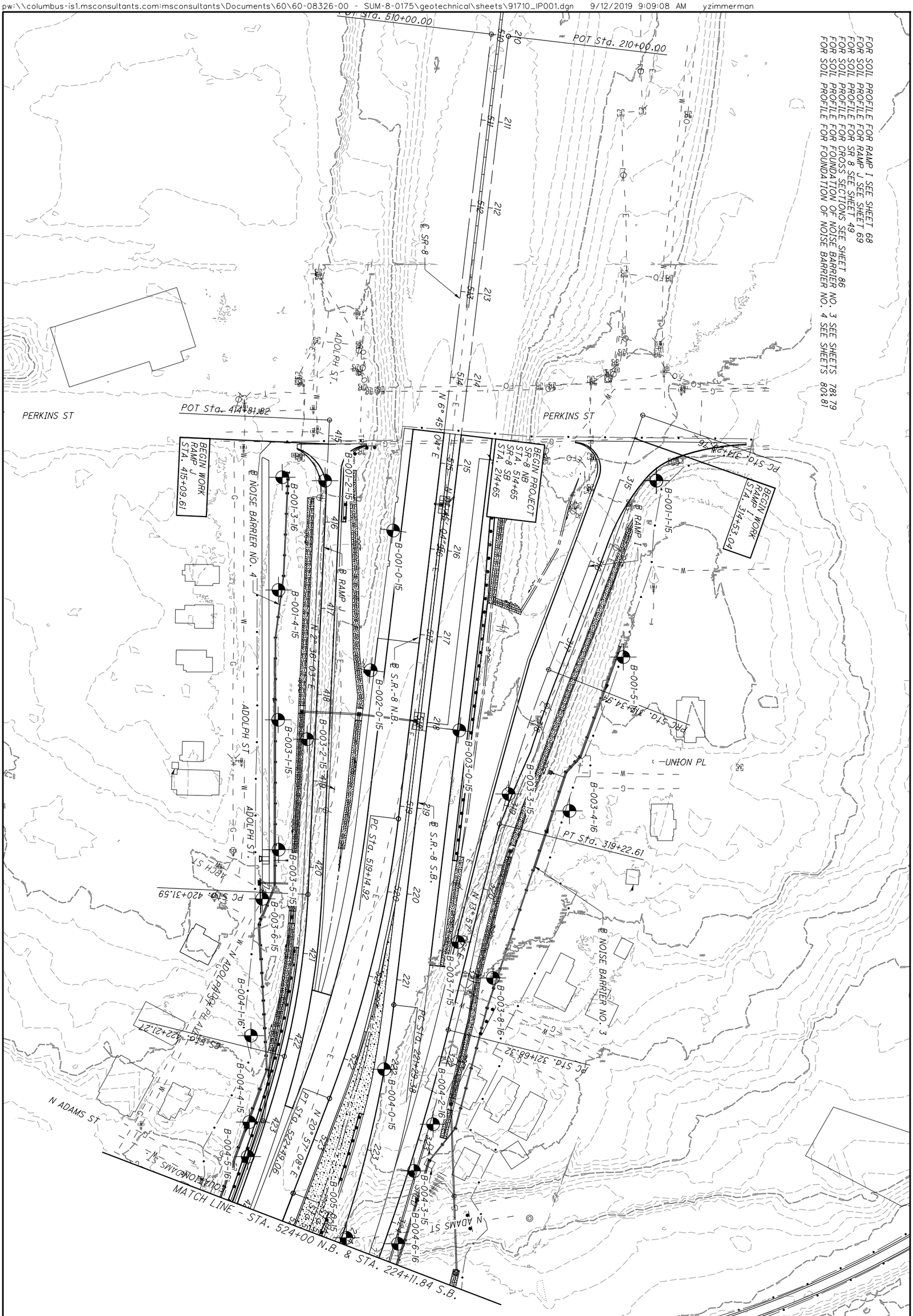
The Ohio Department of Transportation
Office of Geotechnical Engineering

PROJECT: SUM-8-1.75 **DISTRICT No.:** 4 **PID No.** 91710 **Tech:** JB

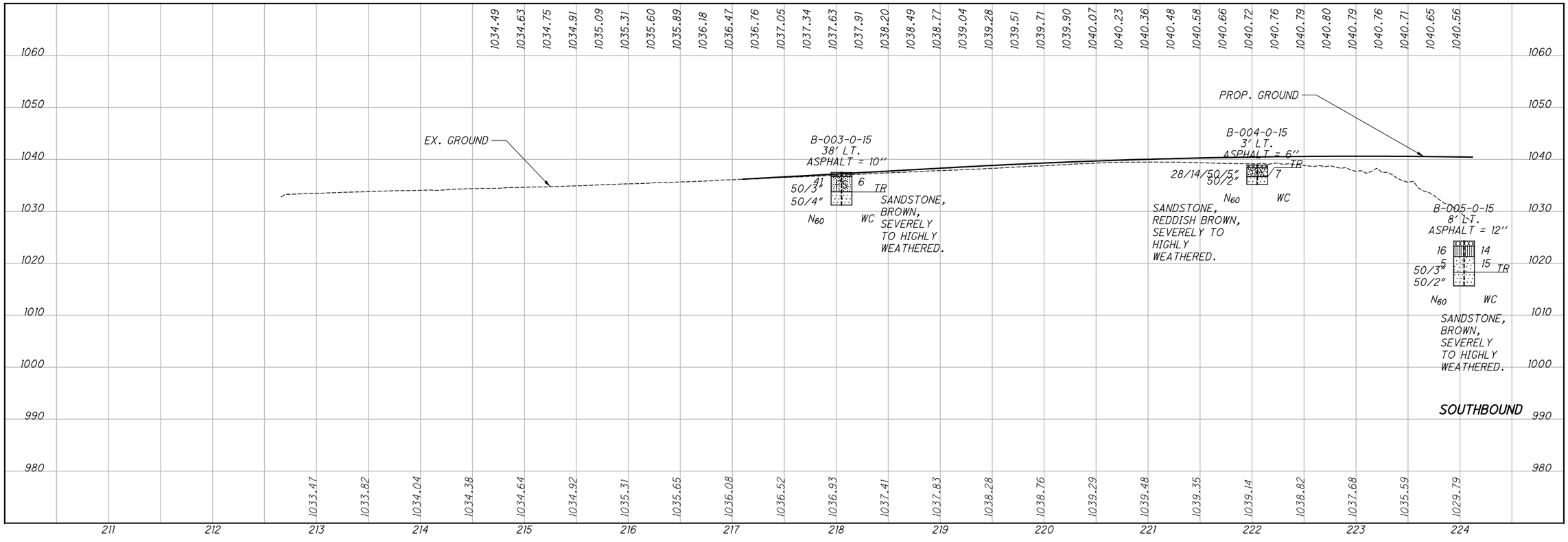
Point Load Strength Calc*: $Is = P / (D_e^2)$ $D_e^2 = 4A/\pi$ $A = (WD)$ $F = (De/50)^{0.45}$ Is50 = Is*F Strength = Is * K K = 12

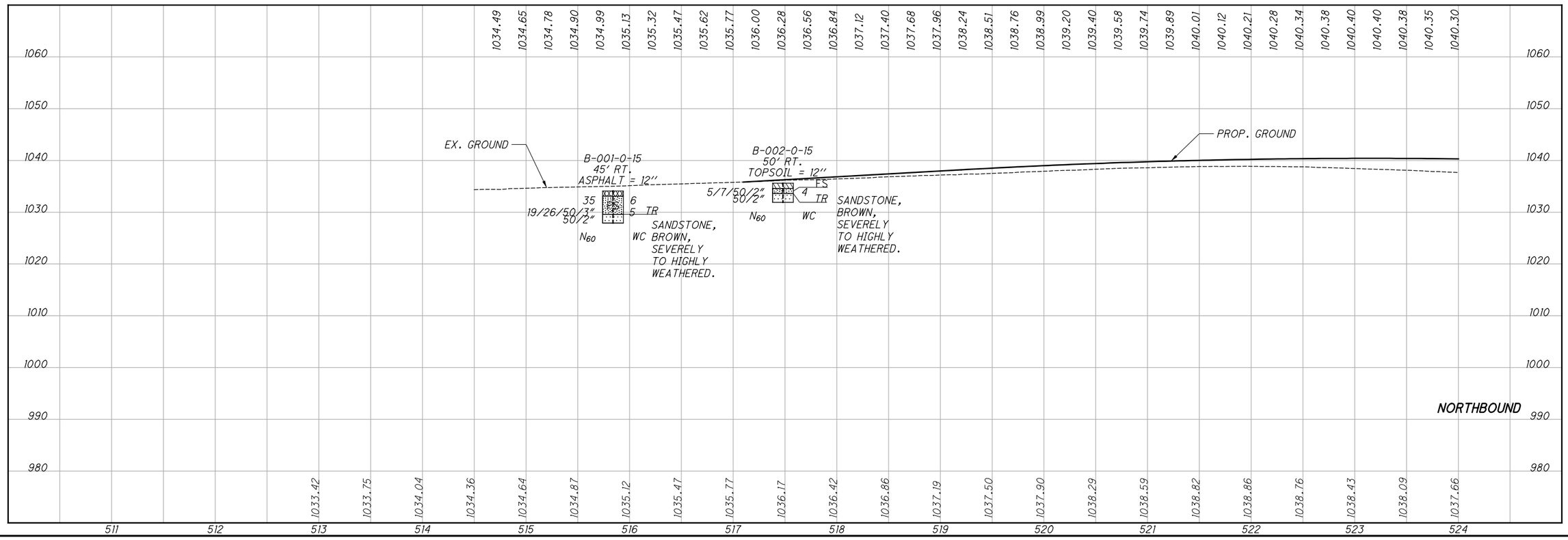
Boring #	Sample Depth (ft)	Material Type	W (in)	W (mm)	D (in)	D (mm) Initial	D (mm) Final	D (mm) Avg	L/D	Failure Load (kN)	Is (Mpa)	F	Is_{50} (MPa)	Is_{50} (psi)	Strength S_c (MPa)	Strength S_c (psi)
B-011-7-19	36.3'-37.6'	Shale	2.3819	60.501	1.102	30.0	26.0	28.00	0.463	5.785	2.68	0.97	2.59	376	31	4514
			2.3819	60.501	1.132	31.5	26.0	28.75	0.475	2.157	0.97	0.97	0.95	137	11	1649
			2.3819	60.501	1.112	30.0	26.5	28.25	0.467	1.225	0.56	0.97	0.55	79	7	949
			2.3819	60.501	0.965	27.0	22.0	24.50	0.405	1.078	0.57	0.94	0.54	78	6	933
			2.3819	60.501	1.053	29.0	24.5	26.75	0.442	6.335	3.07	0.96	2.94	427	35	5122
			2.3819	60.501	0.817	23.5	18.0	20.75	0.343	3.442	2.15	0.90	1.95	282	23	3388
			2.3819	60.501	0.709	21.0	15.0	18.00	0.298	4.050	2.92	0.88	2.56	371	31	4451
			2.3819	60.501	0.994	26.5	24.0	25.25	0.417	2.020	1.04	0.95	0.98	142	12	1708
			2.3819	60.501	0.738	21.0	16.5	18.75	0.310	3.069	2.12	0.88	1.88	272	23	3268
			2.3819	60.501	0.768	22.0	17.0	19.50	0.322	3.461	2.30	0.89	2.05	298	25	3575
														Avg. S_c Value		3006

Comments: Red highlights excluded in S_c calculation



	48/181	SUM-8-1.75	SOIL PROFILE-SR 8 NB/SB STA. 511+00/211+00 TO STA. 524+00/224+11.84	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET





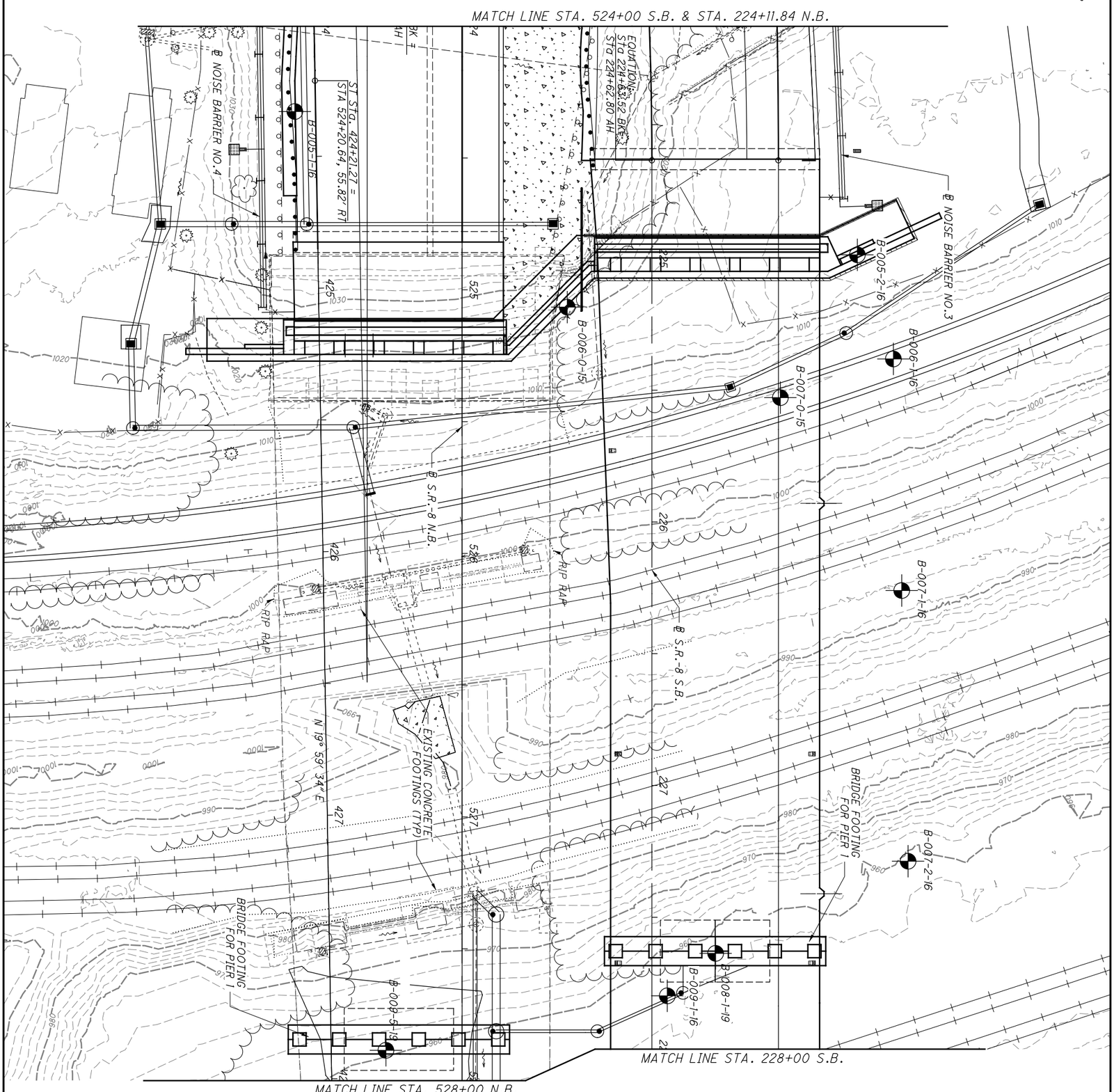
HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN YLZ
CHECKED TLM

SOIL PROFILE-SR 8 NB/SB
STA. 511+00/ 211+00 TO STA. 524+00/ 224+11.84

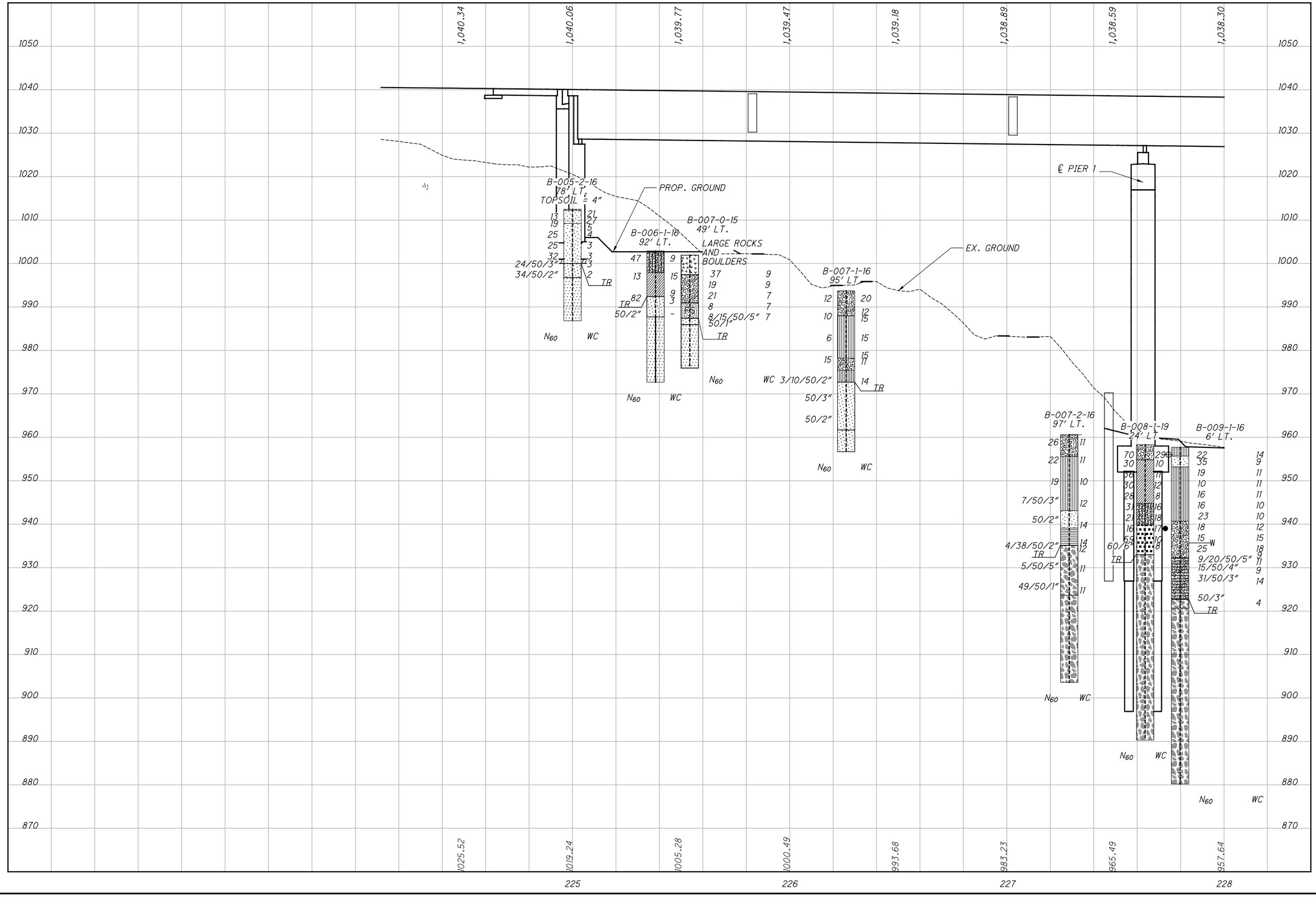
SUM-8-1.75

FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEETS 51 & 52
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEETS 86 & 87



STA 524+00 TO STA 528+00 S.R. 8 N.B. & STA 224+11.84 TO STA 228+00 S.R. 8 S.B.

50/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199	DRAWN YLZ CHECKED TLM	0 20 10 40 HORIZONTAL SCALE IN FEET	N



HORIZONTAL SCALE IN FEET
0 10 20 40

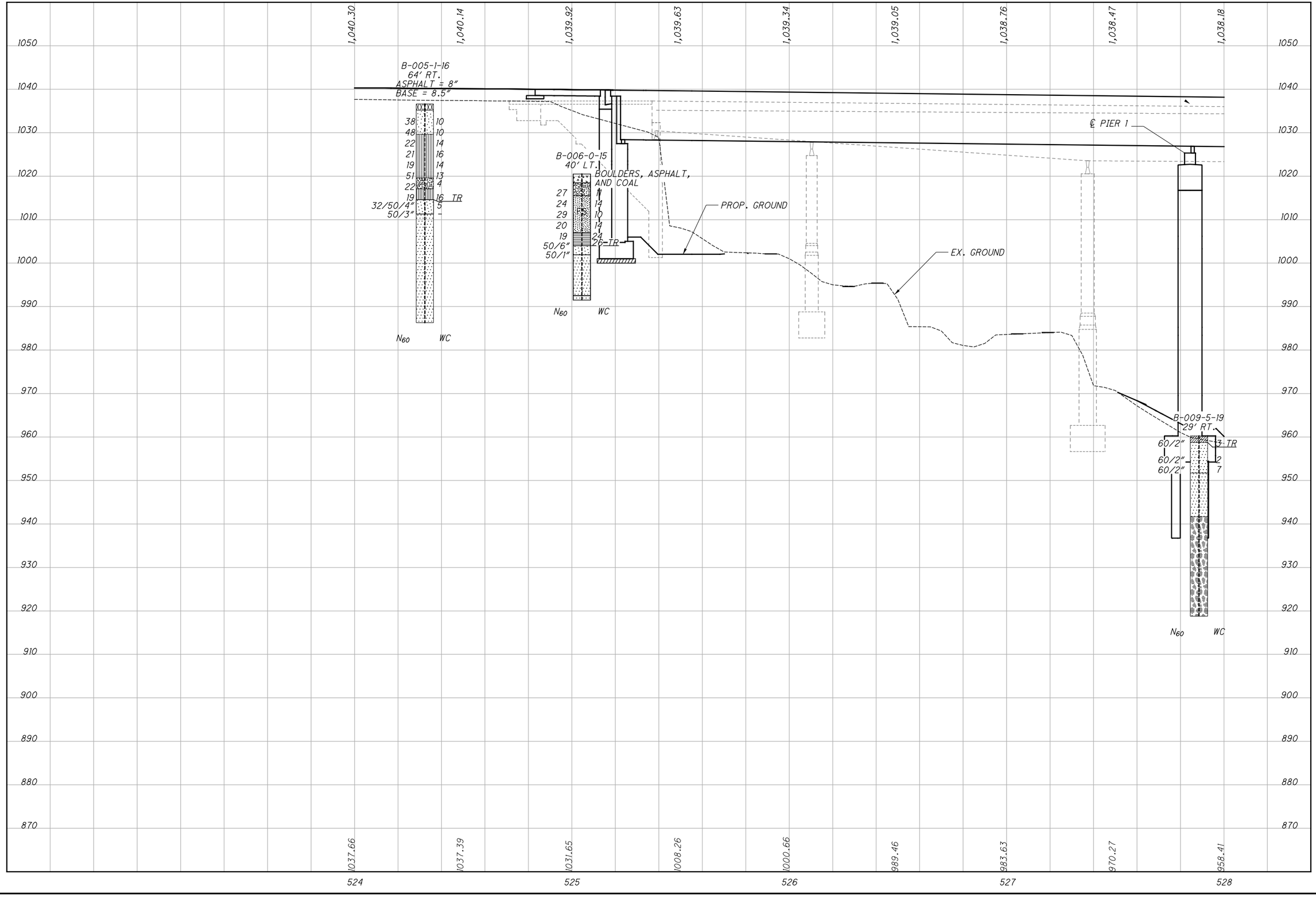
DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 224+11.84 TO STA 228+00 S.R. 8 S.B.

SUM-8-1.75

51 / 181



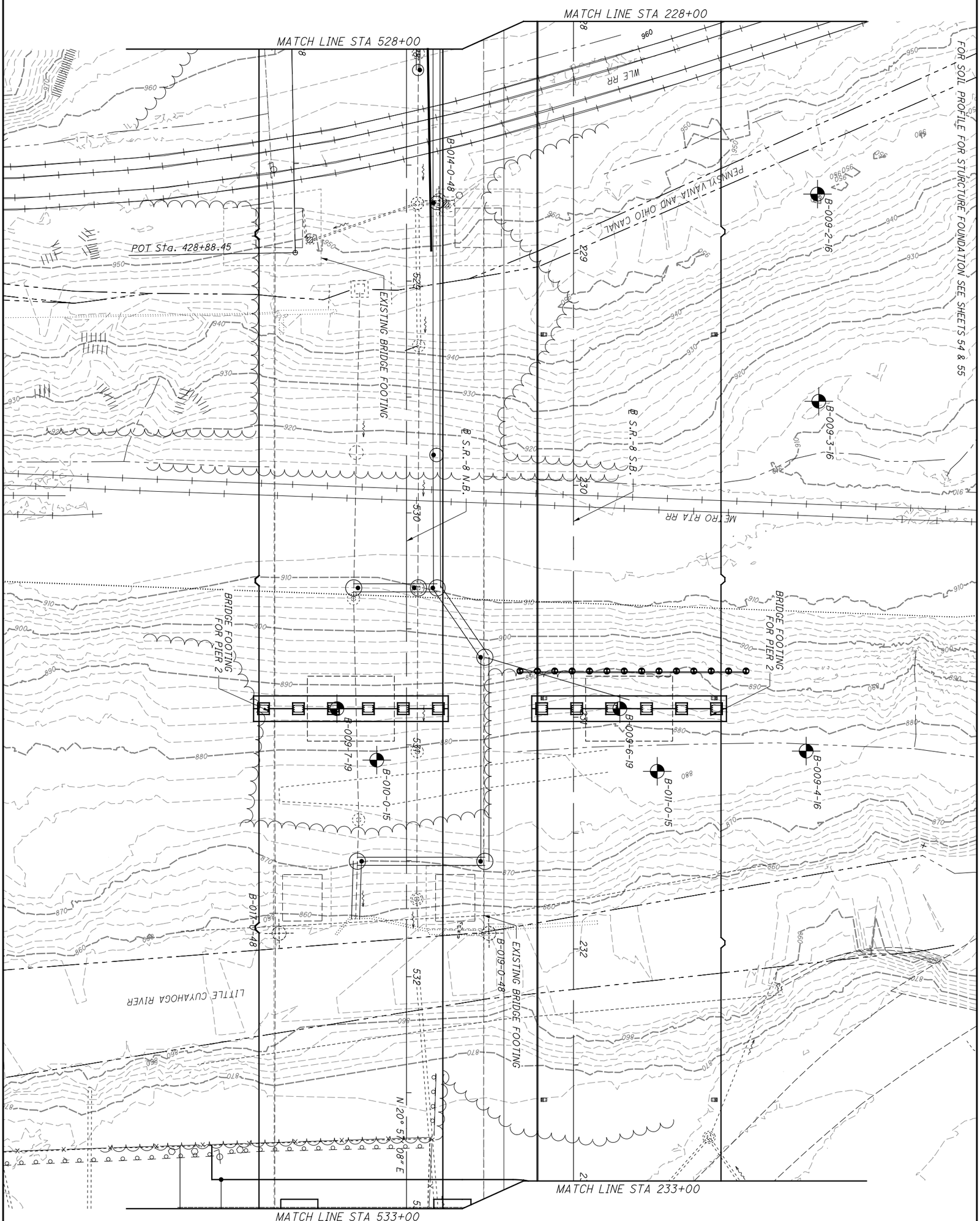
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

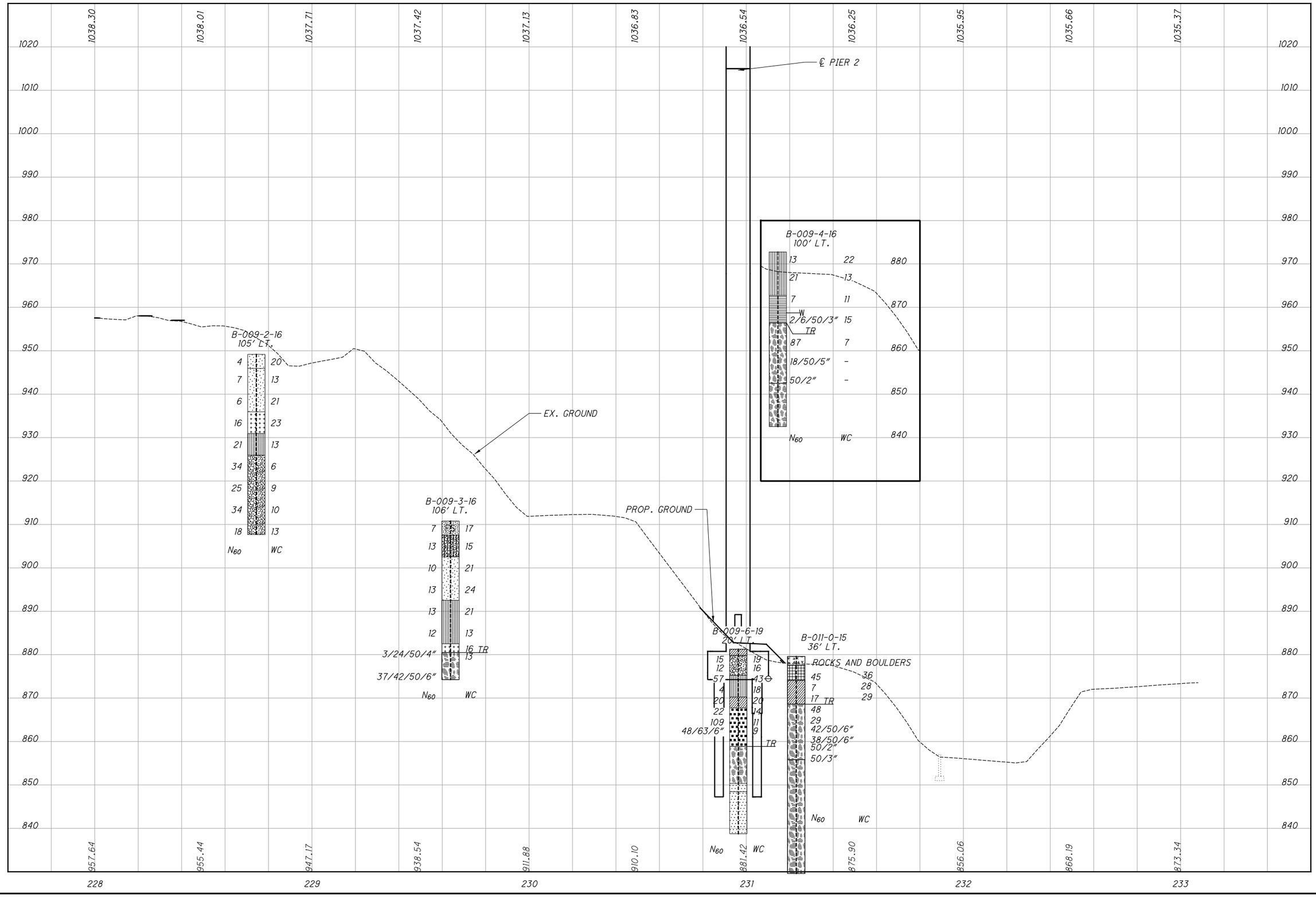
BRIDGE NO. SUM-8-0199, STA 524+00 TO STA 528+00 S.R. 8 N.B.

SUM-8-1.75



STA. 528+00 TO STA. 533+00 S.R. 8 N.B. & STA. 228+00 TO STA. 233+00 S.R. 8 S.B.

53/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199	DRAWN YLZ CHECKED TLM	0 20 10 40 HORIZONTAL SCALE IN FEET	N



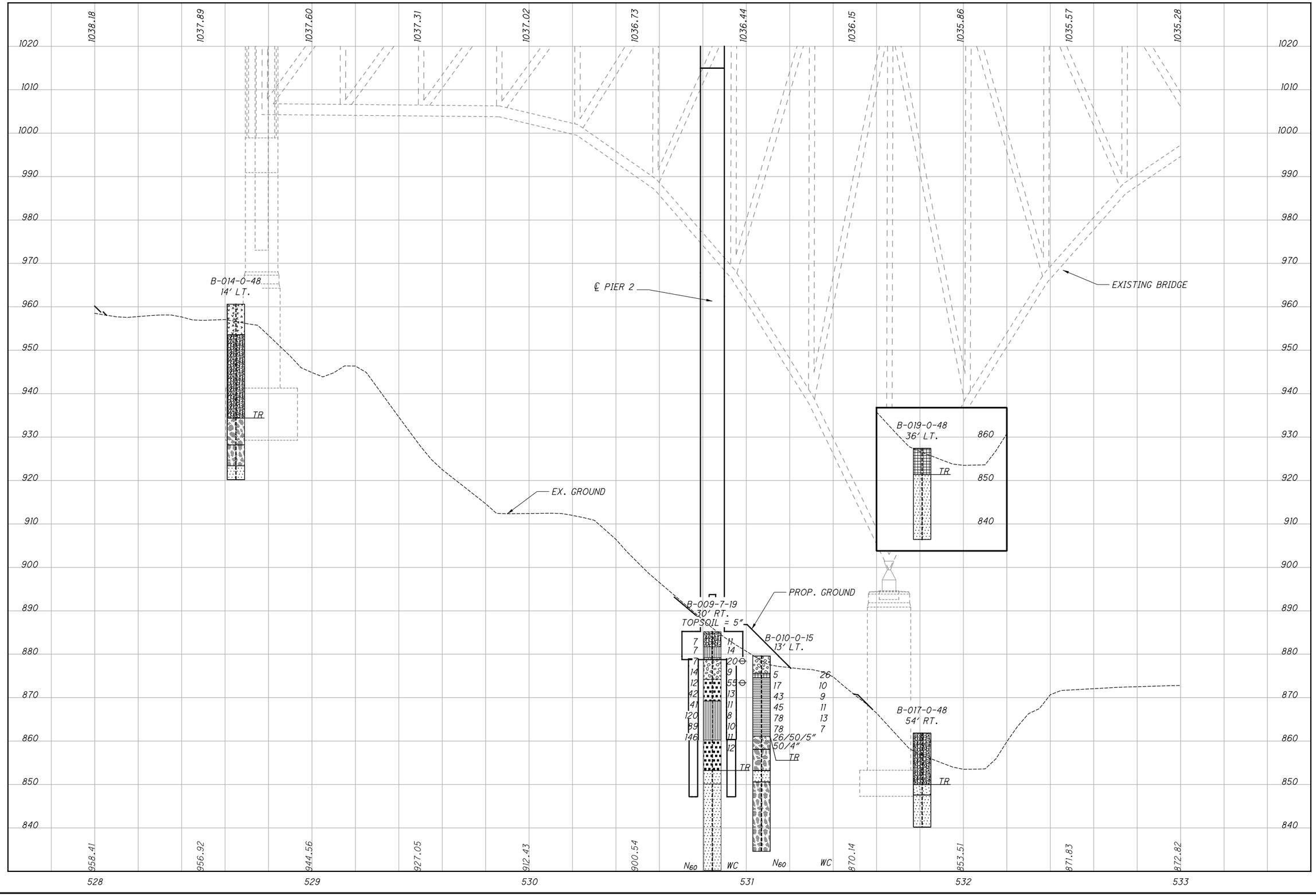
0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 228+00 TO STA 233+00 S.R. 8 S.B.

SUM-8-1.75



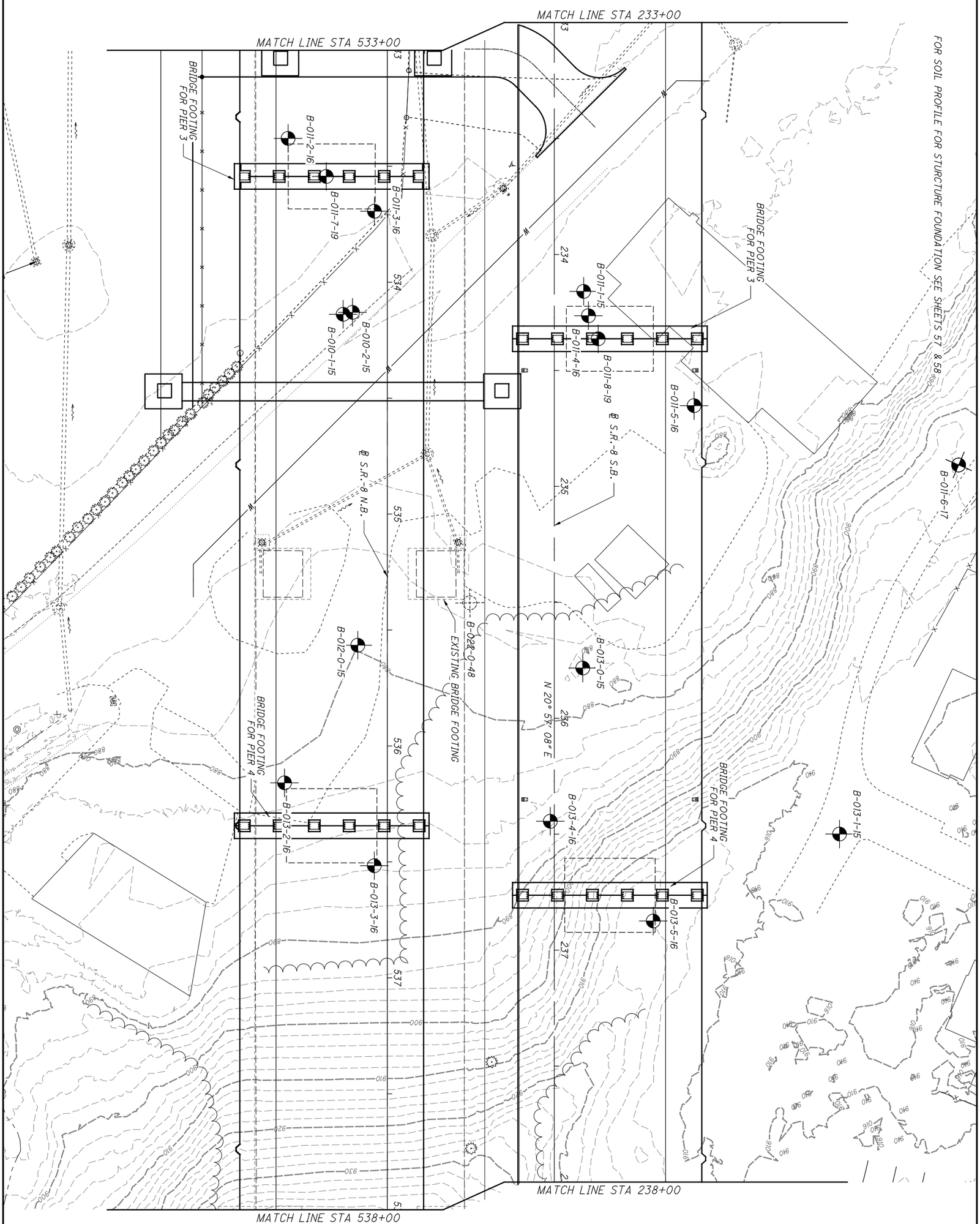
0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

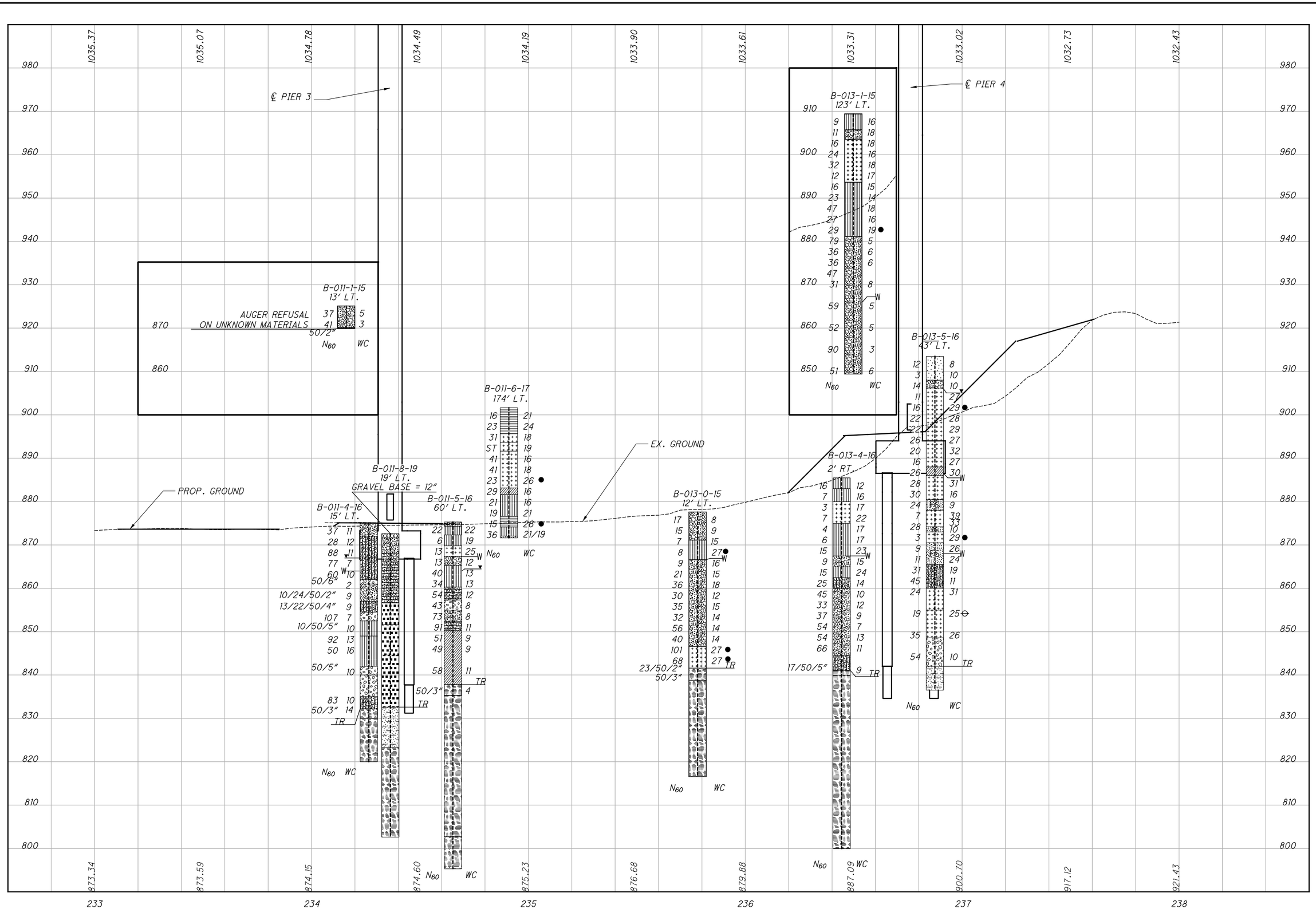
BRIDGE NO. SUM-8-0199, STA 528+00 TO STA 533+00 S.R. 8 N.B.

SUM-8-1.75



STA. 533+00 TO STA. 538+00 S.R. 8 N.B. & STA. 233+00 TO STA. 238+00 S.R. 8 S.B.

56/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO SUM-8-0199	DRAWN YLZ CHECKED TLM	0 20 10 40 HORIZONTAL SCALE IN FEET	



0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO SUM-8-0199, STA 233+00 TO STA 238+00 S.R. 8 S.B.

SUM-8-1.75

57 / 181

pw:\\columbus-is1.msconsultants.com:msconsultants\Documents\60\60-08326-00 - SUM-8-0175\geotechnical\sheets\91710_ZP003.dgn 9/12/2019 9:00:24 AM yzimmerman

1035.28 1034.99 1034.70 1034.41 1034.12 1033.83 1033.54 1033.25 1032.96 1032.67 1032.38

℄ PIER 3

EXISTING BRIDGE

℄ PIER 4

PROP. GROUND

EX. GROUND

B-010-2-15
15' RT.

32	12	
50/4"	12	
16	28	
31	30	
17	32	
59	33	W
31	33	
29	37	
22/50/3"	38	
50/1"		

N60 WC

B-011-2-16
43' RT.
ASPHALT = 4"
BASE = 7"

26	12
7	15
11	12
12	12
15/50/4"	11
50/5"	4
9/21/50/5"	11
34	15
TR	75 11
	61 11
20/50/4"	12
50/3"	16

N60 WC

B-011-7-19
26' RT.
ASPHALT = 3.0"
BASE = 9.0"

22	
9	
5	
7	
19	W
20	
50	
31/50/5"	
50/3"	
18/28/50/5"	
50/2"	
36/50/5"	
50/6"	
TR	

TR

B-011-3-16
6' RT.
ASPHALT = 6"

19/10	
14	
12	
14	
18	
29	
14	
10	
8	
6	
10/10	
12	
9	
10	

N60 WC

B-010-1-15
19' RT.

20	24
19	26
9	26
11	18
8	17
61 W	9
33/50/4"	9

TR

N60 WC

B-022-0-48
36' LT.

TR

B-012-0-15
13' RT.

20	5
20	6
4	13
28	12
32 TR	30
56	
42	
55	
38/50/5"	

N60 WC

B-013-2-16
44' RT.

12	11
4	18
6	12
3	19
9	15
16	16
12	18
7	17
28	13
42	12
75	11
112 TR	
15/34/50/5"	
81	
50/3"	

N60 WC

B-013-3-16
6' RT.

16	16
16	8
32	7
9	13
8	26
14	32
11	16 W
24	15
54	10
43	11 W
51	9
38	14
62	12
103	9
84/6"	TR
	13

N60 WC

872.82 873.53 874.18 874.30 876.67 880.99 885.66 892.21 912.75 937.96

533 534 535 536 537 538

880 870 860 850 840 830 820 810 800

980 970 960 950 940 930 920 910 900 890

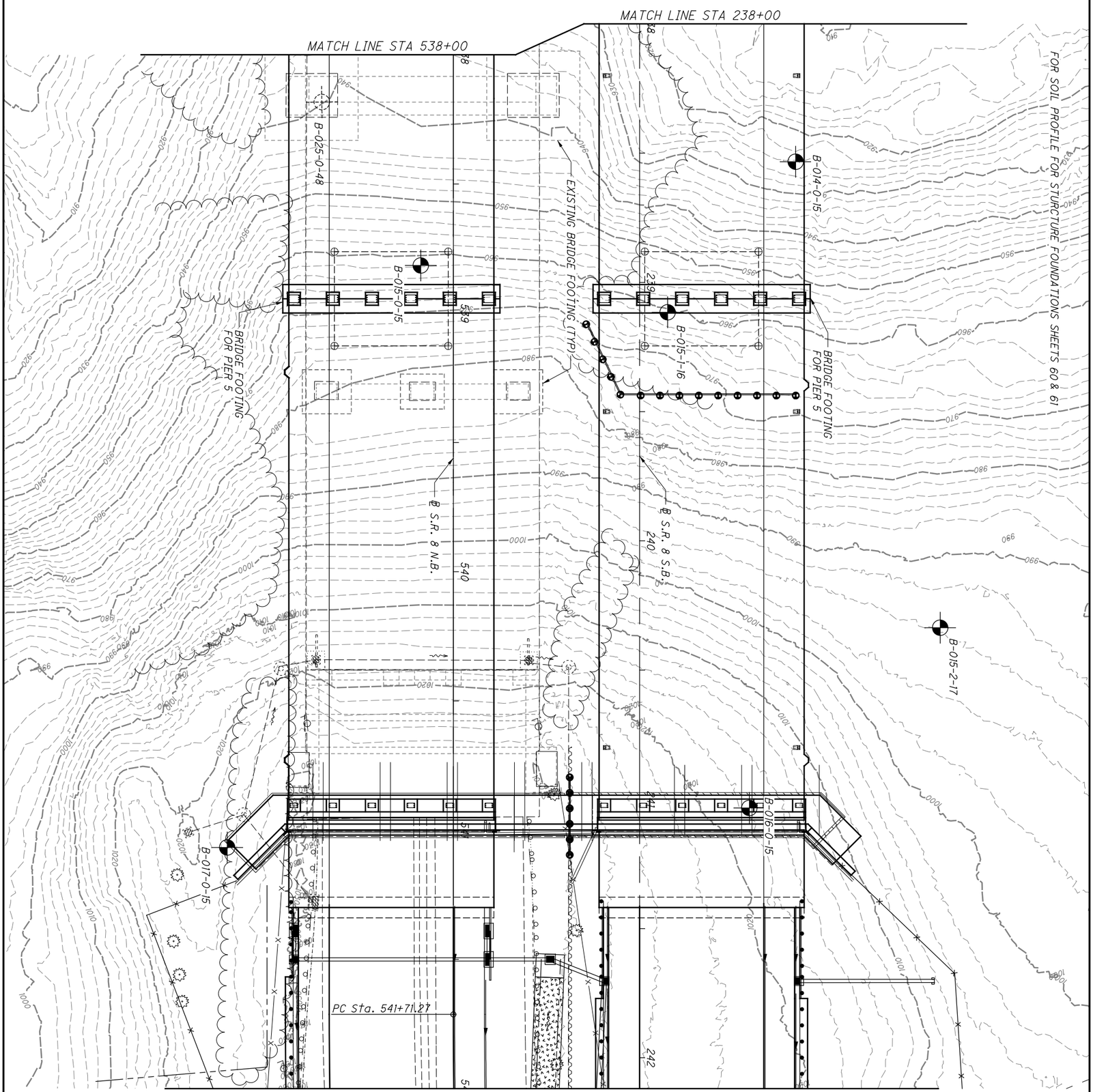
0 10 20 40 HORIZONTAL SCALE IN FEET

DRAWN YLZ CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO SUM-8-0199, STA 533+00 TO STA 538+00 S.R. 8 N.B.

SUM-8-1.75



MATCH LINE STA. 542+00 N.B. & STA. 242+12 S.B.

STA. 538+00 TO STA. 542+00 S.R. 8 N.B. & STA. 238+00 TO STA. 242+12 S.R. 8 S.B.

59/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199	DRAWN YLZ CHECKED TLM	0 20 10 40 HORIZONTAL SCALE IN FEET	N

1032.43 1032.14 1031.85 1031.55 1031.26 1030.97 1030.67 1030.38 1030.09 1029.79 1029.50

1040 1030 1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860

PROP. GROUND

℄ PIER 5

EX. GROUND

TEMPERARY SHORING

RUBBER TIRE, FRAGMENTS, PLASTIC, PAPER, FIBERGLASS, WOOD, AND SANDY SILT.

B-015-1-16
11' LT.

6	22	
16	-	
5	-	
5	-	
13	-	
13	20	
25	13	
9	8	
6	8	
15	6	
25	11	
57	7	
13	6	
25	6	
27	8	
30	7	
13	6	
21	15	
31	11	
33	12	
28	9	
28	9	
25	15	
31	7	
33	7	
33	7	
26	16	
30	22	
27	31	
20	31	
15	31	
24	30	
21	67	
12	81	
10	152	
12	N60	WC

B-015-2-17
116' LT.
TOPSOIL = 17"

20	3	
8	-	
13	36	⊖
9	21	⊖
20	-	
50	35	⊖
27	21	⊖
12	28	●
35	47	⊖
32/50/2"	35	⊖
41	12	
19	8	
35	12	
16	15	
11/50/3"	20	
16/50/0"	26	⊖
N60	WC	

B-014-0-15
60' LT.

5	26	●
1/12"/1	28	
13	29	⊖
19	30	
19	34	
16	35	●
12	33	
15	36	●
20	34	●
15	36	● W
27	37	●
31	38	●
44	33	
47	15	
62	16	
56	37	⊖
79	20	⊖
67	21	⊖
99	22	⊖
N60	WC	

B-016-0-15
42' LT.

28	8	
24/50/5	8	
30	5	
5	13	
3	13	
23	12	
9	14	
8	15	
5	15	
8	14	
15	20	
23	12	
39	11	
42	11	
55	10	
44	11	
32	11	
32	17	
35	17 W	
31	29	
34	16	
54	27	●
67	29	
38	14	
38	18	
13	15	
32	26	●
38	37	●
N60	38	●
	WC	

921.43 928.00 956.95 974.76 994.99 1014.36 1023.35 1024.70 1024.17 1024.35 1023.26

238 239 240 241 242 243

0 10 20 40 HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 238+00 TO STA 242+12 S.R. 8 S.B.

SUM-8-1.75

60 / 181

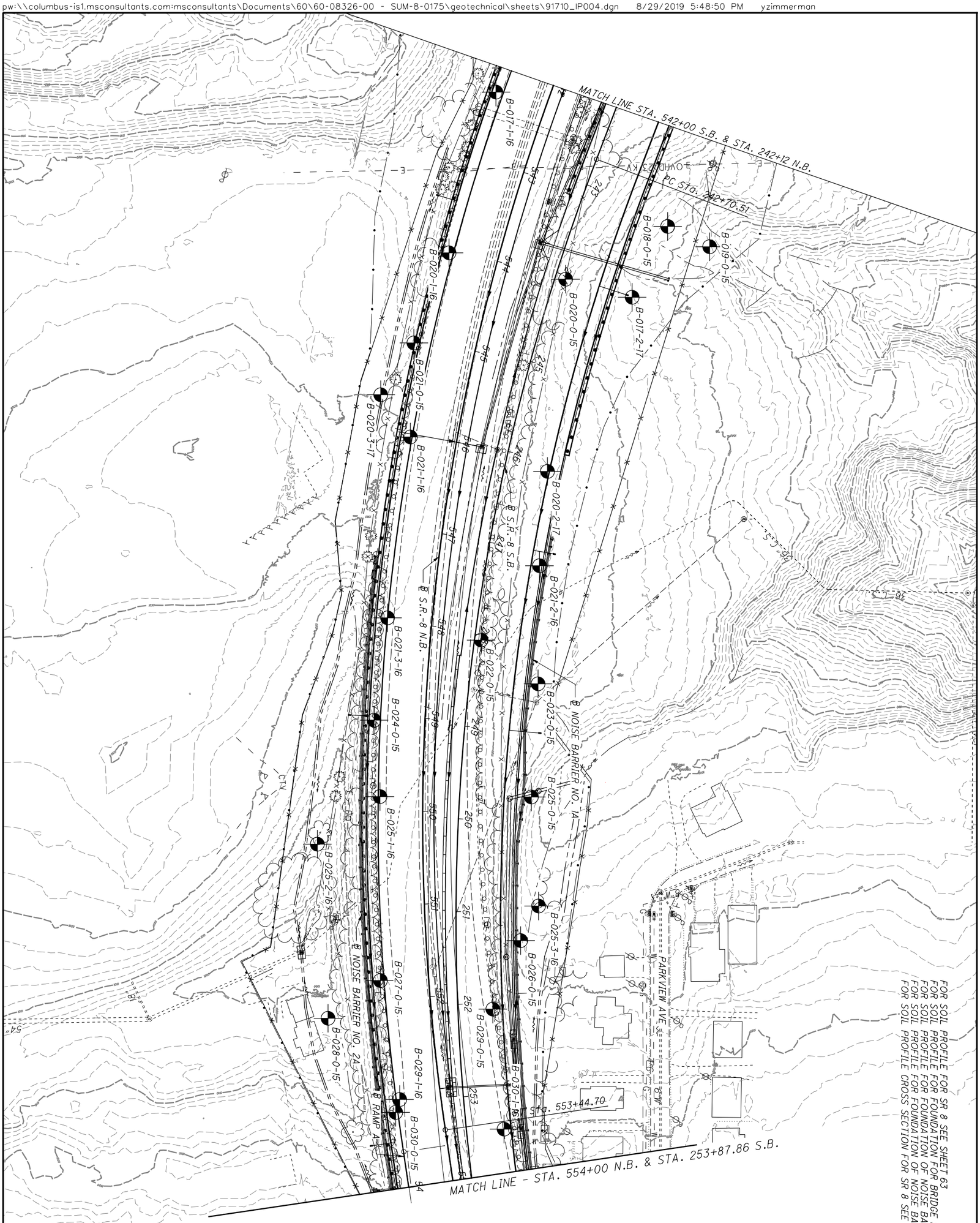
0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

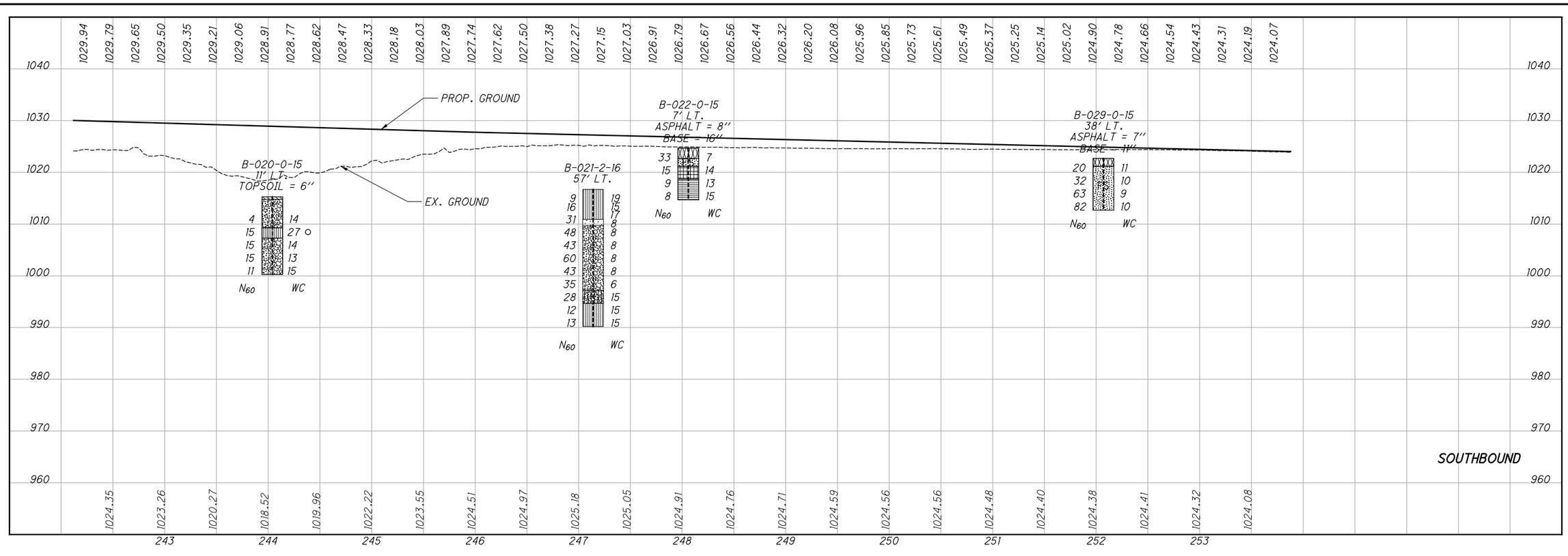
BRIDGE NO. SUM-8-0199, STA 538+00 TO STA 542+00 S.R. 8 N.B.

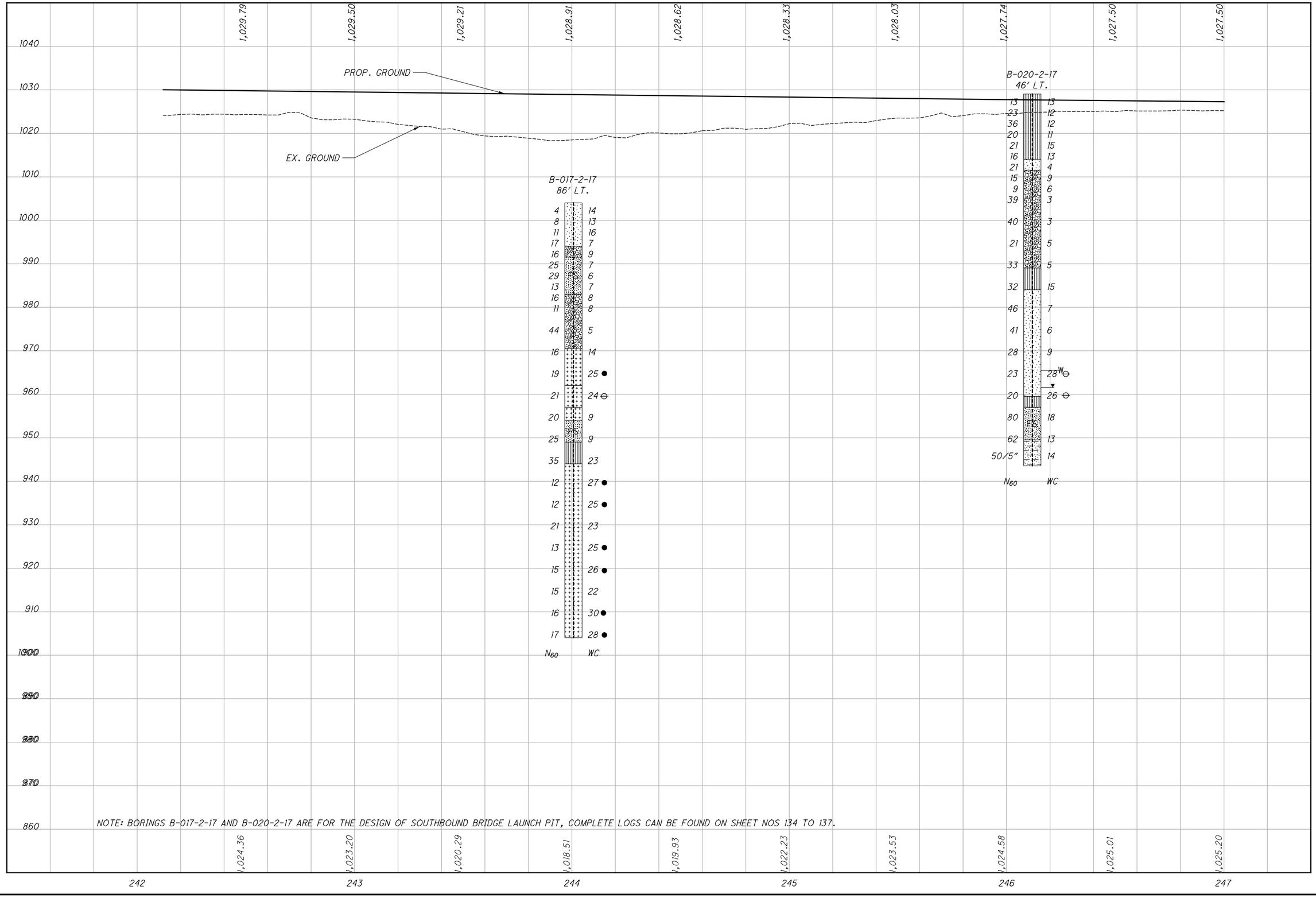
SUM-8-1.75



FOR SOIL PROFILE FOR SR 8 SEE SHEET 63
FOR SOIL PROFILE FOR FOUNDATION FOR BRIDGE LAUNCH PIT SEE SHEETS64& 65
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 1A SEE SHEETS 70& 71
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 2A SEE SHEETS 75& 76
FOR SOIL PROFILE CROSS SECTION FOR SR 8 SEE SHEET 87

62/181	SUM-8-1.75	SOIL PROFILE-SR 8 NB/SB STA. 542+00/242+12 TO STA. 554+00/253+87.86	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET	N


PROP. GROUND
EX. GROUND
B-020-0-15
11' LT.
TOPSOIL = 6"
4 14
15 27
15 14
15 13
11 15
N60 WC
B-021-2-16
57' LT.
9 19
16 15
31 17
48 8
43 8
60 8
43 8
35 6
28 15
12 15
13 15
N60 WC
B-022-0-15
7' LT.
ASPHALT = 8"
BASE = 16"
33 7
15 14
9 13
8 15
N60 WC
B-029-0-15
38' LT.
ASPHALT = 7"
BASE = 11"
20 11
32 10
63 9
82 10
N60 WC
SOUTHBOUND
B-017-1-16
56' RT.
ASPHALT = 8.0"
BASE = 7.5"
46 9
21 10
13 15
12 7
10 6
9 12
7 8
16 6
13 4
16 4
N60 WC
B-020-1-16
52.0' RT.
ASPHALT = 8.0"
BASE = 6.5"
19 17
10 15
9 16
7 17
12 16
10 8
7 7
13 10
6 4
9 4
N60 WC
B-021-0-15
66' RT.
ASPHALT = 6"
BASE = 12"
12 25
11 25
13 19
16 6
N60 WC
B-021-1-16
50' RT.
ASPHALT = 9"
BASE = 6"
18 8
10 8
9 6
7 5
9 13
12 9
6 7
4 5
6 5
9 4
N60 WC
B-021-3-16
48' RT.
ASPHALT = 8"
BASE = 9"
29 -
13 17
18 16
21 15
3 12
1 8
7 4
9 5
13 7
12 7
N60 WC
B-024-0-15
55' RT.
ASPHALT = 8"
BASE = 10"
17 15
16 16
13 13
19 13
N60 WC
B-025-1-16
46' RT.
ASPHALT = 7"
BASE = 13"
21 15
21 15
28 15
16 10
16 11
28 9
21 12
26 11
43 10
25 14
N60 WC
PROP. GROUND
B-027-0-15
52' RT.
ASPHALT = 6"
BASE = 10"
33 12
31 10
52 9
51 8
43 7
45 9
13 15
23 17
29 25
40 8
50/2" TR
50/1"
N60 WC
B-028-0-15
111' RT.
TOPSOIL = 1.3'
7 29
50/4"TR
50/2"
50/1"
SANDSTONE, BROWN,
SEVERELY TO HIGHLY WEATHERED.
N60 WC
SANDSTONE, BROWN,
SEVERELY TO HIGHLY WEATHERED.
B-030-0-15
74' RT.
ASPHALT = 6"
20 15
32 8
34 7
40 10
N60 WC
NORTHBOUND
HORIZONTAL
SCALE IN FEET
0 25 50 100
DRAWN YLZ
CHECKED TLM
SOIL PROFILE-SR 8 NB/SB
STA. 542+00/ 242+12 TO STA. 554+00/ 253+87.86
SUM-8-1.75
63 181
pw:\\columbus-is1.msconsultants.com:msconsultants\Documents\60\60-08326-00 - SUM-8-0175\geotechnical\sheets\91710_IF004.dgn 9/12/2019 8:54:47 AM yzimmerman



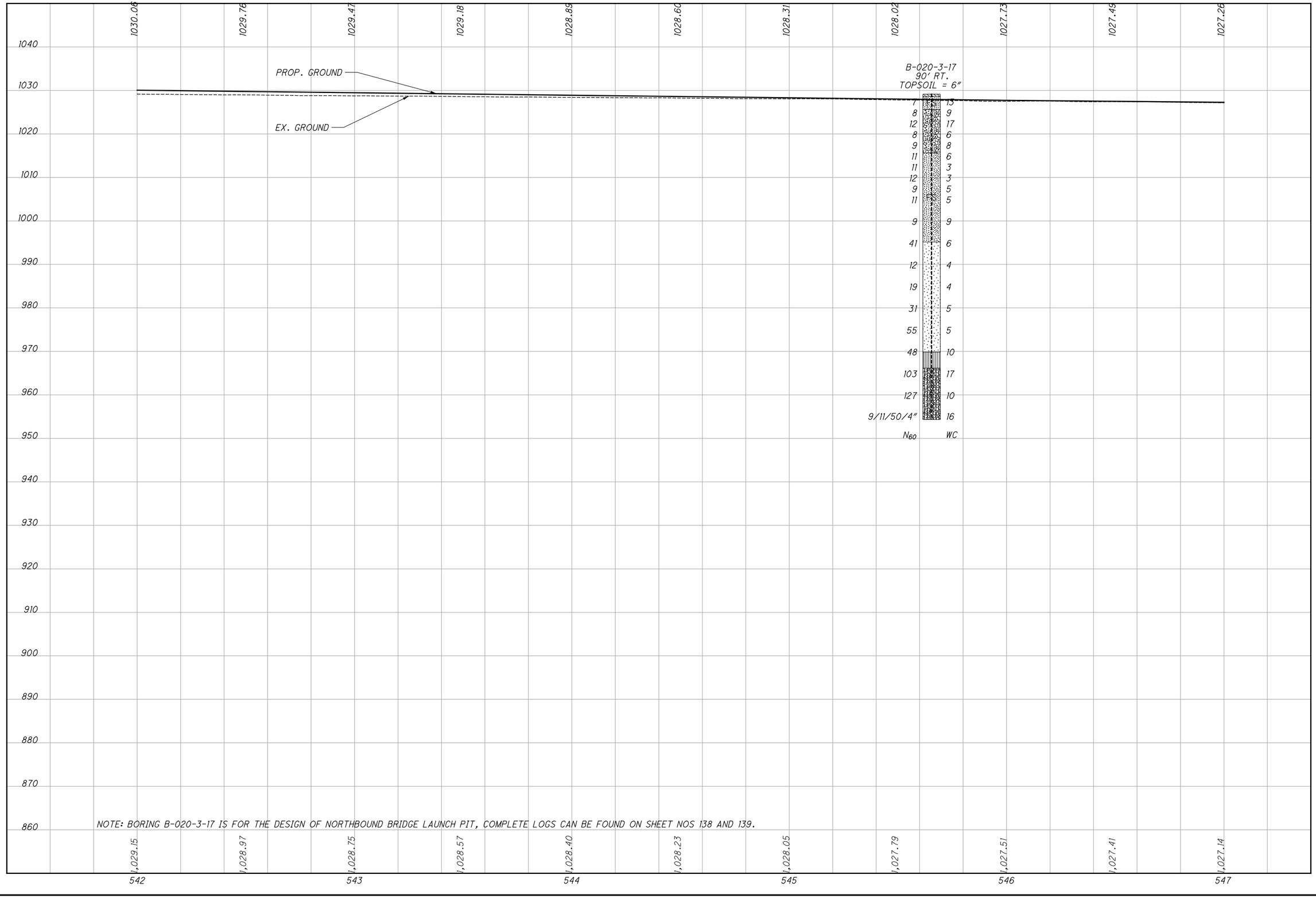
0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 242+12 TO STA 247+00 S.R. 8 S.B.

SUM-8-1.75



0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

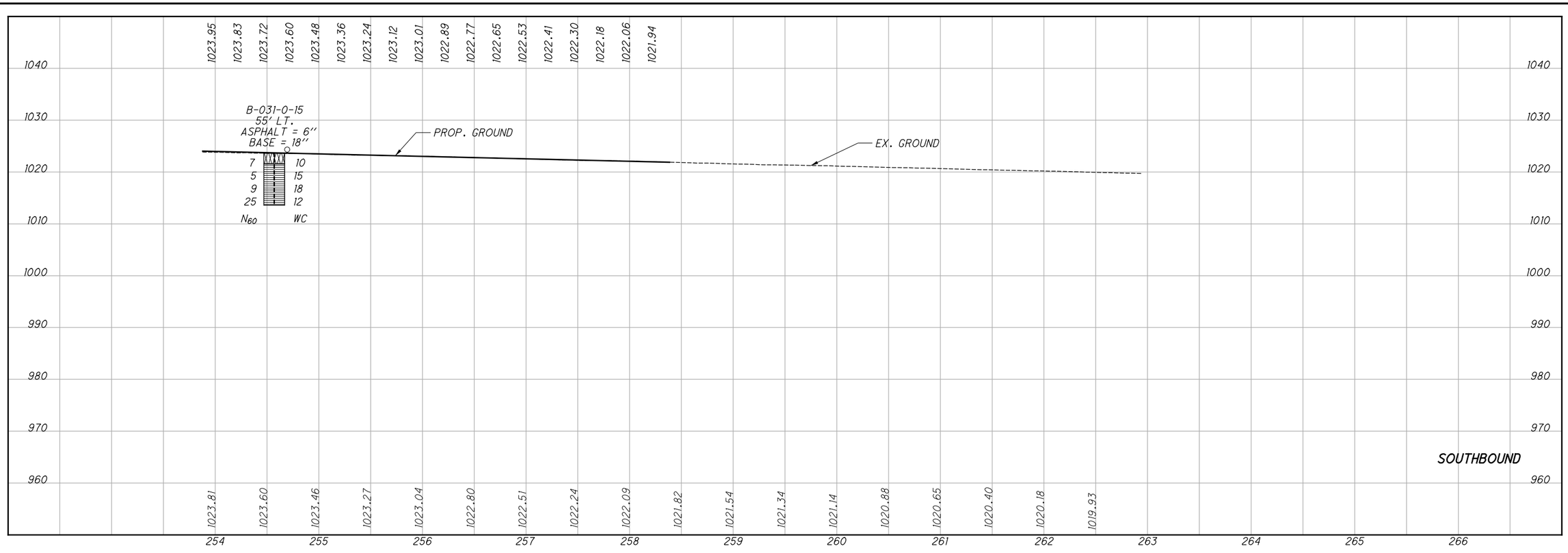
STRUCTURE FOUNDATION EXPLORATION

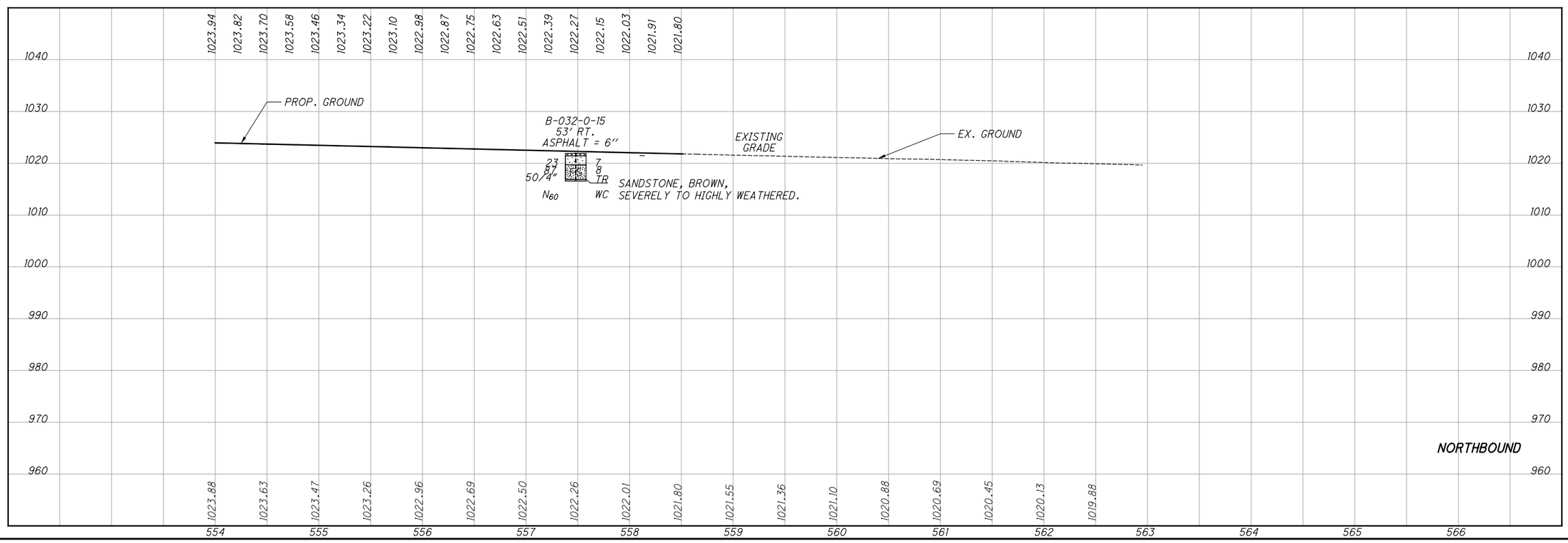
BRIDGE NO. SUM-8-0199, STA 542+00 TO STA 547+00 S.R. 8 N.B.

SUM-8-1.75

64 / 181

99/181	SUM-8-1.75	SOIL PROFILE-SR 8 NB/SB STA. 554+00/253+87.86 TO STA. 562+94.93/262+82.80	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET





HORIZONTAL SCALE IN FEET
0 25 50 100

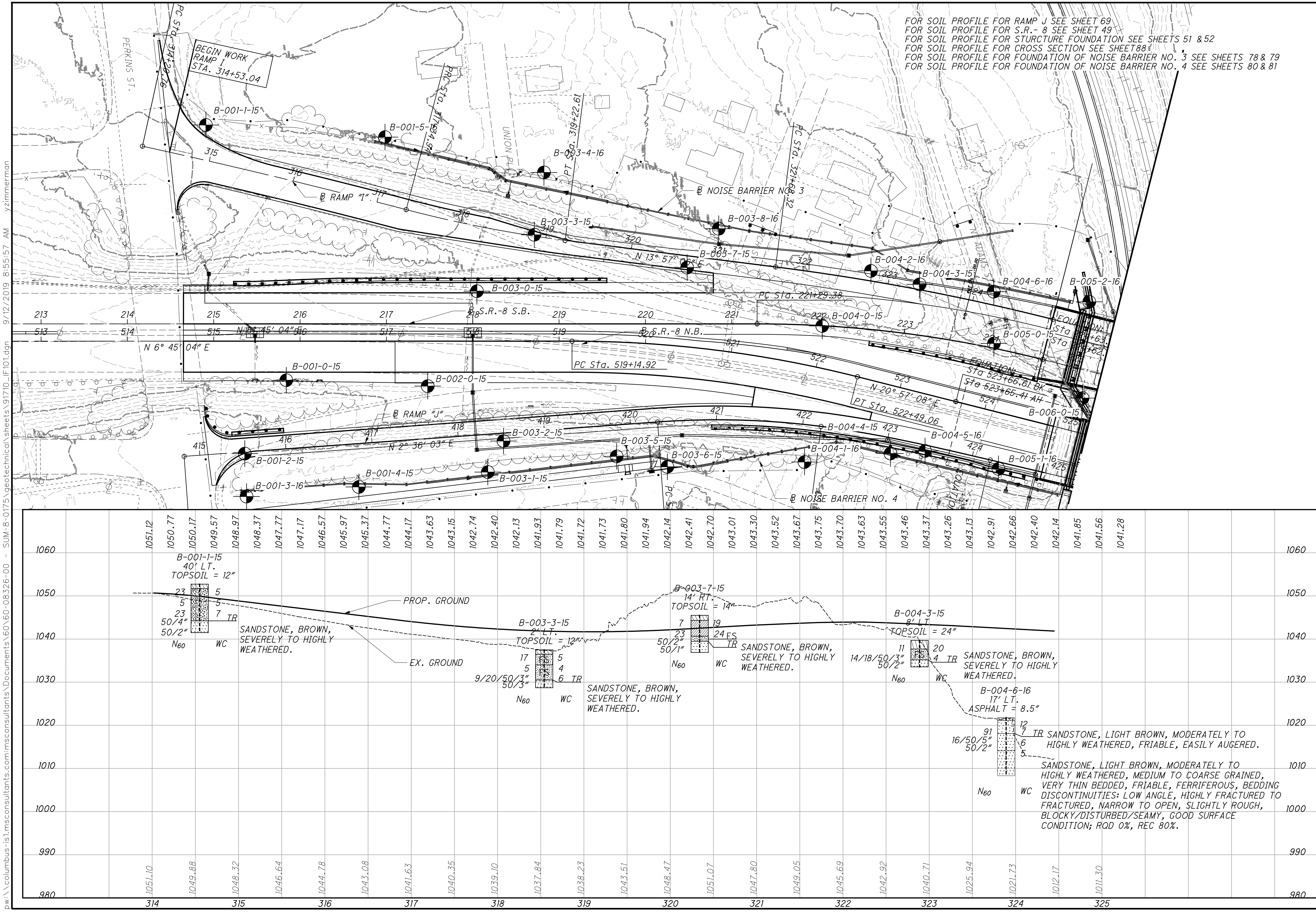
DRAWN YLZ
CHECKED TLM

SOIL PROFILE-SR 8 NB/SB
STA. 554+00/ 253+87.80 TO STA. 562+94.93/ 262+82.80

SUM-8-1.75

67 / 181

FOR SOIL PROFILE FOR RAMP J SEE SHEET 69
FOR SOIL PROFILE FOR S.R.- 8 SEE SHEET 49
FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEETS 51 & 52
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEET 88
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 3 SEE SHEETS 78 & 79
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 4 SEE SHEETS 80 & 81



BEGIN WORK
RAMP I
STA. 314+53.04
PERKINS ST.
UNION
℄ RAMP "I"
℄ RAMP "J"
℄ NOISE BARRIER NO. 3
℄ NOISE BARRIER NO. 4
℄ S.R.-8 S.B.
℄ S.R.-8 N.B.
N 6° 45′ 04″ E
N 13° 57′ 06″ E
N 2° 36′ 03″ E
N 20° 57′ 08″ E
PC Sta. 519+14.92
PC Sta. 221+29.38
PT Sta. 522+49.06
EQUATION:
Sta 523+66.61 BK =
Sta 523+65.41 AH
B-001-1-15
B-001-5-16
B-003-4-16
B-003-3-15
B-003-8-16
B-003-7-15
B-004-2-16
B-004-3-15
B-004-6-16
B-005-2-16
B-003-0-15
B-004-0-15
B-005-0-15
B-001-0-15
B-002-0-15
B-006-0-15
B-004-4-15
B-004-5-16
B-003-2-15
B-003-5-15
B-003-6-15
B-004-1-16
B-005-1-16
B-001-2-15
B-001-4-15
B-003-1-15
B-001-3-16
B-001-1-15
40′ LT.
TOPSOIL = 12″
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.
PROP. GROUND
EX. GROUND
B-003-3-15
2′ LT.
TOPSOIL = 12″
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.
B-003-7-15
14′ RT.
TOPSOIL = 14″
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.
B-004-3-15
8′ LT.
TOPSOIL = 24″
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.
B-004-6-16
17′ LT.
ASPHALT = 8.5″
SANDSTONE, LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.
SANDSTONE, LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, MEDIUM TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, FERRIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; RQD 0%, REC 80%.
N60
WC

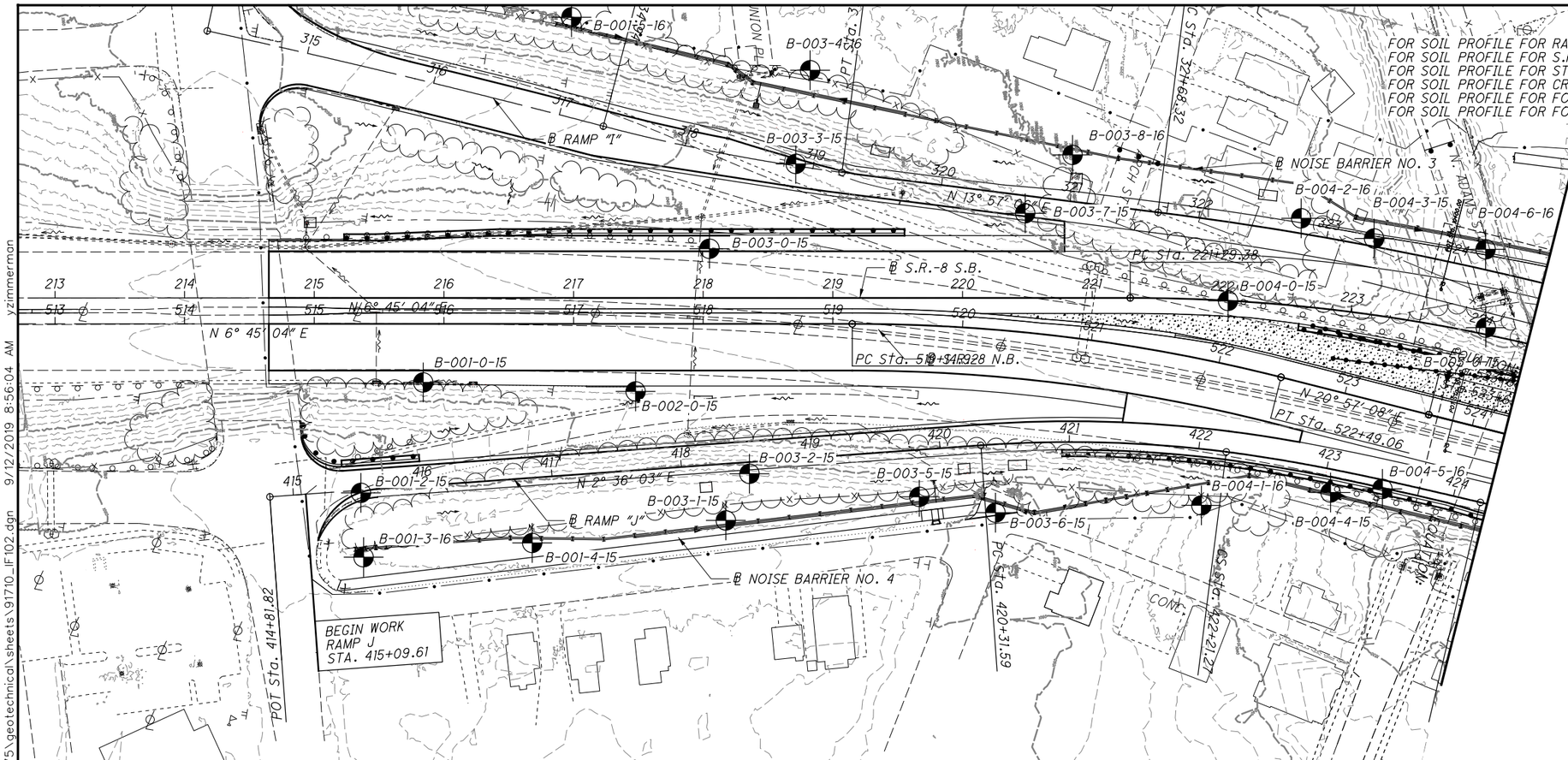
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL PROFILE - RAMP I
STA. 314+53.04 TO STA. 324+95.27

SUM-8-1.75

FOR SOIL PROFILE FOR RAMP J SEE SHEET 68
FOR SOIL PROFILE FOR S.R.- 8 SEE SHEET 49
FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEETS 51 & 52
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEET88
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 3 SEE SHEETS 78 & 79
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 4 SEE SHEETS 80 & 81



HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN | CHECKED

SOIL PROFILE - RAMP J
STA. 415+09.61 TO STA. 424+21.27

SUM-8-1.75

69 / 181

FOR SOIL PROFILE FOR SR 8 SEE SHEET 53

BEGIN NOISE BARRIER NO. 1A
STA. 0+80.00

℄ NOISE BARRIER NO. 1A

B-021-2-16

B-023-0-15

B-025-0-15

B-025-3-16

B-026-0-15

B-029-0-15

B-022-0-15

℄ SR-8 S.B.

℄ SR-8 N.B.

N 0° 05' 05" E

N 3° 36' 23" E

N 8° 0?'

MATCHLINE STA 6+20
NOISE BARRIER NO. 1A

PROP. GROUND

EX. GROUND

B-021-2-16
7' RT.

9	19
16	15
31	17
48	8
43	8
60	8
43	8
35	6
28	15
12	15
13	15

N_{60} WC

B-023-0-15
10' LT.
TOPSOIL = 2"

22	9
4	26
3	28
20	20
51	11
50	13
45	10
22	10
12	27
36	28
18	25
50/5"	20 TR
50/2"	

N_{60} WC

B-025-0-15
8' LT.
TOPSOIL = 11"

11	25
5	28
7	29
18/21/50/3"	14
50/2"	0 TR
98	2
50/4"	
50/1"	

N_{60} WC

B-025-3-16
25' LT.
TOPSOIL = 2"

12	14
6	15
10	13
9/50/5"	10 TR
15/38/50/4"	8
6/15/50/5"	–
17/50/5"	–
50/5"	–
31	8

N_{60} WC

B-026-0-15
5' LT.
TOPSOIL = 13"

9	17
4	15
31	13
63	13
20	14 TR
50/1"	

N_{60} WC

1024.04 1023.92 1023.80 1023.67 1023.55 1023.43 1023.31 1023.18 1023.17 1022.94 1022.98 1022.69 1022.58 1022.45 1022.34 1022.21 1022.09 1021.97 1021.85 1021.72 1021.72 1021.61 1021.48

1020 1010 1000 990 980 970

1016.56 1016.54 1015.69 1015.64 1015.54 1015.20 1013.52 1012.81 1012.60 1013.63 1010.99 1008.70 1009.49 1008.62 1008.07 1008.17 1008.17 1009.13 1010.16 1010.16 1011.85 1013.10

1 2 3 4 5 6

N

0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 1A STA. 0+80 TO STA. 6+20

SUM-8-1.75

70 / 181

FOR SOIL PROFILE FOR SR 8 SEE SHEETS & 57
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 1B SEE SHEET 72
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 2A SEE SHEET 75

℄ NOISE BARRIER NO. 1A

END NOISE BARRIER NO. 1A
STA. 08+96.00

℄ NOISE BARRIER NO. 1B

N 10° 02′ 53″ W

N 8° 22′ 53″ W

B-030-1-16

B-031-0-15

B-031-1-16

B-031-3-16

PT Sta. 252+39.94

MATCHLINE STA 6+20
NOISE BARRIER NO. 1A

℄ SR-8 S.B.

N 8° 23′ 01″ W

PT Sta. 53+01.87

PT Sta. 553+44.70

POT Sta. 53+60.75

℄ SR-8 N.B.

℄ RAMP A

B-029-1-16

B-030-0-15

N 8° 21′ 36″ W

B-032-0-15

PT Sta. 57+58.96

N 8° 23′ 01″ W

℄ NOISE BARRIER NO. 2A

B-030-1-16
24′ RT.
ASPHALT = 3″
CONCRETE = 10″

EX. GROUND

PROP. GROUND

B-031-1-16
17′ RT.
ASPHALT = 6″
BASE = 18″

1021.36	1021.25	1021.15	1021.10	1021.12	1021.14	1021.17	1021.18	1021.19	1021.17	1021.16	
1014.88	1015.77	1016.40	1017.61	1018.73	1020.06	1024.04	1024.49	1025.03	1024.74	1024.77	
				15	8					11	18
				27	7					15	17
				8	16					25	14
				10	11					26	15
				12	15					34	13
				18	17					50/2″	4 TR
				37	18						8
				33	13						
				18/50/3″	11 TR						
				71	6						
				N_{60}	WC					N_{60}	WC

1030 1020 1010 1000 990 980

7 8 9 10 11

N

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 1A STA. 6+20 TO STA. 8+96

SUM-8-1.75

71 / 181

BEGIN NOISE BARRIER NO. 1B
STA. 10+00.00

℄ NOISE BARRIER NO. 1B

℄ NOISE BARRIER NO. 1A

℄ NOISE BARRIER NO. 2A

℄ SR-8 S.B.

℄ SR-8 N.B.

℄ RAMP A

PT Sta. 254+45.94

N 10° 02′ 53″ W

N 8° 22′ 53″ W

N 2° 32′ 53″ W

N 8° 23′ 01″ W

N 8° 21′ 36″ W

B-031-0-15

B-031-1-16

B-031-3-16

B-032-1-16

B-032-0-15

MATCHLINE STA 15+40
NOISE BARRIER NO. 1B

FOR SOIL PROFILE FOR SR 8 SEE SHEETS 63 & 67
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 2A SEE SHEET 76

PROP. GROUND

EX. GROUND

B-031-1-16
45′ RT.
ASPHALT = 6″
BASE = 18″

N_{60}	WC
11	18
15	17
25	14
26	15
34	13
50/2″	4 TR
	8

B-031-3-16
45′ RT.
ASPHALT = 6″

N_{60}	WC
46	8 TR
75	5
29/50/5″	5
93	7
26/50/2″	7
50/2″	-

B-032-1-16
34′ RT.
ASPHALT = 7″
BASE = 10″

N_{60}	WC
62	7 TR
16/50/4″	6
50/5″	7
50/6″	4
48/50/5″	-
50/5″	-
50/4″	-
50/2″	-

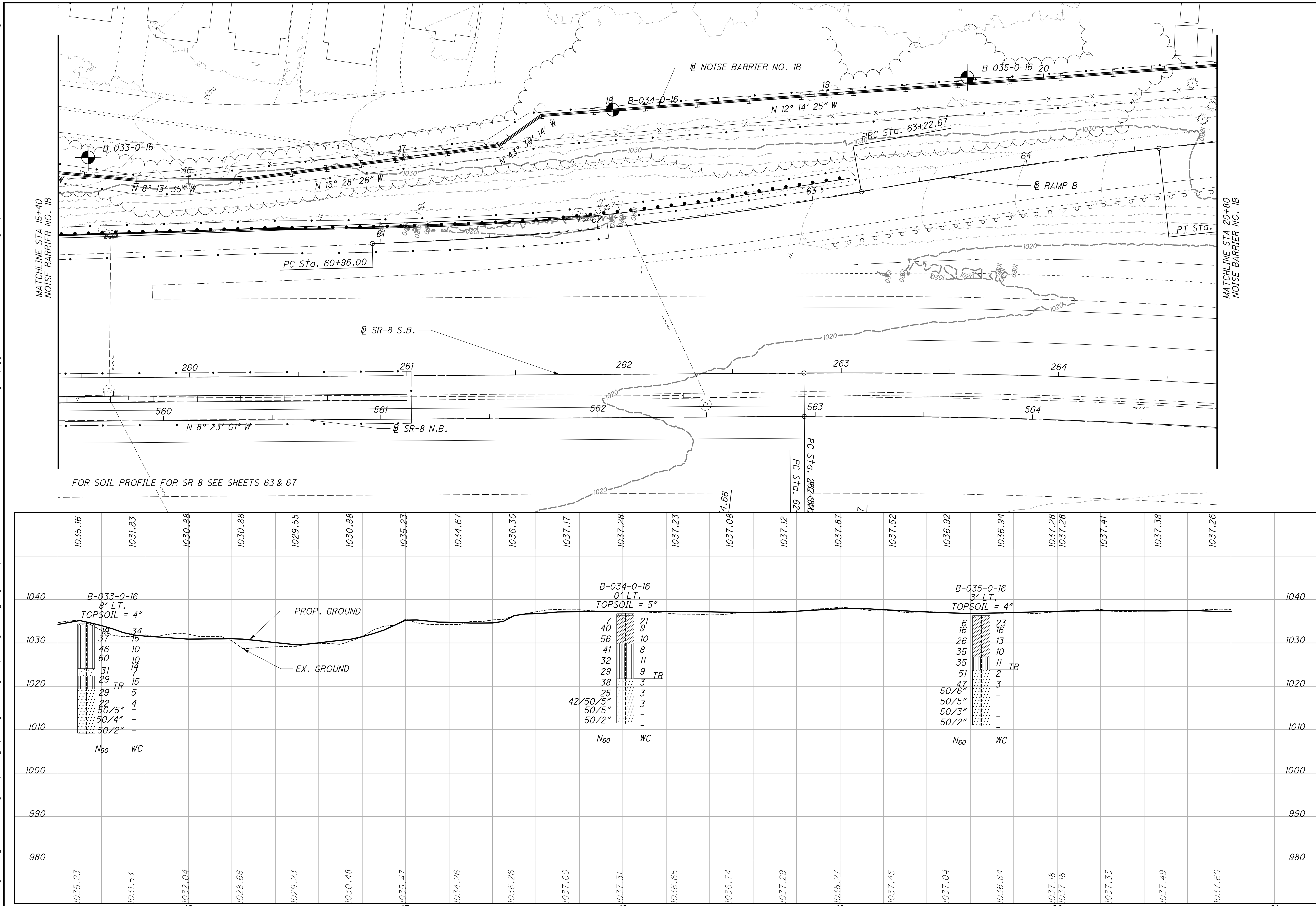
1024.30 1024.97 1025.07 1025.19 1025.40 1026.02 1026.88 1027.53 1027.86 1028.42 1028.97 1029.84 1030.57 1030.05 1032.29 1032.64 1033.03 1033.35 1033.40 1032.22 1032.20 1032.20 1033.61

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 1B STA. 10+00 TO STA. 15+40

SUM-8-1.75



HORIZONTAL SCALE IN FEET

DRAWN YLZ

CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

NOISE BARRIER NO. 1B STA. 15+40 TO STA. 20+80

SUM-8-1.75

FOR SOIL PROFILE FOR SR 8 SEE SHEETS 63 & 67

B-036-0-16
POT STA.
END NOISE BARRIER NO. 1B
STA. 21+52.00
℄ NOISE BARRIER NO. 1B
N 12° 14′ 25″ W
℄ RAMP B
N 14° 20′ 36″ W
MATCHLINE STA 20+80
NOISE BARRIER NO. 1B
64+61.19
℄ SR-8 S.B.
℄ SR-8 N.B.
12" RCP

1036.79 1036.30 1035.73

PROP. GROUND
EX. GROUND

B-036-0-16
11′ LT.
TOPSOIL = 4″

13	10
15	12
13	8
12	9
22	4 TR
62	2
54	3
50/5″	-
36/50/4″	-
50/5″	-
50/3″	-

N_{60} WC

1036.71 1036.27 1036.04

21 22

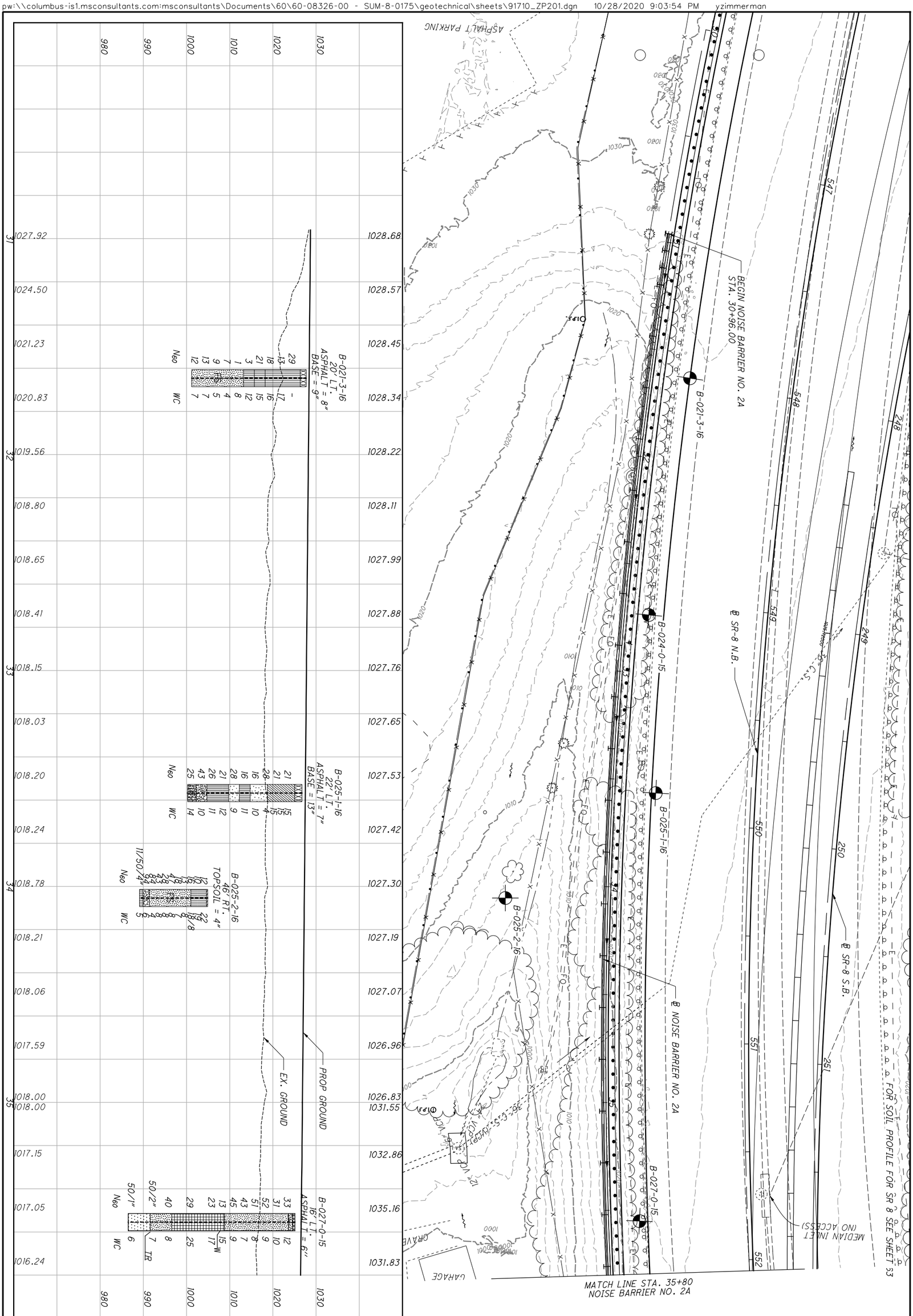
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 1B STA. 20+80 TO STA. 21+52

SUM-8-1.75

74 / 181



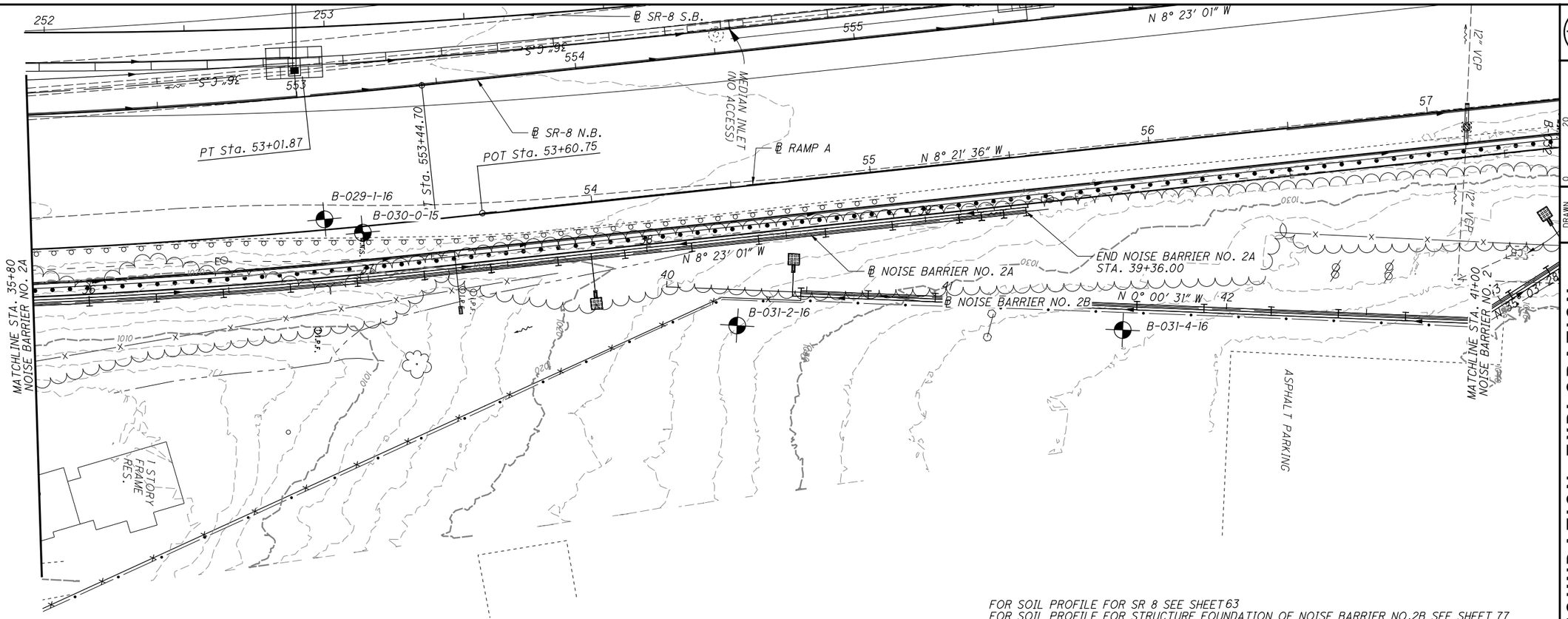
SUM-8-1.75

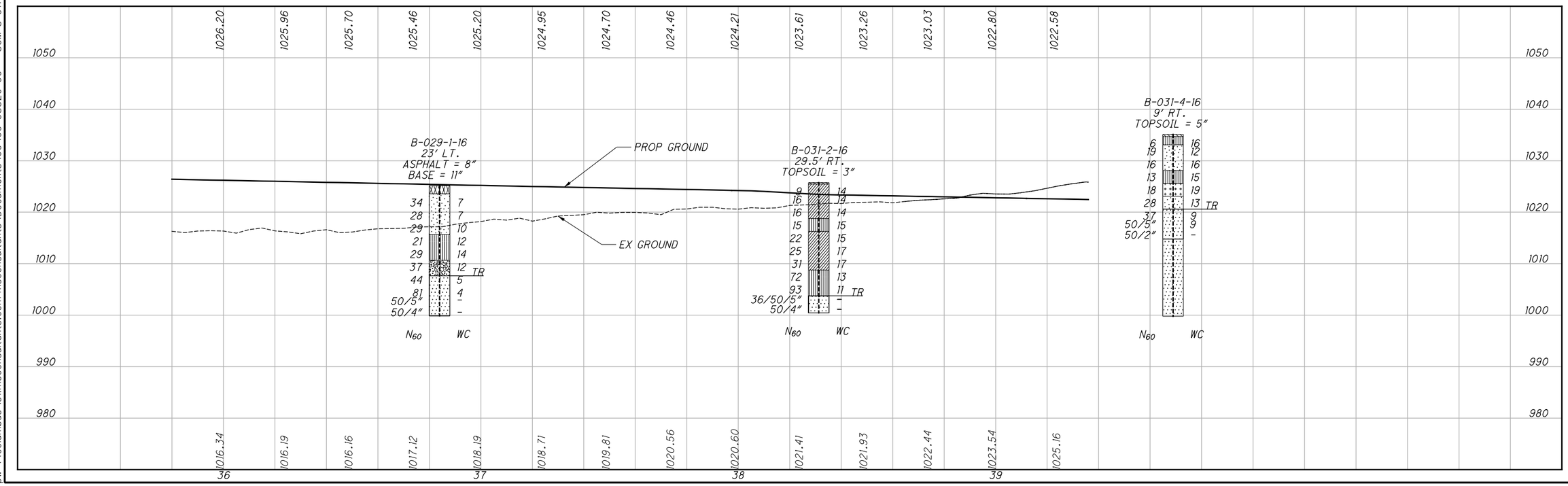
STRUCTURE FOUNDATION EXPLORATION

NOISE BARRIER NO. 2A STA. 30+96 TO STA 35+80

DRAWN YLZ
CHECKED TLM

0 10 20 40
HORIZONTAL SCALE IN FEET

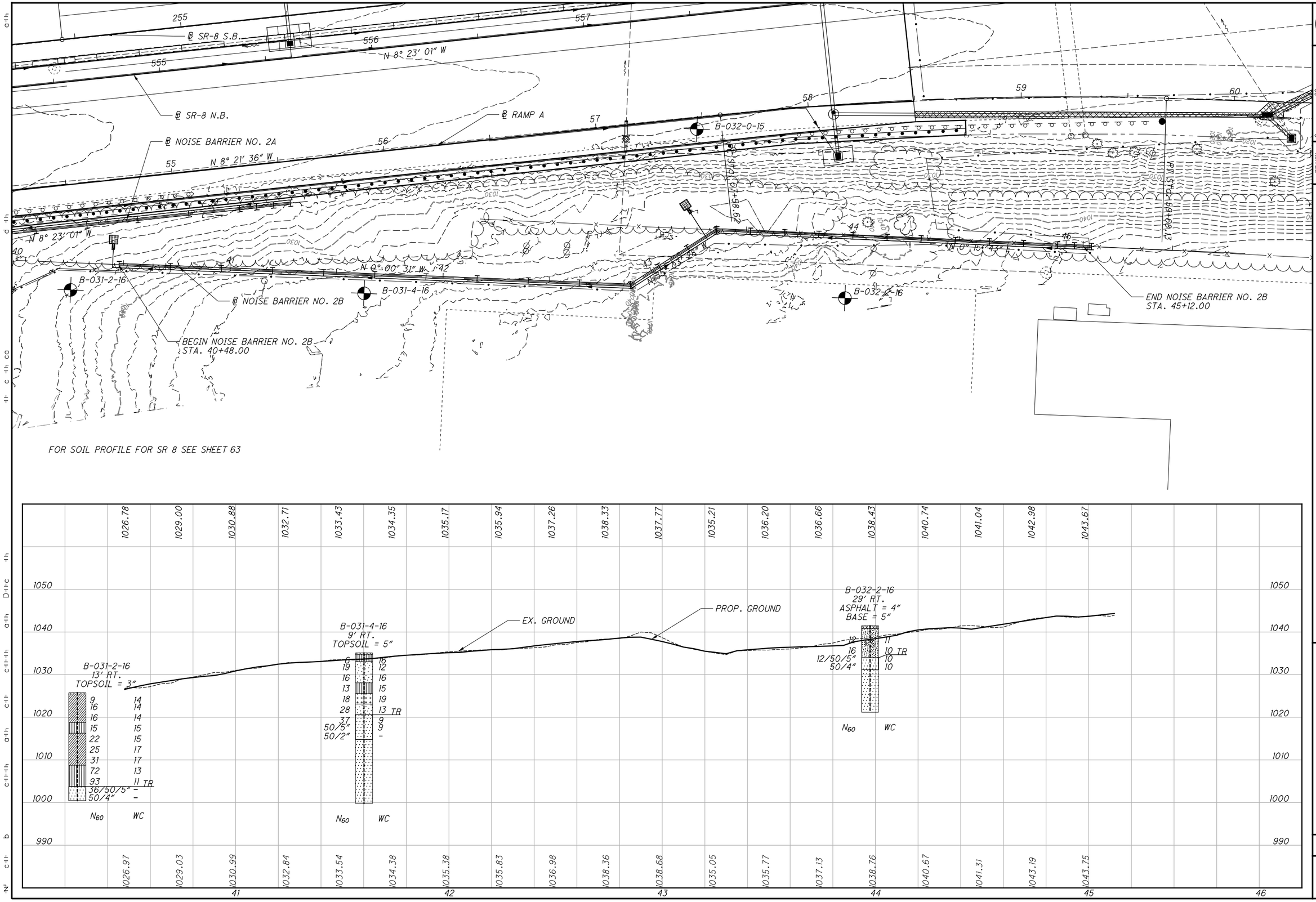




HORIZONTAL SCALE IN FEET
0 10 20 40
DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 2A STA. 35+80 TO STA. 39+36

SUM-8-1.75



HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 2B STA. 40+48 TO STA. 45+12

SUM-8-1.75

FOR SOIL PROFILE FOR RAMP I SEE SHEET 68

2 STORY FRAME RES. 342/344 DUPLEX

2 STORY FRAME RES. 345

GARAGE

2 STORY FRAME RES. 338

2 STORY FRAME RES. 332

WOOD SHED

DIRT

LIMESTONE

CONC

STEEL ARCH CULVERT

BEGIN NOISE BARRIER NO. 3
STA. 51+04.00

℄ NOISE BARRIER NO.3

MATCH LINE STA. 56+10
NOISE BARRIER NO. 3

B-001-5-16

B-003-4-16

B-003-8-16

B-003-3-15

B-003-7-15

℄ RAMP I

PC Sta. 10+10.05

PT Sta. 13+47.73

N 19° 55' 15" E

N 18° 25' 52" E

N 11° 01' 17" E

15" RCP

18" RCP

UNION PL

	1060.07	1059.99	1059.51	1059.03	1058.34	1057.70	1055.67	1053.25	1053.68	1054.02	1054.09	1054.09	1053.15	1051.77	1050.98	1049.97	1049.79	1049.33	1048.10	1047.25	1047.37
	B-001-5-16 8' LT. TOPSOIL = 4"								EX. GROUND	B-003-4-16 18' LT TOPSOIL = 3.5"								B-003-8-16 5' RT. TOPSOIL = 2"			
	16 12									6 21								10 19			
	22 13									4 20								35 16 TR			
	22 14 TR									25 15 TR								12/50/3" 6			
	17/50/5" 6									50/3" 7								50/3" 5			
	22/50/4" 7									50/2" -											
	50/3" 5								PROP. GROUND												
	50/3" 4																				
	N_{60} WC									N_{60} WC								N_{60} WC			
1060																					
1050																					
1040																					
1030																					
1020																					
1010																					
	1060.42	1060.38	1060.44	1059.89	1059.23	1057.68	1056.95	1056.39	1056.05	1055.63	1055.46	1054.67	1054.52	1051.35	1050.55	1049.96	1049.93	1049.16	1047.53	1047.03	1048.21
	51				52				53				54				55				56

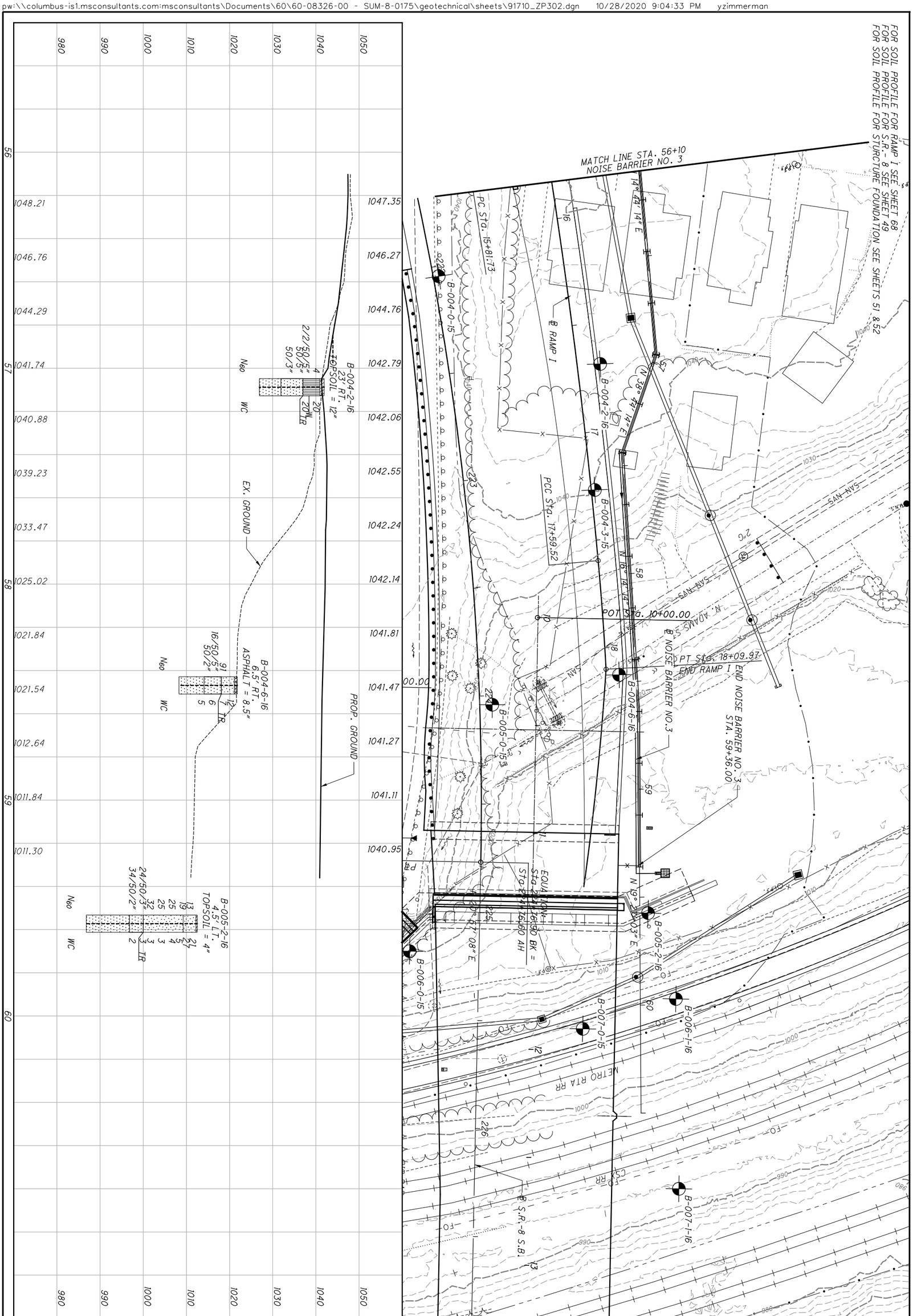
STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 3 STA 51+04 TO 56+10

SUM-8-1.75

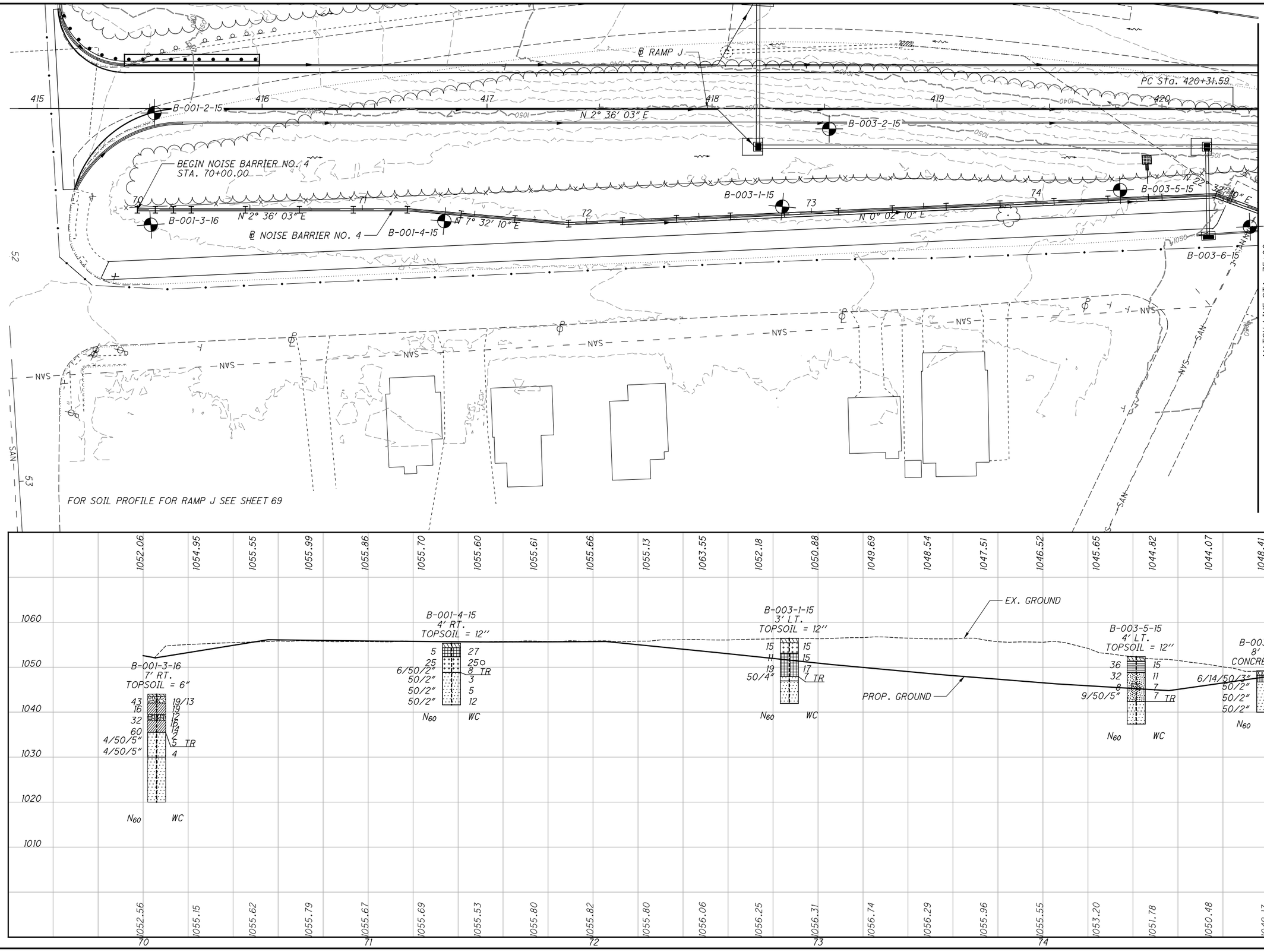
78 / 181

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM



	79/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION NOISE BARRIER NO. 3 STA. 56+10 TO STA. 59+36	DRAWN JJH CHECKED YLZ	0 10 20 40 HORIZONTAL SCALE IN FEET



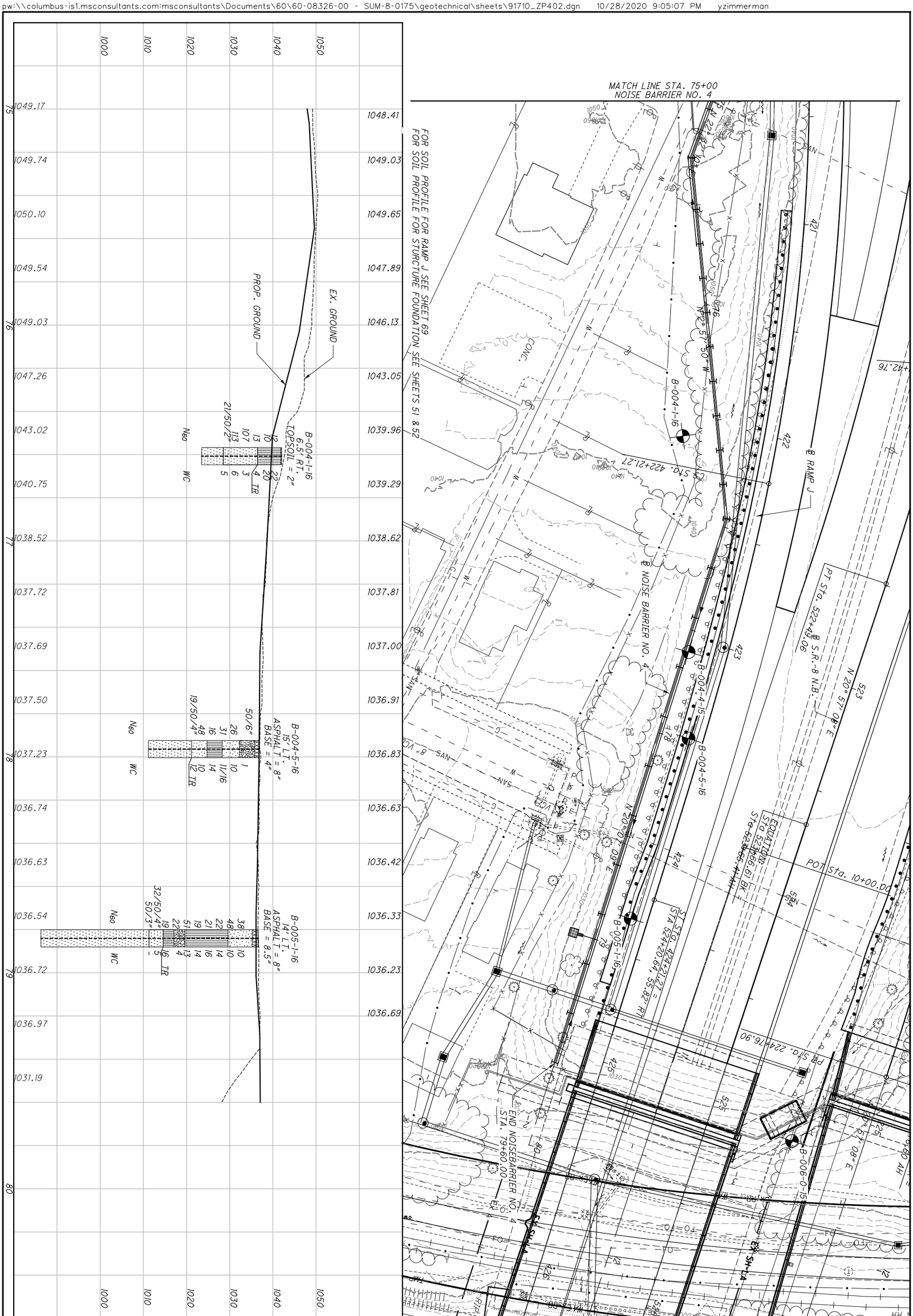
HORIZONTAL SCALE IN FEET

DRAWN JJH CHECKED YLZ

STRUCTURE FOUNDATION EXPLORATION
NOISE BARRIER NO. 4 STA 70+00 TO STA 75+00

SUM-8-1.75

80 / 181



	81/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION NOISE BARRIER NO. 4 STA. 75+00 TO STA. 79+60	DRAWN JJH CHECKED YLZ	0 10 20 40 HORIZONTAL SCALE IN FEET

FOR SOIL PROFILE FOR RAMP J SEE SHEET
FOR SOIL PROFILE FOR RAMP J SEE SHEET 69
FOR SOIL PROFILE FOR S.R.- 8 SEE SHEET 49
FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEETS 51 & 52
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 3 SEE SHEETS 78& 79
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 4 SEE SHEETS 80& 81
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEET86
FOR SOIL PROFILE FOR ACR 1 CROSS SECTIONS SEE SHEET 89

82/181	SUM-8-1.75	SOIL PROFILE ACCESS ROAD 1/3A STA. 10+00/ 34+50 TO STA. 18+50/ 47+25.95	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET

SOIL PROFILE
STA. 30+00 TO STA. 44+00 ACCESS ROAD 2A

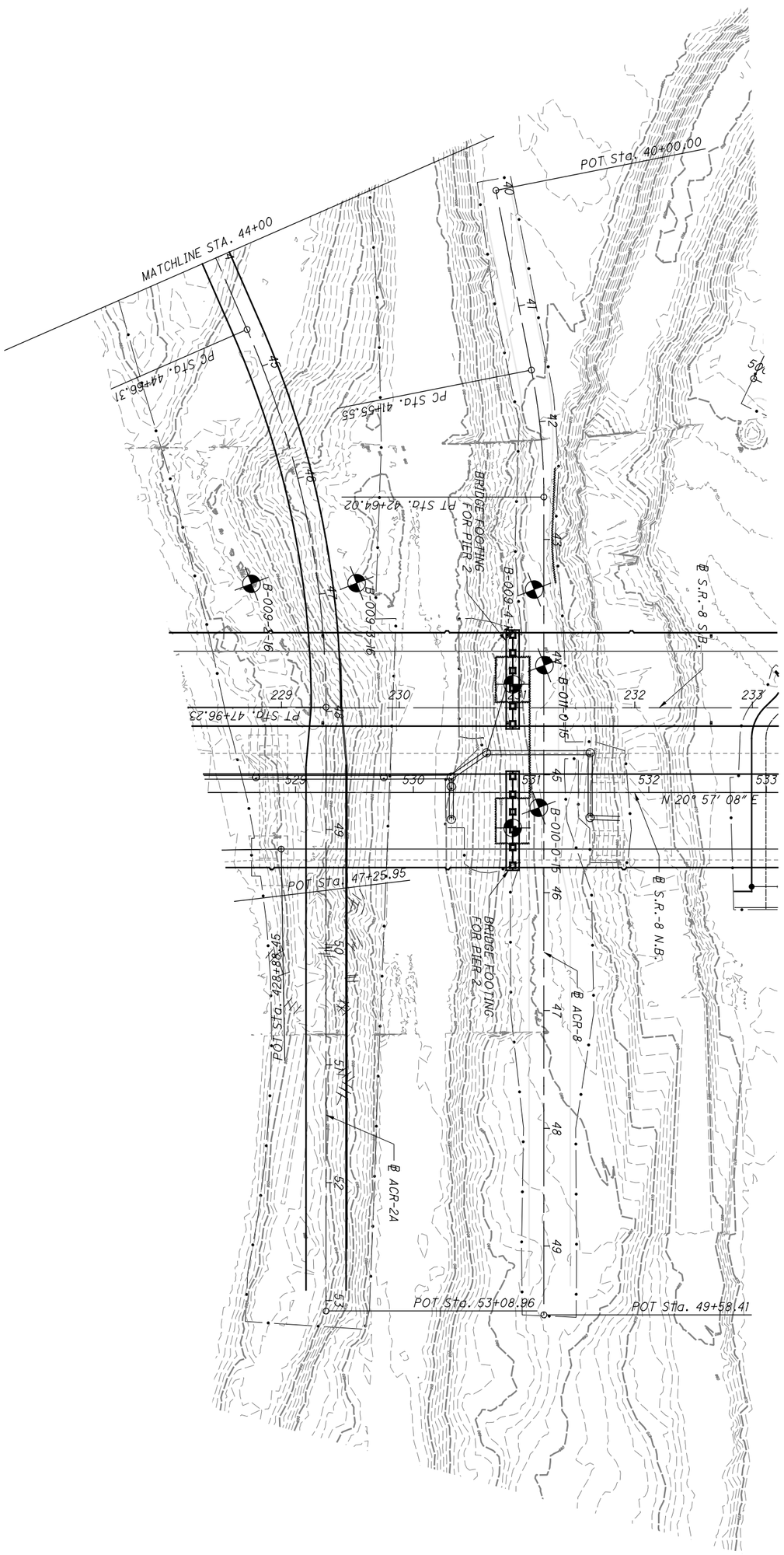
DRAWN YLZ
CHECKED TLM

HORIZONTAL SCALE IN FEET
0 25 50 100

SUM-8-1.75

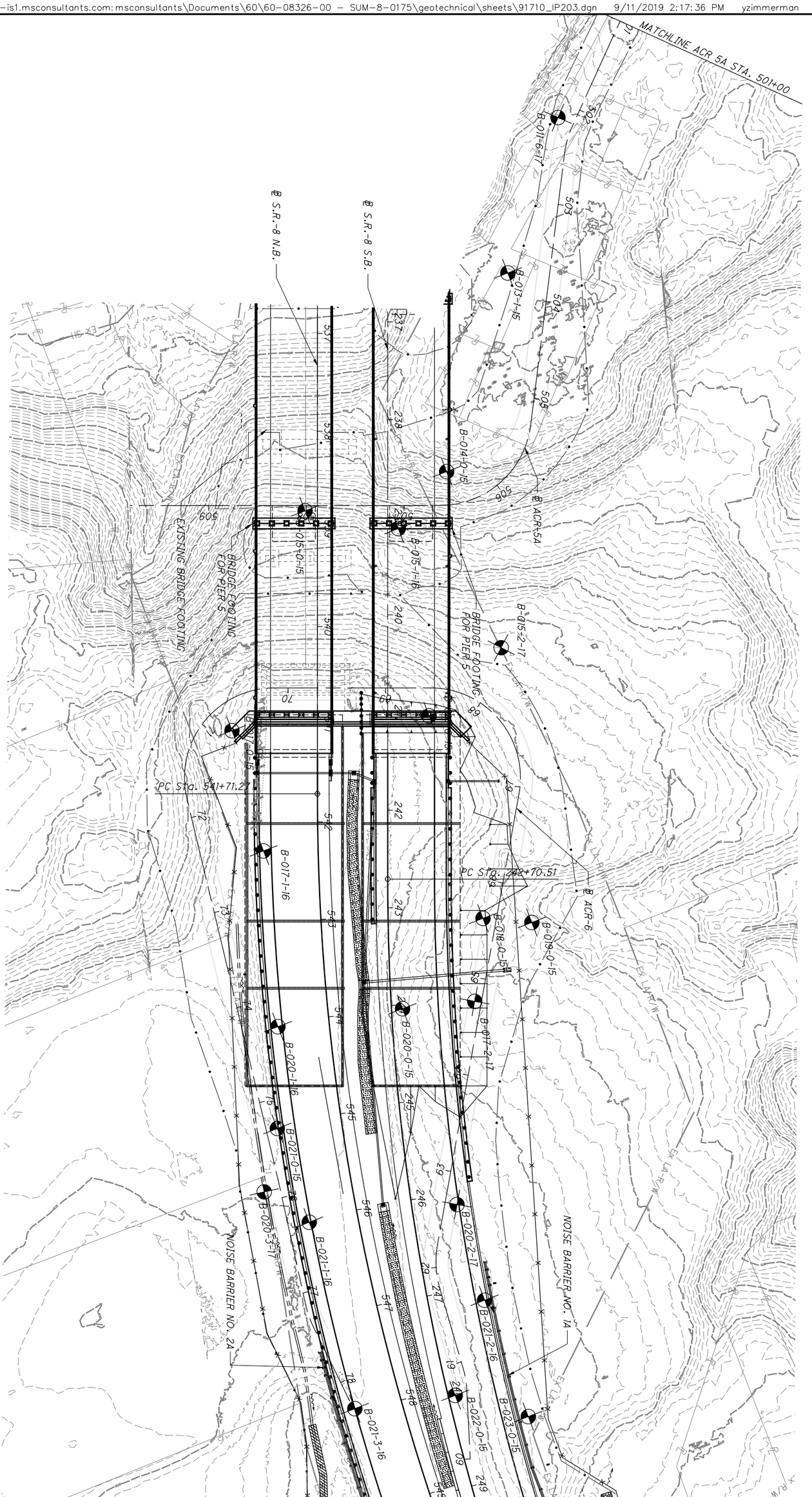
83/181

FOR SOIL PROFILE FOR SR 8 SEE SHEET 53
FOR SOIL PROFILE FOR ACR 2A CROSS SECTIONS SEE SHEET 90
FOR SOIL PROFILE FOR ACR 8 CROSS SECTIONS SEE SHEET 94

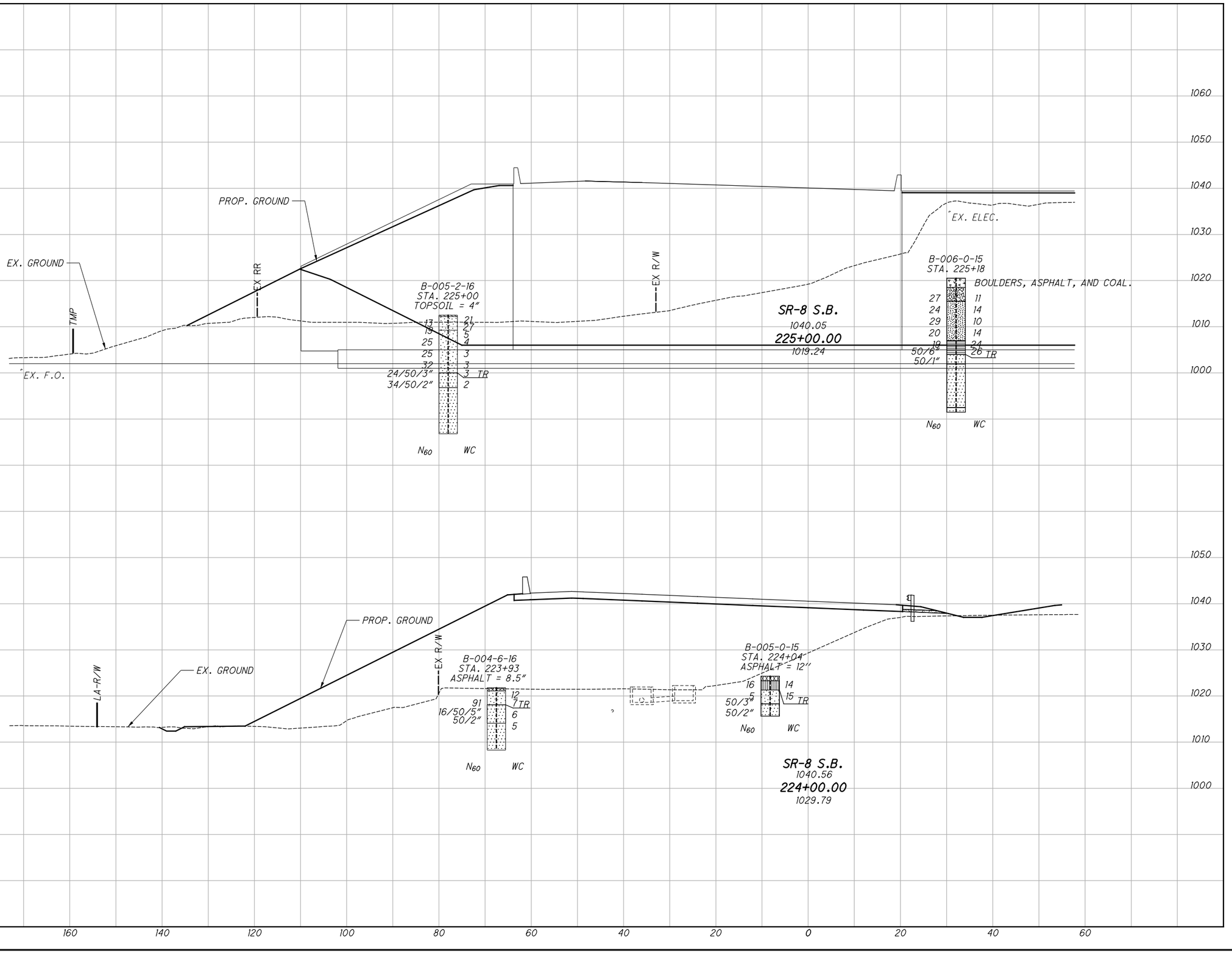


84/181	SUM-8-1.75	SOIL PROFILE ACCESS ROAD 2A/8 STA. 44+00/40+00 TO STA. 53+08.96/49+58.57	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET	N

FOR SOIL PROFILE FOR SR 8 SEE SHEET 60 & 61, 63 TO 65
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 1 SEE SHEET 70
FOR SOIL PROFILE FOR FOUNDATION OF NOISE BARRIER NO. 2 SEE SHEET 75
FOR SOIL PROFILE FOR SR 8 CROSS SECTION SEE SHEET 87
FOR SOIL PROFILE FOR ACR 5A CROSS SECTIONS SEE SHEET 91 & 92
FOR SOIL PROFILE FOR ACR 6 CROSS SECTION SEE SHEET 93



	85/181	SUM-8-1.75	SOIL PROFILE ACCESS ROAD 5A/6 STA. 501+00/60+00 TO STA. 509+80 /78+26.50	DRAWN YLZ CHECKED TLM	0 50 25 100 HORIZONTAL SCALE IN FEET



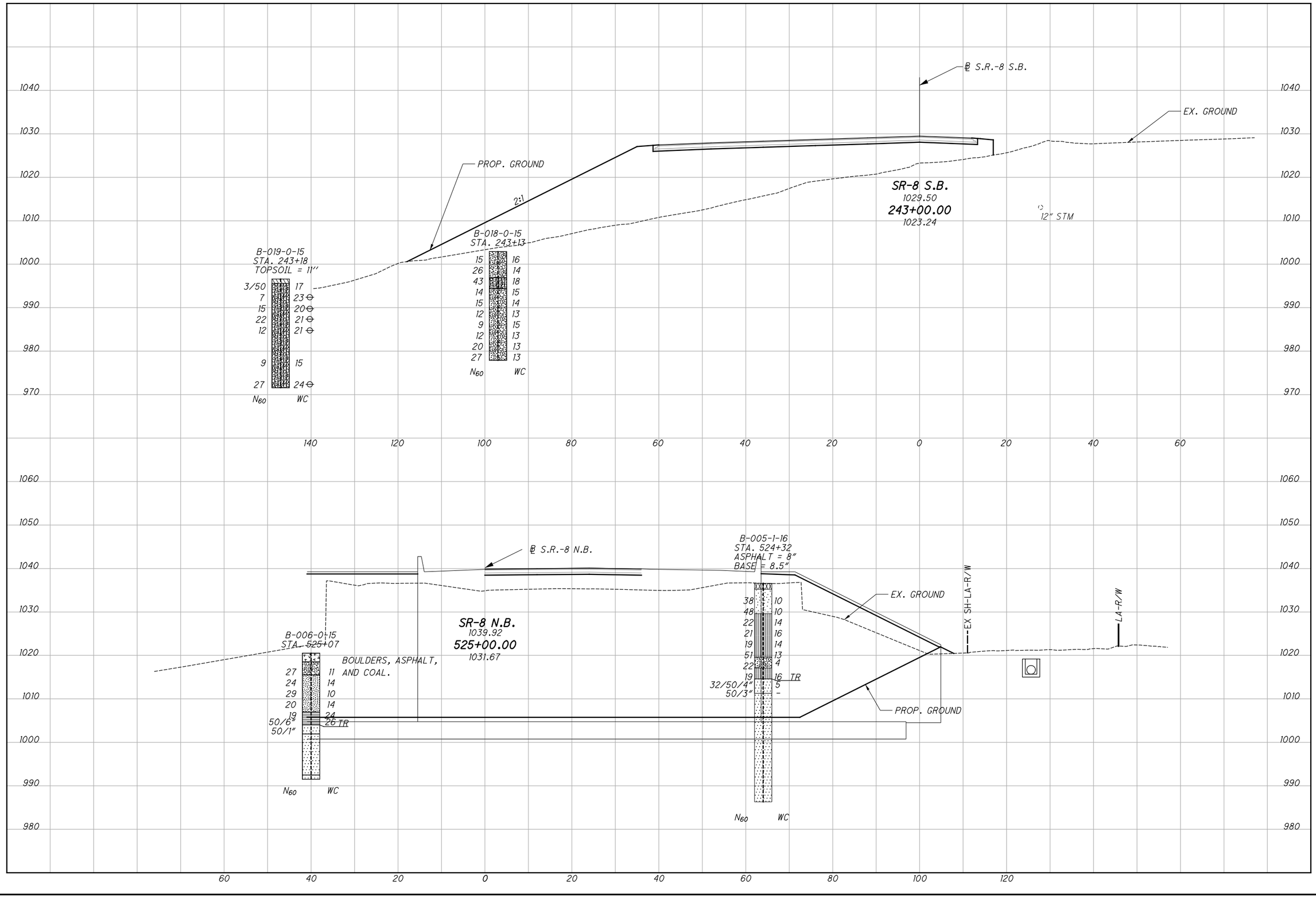
0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

SOIL PROFILE
CROSS SECTION 224+00 & 225+00 SB SR-8

SUM-8-1.75

86 / 181

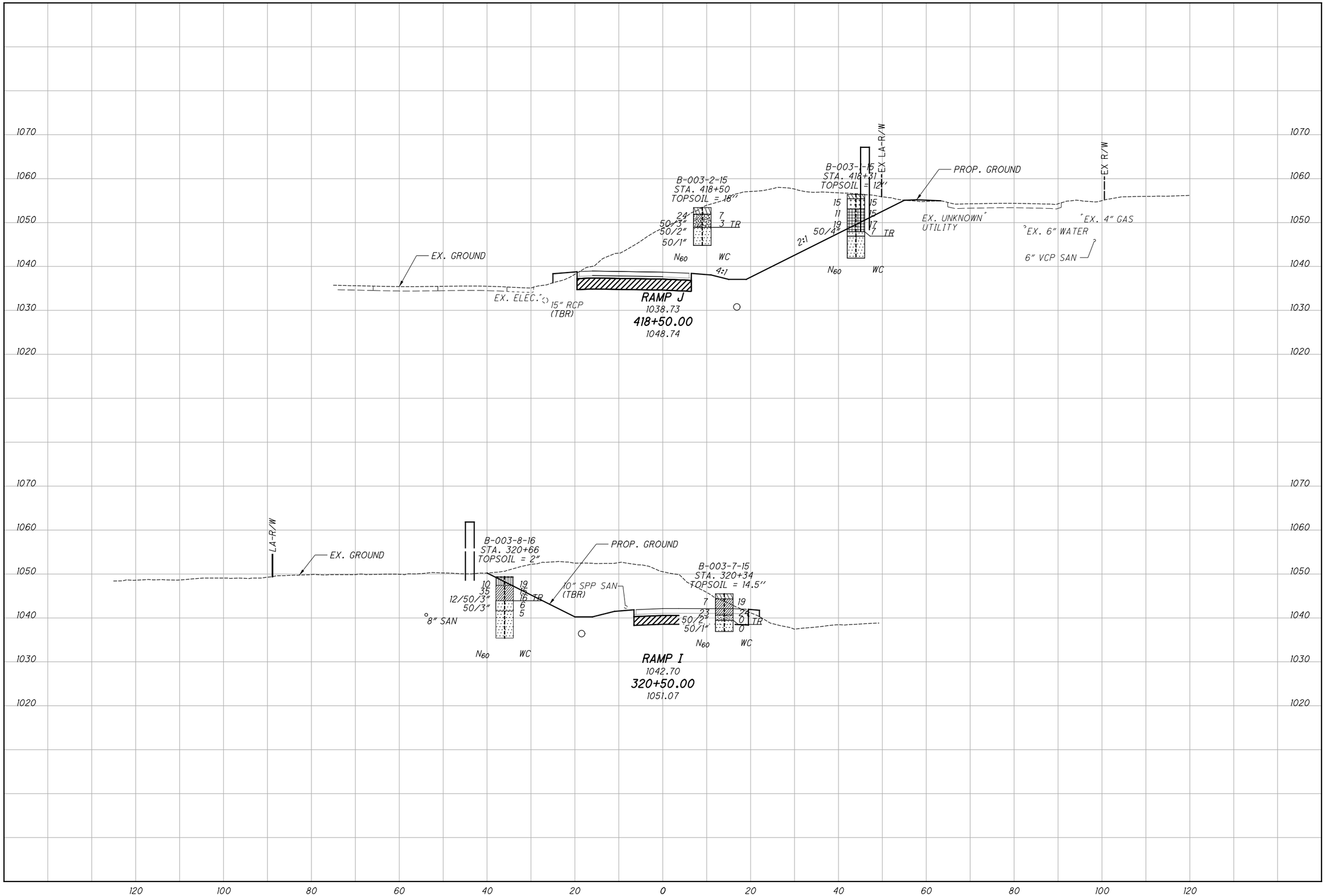


HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA 243+00 SB SR-8 & STA 525+00 NB SR-8

SUM-8-1.75

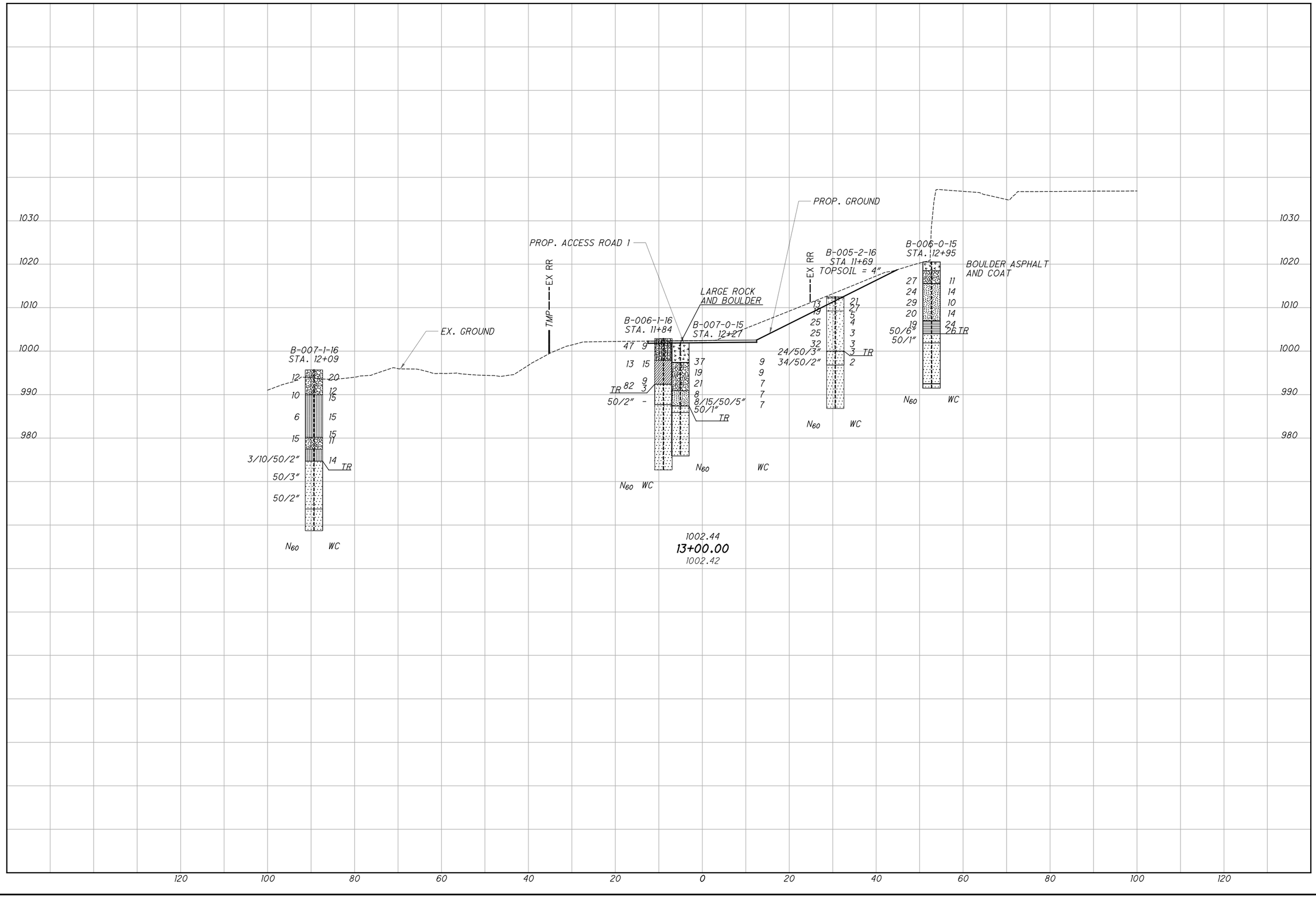


HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA 320+50 RAMP I & STA 418+50 RAMP J

SUM-8-1.75

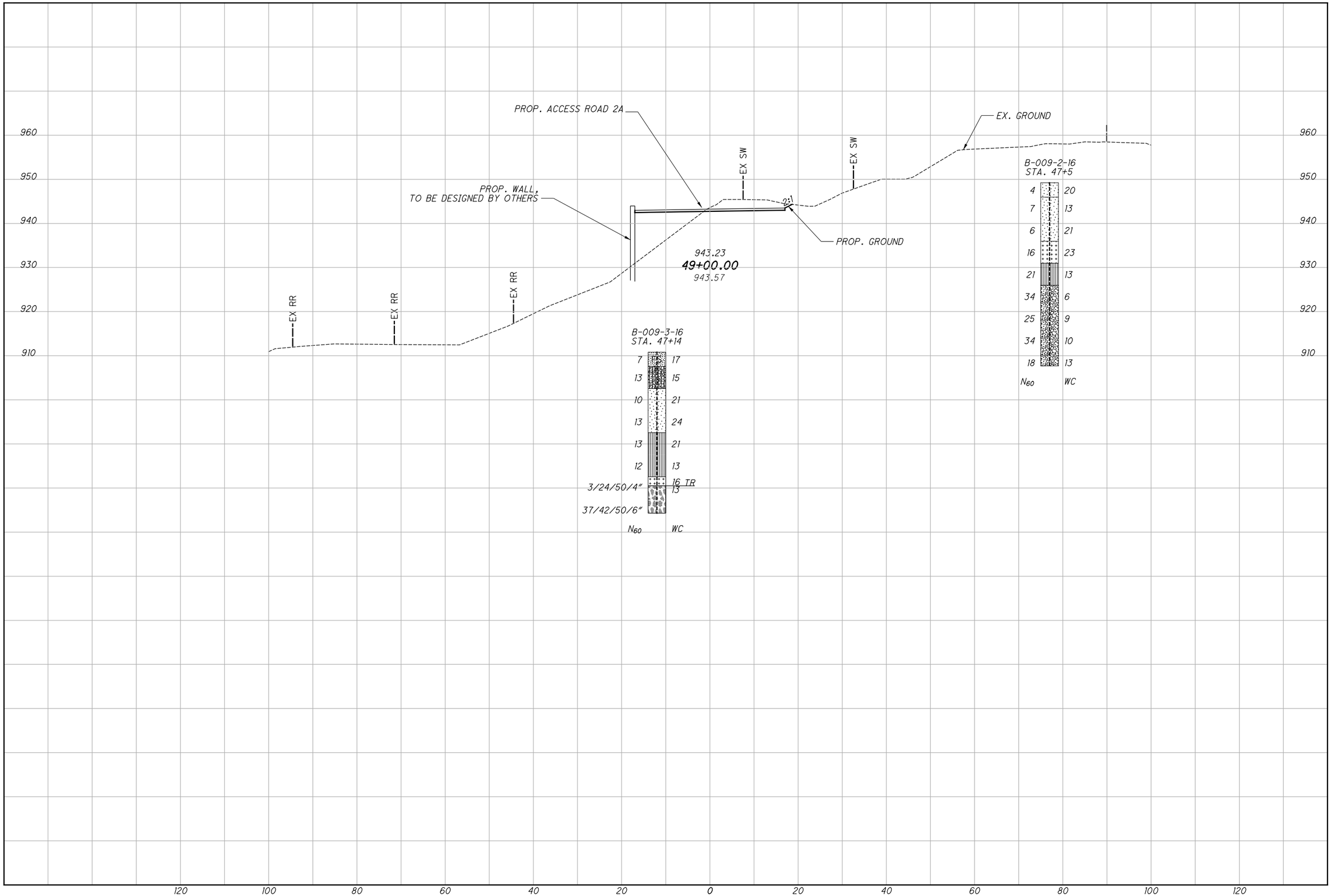


HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 13+00 ACCESS ROAD 1

SUM-8-1.75

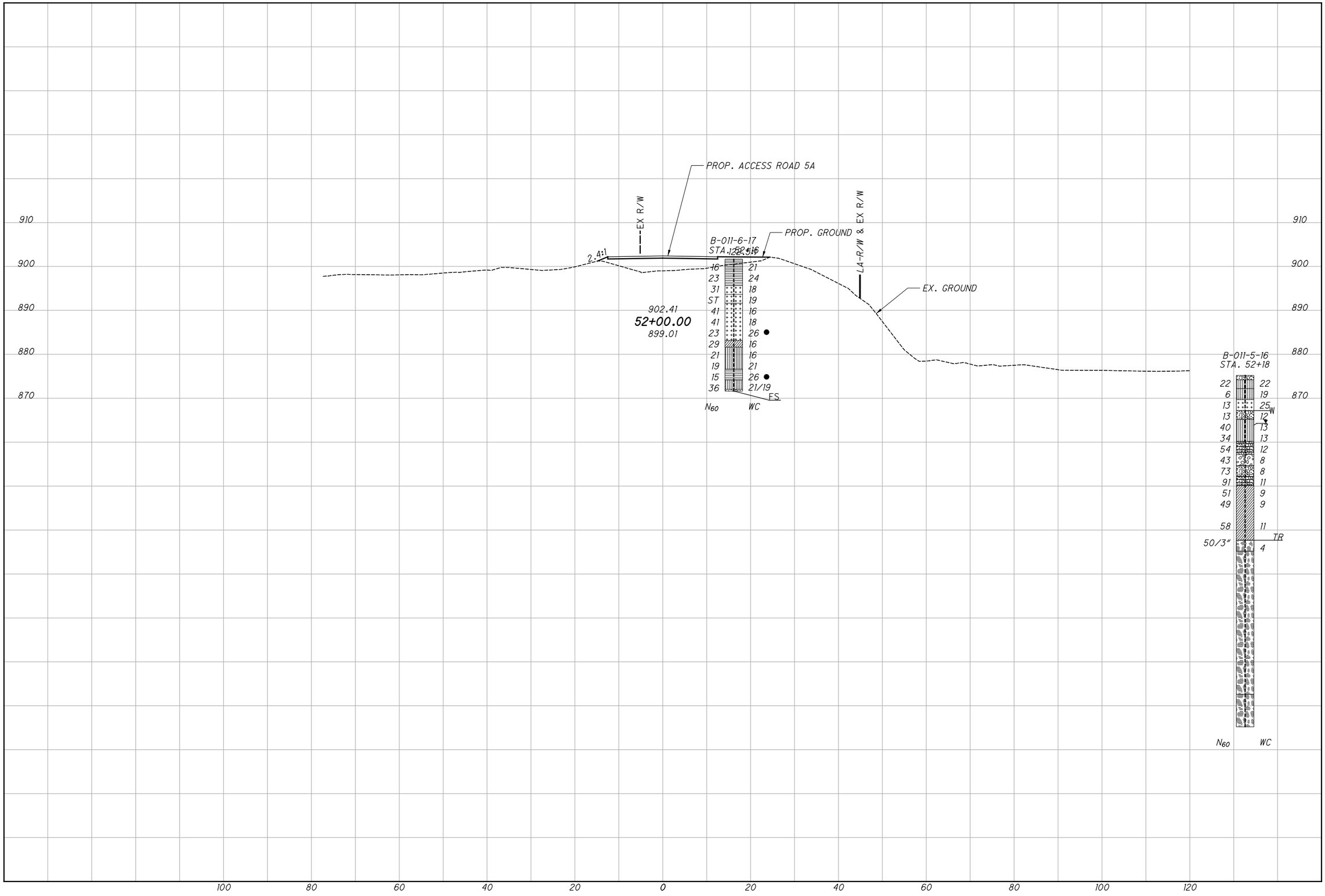


0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL CROSS SECTION SECTION STA. 49+00 ACCESS ROAD 2A

SUM-8-1.75



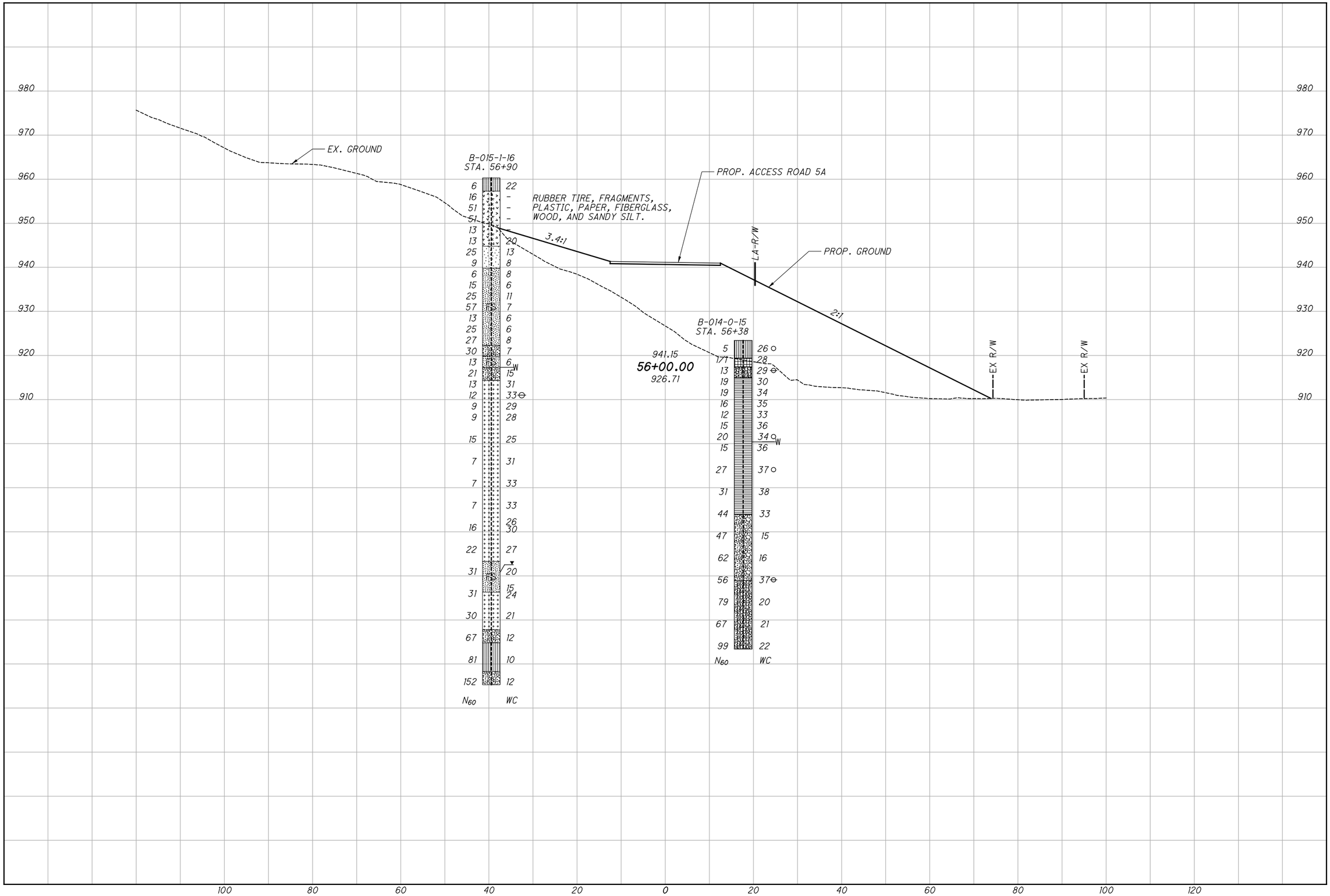
HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 52+00 ACCESS ROAD 5A

SUM-8-1.75

91 / 156



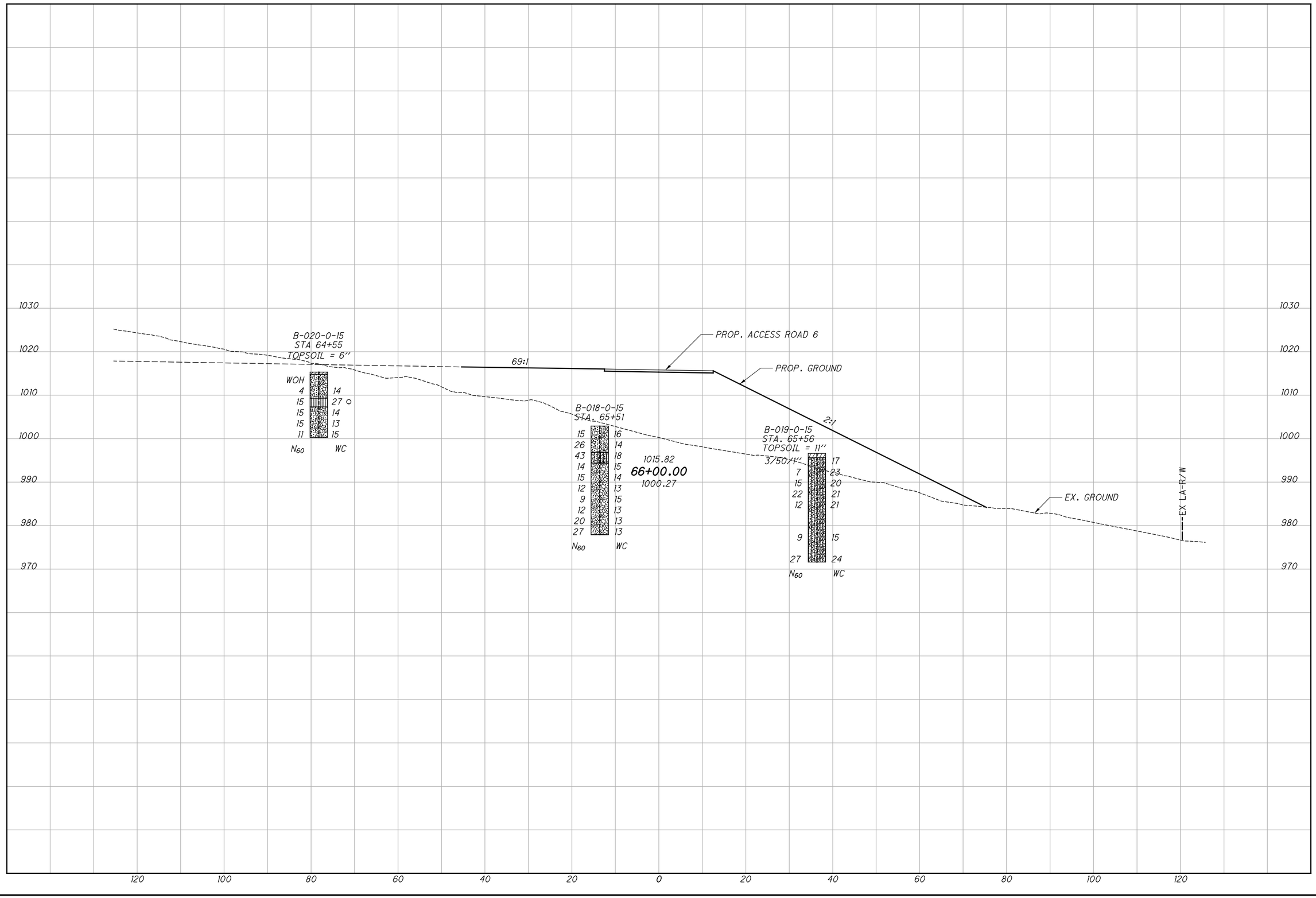
0 5 10 20
HORIZONTAL
SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 56+00 ACCESS ROAD 5A

SUM-8-1.75

92 / 181

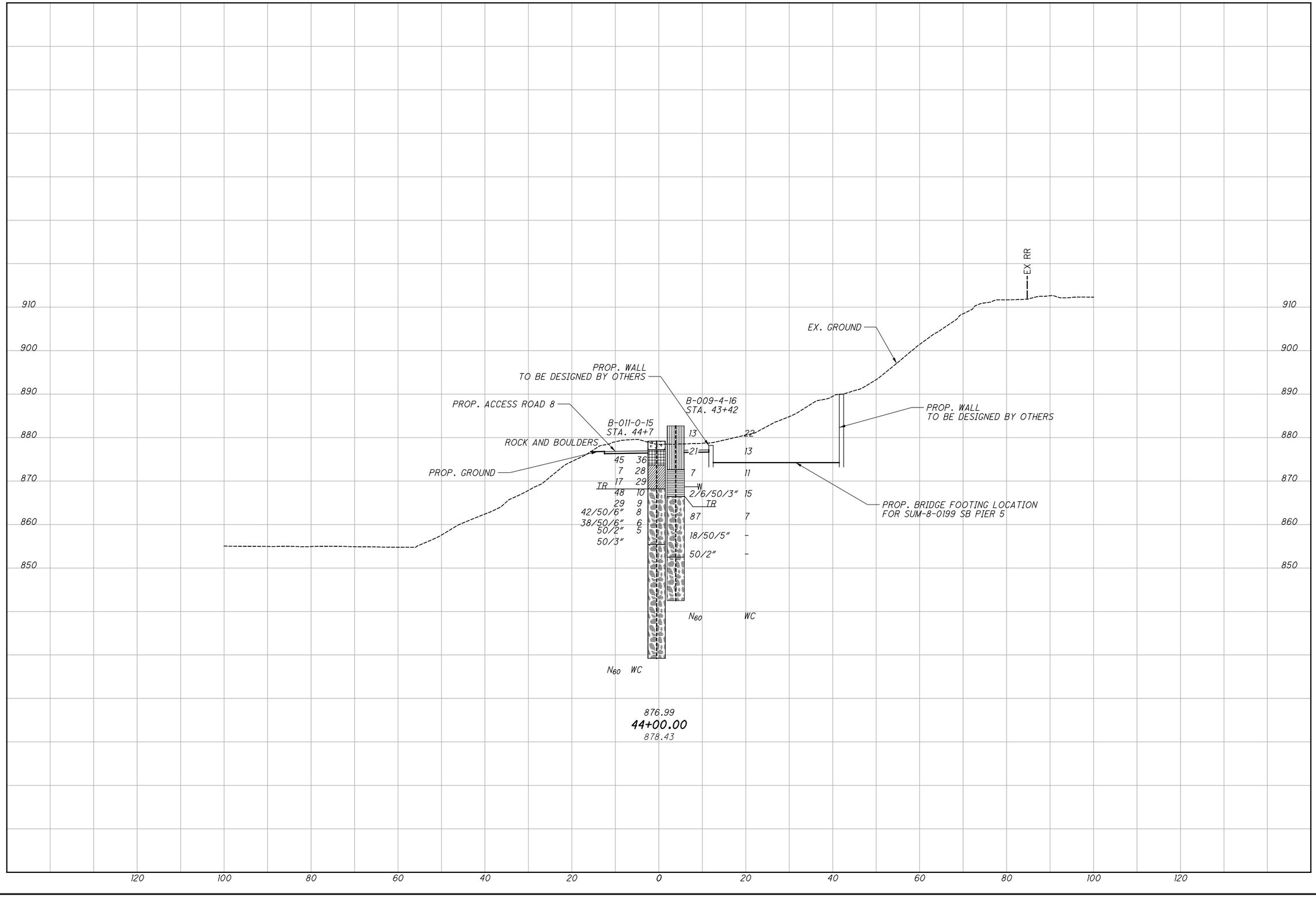


0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 66+00 ACCESS ROAD 6

SUM-8-1.75

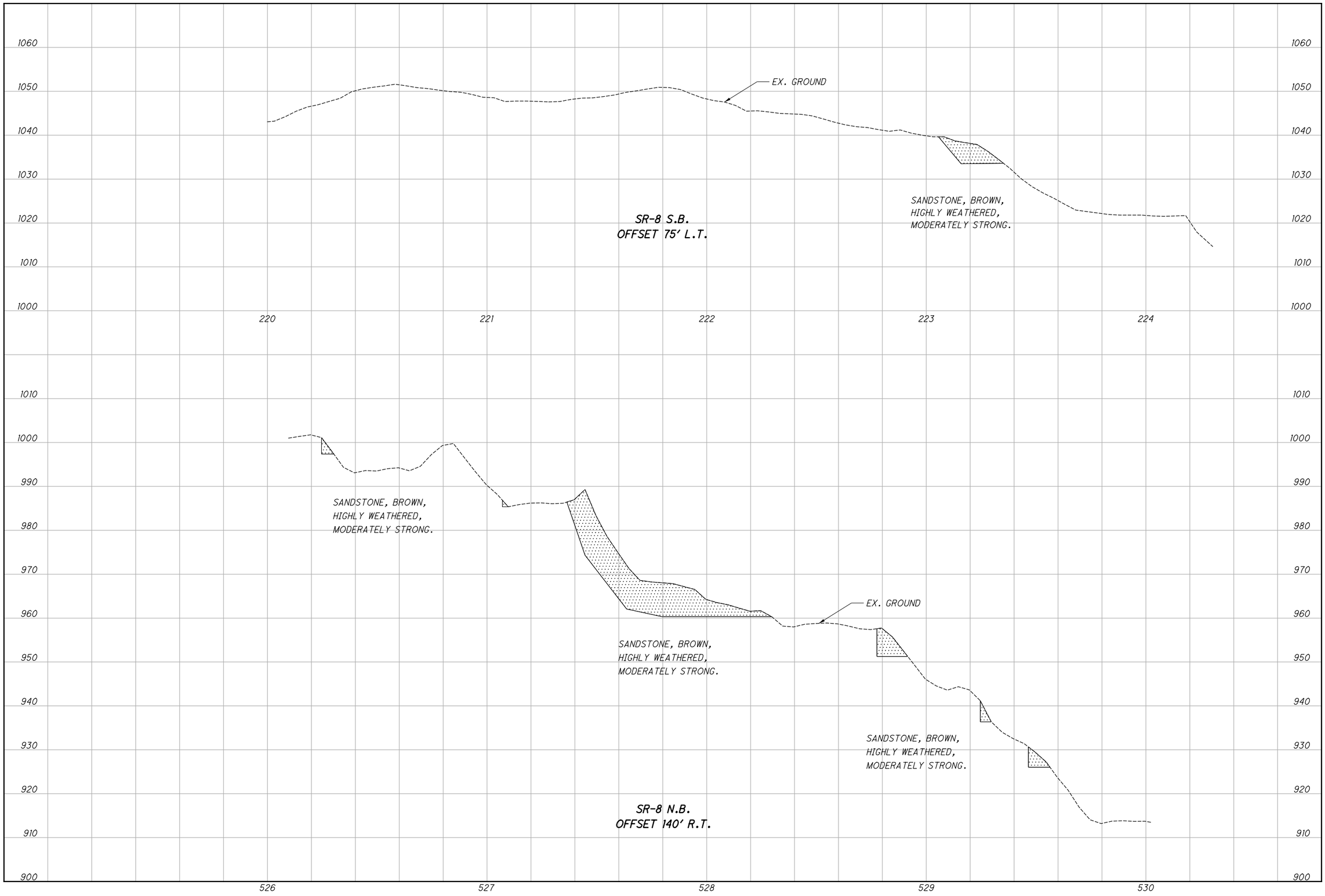


HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 44+00 ACCESS ROAD 8

SUM-8-1.75



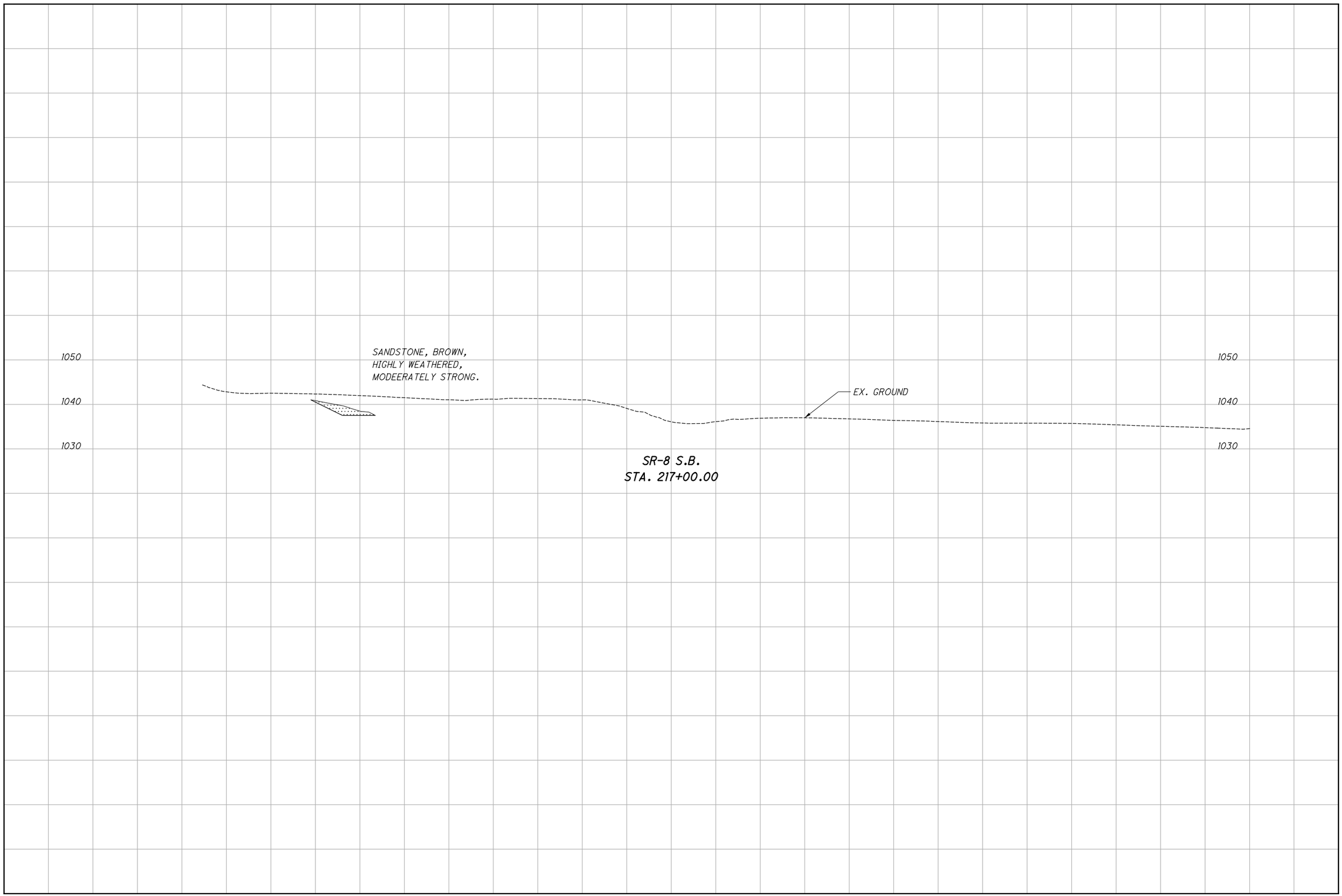
0 10 20 40
HORIZONTAL
SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL PROFILE

STA 220+00 TO 224+30 S.R. 8 S.B. & STA 526+9.6 TO 530+2.7 S.R. 8 N.B.

SUM-8-1.75



HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 217+00 SB SR-8

SUM-8-1.75

96/181

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 419+81, 36' RT. | EXPLORATION ID B-001-3-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / J.HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1054.0 (MSL) EOB: 24.0 ft.
START: 12/28/16 END: 12/28/16 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.084037, -81.502378

MATERIAL DESCRIPTION AND NOTES	ELEV. 1054.0	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
TOPSOIL (6.0")	1053.5		7			SS-1A	2.75 -	-	-	-	-	-	-	-	-	19		
DENSE, GRAYISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS CONCRETE FRAGMENTS, DAMP **(FILL)**	1052.0		23 6	43	89	SS-1B	3.25 -	-	-	-	-	-	-	-	-	13	A-1-b (V)	
STIFF, GRAYISH BROWN WITH ORANGISH BROWN AND GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, CONTAINS CINDERS, SLAG, AND MANY BRICK FRAGMENTS, MOIST **(FILL)**	1049.5		4 4 7	16	100	SS-2	1.25	8	15	26	33	18	30	19	11	19	A-6a (4)	
DENSE, LIGHT GRAYISH BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**	1048.2		8 9 13	32	100	SS-3A	-	34	17	20	18	11	23	17	6	12	A-2-4 (0)	
						SS-3B	2.9 - 4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	1045.5		4 7 34	60	100	SS-4A	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	
						SS-4B	-	-	-	-	-	-	-	-	-	2	Rock (V)	
SANDSTONE, PINKISH BROWN, MODERATELY WEATHERED, MODERATELY FRIABLE, EASILY AUGERED.		TR	4 50/5"	-	100	SS-5	-	-	-	-	-	-	-	-	-	5	Rock (V)	
			4 50/5"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, LIGHT BROWN, MAROONISH BROWN AND LIGHT GRAY, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, MEDIUM GRAINED, THIN BEDDED, FINE GRAINED TO 14.5', JOINT DISCONTINUITIES: LOW ANGLE FRACTURES WITH VERTICAL FRACTURES 14.0' TO 14.5', FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, DISINTEGRATED, FAIR SURFACE CONDITION; RQD 0%, REC 61%.	1040.0		0		34	NQ2-1											CORE	
			0		88	NQ2-2											CORE	
	1030.0	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:52 - W:\062368-MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRUCK (RW) | STATION / OFFSET: 416+81, 50' RT. | EXPLORATION ID B-001-4-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / S. MW. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA | CALIBRATION DATE: 4/4/15 | ELEVATION: 1055.3 (MSL) EOB: 13.7 ft.
START: 6/8/15 END: 6/8/15 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 80.25 | LAT / LONG: 41.084395, -81.502357

MATERIAL DESCRIPTION AND NOTES	ELEV. 1055.3	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
12" TOPSOIL (DRILLER'S DESCRIPTION)	1054.3																	
SOFT, BROWN, **CLAY**, "AND" SILT, TRACE SAND AND GRAVEL, DAMP	1052.3		3 2 2	5	67	SS-1	0.50	5	2	4	54	35	44	20	24	22	A-7-6 (14)	
VERY STIFF, BROWN, **SILT**, SOME CLAY, LITTLE GRAVEL, TRACE SAND, DRY	1048.8		6 8 11	25	83	SS-2	4.00	13	2	7	50	28	24	22	2	25	A-4b (8)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR	6 50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1041.6	EOB	50/2"	-	67	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:08 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

97/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOGS B-001-3-16 & B-001-4-15	DRAWN JJH	CHECKED YLZ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 316+56, 75' LT. | EXPLORATION ID B-001-5-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP I | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1060.1 (MSL) EOB: 20.5 ft.
START: 12/28/16 END: 12/28/16 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.084620, -81.503801

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
TOPSOIL (4.0")	1059.8																	
VERY STIFF TO HARD, BROWN WITH DARK GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL (SANDSTONE), CONTAIN CINDERS, AND FEW ROOT HAIRS, @0.3' TO 1.5'; CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**	1060.1	1	4 5 6	16	83	SS-1	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
		2																
		3	7 9 6	22	100	SS-2	4.00	13	8	38	26	15	20	14	6	13	A-4a (1)	
		4																
		5	3 7 8	22	67	SS-3	2.0-2.5	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1053.1	6																
SANDSTONE, ORANGISH BROWN TO WHITE AND ORANGISH BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 7	17 50/5"	-	9	SS-4	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		8																
		9																
		10	22 50/4"	-	60	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		11																
@12.5' TO 15.3'; BECOMES LIGHT AND DARK ORANGISH BROWN		12																
		13	50/3"	-	100	SS-6	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	1044.6	14																
		15	50/3"	-	100	SS-7	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, BROWN WITH LIGHT GRAY AND MAROONISH BROWN, SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MEDIUM TO COARSE GRAINED, VERY THIN BEDDED, JOINT DISCONTINUITIES: LOW ANGLE FRACTURES, DIAGONAL FRACTURE AT 16.0-16.2', FRACTURED TO MODERATELY FRACTURED, TIGHT, SLIGHTLY ROUGH, VERY BLOCKY STRUCTURE, GOOD SURFACE CONDITION; RQD 63%, REC 100%.		16																
		17																
		18	63		100	NQ2-1											CORE	
		19																
	1039.6	EOB 20																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRUCK (RW) | STATION / OFFSET: 418+31, 44' RT. | EXPLORATION ID B-003-1-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / S. MW. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA / NX | CALIBRATION DATE: 4/4/15 | ELEVATION: 1056.4 (MSL) EOB: 14.5 ft.
START: 6/9/15 END: 6/9/15 | SAMPLING METHOD: SPT/NX | ENERGY RATIO (%): 80.25 | LAT / LONG: 41.084807, -81.502349

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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1056.4																	
HARD, BROWN, **SILT**, SOME CLAY, LITTLE SAND AND GRAVEL, DRY	1055.4	1	4 6 5	15	83	SS-1	4.5+	11	1	9	55	24	25	20	5	15	A-4b (8)	
	1053.1	2																
VERY STIFF TO HARD, BROWN, **CLAY**, SOME SAND LITTLE GRAVEL, DRY		3																
		4	3 4 4	11	72	SS-2	4.00	12	3	14	41	30	-	-	-	15	A-7-6 (V)	
		5																
		6																
		7	4 6 8	19	89	SS-3	4.5+	-	-	-	-	-	38	21	17	17	A-7-6 (V)	
	1047.9	8																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1046.9	TR 9	50/4"	-	50	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, REDDISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, FINE TO COARSE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY FRACTURED; RQD 62%, REC 100%. @ 10.1' TO 10.6'; Qu = 5,010 PSI @ 10.7' TO 10.9'; VERTICAL FRACTURE @ 11.9' TO 12.5'; Qu = 5,120 PSI		10																
		11																
		12	62		100	NX-1											CORE	
		13																
	1041.9	EOB 14																

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

98/181

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-001-5-16 & B-003-1-15

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 318+54, 2' LT. | EXPLORATION ID B-003-4-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP I | PAGE 1 OF 1
PID: 91710 SFN:7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1056.0 (MSL) EOB: 15.2 ft.
START: 1/4/17 END: 1/4/17 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.085107, -81.503568

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
TOPSOIL (3.5")	1056.0																	
LOOSE, DARK GRAYISH BROWN, BROWN, AND ORANGISH BROWN, **GRAVEL WITH SAND AND SILT** LITTLE CLAY, CONTAINS ROOTS, IRON STAINING AND CINDERS, MOIST **(FILL)**	1055.7 / 1054.0	1	1 2 2	6	89	SS-1	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
SOFT TO MEDIUM STIFF, DARK GRAYISH BROWN AND BROWN, **SILT AND CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, @2.5' TO 4.0'; CONTAINS DECAYED LEAVES AND MANY ROOTS, DAMP TO MOIST @5.0' TO 6.5'; BECOMES VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, CONTAINS ROOTS		2 3 4 5 6	WOH 1 2	4	78	SS-2	0.25 - 1.0	4	9	26	35	26	28	17	11	20	A-6a (6)	
			6 8 9	25	100	SS-3	3.25 - 4.5+	11	6	20	39	24	29	18	11	15	A-6a (6)	
SANDSTONE, BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1049.5 TR	7 8 9	50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	7	Rock (V)	
@10.0' TO 10.2'; BECOMES ORANGISH BROWN WITH MAROONISH BROWN, CONTAINS IRON STAINING	1045.8	10	50/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, STRONG, FINE TO COARSE GRAINED, VERY THIN TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 12.7' - 12.9', MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, VERY BLOCKY, FAIR TO GOOD SURFACE CONDITION; RQD 45%, REC 86%.	1040.8 EOB	10 11 12 13 14 15	45		86	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 30 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:52 - W:\062368- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRUCK (RW) | STATION / OFFSET: 419+81, 36' RT. | EXPLORATION ID B-003-5-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / S. MW. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN:7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA / NX | CALIBRATION DATE: 4/4/15 | ELEVATION: 1052.3 (MSL) EOB: 15.0 ft.
START: 6/9/15 END: 6/9/15 | SAMPLING METHOD: SPT/NX | ENERGY RATIO (%): 80.25 | LAT / LONG: 41.085220, -81.502345

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
12" TOPSOIL (DRILLER'S DESCRIPTION)	1052.3																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY	1051.3 / 1048.8	1 2 3	5 6 21	36	67	SS-1	4.5+	18	11	3	37	31	38	18	20	15	A-6b (11)	
LOOSE TO DENSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY BRICK FRAGMENTS THROUGH (POSSIBLE OLD FOUNDATION)	FILL	4 5 6 7 8 9	6 9 15	32	22	SS-2	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
			3 3 3	8	22	SS-3	-	21	11	62	- 6 -		NP	NP	NP	7	A-3 (0)	
			9 50/5"	-	73	SS-4	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
SANDSTONE, REDDISH BROWN, MODERATELY TO HIGHLY WEATHERED, SLIGHTLY STRONG, FINE TO COARSE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY FRACTURED; RQD 58%, REC 100%. @ 13.4' TO 13.9'; Qu = 4,230 PSI @ 14.4' TO 15.0'; Qu = 4,830 PSI @ 14.7' TO 15.0'; VERTICAL FRACTURE	1042.3 TR / 1037.3 EOB	10 11 12 13 14 15	58		100	NX-1											CORE	

NOTES: *ESTIMATED ELEVATION 1057', ACTUAL ELEVATION 1025', BORING ADVANCED TO 1037, 5' BELOW PROPOSED ELEVATION
ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:08 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-003-4-16 & B-003-5-15

DRAWN JJH | CHECKED YLZ

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRUCK (RW) | STATION / OFFSET: 420+35, 52' RT. | EXPLORATION ID B-003-6-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / S. MW. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: RAMP J
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA | CALIBRATION DATE: 4/4/15 | ELEVATION: 1049.2 (MSL) EOB: 9.2 ft. | PAGE 1 OF 1
START: 6/9/15 END: 6/9/15 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 80.25 | LAT / LONG: 41.085375, -81.502274

MATERIAL DESCRIPTION AND NOTES	ELEV. 1049.2	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
12" CONCRETE (DRILLER'S DESCRIPTION)	1048.2																	
BROWN, **SANDY SILT**, (IDENTIFIED FROM AUGER), DRY	1047.2	TR	6 14 50/3"	-	67	SS-1	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.			50/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1040.0	EOB	50/2"	-	50	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: *BORING MOVED 5' NORTH DUE TO EXISTING SEWER LINE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 12 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:08 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 320+66, 36' LT. | EXPLORATION ID B-003-8-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP I
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1049.4 (MSL) EOB: 14.0 ft. | PAGE 1 OF 1
START: 12/29/16 END: 12/29/16 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.085635, -81.503239

MATERIAL DESCRIPTION AND NOTES	ELEV. 1049.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
TOPSOIL (2.0")	1049.2																	
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW ROOT HAIRS, MOIST	1047.4		3 3 4	10	67	SS-1	1.25 - 1.75	-	-	-	-	-	-	-	-	19	A-4a (V)	
STIFF TO VERY STIFF, BROWN TO BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, DAMP TO MOIST	1043.9	TR	8 10 14	35	100	SS-2	2.0 - 2.25	10	9	33	29	19	26	15	11	15	A-6a (3)	
SANDSTONE, LIGHT BROWN TO BROWN WITH GRAY, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1041.6		12 50/3"	-	100	SS-3A SS-3B	1.5 - 1.75 -	6 -	9 -	28 -	34 -	23 -	28 -	17 -	11 -	16 6	A-6a (5) Rock (V)	
			50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, LIGHT BROWN AND ORANGISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, FRACTURED TO HIGHLY FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; RQD 8%, REC 49%.	1035.4	EOB	8		49	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:52 - W:\062388- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE IN\VEST\BORING 2017\RENUMBERED SUM-8

100/181

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-003-6-15 & B-003-8-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 420+35, 52' RT.	EXPLORATION ID B-004-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1042.0 (MSL) EOB: 18.5 ft.	PAGE 1 OF 1
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.085810, -81.502220	

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
TOPSOIL (2.0")	1041.8																	
LOOSE TO MEDIUM DENSE, DARK GRAY CHANGING TO DARK GRAY WITH BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, CONTAIN SLAG AND ROOTS, @0.0' TO 1.5'; CONTAINS ORGANICS AND BRICK FRAGMENTS, MOIST **(FILL)**		1	2 5 3	12	61	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
		2																
		3	2 3 4	10	89	SS-2	-	12	19	30	27	12	NP	NP	NP	20	A-4a (1)	
		4																
	1036.4	5																
SANDSTONE, BROWN TO LIGHT BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY FRIABLE, EASILY AUGERED.		TR 6	10 5 4	13	83	SS-3	-	16	7	54	15	8	NP	NP	NP	4	Rock (V)	
		7																
		8	15 26 47	107	100	SS-4	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		9																
		10																
		11	16 29 48	113	100	SS-5	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		12																
	1028.5	13	21 50/2"	-	88	SS-6	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, LIGHT GRAY AND ORANGISH BROWN, SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO MEDIUM GRAINED, VERY THIN TO THIN BEDDED, CONTAINS A PLANT FOSSIL, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES WITH DIAGONAL AT 17.0' TO 17.3', FRACTURED , NARROW, VERY ROUGH, BLOCKY STRUCTURE, GOOD SURFACE CONDITION; RQD 37%, REC 78%.		14																
		15																
		16	37		78	NQ2-1											CORE	
		17																
	1023.5	EOB 18																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 27 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 322+46, 14' LT.	EXPLORATION ID B-004-2-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 1041.9 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 4/5/17 END: 4/5/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.086097, -81.502980	

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
12.0" TOPSOIL (DRILLER'S DESCRIPTION)	1040.9																	
MEDIUM STIFF, DARK BROWN AND LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, TRACE TO LITTLE GRAVEL, 1.0' TO 2.5' CONTAINS FEW ROOTS, MOIST **(FILL)**		1	2 1 2	4	78	SS-1	0.60	4	15	32	34	15	24	17	7	20	A-4a (3)	
		2																
		W 3																
	1037.0	4	2 50/5"	-	44	SS-2	0.60	-	-	-	-	-	-	-	-	20	A-4a (V)	
SANDSTONE, LIGHT BROWN, HIGHLY WEATHERED, FRIABLE.		TR 5																
		6	50/5"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		7																
		8																
		9	50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1031.9	10																
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, VERY THIN TO LAMINATED, CONGLOMERITIC, FRIABLE, FERRIFEROUS, CROSS BEDDED, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, HIGHLY FRACTURED TO FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY/DISTURBED/SEAMY, FAIR SURFACE CONDITION; RQD 0%, REC 38%.		11																
		12	0		38	NX-1											CORE	
		13																
		14																
	1026.9	EOB 15																

NOTES: GROUNDWATER ENCOUNTERED AT 3.5' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 20 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 10/29/18 15:52 - W:\062368- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 423+45, 3' RT. | EXPLORATION ID B-004-5-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN:7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1036.8 (MSL) EOB: 25.6 ft.
START: 1/21/17 END: 1/21/17 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.086194, -81.502201

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
ASPHALT (8.0") & GRANULAR BASE (4.0")	1035.8																	
VERY DENSE, LIGHT GRAYISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS ASPHALT FRAGMENTS (3/8" TO 1.0" EXCLUDED FROM GRADATION), DRY **(FILL)**	1032.3		50/6"	-	67	SS-1	-	26	34	17	18	5	NP	NP	NP	1	A-1-b (0)	
MEDIUM DENSE TO DENSE, BROWN BECOMING BROWN AND BLACK, **COARSE AND FINE SAND**, SOME TO LITTLE SILT, TRACE TO LITTLE GRAVEL, TRACE TO LITTLE CLAY, CONTAINS PLASTIC FRAGMENTS AND CINDERS, DAMP **(FILL)**	1028.3		19 10 8	26	39	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
VERY STIFF TO HARD, BROWN TO BLACK WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS CINDERS, @8.5' TO 9.0'; SLIGHTLY ORGANIC, DAMP TO MOIST **(FILL)**	1024.8		9 7 14	31	78	SS-3A	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
						SS-3B	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
			10 7 4	16	100	SS-4	3.25 - 4.5+	9	11	32	30	18	23	14	9	14	A-4a (3)	
DENSE TO VERY DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP **(FILL)**			21 17 16	48	100	SS-5	-	7	19	55	11	8	NP	NP	NP	10	A-3a (0)	
@15.0' TO 15.8'; CHANGES TO BROWN WITH LIGHT BROWN, CONTAINS FEW CINDERS	1021.2	TR	19 50/4"	-	50	SS-6	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
SANDSTONE, BROWN AND GRAY BECOMING ORANGISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, SLIGHTLY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY TO VERY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 37%, REC 77%.			17		53	NQ2-1										CORE	
			57		100	NQ2-2											CORE	
	1011.2	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 10/29/18 15:52 - W:\062368- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 323+89, 17' LT. | EXPLORATION ID B-004-6-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP I | PAGE 1 OF 1
PID: 91710 SFN:7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1021.8 (MSL) EOB: 13.5 ft.
START: 12/27/16 END: 12/27/16 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.086476, -81.502828

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
ASPHALT (8.5")	1021.1																	
VERY DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS SLAG AND BRICK FRAGMENTS, DAMP **(FILL)**	1018.1	TR	14 18 44	91	100	SS-1A	-	21	20	32	17	10	NP	NP	NP	12	A-3a (0)	
@3.5'; CONTAINS BROWN SILTY CLAY LENSE						SS-1B	-	-	-	-	-	-	-	-	-	7	Rock (V)	
SANDSTONE, BROWN BECOMING LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.			16 50/5"	-	27	SS-2	-	-	-	-	-	-	-	-	-	6	Rock (V)	
@7.5' TO 7.7'; BECOMES ORANGISH BROWN, CONTAINS IRON STAINING	1014.1		50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	5	Rock (V)	
SANDSTONE, ORANGISH BROWN WITH LIGHT BROWN AND GRAY, MODERATELY TO HIGHLY WEATHERED, STRONG, MEDIUM TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, FERRIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; RQD 0%, REC 80%.			0		80	NQ2-1										CORE	
	1008.3	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 40 GAL. BENTONITE GROUT

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-004-5-16 & B-004-6-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 524+32, 64' RT.	EXPLORATION ID B-005-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.6 (MSL) EOB: 50.3 ft.	PAGE 1 OF 1
START: 1/21/17 END: 1/21/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086418, -81.502086	

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
ASPHALT (8.0") & GRANULAR BASE (8.5")	1036.6																	
	1035.2																	
DENSE, BROWN AND LIGHT GRAY BECOMING BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, DAMP		1																
		2																
		3	38 15 11	38	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
		4																
		5																
		6	22 18 15	48	100	SS-2	-	19	8	53	12	8	NP	NP	NP	10	A-3a (0)	
	1029.6																	
STIFF TO HARD, BROWN AND BLACK BECOMING BROWNISH GRAY AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN TRACE ANTHRACITE COAL FRAGMENTS, DAMP		7																
		8	23 8 7	22	100	SS-3	2.5 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		9																
		10																
		11	11 8 6	21	100	SS-4	1.25 - 1.75	9	10	29	33	19	26	16	10	16	A-4a (3)	
		12																
		13	11 6 7	19	78	SS-5	3.75 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		14																
		15																
@15.0' TO 17.0'; BECOMES BLACK AND DARK BROWN, CONTAINS IRON STAINING AND FUEL ODOR		16	12 20 15	51	100	SS-6	2.0 - 4.5+	7	14	39	28	12	22	16	6	13	A-4a (1)	
	1019.6	17																
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP		18	9 10 5	22	100	SS-7	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	1017.1	19																
MEDIUM DENSE, BROWN, **SANDY SILT**, LITTLE STONE FRAGMENTS, LITTLE CLAY, CONTAINS IRON STAINING, DAMP @20.0'; NO HP, SAMPLE IS NON COHESIVE		20																
		21	9 7 6	19	100	SS-8	-	-	-	-	-	-	-	-	-	16	A-4a (V)	
	1014.6	22																
SANDSTONE, ORANGISH BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR 23	32 50/4"	-	100	SS-9	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	1011.3	24																
SANDSTONE, BROWN AND ORANGISH BROWN, BECOMES DARK BROWN AND GRAY FROM 38.6' - 39.5', SLIGHTLY TO HIGHLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, TRACE QUARTZITE PEBBLES THROUGHOUT, CONTAINS FEW VUGS FROM 36.5' - 36.8', SLIGHTLY MICACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO SLIGHTLY FRACTURED, OPEN TO TIGHT, BLOCKY/DISTURBED/SEAMY TO INTACT, DISINTEGRATED FROM 25.3' - 26.1', GOOD TO FAIR SURFACE CONDITION; RQD 68%, REC 88%.		25	50/3"	-	67	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		26																
		27																
		28	0		47	NQ2-1											CORE	
		29																
		30																
		31																
		32																
		33																
		34																
		35	85		98	NQ2-2											CORE	
		36																
		37																
@37.5'; Qu = 4680 PSI		38																
		39																
		40																
		41																
		42																
		43																
		44																
		45	85		98	NQ2-3											CORE	
		46																
		47																
		48																
		49																
	986.3	EOB 50																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 10/29/18 15:56 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-005-1-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 225+00, 78' LT. | EXPLORATION ID B-005-2-16
TYPE: BRIDGE | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1012.5 (MSL) EOB: 25.7 ft.
START: 12/28/16 END: 12/28/16 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.086773, -81.502733

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
TOPSOIL (4.0")	1012.5																	
MEDIUM DENSE, DARK GRAY AND DARK BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE CLAY, LITTLE GRAVEL, CONTAIN FEW ROOTS, @0.3' TO 1.5'; CONTAINS SLAG AND CINDERS, WET	1012.2	1	4 4 5	13	83	SS-1	-	11	21	37	18	13	NP	NP	NP	21	A-3a (0)	
(FILL)	1009.2	2																
MEDIUM DENSE TO DENSE, BROWN AND LIGHT BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, DRY TO DAMP		3	4 5 8	19	67	SS-2A	-	-	-	-	-	-	-	-	-	27	A-3a (V)	
		4				SS-2B	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
		5																
		6	18 10 7	25	100	SS-3	-	13	21	49	11	6	NP	NP	NP	4	A-3a (0)	
		7																
		8	9 9 8	25	83	SS-4	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
		9																
@10.0' TO 11.5'; BECOMES SOME GRAVEL		10	9 12 10	32	67	SS-5	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
	1000.0	11																
SANDSTONE, BROWN TO PINKISH BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 12																
		13	24 50/3"	-	78	SS-6	-	-	-	-	-	-	-	-	-	3	Rock (V)	
	996.8	14																
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, VERY THIN TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY TO SLIGHTLY FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, GOOD SURFACE CONDITION; RQD 31%, REC 85%.		15	34 50/2"	-	75	SS-7	-	-	-	-	-	-	-	-	2	Rock (V)	
		16																
		17																
		18																
		19																
		20																
		21	31		85	NQ2-1											CORE	
		22																
		23																
		24																
@25.2'; Qu = 4111 PSI	986.8	EOB 25																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / R.M. | DRILL RIG: D-50 TRUCK (RW) | STATION / OFFSET: 525+07, 40' LT. | EXPLORATION ID B-006-0-15
TYPE: BRIDGE | SAMPLING FIRM / LOGGER: GF / M. HILTY | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: SR 8 NB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA / NX | CALIBRATION DATE: 4/4/15 | ELEVATION: 1020.5 (MSL) EOB: 29.0 ft.
START: 6/25/15 END: 6/25/15 | SAMPLING METHOD: SPT/NX | ENERGY RATIO (%): 80.25 | LAT / LONG: 41.086712, -81.502336

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
UNCONTROLLED FILL (BOULDER ASPHALT AND COAL)	1020.5																	
	1018.5	1																
MEDIUM DENSE, BLACK, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, AND SLAG, TRACE SILT AND CLAY, DAMP		2																
	1015.5	3																
MEDIUM DENSE, BROWN, **FINE SAND**, SOME COARSE SAND AND GRAVEL, TRACE SILT AND CLAY, DAMP		4	6 9 11	27	72	SS-1	-	19	30	45	- 6 -		NP	NP	NP	11	A-1-b (0)	
		5																
		6																
		7	8 9 9	24	78	SS-2	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
		8																
		9	7 9 13	29	78	SS-3	-	20	20	52	- 8 -		NP	NP	NP	10	A-3 (0)	
		10																
		11																
		12	6 7 8	20	83	SS-4	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
	1007.0	13																
HARD, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DAMP		14	5 6 8	19	78	SS-5	4.50	13	8	11	45	23	36	20	16	24	A-6b (9)	
	1004.0	15																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 16																
		17	50/6"	-	83	SS-6	-	-	-	-	-	-	-	-	-	26	A-6b (V)	
	1002.0	18																
SANDSTONE, BROWN, MODERATELY WEATHERED, SLIGHTLY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 72%, REC 98%. @ 19.0' TO 19.5'; Qu = 5,560 PSI		19	50/1"	-	100/	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		20	29		100	NX-1											CORE	
		21																
		22	92		100	NX-2											CORE	
		23																
		24																
		25																
		26																
	992.5	27	67		92	NX-3											CORE	
SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 67%, REC 92%.	991.5	EOB 28																

NOTES: NONE
ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 21 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 10/29/18 15:52 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8
STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT GDT - 7/18/19 17:08 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-005-2-16 & B-006-0-15

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 225+36, 92' LT.	EXPLORATION ID B-006-1-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1002.9 (MSL) EOB: 30.2 ft.	PAGE 1 OF 1
START: 1/4/17 END: 1/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086887, -81.502727	

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, DARK GRAY, GRAY AND DARK BROWN, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS CINDERS, DAMP **(FILL)**	1002.9		6 13 19	47	83	SS-1	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	997.9																	
STIFF, BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, DAMP			11 5 4	13	78	SS-2	1.0 - 1.5	12	26	14	27	21	30	18	12	15	A-6a (3)	
SS-3A RECOVERY TOO LOW FOR HP READING.	992.4	TR	9			SS-3A	-	-	-	-	-	-	-	-	-	9	A-6a (V)	
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.			17 39	82	100	SS-3B	-	-	-	-	-	-	-	-	-	3	Rock (V)	
@15.0' TO 15.2'; BECOMES LIGHT ORANGISH BROWN	987.7		50/2"		100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, FEW VUGS FROM 19.4' - 19.8', BEDDING DISCONTINUITIES: LOW ANGLE, SLIGHTLY FRACTURED TO FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 72%, REC 87%. @16.6'; Qu = 4737 PSI			46		63	NQ2-1											CORE	
@25.2'; Qu = 4635 PSI			85		98	NQ2-2											CORE	
	972.7	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:56 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

105/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-006-1-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 225+54, 49' LT.	EXPLORATION ID B-007-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 S3	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1001.9 (MSL) EOB: 26.0 ft.	PAGE 1 OF 1
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.086881, -81.502563	

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
UNCONTROLLED FILL (LARGE ROCK AND BOULDER)	1001.9																	
	997.4	4	8 16 12	37	72	SS-1	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST		6	5 7 7	19	67	SS-2	-	15	42	35	- 8 -		NP	NP	NP	9	A-1-b (0)	
		9	6 8 8	21	67	SS-3	-	32	33	31	- 4 -		NP	NP	NP	7	A-1-b (0)	
	990.9																	
LOOSE, BROWN, **FINE SAND**, AND COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, MOIST		12	3 3 3	8	72	SS-4	-	10	39	42	- 9 -		NP	NP	NP	7	A-3 (0)	
	987.4	14	8 15 50/5"	-	47	SS-5	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR																
AUTOGER REFUSAL @ 16'	985.9	16	50/1"	-	-	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, MODERATELY WEATHERED, MODERATELY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 80%, REC 90%.		17	48		48	NX-1											CORE	
@ 18.8' TO 19.2'; Qu = 5,120 PSI		21	85		100	NX-2											CORE	
@ 24.6' TO 25.35'; Qu = 6,200 PSI	975.9	EOB 26	94		100	NX-3											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 20 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:08 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

106/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-007-0-15	DRAWN JJH	CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 226+26, 95' LT.	EXPLORATION ID B-007-1-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 993.7 (MSL) EOB: 37.0 ft.	PAGE 1 OF 1
START: 4/13/17 END: 4/13/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087115, -81.502620	

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
LOOSE TO MEDIUM DENSE, BLACK BECOMING LIGHT BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST	993.7		1 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	20	A-1-b (V)	
	987.9		3 4 3	10	100	SS-2A	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
						SS-2B	-	-	-	-	-	-	-	-	-	15	A-4a (V)	
LOOSE, GRAY, **SANDY SILT**, TRACE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, MOIST @10.0' TO 11.5'; BECOMES ORANGISH BROWN AND GRAY, CONTAINS IRON STAINING			3 2 2	6	56	SS-3	-	5	8	37	40	10	NP	NP	NP	15	A-4a (3)	
	978.2		4 4 6	15	100	SS-4A	-	-	-	-	-	-	-	-	-	15	A-4a (V)	
						SS-4B	-	38	26	14	16	6	NP	NP	NP	11	A-1-b (0)	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST	975.4																	
HARD, BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	972.7	TR	3 10 50/2"	-	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
SANDSTONE, LIGHT BROWN BECOMING ORANGISH BROWN WITH BROWN, HIGHLY WEATHERED, FINE TO COARSE GRAINED, FRIABLE.			50/3"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	961.7																	
@32.0' TO 37.0'; NO RECOVERY, POSSIBLE SANDSTONE			0		0	NQ2-1											CORE	
	956.7	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 14.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 60 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:56 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

107/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-007-1-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+29, 97' LT.	EXPLORATION ID B-007-2-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 960.6 (MSL) EOB: 57.0 ft.	PAGE 1 OF 1
START: 4/6/17 END: 4/6/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087379, -81.502491	

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, DARK BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP	960.6		2 4 14	26	44	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	955.6																	
MEDIUM STIFF TO VERY STIFF, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP			4 4 11	22	89	SS-2	3.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
			5 6 7	19	89	SS-3	2.5 - 3.75	21	13	19	32	15	19	15	4	10	A-4a (2)	
			7 50/3"	-	78	SS-4	0.6 - 1.25	-	-	-	-	-	-	-	-	12	A-4a (V)	
	943.1																	
VERY DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, WET			60/2"	-	100	SS-5	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
	939.1																	
VERY STIFF, GRAY AND BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP																		
	935.1	TR	4 38 50/2"	-	71	SS-6A SS-6B	3.0 - 3.2 -	12 -	11 -	9 -	32 -	36 -	39 -	22 -	17 -	14 12	A-6b (9) Rock (V)	
SHALE, GRAY AND DARK GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE.			5 50/5"	-	82	SS-7	-	-	-	-	-	-	-	-	-	11	Rock (V)	
			49 50/1"	-	86	SS-8	-	-	-	-	-	-	-	-	-	11	Rock (V)	
	923.6																	
INTERBEDDED SHALE (76%) AND SILTSTONE (24%), RQD 15%, REC. 77%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 44.8' - 45.1' AND 52.8' - 53.1', MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.			0		34	NQ2-1											CORE	
			7		85	NQ2-2											CORE	
@49.5'; Qu = 9344 PSI (SILTSTONE)			35		95	NQ2-3											CORE	
			16		93	NQ2-4											CORE	
	903.6	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 60 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062366- MS-SUM-8-1.75E. PRJ WRK\E. ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

108/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-007-2-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 227+64, 24' LT.	EXPLORATION ID B-008-1-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 958.3 (MSL) EOB: 68.0 ft.	PAGE 1 OF 2
START: 6/24/19 END: 6/25/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087395, -81.502198	

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, BLACK, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WITH WOOD FRAGMENTS, MOIST	958.3		9 19 28	70	78	SS-1	-	41	19	23	13	4	NP	NP	NP	29	A-1-b (0)	
HARD, GRAY, **SILT AND CLAY**, "AND" STONE FRAGMENTS, LITTLE SAND, WITH WOOD FRAGMENTS, (NOT ENOUGH MATERIAL TO TEST), DAMP	954.8		9 9 11	30	33	SS-2	4.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
			8 10 14	36	33	SS-3	4.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
@8.5'; STIFF			6 9 11	30	22	SS-4	1.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
@11.0'; VERY STIFF			7 8 11	28	17	SS-5	2.00	-	-	-	-	-	-	-	-	8	A-6a (V)	
MEDIUM DENSE TO DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, MOIST	944.8		10 10 11	31	78	SS-6	-	34	14	19	21	12	NP	NP	NP	16	A-2-4 (0)	
@16.0'; WITH WOOD FRAGMENTS			7 7 7	21	17	SS-7	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
MEDIUM DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS BOULDERS, WET	939.8		3 5 6	16	56	SS-8	-	22	44	15	13	6	18	14	4	17	A-1-b (0)	
			11 16 24	59	33	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			60	-	100	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 97%; **SHALE**, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10".	933.0	TR	0		83	NQ2-1											CORE	
			0		90	NQ2-2											CORE	
			30		97	NQ2-3											CORE	
@39.3' - 40.3'; SHALE Sc = 1719 psi @40.6' - 41.2'; HIGH ANGLE FRACTURE @41.2' - 41.6'; SANDSTONE γ = 160 pcf; Qu = 2,800 psi			18		100	NQ2-4											CORE	
@44.8' - 47.3'; SANDSTONE @45.4'; VERY THIN CLAY SEAM @46.6' - 47.0'; SANDSTONE γ = 161 pcf; Qu = 6,090 psi @47.4' - 47.7'; SHALE γ = 161 pcf; Qu = 808 psi @48.3' - 50.1'; SHALE Sc = 1642 psi			70		97	NQ2-5											CORE	
@51.2' - 52.2'; HIGH ANGLE FRACTURE @52.4' - 53.4'; HIGH ANGLE FRACTURE			52		95	NQ2-6											CORE	
@54.2' - 54.6'; SANDSTONE γ = 159 pcf; Qu = 6,320 ps @54.7' - 55.1'; SANDSTONE γ = 159 pcf; Qu = 5,450 psi			68		95	NQ2-7											CORE	
@58.1' - 58.5'; SHALE γ = 160 pcf; Qu = 1,379 psi @58.6' - 59.1'; HIGH ANGLE FRACTURE @59.5' - 59.9'; SHALE γ = 161 pcf; Qu = 1,587 psi																		

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 8/24/19 17:19 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-01.75 2019 ODOT.GPJ

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 227+64, 24' LT.	START: 6/24/19	END: 6/25/19	PG 2 OF 2	B-008-1-19

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
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 97%; **SHALE**, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10". *(continued)* @61.9'; VERY THIN CLAY SEAM	898.3	61 62 63 64 65 66 67	77		97	NQ2-8											CORE	
			75		93	NQ2-9											CORE	
	890.3	EOB 68																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 2 BAGS BENTONITE GROUT; TREMIED 3 BAGS CEMENT; TREMIED 120 GAL. WATER

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+80, 6' LT.	EXPLORATION ID B-009-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 957.7 (MSL) EOB: 77.5 ft.	PAGE 1 OF 2
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087417, -81.502115	

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, BROWN, DARK GRAYISH BLACK, AND REDDISH BROWN, **SANDY SILT**, SOME GRAVEL (SANDSTONE FRAGMENTS), TRACE CLAY, CONTAINS FEW ROOT HAIRS AND TRACE COAL FRAGMENTS, DAMP NO HP	957.7		5 11 4	22	50	SS-1	-	-	-	-	-	-	-	-	-	14	A-4a (V)	
SAMPLE FELL APART **(FILL)**	955.7																	
DENSE, BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT , TRACE TO LITTLE CLAY, LITTLE GRAVEL, DAMP			12 14 10	35	72	SS-2	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
(FILL)	953.2																	
VERY STIFF TO HARD, GRAY WITH ORANGISH BROWN AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP			2 6 7	19	100	SS-3	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
			2 3 4	10	44	SS-4	2.6 - 3.5	18	14	18	30	20	23	15	8	11	A-4a (3)	
@10.0' to 17.0'; BECOMES SOME GRAVEL			3 5 6	16	56	SS-5	3.1 - 4.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
@12.5' to 17.0'; BECOMES GRAY			2 5 6	16	50	SS-6	2.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
			3 4 12	23	78	SS-7	3.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	940.7																	
MEDIUM DENSE, ORANGISH BROWN BECOMING BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, 17.5' TO 21.5' CONTAINS 1.0" TO 1.5" SILTY CLAY LENSES, MOIST TO WET			5 7 5	18	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			3 4 6	15	89	SS-9	-	51	16	10	14	9	NP	NP	NP	15	A-1-b (0)	
		W 935.7																
			9 7 10	25	50	SS-10	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
	931.7	TR	9 20 50/5"	-	82	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK, FRAGMENTED.						SS-11	-	-	-	-	-	-	-	-	-	11	Rock (V)	
			15 50/4"	-	100	SS-12	-	-	-	-	-	-	-	-	-	9	Rock (V)	
			31 50/3"	-	78	SS-13	-	-	-	-	-	-	-	-	-	14	Rock (V)	
			50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
	920.7																	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.			13		38	NQ2-1											CORE	
			16		92	NQ2-2											CORE	
@47.7'; Qu = 18462 PSI (SILTSTONE)			36		99	NQ2-3											CORE	
			30		100	NQ2-4											CORE	
			7		78	NQ2-5											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/22/19 17:16 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 2 OF 2	B-009-1-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS. *(continued)* @62.4'; Qu = 9789 PSI (SILTSTONE)	897.7	61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77	39		97	NQ2-6											CORE	
			49		100	NQ2-7											CORE	
			46		98	NQ2-8											CORE	
	880.2	EOB	15		83	NQ2-9											CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 22.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 65 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/22/19 17:16 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 228+74, 105' LT.	EXPLORATION ID B-009-2-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 949.2 (MSL) EOB: 41.5 ft.	PAGE 1 OF 1
START: 4/10/17 END: 4/10/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087759, -81.502323	

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 LOOSE, DARK BROWN AND BLACK, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAINS WOOD FRAGMENTS AND ROOTS, WET	949.2		WOH 1 2	4	44	SS-1	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
LOOSE, BROWN BECOMING BLACK, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, MOIST TO WET @5.0' TO 6.5'; IRON STAINING	945.9		4 3 2	7	100	SS-2	-	15	21	36	20	8	NP	NP	NP	13	A-3a (0)	
			3 1 3	6	11	SS-3	-	-	-	-	-	-	-	-	-	21	A-3a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, CONTAINS IRON STAINING, WET	935.9		5 5 6	16	100	SS-4	-	3	8	20	55	14	NP	NP	NP	23	A-4b (7)	
STIFF TO VERY STIFF, GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL AND STONE FRAGMENTS, DAMP	930.9		5 7 7	21	11	SS-5	1.75 - 3.75	-	-	-	-	-	-	-	-	13	A-4a (V)	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST	925.9		4 12 11	34	100	SS-6	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
@30.0' TO 41.5'; GRAY			4 6 11	25	89	SS-7	-	40	14	23	16	7	NP	NP	NP	9	A-1-b (0)	
			7 12 11	34	56	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	907.7	EOB	3 6 6	18	50	SS-9	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 15.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 65 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062268- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 229+64, 106' LT.	EXPLORATION ID B-009-3-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 910.8 (MSL) EOB: 36.5 ft.	PAGE 1 OF 1
START: 4/11/17 END: 4/11/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087988, -81.502206	

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
LOOSE, ORANGISH BROWN AND BLACK, **FINE SAND**, LITTLE COARSE SAND, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING AND ROOT HAIRS, MOIST	910.8		1 3 2	7	100	SS-1	-	-	-	-	-	-	-	-	-	17	A-3 (V)	
MEDIUM DENSE, ORANGISH BROWN AND BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE TO LITTLE CLAY, CONTAINS ANTHRACITE COAL FRAGMENTS AND IRON STAINING, MOIST	907.5		4 5 4	13	89	SS-2	-	-	-	-	-	-	-	-	-	15	A-2-4 (V)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE GRAVEL, WET	902.5		4 3 4	10	100	SS-3	-	1	1	64	24	10	NP	NP	NP	21	A-3a (0)	
@15.0' TO 16.5'; IRON STAINING			3 4 5	13	89	SS-4	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN BECOMING GRAY AND ORANGISH BROWN, **SANDY SILT**, LITTLE GRAVEL AND STONE FRAGMENTS, TRACE TO LITTLE CLAY, CONTAINS IRON STAINING, DAMP TO MOIST	892.5		3 4 5	13	89	SS-5	1.25 - 2.25	-	-	-	-	-	-	-	-	21	A-4a (V)	
@25.0'; 1.25" ORANGISH BROWN SILT SEAM			2 4 4	12	100	SS-6	2.75 - 4.0	16	14	19	36	15	NP	NP	NP	13	A-4a (3)	
VERY LOOSE, GRAY, **SILT**, TRACE SAND, TRACE CLAY, SAMPLE IS NP, NO HP, DAMP	882.5																	
SHALE, GRAY, SEVERELY WEATHERED.	880.5	TR	3 24 50/4"	-	88	SS-7A	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
						SS-7B	-	-	-	-	-	-	-	-	-	13	Rock (V)	
	874.3	EOB	37 42 50/6"	-	83	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 19.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 57 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

114/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-009-3-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 231+15, 100' LT.	EXPLORATION ID B-009-4-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 882.7 (MSL) EOB: 40.2 ft.	PAGE 1 OF 1
START: 2/1/17 END: 2/1/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.088367, -81.501986	

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 VERY STIFF, BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, @0.0' TO 1.5'; CONTAIN ROOTS AND BRICK FRAGMENTS, DAMP TO MOIST **(FILL)**	882.7		1 2 7	13	78	SS-1	1.25 - 1.5	-	-	-	-	-	-	-	-	22	A-4a (V)	
			5 6 8	21	100	SS-2	2.25 - 2.75	17	14	30	26	13	19	16	3	13	A-4a (1)	
	872.7																	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL AND STONE FRAGMENTS, DAMP TO MOIST		W 868.7	1 2 3	7	56	SS-3	0.5 - 1.0	-	-	-	-	-	-	-	-	11	A-6b (V)	
	866.4		2 6 50/3"	-	60	SS-4	0.75 - 1.25	-	-	-	-	-	-	-	-	15	A-6b (V)	
VERY DENSE, GRAY, **SILTY CLAY**, (BOULDER ZONE, HIGHLY FRACTURED SHALE), DAMP			6 11 48	87	100	SS-5	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
	857.2	TR	18 50/5"	-	73	SS-6A SS-6B	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	A-6b (V) Rock (V)	
SHALE, GRAY, MODERATELY WEATHERED, EASILY AUGERED.	852.5																	
@30.0' to 30.2', NO RECOVERY			60/2"		0	SS-7	-	-	-	-	-	-	-	-	-	-		
SHALE, GRAY AND DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, LAMINATED TO THIN BEDDED, MODERATELY FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 34.1' - 34.3' AND 36.9' - 37.1', SLIGHTLY TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 94%. @32.3'; Qu = 7964 PSI (SHALE)			75		94	NQ2-1											CORE	
	842.5	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 14.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 45 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/23/19 11:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

115/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-009-4-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 527+89, 29' RT.	EXPLORATION ID B-009-5-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 960.3 (MSL) EOB: 41.5 ft.	PAGE 1 OF 1
START: 6/26/19 END: 7/1/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087362, -81.501727	

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
BROWN, **SILT AND CLAY**, SOME STONE FRAGMENT, SOME SAND, DAMP	960.3																	
	958.8	TR																
SANDSTONE, BROWNISH GRAY AND LIGHT GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, MEDIUM TO COARSE GRAINED. NOTE: AUGERS ADVANCED TO SET CORE BARREL		1	60/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		2																
		3																
		4																
		5																
@6.0' - 8.5'; FINE TO MEDIUM GRAINED		6	60/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	2	Rock (V)	
		7																
		8																
	951.8		60/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG, MEDIUM TO GRAVEL GRAINED, THIN BEDDED, SLIGHTLY FRIABLE, OCCASSIONAL RUST STAINING, CONTAINS LAYERS OF MEDIUM TO COARSE GRAINED, BLOCKY, GOOD; RQD 75%, REC 100%.		9						-	-	-	-	-	-	-	-	7		
		10	56		100	NQ2-1											CORE	
		11																
		12																
		13																
		14	78		100	NQ2-2											CORE	
@14.9' - 15.3'; γ = 142 pcf; Qu = 4,630 psi		15																
		16																
@16.4'; LIGHT GRAY WITH BROWN, MEDIUM TO COARSE GRAINED WITH OCCASIONAL GRAVEL		17																
@17.6' - 18.0'; γ = 142 pcf; Qu = 5,110 psi		18																
	941.7																	
@18.4'; GRAY		19	40		87	NQ2-3											CORE	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 37%, REC. 90%; **SHALE**, GRAYISH BLACK, HIGHLY TO MODERATELY WEATHERED, VERY WEAK TO WEAK, LAMINATED TO VERY THIN BEDDED, CONTAINS SLIGHTLY ARENACESOUS LAYERS, RANGES IN THICKNESS 0.5" TO 10", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 4".		20																
		21																
		22																
		23																
		24	10		75	NQ2-4											CORE	
@21.3' - 21.9'; HIGH ANGLE FRACTURE		25																
@21.8' - 22.7'; SHALE Sc = 627 psi		26																
@22.6' - 24.6'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS		27																
@26.1' - 27.8'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS		28																
@27.5'; MODERATELY WEATHERED, BLOCKY, GOOD		29	37		95	NQ2-5											CORE	
@29.6' - 30.6'; HIGH ANGLE FRACTURE		30																
@30.6'; SLIGHTLY WEATHERED		31																
@30.6' - 31.4'; SHALE Sc = 1,184 psi		32																
@31.8' - 32.8'; SHALE Sc = 1,286 psi		33																
@32.8' - 33.4'; HIGH ANGLE FRACTURE		34	52		98	NQ2-6											CORE	
		35																
		36																
@36.8' - 37.5'; HIGH ANGLE FRACTURE		37																
@38.0' - 39.4'; SHALE Sc = 1,028 psi		38																
		39	72		100	NQ2-7											CORE	
		40																
	918.8	41 EOB																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 1 BAG BENTONITE GROUT; TREMIED 1 BAG CEMENT; TREMIED 50 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/24/19 17:19 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 230+96, 20' LT.	EXPLORATION ID B-009-6-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / MCINTOSH	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 881.3 (MSL) EOB: 42.5 ft.	PAGE 1 OF 1
START: 6/5/19 END: 6/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088239, -81.501739	

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
BROWN, **SILT AND CLAY**, CONTAINS COBBLES AND BOULDERS	881.3																	
	879.8																	
MEDIUM DENSE, GRAY AND BLACK, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET			6 4 7	15	44	SS-1	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
			4 5 4	12	44	SS-2	-	44	17	25	10	4	NP	NP	NP	16	A-1-b (0)	
	875.3																	
DENSE, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGEMENTS, LITTLE CLAY, MODERATELY ORGANIC (LOI=4.1%), WET			0 18 24	57	56	SS-3	-	30	8	19	30	13	NP	NP	NP	43	A-4a (2)	
@8.5'; VERY LOOSE, GRAYISH BROWN, NO ORGANICS			1 1 2	4	67	SS-4	-	-	-	-	-	-	-	-	-	18	A-4a (V)	
	870.3																	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, LITTLE STONE FRAGMENTS, MOIST			6 6 9	20	67	SS-5	1.00	10	7	26	30	27	29	18	11	20	A-6a (5)	
	867.8																	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, DAMP			10 7 9	22	33	SS-6	4.5+	30	5	8	32	25	27	17	10	14	A-4a (4)	
	865.3																	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP			37 41 40	109	56	SS-7	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
			48 63	-	83	SS-8	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
			0		22	NQ2-1											CORE	
	858.9	TR																
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 88%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, VERY WEAK TO WEAK, LAMINATED, SLIGHTLY ARENACEOUS, RANGES IN THICKNESS 0.5" TO 4", BLOCKY, GOOD; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 1.5". @23.2' - 24.2'; SHALE, Sc = 842 psi @24.7' 25.3'; BROKEN, HIGHLY TO MODERATELY WEATHERED WITH CORE LOSS @27.5' - 28.4'; SHALE, Sc = 1,220 psi			43		88	NQ2-2											CORE	
			72		100	NQ2-3											CORE	
@30.5' - 30.9'; SANDSTONE γ = 159 pcf; Qu = 6,387 psi	850.4																	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, INTACT, VERY GOOD; RQD 100%, REC 100%. @31.0' - 31.4'; SANDSTONE γ = 152 pcf; Qu = 12,996 psi	848.5																	
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 91%, REC. 100%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 11", BLOCKY, GOOD; **SHALE**, DARK GRAY AND GRAYISH BLACK, SLIGHTLY WEATHERED, WEAK, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5". @35.2' - 35.6'; γ = 160 pcf; Qu = 1,240 psi @35.7' - 36.1'; γ = 161 pcf; Qu = 1,656 psi			92		100	NQ2-4											CORE	
@39.5' - 39.9'; γ = 161 pcf; Qu = 1,823 psi			90		100	NQ2-5											CORE	
	838.8	EOB																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; PLACED 120 IN. TRIM PIPE; TREMIED 30 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/24/19 17:19 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 530+84, 30' RT.	EXPLORATION ID B-009-7-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 885.2 (MSL) EOB: 55.0 ft.	PAGE 1 OF 1
START: 6/4/19 END: 6/5/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088116, -81.501328	

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
Topsoil - 5"	885.2																	
LOOSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	884.9		4 3 2	7	56	SS-1	-	35	16	17	19	13	21	16	5	11	A-2-4 (0)	
MEDIUM STIFF, GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP	881.7		2 2 3	7	39	SS-2	0.50	29	12	16	24	19	25	17	8	14	A-4a (2)	
LOOSE, BLACK WITH BROWN, **STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET	879.2		2 2 3	7	39	SS-3	-	59	13	16	8	4	NP	NP	NP	20	A-1-a (0)	
@8.5'; MEDIUM DENSE, CONTAINS COBBLES AND BOULDERS	874.2		2 7 3	14	22	SS-4	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
MEDIUM DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS ROOTS, MODERATELY ORGANIC (LOI=7.5%), WET	871.7		6 6 3	12	50	SS-5	-	48	5	15	12	20	NP	NP	NP	55	A-2-4 (0)	
DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP	869.2		4 12 19	42	11	SS-6	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, DAMP	866.7		11 15 15	41	67	SS-7	3.50	48	7	8	22	15	27	18	9	11	A-4a (0)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS) @ 18.5' - 25.0'; ENCOUNTERED COBBLES AND BOULDERS	860.2		13 39 50	120	72	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
			31 33 33	89	100	SS-9	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
			43 48 60	146	39	SS-10	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP	853.2	TR					-	60	3	6	17	14	24	15	9	12	A-2-4 (0)	
			0		68	NQ2-1	-	-	-	-	-	-	-	-	-	-	CORE	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, BLOCKY, GOOD; RQD 79%, REC 100%. @ 33.7' - 34.1'; SANDSTONE γ = 150 pcf; Qu = 13,112 psi	850.1		43		55	NQ2-2											CORE	
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 85%, REC. 99%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 1" TO 6", BLOCKY, GOOD; **SHALE**, DARK GRAY, SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5". @36.3' - 39.0'; SHALE Sc = 1,753 psi @36.4' - 36.8'; γ = 163 pcf; Qu = 1,783 psi @39.0' - 39..2'; MODERATELY WEATHERED			90		100	NQ2-3											CORE	
@43.8' - 44.0'; MODERATELY WEATHERED			83		100	NQ2-4											CORE	
@47.7'; VERY THIN CLAY SEAM @49.4' - 49.9'; γ = 158 pcf; Qu = 1,985 psi @50.4' - 50.9'; MODERATELY WEATHERED, WITH LOSS @51.1' - 51.6'; LIMESTONE, VERY STRONG, THIN BEDDED @51.1' - 51.6'; LIMESTONE Sc = 28,950 psi @52.5' - 52.9'; γ = 162 pcf; Qu = 2,012 psi			87		100	NQ2-5											CORE	
@54.7' - 55.0'; LIMESTONE, VERY STRONG, THIN BEDDED	830.2	EOB	80		97	NQ2-6											CORE	

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; TREMIED 30 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 8/24/19 17:19 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 531+07, 13' LT.	EXPLORATION ID B-010-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088190, -81.501356	

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
LOOSE, GRAVEL, DAMP (FILL)	879.2		3 2 2	5	44	SS-1	1.00	10	6	6	40	38	45	21	24	26	A-7-6 (15)	
MEDIUM STIFF, BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL AND SAND, MOIST	875.2		6 6 7	17	78	SS-2	-	-	-	-	-	-	-	-	-	10	A-6b (V)	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, CONTAINS SHALE FRAGMENTS, (SEVERELY WEATHERED SHALE), MOIST	874.2		7 7 25	43	67	SS-3	-	5	7	7	53	28	39	19	20	9	A-6b (12)	
			13 14 20	45	72	SS-4	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
			22 28 30	78	78	SS-5	-	-	-	-	-	-	-	-	-	13	A-6b (V)	
			25 28 30	78	100	SS-6	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
	860.7																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, (BOULDER ZONE), DAMP			26 50/5"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
			50/4"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	855.7	TR	0		33	NX-1											CORE	
SHALE, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, ARGILLACEOUS; RQD 31%, REC 63%.	852.8		46		75	NX-2											CORE	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, INTACT; RQD 63%, REC 98%. @ 28.5' TO 29.0'; Qu = 4,380 PSI	850.2		63		98	NX-3											CORE	
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, LAMINATED, ARGILLACEOUS; RQD 94%, REC 100%.			94		100	NX-4											CORE	
			98		100	NX-5											CORE	
@ 41.8' TO 42.2'; Qu = 3,840 PSI	834.2	EOB	100		100	NX-6											CORE	

NOTES: CAVE @ 14'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/22/19 15:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

119/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-010-0-15	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 534+14, 19' RT.	EXPLORATION ID B-010-1-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 875.0 (MSL) EOB: 45.0 ft.	PAGE 1 OF 1
START: 6/24/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088968, -81.500925	

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, BROWN, **SILT AND CLAY**, LITTLE SAND AND ROCK FRAGMENT, DAMP	875.0		6 6 9	20	89	SS-1	4.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
			6 6 8	19	56	SS-2	4.00	-	-	-	-	-	-	-	-	26	A-6a (V)	
	866.5		7 4 3	9	72	SS-3	4.00	12	4	9	46	29	37	23	14	26	A-6a (9)	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, SOME CLAY, MOIST TO WET			3 4 4	11	100	SS-4	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
			2 3 3	8	100	SS-5	-	7	48	44	-	1 -	NP	NP	NP	17	A-1-b (0)	
	861.4																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, DAMP		W 861.0	11 17 21	51	83	SS-6	-	43	22	29	-	6 -	NP	NP	NP	9	A-1-b (0)	
	858.7		33 50/4"	-	100	SS-7	-	16	39	38	-	7 -	NP	NP	NP	9	A-1-b (0)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, (FILL), DRY																		
@ 18.0' TO 22.0'; SILTSTONE BOULDER FRAGMENT			0		42	NX-1											CORE	
			0		17	NX-2											CORE	
@ 22.0' TO 25.0'; AUGERED THROUGH WITHOUT SAMPLING.																		
			0		17	NX-3											CORE	
@ 27.0' TO 31.0'; LIMESTONE BOULDER			54		96	NX-4											CORE	
			40		57	NX-5											CORE	
			0		83	NX-6											CORE	
			0		22	NX-7											CORE	
	833.6	TR																
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 38%, REC. 57%; **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 41.8' TO 42.35'; Qu = 3,440 PSI			75		100	NX-8											CORE	
			0		13	NX-9											CORE	
	830.0	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 90 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

120/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-010-1-15	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 534+13, 15' RT.	EXPLORATION ID B-010-2-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 875.0 (MSL) EOB: 23.6 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088970, -81.500941	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST	875.0		13 15 9	32	72	SS-1	-	8	47	38	-	7 -	NP	NP	NP	12	A-1-b (0)	
			50/4"	-	100	SS-2	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	869.0																	
VERY STIFF TO HARD, BROWN AND GRAY, **CLAY**, "AND" SILT, LITTLE SAND AND GRAVEL, MOIST TO WET			6 8 4	16	83	SS-3	2.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
			6 11 12	31	83	SS-4	3.00	-	-	-	-	-	-	-	-	30	A-7-6 (V)	
			4 6 7	17	72	SS-5	3.00	-	-	-	-	-	-	-	-	32	A-7-6 (V)	
		W 860.0	6 7 37	59	67	SS-6	4.50	12	2	8	40	38	42	20	22	33	A-7-6 (13)	
			9 11 12	31	72	SS-7	3.50	-	-	-	-	-	-	-	-	33	A-7-6 (V)	
			8 11 11	29	67	SS-8	4.00	-	-	-	-	-	-	-	-	37	A-7-6 (V)	
	853.5		22 50/3"	-	71	SS-9	4.00	-	-	-	-	-	-	-	-	38	A-7-6 (V)	
AUGER REFUSAL IN CLAY STONE BOULDERS	851.4	EOB	50/1"	-	-	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: CAVE @ 16; ADD WATER @ 22'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47.2 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 231+23, 36' LT.	EXPLORATION ID B-011-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 50.0 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089047, -81.501288	

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
UNCONTROLLED FILL (ROCK AND BOULDERS)	879.2																	
	877.2																	
MEDIUM STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND AND GRAVEL, MOIST TO WET			2 3 31	45	72	SS-1	1.00	14	7	12	36	31	41	20	21	36	A-7-6 (11)	
	873.7																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK AND GRAVEL, WET @ 6.0' TO 7.0'; HARSH PETROLEUM SMELL			2 3 2	7	78	SS-2	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
			5 7 6	17	67	SS-3	1.25	14	7	19	33	27	35	24	11	29	A-6a (5)	
	868.2																	
VERY DENSE, GRAY, **SILT AND CLAY**, (BOULDER ZONE, SHALE), DAMP			11 13 23	48	72	SS-4	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
			15 9 13	29	78	SS-5	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
	862.7	TR	42 50/6"	-	83	SS-6A SS-6B	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	A-6a (V) Rock (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.			38 50/6"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	855.5		50/3"	-	-	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 26.3' TO 26.9'; Qu = 3,840 PSI (SANDSTONE)			96		100	NX-1											CORE	
			93		97	NX-2											CORE	
			93		100	NX-3											CORE	
			98		98	NX-4											CORE	
			100		100	NX-5											CORE	
@ 47.2' TO 47.8'; Qu = 3,910 PSI (SHALE)			100		100	NX-6											CORE	
	829.2	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 50 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/22/19 15:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

122/181

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-011-0-15

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 234+16, 13' LT.	EXPLORATION ID B-011-1-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 875.1 (MSL) EOB: 5.2 ft.	PAGE 1 OF 1
START: 6/24/15 END: 6/24/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089035, -81.501286	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	875.1		8 14 14	37	89	SS-1	-	44	13	34	- 9 -		NP	NP	NP	5	A-1-b (0)	
	870.1		17 15 16	41	50	SS-2	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
@ 5.0' TO 5.2'; AUGER REFUSED UNKNOWN MATERIAL, BORING TERMINATED.	869.9	EOB	50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-		

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

123/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-011-1-15	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 533+38, 43' RT.	EXPLORATION ID B-011-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 872.6 (MSL) EOB: 71.0 ft.	PAGE 1 OF 2
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.088750, -81.500946	

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
ASPHALT (4.0") & BASE (7.0")	872.6 / 871.7																	
VERY STIFF TO HARD, GRAYISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**			12 11 8	26	100	SS-1	2.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@5.0' TO 6.5'; CHANGES TO MEDIUM STIFF TO VERY STIFF, GREENISH BROWN AND GRAYISH BROWN, CONTAINS CINDERS	865.1		3 2 3	7	100	SS-2	0.75 - 2.75	24	15	21	27	13	24	17	7	15	A-4a (1)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP	862.6		7 5 3	11	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
MEDIUM DENSE, ORANGISH BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST	860.6		3 4 5	12	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
HARD, GRAYISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	858.1		15 50/4"	-	80	SS-5	4.0 - 4.25	30	16	16	24	14	25	17	8	11	A-4a (1)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, (SILTSTONE), DAMP	855.1		50/5"	-	80	SS-6	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	853.1		9 21 50/5"	-	59	SS-7	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTSTONE), WET	850.6		19 7 18	34	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	847.6		6 27 28	75	67	SS-9	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE, SHALE), DAMP	844.6	TR	39 17 28	61	100	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FISSILE.	843.1		20 50/4"	-	90	SS-11A SS-11B	-	-	-	-	-	-	-	-	-	12 -	A-2-6 (V) Rock (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED.	840.8		50/3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	16	Rock (V)	
INTERBEDDED SILTSTONE (54%) AND SHALE (46%), RQD 42%, REC. 100%; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, CONTAINS CLAY SEAMS, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 37.4' - 37.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; **SHALE**, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, FISSILE.	830.6		38		100	NQ2-1											CORE	
			47		100	NQ2-2											CORE	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. @44.1'; Qu = 3331 PSI (SHALE) @48.1'; Qu = 10278 PSI (SILTSTONE)			39		99	NQ2-3											CORE	
			60		100	NQ2-4											CORE	
@52.9'; Qu = 8084 PSI (SILTSTONE)			55		100	NQ2-5											CORE	
			73		100	NQ2-6											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/22/19 15:55 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

124/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-011-2-16	DRAWN JJH CHECKED YLZ

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 533+38, 43' RT. | START: 4/3/17 | END: 4/4/17 | PG 2 OF 2 | B-011-2-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. *(continued)*	812.6	61																	
		62																
		63																
		64	42		100	NQ2-7											CORE	
		65																
		66																
		67																
		68	72		100	NQ2-8											CORE	
		69																
		70																
	801.6	EOB 71																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 1 BAG ASPHALT PATCH; PUMPED 65 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/22/19 15:55 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 533+69, 6' RT.	EXPLORATION ID B-011-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 873.8 (MSL) EOB: 45.5 ft.	PAGE 1 OF 1
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.088868, -81.501030	

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
ASPHALT (6.0")	873.8																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW CINDERS, MOIST **(FILL)**	873.3		4 6 10	22	39	SS-1A	2.0 - 4.5+	-	-	-	-	-	-	-	-	19	A-4a (V)	
	872.2					SS-1B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	870.8																	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, DAMP **(FILL)**	868.3		3 3 4	9	72	SS-2	1.5 - 3.5	25	13	19	28	15	25	18	7	14	A-4a (2)	
LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW CINDERS, DAMP **(FILL)**	865.8		2 2 2	5	61	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST **(FILL)**	862.8		2 2 3	7	72	SS-4	1.1 - 2.75	-	-	-	-	-	-	-	-	14	A-4a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS CINDERS, MOIST **(FILL)**	860.8	W 860.8	3 5 9	19	56	SS-5	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
VERY LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET	859.4		1 1 14	20	83	SS-6A	-	-	-	-	-	-	-	-	-	29	A-3a (V)	
						SS-6B	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
MEDIUM DENSE TO VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE AND SHALE), DAMP		▼	13 17 20	50	67	SS-7	-	48	13	14	17	8	21	16	5	10	A-1-b (0)	
			31 50/5"	-	73	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			50/3"	-	67	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	851.3																	
HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP	849.3		18 28 50/5"	-	88	SS-10A	4.3 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
						SS-10B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST			50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	846.3																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, CONTAINS 1.0" BY 2.0" COARSE GRAVEL PIECE, MOIST	843.8		36 50/5"	-	82	SS-12	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	
SILTSTONE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK.		TR																
			50/6"	-	67	SS-13	-	-	-	-	-	-	-	-	-	10	Rock (V)	
	838.3																	
INTERBEDDED SHALE (57%) AND SILTSTONE (43%), RQD 47%, REC. 99%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, DISINTEGRATED FROM 36.3' - 36.5', GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG, JOINT DISCONTINUITY: HIGH ANGLE FROM 38.8' - 39.0'.	828.3	EOB	47		99	NX-1											CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 13.0' DURING DRILLING, 16.1' AFTER DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 55 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/23/19 12:21 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75_2016.GPJ

126/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-011-3-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 234+26, 15' LT.	EXPLORATION ID B-011-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 875.0 (MSL) EOB: 55.0 ft.	PAGE 1 OF 1
START: 3/31/17 END: 4/3/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089076, -81.501281	

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, GRAYISH BROWN AND BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING (STONE FRAGMENTS ARE SILTSTONE), DAMP **(FILL)**	875.0		14 13 14	37	67	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
MEDIUM DENSE, GRAYISH BROWN AND BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**	872.0		6 9 12	28	78	SS-2	-	-	-	-	-	-	-	-	-	12	A-2-4 (V)	
@6.0' TO 7.5'; CHANGES TO VERY DENSE, GRAY AND ORANGISH BROWN			9 27 38	88	78	SS-3	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP	867.0	W	10 13 44	77	61	SS-4	-	51	10	5	21	13	28	19	9	7	A-2-4 (0)	
			19 22 22	60	89	SS-5	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), DRY	862.0		50/6"	-	67	SS-6	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP	861.0		10 24 50/2"	-	79	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP	857.0		13 22 50/4"	-	94	SS-8	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP	854.5		15 29 50	107	78	SS-9	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP @23.5' TO 24.4'; NO HP, SAMPLE CRUMBLED	852.5		10 50/5"	-	91	SS-10	-	37	17	8	21	17	30	20	10	10	A-4a (1)	
VERY DENSE, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC	849.0		20 36 32	92	78	SS-11	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
			31 23 14	50	89	SS-12	-	-	-	-	-	-	-	-	-	16	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), MOIST	842.0		50/5"	-	80	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, (SILTSTONE COBBLE), DRY	840.0		0		18	NX-1										1	CORE	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	835.0		26 29 32	83	67	SS-14	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
SHALE, GRAY, SEVERELY WEATHERED.	832.2	TR	50/3"	-	33	SS-15	-	-	-	-	-	-	-	-	-	14	Rock (V)	
INTERBEDDED SHALE (63%) AND SILTSTONE (37%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO SLICKENSIDED, INTACT TO BLOCKY, GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG. @50.0'; Qu = 2492 PSI (SHALE)	830.0		76		98	NX-2											CORE	
	820.0	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 11.0' BEFORE DRILLING ON 4/3/2017, 8.0' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 66 GAL. BENTONITE GROUT

127/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-011-4-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 234+65, 60' LT.	EXPLORATION ID B-011-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 875.2 (MSL) EOB: 80.0 ft.	PAGE 1 OF 2
START: 4/3/17 END: 4/3/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089221, -81.501383	

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
DARK BROWN AND BLACK, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	874.2		4 7 8	22	100	SS-1	3.9 - 4.5+	-	-	-	-	-	-	-	-	22	A-4a (V)	
VERY STIFF TO HARD, DARK GRAY AND GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS COAL AND BRICK FRAGMENTS, FEW ROOTS AND MANY WOOD FRAGMENTS, MOIST **(FILL)**	872.2		1 2 2	6	83	SS-2	1.9 - 2.9	-	-	-	-	-	-	-	-	19	A-4a (V)	
STIFF TO VERY STIFF, GRAYISH BROWN MOTTLED WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS DECAYED ROOT, MOIST	869.7																	
MEDIUM DENSE, GRAY MOTTLED WITH BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW IRON STAINS, WET	867.2	W	5 3 6	13	67	SS-3	-	2	4	24	56	14	NP	NP	NP	25	A-4b (7)	
MEDIUM DENSE, GRAY WITH BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST	865.2		5 5 4	13	78	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL AND STONE FRAGMENTS (SHALE), LITTLE CLAY, DAMP		▼	4 14 13	40	44	SS-5	3.9 - 4.5+	31	11	10	36	12	23	18	5	13	A-4a (3)	
@13.5' to 15.0'; BECOMES "AND" GRAVEL AND STONE FRAGMENTS	860.2		6 11 12	34	50	SS-6	3.4 - 4.5+	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	857.2		11 18 18	54	78	SS-7	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS**, (SHALE), DAMP	854.7		11 14 15	43	83	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE CLAY, TRACE SILT, DAMP	852.2		14 18 31	73	100	SS-9	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	850.2		11 23 38	91	78	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP	837.7	TR	10 15 19	51	33	SS-11	4.5+	22	17	7	27	27	32	20	12	9	A-6a (5)	
			9 15 18	49	78	SS-12	4.5+	-	-	-	-	-	-	-	-	9	A-6a (V)	
			11 14 25	58	89	SS-13	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
SHALE, GRAY, HIGHLY WEATHERED, FRAGMENTED.	835.2		50/3"	-	33	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT.			40		99	NQ-1											CORE	
@48.7'; Qu = 1384 PSI (SHALE)			61		96	NQ-2											CORE	
@54.8'; Qu = 12128 PSI (SILTSTONE)			79		100	NQ-3											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062366 - MS-SUM-8-1.75E. PRJ WRKE_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 2 OF 2	B-011-5-16

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
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. *(continued)*	815.2	61 62 63 64 65 66 67 68 69 70	80		98	NQ-4											CORE	
	802.6	71 72 73 74																
SHALE, DARK GRAY, UNWEATHERED, WEAK TO MODERATELY STRONG, THINLY LAMINATED TO LAMINATED, FISSILE, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, INTACT, GOOD TO VERY GOOD SURFACE CONDITION; RQD 100%, REC 100%.		75 76 77 78 79	97		100	NQ-5											CORE	
	795.2	EOB 80																

NOTES: GROUNDWATER ENCOUNTERED AT 8.0' DURING DRILLING, 11.3' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 54 GAL. BENTONITE GROUT

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 234+91, 174' LT.	EXPLORATION ID B-011-6-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 901.6 (MSL) EOB: 30.0 ft.	PAGE 1 OF 1
START: 4/3/18 END: 4/3/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.089401, -81.501735	

MATERIAL DESCRIPTION AND NOTES	ELEV. 901.6	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
STIFF, BROWN AND GRAY, **SILTY CLAY**, TRACE GRAVEL, MOIST			4 4 8	16	94	SS-1	1.50	-	-	-	-	-	-	-	-	21	A-6b (V)	
			3 8 9	23	100	SS-2	1.50	-	-	-	-	-	-	-	-	24	A-6b (V)	
	895.6																	
STIFF, BROWN AND GRAY, **SILT**, SOME CLAY AND LITTLE SAND, DAMP			7 9 14	31	100	SS-3	1.75	0	4	8	58	30	23	21	2	18	A-4b (8)	
	893.6																	
DENSE, BROWN AND GRAY, **SILT**, LITTLE CLAY AND SAND, TRACE GRAVEL, MOIST					88	ST-1	NP	0	3	8	77	12	NP	NP	NP	19	A-4b (8)	
	891.6																	
VERY STIFF, BROWN AND GRAY, **SILT**, AND CLAY, TRACE SAND AND GRAVEL, DAMP			6 13 18	41	89	SS-4	NI	0	1	5	52	42	28	21	7	16	A-4b (8)	
			6 12 19	41	100	SS-5	NI	-	-	-	-	-	-	-	-	18	A-4b (V)	
			7 9 8	23	100	SS-6	2.50	-	-	-	-	-	-	-	-	26	A-4b (V)	
	883.1																	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, DAMP			5 10 12	29	100	SS-7	1.50	0	3	14	25	58	28	16	12	16	A-6a (9)	
	881.6																	
STIFF, GRAY, **SANDY SILT**, DAMP TO MOIST			6 7 9	21	100	SS-8	1.25	-	-	-	-	-	-	-	-	16	A-4a (V)	
			5 5 9	19	100	SS-9	1.75	-	-	-	-	-	-	-	-	21	A-4a (V)	
	876.6																	
STIFF, GRAY, **SILTY CLAY**, MOIST			4 5 6	15	100	SS-10	2.00	-	-	-	-	-	-	-	-	26	A-6b (V)	
	874.1																	
STIFF, GRAY, **SANDY SILT**, TRACE CLAY, MOIST			9 12 15	36	94	SS-11	1.50	-	-	-	-	-	-	-	-	21	A-4a (V)	
	872.0																	
DENSE, BROWN, **FINE SAND**, MOIST	CPS: 1 871.6	EOB				SS-11	-	-	-	-	-	-	-	-	-	19	A-3 (V)	

NOTES: CAVE IN AT 27.4'. NI - NOT INTACT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 533+54, 26' RT.	EXPLORATION ID B-011-7-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 872.6 (MSL) EOB: 50.0 ft.	PAGE 1 OF 1
START: 6/28/19 END: 6/28/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.088809, -81.500980	

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
MOIST ASPHALT (3.0") & BASE (9.0")	872.6																	
	871.6						-	-	-	-	-	-	-	-	-	-	A-3a (V)	
LIGHT BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	871.1	1					-	-	-	-	-	-	-	-	-	-	A-4a (V)	
	870.6	2					-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	869.9	3			100		-	-	-	-	-	-	-	-	-	-	A-4a (V)	
BLACK, **COARSE AND FINE SAND**, BRICK FRAGMENTS, (FILL), MOIST		4					1.00	-	-	-	-	-	-	-	-	-		
STIFF, GREY, **SANDY SILT**, SOME CLAY, SOME ROCK FRAGMENTS, COAL FRAGMENTS, (FILL), MOIST @ 5.0'; GREY TO BROWN, LITTLE GRAVEL, TRACE TERRACOTTA PIPE		5																
		6																
		7			100		1.50	-	-	-	-	-	-	-	-	-	A-4a (V)	
		8																
	863.6	9																
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, BRICK FRAGMENTS, LITTLE SILT, TRACE CLAY, (FILL), MOIST TO WET @ 10.0' TO 12.0'; WET		10					-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		11																
		12					-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	860.1	13			70													
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, MOIST TO DAMP		14					-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		15																
@ 15.0'; BROWN AND ORANGE MOTTLING		16																
		17			92		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		18																
		19																
		20																
	851.0	21					-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, (BOULDER ZONE), MOIST TO DAMP @ 21.6'; 5" (DIA.) WELL ROUNDED COBBLE @ 23.5'; "AND" CLAY		22			88													
		23					-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
		24																
	847.6	25																
HARD, GREY, **SILT AND CLAY**, LITTLE GRAVEL, (BOULDER ZONE), DAMP TO MOIST	846.8	26					-	-	-	-	-	-	-	-	-	-	A-6a (V)	
GREY, **STONE FRAGMENTS**, SOME SILT, (BOULDER ZONE: SILTSTONE AND SHALE), DRY		27			92		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
		28																
	843.9	29 TR																
INTERBEDDED SILTSTONE (80%) AND SHALE (20%); **SILTSTONE**, LIGHT GREY, HIGHLY WEATHERED, WEAK; **SHALE**, GREY, HIGHLY WEATHERED, WEAK.	842.6	30					-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SILTSTONE (67%) AND SHALE (33%), RQD 40%, REC. 66%; **SILTSTONE**, LIGHT GREY, UNWEATHERED, MODERATELY STRONG TO STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED TO MODERATELY FRACTURED; **SHALE**, DARK GREY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS. @ 30.6' TO 31.0'; QU = 13,190 PSI (SILTSTONE)	840.1	31																
	839.4	32	40		66	NX-1											CORE	
		33																
		34																
LIMESTONE, LIGHT GREY, UNWEATHERED, VERY STRONG, THIN BEDDED; RQD 40%, REC 66%. @ 32.5' TO 32.9'; QU = 19,920 PSI (LIMESTONE)		35																
		36																
		37	14		76	NX-2											CORE	
		38																
		39																
INTERBEDDED SHALE (56%) AND SILTSTONE (44%), RQD 31%, REC. 85%; **SHALE**, DARK GREY, MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, FRACTURED TO MODERATELY FRACTURED. @ 36.3' TO 37.6'; AVG SC VALUE = 3006 PSI (SHALE AND SILTSTONE) @ 42.9' TO 43.3'; GREY CLAY INFILLING @ 44.1' TO 44.2'; GREY CLAY INFILLING		40																
		41																
		42																
		43	23		88	NX-3											CORE	
		44																
		45																
		46																
@ 46.0' TO 49.0'; SANDSTONE INTERBEDS		47	54		98	NX-4											CORE	
		48																
		49																
@ 49.0'; 70 DEGREE, HIGH ANGLE FRACTURE @ 49.6' TO 50.0'; HIGHLY FRACTURED, GREY CLAY INFILLING	822.6	50 EOB																

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE PELLETS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/16/20 18:05 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 234+36, 19' LT.	EXPLORATION ID B-011-8-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 875.0 (MSL) EOB: 70.0 ft.	PAGE 1 OF 2
START: 6/28/19 END: 7/1/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.089106, -81.501282	

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
GRAVEL BASE (12") @ 0.6'; "AND" SAND	875.0																	
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, DRY @ 2.5'; GREY AND BROWN ROCK FRAGMENTS @ 3.0'; SOME VERY STIFF SANDY SILT, LITTLE CLAY	874.0				100		-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP @ 6.3'; COLOR CHANGE TO GREY, BOULDERS	871.0						-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					94		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					92		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	859.0						-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE), DAMP @ 16.6'; HARD SILT AND CLAY WITH ROCK FRAGMENTS @ 16.9'; ROCK FRAGMENTS, SAND AND SILT; SILTSTONE (BOULDER) @ 17.2'; SILTSTONE (BOULDER) @ 17.6'; SILTSTONE (BOULDER) @ 19.0'; GREY SILT AND CLAY WITH ROCK FRAGMENTS					100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	854.0				75		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
GREY, **GRAVEL**, (BOULDER ZONE), MOIST @ 26.0'; ROCK FRAGMENTS, LITTLE SAND, TRACE SILT AND CLAY, WET @ 26.0' TO 28.4'; WET					16		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	847.0				100		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
GREY, **STONE FRAGMENTS WITH SAND AND SILT**, (BOULDER ZONE), WET TO MOIST @ 29.0'; 5" (DIA.) SILTSTONE COBBLE							-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					96		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	835.0	TR																
SILTSTONE, GREY, HIGHLY WEATHERED, WEAK, VERY THIN BEDDED.					100		-	-	-	-	-	-	-	-	-	-	Rock (V)	
	825.7				96		-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%), RQD 22%, REC. 74.5%; **SHALE**, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. @ 51.9' TO 52.7'; QU = 5,380 PSI (SHALE AND SILTSTONE) @ 54.9'; MECHANICAL BREAK @ 55.0'; VERY WEAK SHALE @ 55.2' TO 55.9'; 8" GREY CLAY @ 55.9' TO 59.6'; MODERATELY STRONG @ 56.4' TO 57.6'; QU = 5,110 PSI (SHALE AND SILTSTONE)			32		74	NX-1											CORE	
			30		92	NX-2											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/16/20 18:05 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\COMBINE BORING\SUM-8-01.75 2019 ODOT.GPJ

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 234+36, 19' LT.	START: 6/28/19	END: 7/1/19	PG 2 OF 2	B-011-8-19

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
@ 59.6'; HIGHLY WEATHERED, VERY WEAK, VERY BLOCKY WITH CLAY INFILLING **INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%)**, RQD 22%, REC. 74.5%; **SHALE**, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. *(continued)* @ 60.1' TO 61.2'; CLAY INFILLED SHALE, HIGHLY WEATHERED, VERY WEAK, HIGHLY FRACTURED @ 61.2' TO 65.0'; FRACTURED TO VERY FRACTURED @ 65.0' TO 66.1'; SLIGHTLY STRONG @ 65.1' TO 65.7'; QU = 5140 PSI (SHALE AND SILTSTONE) @ 66.1' TO 69.6'; WEAK, HIGHLY FRACTURED. @ 69.6' TO 69.9'; VERY STRONG	815.0	61 62 63 64 65	0		58	NX-3											CORE	
		66 67 68 69	26		74	NX-4											CORE	
	805.0	EOB 70																

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 6 BAGS BENTONITE PELLETS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 535+57, 13' RT.	EXPLORATION ID B-012-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 880.2 (MSL) EOB: 45.9 ft.	PAGE 1 OF 1
START: 6/16/15 END: 6/16/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.58	LAT / LONG: 41.089338, -81.500755	

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, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY TO DAMP	880.2		4 6 9	20	17	SS-1	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
			9 9 6	20	83	SS-2	-	41	22	29	8	-	NP	NP	NP	6	A-1-b (0)	
@ 6.0'; VERY LOOSE			3 2 1	4	72	SS-3	-	39	26	28	7	-	NP	NP	NP	13	A-1-b (0)	
	870.7		6 12 9	28	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
STIFF, GRAY TO BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET TO MOIST			9 14 10	32	61	SS-5	2.00	6	13	19	33	29	28	21	7	30	A-4a (5)	
	866.7	TR																
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.			18 23 19	56	67	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			15 16 15	42	89	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			10 19 22	55	100	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	858.3		38 50/5"	-	91	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 14%, REC. 90%; **SHALE**, DARK GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, ARGILLACEOUS; **SANDSTONE**, GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE GRAINED, VERY THIN BEDDED.			13		92	NX-1											CORE	
			18		80	NX-2											CORE	
			8		87	NX-3											CORE	
	839.3		15		100	NX-4											CORE	
INTERBEDDED SHALE (55%) AND SANDSTONE (45%), RQD 33%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, MODERATELY STRONG, VERY FINE GRAINED, LAMINATED TO THIN BEDDED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 41.4' TO 41.8'; Qu = 6,300 PSI			33		100	NX-5											CORE	
	834.3	EOB																

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 48 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 235+76, 12' LT.	EXPLORATION ID B-013-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 877.6 (MSL) EOB: 61.0 ft.	PAGE 1 OF 2
START: 6/16/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.58	LAT / LONG: 41.089461, -81.501070	

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, BROWN TO GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST TO DAMP	877.6		13 8 5	17	39	SS-1	-	43	35	17	- 5 -		NP	NP	NP	8	A-1-b (0)	
			4 5 6	15	67	SS-2	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
MEDIUM STIFF, BROWN TO GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST TO DAMP	871.1		4 2 3	7	72	SS-3	1.00	-	-	-	-	-	-	-	-	15	A-4a (V)	
	866.6	W 866.6	2 3 3	8	78	SS-4	1.00	9	14	18	33	26	25	20	5	27	A-4a (5)	
LOOSE TO MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET			3 3 4	9	100	SS-5	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	862.6		9 6 10	21	83	SS-6	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET			14 12 15	36	83	SS-7	-	45	23	29	- 3 -		NP	NP	NP	18	A-1-b (0)	
			8 11 11	30	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			6 12 14	35	83	SS-9	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
			6 12 12	32	78	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			12 18 24	56	89	SS-11	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			14 15 15	40	78	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
	846.6																	
HARD, GRAY, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, (FILL), WET			18 25 50	101	83	SS-13	4.50	-	-	-	-	-	-	-	-	27	A-4b (V)	
			14 20 31	68	78	SS-14	4.50	7	13	12	50	18	29	22	7	27	A-4b (7)	
	841.6	TR																
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.			23 50/2"	-	75	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	838.8		50/3"	-	100	SS-16	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 66%, REC. 97%; **SHALE**, DARK GRAY, MODERATELY TO HIGHLY WEATHERED, WEAK TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, FINE GRAINED, THIN BEDDED. @ 42.5' TO 42.9'; VERTICAL FRACTURE			83		100	NX-1											CORE	
@ 45.6' TO 45.9'; VERTICAL FRACTURE			45		100	NX-2											CORE	
@ 51.5' TO 52.1'; Qu = 6,740 PSI (SHALE)			63		100	NX-3											CORE	
@ 55.3' TO 56.0'; Qu = 5,280 PSI (SANDSTONE)			58		87	NX-4											CORE	
			92		100	NX-5											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

135/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-013-0-15	DRAWN JJH CHECKED YLZ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 235+78, 12' LT.	START: 6/16/15	END: 6/26/15	PG 2 OF 2	B-013-0-15

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
	817.6																	
	816.6	EOB 61																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 122 LB. BENTONITE CHIPS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 236+50. 123' LT.	EXPLORATION ID B-013-1-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 909.5 (MSL) EOB: 60.0 ft.	PAGE 1 OF 1
START: 6/24/15 END: 6/24/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089756, -81.501347	

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, DARK BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DRY	909.5		5 3 4	9	94	SS-1	4.00	14	2	7	44	33	25	22	3	16	A-4a (8)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	905.8		3 3 5	11	83	SS-2	-	48	17	30	- 5 -		NP	NP	NP	18	A-1-b (0)	
VERY STIFF TO HARD, BROWN, **SILT**, SOME CLAY, TRACE SAND AND GRAVEL, DRY	903.5		4 5 7	16	100	SS-3	3.00	-	-	-	-	-	-	-	-	18	A-4b (V)	
			5 7 11	24	100	SS-4	3.00	-	-	-	-	-	-	-	-	16	A-4b (V)	
			6 8 16	32	100	SS-5	4.50	5	1	5	53	36	26	21	5	18	A-4b (8)	
			4 4 5	12	100	SS-6	4.50	-	-	-	-	-	-	-	-	17	A-4b (V)	
VERY STIFF TO HARD, BROWN TO GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DRY	893.7		4 5 7	16	100	SS-7	4.5+	-	-	-	-	-	-	-	-	15	A-4a (V)	
			4 5 12	23	100	SS-8	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
			8 15 20	47	100	SS-9	4.5+	-	-	-	-	-	-	-	-	18	A-4a (V)	
			7 9 11	27	100	SS-10	4.00	7	3	22	34	34	26	22	4	16	A-4a (7)	
			8 8 14	29	100	SS-11	3.00	-	-	-	-	-	-	-	-	19	A-4a (V)	
DENSE TO VERY DENSE, BROWN TO GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	881.2		19 25 34	79	83	SS-12	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
			15 12 15	36	100	SS-13	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			9 12 15	36	100	SS-14	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			7 8 15	31	89	15	-	41	20	36	- 3 -		NP	NP	NP	5	A-1-b (0)	
@ 43.5'; WATER		W 866.0	8 20 24	59	100	SS-16	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
			12 16 23	52	100	SS-17	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
@ 45'; WATER ADDED			26 31 36	90	100	SS-18	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	849.5	EOB	8 15 23	51	89	SS-19	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 120 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:12 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 536+16, 44' RT.	EXPLORATION ID B-013-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/7/15	ELEVATION: 880.5 (MSL) EOB: 85.0 ft.	PAGE 1 OF 2
START: 3/30/17 END: 3/31/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089458, -81.500570	

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, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW PORCELAIN FRAGMENTS, DAMP **(FILL)**	880.5		4 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
VERY LOOSE, DARK BROWN AND BLACK, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS TRACE BLACK ORGANICS, LOI = 1.8% ASH, MOIST **(FILL)**	877.5		1 2 1	4	39	SS-2	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
VERY LOOSE TO LOOSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST **(FILL)** @6.0' TO 7.5'; CONTAINS 2.0" SILTY CLAY SEAM	875.0		2 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
	870.0		1 1 1	3	39	SS-4	-	-	-	-	-	-	-	-	-	19	A-3a (V)	
LOOSE TO MEDIUM DENSE, GRAY AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST TO WET			2 3 3	9	83	SS-5	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
			6 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
			3 4 4	12	100	SS-7	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
	860.0		3 3 2	7	100	SS-8	-	38	31	12	14	5	NP	NP	NP	17	A-1-b (0)	
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET	856.8		3 5 14	28	100	SS-9	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
VERY STIFF TO HARD, GRAY, **SILT AND CLAY**, SOME GRAVEL, SOME SAND, RELIC SHALE STRUCTURE, DAMP			7 13 15	42	100	SS-10	3.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
			10 23 27	75	100	SS-11	4.5+	28	16	8	27	21	30	17	13	11	A-6a (4)	
	851.5	TR	20 30 45	112	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK TO WEAK, BECOMES MORE INDURATED WITH DEPTH.			15 34 50/5"	-	100	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			18 20 34	81	100	SS-14	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	836.8		50/3"		100	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS.			29		100	NQ2-1											CORE	
			16		77	NQ2-2											CORE	
@53.4'; Qu = 683 PSI (SHALE INTERBEDDED WITH SILTSTONE)			29		84	NQ2-3											CORE	
@55.8'; Qu = 11709 PSI (SILTSTONE)			61		100	NQ2-4											CORE	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 10/29/18 15:57 - W:\062366- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-013-2-16

DRAWN JJH
CHECKED YLZ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 2 OF 2	B-013-2-16

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
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE. FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS. *(continued)* @63.4'; Qu = 942 PSI (SHALE)	820.5	61	79		100	NQ2-5											CORE	
		65	55		100	NQ2-6											CORE	
		70	87		98	NQ2-7											CORE	
		75	95		100	NQ2-8											CORE	
		80	98		100	NQ2-9											CORE	
	795.5	EOB 85																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 85 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 536+52, 6' RT.	EXPLORATION ID B-013-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 56.0 ft.	PAGE 1 OF 1
START: 3/27/17 END: 3/28/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089588, -81.500652	

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, DARK BROWN CHANGING TO BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST **FILL** @1.0' TO 2.5'; CONTAINS CONCRETE AND ANTHRACITE COAL FRAGMENTS	885.5		7 6 6	16	89	SS-1	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	881.6					SS-2A	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, DAMP **FILL** @6.0' TO 7.5'; CONTAINS 1.0" GRAY SILTY CLAY SEAM			7 7 5	16	61	SS-2B	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
			6 11 13	32	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	877.5																	
LOOSE, DARK BROWN CHANGING TO DARK BROWN WITH BLACK AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE TO SOME SILT, TRACE CLAY, STONE FRAGMENTS ARE SANDSTONE, DAMP TO WET **FILL** @8.5' TO 10.0'; CONTAINS TRACE ANTHRACITE COAL FRAGMENTS @11.0' TO 12.5'; CONTAINS TRACE BLACK ROOTS			3 3 4	9	78	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			6 3 3	8	56	SS-5	-	-	-	-	-	-	-	-	-	26	A-1-b (V)	
	872.0																	
MEDIUM STIFF TO STIFF, BLACK AND GRAY, **SILT AND CLAY**, "AND" SAND, ORGANIC, CONTAINS TRACE BLACK ROOTS, LOI = 7.2% ASH, MOIST		▼ 24 hr	3 2 1	4	72	SS-6	0.75 - 1.7	0	6	42	38	14	38	24	14	32	A-6a (5)	
	870.0																	
MEDIUM DENSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST			5 3 5	11	67	SS-7	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	
	867.5	W																
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, TRACE TO LITTLE SAND, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE SILTSTONE, WET			9 11 7	24	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-a (V)	
	865.0																	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET		W	20 20 20	54	72	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			20 16 16	43	72	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			12 18 20	51	67	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
@28.5' TO 30.0'; GRAVEL IS ROUNDED TO SUBROUNDED			9 14 14	38	61	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			12 22 24	62	67	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			8 43 33	103	72	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	842.0	TR																
SILTSTONE, GRAY, SEVERLY WEATHERED, MODERATELY ARGILLACEOUS.			84/6"	-	33	SS-15	-	-	-	-	-	-	-	-	-	13	Rock (V)	
	839.5																	
SILTSTONE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, PYRITIC, MODERATELY ARGILLACEOUS, CONTAINS FEW THIN SHALE SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 47.1° - 47.5', FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD TO VERY GOOD SURFACE CONDITION; RQD 78.4%, REC 99.3%.	836.9		65		92	NX-1											CORE	
INTERBEDDED SHALE (69%) AND SILTSTONE (31%), RQD 26.1%, REC. 77.7%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BECOMES FISSILE AT 53.0', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURES FROM 50.8' - 51.0', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, POOR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG. @51.3'; Qu = 10916 PSI (SILTSTONE)			11		72	NX-2											CORE	
	829.5	EOB	52		91	NX-3											CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING, 23.5' BEFORE CORING, 15.0' UPON COMPLETION. CAVE DEPTH 29.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 80 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 10/29/18 15:57 - W:\062268- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 236+44, 2' RT.	EXPLORATION ID B-013-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 85.5 ft.	PAGE 1 OF 2
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089616, -81.500934	

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 WITH DARK GRAY AND GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, CONTAINS FEW ROOTS, DAMP **(FILL)**	885.5		4 6 5	16	67	SS-1	3.2 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST	883.0		3 3 2	7	100	SS-2	1.25 - 2.2	-	-	-	-	-	-	-	-	16	A-4a (V)	
VERY LOOSE TO LOOSE, ORANGISH BROWN BECOMING ORANGISH BROWN WITH LIGHT GRAY, **SILT**, SOME SAND, LITTLE CLAY, LITTLE GRAVEL, MOIST TO WET	880.0		1 1 1	3	97	SS-3	-	12	12	12	51	13	NP	NP	NP	17	A-4b (6)	
			2 2 3	7	100	SS-4	-	-	-	-	-	-	-	-	-	22	A-4b (V)	
VERY LOOSE TO MEDIUM DENSE, YELLOWISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, 11.0' TO 15.0' CONTAINS FEW ROOTS, MOIST TO WET @11.0' TO 17.5'; NO HP, NON PLASTIC	875.0		2 1 2	4	100	SS-5	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@13.5' TO 15.0'; BECOMES GRAYISH BROWN WITH ORANGISH BROWN, TRACE CLAY			2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@16.0' TO 17.5'; BECOMES ORANGISH BROWN	867.5	W	3 5 5	15	94	SS-7	-	0	12	47	23	18	NP	NP	NP	23	A-4a (1)	
LOOSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, LITTLE CLAY, WET	865.0		3 3 3	9	72	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
MEDIUM DENSE, GRAY, **SANDY SILT**, TRACE CLAY, WET @21.0' TO 22.5'; NO HP, NON PLASTIC	862.5		4 4 6	15	100	SS-9	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP	860.0		6 10 7	25	67	SS-10	-	47	11	9	24	9	NP	NP	NP	14	A-2-4 (0)	
DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST			11 15 15	45	83	SS-11	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			6 11 11	33	83	SS-12	-	37	28	18	13	4	NP	NP	NP	12	A-1-b (0)	
			10 10 15	37	78	SS-13	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
			10 18 18	54	78	SS-14	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			10 21 15	54	94	SS-15	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			19 19 25	66	83	SS-16	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	844.5																	
	841.1	TR	17 50/5"	-	100	SS-17	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
INTERBEDDED SHALE (65%) AND SILTSTONE (35%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. @47.8'; Qu = 12151 PSI (SILTSTONE)				64		95	NQ-1												CORE
			70		99	NQ-2												CORE

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062268- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 2 OF 2	B-013-4-16

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
INTERBEDDED SHALE (65%) AND SILTSTONE (35%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. *(continued)* @62.1'; Qu = 11803 PSI (SILTSTONE) @68.5'; Qu = 3028 PSI (SHALE)	825.5	61	62		99	NQ-3											CORE	
		66	88		99	NQ-4												CORE	
		76	89		100	NQ-5												CORE	
	800.0	EOB 85																	

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 75 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:57 - W:\062366- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-013-4-16 (CONT')

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 236+87, 43' LT.	EXPLORATION ID B-013-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 913.5 (MSL) EOB: 77.0 ft.	PAGE 1 OF 2
START: 3/29/17 END: 3/30/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089770, -81.501026	

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, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**	913.5		4 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
@3.5' TO 5.0'; CHANGES TO VERY LOOSE			2 1 1	3	72	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE), CONTAINS IRON STAINING, DAMP **(FILL)**	908.0		5 5 5	14	61	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
STIFF TO HARD, ORANGISH BROWN BECOMING ORANGISH BROWN MOTTLED WITH GRAY, **SILT**, TRACE SAND, TRACE CLAY, CONTAINS IRON STAINING, WET	906.0	▼ 24 hr	3 3 5	11	78	SS-4	1.1 - 2.5	-	-	-	-	-	-	-	-	27	A-4b (V)	
			3 4 8	16	100	SS-5	1.0 - 2.5	0	2	8	80	10	27	24	3	29	A-4b (8)	
			3 7 9	22	89	SS-6	1.25 - 3.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
			2 7 9	22	100	SS-7	2.0 - 3.5	-	-	-	-	-	-	-	-	29	A-4b (V)	
			5 8 11	26	100	SS-8	1.25 - 4.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
			5 6 9	20	89	SS-9	2.0 - 4.5+	-	-	-	-	-	-	-	-	32	A-4b (V)	
			3 5 7	16	100	SS-10	1.75 - 3.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
MEDIUM STIFF TO VERY STIFF, ORANGISH BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, WET	888.0	W	3 8 11	26	100	SS-11	0.5 - 3.2	-	-	-	-	-	-	-	-	30	A-6a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET	886.0		8 10 11	28	100	SS-12	1.25 - 3.9	-	-	-	-	-	-	-	-	31	A-4b (V)	
@31.0' TO 32.5'; BROWN WITH ORANGISH BROWN AND GRAY, NO HP, NO SOIL PLUG			2 11 11	30	56	SS-13	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE GRAVEL, TRACE CLAY, DAMP	880.5		6 8 10	24	89	SS-14	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
MEDIUM STIFF, GRAY, **SILT**, TRACE TO LITTLE SAND, TRACE TO LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, WET	878.0		1 2 3	7	83	SS-15	0.5 - 0.8	-	-	-	-	-	-	-	-	39	A-4b (V)	
@38.5' TO 39.3'; STIFF TO VERY STIFF, ORANGISH BROWN,	874.2		5 10 11	28	100	SS-16A	1.8 - 3.5	-	-	-	-	-	-	-	-	33	A-4b (V)	
MEDIUM DENSE, DARK BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP	873.0					SS-16B	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
VERY SOFT TO SOFT, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, WET @41.0' TO 42.5'; NO HP, NO SOIL PLUG	870.5		1 1 1	3	100	SS-17	-	0	0	14	75	11	18	16	2	29	A-4b (8)	
LOOSE TO MEDIUM DENSE, GRAY, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, TRACE GRAVEL, WET		W	3 3 4	9	100	SS-18	-	-	-	-	-	-	-	-	-	26	A-3 (V)	
			1 2 6	11	89	SS-19	-	-	-	-	-	-	-	-	-	24	A-3 (V)	
DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST	865.5		6 9 14	31	78	SS-20	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
			13 16 17	45	78	SS-21	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
MEDIUM STIFF TO STIFF, GRAY, **SILT**, TRACE SAND, TRACE CLAY, TRACE GRAVEL, WET	860.0		5 8 10	24	89	SS-22	0.75 - 1.7	-	-	-	-	-	-	-	-	31	A-4b (V)	
MEDIUM DENSE TO DENSE, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET	855.0		6 6 8	19	100	SS-23	-	0	1	19	66	14	NP	NP	NP	25	A-4b (8)	

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 236+87, 43' LT. | START: 3/29/17 | END: 3/30/17 | PG 2 OF 2 | B-013-5-16

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, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET *(continued)*	853.5	61 62 63 64																
		64	4 7 19	35	94	SS-24	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTY SHALE AND GRANITE), MOIST	848.6	65 66 67 68																
		69	12 23 17	54	50	SS-25	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
@71.0'; ENCOUNTERED GRANITE BOULDER (GLACIAL ERRATIC)	842.0	TR 70 71																
INTERBEDDED SILTSTONE (85%) AND SHALE (15%), RQD 20%, REC. 76%; **SILTSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THINLY LAMINATED, MODERATELY ARGILLACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 75.4' - 75.6', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO VERY BLOCKY, DISINTEGRATED FROM 73.9' - 74.8', FAIR TO GOOD SURFACE CONDITION; **SHALE**, GRAY, MODERATELY STRONG, SILTY, PYRITIC. @71.6'; Qu = 9267 PSI (SILTSTONE) @75.0'; Qu = 24283 PSI (SILTSTONE)		72	31		67	NX-1												CORE	
		74	0		81	NX-2												CORE
		76	25		81	NX-3												CORE
	836.5	EOB 77																

NOTES: GROUNDWATER ENCOUNTERED AT 45.5' DURING DRILLING, 27.0' BEFORE CORING, 7.5' AFTER DRILLING, CAVE DEPTHS 7.7' AND 70.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 100 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:58 - W:\062366- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 238+53, 60' LT.	EXPLORATION ID B-014-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 923.4 (MSL) EOB: 70.0 ft.	PAGE 1 OF 2
START: 7/7/15 END: 7/7/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090211, -81.500864	

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 STIFF, BLACK, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP	923.4		1 2 2	5	72	SS-1	-	10	10	18	39	23	28	21	7	26	A-4a (5)	
SOFT, BLACKISH BROWN, **CLAY**, SOME SAND, LITTLE GRAVEL AND SILT, MOIST	919.4		1/12" 1	-	78	SS-2	0.50	-	-	-	-	-	-	-	-	28	A-7-6 (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, MOIST	917.4		7 5 5	13	17	SS-3	-	29	7	36	12	16	NP	NP	NP	29	A-2-4 (0)	
SOFT TO MEDIUM STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST TO WET	914.9		7 8 6	19	17	SS-4	0.40	8	7	7	55	23	40	19	21	30	A-6b (12)	
@ 11.0' TO 16.0'; STIFF TO VERY STIFF			4 7 7	19	83	SS-5	2.25	-	-	-	-	-	-	-	-	34	A-6b (V)	
			5 6 6	16	78	SS-6	2.00	-	-	-	-	-	-	-	-	35	A-6b (V)	
			4 4 5	12	89	SS-7	1.00	-	-	-	-	-	-	-	-	33	A-6b (V)	
			4 5 6	15	83	SS-8	0.50	-	-	-	-	-	-	-	-	36	A-6b (V)	
			4 7 8	20	83	SS-9	0.50	7	7	9	55	22	36	20	16	34	A-6b (10)	
		W 900.4	3 5 6	15	89	SS-10	0.75	-	-	-	-	-	-	-	-	36	A-6b (V)	
			5 9 11	27	94	SS-11	0.50	9	5	9	50	27	37	21	16	37	A-6b (10)	
			9 10 13	31	94	SS-12	0.40	-	-	-	-	-	-	-	-	38	A-6b (V)	
	883.9		15 15 18	44	39	SS-13	0.25	-	-	-	-	-	-	-	-	33	A-6b (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET			11 18 17	47	67	SS-14	-	29	21	44	- 6 -		NP	NP	NP	15	A-1-b (0)	
@ 48.5'; LITTLE SILT AND CLAY			25 21 25	62	67	SS-15	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	868.9		21 18 24	56	67	SS-16	1.50	29	25	19	11	16	NP	NP	NP	37	A-2-4 (0)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET			18 26 33	79	61	SS-17	-	-	-	-	-	-	-	-	-	20	A-2-4 (V)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

145/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-014-0-15	DRAWN JJH CHECKED YLZ

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-1.75 | STATION / OFFSET: 238+53, 60' LT. | START: 7/7/15 | END: 7/7/15 | PG 2 OF 2 | B-014-0-15

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, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET *(continued)*	863.4	61																
		62																
		63																
		64	21 23 27	67	61	SS-18	-	32	23	10	16	19	NP	NP	NP	21	A-2-4 (0)	
		65																
		66																
		67																
		68																
		69	12 32 42	99	33	SS-19	-	-	-	-	-	-	-	-	-	22	A-2-4 (V)	
	853.4	EOB 70																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 140 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 538+82, 13' RT.	EXPLORATION ID B-015-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 961.2 (MSL) EOB: 95.0 ft.	PAGE 1 OF 2
START: 7/10/15 END: 7/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.090167, -81.500322	

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
UNCONTROLLED FILL (ROCK FRAGMENTS)	961.2		7 12 12	32	50	SS-1	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	958.9																	
MEDIUM DENSE, BLACK, RED, GRAY, AND BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY TO DAMP (POSSIBLE FILL)			9 13 9	30	56	SS-2	-	55	12	29	- 4 -		NP	NP	NP	8	A-1-b (0)	
			6 9 11	27	94	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	952.7																	
MEDIUM STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST (POSSIBLE FILL)	951.2		6 4 4	11	94	SS-4	0.75	9	11	21	30	29	28	21	7	28	A-4a (5)	
VERY LOOSE TO LOOSE, BLACKISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP (POSSIBLE FILL)			3 1 2	4	61	SS-5	-	10	22	60	- 8 -		NP	NP	NP	12	A-3 (0)	
			3 2 3	7	61	SS-6	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
	945.7																	
VERY LOOSE TO LOOSE, BROWN, **FINE SAND**, TRACE GRAVEL, COARSE SAND, SILT AND CLAY, DAMP TO WET			2 2 2	5	56	SS-7	-	5	5	85	- 5 -		NP	NP	NP	18	A-3 (0)	
		W 942.7	3 2 2	5	50	SS-8	-	-	-	-	-	-	-	-	-	21	A-3 (V)	
			1 1 2	4	72	SS-9A	-	-	-	-	-	-	-	-	-	30	A-3 (V)	
	939.0					SS-9B	0.40	5	5	34	24	32	27	20	7	34	A-4a (4)	
VERY SOFT TO MEDIUM STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET			3 3 3	8	100	SS-10	1.25	-	-	-	-	-	-	-	-	38	A-4a (V)	
@ 23.5'; BECOMES GRAY.																		
@ 23.5' To 25.5'; Stiff																		
	934.2		4 9 8	23	78	SS-11A	0.10	7	8	25	28	32	31	22	9	36	A-4a (5)	
						SS-11B	0.30	-	-	-	-	-	-	-	-	30	A-6b (V)	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET			2 5 7	16	78	SS-12	0.75	4	4	12	54	26	37	20	17	40	A-6b (11)	
			3 4 6	13	72	SS-13	0.70	-	-	-	-	-	-	-	-	38	A-6b (V)	
			2 5 5	13	89	SS-14	1.25	-	-	-	-	-	-	-	-	42	A-6b (V)	
			4 5 9	19	89	SS-15	1.00	7	2	9	56	26	38	21	17	44	A-6b (11)	
			5 6 9	20	92	SS-16	0.65	-	-	-	-	-	-	-	-	46	A-6b (V)	
			4 5 9	19	89	SS-17	0.65	-	-	-	-	-	-	-	-	43	A-6b (V)	
			4 6 7	17	78	SS-18	0.25	-	-	-	-	-	-	-	-	41	A-6b (V)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-1.75 | STATION / OFFSET: 538+82, 13' RT. | START: 7/10/15 | END: 7/10/15 | PG 2 OF 2 | B-015-0-15

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
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET *(continued)*	901.2	61																
	898.7	62																
DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		63																
		64	12 12 13	34	58	SS-19	-	27	6	36	27	4	NP	NP	NP	21	A-2-4 (0)	
	894.7	65																
DENSE, BROWN TO GRAY, **COARSE AND FINE SAND**, SOME SILT, TRACE GRAVEL AND CLAY, WET		66																
		67																
		68																
@ 69.7'; BECOMES GRAY.		69	6 9 18	36	56	SS-20	-	-	-	-	-	-	-	-	-	22	A-3a (V)	
		70																
		71																
		72																
		73																
		74	9 10 15	34	100	SS-21	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
		75																
		76																
		77																
		78																
		79	5 11 14	34	100	SS-22	-	8	28	33	26	5	NP	NP	NP	25	A-3a (0)	
		80																
		81																
	878.7	82																
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		83																
		84	15 22 26	64	100	SS-23	-	-	-	-	-	-	-	-	-	38	A-2-4 (V)	
		85																
		86																
		87																
		88																
		89	32 27 34	82	100	SS-24	-	-	-	-	-	-	-	-	-	35	A-2-4 (V)	
		90																
		91																
		92																
		93																
		94	24 17 16	44	78	SS-25	-	-	-	-	-	-	-	-	-	34	A-2-4 (V)	
	866.2	EOB 95																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 190 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 239+12, 11' LT.	EXPLORATION ID B-015-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 5/7/15	ELEVATION: 960.3 (MSL) EOB: 115.0 ft.	PAGE 1 OF 2
START: 4/5/17 END: 4/5/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89.7	LAT / LONG: 41.090310, -81.500620	

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
LOOSE, DARK BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, CONTAINS WOOD AND PLASTIC, DAMP **(FILL)** @1.0' TO 3.0'; NO HP, NON PLASTIC	960.3		2 2 2	6	39	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
	957.3																	
UNCONTROLLED FILL, CONTAINING RUBBER TIRE FRAGMENTS, PLASTIC, PAPER, FIBERGLASS, AND WOOD, MOISTURE CONTENT MAY REFLECT INNACCURATE RESULTS DUE TO LACK OF SOIL IN SAMPLES **(FILL)**			4 5 6	16	72	SS-2	-	-	-	-	-	-	-	-	-	103	UCF (V)	
			4 7 27	51	44	SS-3	-	-	-	-	-	-	-	-	-	19	UCF (V)	
			4 6 28	51	50	SS-4	-	-	-	-	-	-	-	-	-	96	UCF (V)	
			4 4 5	13	39	SS-5	-	-	-	-	-	-	-	-	-	30	UCF (V)	
@13.5' TO 15.5' MIXED WITH SANDY SILT			3 4 5	13	72	SS-6	-	-	-	-	-	-	-	-	-	20	UCF (V)	
	944.8																	
LOOSE TO MEDIUM DENSE, ORANGISH BROWN AND BLACK CHANGING TO BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS DECAYED WOOD FRAGMENTS, DAMP TO MOIST **(FILL)** @16.0' TO 17.5'; CONTAINS METAL FRAGMENTS			21 11 6	25	61	SS-7	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
			2 3 3	9	11	SS-8	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
	939.8																	
LOOSE TO VERY DENSE, BROWN, **FINE SAND**, LITTLE TO SOME COARSE SAND, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, TRACE SILT, TRACE CLAY, DAMP			2 2 2	6	72	SS-9	-	20	23	48	6	3	NP	NP	NP	8	A-3 (0)	
			1 4 6	15	50	SS-10	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
@26.0' TO 27.5'; BECOMES BROWN AND BLACK			3 5 12	25	83	SS-11	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
@28.5' TO 32.5'; BECOMES ORANGISH BROWN	FS		19 22 16	57	83	SS-12	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
			4 4 5	13	83	SS-13	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
33.5' TO 37.5'; BECOMES BROWN			5 8 9	25	67	SS-14	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			7 8 10	27	89	SS-15	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
	922.3																	
MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, CONTAINS A 1.5" GRAVEL PIECE, DAMP			7 10 10	30	17	SS-16	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
	919.8																	
MEDIUM DENSE, BROWN, **FINE SAND**, LITTLE COARSE SAND, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP	FS		4 4 5	13	72	SS-17	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
	917.3	W																
MEDIUM DENSE, DARK BROWN AND LIGHT BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET			4 6 8	21	56	SS-18	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
	914.3																	
LOOSE TO MEDIUM DENSE, BROWN, **SILT**, LITTLE TO SOME CLAY, TRACE SAND, MOIST TO WET			3 4 5	13	72	SS-19	-	-	-	-	-	-	-	-	-	31	A-4b (V)	
			2 4 4	12	100	SS-20	-	0	1	2	83	14	NP	NP	NP	33	A-4b (8)	
@51.0' TO 85.0'; BECOMES GRAY			3 3 3	9	61	SS-21	-	-	-	-	-	-	-	-	-	29	A-4b (V)	
			2 3 3	9	100	SS-22	-	-	-	-	-	-	-	-	-	28	A-4b (V)	
			4 5 5	15	100	SS-23	-	-	-	-	-	-	-	-	-	25	A-4b (V)	

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-015-1-16

DRAWN JJH
CHECKED YLZ

PID: 91710 | SFN:7700370/7700371 (P) | PROJECT: SUM-8-01.75 | STATION / OFFSET: 239+12, 11' LT. | START: 4/5/17 | END: 4/5/17 | PG 2 OF 2 | B-015-1-16

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
LOOSE TO MEDIUM DENSE, BROWN, **SILT**, LITTLE TO SOME CLAY, TRACE SAND, MOIST TO WET *(continued)*	900.3	61–63																
		64	1 2 3	7	100	SS-24	-	-	-	-	-	-	-	-	-	31	A-4b (V)	
		65–68																
		69	1 2 3	7	100	SS-25	-	-	-	-	-	-	-	-	-	33	A-4b (V)	
		70–73																
		74	1 2 3	7	100	SS-26	-	-	-	-	-	-	-	-	-	33	A-4b (V)	
		75–78																
		79				SS-27A	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
			4 5 6	16	100	SS-27B	-	-	-	-	-	-	-	-	-	30	A-4b (V)	
		80–83																
		84	3 7 8	22	100	SS-28	-	-	-	-	-	-	-	-	-	27	A-4b (V)	
		85–88																
DENSE, GRAY, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, MOIST	873.3	89	4 9 12	31	89	SS-29	-	-	-	-	-	-	-	-	-	20	A-3 (V)	
		90–93																
	866.3	94				SS-30A	-	-	-	-	-	-	-	-	-	15	A-3 (V)	
MEDIUM DENSE TO DENSE, GRAY, **SILT**, TRACE TO LITTLE CLAY, SOME TO "AND" SAND, SS-30B IS INTERBEDDED WITH CLAY, WET			10 9 12	31	100	SS-30B	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
		95–98																
		99	5 8 12	30	78	SS-31	-	0	1	39	53	7	NP	NP	NP	21	A-4b (5)	
	857.8	100–103																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST		104	28 25 20	67	44	SS-32	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	854.8	105–108																
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP		109	18 29 25	81	61	SS-33	2.25 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	848.3	110–113																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (FINE GRAINED SANDSTONE), MOIST		114	56 45 57	152	39	SS-34	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	845.3	EOB 115																

NOTES: GROUNDWATER ENCOUNTERED AT 43.0' DURING DRILLING, 89.5' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 170 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 10/29/18 15:58 - W:\062366- MS-SUM-8-1.75E. PRJ WRK\E. ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

150/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-015-1-16 (CONT')	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 240+34, 116' LT.	EXPLORATION ID B-015-2-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 993.5 (MSL) EOB: 39.0 ft.	PAGE 1 OF 1
START: 3/28/18 END: 3/28/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.090728, -81.500813	

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
17 TOPSOIL(DRILLER'S DESCRIPTION)	992.0																	
MEDIUM DENSE, GRAY, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE ORGANICS, DRY TO DAMP (FILL)	990.5		13 11 4	20	67	SS-1	NP	0	6	72	21	1	NP	NP	NP	3	A-3a (0)	
LOOSE TO MEDIUM DENSE, BROWN/BLACK, **FINE SAND**, SOME GARBAGE(SOME SPONGE), LITTLE GRAVEL, MOIST TO WET (FILL)			6 2 4	8	0	SS-2	NR	-	-	-	-	-	-	-	-	-	A-3 (V)	
			10 5 5	13	11	SS-3	NP	-	-	-	-	-	-	-	-	36	A-3 (V)	
	985.0																	
LOOSE, BROWN/BLUE, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, SOME GARBAGE(SOME PLASTIC), MOIST TO WET (FILL)	982.5		10 5 2	9	6	SS-4	NP	-	-	-	-	-	-	-	-	21	A-2-6 (V)	
MEDIUM DENSE TO DENSE, GRAY/BLUE/BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, SOME GARBAGE (PAPER, FIBERS, GLASS FRAGMENTS, PLASTIC, WOOD FRAGMENTS, AND PETROLEUM ODOR), WET (FILL)			4 6 9	20	0	SS-5	NR	-	-	-	-	-	-	-	-	-	A-1-b (V)	
			16 14 23	50	22	SS-6	NP	-	-	-	-	-	-	-	-	35	A-1-b (V)	
			7 9 11	27	67	SS-7	NP	52	17	15	15	1	NP	NP	NP	21	A-1-b (0)	
	975.5																	
STIFF, BLACK, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, SOME GARBAGE (BRICK FRAGMENTS, PLASTIC, WOOD AND ORGANICS), MOIST (FILL) (PETROLEUM ODOR NOTED IN JAR)	972.5		10 4 5	12	44	SS-8	1.25	22	15	9	44	10	33	26	7	28	A-4a (4)	
DENSE, BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, SOME GARBAGE (FIBERS, PLASTICS, WOOD AND ORGANICS), WET (FILL)	970.0		10 11 15	35	17	SS-9	NP	-	-	-	-	-	-	-	-	47	A-1-b (V)	
DENSE TO VERY DENSE, BLACK, **FINE SAND**, TRACE SILT, SOME GARBAGE (FIBERS, PLASTICS, WOOD AND ORGANICS), MOIST TO WET (FILL) (PETROLEUM ODOR NOTED IN JAR)			32 50/2"	-	0	SS-10	NP	-	-	-	-	-	-	-	-	35	A-3 (V)	
@26'; DENSE, BLACK/BROWN, SOME GRAVEL, (PETROLEUM ODOR NOTED IN JAR)			9 13 18	41	89	SS-11	NP	-	-	-	-	-	-	-	-	12	A-3 (V)	
	965.0																	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, SOME SILT, TRACE CLAY, DAMP TO MOIST (FILL)			6 8 6	19	100	SS-12	NP	-	-	-	-	-	-	-	-	8	A-3a (V)	
@31'; BLACK/GRAY, SOME GARBAGE(WOOD AND PLASTIC), GRAVEL, TRACE CLAY			5 4 22	35	100	SS-13	NP	20	23	33	23	1	NP	NP	NP	12	A-3a (0)	
@32.4'; DARK BROWN, TRACE GRAVEL			6 5 7	16	11	SS-14	NP	-	-	-	-	-	-	-	-	15	A-3a (V)	
	957.5																	
VERY DENSE, GRAY/DARK BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE WOOD, MOIST (FILL)	955.5		11 50/3"	-	11	SS-15	NP	-	-	-	-	-	-	-	-	20	A-1-b (V)	
VERY DENSE, BLACK, **FINE SAND**, SOME GARBAGE(WOOD AND PLASTIC), TRACE GRAVEL, MOIST TO WET (FILL) (PETROLEUM ODOR NOTED IN JAR)	954.5	EOB	16 50/0"	-	17	SS-16	NP	-	-	-	-	-	-	-	-	26	A-3 (V)	

NOTES: NP - NON PLASTIC, NR - NO RECOVERY

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 12:50 - W:\062388- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 BORING LOGS - ON SHEETS.GPJ

151/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-015-2-17	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75
TYPE: BRIDGE
PID: 91710 SFN: 7700370/7700371 (P)
START: 7/6/15 END: 7/6/15

DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.
SAMPLING FIRM / LOGGER: GF / S. MW.
DRILLING METHOD: 4.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: D-50 TRACK (RW)
HAMMER: DIEDRICH AUTOMATIC
CALIBRATION DATE: 4/4/15
ENERGY RATIO (%): 80.58

STATION / OFFSET: 241+03, 42' LT.
ALIGNMENT: SR 8 SB
ELEVATION: 1017.6 (MSL) EOB: 100.0 ft.
LAT / LONG: 41.090831, -81.500470

EXPLORATION ID B-016-0-15

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
MEDIUM DENSE TO DENSE, BROWN AND GRAY AND RED, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY SLAG (FILL)	1017.6		8 12 9	28	61	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			24 50/5"	-	64	SS-2	-	53	16	27	- 4 -		NP	NP	NP	8	A-1-b (0)	
@ 6.0'; BRICK FRAGMENTS			24 14 8	30	39	SS-3	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
VERY LOOSE TO LOOSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, TRACE SLAG, DRY	1009.1		2 2 2	5	28	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			1 1 1	3	61	SS-5	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
@ 13.5'; MEDIUM DENSE			5 8 9	23	53	SS-6	-	10	54	30	- 6 -		NP	NP	NP	12	A-1-b (0)	
			2 3 4	9	83	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			4 3 3	8	61	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
			2 2 2	5	83	SS-9	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
			3 3 3	8	67	SS-10	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
	990.6		5 6 5	15	78	SS-11	1.50	8	15	22	27	28	26	23	3	20	A-4a (4)	
STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	988.6																	
DENSE TO VERY DENSE, BROWNISH GRAY, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DAMP			12 9 8	23	56	SS-12	-	-	-	-	-	-	-	-	-	12	A-3 (V)	
			12 12 17	39	67	SS-13	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
			14 13 18	42	78	SS-14	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
			30 20 21	55	72	SS-15	-	29	16	47	- 8 -		NP	NP	NP	10	A-3 (0)	
F-S			12 13 20	44	72	SS-16	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
			12 13 11	32	78	SS-17	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
	969.6																	
MEDIUM DENSE, BROWNISH GRAY, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP			12 11 13	32	83	SS-18	-	11	34	52	- 3 -		NP	NP	NP	17	A-3 (0)	
F-S		W 965.6																
	963.9																	
VERY STIFF, BROWNISH GRAY, **SILTY CLAY**, SOME GRAVEL, TRACE SAND, MOIST			10 12 14	35	89	SS-19	3.00	-	-	-	-	-	-	-	-	29	A-6b (V)	
	959.6																	
DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST			9 11 12	31	67	SS-20	-	6	44	43	- 7 -		NP	NP	NP	16	A-1-b (0)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/29/19 00:24 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-1.75 | STATION / OFFSET: 241+03, 42' LT. | START: 7/6/15 | END: 7/6/15 | PG 2 OF 2 | B-016-0-15

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
DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST *(continued)*	957.6	61																
	954.4	62																
		63																
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, WET		64	9 13 12	34	67	SS-21	4.5+	1	27	13	19	40	28	22	6	27	A-4a (5)	
		65																
		66																
		67																
	949.6	68																
MEDIUM STIFF, BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, MOIST	948.1	69	17 18 22	54	61	SS-22	0.50	8	8	21	36	27	37	20	17	29	A-6b (8)	
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET		70																
		71																
		72																
		73																
		74	19 22 28	67	61	SS-23	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		75																
		76																
		77																
		78																
		79	10 12 16	38	56	SS-24	-	23	32	39	- 6 -		NP	NP	NP	18	A-1-b (0)	
		80																
		81																
		82																
		83																
		84	10 12 16	38	44	SS-25	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		85																
		86																
		87																
	929.6	88																
SOFT, BROWN, **SANDY SILT**, TRACE GRAVEL, WET		89	4 5 5	13	67	SS-26	0.25	-	-	-	-	-	-	-	-	26	A-4a (V)	
		90																
		91																
		92																
	924.1	93																
MEDIUM STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, WET		94	9 10 14	32	89	SS-27	0.75	8	8	11	50	23	39	20	19	37	A-6b (11)	
		95																
		96																
		97																
		98																
	917.6	99	10 12 16	38	94	SS-28	3.25	7	7	7	52	27	40	20	20	38	A-6b (12)	
	EOB	100																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 200 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 8/29/19 00:24 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-1.75
TYPE: BRIDGE
PID: 91710 SFN: 7700370/7700371 (P)
START: 7/8/15 END: 7/8/15

DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.
SAMPLING FIRM / LOGGER: GF / S. MW.
DRILLING METHOD: 4.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: D-50 TRACK (RW)
HAMMER: DIEDRICH AUTOMATIC
CALIBRATION DATE: 4/4/15
ENERGY RATIO (%): 80.58

STATION / OFFSET: 541+07, 87' RT.
ALIGNMENT: SR 8 NB
ELEVATION: 1024.4 (MSL) EOB: 70.0 ft.
LAT / LONG: 41.090666, -81.499769

EXPLORATION ID B-017-0-15
PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1024.4	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
5" TOPSOIL (DRILLER'S DESCRIPTION)	1023.9																	
LOOSE TO MEDIUM DENSE, BROWN AND BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP			5 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			2 2 3	7	100	SS-2	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			2 3 2	7	83	SS-3	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			3 2 3	7	61	SS-4	-	15	41	36	-	8 -	NP	NP	NP	14	A-1-b (0)	
			2 2 3	7	83	SS-5	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
@ 0.5' TO 15.0'; FILL			2 2 3	7	25	SS-6	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			3 3 4	9	83	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			3 3 3	8	67	SS-8	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	1001.4		3 4 7	15	72	SS-9	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
MEDIUM DENSE TO DENSE, BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, SILT AND CLAY, MOIST			7 9 15	32	72	SS-10	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
			10 11 13	32	94	SS-11	-	-	-	-	-	-	-	-	-	15	A-3 (V)	
			5 4 4	11	89	SS-12	-	7	17	73	-	3 -	NP	NP	NP	17	A-3 (0)	
	992.9		10 20 21	55	78	SS-13	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST			14 16 24	54	61	SS-14	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	986.4		19 15 18	44	67	SS-15	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
DENSE, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DAMP			10 11 14	34	78	SS-16	-	12	20	60	-	8 -	NP	NP	NP	15	A-3 (0)	
	980.9		12 41 29	94	39	SS-17	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP			9 12 12	32	78	SS-18	-	30	36	32	-	2 -	NP	NP	NP	12	A-1-b (0)	
	969.9		12 12 14	35	94	SS-19	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP	966.4	W 966.4				SS-20	4.25	11	22	16	28	23	28	22	6	24	A-4a (3)	
DENSE, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, WET			11 12 16	38	78	SS-21	-	10	22	60	-	8 -	NP	NP	NP	14	A-3 (0)	

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-017-0-15

DRAWN JJH
CHECKED YLZ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 541+07, 87' RT.	START: 7/8/15	END: 7/8/15	PG 2 OF 2	B-017-0-15

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
DENSE, BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, WET *(continued)* @ 61.0'; BECOMES GRAY.	964.4	61 62 63 64 65 66 67 68																
	F.S.		10 12 14	35	89	SS-22	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
	956.4																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, WET	954.4	69 EOB 70	12 20 24	59	83	23	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 140 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-017-0-15 (CONT')

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75
TYPE: NOISE WALL
PID: 91710 SFN: 7700370/7700371 (P)
START: 2/13/17 END: 2/13/17

DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH
SAMPLING FIRM / LOGGER: NEAS / K.BAME
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55X
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 12/3/15
ENERGY RATIO (%): 88.1

STATION / OFFSET: 542+26, 56' RT.
ALIGNMENT: SR 8 NB
ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.
LAT / LONG: 41.091013, -81.499713

EXPLORATION ID: B-017-1-16
PAGE 1 OF 1

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
ASPHALT (8.0") & GRANULAR BASE (7.5")	1029.2																	
	1027.9																	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			8 16 15	46	50	SS-1	-	12	52	29	4	3	NP	NP	NP	9	A-1-b (0)	
	1023.5		9 7 7	21	72	SS-2A	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
VERY STIFF, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS 1/8" GRAY CLAY LENSE, MOIST	1022.2					SS-2B	2.0 - 2.5	5	12	32	31	20	22	14	8	15	A-4a (3)	
LOOSE TO MEDIUM DENSE, BROWN AND DARK BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, DAMP TO MOIST			7 4 5	13	100	SS-3	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			7 3 5	12	100	SS-4	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
			2 3 4	10	100	SS-5	-	30	40	25	3	2	NP	NP	NP	6	A-1-b (0)	
@15.0' TO 19.0'; BECOMES DARK BROWN			1 2 4	9	78	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			1 2 3	7	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@20.0' TO 21.5'; BECOME GRAYISH BROWN AND ORANGISH BROWN			2 5 6	16	100	SS-8	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	1007.2																	
MEDIUM DENSE, BROWNISH GRAY AND ORANGISH BROWN, **COARSE AND FINE SAND**, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP			2 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
	1002.7	EOB	2 5 6	16	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 8.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 244+01, 86' LT.	EXPLORATION ID B-017-2-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1004.0 (MSL) EOB: 100.0 ft.	PAGE 1 OF 2
START: 4/4/18 END: 4/4/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.091624, -81.500238	

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
LOOSE TO MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE GRAVEL, TRACE CLAY, MOIST	1004.0		2 1 2	4	61	SS-1	-	-	-	-	-	-	-	-	-	14	A-3a (V)	
			2 3 3	8	89	SS-2	-	2	19	46	32	1	NP	NP	NP	13	A-3a (0)	
			3 4 4	11	61	SS-3	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
	994.0		3 6 7	17	72	SS-4	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, DAMP	991.5		5 5 7	16	61	SS-5	-	47	23	17	13	0	NP	NP	NP	9	A-1-b (0)	
MEDIUM DENSE, BROWN AND WHITE, **FINE SAND**, SOME GRAVEL, DAMP			11 9 10	25	67	SS-6	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
@ SS-7; HIT A GRAVEL			10 11 11	29	0	SS-7	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			4 5 5	13	67	SS-8	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
	983.0																	
MEDIUM DENSE TO DENSE, BROWN AND WHITE, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE WOOD, DAMP			5 6 6	16	61	SS-9	-	42	26	17	15	0	NP	NP	NP	8	A-1-b (0)	
			7 4 4	11	61	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			15 16 17	44	67	SS-11	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
	970.5																	
VERY STIFF, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, MOIST TO WET @ 34.3'; SAND SEAM			5 5 7	16	89	SS-12	4.00	-	-	-	-	-	-	-	-	14	A-4b (V)	
			5 6 8	19	100	SS-13	2.50	-	-	-	-	-	-	-	-	25	A-4b (V)	
	962.0																	
MEDIUM DENSE, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, MOIST TO WET			7 9 7	21	89	SS-14	1.25	0	2	31	54	13	NP	NP	NP	24	A-4b (6)	
	957.0																	
VERY STIFF, BROWN AND GRAY, **SILT**, SOME SAND, LITTLE CLAY, DAMP			3 8 7	20	67	SS-15	2.00	-	-	-	-	-	-	-	-	9	A-4b (V)	
	954.0																	
MEDIUM DENSE, BROWN, TAN AND WHITE, **FINE SAND**, SOME GRAVEL, DAMP TO MOIST			4 11 8	25	72	SS-16	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
	949.0																	
VERY STIFF, BROWN, **SANDY SILT**, MOIST			7 11 15	35	100	SS-17	2.00	-	-	-	-	-	-	-	-	23	A-4a (V)	
	944.0																	

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-1.75 | STATION / OFFSET: 244+01, 86' LT. | START: 4/4/18 | END: 4/4/18 | PG 2 OF 2 | B-017-2-17

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 STIFF TO STIFF, GRAY, **SILT**, AND CLAY, TRACE SAND, MOIST TO WET	944.0	61																
		62																
		63																
		64	4 4 5	12	89	SS-18	1.00	-	-	-	-	-	-	-	-	27	A-4b (V)	
		65																
		66																
		67																
		68																
		69	4 5 4	12	100	SS-19	0.75	0	1	4	58	37	27	25	2	25	A-4b (8)	
		70																
		71																
		72																
		73																
		74	7 9 7	21	100	SS-20	1.00	-	-	-	-	-	-	-	-	23	A-4b (V)	
		75																
		76																
		77																
		78																
		79	4 5 5	13	100	SS-21	1.00	-	-	-	-	-	-	-	-	25	A-4b (V)	
		80																
		81																
		82																
		83																
		84	4 5 6	15	100	SS-22	0.50	-	-	-	-	-	-	-	-	26	A-4b (V)	
		85																
		86																
		87																
		88																
		89	5 5 6	15	100	SS-23	1.00	-	-	-	-	-	-	-	-	22	A-4b (V)	
		90																
		91																
		92																
		93																
		94	5 6 6	16	100	SS-24	0.75	0	1	1	61	37	27	24	3	30	A-4b (8)	
		95																
		96																
		97																
		98																
		99	4 5 8	17	100	SS-25	1.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
	904.0	EOB 100																

NOTES: CAVE IN AT 25.7'; SITE CONDITION RESTRICTS OPERATIONS OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-01.75
TYPE: NOISE WALL
PID: 91710 SFN: 7700370/7700371 (P)
START: 2/13/17 END: 2/13/17

DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH
SAMPLING FIRM / LOGGER: NEAS / K.BAME
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55X
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 12/3/15
ENERGY RATIO (%): 88.1

STATION / OFFSET: 544+04, 52' RT.
ALIGNMENT: SR 8 SB
ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.
LAT / LONG: 41.091487, -81.499523

EXPLORATION ID: B-020-1-16
PAGE 1 OF 1

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
ASPHALT (8.0") & GRANULAR BASE (6.5")	1029.2																	
	1028.0																	
STIFF TO VERY STIFF, BROWN AND GRAY BECOMING BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST		3	13 7 6	19	56	SS-1	1.0 - 2.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
		6	5 3 4	10	89	SS-2	1.0 - 2.25	-	-	-	-	-	-	-	-	15	A-4a (V)	
@7.5' TO 13.3'; CONTAINS IRON STAINING		8	5 3 3	9	100	SS-3	1.0 - 2.25	7	9	26	34	24	27	17	10	16	A-4a (5)	
		11	3 2 3	7	100	SS-4	1.0 - 1.75	-	-	-	-	-	-	-	-	17	A-4a (V)	
	1015.9	13	3 3 5	12	100	SS-5A	1.25 - 2.25	-	-	-	-	-	-	-	-	16	A-4a (V)	
						SS-5B	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, 13.3' TO 16.5'; CONTAINS IRON STAINING, DAMP		16	2 3 4	10	100	SS-6	-	19	34	39	3	5	NP	NP	NP	7	A-1-b (0)	
@17.5' TO 19.0'; BECOMES BROWN AND DARK BROWN		18	6 3 2	7	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
	1009.7																	
LOOSE TO MEDIUM DENSE, BROWN AND LIGHT BROWN, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE GRAVEL, DAMP		21	4 4 5	13	100	SS-8	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
@22.5' TO 26.5'; BECOME TRACE SILT, DRY		23	2 1 3	6	100	SS-9	-	1	9	88	1	1	NP	NP	NP	4	A-3 (0)	
		26	1 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 6.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

159/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-020-1-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 246+12, 46' LT.	EXPLORATION ID B-020-2-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1029.0 (MSL) EOB: 85.5 ft.	PAGE 1 OF 2
START: 4/4/18 END: 4/5/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.092137, -81.499899	

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, **SANDY SILT**, TRACE GRAVEL, TRACE CLAY, DAMP TO MOIST	1029.0		3 5 5	13	61	SS-1	2.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
			7 8 9	23	72	SS-2	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
			9 13 14	36	89	SS-3	3.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
			6 8 7	20	61	SS-4	4.5+	2	15	34	47	2	21	14	7	11	A-4a (3)	
			6 8 8	21	83	SS-5	4.5+	-	-	-	-	-	-	-	-	15	A-4a (V)	
	1014.0		5 5 7	16	100	SS-6	4.00	-	-	-	-	-	-	-	-	13	A-4a (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP	1011.5		5 8 8	21	83	SS-7	-	4	34	50	11	1	NP	NP	NP	4	A-3a (0)	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			5 5 6	15	72	SS-8	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
@21' to 23'; LOOSE			3 3 4	9	56	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			8 11 18	39	28	SS-10	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
			8 12 18	40	61	SS-11	-	36	31	23	9	1	NP	NP	NP	3	A-1-b (0)	
			4 7 9	21	94	SS-12	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
	989.0		9 11 14	33	72	SS-13	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	984.0		6 8 16	32	100	SS-14	4.5+	8	5	19	46	22	24	16	8	15	A-4a (7)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP			14 19 15	46	83	SS-15	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
			10 13 18	41	100	SS-16	-	-	-	-	-	-	-	-	-	6	A-3a (V)	
			7 10 11	28	100	SS-17	-	4	15	68	12	1	NP	NP	NP	9	A-3a (0)	

160/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-020-2-17	DRAWN JJH CHECKED YLZ

PID: 91710 | SFN: 7700370/7700371 (P) | PROJECT: SUM-8-1.75 | STATION / OFFSET: 246+12, 46' LT. | START: 4/4/18 | END: 4/5/18 | PG 2 OF 2 | B-020-2-17

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, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, DAMP *(continued)*																		
@63.5' to 69.5'; WET		W 965.5	4 7 10	23	100	SS-18	-	-	-	-	-	-	-	-	-	28	A-3a (V)	
		▼ 0 hrs																
	959.5		10 7 8	20	100	SS-19	2.00	10	4	8	34	44	NP	NP	NP	26	A-4a (8)	
VERY STIFF, BROWN, **SANDY SILT**, AND CLAY, LITTLE GRAVEL, WET	957.0																	
VERY DENSE, BROWN, **FINE SAND**, SOME CLAY, WET			25 34 26	80	100	SS-20	-	-	-	-	-	-	-	-	-	18	A-3 (V)	
	949.5		11 17 29	62	100	SS-21	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG TO VERY STRONG.																		
			50/5"	-	100	SS-22	-	-	-	-	-	-	-	-	-	14	Rock (V)	
@ 85.5'; BORING TERMINATED DUE TO AUGER REFUSAL	943.5	EOB																

NOTES: CAVE IN AT 48.9'; AUGUR REFUSAL AT 85.5'; SITE CONDITION RESTRICTS OPERATION OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 300 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 12:50 - W:\062388- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 BORING LOGS - ON SHEETS.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 545+66, 90' RT.	EXPLORATION ID B-020-3-17
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 1029.1 (MSL) EOB: 74.8 ft.	PAGE 1 OF 2
START: 4/5/18 END: 4/5/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.091904, -81.499250	

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
6 TOPSOIL(DRILLER'S DESCRIPTION)	1028.6																	
LOOSE, BROWN, **FINE SAND**, LITTLE GRAVEL, LITTLE CLAY, MOIST	1025.6		1 2 3	7	72	SS-1	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST	1015.6		3 3 3	8	67	SS-2	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
			4 4 5	12	11	SS-3	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
			2 3 3	8	72	SS-4	-	10	48	35	6	1	NP	NP	NP	6	A-1-b (0)	
			3 3 4	9	72	SS-5	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
LOOSE TO MEDIUM DENSE, BROWN, **FINE SAND**, TRACE SILT, TRACE CLAY, DAMP	995.1		3 3 5	11	83	SS-6	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			3 3 5	11	61	SS-7	-	-	-	-	-	-	-	-	-	3	A-3 (V)	
			4 4 5	12	100	SS-8	-	-	-	-	-	-	-	-	-	3	A-3 (V)	
			3 3 4	9	72	SS-9	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
			3 4 4	11	83	SS-10	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
			3 3 4	9	100	SS-11	-	0	29	62	8	1	NP	NP	NP	9	A-3 (0)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, DAMP	969.8		8 14 17	41	83	SS-12	-	-	-	-	-	-	-	-	-	6	A-3a (V)	
			4 4 5	12	94	SS-13	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
			6 6 8	19	94	SS-14	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
			8 10 13	31	100	SS-15	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
			12 21 20	55	89	SS-16	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
			8 17 19	48	83	SS-17	4.5+	14	9	23	45	9	21	14	7	10	A-4a (4)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 7/18/19 12:50 - W:\062388- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 BORING LOGS - ON SHEETS.GPJ

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 545+66, 90' RT.	START: 4/5/18	END: 4/5/18	PG 2 OF 2	B-020-3-17

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, BROWN, **SANDY SILT**, LITTLE GRAVEL, TRACE CLAY, DAMP *(continued)*	969.1	61 62 63																
	966.1																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP TO MOIST		64	16 33 44	103	100	SS-18	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
		65 66 67 68																
		69	21 45 50	127	100	SS-19	-	27	14	25	28	6	NP	NP	NP	10	A-2-4 (0)	
		70 71 72 73																
		74	9 11 50/4"	-	100	SS-20	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	
	954.3	EOB																

NOTES: CAVE IN AT 57.2'; SITE CONDITION RESTRICTS OPERATION OF GROUTING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 100 LB. BENTONITE CHIPS; BACKFILLED WITH 100 LB. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 12:50 - W:\062368- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 BORING LOGS - ON SHEETS.GPJ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 546+05, 50' RT. | EXPLORATION ID B-021-1-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1028.8 (MSL) EOB: 26.5 ft.
START: 2/13/17 END: 2/13/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.092030, -81.499363

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
ASPHALT (9.0") & GRANULAR BASE (6.0")	1027.5																	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			9 6 6	18	83	SS-1	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			5 3 4	10	100	SS-2	-	21	37	36	4	2	NP	NP	NP	8	A-1-b (0)	
	1021.8																	
LOOSE TO MEDIUM DENSE, LIGHT BROWN AND BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP TO MOIST			2 3 3	9	100	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			3 2 3	7	100	SS-4	-	2	13	82	2	1	NP	NP	NP	5	A-3 (0)	
			4 3 3	9	100	SS-5	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
			3 3 5	12	100	SS-6	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
F.S.			1 2 2	6	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
@20.0' TO 21.5'; BECOMES VERY LOOSE			2 2 1	4	100	SS-8	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
			1 2 2	6	100	SS-9	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
	1002.3	EOB	2 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 12.0'.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 247+14, 57' LT. | EXPLORATION ID B-021-2-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1016.7 (MSL) EOB: 26.5 ft.
START: 1/6/17 END: 1/6/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.092416, -81.499862

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 STIFF, BROWN AND DARK BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAIN ROOTS, MOIST			1 2 4	9	83	SS-1	0.5 - 1.0	2	13	34	30	21	23	15	8	19	A-4a (3)	
			4 5 6	16	100	SS-2	0.5 - 0.75	9	10	28	31	22	20	13	7	15	A-4a (4)	
@5.0' TO 5.8'; BECOMES STIFF TO VERY STIFF	1010.9		5 10 11	31	100	SS-3A	1.5 - 2.25	-	-	-	-	-	-	-	-	17	A-4a (V)	
DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, TRACE SILT, TRACE GRAVEL (SANDSTONE), TRACE CLAY, DAMP	1009.7					SS-3B	-	8	29	48	8	7	NP	NP	NP	8	A-3a (0)	
DENSE TO VERY DENSE, BROWN BECOMING ORANGISH BROWN WITH BROWN, **GRAVEL WITH SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE CLAY, GRAVEL IS FRIABLE SANDSTONE, DAMP			6 11 22	48	100	SS-4	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@7.5' TO 9.0'; CONTAINS 1.5" SILT AND CLAY SEAM			5 13 16	43	100	SS-5	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@12.5' TO 14.0'; CONTAINS 1.5" SILT AND CLAY SEAM			9 18 23	60	100	SS-6	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			5 14 15	43	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
@17.5' to 20.0'; BECOMES ORANGISH BROWN WITH REDDISH BROWN	997.2		9 11 13	35	100	SS-8	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
MEDIUM DENSE, ORANGISH BROWN WITH BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, MOIST	994.7		6 11 8	28	100	SS-9	-	-	-	-	-	-	-	-	-	15	A-2-4 (V)	
STIFF TO VERY STIFF, BROWN MOTTLED WITH GRAY BECOMING BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST			6 3 5	12	100	SS-10	1.0 - 2.25	7	10	32	30	21	23	14	9	15	A-4a (3)	
@25.0' to 26.5'; CONTAINS IRON STAINING	990.2	EOB	4 4 5	13	100	SS-11	1.0 - 1.5	-	-	-	-	-	-	-	-	15	A-4a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:54 - W:\062368- MS-SUM-8-1.75\E. PRJ WRK\E. ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75
TYPE: NOISE WALL
PID: 91710 SFN: 7700370/7700371 (P)
START: 2/13/17 END: 2/13/17

DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH
SAMPLING FIRM / LOGGER: NEAS / K.BAME
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: CME 55X
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 12/3/15
ENERGY RATIO (%): 88.1

STATION / OFFSET: 547+95, 48' RT.
ALIGNMENT: SR 8 NB
ELEVATION: 1027.7 (MSL) EOB: 26.5 ft.
LAT / LONG: 41.092565, -81.499265

EXPLORATION ID: B-021-3-16
PAGE 1 OF 1

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
ASPHALT (8.0") & GRANULAR BASE (9.0")	1027.7																	
	1026.3																	
MEDIUM STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @5.0' TO 6.5'; CONTAINS A 1.25" GRAVEL PIECE, DAMP TO MOIST **(FILL)** @2.5' TO 4.0'; NO RECOVERY			12 9 11	29	0	SS-1	-	-	-	-	-	-	-	-	-	-		
			8 5 4	13	78	SS-2	0.5 - 1.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
@7.5' TO 9.0'; CHANGES TO BROWN, GRAY AND DARK GRAY, CONTAINS FEW PORCELAIN AND ASPHALT FRAGMENTS, AND IRON STAINING	1018.2		5 6 6	18	100	SS-3	1.75 - 3.0	6	11	30	32	21	25	16	9	16	A-4a (4)	
VERY STIFF TO HARD, BROWN WITH BROWNISH GRAY AND DARK GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, DAMP	1015.7		7 7 7	21	100	SS-4	3.25 - 4.5+	5	10	28	35	22	25	15	10	15	A-4a (4)	
VERY LOOSE, BROWN WITH ORANGISH BROWN AND DARK GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, SS-5 NO HP, SAMPLE IS NON COHESIVE	1013.2		3 1 1	3	39	SS-5	-	-	-	-	-	-	-	-	-	12	A-4a (V)	
VERY LOOSE, ORANGISH BROWN, **FINE SAND**, SOME COARSE SAND, TRACE TO LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP @15.0' TO 16.5'; CONTAINS DECAYED WOOD FRAGMENTS AND IRON STAINING			1 WOH 1	1	50	SS-6	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@17.5' TO 26.5'; BECOMES LOOSE TO MEDIUM DENSE, BROWN			2 3 2	7	100	SS-7	-	6	32	58	2	2	NP	NP	NP	4	A-3 (0)	
			2 3 3	9	100	SS-8	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
			3 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
		EOB	3 4 4	12	100	SS-10	-	-	-	-	-	-	-	-	-	7	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-021-3-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / D. S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 248+45, 75' LT.	EXPLORATION ID B-023-0-15
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1012.4 (MSL) EOB: 43.7 ft.	PAGE 1 OF 1
START: 7/6/15 END: 7/6/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.092765, -81.499854	

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
2" TOPSOIL (DRILLER'S DESCRIPTION)	1012.2																	
LOOSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP (FILL)	1008.8		4 7 9	22	67	SS-1	-	44	33	17	- 6 -		NP	NP	NP	9	A-1-b (0)	
SOFT, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK FRAGMENTS AND GRAVEL, MOIST	1006.4		2 2 1	4	56	SS-2	0.30	12	4	16	40	28	36	21	15	26	A-6a (9)	
VERY SOFT TO SOFT, BROWN, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL, MOIST @ 8.5'; VERY STIFF	1002.9		3 1 1	3	94	SS-3	0.25	11	5	23	39	22	38	20	18	28	A-6b (8)	
			4 7 8	20	72	SS-4	2.25	-	-	-	-	-	-	-	-	25	A-6b (V)	
MEDIUM DENSE TO VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, MOIST	988.7		7 16 22	51	78	SS-5	-	11	40	40	- 9 -		NP	NP	NP	11	A-1-b (0)	
			11 15 22	50	89	SS-6	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			11 11 22	45	67	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			7 8 8	22	78	SS-8	-	41	25	27	- 7 -		NP	NP	NP	10	A-1-b (0)	
SOFT TO STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST @ 28.5' TO 30.0'; STIFF @ 33.5'; VERY SOFT	973.4	TR	6 4 5	12	72	SS-9	0.60	-	-	-	-	-	-	-	-	27	A-6b (V)	
			5 11 16	36	67	SS-10	1.80	-	-	-	-	-	-	-	-	28	A-6b (V)	
			7 6 7	18	67	SS-11	0.25	9	7	7	50	27	35	19	16	25	A-6b (10)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	968.7	EOB	50/5"	-	120	SS-12	0.50	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 17:13 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

181/199	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-023-0-15	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRACK (RW) | STATION / OFFSET: 249+72, 77' LT. | EXPLORATION ID B-025-0-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / Y.Z. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA | CALIBRATION DATE: 4/4/15 | ELEVATION: 1004.9 (MSL) EOB: 18.58 ft.
START: 6/30/15 END: 6/30/15 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 80.58 | LAT / LONG: 41.093100, -81.499820

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
11" TOPSOIL (DRILLER'S DESCRIPTION)	1003.9																	
SOFT TO STIFF, BROWN, **SILT AND CLAY**, LITTLE CLAY AND GRAVEL, DAMP	998.9		3 4 4	11	78	SS-1	0.25	-	-	-	-	-	-	-	-	25	A-6a (V)	
			4 2 2	5	83	SS-2	1.50	15	3	14	39	29	35	22	13	28	A-6a (8)	
LOOSE, BROWN, **SILTY CLAY**, LITTLE GRAVEL, TRACE SAND, MOIST	995.9		2 3 2	7	56	SS-3	0.50	14	2	6	50	28	38	19	19	29	A-6b (12)	
VERY DENSE, BROWN, **FINE SAND**, SOME COARSE SAN AND GRAVEL, TRACE SILT AND CLAY, DAMP	995.4	TR	18 21 50/3"	-	87	SS-4	-	20	23	50	-	7 -	NP	NP	NP	14	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	986.3	EOB	50/2"	-	50	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			18 31 42	98	61	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/4"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/1"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:09 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 549+84, 46' RT. | EXPLORATION ID B-025-1-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 NB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1026.7 (MSL) EOB: 26.5 ft.
START: 2/14/17 END: 2/14/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.093093, -81.499228

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (7.0") & GRANULAR BASE (13.0")	1025.0																	
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, @1.7' TO 6.5'; CONTAIN FEW ROOT HAIRS, DAMP			5 6 8	21	100	SS-1	4.0 - 4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	
@5.0' TO 6.5'; CONTAINS FEW BLACK ORGANICS @5.0' TO 8.0'; BECOME BROWN WITH BROWNISH GRAY AND DARK GRAY	1018.7		10 6 8	21	100	SS-2	2.5 - 4.0	8	9	27	34	22	27	15	12	15	A-6a (5)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL (FRIABLE SANDSTONE), TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1014.7		4 7 12	28	100	SS-3A	2.0 - 3.25/	-	-	-	-	-	-	-	-	15	A-6a (V)	
						SS-3B	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
			3 4 7	16	100	SS-4	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL (FRIABLE SANDSTONE), CONTAINS IRON STAINING, NO HP, SAMPLE IS NON COHESIVE, DAMP	1012.2		2 4 7	16	100	SS-5	-	8	15	39	24	14	17	12	5	11	A-4a (1)	
MEDIUM DENSE, ORANGISH BROWN AND BROWNISH GRAY, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1009.7		2 4 15	28	100	SS-6	-	12	19	40	18	11	NP	NP	NP	9	A-3a (0)	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP			3 5 9	21	100	SS-7	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@20.0' TO 21.5'; BECOMES BROWN WITH ORANGISH BROWN AND MAROONISH BROWN, GRAVEL IS FRIABLE SANDSTONE	1004.7		3 7 11	26	100	SS-8	2.5 - 4.0	6	10	36	31	17	19	12	7	11	A-4a (3)	
DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, (FRIABLE SANDSTONE), TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP	1002.2		6 14 15	43	100	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1000.2	EOB	6 9 8	25	78	SS-10	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:54 - W:\062388- MS-SUM-8-1.75\E. PRJ WRKIE_ENG\GEO\30 SUBSURFACE IN\VEST\BORING 2017\RENUMBERED SUM-8

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-025-0-15 & B-025-1-16

DRAWN JJH | CHECKED YLZ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 248+45, 75' LT. | EXPLORATION ID B-025-2-16
TYPE: UNDERGROUND UTILITY | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1004.9 (MSL) EOB: 15.8 ft.
START: 1/19/17 END: 1/19/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.093232, -81.498981

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
TOPSOIL (4.0")	1004.6																	
MEDIUM STIFF TO STIFF, DARK BROWN AND LIGHT BROWN, **SANDY SILT**, TRACE GRAVEL, LITTLE CLAY, SS-1 AND SS-2 NO HP DUE TO SAMPLE DISTURBANCE DURING RECOVERY, DAMP TO MOIST @0.3' TO 3.0'; CONTAINS ROOTS	1001.0		3 5 3	12	33	SS-1	-	-	-	-	-	-	-	-	-	22	A-4a (V)	
			2 3 4	10	100	SS-2	-	6	18	38	27	11	24	20	4	19	A-4a (1)	
MEDIUM DENSE TO DENSE, ORANGISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP			3 6 5	16	100	SS-3A	0.75 - 1.25	-	-	-	-	-	-	-	-	18	A-4a (V)	
						SS-3B	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
			3 5 4	13	100	SS-4	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
			5 6 6	18	100	SS-5	-	18	28	46	5	3	NP	NP	NP	7	A-3 (0)	
			6 11 21	47	56	SS-6	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
			5 9 10	28	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@10.5' TO 12.0'; BECOMES BROWN AND LIGHT BROWN, SOME GRAVEL, CONTAINS SANDY SILT SEAM			9 11 18	43	67	SS-8	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@12.0' TO 13.5'; BECOMES VERY DENSE, BROWN	991.4		10 21 36	84	50	SS-9	-	-	-	-	-	-	-	-	-	4	A-3 (V)	
VERY DENSE, BROWN AND LIGHT BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP	989.9		11 26 38	94	83	SS-10	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
VERY DENSE, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, NO HP, SAMPLE IS NON COHESIVE, DRY	989.1	EOB	11 50/4"	-	60	SS-11	-	4	19	40	23	14	17	13	4	5	A-4a (0)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 250+93, 89' LT. | EXPLORATION ID B-025-3-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1003.3 (MSL) EOB: 21.5 ft.
START: 1/18/17 END: 1/18/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.093422, -81.499843

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
TOPSOIL (2.0")	1003.1																	
VERY STIFF, DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS ROOTS AND IRON STAINING, DAMP	1001.3		1 3 5	12	100	SS-1	2.0 - 2.5	-	-	-	-	-	-	-	-	14	A-4a (V)	
SOFT, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW ROOT HAIRS, DAMP	998.8		3 3 1	6	100	SS-2	0.25 - 0.5	13	19	30	24	14	20	15	5	15	A-4a (1)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAINS IRON STAINING, MOIST	995.3		1 3 4	10	100	SS-3	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
SANDSTONE, BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR	9 50/5"	-	64	SS-4	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
			15 30 50/4"	-	88	SS-5	-	-	-	-	-	-	-	-	-	8	Rock (V)	
			6 15 50/5"	-	71	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			17 50/5"	-	55	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
@17.5' TO 21.5'; BECOMES DARK BROWN			50/5"	-	100	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	981.8	EOB	15 7 14	31	100	SS-9	-	-	-	-	-	-	-	-	-	8	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

181/689	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOGS B-025-2-16 & B-025-3-16	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75 | DRILLING FIRM / OPERATOR: RIDGEWAY / P.S. | DRILL RIG: D-50 TRACK (RW) | STATION / OFFSET: 251+32, 70' LT. | EXPLORATION ID B-026-0-15
TYPE: RETAINING WALL | SAMPLING FIRM / LOGGER: GF / Y.Z. | HAMMER: DIEDRICH AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 4.25" HSA | CALIBRATION DATE: 4/4/15 | ELEVATION: 1007.7 (MSL) EOB: 13.6 ft.
START: 6/30/15 END: 6/30/15 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 80.58 | LAT / LONG: 41.093524, -81.499772

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
13" TOPSOIL (DRILLER'S DESCRIPTION)	1006.7																	
VERY LOOSE TO LOOSE, BROWN, **SANDY SILT**, LITTLE GRAVEL AND CLAY, MOIST TO DAMP			3 4 3	9	89	SS-1	0.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
			2 1 2	4	44	SS-2	-	22	11	28	29	10	NP	NP	NP	15	A-4a (1)	
@ 6.4'; DENSE, ROCK FRAGMENTS AND GRAVEL	999.2		5 8 15	31	78	SS-3	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
MEDIUM DENSE TO VERY DENSE, LIGHT BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DAMP TO MOIST			18 21 26	63	72	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			7 8 7	20	72	SS-5	-	22	33	37	- 8 -		NP	NP	NP	14	A-1-b (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	994.2 994.1	TR	50/1"	-	-		-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/18/19 17:09 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 249+72, 77' LT. | EXPLORATION ID B-029-1-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1025.2 (MSL) EOB: 25.3 ft.
START: 2/14/17 END: 2/14/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.093990, -81.499291

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (8.0") & GRANULAR BASE (11.0")	1025.2 1023.6																	
MEDIUM DENSE TO DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP			15 9 14	34	100	SS-1	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
			7 9 10	28	100	SS-2	-	11	37	41	6	5	NP	NP	NP	7	A-3a (0)	
			7 10 10	29	100	SS-3	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST	1015.7		4 6 8	21	100	SS-4	3.25 - 4.5+	5	9	33	32	21	22	13	9	12	A-4a (4)	
@12.5' TO 14.0'; BECOMES BROWN WITH BROWNISH GRAY AND BLACK, CONTAINS FEW BLACK ORGANICS, ROOT HAIRS, AND IRON STAINS			4 9 11	29	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST	1010.7		4 12 13	37	100	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
SANDSTONE, LIGHT BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.	1007.7	TR	4 12 18	44	100	SS-7	-	-	-	-	-	-	-	-	-	5	Rock (V)	
@20.0' TO 23.0'; BECOMES MAROONISH BROWN			27 24 31	81	100	SS-8	-	-	-	-	-	-	-	-	-	4	Rock (V)	
			50/5"	-	80	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	999.9	EOB	50/4"	-	75	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 11.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:54 - W:\062388- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE IN\VEST\BORING 2017\RENUMBERED SUM-8

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-026-0-15 & B-029-1-16

DRAWN JJH | CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 251+32, 70' LT.	EXPLORATION ID B-030-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1023.1 (MSL) EOB: 33.0 ft.	PAGE 1 OF 1
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094081, -81.499698	

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
ASPHALT (3.0") OVER CONCRETE (10.0")	1023.1																	
	1022.0																	
MEDIUM DENSE, ORANGISH BROWN AND BROWN BECOMING ORANGISH BROWN AND REDDISH BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, DAMP			5 5 6	15	56	SS-1	-	21	17	40	14	8	NP	NP	NP	8	A-3a (0)	
			5 8 12	27	33	SS-2	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	1016.1																	
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, TRACE BLACK ORGANICS, MOIST			6 3 3	8	100	SS-3	0.5 - 0.75	6	11	29	34	20	25	15	10	16	A-4a (4)	
	1013.6																	
LOOSE TO MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST			3 3 4	10	100	SS-4	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	1010.1		5 5 4	12	100	SS-5A	-	-	-	-	-	-	-	-	-	15	A-3a (V)	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @15.0' TO 16.5'; CONTAINS IRON STAINING AND TRACE BLACK ORGANICS, DAMP TO MOIST						SS-5B	1.75 - 2.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
			3 5 8	18	100	SS-6	1.75 - 2.0	4	5	18	49	24	26	17	9	18	A-4a (8)	
	1006.1																	
DENSE, BROWN WITH ORANGISH BROWN AND DARK, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS IRON STAINING, MOIST			6 10 17	37	100	SS-7	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
	1003.6																	
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, LITTLE CLAY, MOIST			5 10 14	33	100	SS-8	-	15	8	44	21	12	NP	NP	NP	11	A-3a (0)	
	1000.1	TR	18 50/3"	-	78	SS-9	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.			18 24 28	71	67	SS-10	-	-	-	-	-	-	-	-	-	6	Rock (V)	
	995.1																	
SANDSTONE, LIGHT GRAY AND ORANGISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO VERY THIN BEDDED, FRIABLE, MICACEOUS, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY, FAIR TO GOOD SURFACE CONDITION; RQD 66%, REC 88%. @29.3'; Qu = 5184 PSI	990.1	EOB	66		88	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 10/29/18 15:58 - W:\062266- MS-SUM-8-1.75E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8-1.75_051917.GPJ

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-030-1-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55 | STATION / OFFSET: 254+86, 47' LT. | EXPLORATION ID B-031-1-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1023.1 (MSL) EOB: 20.5 ft.
START: 1/7/17 END: 1/7/17 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 81.8 | LAT / LONG: 41.094480, -81.499786

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
ASPHALT (6.0") & GRANULAR BASE (18.0")	1023.1																	
	1021.1																	
MEDIUM STIFF TO VERY STIFF, BROWNISH GRAY WITH BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST			5 4 4	11	100	SS-1	0.75 - 1.0	4	10	28	38	20	25	16	9	18	A-4a (5)	
@5.0' TO 6.5'; BECOMES BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, CONTAINS IRON STAINING	1016.1		4 4 7	15	100	SS-2	1.75 - 3.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, MOIST	1013.6		7 8 10	25	100	SS-3	-	-	-	-	-	-	-	-	-	14	A-2-6 (V)	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, SS-4 NO HP DUE TO SAMPLE DISTURBANCE DURING RECOVERY, DAMP	1008.1		6 8 11	26	100	SS-4	-	7	8	28	42	15	20	16	4	15	A-4a (4)	
			7 11 14	34	100	SS-5	1.75 - 3.25	8	12	30	34	16	19	14	5	13	A-4a (3)	
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1007.6	TR	50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY WEATHERED, STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, MEDIUM TO COARSE GRAINED FROM 19.8' - 20.5', FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, SLIGHTLY FRACTURED TO HIGHLY FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 100%.	1002.6	EOB	75		100	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 554+47, 97' RT. | EXPLORATION ID B-031-2-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 NB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1025.7 (MSL) EOB: 25.3 ft.
START: 1/20/17 END: 1/20/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.094397, -81.499169

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
TOPSOIL (3.0")	1025.4																	
MEDIUM STIFF TO VERY STIFF, BROWN BECOMING BROWN AND GRAYISH BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, FEW ROOT HAIRS, DAMP			1 2 4	9	72	SS-1	0.5 - 2.0	-	-	-	-	-	-	-	-	14	A-6a (V)	
			2 5 6	16	89	SS-2	1.25 - 2.25	14	12	31	24	19	25	14	11	14	A-6a (2)	
	1018.7		2 4 7	16	83	SS-3	0.75 - 1.5	-	-	-	-	-	-	-	-	14	A-6a (V)	
MEDIUM STIFF, BROWN AND BROWNISH GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP	1016.2		2 5 5	15	100	SS-4	0.75 - 1.0	13	11	35	28	13	21	15	6	15	A-4a (1)	
STIFF TO VERY STIFF, BROWN WITH ORANGISH BROWN AND BROWNISH GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, @10.0' TO 11.5'; CONTAIN IRON STAINING, DAMP TO MOIST			3 7 8	22	100	SS-5	1.5 - 3.0	-	-	-	-	-	-	-	-	15	A-6a (V)	
@12.5' TO 16.5'; BECOME BROWN AND GRAY, INTERBEDDED SILT AND CLAY			6 8 9	25	100	SS-6	2.25 - 2.5	4	5	18	47	26	28	16	12	17	A-6a (8)	
	1008.7		8 10 11	31	100	SS-7	2.0 - 2.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
STIFF TO VERY STIFF, BROWN AND LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP			8 13 36	72	100	SS-8	1.25 - 1.75	11	4	33	32	20	21	13	8	13	A-4a (3)	
	1003.7		13 15 48	93	44	SS-9	2.25 - 3.0	-	-	-	-	-	-	-	-	11	A-4a (V)	
SANDSTONE, BROWN AND ORANGISH BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR	36 50/5"	-	73	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1000.4	EOB	50/4"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: SUM-8-01.75
TYPE: NOISE WALL
PID: 91710 SFN: 7700370/7700371 (P)
START: 1/7/17 END: 1/7/17

DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH
SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH
DRILLING METHOD: 3.25" HSA / NQ2
SAMPLING METHOD: SPT / NQ2

DRILL RIG: CME 55
HAMMER: CME AUTOMATIC
CALIBRATION DATE: 12/3/15
ENERGY RATIO (%): 81.8

STATION / OFFSET: 256+63, 53' LT.
ALIGNMENT: SR 8 SB
ELEVATION: 1022.2 (MSL) EOB: 20.5 ft.
LAT / LONG: 41.094952, -81.499890

EXPLORATION ID: B-031-3-16
PAGE 1 OF 1

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
ASPHALT (6.0")	1022.2																	
DENSE TO VERY DENSE, LIGHT BROWN BECOMING BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, TRACE SILT, TRACE CLAY, (GRAVEL IS QUARTZITE PEBBLES AND FRIABLE SANDSTONE), DAMP	1021.7		14 18 16	46	100	SS-1	-	34	1	52	8	5	NP	NP	NP	8	A-3a (0)	
SANDSTONE, BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.	1017.2	TR	19 21 34	75	100	SS-2	-	-	-	-	-	-	-	-	-	5	Rock (V)	
@7.5' TO 8.4'; BECOME LIGHT BROWN AND ORANGISH BROWN			29 50/5"	-	36	SS-3	-	-	-	-	-	-	-	-	-	5	Rock (V)	
@10.0' TO 13.2'; CONTAINS FUEL ODOR			17 30 38	93	67	SS-4	-	-	-	-	-	-	-	-	-	7	Rock (V)	
			26 50/2"	-	50	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
	1006.7		50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND MAROONISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, HIGH ANGLE JOINT DISCONTINUITY FROM 15.8' - 16.0', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 64%, REC 91%. @16.7'; Qu = 3826 PSI	1001.7	EOB	64		91	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOG B-031-3-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 555+84, 113' RT.	EXPLORATION ID B-031-4-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1035.1 (MSL) EOB: 35.3 ft.	PAGE 1 OF 1
START: 1/19/17 END: 1/19/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.094775, -81.499178	

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
TOPSOIL (5.0")	1034.7																	
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS ROOT HAIRS, MOIST	1033.1		1 2 2	6	100	SS-1	0.5 - 1.0	-	-	-	-	-	-	-	-	16	A-4a (V)	
MEDIUM DENSE, BROWN BECOMING BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, LITTLE CLAY, TRACE GRAVEL, CONTAIN ROOT HAIRS, MOIST	1028.1		5 6 7	19	100	SS-2	-	5	16	44	20	15	18	12	6	12	A-3a (0)	
			3 3 8	16	67	SS-3	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
SOFT TO VERY STIFF, BROWN WITH GRAY AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST	1025.6		2 4 5	13	100	SS-4	0.25 - 2.5	-	-	-	-	-	-	-	-	15	A-4a (V)	
VERY STIFF, LIGHT BROWN AND GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS ROOTS, MOIST	1023.1		4 5 7	18	100	SS-5	2.5 - 3.25	2	4	16	58	20	28	18	10	19	A-4b (8)	
MEDIUM DENSE, BROWN WITH ORANGISH BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL AND STONE FRAGMENTS, CONTAINS IRON STAINING, MOIST	1020.6		8 9 10	28	100	SS-6	-	9	6	59	16	10	NP	NP	NP	13	A-3a (0)	
		TR																
SANDSTONE, LIGHT BROWN TO ORANGISH BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.	1014.8		8 14 11	37	100	SS-7	-	-	-	-	-	-	-	-	-	9	Rock (V)	
			50/5"	-	60	SS-8	-	-	-	-	-	-	-	-	-	9	Rock (V)	
			50/2"	-	100	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN WITH MAROONISH BROWN AND LIGHT BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, MODERATELY FRIABLE, CONTAINS CLAY LENSES BETWEEN SOME DISCONTINUITIES, MODERATELY MICACEOUS, TRACE QUARTZITE PEBBLES FROM 28.4 - 35.3', CROSS BEDDED, CONTAINS ONE CLAY FILLED VUG AT 28.5', BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, TIGHT TO OPEN, SLIGHTLY TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 34.7 - 35.3' GOOD TO FAIR SURFACE CONDITION; RQD 60%, REC 88%.			28		71	NQ2-1											CORE	
(Continued)			76		96	NQ2-2											CORE	
	999.8	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 35 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 259+26, 62' LT. | EXPLORATION ID B-032-1-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 SB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1020.9 (MSL) EOB: 22.0 ft.
START: 2/14/17 END: 2/14/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.095666, -81.500051

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
ASPHALT (7.0") & GRANULAR BASE (10.0")	1020.9																	
	1019.5	TR																
SANDSTONE, LIGHT PINKISH BROWN, SEVERLY WEATHERED, FRIABLE, EASILY AUGERED.		1																
		2																
		3	14 19 23	62	89	SS-1	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		4																
		5	16 50/4"	-	50	SS-2	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		6																
		7																
		8	50/5"	-	100	SS-3	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		9																
		10	50	-	50	SS-4	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		11																
		12																
@12.5' TO 15.4'; BECOMES BROWN		13	48 50/5"	-	64	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		14																
		15	50/5"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		16																
		17																
@17.5' TO 20.2'; BECOMES BROWN AND LIGHT BROWN		18	50/4"	-	75	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19																
		20	50/2"	-	50	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	998.9	EOB 22																
@22.0'; AUGER REFUSAL.																		

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 9.0'.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 24 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 558+07, 140' RT. | EXPLORATION ID B-032-2-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: SR 8 NB | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA / NQ2 | CALIBRATION DATE: 12/3/15 | ELEVATION: 1041.5 (MSL) EOB: 20.3 ft.
START: 1/18/17 END: 1/18/17 | SAMPLING METHOD: SPT / NQ2 | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.095394, -81.499193

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
ASPHALT (4.0") & GRANULAR BASE (5.0")	1041.5																	
	1040.8																	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE GRAVEL, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, GRAVEL IS FRIABLE SANDSTONE, DAMP		1																
		2																
		3	8 4 4	12	72	SS-1	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
F/S		4																
		5	5 6 5	16	100	SS-2	-	7	3	82	5	3	NP	NP	NP	10	A-3 (0)	
	1034.0	6 TR																
SANDSTONE, BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		7																
		8	12 50/5"	-	82	SS-3	-	-	-	-	-	-	-	-	-	10	Rock (V)	
	1031.2	9																
SANDSTONE, BROWN AND MAROONISH BROWN, DARK BROWN FROM 16.6 - 18.5', SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, VERY THIN BEDDED, FRIABLE, CONTAINS TRACE QUARTZ PEBBLES THROUGHOUT, MEDIUM TO COARSE GRAINED FROM 16.6 - 20.3', CONTAINS A 0.5" CEMENTED QUARTZITE GRAVEL SEAM AT 19.0', BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY TO VERY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 28%, REC 82%.		10	50/4"	-	100	SS-4	-	-	-	-	-	-	-	-	-	10	Rock (V)	
		11																
		12																
		13	17		63	NQ2-1											CORE	
		14																
		15																
		16																
		17																
		18	39		100	NQ2-2											CORE	
		19																
	1021.2	20 EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 21 GAL. BENTONITE GROUT

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-032-1-16 & B-032-2-16

DRAWN JJH
CHECKED YLZ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:55 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 415+52, 2' RT. | EXPLORATION ID B-033-0-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1034.4 (MSL) EOB: 25.2 ft.
START: 1/16/17 END: 1/16/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.095726, -81.500208

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
TOPSOIL (4.0")	1034.4																	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @2.5' TO 4.0'; CONTAINS FEW ROOTS, DAMP @0.0' TO 1.5'; ONLY RECOVERED 4.0" OF SAMPLE (TOPSOIL)	1034.1	1	9 9 4	19	22	SS-1	-	-	-	-	-	-	-	-	-	34	Topsoil (V)	
		3	6 10 15	37	89	SS-2	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
		6	9 16 15	46	100	SS-3	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		8	12 20 21	60	100	SS-4	4.5+	4	4	19	47	26	26	16	10	10	A-4a (8)	
	1024.1	10				SS-5A	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, TRACE CLAY, TRACE GRAVEL, DAMP	1022.4	11	7 10 11	31	100	SS-5B	-	6	13	48	26	7	NP	NP	NP	7	A-3a (0)	
VERY STIFF, BROWN AND MAROONISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP	1019.4	13	4 6 14	29	100	SS-6	3.0 - 4.0	13	14	16	35	22	26	16	10	15	A-4a (4)	
SANDSTONE, LIGHT BROWN AND PINKISH BROWN BECOMING BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 15	10 10 10	29	100	SS-7	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		18	7 10 5	22	100	SS-8	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		20	50/5"	-	40	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		23	50/4"	-	50	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1009.2	EOB 25	50/2"	-	50	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:55 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 416+81, 50' RT. | EXPLORATION ID B-034-0-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1036.7 (MSL) EOB: 25.2 ft.
START: 1/17/17 END: 1/17/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.096376, -81.500399

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
TOPSOIL (5.0")	1036.7																	
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, @0.4' TO 1.5'; CONTAINS ROOTS AND WOOD FRAGMENTS, DAMP TO MOIST @2.5' to 4.0'; BECOMES HARD, BROWN MOTTLED WITH GRAY, CONTAINS SILT AND ROOT FILLED DESSICATION CRACKS @5.0' to 7.0'; BECOMES HARD, BROWN , TRACE GRAVEL	1036.3	1	1 2 3	7	89	SS-1	0.5 - 1.5	-	-	-	-	-	-	-	-	21	A-6a (V)	
		3	4 10 17	40	100	SS-2	4.5+	15	7	22	34	22	27	16	11	9	A-6a (5)	
		6	11 18 20	56	100	SS-3	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
	1029.7																	
HARD, BROWN AND ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, DAMP		8	11 15 13	41	100	SS-4	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
		11	5 10 12	32	100	SS-5	4.5+	9	8	31	37	15	21	15	6	11	A-4a (3)	
		13	7 9 11	29	100	SS-6	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
	1021.7	TR 15																
SANDSTONE, LIGHT ORANGISH BROWN TO LIGHT BROWN, MODERATELY TO HIGHLY WEATHERED, FINE TO MEDIUM GRAINED, FRIABLE, EASILY AUGERED.		16	6 14 12	38	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		18	4 10 7	25	100	SS-8	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		20	42 50/5"	-	45	SS-9	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		23	50/5"	-	60	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
@25.0' to 25.2'; BECOMES ORANGISH BROWN WITH REDDISH BROWN	1011.5	EOB 25	50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

175/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOGS B-033-0-16 & B-034-0-16	DRAWN JJH CHECKED YLZ

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:55 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 418+31, 44' RT. | EXPLORATION ID B-035-0-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1036.4 (MSL) EOB: 25.2 ft.
START: 1/16/17 END: 1/16/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.096815, -81.500529

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
TOPSOIL (4.0")	1036.1		2 1 3	6	83	SS-1	1.5 - 2.0	-	-	-	-	-	-	-	-	23	A-6a (V)	
STIFF TO HARD, DARK BROWN AND LIGHT BROWN, **SILT AND CLAY**, LITTLE TO SOME SAND, TRACE GRAVEL, DAMP TO MOIST @0.3' TO 4.0'; CONTAIN FEW ROOTS @2.5' TO 4.0'; BECOMES VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, CONTAINS FEW IRON STAINS			3 3 8	16	100	SS-2	3.25 - 4.5+	5	5	20	41	29	29	17	12	16	A-6a (8)	
			4 8 10	26	100	SS-3	4.25	-	-	-	-	-	-	-	-	13	A-6a (V)	
@7.5' TO 9.0'; BECOMES LITTLE GRAVEL			5 11 13	35	100	SS-4	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
	1026.9																	
VERY STIFF, BROWN MOTTLED WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP			4 11 13	35	100	SS-5	3.5 - 4.0	23	13	26	25	13	24	17	7	11	A-4a (1)	
	1023.9	TR																
SANDSTONE, LIGHT ORANGISH BROWN, HIGHLY WEATHERED, FINE TO MEDIUM GRAINED, FRIABLE, EASILY AUGERED.			6 14 21	51	89	SS-6	-	-	-	-	-	-	-	-	-	2	Rock (V)	
			4 13 19	47	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
			50/6"	-	50	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/5"	-	100	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/3"	-	67	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1011.2	EOB																
@25.0' TO 26.2'; NO RECOVERY			50/2"	-	0	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 27 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/29/18 15:55 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\BORING 2017\RENUMBERED SUM-8

PROJECT: SUM-8-01.75 | DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH | DRILL RIG: CME 55X | STATION / OFFSET: 418+20, 9' RT. | EXPLORATION ID B-036-0-16
TYPE: NOISE WALL | SAMPLING FIRM / LOGGER: NEAS / K.BAME | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP J | PAGE 1 OF 1
PID: 91710 SFN: 7700370/7700371 (P) | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 12/3/15 | ELEVATION: 1034.3 (MSL) EOB: 25.3 ft.
START: 1/18/17 END: 1/18/17 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 88.1 | LAT / LONG: 41.097400, -81.500718

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
TOPSOIL (4.0")	1034.0		1 4 5	13	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, SOME SILT, LITTLE CLAY, CONTAINS A 2.5" SILT AND CLAY SEAM, DAMP	1032.3																	
VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS 0.25" DIAMETER ROOTS, DAMP	1029.8		4 5 5	15	100	SS-2	2.75	12	15	34	26	13	17	13	4	12	A-4a (1)	
MEDIUM DENSE, BROWN BECOMING LIGHT BROWN AND MAROONISH BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			5 4 5	13	100	SS-3	-	27	22	41	7	3	NP	NP	NP	8	A-1-b (0)	
			4 4 4	12	72	SS-4	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
			4 4 11	22	67	SS-5	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	1021.8	TR																
SANDSTONE, MAROONISH BROWN AND BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.			13 19 23	62	100	SS-6	-	3	64	26	4	3	NP	NP	NP	2	Rock (V)	
			10 16 21	54	100	SS-7	-	-	-	-	-	-	-	-	-	3	Rock (V)	
			50/5"	-	80	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			36 50/4"	-	60	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/5"	-	60	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1009.0	EOB																
			50/3"	-	67	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
BORING LOGS B-035-0-16 & B-036-0-16

DRAWN JJH
CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 34+72, 21' RT.	EXPLORATION ID B-037-0-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: AR2A	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 926.8 (MSL) EOB: 40.0 ft.	PAGE 1 OF 1
START: 3/27/18 END: 3/28/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.087955, -81.506639	

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
3 TOPSOIL(DRILLER'S DESCRIPTION)	926.5																	
MEDIUM DENSE, DARK BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, SOME GARBAGE, TRACE CLAY, TRACE BRICK FRAGMENTS, DAMP (FILL)	923.8		6 4 8	16	78	SS-1	NI	21	27	19	32	1	19	16	3	14	A-2-4 (0)	
LOOSE, BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE ORGANICS, TRACE ROOT HAIRS, MOIST (FILL)			3 3 4	9	78	SS-2	NP	-	-	-	-	-	-	-	-	18	A-1-b (V)	
@6'; BROWN/BLACK, TRACE BRICK FRAGMENTS	918.8		4 2 3	7	89	SS-3	NP	-	-	-	-	-	-	-	-	16	A-1-b (V)	
MEDIUM DENSE, DARK BROWN/GRAY, **FINE SAND**, SOME GARBAGE, TRACE GRAVEL, TRACE CLAY, SOME ASPHALT FRAGMENTS, TRACE CONCRETE FRAGMENTS, DAMP TO MOIST (FILL)	915.8	W 915.8	22 12 3	20	67	SS-4	NP	-	-	-	-	-	-	-	-	10	A-3 (V)	
VERY LOOSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, WET (FREE WATER NOTED IN JAR)	913.8		WOH	-	100	SS-5	NI	2	1	42	40	15	NP	NP	NP	26	A-4a (4)	
MEDIUM STIFF, BROWN/GRAY, **SILT**, LITTLE CLAY, TRACE SAND, MOIST TO WET	910.8		2 4 4	11	100	SS-6	0.75	-	-	-	-	-	-	-	-	26	A-4b (V)	
SOFT, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, MOIST TO WET	908.8	▼	2 2 4	8	100	SS-7	0.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
SOFT TO MEDIUM STIFF, GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET			2 2 1	4	33	SS-8	0.50	0	1	10	56	33	25	19	6	28	A-4b (8)	
@21'; TRACE GRAVEL, MOIST			1 1 2	4	100	SS-9	0.25	-	-	-	-	-	-	-	-	19	A-4b (V)	
			1 1 2	4	78	SS-10	0.50	-	-	-	-	-	-	-	-	28	A-4b (V)	
	898.8		2 3 5	11	67	SS-11	0.75	-	-	-	-	-	-	-	-	26	A-4b (V)	
STIFF TO VERY STIFF, GRAY, **SILT**, TRACE SAND, MOIST TO WET			4 6 7	17	67	SS-12	1.25	-	-	-	-	-	-	-	-	22	A-4b (V)	
			5 8 11	25	78	SS-13	1.75	-	-	-	-	-	-	-	-	24	A-4b (V)	
			5 7 11	24	100	SS-14	2.00	0	1	7	55	37	25	21	4	24	A-4b (8)	
	888.8		6 8 12	27	89	SS-15	2.75	-	-	-	-	-	-	-	-	22	A-4b (V)	
HARD, GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, MOIST	886.8	EOB	5 9 11	27	100	SS-16	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	

NOTES: CAVE IN AT 17.9'. NP - NON PLASTIC

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 3 BAG BENTONITE CHIPS

177/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-037-0-17	DRAWN JJH CHECKED YLZ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: TTL / TONY	DRILL RIG: CME 550 ATV	STATION / OFFSET: 37+90, 113' LT.	EXPLORATION ID B-038-0-17
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / H.TAO	HAMMER: CME AUTOMATIC	ALIGNMENT: AR2A	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25 HSA	CALIBRATION DATE: 1/10/17	ELEVATION: 933.5 (MSL) EOB: 27.25 ft.	PAGE 1 OF 1
START: 3/27/18 END: 3/27/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.3	LAT / LONG: 41.088265, -81.505426	

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
6 TOPSOIL(DRILLER'S DESCRIPTION)	933.0																	
MEDIUM DENSE, DARK BROWN, **SANDY SILT**, TRACE GRAVEL, CLAY, ORGANICS, MOIST	930.0		6 5 4	12	78	SS-1	NI	6	19	35	36	4	NP	NP	NP	19	A-4a (1)	
VERY LOOSE, DARK BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT, ORGANICS, TRACE ROOT HAIRS, DAMP TO MOIST	927.5		2 1 2	4	83	SS-2	NP	-	-	-	-	-	-	-	-	9	A-3 (V)	
STIFF, GRAY/BROWN, **SILT**, LITTLE CLAY, TRACE SAND, ORGANICS, MOIST TO WET	922.5		2 2 3	7	78	SS-3	1.25	-	-	-	-	-	-	-	-	30	A-4b (V)	
			3 5 7	16	100	SS-4	1.50	-	-	-	-	-	-	-	-	25	A-4b (V)	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST			8 13 17	40	89	SS-5	2.25	2	8	16	43	31	28	19	9	21	A-4a (8)	
@13'; GRAY, LITTLE CLAY, GRAVEL @13.2'; LITTLE LIMESTONE FRAGMENTS			6 7 17	32	78	SS-6	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
@14.9'; 1 SAND SEAM			16 32 50/5"	-	76	SS-7	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
@16.8'; 2 SAND SEAM			32 50/3"	-	89	SS-8	NI	-	-	-	-	-	-	-	-	7	A-4a (V)	
	910.0		13 23 36	79	94	SS-9	3.00	21	11	11	34	23	21	13	8	8	A-4a (4)	
HARD, GRAY, **SILTY CLAY**, TRACE SAND AND GRAVEL, DAMP TO MOIST	907.5		16 28 32	80	11	SS-10	NI	-	-	-	-	-	-	-	-	16	A-6b (V)	
HARD, GRAY, **SANDY SILT**, LITTLE CLAY AND GRAVEL, DAMP	906.3	EOB	16 35 50/3"	-	87	SS-11	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	

NOTES: CAVE IN AT 11.2'. NP - NON PLASTIC, NI - NOT INTACT

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 7/18/19 12:50 - W:\062388- MS-SUM-8-1.75\E PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 BORING LOGS - ON SHEETS.GPJ

178/181	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER BORING LOG B-038-0-17	DRAWN JJH CHECKED YLZ

PILE PENETRATION CURVES

#3 Abut - Pier
T.H. 14 Date _____
Sta. 28+64 Offset 26' Lt.
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St Viaduct
over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG	ELEV.	DEPTH
Ground Line		
Proposed Footer Elev.		
Cinder fill	961.2	0
		2
	957.2	4
		6
Brown Silt, Sand & gravel	953.2	8
		10
	949.2	12
		14
	945.2	16
		18
	941.2	20
		22
	937.2	24
		26
Soft Shale {Chopped}	933.2	28
		30
Soft Shale (33% Recovery) {Cored}	929.2	32
		34
Soft Shale (42% Recovery) {Cored}	925.2	36
		38
Hard Shale Changing to Sandstone (71% Recovery) {Cored}	921.2	40
		42

Piling _____
Hammer _____
Formula _____
Reference _____

CORE BORING

10 20 30 40 50 60 70 80 90 100 110 120 130
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.G.T.
Date _____

PILE PENETRATION CURVES

#4 Abut - Pier
T.H. 17 Date _____
Sta. 31+80 Offset 43' Rt.
Water Elev. _____

County Summit
S.H. _____ Sec. City of Akron
Bridge No. Union St Viaduct
over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No. _____

SOIL LOG	ELEV.	DEPTH
Ground Line		
Proposed Footer Elev.		
	862.4	0
		2
Sand, gravel Silt & Scattered boulders	858.4	4
		6
	854.4	8
		10
Soft & hard layers Sandstone 24% recovery	850.4	12
		14
	846.4	16
Solid Sandstone 93% recovery		18
	842.4	20
		22
	838.4	24
		26
		28
		30
		32
		34
		36
		38
		40
		42

Piling _____
Hammer _____
Formula _____
Reference _____

CORE BORING

10 20 30 40 50 60 70 80 90 100 110 120 130
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.G.T.
Date _____

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
CORE BORING LOGS B-017-0-48 & B-017-0-48

SUM-8-1.75

PILE PENETRATION CURVES

#4 ~~Abut.~~ - Pier
T.H. 19 Date
Sta. 31+80 Offset 47.5' Lt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

SOIL LOG	ELEV.	DEPTH
Ground Line		
~~Proposed Footer Elev.~~		
	858.0	0
Silt Changing to Clay		2
	854.0	4
		6
Grey Sandstone 50% Recovery	850.0	8
		10
Grey Sandstone 70% Recovery	846.0	12
		14
Grey Sandstone 94% Recovery	842.0	16
		18
	838.0	20
		22
	834.0	24
		26
		28
		30
		32
		34
		36
		38
		40
		42

Piling
Hammer
Formula
Reference

10 20 30 40 50 60 70 80 90 100 110 120 130
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.G.T.
Date

PILE PENETRATION CURVES

Direction
#5 ~~Abut.~~ - Pier
T.H. 22 Date
Sta. 35+37 Offset 47.5' Lt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

SOIL LOG	ELEV.	DEPTH
Ground Line		
~~Proposed Footer~~ Elev.		
	876.2	0
		2
Brown silt and small amount of gravel	872.2	4
		6
	868.2	8
		10
Fine grey sand and small amount of silt	864.2	12
		14
Hardpan	860.2	16
		18
Sand and gradel	856.2	20
		22
	852.2	24
Soft shale		26
	848.2	28
		30
Thin layers of Sandstone and Soft shale	844.2	32
		34
	840.2	36
		38
Hard shale	836.2	40
		42
Layers shale and sandstone	832.2	44
		46
	828.2	48
		50
		52
		54
		56
		58
		60
		62
		64
		66
		68
		70

Piling
Hammer
Formula
Reference

CORE BORING

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By W.G.T.
Date

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
CORE BORING LOGS B-019-0-48 & B-022-0-48

SUM-8-1.75

PILE PENETRATION CURVES

#6 Abut. - Pier
T.H. 25 Date
Sta. 38+17 Offset 39' Rt.
Water Elev.

County Summit
S.H. Sec. City of Akron
Bridge No. Union St. Viaduct
Over Little Cuyahoga River
AKRON EXPRESSWAY
Fed. No.

Piling
Hammer
Formula
Reference

SOIL LOG ELEV. DEPTH

Ground Line
~~Proposed Footer Elev.~~

928.2 — 2
924.2 — 4, 6
920.2 — 8, 10
916.2 — 12, 14
912.2 — 16, 18
908.2 — 20, 22
904.2 — 24, 26
900.2 — 28, 30
896.2 — 32, 34
892.2 — 36, 38
888.2 — 40, 42
884.2 — 44, 46
880.2 — 48, 50
876.2 — 52, 54
872.2 — 56, 58
868.2 — 60, 62
864.2 — 64, 66
860.2 — 68, 70

Fine brown sand and silt

Grey sand, silt and clay

Fine grey sand and silt

Gravel, sand and silt

Dense grey sand and clay

Casing driven to elevation 857.9. Unable to core below elev. 865.9 due to casing breaking off

CORE BORING

0 10 20 30 40 50 60 70 80 90 100 120 130 140 150 160 170 180 190
Capacity "R" in Thousands of Pounds

BUREAU OF BRIDGES
DEPT. OF HIGHWAYS
STATE OF OHIO

By YLZ
Date

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199 OVER LITTLE CUYAHOGA RIVER
CORE BORING LOG B-025-0-48

SUM-8-1.75

181 / 181

Gannett Fleming
Engineers and Architects, P.C.
Excellence Delivered As Promised

APPENDIX F

Calculations

Appendix F.1

Geotechnical Design Parameter Summary

Objective:

The purpose of these calculations is to determine the subsurface soil and rock strata based on project boring logs and coring photos to provide geotechnical design parameters for the Sum-8-0199 Northbound and Southbound bridges substructures.

Source of Data:

1. Boring Logs are from the 2015 and 2016 exploration;
2. Unconfined compressive strength were taken from lab testing results.

Assumptions:

1. Subsurface profiles were developed for each substructure, ground water has been assumed based on the borings logs for each sub-structure;
2. The saturated unit weight of soil is assumed to be the moist unit weight of soil plus 5 pcf; the unit weight of water is assumed to be 62.5 pcf; the unit weight of rock is assumed to be 150 pcf;
3. For all the SPT >= 50, an approximate N_{60} number has been assumed for calculation purpose;
4. The drain friction angle of granular material was obtained based on $N1_{60}$ according to AASHTO Table 10.4.6.2.4-1;
5. All the data highlighted in yellow is possible outlier and neglected from calculation; and
6. The design values of N_{60}= 60, $N1_{60}$ =60 have been assumed for all the soil strata of which N_{60} >60, $N1_{60}$ >60;
7. As for the Lateral Resistance analyses, assume Design RQD = 10 for rock strata, of which average RQD < 10.

References:

1. Geotechnical Bulletin 7: Drilled Shaft and Landslide Stabilization Design, Ohio Department of Transportation, Division of Geotechnical Engineering, November 2014.
2. GEOTECH CIRCULAR No. 5 Evaluation of Soil & Rock Properties: FHWA-IF-02-034, Ohio Department of Transportation, GeoSyntec Consultants, April 2002.
3. Drilled Shaft: Construction Procedures and LRFD Design Methods, FHWA-NHI-10-016 FHWA GEC 010, Department of Transportation Federal Highway Administration, May 2010.
4. AASHTO LRFD Bridge Design Specification, Eighth Edition, 2017.
5. 2016 LPIILE Technical Manual.

Definition of parameters:

Soil Page :

Depth Depth of top of the Spoon

Sample Interval Length between the bottoms of last spoon and this spoon

γ Moist weight of soil sample
obtained based on blow count N_{60} according to Table 1 ref. 1

γ' Effective unit weight of soil sample
obtained based on γ and water table and strata depths

N_{60} N_{60} is the SPT N-value corrected for field procedures and apparatus
N_{60} = blow counts X energy ratio/ 60% = (ER/60%)N

σ'_v Vertical effective stress at the location of the SPT N-value (KSF)

C_N $C_N = [0.77 \log10 (40/\sigma'v)]$, CN < 2.0

$N1_{60}$ $N1_{60} = C_N X(N_{60})$

CLASF. AASHTO Soil Classification (ODOT)

HP Hand penetrometer readings

Φ' Drained friction angle developed based on $N1_{60}$ according to *AASHTO Table 10.4.6.2.4-1per coarse granular content*

$N1_{60}$	A-4a A-4b	A-3	A-2-5 A-2-6 A-2-7 A-3a	A-2-4	A-1-b	A-1-a
<4	25	26	27	28	29	30
4	27	28	29	30	31	32
10	30	31	32	33	34	35
30	35	36	37	38	39	40
50	38	39	40	41	42	43

Linearly interpolate between values of N160 and drained friction angle.

S_u Undrained shear strength from In-situ Tests (*Stroud,* 1974 & 1989, See Table 33 Ref. 2)
$S_u = (f_{1(}N_{60})P_a)/100$
f_1 = 4.5 for PI = 50; f_1 = 5.5 for PI = 15
Pa = atmospheric pressure, 2116 psf

PI Plastic Index

W_n Moisture content

Φ'_{PI} Drained friction angle based on PI (*Terzaghi, Peck, and Mesri, 1996, See Fig. 74 Ref. 2*)

Rock Page :

RQD Weighted RQD of each rock stratum;

RQD_I Design RQD of each rock stratum for lateral resistance analysis;

Q_u Unconfined compressive strength of rock in each stratum

GSI GSI index of each rock stratum (*AASHTO Table 10.4.6.4-1*)

Design Page :

γ_{total} total unit weight of each stratum;

Subgrade Modulus For sand, k is based on its relative density (*Reese et al., 1974*)

k For clay, k is based on its undrained shear strength (*Reese et al., 1975*)

Principal Strain ε_{50} ε_{50} is based on its undrained shear strength (*Reese et al., 1975; Reese & Welch, 1975*)

Intact Modulus E_i	E_i = Modulus X Q_u (Qu =90 according to *Horvath and Kenney, 1979, Figure 3-56*)
Modulus Ratio E_m/E_i	Modulus Ratio is estimated based on RQD (*after O'Neill and Reese, 1999*)
Mass Modulus E_m	E_i = Modulus Ratio X Intact Modulus = E_m/E_i X E_i
Poisson's Ratio μ	the Poisson's ratio for soil is obtained according to AASHTO Table C10.4.6.3-1 For clay μ is assumed to be 0.45; For sand μ is assumed to be 0.325; the Poisson's ratio for rock is obtained according to AASHTO Table C10.4.6.5-2: For sandstone μ is assumed to be 0.2; For mudstone μ is assumed to be 0.1;
Shear Modulus G_i	$G_i = E_i/(2X(1+\mu)$;
Stiffness Constant K_{rm}	K_{rm} ranges from 0.0005 to 0.00005 for weak rock; for rock stratum with Q_u>= 1000 psi, K_{rm} is assumed to be 0.00005;
Rock ϕ	Internal friction angle of rock, obtained from Roclab analysis;
Split Tensile Strength	Tensile strength of rock is assumed to be $Q_u/10$;
Torsional Shear Stress	Assumed to be the same as the ultimate skin friction, here we rounded to 100 psf: 1. For drilled shaft clay: ΦRs = 500 psf 2. For drilled shaft sand or gravel: ΦRs = 1000 psf 3. For drilled shaft rock: competent rock (RQD>20) : ΦRs = (QuXPa)^0.5 (*AASHTO 10.8.3.5.4b-1*) fractured rock (RQD<=20) : ΦRs = 0.65X0.45X (QuXPa)^0.5 (*AASHTO 10.8.3.5.4b-2*) 4. For driven pile, maximum skin friction (bottom 1 foot of each layer) obtained from Apile analysis
Pile Bearing Failure	Assumed to be the same as the ultimate tip resistance (maximum tip resistance obtained from Apile analysis) of each layer, here we rounded up to 10 kips.

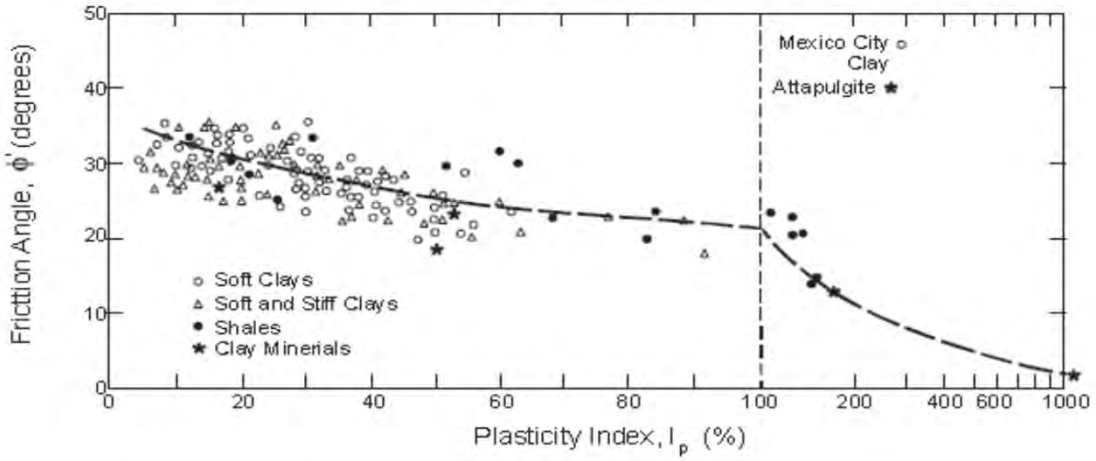


Figure 74. Relationship between ϕ' and PI (Terzaghi, Peck, and Mesri, 1996).

Table 10.4.6.2.4-1—Correlation of $SPT\ N1_{60}$ Values to Drained Friction Angle of Granular Soils (modified after Bowles, 1977)

N_{60}	ϕ_f
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

Soil Modulus Parameter k for Sands			
Relative Density	**Loose**	**Medium**	**Dense**
Submerged Sand	20 lb/in3	60 lb/in3	125 lb/in3
Submerged Sand	5,430 KPa/m	16,300 KPa/m	33,900 KPa/m
Sand Above WT	25 lb/in3	90 lb/in3	225 lb/in3
Sand Above WT	6,790 KPa/m	24,430 KPa/m	61,000 KPa/m

Soil Modulus Parameter k for Clays			
Average Undrained Shear Strength		**Static**	**Cyclic**
Soft Clay	c = 1.74 to 3.47 psi	30 pci	--
	250 to 500 psf		
	12 to 24 KPa	8,140 KPa/m	--
Medium Clay	c = 3.47 to 6.94 psi	100 pci	--
	500 to 1000 psf		
	24 to 48 KPa	27,150 KPa/m	--
Stiff Clay	c = 6.94 to 13.9 psi	500 pci	200 pci
	1000 to 2000 psf		
	48 to 96 KPa	136,000 KPa/m	54,300 KPa/m
Very Stiff Clay	c = 13.9 to 27.8 psi	1000 pci	400 pci
	2000 to 4000 psf		
	96 to 192 KPa	271,000 KPa/m	108,500 KPa/m
Hard Clay	c = 27.8 to 55.6 psi	2000 pci	800 pci
	4000 to 8000 psf		
	192 to 383 KPa	543,000 KPa/m	217,000 KPa/m

Soil Strain Parameter E50		
Soft Clay	c = 1.74 to 3.47 psi 250 to 500 psf 12 to 24 KPa	E50 = 0.02
Medium Clay	c = 3.47 to 6.94 psi 500 to 1000 psf 24 to 48 KPa	E50 = 0.01
Stiff Clay	c = 6.94 to 13.9 psi 1000 to 2000 psf 48 to 96 KPa	E50 = 0.007
Very Stiff Clay	c = 13.9 to 27.8 psi 2000 to 4000 psf 96 to 192 KPa	E50 = 0.005
Hard Clay	c = 27.8 to 55.6 psi 4000 to 8000 psf 192 to 383 KPa	E50 = 0.004
Limestone		E50 = 0.001

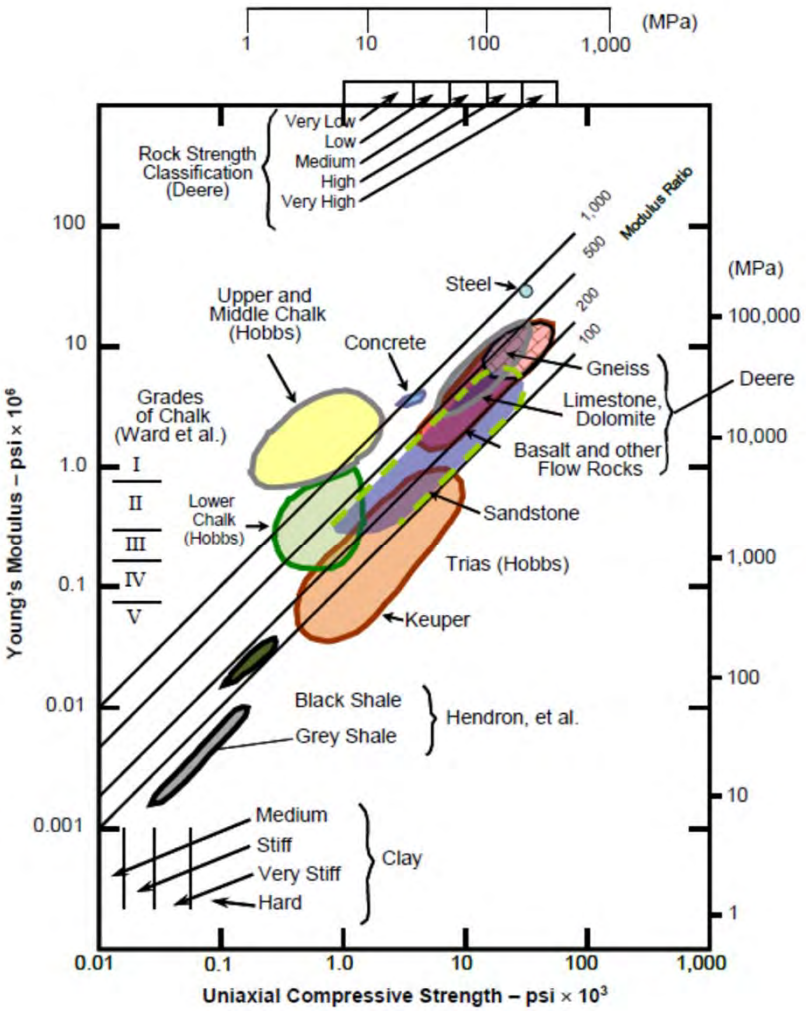


Figure 3-56 Engineering Properties for Intact Rocks
(after Deere, 1968; Peck, 1976; and Horvath and Kenney, 1979)

Table 10.4.6.5-1 Estimation of E_m based on *RQD* (after *O'Neill and Reese, 1999*).

RQD (percent)	E_m/E_i	
	Closed Joints	Open Joints
100	1.00	0.60
70	0.70	0.10
50	0.15	0.10
20	0.05	0.05

Table C10.4.6.3-1—Elastic Constants of Various Soils (modified after U.S. Department of the Navy, 1982; Bowles, 1988)

Soil Type	Typical Range of Young's Modulus Values, E_s (ksi)	Poisson's Ratio, ν (dim)
Clay:		
Soft sensitive	0.347–2.08	0.4–0.5 (undrained)
Medium stiff	2.08–6.94	
to stiff	6.94–13.89	
Very stiff		
Loess	2.08–8.33	0.1–0.3
Silt	0.278–2.78	0.3–0.35
Fine Sand:		
Loose	1.11–1.67	0.25
Medium dense	1.67–2.78	
Dense	2.78–4.17	
Sand:		
Loose	1.39–4.17	0.20–0.36
Medium dense	4.17–6.94	
Dense	6.94–11.11	0.30–0.40
Gravel:		
Loose	4.17–11.11	0.20–0.35
Medium dense	11.11–13.89	
Dense	13.89–27.78	0.30–0.40

Table C10.4.6.5-2—Summary of Poisson's Ratio for Intact Rock (modified after Kulhawy, 1978)

Rock Type	No. of Values	No. of Rock Types	Poisson's Ratio, ν			Standard Deviation
			Maximum	Minimum	Mean	
Granite	22	22	0.39	0.09	0.20	0.08
Gabbro	3	3	0.20	0.16	0.18	0.02
Diabase	6	6	0.38	0.20	0.29	0.06
Basalt	11	11	0.32	0.16	0.23	0.05
Quartzite	6	6	0.22	0.08	0.14	0.05
Marble	5	5	0.40	0.17	0.28	0.08
Gneiss	11	11	0.40	0.09	0.22	0.09
Schist	12	11	0.31	0.02	0.12	0.08
Sandstone	12	9	0.46	0.08	0.20	0.11
Siltstone	3	3	0.23	0.09	0.18	0.06
Shale	3	3	0.18	0.03	0.09	0.06
Limestone	19	19	0.33	0.12	0.23	0.06
Dolostone	5	5	0.35	0.14	0.29	0.08

B-006-0-15 **Surface Elevation=** 1020.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	W_n (%)
3.5	1017.0	1.5	5.0	0.125	27	0.53125	1.44511	39	A-1-b	40.4				11.0
6	1014.5	2.5	7.5	0.125	24	0.84375	1.2904	31	A-3	36.1				14.0
8.5	1012.0	2.5	10.0	0.125	29	1.15625	1.18504	34	A-3	36.7				10.0
11	1009.5	2.5	12.5	0.13	20	1.4775	1.10305	22	A-3	34.0				14.0
13.5	1007.0	2.5	15.0	0.13	19	1.8025	1.03656	20	A-6b		4.5	2211.2	16.0	24.0

Strata No.	**B-006-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**C=S_u** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S	0	13.5	1007.0	13.5	25	32	126	12.3	36.8				
Strata 2	C	13.5	16.5	1004.0	3.0	19	20	130	24.0		4,500	2,211	16	31.0

B-008-0-15 **Surface Elevation=** 960.3 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	W_n (%)
1	959.3	1.5	2.5	0.125	37	0.21875	1.74183	64	A-1-b	42.0				
3.5	956.8	2.5	5.0	0.125	25	0.53125	1.44511	36	A-7-6		2.5	2,910	25.0	4.0
6	954.3	24.0	29.0	0.13	100	2.25	0.96241	96	A-2-7	40.0				16.0

Strata No.	**B-008-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	γ_{moist} (pcf.)	W_n (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**C=S_u** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	C	4.5	6.0	954.3	1.5	25	36	125.0	4.0		2500	2,910	25	29.5
Strata 3	G/SL	6.0	29.0	931.3	23.0	100	96	130.0	16.0	40.0				

B-009-0-15 **Surface Elevation=** 968.9 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
1	967.9	1.5	2.5	0.125	70	0.21875	1.74183	122	A-3	39.0				4.0

Strata No.	**B-009-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	**Str. Dep.** (ft.)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**C=S_u** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	S	0.0	2.5	966.4	2.5	70	122	125	4.0	39.0				

B-010-0-15 **Surface Elevation=** 879.2 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
3.5	875.7	1.5	5.0	0.11	5	0.4675	1.48785	7	A-7-6		1	582	24.0	26.0
6	873.2	2.5	7.5	0.125	17	0.76875	1.32153	22	A-6b			1978		10.0
8.5	870.7	2.5	10.0	0.13	43	1.09	1.20477	52	A-6b			5004	20.0	9.0
11	868.2	2.5	12.5	0.135	45	1.42375	1.11544	50	A-6b			5237		11.0
13.5	865.7	2.5	15.0	0.135	78	1.76125	1.0443	81	A-6b			9078		13.0
16	863.2	2.5	17.5	0.135	78	2.09875	0.98568	77	A-6b			9078		7.0

Strata No.	**B-010-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**C=S_u** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	C	3.7	8.5	870.7	4.8	11	15	118	18.0		1000	1,280	24	29.5
Strata 2	C	8.5	18.5	860.7	10.0	69	71	122	10.0			8,007	20	30.5

B-011-0-15 **Surface Elevation=** 879.2 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
3.5	875.7	1.5	5.0	0.125	45	0.531	1.445	65	A-7-6		1	5,237	21.0	36.0
6	873.2	2.5	7.5	0.12	7	0.835	1.294	9	A-6a		1.25	815		28.0
8.5	870.7	2.5	10.0	0.125	17	1.14375	1.18867	20	A-6a		1.25	1,978	11.0	29.0

Strata No.	**B-011-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**C=S_u** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	C	2	11.0	868.2	9.0	12	15	123	31.0		1167	1,397	16	31.0

B-015-0-15 **Surface Elevation=** 961.2 **Water Dep. (ft.)=** 18.5 Water Elv. = 942.7

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	Wn (%)
1	960.2	1.5	2.5	0.125	32	0.219	1.742	56	A-1-b	42.0				
3.5	957.7	2.5	5.0	0.125	30	0.531	1.445	43	A-1-b	41.0				8.0
6	955.2	2.5	7.5	0.125	27	0.844	1.290	35	A-1-b	39.8				10.0
8.5	952.7	2.5	10.0	0.125	11	1.156	1.185	13	A-4a		0.75	1280	7.0	28.0
11	950.2	2.5	12.5	0.115	4	1.451	1.109	4	A-3	28.0				12.0
13.5	947.7	2.5	15.0	0.12	7	1.748	1.047	7	A-3	29.5				13.0
16	945.2	2.5	17.5	0.12	5	2.048	0.994	5	A-3	28.5				18.0
18.5	942.7	2.5	20.0	0.12	5	2.348	0.948	5	A-3	28.5				21.0
21	940.2	2.5	22.5	0.0626	4	2.547	0.921	4	A-3	28.0				30.0
23.5	937.7	2.5	25.0	0.0676	8	2.712	0.900	7	A-4a		0.83	931		38.0
26	935.2	2.5	27.5	0.0776	23	2.899	0.878	20	A-4a		0.10	2677	9.0	33.0
28.5	932.7	2.5	30.0	0.0776	16	3.093	0.856	14	A-6b		0.75	1862	17.0	40.0
33.5	927.7	5	35.0	0.0726	13	3.460	0.819	11	A-6b		0.70	1513		38.0
38.5	922.7	5	40.0	0.0726	13	3.823	0.785	10	A-6b		1.25	1513		42.0
43.5	917.7	5	45.0	0.0826	19	4.228	0.751	14	A-6b		1.00	2211		44.0
48.5	912.7	5	50.0	0.0826	20	4.641	0.720	14	A-6b		0.65	2328	17.0	46.0
53.5	907.7	5	55.0	0.0826	19	5.054	0.692	13	A-6b		0.65	2211		43.0
58.5	902.7	5	60.0	0.0826	17	5.467	0.666	11	A-6b		0.25	1978		41.0
63.5	897.7	5	65.0	0.0876	34	5.901	0.640	22	A-2-4	36.0				21.0
68.5	892.7	5	70.0	0.0876	36	6.339	0.616	22	A-3a	35.0				22.0
73.5	887.7	5	75.0	0.0876	34	6.777	0.594	20	A-3a	34.5				20.0
78.5	882.7	5	80.0	0.0876	34	7.215	0.573	19	A-3a	34.3				25.0
83.5	877.7	5	85.0	0.0876	64	7.653	0.553	35	A-2-4	38.8				38.0
88.5	872.7	5	90.0	0.0876	82	8.091	0.534	44	A-2-4	40.1				35.0
93.5	867.7	5	95.0	0.0876	44	8.529	0.517	23	A-2-4	36.3				34.0

Strata No.	B-015-0-15													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	S	1	22.2	939	21.2	6	6	122	17.5	28.5				
Strata 2	C	22.2	62.5	898.7	40.3	16	13	135	40.6		686	1914	14	31.5
Strata 3	S	62.5	95.0	866.2	32.5	47	26	145	27.9	36.4				

B-016-0-15 **Surface Elevation=** 1017.6 **Water Dep. (ft.)=** 52 Water Elv. = 965.6

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	Wn (%)
1	1016.6	1.5	2.5	0.125	28	0.219	1.74183	49	A-1-b	41.9				6.0
3.5	1014.1	2.5	5.0	0.125	50	0.531	1.44511	72	A-1-b	42.0				8.0
6	1011.6	2.5	7.5	0.125	30	0.844	1.2904	39	A-1-b	40.4				5.0
8.5	1009.1	2.5	10.0	0.12	5	1.148	1.18758	6	A-1-b	32.0				13.0
11	1006.6	2.5	12.5	0.115	3	1.439	1.11194	3	A-1-b	30.0				13.0
13.5	1004.1	2.5	15.0	0.13	23	1.753	1.04597	24	A-1-b	37.5				12.0
16	1001.6	2.5	17.5	0.125	9	2.069	0.99049	9	A-1-b	33.5				14.0
18.5	999.1	2.5	20.0	0.12	8	2.373	0.94468	8	A-1-b	33.0				15.0
21	996.6	2.5	22.5	0.125	5	2.681	0.90377	5	A-1-b	31.5				15.0
23.5	994.1	2.5	25.0	0.125	8	2.994	0.8669	7	A-1-b	32.5				14.0
26	991.6	2.5	27.5	0.13	15	3.315	0.83281	12	A-4a		1.5	1746	3.0	20.0
28.5	989.1	2.5	30.0	0.135	23	3.649	0.80074	18	A-3	33.0				12.0
31	986.6	2.5	32.5	0.14	39	3.995	0.77042	30	A-3	36.0				11.0
33.5	984.1	2.5	35.0	0.14	42	4.345	0.74233	31	A-3	36.2				11.0
36	981.6	2.5	37.5	0.14	55	4.695	0.71643	39	A-3	37.4				10.0
38.5	979.1	2.5	40.0	0.14	44	5.045	0.69238	30	A-3	36.0				11.0
43.5	974.1	5.0	45.0	0.145	32	5.766	0.6477	21	A-3	33.8				11.0
48.5	969.1	5.0	50.0	0.145	32	6.491	0.60809	19	A-3	33.3				17.0
53.5	964.1	5.0	55.0	0.0876	35	6.972	0.58419	20	A-6b		3	4073		29.0
58.5	959.1	5.0	60.0	0.0876	31	7.410	0.56381	17	A-1-b	35.8				16.0
63.5	954.1	5.0	65.0	0.0876	34	7.848	0.54461	19	A-4a		4.5	3957	6.0	27.0
68.5	949.1	5.0	70.0	0.0876	54	8.286	0.52645	28	A-6b		0.5	6285	17.0	29.0
73.5	944.1	5.0	75.0	0.0876	67	8.724	0.50922	34	A-1-b	39.6				14.0
78.5	939.1	5.0	80.0	0.0876	38	9.162	0.49284	19	A-1-b	36.3				18.0
83.5	934.1	5.0	85.0	0.0876	38	9.600	0.47723	18	A-1-b	36.0				15.0
88.5	929.1	5.0	90.0	0.0776	13	9.996	0.46373	6	A-4a		0.25	1513		26.0
93.5	924.1	5.0	95.0	0.0876	32	10.426	0.44963	14	A-6b		0.75	3724	19.0	37.0
98.5	919.1	5.0	100.0	0.0876	38	10.864	0.43586	17	A-6b		3.25	4422	20.0	38.0

Strata No.	B-016-0-15													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	G	3.5	29.0	988.6	25.5	8	7	124.0	14.5	32.1				
Strata 2	S	29.0	53.7	963.9	24.7	38	27	140.7	11.9	35.1				
Strata 3	C	53.7	69.5	948.1	15.8	33	19	145.0	25.3		3750	4015	12	32.0
Strata 4	G	69.5	88.0	929.6	18.5	48	24	145.0	15.7	37.3				
Strata 5	C	88.0	100.0	917.6	12.0	28	12	141.7	33.7		1417	3220	20	30.5

B-017-0-15 **Surface Elevation=** 1024.4 **Water Dep. (ft.)=** 58 Water Elv. = 966.4

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	Wn (%)
1	1023.4	1.5	2.5	0.12	12	0.21	1.75548	21	A-1-b	36.8				13.0
3.5	1020.9	2.5	5.0	0.11	7	0.4925	1.47043	10	A-1-b	34.0				12.0
6	1018.4	2.5	7.5	0.12	7	0.785	1.31454	9	A-1-b	33.5				12.0
8.5	1015.9	2.5	10.0	0.12	7	1.085	1.20631	8	A-1-b	33.0				14.0
11	1013.4	2.5	12.5	0.12	7	1.385	1.12467	8	A-1-b	33.0				12.0
13.5	1010.9	2.5	15.0	0.12	7	1.685	1.0591	7	A-1-b	32.5				11.0
16	1008.4	2.5	17.5	0.125	9	1.99375	1.00284	9	A-1-b	33.5				10.0
18.5	1005.9	2.5	20.0	0.12	8	2.2975	0.95542	8	A-1-b	33.0				11.0
21	1003.4	2.5	22.5	0.13	15	2.615	0.91213	14	A-1-b	35.0				12.0
23.5	1000.9	2.5	25.0	0.14	32	2.9575	0.87097	28	A-3	35.5				13.0
26.0	998.4	2.5	27.5	0.14	32	3.3075	0.83357	27	A-3	35.3				15.0
28.5	995.9	2.5	30.0	0.13	11	3.64	0.80154	9	A-3	30.5				17.0
31.0	993.4	2.5	32.5	0.14	55	3.9825	0.77147	42	A-1-b	40.8				14.0
33.5	990.9	2.5	35.0	0.14	54	4.3325	0.7433	40	A-1-b	40.5				12.0
36.0	988.4	2.5	37.5	0.14	44	4.6825	0.71732	32	A-1-b	39.3				12.0
38.5	985.9	2.5	40.0	0.14	34	5.0325	0.69321	24	A-3	34.5				15.0
43.5	980.9	5	45.0	0.145	94	5.75375	0.64842	61	A-1-b	42.0				12.0
48.5	975.9	5	50.0	0.145	32	6.47875	0.60874	19	A-1-b	36.3				12.0
53.5	970.9	5	55.0	0.145	35	7.20375	0.57327	20	A-4a		4.25	4,073		17.0
58.5	965.9	5	60.0	0.0876	38	7.6848	0.55165	21	A-3	33.8				14.0
63.5	960.9	5	65.0	0.0876	35	8.1228	0.53311	19	A-3	33.3				9.0
68.5	955.9	5	70.0	0.0876	59	8.5608	0.51555	30	A-1-b	39.0				10.0

Strata No.	B-017-0-15													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	G	11	31.5	992.9	20.5	15	14	128	12.6	33.5				
Strata 2	S	31.5	70.0	954.4	38.5	43	27	141	12.7	37.2				

B-005-2-16 **Surface Elevation=** 1012.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
0	1012.5	1.5	1.5	0.12	13	0.090	2.000	26	A-3a	36.0				21
2.5	1010.0	2.5	4.0	0.125	19	0.399	1.541	29	A-3a	36.8				16
5	1007.5	2.5	6.5	0.125	25	0.711	1.348	34	A-3a	37.6				4
7.5	1005.0	2.5	9.0	0.125	25	1.024	1.226	31	A-3a	37.2				3
10	1002.5	2.5	11.5	0.135	32	1.354	1.132	36	A-3a	37.9				3

Strata No.	**B-005-2-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**$N_{60.}$** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S	0	12.5	1000.0	12.5	23	31	126	9	37.1				

B-009-1-16 **Surface Elevation=** 957.7 **Water Dep. (ft.)=** 22 Water Elv. = 935.7

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
0	957.7	1.5	1.5	0.125	22	0.094	2.000	44	A-4a			2,560		14
2.5	955.2	2.5	4.0	0.125	35	0.406	1.535	54	A-3a	40.0				9
5	952.7	2.5	6.5	0.125	19	0.719	1.344	26	A-4a		4.5	2,211	8	11
7.5	950.2	2.5	9.0	0.125	10	1.031	1.223	12	A-4a		3	1,164		11
10	947.7	2.5	11.5	0.13	16	1.353	1.133	18	A-4a		3.5	1,862		11
12.5	945.2	2.5	14.0	0.13	16	1.678	1.061	17	A-4a		3.25	1,862		10
15	942.7	2.5	16.5	0.13	23	2.003	1.001	23	A-4a		3.5	2,677		10
17.5	940.2	2.5	19.0	0.13	18	2.328	0.951	17	A-1-b	35.8				12
20	937.7	2.5	21.5	0.13	15	2.653	0.907	14	A-1-b	35.0				15
22.5	935.2	2.5	24.0	0.0776	25	2.886	0.879	22	A-1-b	37.0				18
25	932.7	2.5	26.5	0.0826	70	3.089	0.856	60	A-2-6	40.0				10
27.5	930.2	2.5	29.0	0.0826	100	3.295	0.835	83	A-2-6	40.0				9
30	927.7	2.5	31.5	0.0826	100	3.502	0.815	81	A-2-6	40.0				14

Strata No.	B-009-1-16 Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	0	17.0	940.7	17.0	18	19	127	11		3550	2056	8	33
Strata 2	G	17.0	25.4	932.3	8.4	19	18	132	15	35.9				
Strata 3	G/SL	25.4	35.0	922.7	9.6	90	75	140	11	40.0				

B-009-4-16 **Surface Elevation=** 882.7 **Water Dep. (ft.)=** 14 Water Elv. = 868.7

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
0	882.7	1.5	1.5	0.12	13	0.090	2.000	26	A-4a		1.25	1,513		22
5	877.7	5	6.5	0.125	21	0.711	1.348	28	A-4a		2.5	2,444	3	13
10	872.7	5	11.5	0.12	7	1.315	1.142	8	A-6b		0.75	815		11
15	867.7	5	16.5	0.0776	56	1.735	1.049	59	A-6b		1	6,517		15

Strata No.	B-009-4-16 Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	0	16.3	866.4	16.3	14	21	122	15		1000	1591		

B-011-3-16 **Surface Elevation=** 873.8 **Water Dep. (ft.)=** 13 Water Elv. = 860.8

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
1	872.8	1.5	2.5	0.125	22	0.219	1.742	38	A-4a		3	2,560		15
3.5	870.3	2.5	5.0	0.12	9	0.523	1.451	13	A-4a		2.5	1,047	7	14
6	867.8	2.5	7.5	0.12	5	0.823	1.299	6	A-3a	30.0				12
8.5	865.3	2.5	10.0	0.12	7	1.123	1.195	8	A-4a		1.75	815		14
11	862.8	2.5	12.5	0.13	19	1.440	1.112	21	A-2-4	35.8				18
13.5	860.3	2.5	15.0	0.0726	20	1.665	1.063	21	A-3a	34.8				22
16	857.8	2.5	17.5	0.0776	50	1.855	1.027	51	A-1-b	42.0			5	10
18.5	855.3	2.5	20.0	0.0776	100	2.049	0.994	99	A-1-b	42.0				8
21	852.8	2.5	22.5	0.0826	100	2.252	0.962	96	A-1-b	42.0				6
23.5	850.3	2.5	25.0	0.0826	78	2.458	0.933	73	A-4a		4.3	9,078		10
26	847.8	2.5	27.5	0.0826	100	2.665	0.906	91	A-1-b	42.0				12
28.5	845.3	2.5	30.0	0.0826	100	2.871	0.881	88	A-2-6	40.0				9
33.5	840.3	5.5	35.5	0.0826	100	3.305	0.834	83	A-1-b	42.0				10

Strata No.	**B-011-3-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**$N_{60.}$** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	C	1	11.0	862.8	10.0	7	9	120	14		2130	931	7	33
Strata 2	G/SL	11.0	14.5	859.3	3.5	20	21	130	20	35.3				
Strata 3	G	14.5	35.5	838.3	21.0	90	83	139	9	41.7				

B-011-2-16 **Surface Elevation=** 872.6 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
2.5	870.1	1.5	4.0	0.125	26	0.406	1.535	40	A-4a		3.5	3,026		12
5	867.6	2.5	6.5	0.12	7	0.710	1.348	9	A-4a		1.5	815	7	15
7.5	865.1	2.5	9.0	0.125	11	1.019	1.227	14	A-3a	33.0				12
10	862.6	2.5	11.5	0.125	12	1.331	1.138	14	A-1-b	35.0				12
12.5	860.1	2.5	14.0	0.135	100	1.661	1.064	106	A-4a		4	11,638	8	11
15	857.6	2.5	16.5	0.135	100	1.999	1.002	100	A-1-a	43.0				4
17.5	855.1	2.5	19.0	0.135	70	2.336	0.950	66	A-2-6	40.0				11
20	852.6	2.5	21.5	0.14	34	2.683	0.904	31	A-1-b	39.2				15
22.5	850.1	2.5	24.0	0.14	75	3.033	0.863	65	A-2-6	40.0				11

Strata No.	B-011-2-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	2.5	7.5	865.1	5.0	7	9	123	14		1500	815	7	33
Strata 2	G	7.5	12	860.6	4.5	12	14	125	12	34.0				
Strata 3	G/SL	12	25.0	847.6	13.0	76	74	137	12	40.5				

B-011-4-16 **Surface Elevation=** 875 **Water Dep. (ft.)=** 8 Water Elv. = 867

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
1	874	1.5	2.5	0.125	37	0.219	1.742	64	A-1-b	42.0				11
3.5	871.5	2.5	5	0.125	28	0.531	1.445	40	A-2-4	39.5				12
6	869	2.5	7.5	0.13	88	0.853	1.287	113	A-2-4	41.0				11
8.5	866.5	2.5	10.0	0.0726	77	1.077	1.209	93	A-2-4	41.0			9	7
11	864.0	2.5	12.5	0.0776	60	1.267	1.154	69	A-2-4	41.0				10
13.5	861.5	2.5	15.0	0.0776	100	1.461	1.107	111	A-1-a	43.0				2
16	859.0	2.5	17.5	0.0776	74	1.655	1.065	79	A-1-b	42.0				9
18.5	856.5	2.5	20.0	0.0776	72	1.849	1.028	74	A-2-4	41.0				9
21	854.0	2.5	22.5	0.0826	107	2.052	0.993	106	A-1-a	43.0				7
23.5	851.5	2.5	25.0	0.0826	100	2.259	0.961	96	A-4a			11638	10	10
26	849.0	2.5	27.5	0.0826	92	2.465	0.932	86	A-4a(NP)	38.0				13
28.5	846.5	2.5	30.0	0.0826	50	2.672	0.905	45	A-4a(NP)	37.3				16
33.5	841.5	10.0	40.0	0.0826	100	3.291	0.835	84	A-1-a	43.0				10
40	835.0	1.5	41.5	0.0876	83	3.625	0.803	67	A-2-4	0.0				10

Strata No.	B-011-4-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 2	G/SL	1.0	42.8	832.2	41.8	76	81	135	10	37.8				

B-011-5-16 **Surface Elevation=** 875.2 **Water Dep. (ft.)=** 8 Water Elv. = 867.2

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
1	874.2	1.5	2.5	0.125	22	0.219	1.742	38	A-4a		4	2560		22
3.5	871.7	2.5	5.0	0.11	6	0.505	1.462	9	A-4a		2.25	698		19
6	869.2	2.5	7.5	0.125	13	0.806	1.306	17	A-4b			1513		25
8.5	866.7	2.5	10.0	0.0676	13	1.018	1.228	16	A-1-b	35.5				12
11	864.2	2.5	12.5	0.0776	40	1.205	1.171	47	A-4a		4	4655	5	13
13.5	861.7	2.5	15.0	0.0776	34	1.399	1.121	38	A-4a		4	3957		13
16	859.2	2.5	17.5	0.0776	54	1.593	1.078	58	A-2-6	40.0				12
18.5	856.7	2.5	20.0	0.0776	43	1.787	1.039	45	A-1-a	42.3				8
21	854.2	2.5	22.5	0.0826	73	1.990	1.004	73	A-1-b	42.0				8
23.5	851.7	2.5	25.0	0.0826	91	2.196	0.971	88	A-2-6	40.0				11
26	849.2	2.5	27.5	0.0826	51	2.403	0.940	48	A-6a		4.5	5935	12	9
28.5	846.7	2.5	30.0	0.0826	49	2.609	0.913	45	A-6a		4.5	5703		9
33.5	841.7	5	35.0	0.0826	58	3.022	0.864	50	A-6a		4.5	6750		11

Strata No.	B-011-5-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	1.0	15.0	860.2	14.0	21	28	126	17		3562.5	2677	5	34.0
Strata 2	G	15.0	25.0	850.2	10.0	65	66	138	10	41.1				
Strata 3	C	25.0	37.5	837.7	12.5	53	48	140	10		4500	6129	12	32.0

B-013-2-16 **Surface Elevation=** 880.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
1	879.5	1.5	2.5	0.12	12	0.21	1.755477	21	A-3a	34.8				11
3.5	877.0	2.5	5.0	0.105	4	0.48375	1.476428	6	A-2-4	31.0				18
6	874.5	2.5	7.5	0.12	6	0.7725	1.319904	8	A-3a	31.0				12
8.5	872.0	2.5	10.0	0.11	3	1.055	1.215682	4	A-3a	29.0				19
11	869.5	2.5	12.5	0.125	9	1.35625	1.131685	10	A-1-b	34.0				15
13.5	867.0	2.5	15.0	0.13	16	1.6775	1.060596	17	A-1-b	35.8				16
16	864.5	2.5	17.5	0.125	12	1.99375	1.00284	12	A-1-b	34.5				18
18.5	862.0	2.5	20.0	0.12	7	2.2975	0.955419	7	A-1-b	32.5				17
21	859.5	2.5	22.5	0.135	28	2.62375	0.911016	26	A-2-4	37.0				19
23.5	857.0	2.5	25.0	0.14	42	2.97	0.869564	37	A-6a		4	4888		12
26	854.5	2.5	27.5	0.14	75	3.32	0.83231	62	A-6a		4.5	8729	13	11

Strata No.	**B-013-2-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S	1.5	10.5	870.0	9.0	4	6	113.8	15	30.3				
Strata 2	G	10.5	29.0	851.5	18.5	14	14	135.0	15	34.8				

B-013-3-16 **Surface Elevation=** 885.5 **Water Dep. (ft.)=** 15 Water Elv. = 870.5

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
1	884.5	1.5	2.5	0.125	16	0.21875	1.741826	28	A-1-b	38.5				16
3.5	882.0	2.5	5.0	0.125	16	0.53125	1.445106	23	A-3a	35.3				8
6	879.5	2.5	7.5	0.13	32	0.8525	1.286952	41	A-3a	38.7				7
8.5	877.0	2.5	10.0	0.125	9	1.16875	1.181441	11	A-1-b	34.3				13
11	874.5	2.5	12.5	0.12	8	1.4725	1.104184	9	A-1-b	33.5				26
13.5	872.0	2.5	15.0	0.115	4	1.76375	1.04383	4	A-6a		1	466	14	32
16	869.5	2.5	17.5	0.0676	11	1.9683	1.007136	11	A-2-4	33.3				16
18.5	867.0	2.5	20.0	0.0726	24	2.14605	0.978224	23	A-1-a	38.3				15
21	864.5	2.5	22.5	0.0826	54	2.34505	0.948569	51	A-1-b	42.0				10
23.5	862.0	2.5	25.0	0.0826	43	2.55155	0.920347	40	A-1-b	40.5				11
26	859.5	2.5	27.5	0.0826	51	2.75805	0.894323	46	A-1-b	41.4				9
28.5	857.0	2.5	30.0	0.0826	38	2.96455	0.870178	33	A-1-b	39.5				14
33.5	852.0	5	35.0	0.0826	62	3.37755	0.826563	51	A-1-b	42.0				12
38.5	847.0	5	40.0	0.0826	103	3.79055	0.787985	81	A-1-b	42.0				9

Strata No.	**B-013-3-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S	2.5	15.5	870.0	13.0	9	12	115.0	17	34.3			14	31.5
Strata 2	G	15.5	43.5	842.0	28.0	48	42	136.9	12	39.9				

B-013-4-16 **Surface Elevation=** 885.5 **Water Dep. (ft.)=** 18 Water Elv. = 867.5

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
1	884.5	1.5	2.5	0.125	16	0.21875	1.741826	28	A-4a		3.5	1862		12
3.5	882.0	2.5	5.0	0.11	7	0.505	1.462052	10	A-4a		1.5	815		16
6	879.5	2.5	7.5	0.11	3	0.78	1.316673	4	A-4b(NP)	27.0				17
8.5	877.0	2.5	10.0	0.12	7	1.0725	1.21018	8	A-4b(NP)	29.0				22
11	874.5	2.5	12.5	0.115	4	1.36375	1.12984	5	A-4a(NP)	27.5				17
13.5	872.0	2.5	15.0	0.12	6	1.66	1.064103	6	A-4a(NP)	28.0				17
16	869.5	2.5	17.5	0.125	15	1.96875	1.007059	15	A-4a(NP)	31.3				23
18.5	867.0	2.5	20.0	0.0676	9	2.1808	0.972852	9	A-1-b	33.5				15
21	864.5	2.5	22.5	0.0726	15	2.35855	0.946649	14	A-4a(NP)	31.0				24
23.5	862.0	2.5	25.0	0.0776	25	2.5488	0.920708	23	A-2-4	36.3				14
26	859.5	2.5	27.5	0.0826	45	2.75155	0.895112	40	A-1-b	40.5				10
28.5	857.0	2.5	30.0	0.0826	33	2.95805	0.870912	29	A-1-b	38.8				12
31	854.5	2.5	32.5	0.0826	37	3.16455	0.848346	31	A-1-b	39.2				9
33.5	852.0	2.5	35.0	0.0826	54	3.37105	0.827207	45	A-1-b	41.3				7
36	849.5	2.5	37.5	0.0826	54	3.57755	0.807325	44	A-1-b	41.1				13
38.5	847.0	2.5	40.0	0.0826	66	3.78405	0.788559	52	A-1-b	42.0				11
43.5	842.0	5	45.0	0.0876	100	4.2183	0.75223	75	A-2-4	41.0				9
45	840.5	0.5	45.5	0.0926	100									

Strata No.	**B-013-4-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	C	0	5.5	880.0	5.5	12	19	118	14		2500	1300		
Strata 2	S/SL	5.5	23.0	862.5	17.5	8	9	121	19	29.6				
Strata 3	G	23.0	44.4	841.1	21.4	57	42	141	11	40.0				

B-013-5-16 **Surface Elevation=** 913.5 **Water Dep. (ft.)=** 7.5 Water Elv. = 906

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
1	912.5	1.5	2.5	0.12	12	0.21	1.755477	21	A-3a	34.8				8
3.5	910.0	2.5	5.0	0.105	3	0.48375	1.476428	4	A-3a	29.0				10
6	907.5	2.5	7.5	0.125	14	0.78125	1.316138	18	A-1-b	36.0				10
8.5	905.0	2.5	10.0	0.0676	11	0.9933	1.235834	14	A-4b		1.5	1280		27
11	902.5	2.5	12.5	0.0726	16	1.17105	1.180783	19	A-4b		1.5	1862	3	29
13.5	900.0	2.5	15.0	0.0726	22	1.35255	1.132598	25	A-4b		2	2560		28
16	897.5	2.5	17.5	0.0726	22	1.53405	1.09049	24	A-4b		2.5	2560		29
18.5	895.0	2.5	20.0	0.0726	26	1.71555	1.053096	27	A-4b		2.5	3026		27
21	892.5	2.5	22.5	0.0776	20	1.9058	1.017927	20	A-4b		3	2328		32
23.5	890.0	2.5	25.0	0.0776	16	2.0998	0.985509	16	A-4b		2	1862		27
26	887.5	2.5	27.5	0.0776	26	2.2938	0.955958	25	A-6a		1.5	3026		30
28.5	885.0	2.5	30.0	0.0776	28	2.4878	0.928808	26	A-4b		2.5	3259		31
31	882.5	2.5	32.5	0.0776	30	2.6818	0.903698	27	A-4b			3491		16
33.5	880.0	2.5	35.0	0.0776	24	2.8758	0.880342	21	A-3	33.8				9
36	877.5	2.5	37.5	0.0676	7	3.0523	0.860423	6	A-4b		0.5	815		39
38.5	875.0	2.5	40.0	0.0776	28	3.2388	0.84059	24	A-4b		2.5	3259		22
41	872.5	2.5	42.5	0.0676	3	3.4153	0.822846	2	A-4b			349	2	29
43.5	870.0	2.5	45.0	0.0776	9	3.6018	0.805066	7	A-3	29.5				26
46	867.5	2.5	47.5	0.0776	11	3.7958	0.787523	9	A-3	30.5				24
48.5	865.0	2.5	50.0	0.0876	31	4.0073	0.76939	24	A-2-4	36.5				19
51	862.5	2.5	52.5	0.0876	45	4.2263	0.751597	34	A-2-4	38.6				11
53.5	860.0	2.5	55.0	0.0826	24	4.43655	0.735361	18	A-4b		1	2793		31
58.5	855.0	5	60.0	0.0826	19	4.84955	0.705596	13	A-4b(NP)	30.8				25
63.5	850.0	5	65.0	0.0876	35	5.2838	0.676917	24	A-4b(NP)	33.5				26
68.5	845.0	5	70.0	0.0876	54	5.7218	0.650286	35	A-1-a	40.8				10

Strata No.	B-013-5-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	18.5	33.0	880.5	14.5	24	24	134	27		2300	2832	3	34
Strata 2	S/SL	33.0	48.0	865.5	15.0	14	12	132	25	31.0				
Strata 3	G/SL	48.0	71.5	842.0	23.5	35	25	143.0	20	36.0				

B-015-1-16 **Surface Elevation=** 960.3 **Water Dep. (ft.)=** 43 Water Elv. = 917.3

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
1	959.3	1.5	2.5	0.11	6	0.1925	1.7845745	11	A-4a(NP)	30.3				22
3.5	956.8	2.5	5.0	0.125	16	0.49375	1.4695857	24	UF	33.5				103
6	954.3	2.5	7.5	0.13	51	0.815	1.301995	66	UF	38.0				19
8.5	951.8	2.5	10.0	0.13	51	1.14	1.189769	61	UF	38.0				96
11	949.3	2.5	12.5	0.125	13	1.45625	1.107895	14	UF	31.0				30
13.5	946.8	2.5	15.0	0.125	13	1.76875	1.042883	14	UF	31.0				20
16	944.3	2.5	17.5	0.13	25	2.09	0.987074	25	A-3a	35.8				13
18.5	941.8	2.5	20.0	0.125	9	2.40625	0.939954	8	A-3a	31.0				8
21	939.3	2.5	22.5	0.125	6	2.71875	0.899122	5	A-3	28.5				8
23.5	936.8	2.5	25.0	0.13	15	3.04	0.861774	13	A-3	31.8				6
26	934.3	2.5	27.5	0.135	25	3.37375	0.8269393	21	A-3	33.8				11
28.5	931.8	2.5	30.0	0.14	57	3.72	0.7942681	45	A-3	38.3				7
31	929.3	2.5	32.5	0.13	13	4.0525	0.7656395	10	A-3	31.0				6
33.5	926.8	2.5	35.0	0.135	25	4.38625	0.7391743	18	A-3	33.0				6
36	924.3	2.5	37.5	0.135	27	4.72375	0.7143853	19	A-3	33.3				8
38.5	921.8	2.5	40.0	0.135	30	5.06125	0.6913077	21	A-1-b	36.8				7
41	919.3	2.5	42.5	0.135	13	5.39875	0.6697204	9	A-3	30.5				6
43.5	916.8	2.5	45.0	0.0826	21	5.64455	0.6548316	14	A-1-b	35.0				15
46	914.3	2.5	47.5	0.0776	13	5.8423	0.6433166	8	A-4b(NP)	29.0				31
48.5	911.8	2.5	50.0	0.0776	12	6.0363	0.6323927	8	A-4b(NP)	29.0				33
51	909.3	2.5	52.5	0.0776	9	6.2303	0.6218143	6	A-4b(NP)	28.0				29
53.5	906.8	2.5	55.0	0.0776	9	6.4243	0.6115603	6	A-4b(NP)	28.0				28
58.5	901.8	5	60.0	0.0776	15	6.8123	0.59195	9	A-4b(NP)	29.5				25
63.5	896.8	5	65.0	0.0726	7	7.17905	0.5744146	4	A-4b(NP)	27.0				31
68.5	891.8	5	70.0	0.0726	7	7.54205	0.5579193	4	A-4b(NP)	27.0				33
73.5	886.8	5	75.0	0.0726	7	7.90505	0.5421996	4	A-4b(NP)	27.0				33
78.5	881.8	5	80.0	0.0826	16	8.31055	0.5254713	8	A-4b(NP)	29.0				28
83.5	876.8	5	85.0	0.0826	22	8.72355	0.5092524	11	A-4b(NP)	30.3				27
88.5	871.8	5	90.0	0.0876	31	9.1578	0.493007	15	A-3	32.3				20
93.5	866.8	5	95.0	0.0876	31	9.5958	0.4773837	15	A-3	32.3				19
98.5	861.8	5	100.0	0.0826	30	10.01255	0.4631668	14	A-4b(NP)	31.0				21
103.5	856.8	5	105.0	0.0876	67	10.4468	0.4489691	30	A-1-b	39.0				12
108.5	851.8	5	110.0	0.0876	81	10.8848	0.4352344	35	A-4a		2.25	9427		10
113.5	846.8	5	115.0	0.0876	152	11.3228	0.4220417	64	A-1-b	42.0				12

Strata No.	B-015-1-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	UF	6	16	944.3	10.0	32	39	127.5	23	34.5				
Strata 2	S	16	46.0	914.3	30.0	19	14	134.0	8	33.2				
Strata 3	S/SL	46.0	87.0	873.3	41.0	12	7	135.0	30	28.4				
Strata 4	S/SL	87	102.5	857.8	15.5	31	15	143.0	20	31.8				
Strata 5	G	102.5	116.0	844.3	13.5	100	43	145.0	11	40.5				

SUM-8-0199 N.B. Soil Profile Summary Table

Structure	Boring No.	Strata No.	Type	Bot Elv.	Str Dep	N_{60}	$N1_{60}$	γ (pcf)	ϕ' (deg)	C_1 = HP/2 (psf)	C_2 = Su (psf)
Pier 2	B-010-0-15	Strata 1	C	870.7	4.8	11	15	117.5		1000	1280
		Strata 2	C	860.7	10.0	69	71	121.5			8007
Pier 3	B-011-2-16	Strata 1	C	865.1	5.0	7	9	122.5		1500.0	814.7
	B-011-3-16		C	862.8	10.0	7	9	120.0		2130.0	931.0
	Avg.		C			7	9	120.8		1920	892
	B-011-2-16	Strata 2	G	860.6	4.5	12	14	125.0	34.0		
	B-011-3-16		G/SL	859.3	3.5	20	21	130.0	35.3		
	Avg.		G/SL			16	17	127.2	34.6		
	B-011-2-16	Strata 3	G/SL	847.6	13.0	76	74	137.0	40.5		
	B-011-3-16		G	838.3	21.0	90	83	138.6	41.7		
	Avg.		G/SL			85	80	138.0	41.2		
Pier 4	B-013-2-16	Strata 1	S	870.0	9.0	4	6	113.8	30.3		
	B-013-3-16		S	870.0	13.0	9	12	115.0	34.3		
	Avg.		S			7	10	114.5	32.7		
	B-013-2-16	Strata 2	G	851.5	18.5	14	14	135.0	34.8		
	B-013-3-16		G	842.0	28.0	48	42	136.9	39.9		
	Avg.		G			34	31	136.1	37.8		
Pier 5	B-015-0-15	Strata 1	S	939.0	21.2	6	6	121.7	28.5		
		Strata 2	C	898.7	40.3	16	13	135.0		686	1914
		Strata 3	S	866.2	32.5	47	26	145.0	36.4		
F. ABT.	B-017-0-15	Strata 1	G	992.9	20.5	15	14	128.1	33.5		
		Strata 2	S	954.4	38.5	43	27	140.5	37.2		

SUM-8-0199 S.B. Soil Profile Summary Table

Structure	Boring No.	Strata No.	Type	Bot Elv.	Str Dep	N_{60}	$N1_{60}$	γ (pcf)	ϕ' (deg)	C_1 = HP/2 (psf)	C_2 = Su (psf)
R. ABT.	B-005-2-16	Strata 1	S	1000.0	12.5	23	31	126.0	37.1		
Pier 1	B-008-0-15	Strata 1	C	954.3	1.5	25	36	125.0		2500	2910
	B-009-1-16		C	940.7	17.0	18	19	127.1		3550	2056
	Avg.					19	20	127.0		3465	2125
	B-009-1-16	Strata 2	G	932.3	8.4	19	18	131.7	35.9		
	B-008-0-15	Strata 3	G/SL	931.3	23.0	100	96	130.0	40.0		
	B-009-1-16		G/SL	922.7	9.6	90	75	140.0	40.0		
	Avg.					97	90	132.9	40.0		
Pier 2	B-011-0-15	Strata 1	C	868.2	9.0	12	15	123.3		1167	1397
	B-009-4-16		C	866.4	16.3	14	21	121.7		1000	1591
	Avg.					13	19	122.3		1059	1522
Pier 3	B-011-5-16	Strata 1	C	860.2	14.0	21	28	125.8		3563	2677
	B-011-4-16	Strata 2	G/SL	832.2	41.8	76	81	135.4	37.8		
	B-011-5-16		G	850.2	10.0	65	66	137.5	41.1		
	Avg.					74	78	135.8	38.5		
	B-011-5-16	Strata 3	C	837.7	12.5	53	48	140.0		4500	6129
Pier 4	B-013-4-16	Strata 1	C	880.0	5.5	12	19	117.5		2500	1300
	B-013-5-16		C	880.5	14.5	24	24	134.0		2300	2832
	Avg.					21	23	129.5		2355	2411
	B-013-4-16	Strata 2	S/SL	862.5	17.5	8	9	120.7	29.6		
	B-013-5-16		S/SL	865.5	15.0	14	12	132.0	31.0		
	Avg.					11	10	125.9	30.3		
	B-013-4-16	Strata 3	G	841.1	21.4	57	42	141.1	40.0		
	B-013-5-16		G/SL	842.0	23.5	35	25	143.0	36.0		
	Avg.					45	33	142.1	37.9		
Pier 5	B-015-1-16	Strata 1	UF	944.3	10.0	32	39	127.5	34.5		
		Strata 2	S	914.3	30.0	19	14	134.0	33.2		
		Strata 3	S/SL	873.3	41.0	12	7	135.0	28.4		
		Strata 4	S/SL	857.8	15.5	31	15	143.0	31.8		
		Strata 5	G	844.3	13.5	100	43	145.0	40.5		
F. ABT.	B-016-0-15	Strata 1	G	988.6	25.5	8	7	124.0	32.1		
		Strata 2	S	963.9	24.7	38	27	140.7	35.1		
		Strata 3	C	948.1	15.8	33	19	145.0		3750	4015
		Strata 4	G	929.6	18.5	48	24	145.0	37.3		
		Strata 5	C	917.6	12.0	28	12	141.7		1417	3220

SUM-8-0199 N.B. Rock Subsurface Profile Summary Table[1]

Structure	Strata	Boring No.	Type	Top. Elv.	Str Dep	RQD (%)	Q_u (psi)	GSI
R. ABT	R1	B-006-0-15	Sandstone W	1004.0	4.5	20	1500	20
	R2		Sandstone	999.5	7.0	85	5560	65
	R3		Sandstone	992.5	1.0	67	3500	55
Pier 1	R1	B-009-0-15	Sandstone	966.4	16.0	54	3440	60
	R2		Claystone	950.4	2.1	52	200	30
	R3		Shale	948.3	10.3	11	1500	30
	R4		Shale	938.0	14.1	53	4770	55
Pier 2	R1	B-010-0-15	Shale W	860.7	5.0	0	200	5
	R2		Shale	855.7	2.9	52	1500	15
	R3		Sandstone	852.8	2.6	63	4380	65
	R4		Shale	850.2	16.0	94	3840	65
Pier 3	R1	B-011-2-16	Shale W	847.6	6.8	5	200	5
		B-011-3-16	Siltstone W	839.8	1.5	5	360	10
		Avg.	Shale/Siltstone W	839.8		5	229	6
	R2	B-011-2-16	Shale/Siltstone	840.8	14.2	42	6062	40
		B-011-3-16	Shale/Siltstone	838.3	10.0	47	5847	55
		Avg.	Shale/Siltstone	838.3		44	5973	46
	R3	B-011-2-16	Shale/Siltstone	826.6	25.0	60	4969	50
Pier 4	R1[2]	B-013-2-16	Shale W	851.5	14.7	1	360	5
	R2	B-013-2-16	Shale/Siltstone	836.8	11.3	23	683	45
		B-013-3-16	Shale/Siltstone	836.9	4.6	24	683	35
		Avg.	Shale/Siltstone	836.8		23	683	42
	R3	B-013-2-16	Shale/Siltstone	825.5	30.0	47	2665	65
		B-013-3-16	Shale/Siltstone	832.3	2.8	52	3855	60
		Avg.	Shale/Siltstone	825.5		47	2767	65

Note: 1. All the values are based on weighted averages with respect to strata depths;
2. The Rock Stratum 1 of Pier 4 is assumed to consists of weathered shale as shown in B-013-2-

SUM-8-0199 S.B. Rock Subsurface Profile Summary Table[1]

Structure	Strata	Boring No.	Type	Top. Elv.	Str Dep	RQD (%)	Q_u (psi)	GSI
R. ABT	R1	B-005-2-16	Sandstone W	1000.0	3.2	10	1000	30
	R2		Sandstone	996.8	10.0	31	4111	65
Pier 1	R1	B-008-0-15	Shale W	931.3	8.0	11	750	25
		B-009-1-16	Shale/Siltstone W	922.7	10.0	12	1125	25
		Avg.	Shale/Siltstone W	922.7		12	958	25
	R2	B-008-0-15	Shale	923.3	15.0	64	5130	50
		B-009-1-16	Shale/Siltstone	912.7	10.0	33	8000	40
		Avg.	Shale/Siltstone	912.7		52	6278	46
	R3	B-009-1-16	Shale/Siltstone	902.7	5.0	7	750	25
	R4	B-009-1-16	Shale/Siltstone	897.7	17.5	33	6434	40
Pier 2	R1	B-011-0-15	Shale W	868.2	12.7	10	200	5
		B-009-4-16	Shale W	866.4	13.9	10	200	5
		Avg.	Shale W	866.4		10	200	5
	R2	B-011-0-15	Shale/Sandstone	855.5	26.3	97	3875	70
		B-009-4-16	Shale	852.5	10.0	75	7964	65
		Avg.	Shale/Sandstone	852.5		91	5001	69
Pier 3	R1	B-011-4-16	Shale W	832.2	2.2	10	500	5
		B-011-5-16	Shale W	837.7	7.5	30	1125	10
		Avg.	Shale W	832.2		25	983	9
	R2	B-011-4-16	Shale/Siltstone	830.0	10.0	76	6057	65
		B-011-5-16	Shale/Siltstone	830.2	35.0	82	4070	50
		Avg.	Shale/Siltstone	830.0		81	4512	53
Pier 4	R1[2]	B-013-4-16	Shale/Siltstone	841.1	41.1	76	6221	65

Note: 1. All the values are based on weighted averages with respect to strata depths;
2. The Rock Stratum 1 of Pier 4 is assumed to mainly consists of weathered shale as shown in B 013-4-16, the silt dominated rock in B-013-5-16 is neglected from the analyses.

SUM-8-0199 N.B. Geotechnical Design Parameters Summary Table

Structure	Foundation Type	Material Type	Bottom of layer Elevation	γ' (pcf)	γ_{total} (pcf)	N_{60}	$N1_{60}$	ϕ (deg)	C (psf)	RQD_L (%)	Q_u (psi)	GSI	Subgrade Modulus k (pci)	Principal Strain ε_{50}	Intact Modulus E_i (ksi)	Modulus Ratio E_m/E_i	Mass Modulus E_m (ksi)	Poisson's Ratio μ	Shear Modulus G_i (ksi)	Stiffness Constant K_{rm}	Rock: ϕ (RocLab) (deg)	Split Tensile Strength (psf)	Torsional Shear Stress (psf)	Ultimate Pile Tip Resistance (kips)
R. ABT.	Spread Footing	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**	1001																		
		Sandstone W	999.5	150	150					20	1500	20			135	0.05	7	0.2	56.3	0.00005	24.8	21600	6300	
		Sandstone	992.5	150	150					85	5550	65			499.5	0.85	425	0.2	208.1	0.00005	41.0	79920	34900	
		Sandstone	950	150	150					67	3500	55			315	0.62	195	0.2	131.3	0.00005	37.1	50400	32700	
Pier 1	Drilled Shafts	**Water Elv.=**	Dry			∴ **Elv. =**	954.25																	
		Sandstone	950.5	150	150					54	3400	60			306	0.26	80	0.2	127.5	0.00005	38.1	48960	32200	
		Claystone	948	150	150					52	200	30			18	0.21	4	0.1	8.2	0.00036	20.7	2880	7800	
		Shale	938	150	150					11	1500	30			135	0.05	7	0.1	61.4	0.00005	17.8	21600	6300	
		Shale	920	150	150					53	4750	55			427.5	0.23	99	0.1	194.3	0.00005	27.7	68400	34900	
Pier 2	Drilled Shafts	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**	878.75			σ_{vs} (ksf) =	2.18														
		C	870.5	117.5	117.5	11	15		1100					0.0097				0.45	2.6				500	
		C	860.5	121.5	121.5	60	60		8000					0.004				0.45	19.2				500	
		Shale W	855.5	150	150					10	200	5			18	0.05	1	0.1	8.2	0.00036	10.2	2880	2300	
		Shale	852.5	150	150					52	1500	15			135	0.21	28	0.1	61.4	0.00005	16.1	21600	21400	
		Sandstone	850	150	150					63	4350	65			391.5	0.51	199	0.2	163.1	0.00005	40.1	62640	34900	
		Shale	830	150	150					94	3800	65			342	0.94	321	0.1	155.5	0.00005	32.9	54720	34100	
Pier 3	Drilled Shafts	**Water Elv.=**	861		**Btm. Ft. Elv. =**	865			σ_{vs} (ksf) =	2.16														
		C	862.5	121	121	7	9		1400					0.0088									500	
		G/SL	861	127	127	16	17	34.5					45					0.325	0.4				1000	
		G/SL	859	69.5	132	16	17	34.5					31					0.325	0.4				1000	
		G/SL	840	80.5	143	60	60	41					125					0.325	2.1				1000	
		Shale/Siltstone W	838	87.5	150					10	200	6			18	0.05	1	0.1	8.2	0.00036	10.5	2880	2300	
		Shale/Siltstone	826.5	87.5	150					44	5950	46			535.5	0.09	48	0.1	243.4	0.00005	25.2	85680	34900	
		Shale/Siltstone	800	87.5	150					60	4950	50			445.5	0.43	189	0.1	202.5	0.00005	26.3	71280	34900	
Pier 4	Drilled Shafts	**Water Elv.=**	870		**Btm. Ft. Elv. =**	872.5			σ_{vs} (ksf) =	2.48														
		S	870	114.5	114.5	7	10	32.5					17					0.325	0.5				1000	
		G	842	78.5	141	34	31	38					73					0.325	1.6				1000	
		Shale W	837	87.5	150					10	350	5			31.5	0.05	2	0.1	14.3	0.00026	10.2	5040	3000	
		Shale/Siltstone	825.5	87.5	150					23	650	42			58.5	0.06	3	0.1	26.6	0.00013	22.6	9360	14100	
		Shale/Siltstone	795	87.5	150					47	2750	65			247.5	0.10	24	0.1	112.5	0.00005	30.4	39600	29000	
Pier 5	Driven Pile	**Water Elv.=**	943		**Btm. Ft. Elv. =**	965.2				Pile Dia. (in.) = 16														
		S	943	121.5	121.5	6	6	28.5					15					0.325	0.3				900	20
		S	939	64	126.5	6	6	28.5					12					0.325	0.3				1000	20
		C	898.5	77.5	140	16	13		1300				220	0.0091				0.45	3.1				1100	140
		S	865	87.5	150	47	26	36.5					115					0.325	1.4				7400	250
F. ABT.	Driven Pile	**Water Elv.=**	966.5		**Btm. Ft. Elv. =**	1011				Pile Dia. (in.) = 14														
		G	992.5	128	128	15	14	33.5					41					0.325	0.7				1200	120
		S	966.5	140.5	140.5	43	27	37					178					0.325	1.4				4500	230
		S	930	83	145.5	43	27	37					102					0.325	1.4				6900	230

SUM-8-0199 S.B. Geotechnical Design Parameters Summary Table

Structure	Foundation Type	Material Type	Bottom of layer Elevation	Y' (pcf)	Y_{total} (pcf)	N_{60}	$N1_{60}$	ϕ (deg)	C (psf)	RQD_L (%)	Q_u (psi)	GSI	Subgrade Modulus k (pci)	Principal Strain ε_{50}	Intact Modulus E_i (ksi)	Modulus Ratio E_m/E_i	Mass Modulus E_m (ksi)	Poisson's Ratio μ	Shear Modulus G_i (ksi)	Stiffness Constant K_{rm}	Rock: ϕ (RocLab) (deg)	Split Tensile Strength (psf)	Torsional Shear Stress (psf)	Ultimate Pile Tip Resistance (kips)
R. ABT.	Spread Footing	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		1001			**σ_{vs} (ksf) =**	0.13													
		S	1000	126	126	23	31	37					67					0.325	1.6				1000	
		Sandstone W	996.5	150	150					10	1000	30			90	0.05	5	0.2	37.5	0.000050	27.4	14400	5100	
		Sandstone	950	150	150					31	4100	65			369	0.07	25	0.2	153.8	0.000050	38.5	59040	34900	
Pier 1	Drilled Shafts	**Water Elv.=**	935.5		**Btm. Ft. Elv. =**		952			**σ_{vs} (ksf) =**	3.09													
		C	940.5	127	127	19	20		2800					0.0062				0.45	6.7				500	
		G	935.5	131.5	131.5	19	18	36					54					0.325	0.9				1000	
		G	931.5	74	136.5	19	18	36					38					0.325	0.9				1000	
		G/SL	922.5	75.5	138	60	60	40					125					0.325	2.4				1000	
		Shale/Siltstone W	913	87.5	150					12	950	25			85.5	0.05	4	0.1	38.9	0.000060	16.5	13680	5000	
		Shale/Siltstone	903	87.5	150					52	6250	46			562.5	0.19	109	0.1	255.7	0.000050	25.2	90000	34900	
		Shale/Siltstone	898	87.5	150					10	750	25			67.5	0.05	3	0.1	30.7	0.000106	16.5	10800	4400	
		Shale/Siltstone	880	87.5	150					33	6400	40			576	0.07	41	0.1	261.8	0.000050	22.1	92160	34900	
Pier 2	Drilled Shafts	**Water Elv.=**	Dry		**Btm. Ft. Elv. =**		874.25			**σ_{vs} (ksf) =**	0.95													
		C	866.5	122.5	122.5	13	19		1300					0.0091				0.45	3.1				500	
		Shale W	852.5	150	150					10	200	5			18	0.05	1	0.1	8.2	0.000365	10.2	2880	2300	
		Shale/Sandstone	830	150	150					91	5000	69			450	0.91	409	0.1	204.5	0.000050	34.0	72000	34900	
Pier 3	Drilled Shafts	**Water Elv.=**	867		**Btm. Ft. Elv. =**		866.75			**σ_{vs} (ksf) =**	2.73													
		C	867	126	126	21	28		3100					0.0059				0.45	7.4				500	
		C	862.5	68.5	131	21	28		3100				775	0.0059				0.45	7.4				500	
		G/SL	840	78.5	141	60	60	38.5					125					0.325	2.0				1000	
		C	832	82.5	145	53	48		5300				1325	0.00468				0.45	12.7				500	
		Shale W	830	87.5	150					25	950	9			85.5	0.06	5	0.1	38.9	0.000060	12.9	13680	17000	
		Shale/Siltstone	790	87.5	150					81	4500	53			405	0.81	327	0.1	184.1	0.000050	28.4	64800	34900	
Pier 4	Drilled Shafts	**Water Elv.=**	886.5		**Btm. Ft. Elv. =**		886.5			**σ_{vs} (ksf) =**	3.48													
		C	886.5	129.5	129.5	21	23		2400					0.0066				0.45	5.7				500	
		C	880	72	134.5	21	23		2400				600	0.0066				0.45	5.7				500	
		S/SL	862.5	68.5	131	11	10	30.5					22					0.325	0.3				1000	
		G/SL	841	84.5	147	45	33	38					110					0.325	0.9				1000	
		Shale/Siltstone	830	87.5	150					76	6200	65			558	0.20	112	0.1	253.6	0.000050	31.8	89280	34900	
Pier 5	Driven Pile	**Water Elv.=**	917.5		**Btm. Ft. Elv. =**		955			Pile Dia. (in.) = 16														
		UF	944	80*	80*	1*	1*	1*					3					0.1	0.03				1*	20
		S	917.5	134	134	19	14	33					51					0.325	0.7				3000	70
		S	914	76.5	139	19	14	33	80				36					0.325	0.7				3100	60
		S/SL	873.5	77.5	140	12	7	28.5					24					0.325	0.2				3200	40
		S/SL	857.5	85.5	148	31	15	32					63					0.325	0.4				5400	350
		G	830	87.5	150	60	43	40.5					125					0.325	2.3				16800	650
F. ABT.	Driven Pile	**Water Elv.=**	965.5		**Btm. Ft. Elv. =**		1011			Pile Dia. (in.) = 14														
		G	988.5	124	124	8	7	32					20					0.325	0.4				1200	80
		S	965.5	140.5	140.5	38	27	35					144					0.325	1.4				3400	120
		S	964	83	145.5	38	27	35					86					0.325	1.4				3500	100
		C	948	87.5	150	33	19		3900				975	0.0051				0.45	9.3				3000	150
		G	929.5	87.5	150	48	24	37.5					119					0.325	1.3				7300	260
		C	910	84	146.5	28	12		2300				575	0.0067				0.45	5.5				1700	140

Note: Trash zone exists between Elv. 955.2 and Elv. 944 near pier 5 (Stratum 1 for Pier 5). Although, the boring logs shows a relative high blow count for this layer, however, given the high compressibility nature of trash, th stratum has been modelled as very loose sand with N_{60} and $N1_{60}$ equals to 1, and the Poisson's ratio is assumed to be 0.1. The unit weight of the soil layer is assumed to be 110 pcf, the shear strength of the soil layer is ignored from calculation (assume ϕ= 1 degree), and the torsional shear stress is assumed to be 1 psf for calculation purpose.

SUM-8-0199 N.B.

Structure	Soil Type*	Submerged?* (Y/N)	N_{60}	$N1_{60}$	C psf	Young's Modulus α	Young's Modulus β	Young's Modulus (Sand) $E=\alpha*Pa*N1_{60}$ ksf	Young's Modulus (Clay) $E=\beta*C$ ksf	Poisson's Ratio μ	Shear Modulus $G= E/(2(1+\mu))$ ksf	Shear Modulus (Granular) $Gmax= 35*(N1_{60})^{0.68}$ ksf	Shear Modulus G ksi	Subgrade Modulus k pci	Principal Strain ξ_{50}
Pier 2	Clay2	N	11	15	1100	NA	1000	NA	1100	**0.45**	379	NA	**2.6**		**0.0097**
	Clay2	N	69	71	8000	NA	1000	NA	8000	**0.45**	2759	NA	**19.2**		**0.004**
Pier 3	Clay2	N	7	9	1400	NA	1000	NA	1400	**0.45**	483	NA	**3.4**		**0.0088**
	Sand1	N	16	17		5	NA	170	NA	**0.325**	64	240	**0.4**	**45**	
	Sand1	Y	16	17		5	NA	171	NA	**0.325**	64	241	**0.4**	**31**	
	Sand1	Y	85	80		5	NA	796	NA	**0.325**	300	686	**2.1**	**125**	
Pier 4	Sand2	N	7	10		10	NA	200	NA	**0.325**	75	168	**0.5**	**17**	
	Sand2	Y	34	31		10	NA	620	NA	**0.325**	234	362	**1.6**	**73**	
Pier 5	Sand2	N	6	6		10	NA	120	NA	**0.325**	45	118	**0.3**	**15**	
	Sand2	Y	6	6		10	NA	120	NA	**0.325**	45	118	**0.3**	**12**	
	Clay2	Y	16	13	1300	NA	1000	NA	1300	**0.45**	448	NA	**3.1**	**220**	**0.0091**
	Sand2	Y	47	26		10	NA	520	NA	**0.325**	196	321	**1.4**	**115**	
F. ABT.	Sand2	N	15	14		10	NA	280	NA	**0.325**	106	211	**0.7**	**41**	
	Sand2	N	43	27		10	NA	540	NA	**0.325**	204	329	**1.4**	**178**	
	Sand2	Y	43	27		10	NA	540	NA	**0.325**	204	329	**1.4**	**102**	

Note: *Sand1: sands with fines
Sand2: clean normally consolidated sand
Sand3: clean overconsoilidated sand
Clay1: High Plastic clay (PI>=30)
Clay2: Low Plastic clay (PI<30)

SUM-8-0199 S.B.

Structure	Soil Type*	Submerged? (Y/N)	N_{60}	$N1_{60}$	C psf	Young's Modulus α	Young's Modulus β	Young's Modulus (Sand) $E=\alpha*Pa*N1_{60}$ ksf	Young's Modulus (Clay) $E=\beta*C$ ksf	Poisson's Ratio μ	Shear Modulus $G= E/(2(1+\mu))$ ksf	Shear Modulus (Granular) $Gmax= 35*(N1_{60})^{0.68}$ ksf	Shear Modulus G ksi	Subgrade Modulus k pci	Principal Strain ξ_{50}
R. ABT.	Sand2	N	23	31		10	NA	620	NA	**0.325**	234	362	**1.62**	**67**	
Pier 1	Clay2	N	19	20	2800	NA	1000	NA	2800	**0.45**	966	NA	**6.70**		**0.0062**
	Sand2	N	19	18		10	NA	360	NA	**0.325**	136	250	**0.94**	**54**	
	Sand2	Y	19	18		10	NA	360	NA	**0.325**	136	250	**0.94**	**38**	
	Sand1	Y	97	90		5	NA	900	NA	**0.325**	340	746	**2.36**	**125**	
Pier 2	Clay2	N	13	19	1300	NA	1000	NA	1300	**0.45**	448	NA	**3.11**		**0.0091**
Pier 3	Clay2	N	21	28	3100	NA	1000	NA	3100	**0.45**	1069	NA	**7.42**		**0.0059**
	Clay2	Y	21	28	3100	NA	1000	NA	3100	**0.45**	1069	NA	**7.42**	**775**	**0.0059**
	Sand1	Y	74	78		5	NA	780	NA	**0.325**	294	677	**2.04**	**125**	
	Clay2	Y	53	48	5300	NA	1000	NA	5300	**0.45**	1828	NA	**12.69**	**1325**	**0.004675**
Pier 4	Clay2	N	21	23	2400	NA	1000	NA	2400	**0.45**	828	NA	**5.75**		**0.0066**
	Clay2	Y	21	23	2400	NA	1000	NA	2400	**0.45**	828	NA	**5.75**	**600**	**0.0066**
	Sand1	Y	11	10		5	NA	100	NA	**0.325**	38	168	**0.26**	**22**	
	Sand1	Y	45	33		5	NA	330	NA	**0.325**	125	377	**0.86**	**110**	
Pier 5	Sand1	N	1	1		5	NA	10	NA	**0.1**	5	35	**0.03**	**3**	
	Sand2	N	19	14		10	NA	280	NA	**0.325**	106	211	**0.73**	**54**	
	Sand2	Y	19	14		10	NA	280	NA	**0.325**	106	211	**0.73**	**38**	
	Sand1	Y	12	7		5	NA	70	NA	**0.325**	26	131	**0.18**	**24**	
	Sand1	Y	31	15		5	NA	150	NA	**0.325**	57	221	**0.39**	**63**	
	Sand2	Y	100	43		10	NA	860	NA	**0.325**	325	452	**2.25**	**125**	
F. ABT.	Sand2	N	8	7		10	NA	140	NA	**0.325**	53	131	**0.37**	**20**	
	Sand2	N	38	27		10	NA	540	NA	**0.325**	204	329	**1.42**	**144**	
	Sand2	Y	38	27		10	NA	540	NA	**0.325**	204	329	**1.42**	**86**	
	Clay2	Y	33	19	3900	NA	1000	NA	3900	**0.45**	1345	NA	**9.34**	**975**	**0.0051**
	Sand2	Y	48	24		10	NA	480	NA	**0.325**	181	304	**1.26**	**119**	
	Clay2	Y	28	12	2300	NA	1000	NA	2300	**0.45**	793	NA	**5.51**	**575**	**0.0067**

Note: Sand1: sands with fines
Sand2: clean normally consolidated sand
Sand3: clean overconsoilidated sand
Clay1: High Plastic clay
Clay2: Low Plastic clay

R. ABT. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 525+07, 40' LT.	EXPLORATION ID B-006-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 1020.5 (MSL) EOB: 29.0 ft.	PAGE 1 OF 1
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.086718, -81.502300	

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
UNCONTROLLED FILL (BOULDER ASPHALT AND COAL)	1020.5																	
MEDIUM DENSE, BLACK, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, AND SLAG, TRACE SILT AND CLAY, DAMP	1018.5		6 9 11	27	72	SS-1	-	19	30	45	6	-	NP	NP	NP	11	A-1-b (0)	
MEDIUM DENSE, BROWN, **FINE SAND**, SOME COARSE SAND AND GRAVEL, TRACE SILT AND CLAY, DAMP	1015.5		8 9 9	24	78	SS-2	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
			7 9 13	29	78	SS-3	-	20	20	52	8	-	NP	NP	NP	10	A-3 (0)	
			6 7 8	20	83	SS-4	-	-	-	-	-	-	-	-	-	14	A-3 (V)	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DAMP	1007.0		5 6 8	19	78	SS-5	4.50	13	8	11	45	23	36	20	16	24	A-6b (9)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1004.0	TR	50/6"	-	83	SS-6	-	-	-	-	-	-	-	-	-	26	A-6b (V)	
SANDSTONE, BROWN, MODERATELY WEATHERED, SLIGHTLY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 72%, REC 98%. @ 19.0' TO 19.5'; Qu = 5,560 PSI	1002.0		50/1"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			29		100	NX-1											CORE	
			92		100	NX-2											CORE	
			67		92	NX-3											CORE	
SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC; RQD 67%, REC 92%	992.5 / 991.5	EOB																

STRATA R1:
1. RQD = 20 (Assumed)
2. Qu = 1500 psi (Assumed)
3. GSI = 20

STRATA R2:
1. RQD = 85
2. Qu = 5560 psi
3. GSI = 65

STRATA R3:
1. RQD = 67
2. Qu = 3500 psi (Assumed)
3. GSI = 55

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 21 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 15:40 - W:\082368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 2015.GPJ

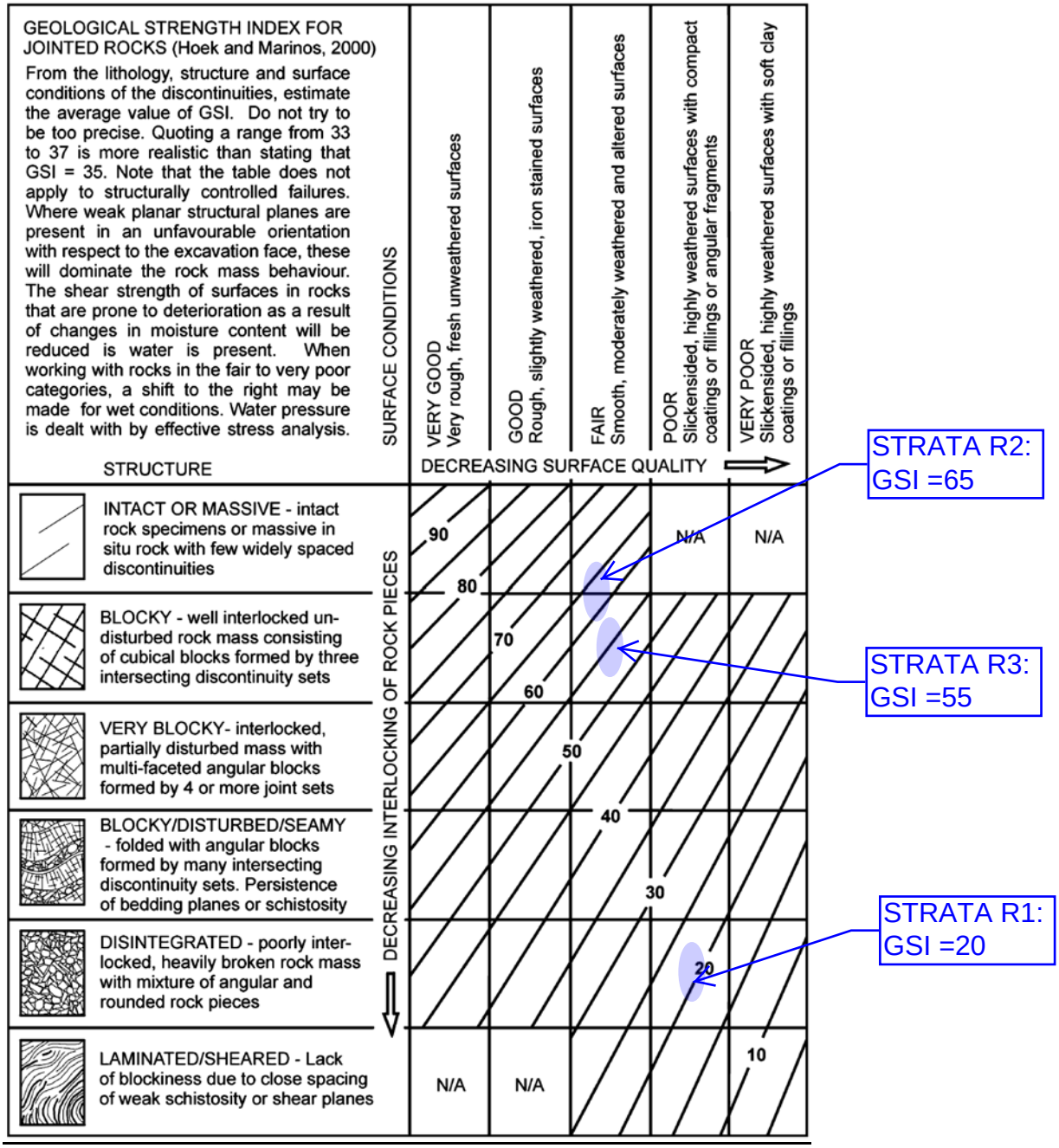


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

N.B. R. ABT. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 1.5 ksi
GSI = 20 mi = 15 Disturbance factor (D) = 0
intact modulus (Ei) = 135 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

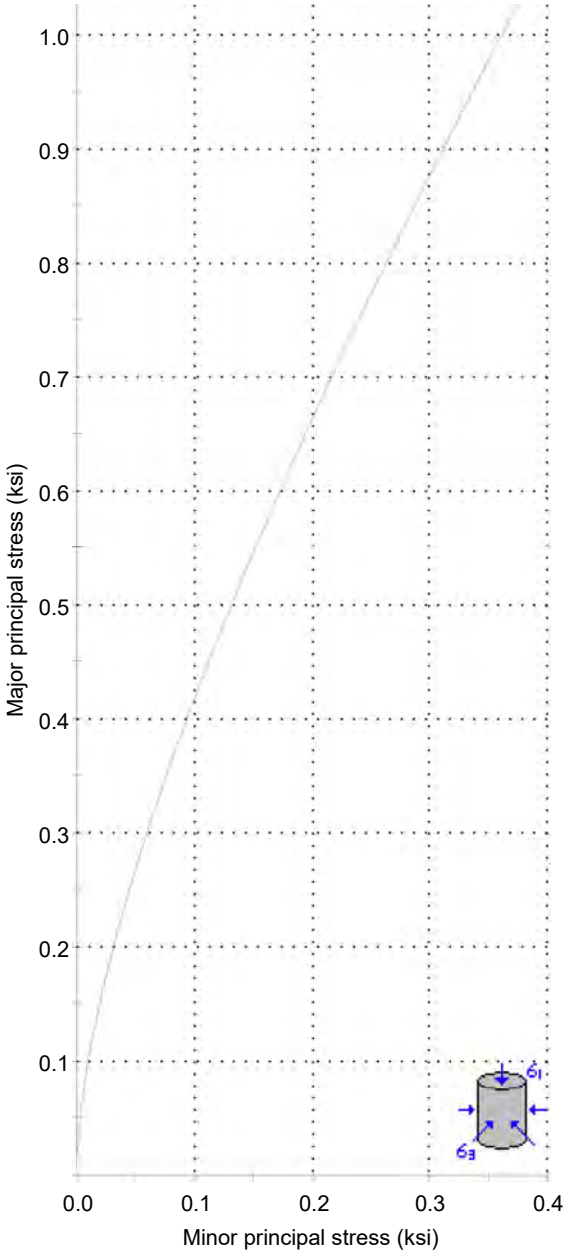
mb = 0.861 s = 0.0001 a = 0.544

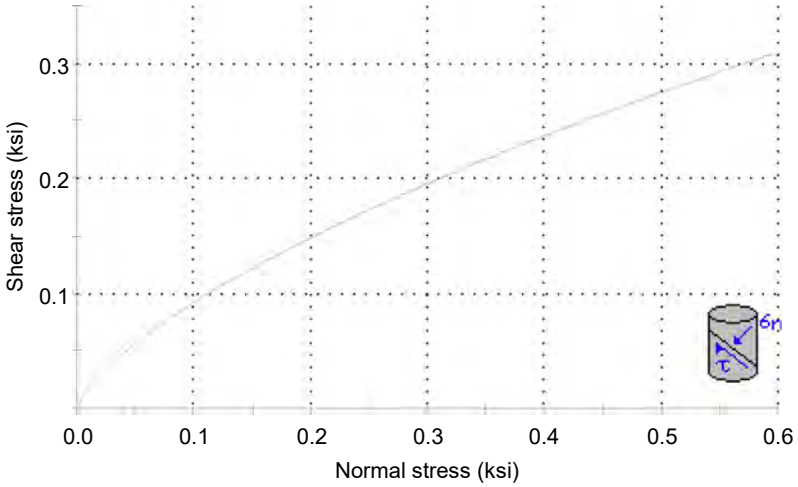
Mohr-Coulomb Fit

cohesion = 0.049 ksi friction angle = 24.76 deg

Rock Mass Parameters

tensile strength = -0.00024 ksi
uniaxial compressive strength = 0.012 ksi
global strength = 0.152 ksi
deformation modulus = 6.17 ksi





N.B. R. ABT. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 5.55 ksi
GSI = 65 mi = 20 Disturbance factor (D) = 0
intact modulus (Ei) = 499.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

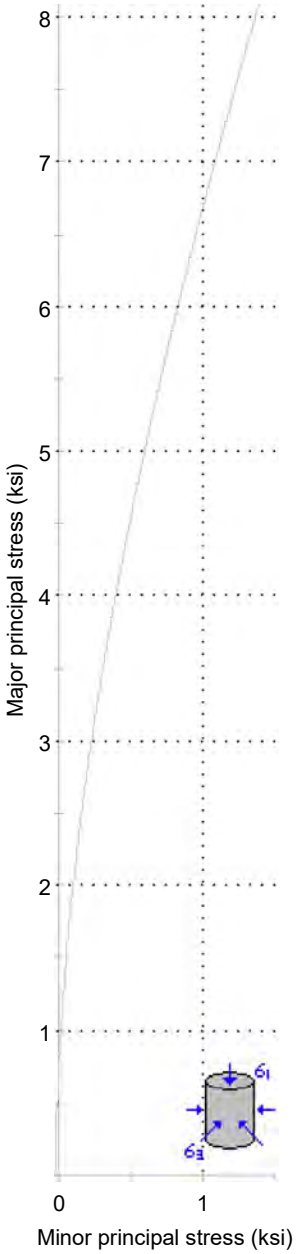
mb = 5.730 s = 0.0205 a = 0.502

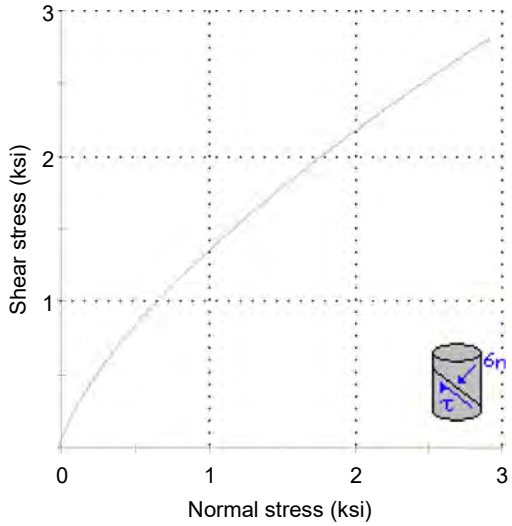
Mohr-Coulomb Fit

cohesion = 0.422 ksi friction angle = 40.99 deg

Rock Mass Parameters

tensile strength = -0.020 ksi
uniaxial compressive strength = 0.788 ksi
global strength = 1.850 ksi
deformation modulus = 315.54 ksi





N.B. R. ABT. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 3.5 ksi
GSI = 55 mi = 18 Disturbance factor (D) = 0
intact modulus (Ei) = 315 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

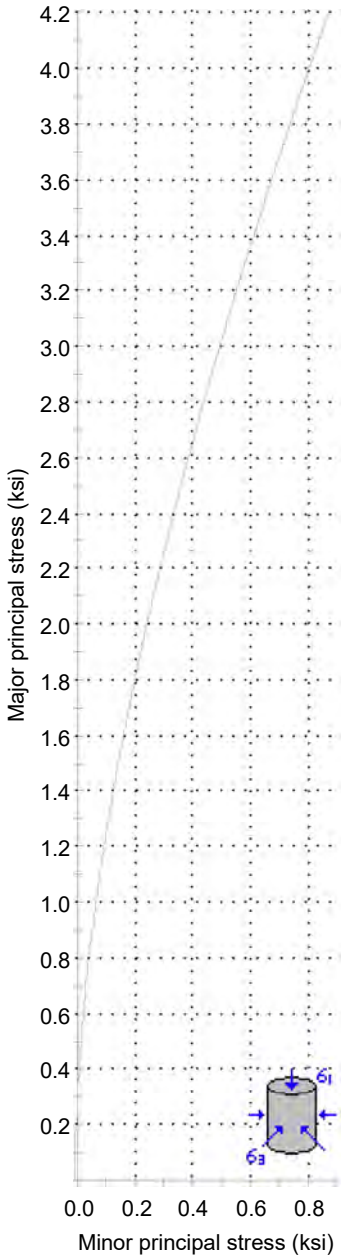
mb = 3.608 s = 0.0067 a = 0.504

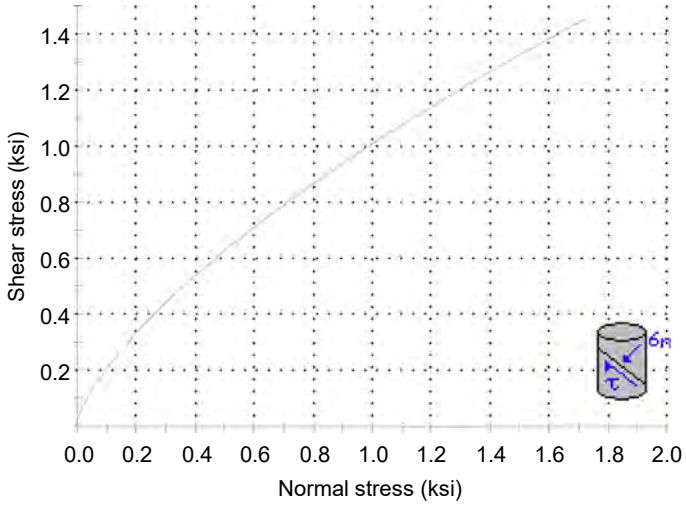
Mohr-Coulomb Fit

cohesion = 0.224 ksi friction angle = 37.09 deg

Rock Mass Parameters

tensile strength = -0.007 ksi
uniaxial compressive strength = 0.282 ksi
global strength = 0.898 ksi
deformation modulus = 128.61 ksi





Pier 1. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 527+57, 13' RT.	EXPLORATION ID B-009-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 968.9 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.087302, -81.501788	

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, **FINE SAND**, SOME COARSE SAND, TRACE SILT CLAY AND GRAVEL, DRY	968.9	1	11 21 50/4"	-	69	SS-1	-	5	33	57	-	5 -	NP	NP	NP	4	A-3 (0)	
	966.4	2																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	965.3	3																
SANDSTONE, REDDISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, COARSE GRAINED WITH GRAVEL, VERY THIN BEDDED, CONGLOMERITIC, BEDDING SLIGHTLY FRACTURED TO FRACTURED; RQD 62%, REC 85%.		4	50/1"	-	100/	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		5																
@ 8.2' TO 8.9'; Qu = 3,440 PSI		6	50		83	NX-1											CORE	
		7																
		8																
		9	65		87	NX-2											CORE	
@ 12.(		10																
		11																
		12																
		13																
		14	68		88	NX-3											CORE	
		15																
		16																
		17																
	950.4	18																
CLAYSTONE, GRAY, HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, SOME QUARTZ ROCK FRAGMENTS; RQD 52%, REC 67%.		19	52		67	NX-4											CORE	
	948.3	20																
SHALE, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 40%, REC 98%.		21																
		22																
		23																
		24	12		92	NX-5											CORE	
		25																
		26																
		27																
		28	10		100	NX-6											CORE	
		29																

STRATA R1:
1. RQD = (10X2.5+50X2+65X5 +68X5+52X1.5)/16=54
2. Qu = 3440 psi
3. GSI = 60

STRATA R2:
1. RQD = 52
2. Qu = 200 psi
3. GSI = 30

STRATA R3:
1. RQD = 11
2. Qu = 1500 psi
3. GSI = 30

PID: 91710	SFN: 7700369	PROJECT: SUM-8-1.75	STATION / OFFSET: 527+57, 13' RT.	START: 6/25/15	END: 6/25/15	PG 2 OF 2	B-009-0-15

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, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 40%, REC 98%. *(continued)*	938.9	31																
@ 31.4' TO 31.9'; Qu = 4,770 PSI		32																
		33	37		97	NX-7											CORE	
		34																
		35																
		36																
		37																
		38	57		100	NX-8											CORE	
		39																
		40																
		41																
		42																
		43	67		100	NX-9											CORE	
		44																
	923.9	45 EOB																

STRATA R4:
1. RQD = 53
2. Qu = 4770 psi
3. GSI = 55

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 83 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

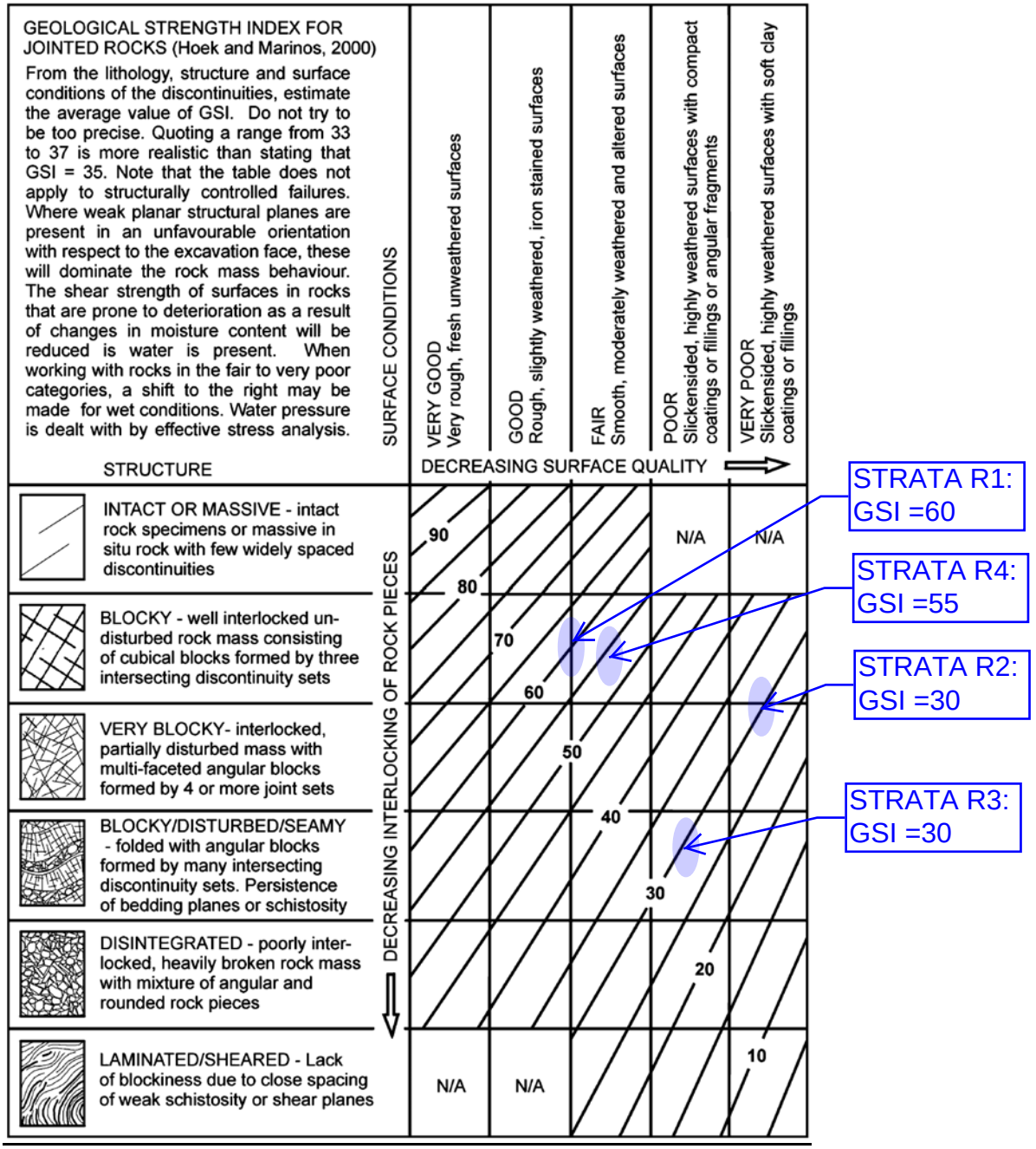


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

N.B. Pier 1. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 3.4 ksi
GSI = 60 mi = 17 Disturbance factor (D) = 0
intact modulus (Ei) = 306 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

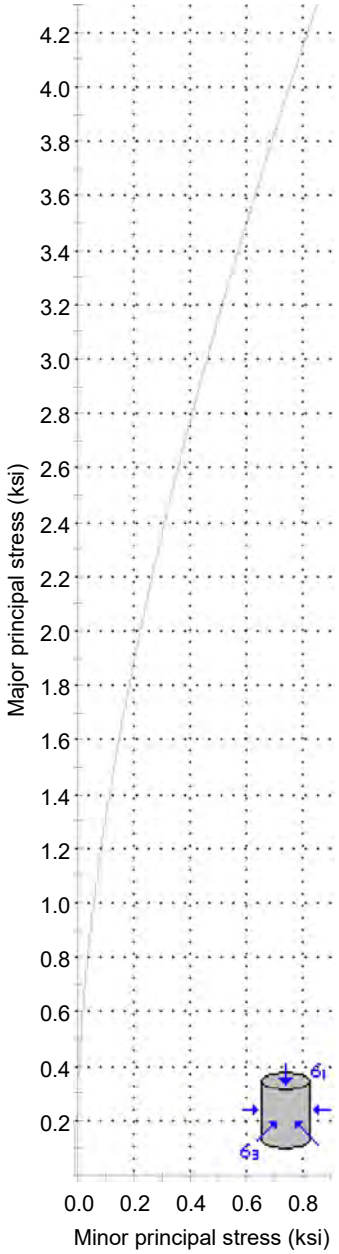
mb = 4.074 s = 0.0117 a = 0.503

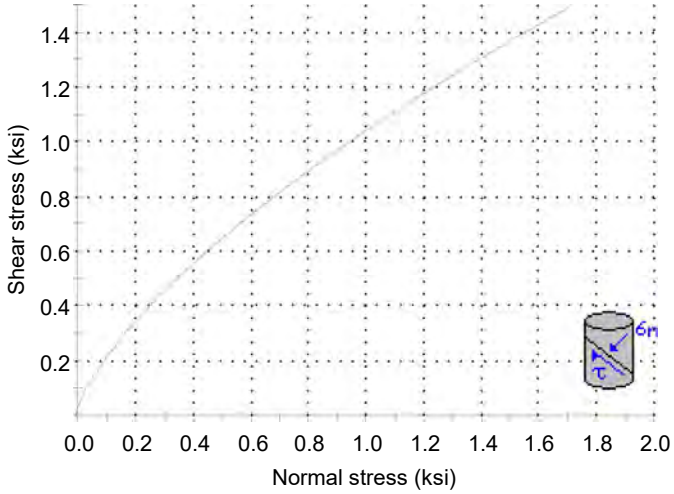
Mohr-Coulomb Fit

cohesion = 0.230 ksi friction angle = 38.09 deg

Rock Mass Parameters

tensile strength = -0.010 ksi
uniaxial compressive strength = 0.364 ksi
global strength = 0.944 ksi
deformation modulus = 159.12 ksi





N.B. Pier 1. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.2 ksi
GSI = 30 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 18 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

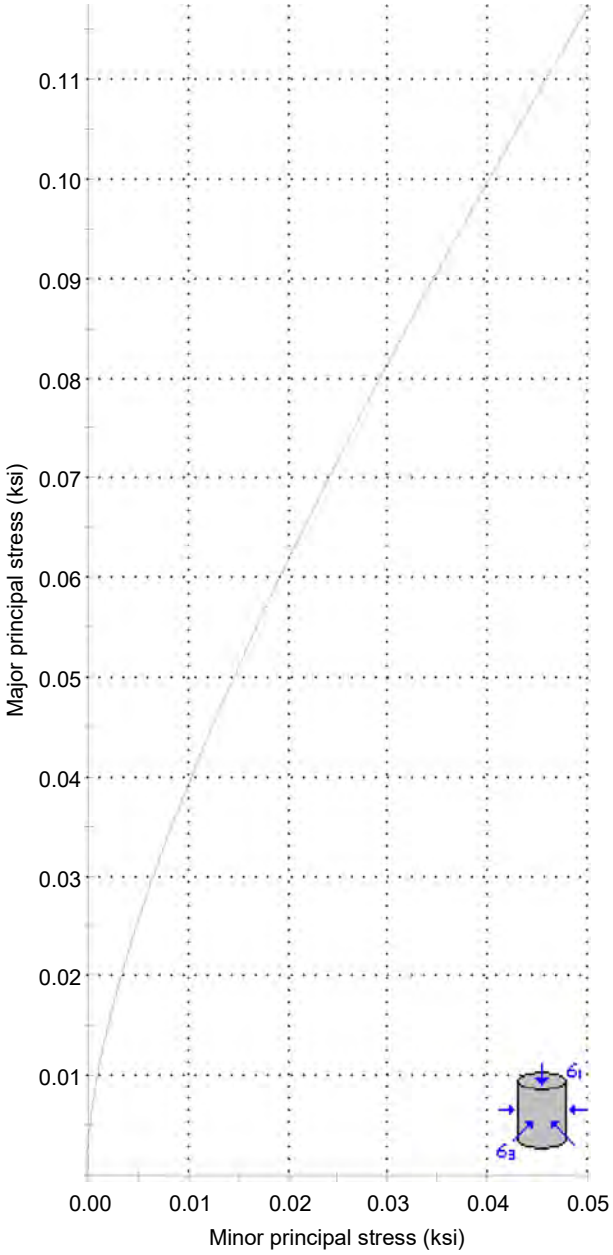
mb = 0.493 s = 0.0004 a = 0.522

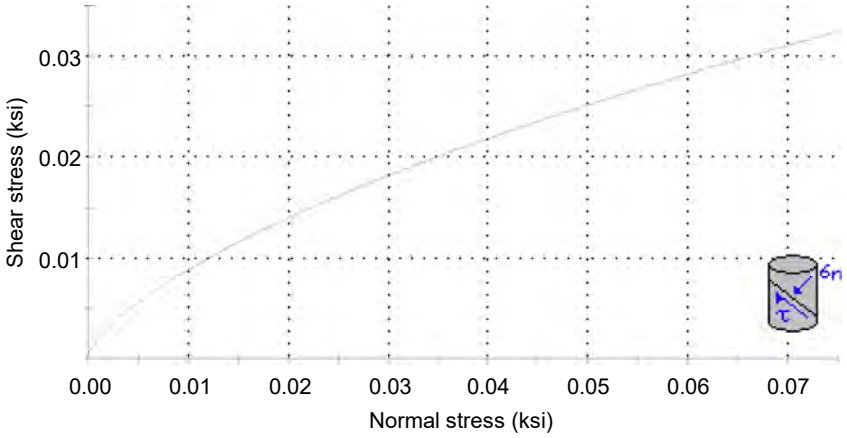
Mohr-Coulomb Fit

cohesion = 0.006 ksi friction angle = 20.67 deg

Rock Mass Parameters

tensile strength = -0.00017 ksi
uniaxial compressive strength = 0.003 ksi
global strength = 0.017 ksi
deformation modulus = 1.46 ksi





N.B. Pier 1. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 1.5 ksi
GSI = 30 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 135 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

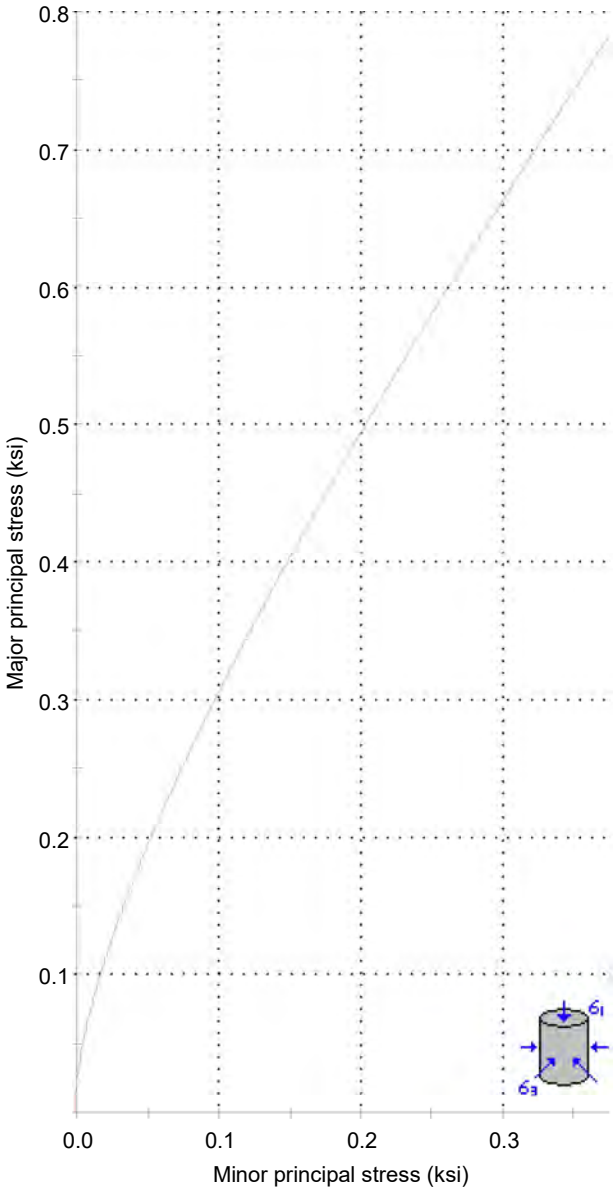
mb = 0.328 s = 0.0004 a = 0.522

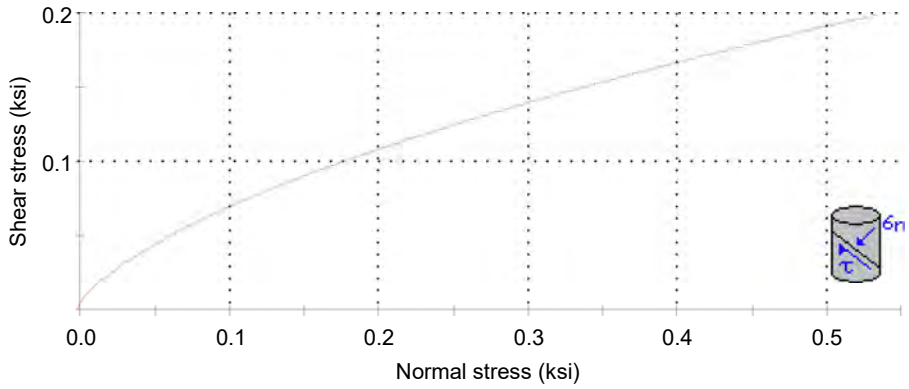
Mohr-Coulomb Fit

cohesion = 0.038 ksi friction angle = 17.83 deg

Rock Mass Parameters

tensile strength = -0.002 ksi
uniaxial compressive strength = 0.026 ksi
global strength = 0.103 ksi
deformation modulus = 10.99 ksi





N.B. Pier 1. Rock-4

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 4.75 ksi
GSI = 55 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 427.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

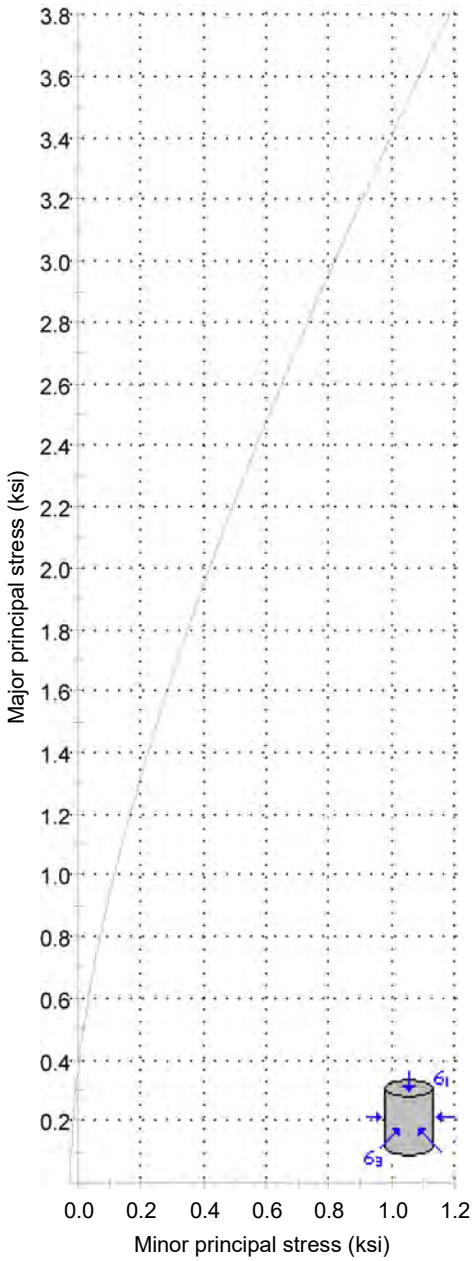
mb = 1.203 s = 0.0067 a = 0.504

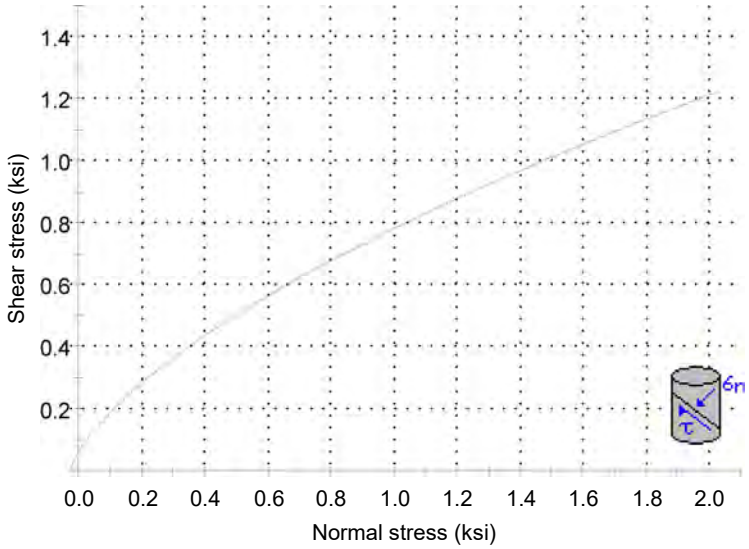
Mohr-Coulomb Fit

cohesion = 0.223 ksi friction angle = 27.67 deg

Rock Mass Parameters

tensile strength = -0.027 ksi
uniaxial compressive strength = 0.382 ksi
global strength = 0.736 ksi
deformation modulus = 174.54 ksi





Pier 2. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 531+07, 13' LT.	EXPLORATION ID B-010-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088196, -81.501321	

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
LOOSE, GRAVEL, DAMP (FILL)	879.2																	
MEDIUM STIFF, BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL AND SAND, MOIST	875.2		3 2 2	5	44	SS-1	1.00	10	6	6	40	38	45	21	24	26	A-7-6 (15)	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, "AND" SHALE FRAGMENTS, (SEVERELY WEATHERED SHALE), MOIST	874.2		6 6 7	17	78	SS-2	-	-	-	-	-	-	-	-	-	10	A-6b (V)	
			7 7 25	43	67	SS-3	-	5	7	7	53	28	39	19	20	9	A-6b (12)	
			13 14 20	45	72	SS-4	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
			22 28 30	78	78	SS-5	-	-	-	-	-	-	-	-	-	13	A-6b (V)	
			25 28 30	78	100	SS-6	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.	860.7	TR	26 50/5"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	857.7		50/4"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 31%, REC 63%.			0		33	NX-1											CORE	
			46		75	NX-2											CORE	
	852.8																	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, INTACT; RQD 63%, REC 98%.			63		98	NX-3											CORE	
@ 28.5' TO 29.0'; Qu = 4,380 PSI	850.2																	

STRATA R1:
1. RQD = 0
2. Qu = 200 psi (Assumed)
3. GSI = 5

STRATA R2:
1. RQD = (46X2+63X1)/3=52
2. Qu = 1500 psi
3. GSI = 15

STRATA R3:
1. RQD = 63
2. Qu = 4380 psi
3. GSI = 65

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 15:40 - W:\082368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 2015.GPJ

PID: 91710	SFN: 7700369	PROJECT: SUM-8-1.75	STATION / OFFSET: 531+07, 13' LT.	START: 6/26/15	END: 6/26/15	PG 2 OF 2	B-010-0-15

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, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED, ARGILLACEOUS; RQD 94%, REC 100%. *(continued)*	849.2	31																
		32																
		33	94		100	NX-4											CORE	
		34																
STRATA R4: 1. RQD = 94 2. Qu = 3840 psi 3. GSI = 65		35																
		36																
		37	98		100	NX-5											CORE	
		38																
		39																
		40																
		41																
@ 41.8' TO 42.2'; Qu = 3,840 PSI		42	100		100	NX-6											CORE	
		43																
		44																
	834.2	EOB 45																

NOTES: CAVE @ 14'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

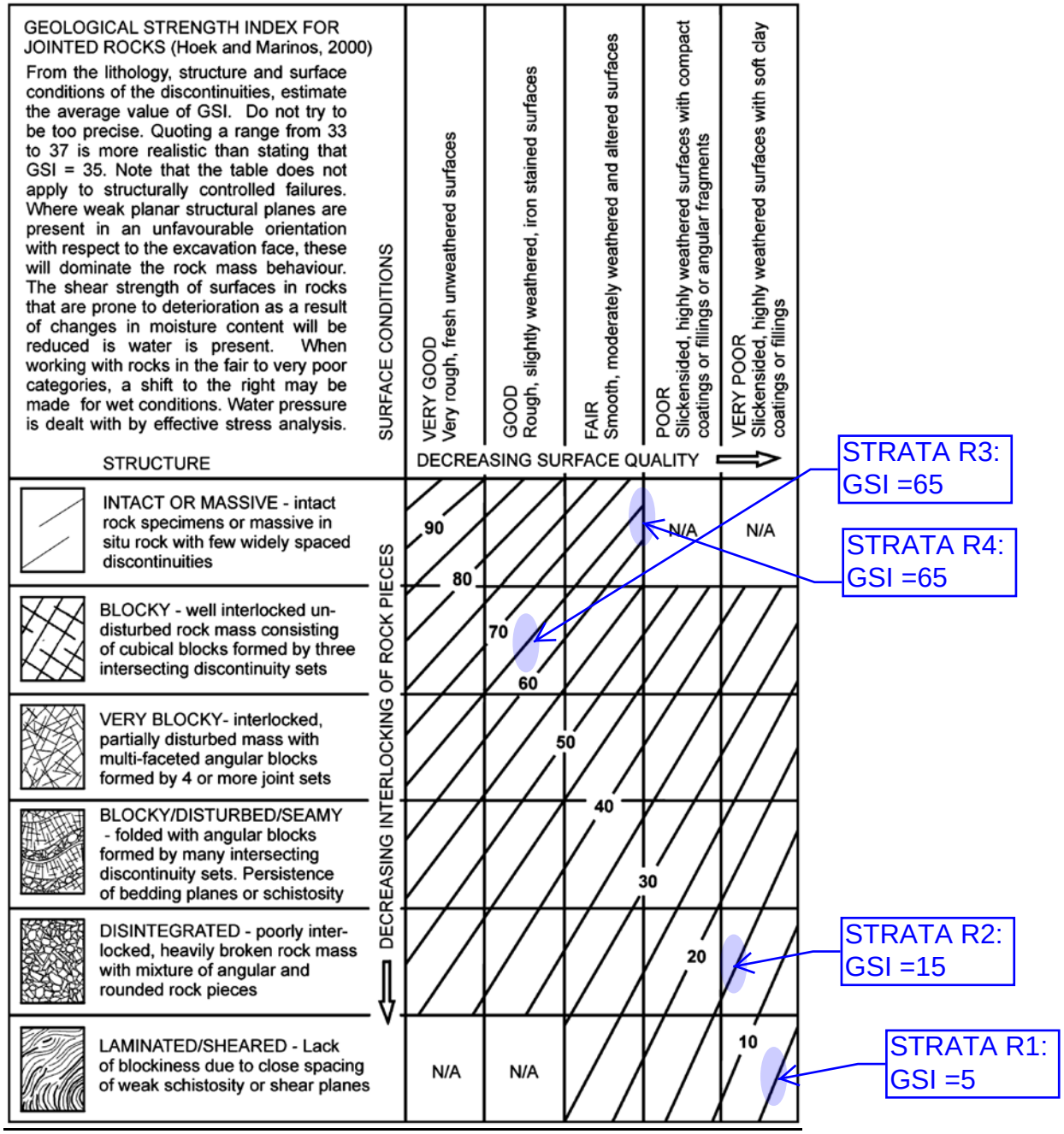


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

N.B. Pier 2. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.2 ksi
GSI = 5 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 18 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

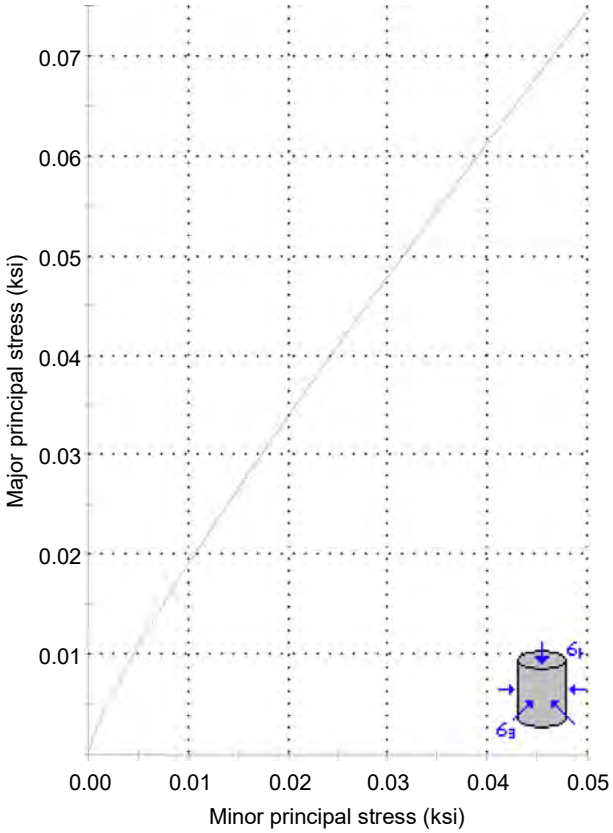
mb = 0.134 s = 2.6e-5 a = 0.619

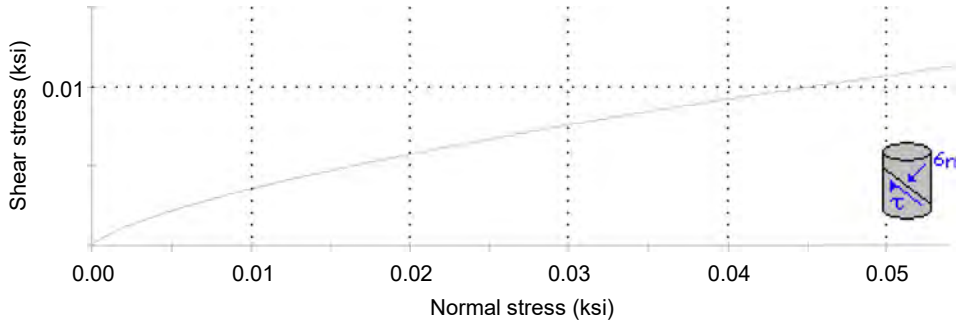
Mohr-Coulomb Fit

cohesion = 0.002 ksi friction angle = 10.16 deg

Rock Mass Parameters

tensile strength = -3.87e-5 ksi
uniaxial compressive strength = 0.00029 ksi
global strength = 0.004 ksi
deformation modulus = 0.48 ksi





N.B. Pier 2. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 1.5 ksi
GSI = 15 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 135 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

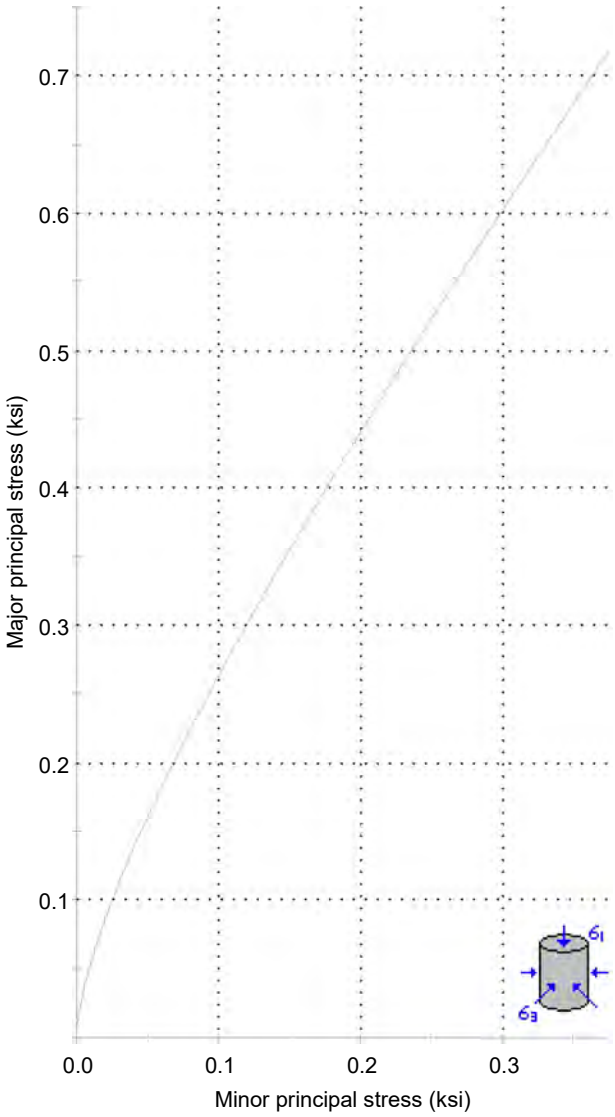
mb = 0.288 s = 0.0001 a = 0.561

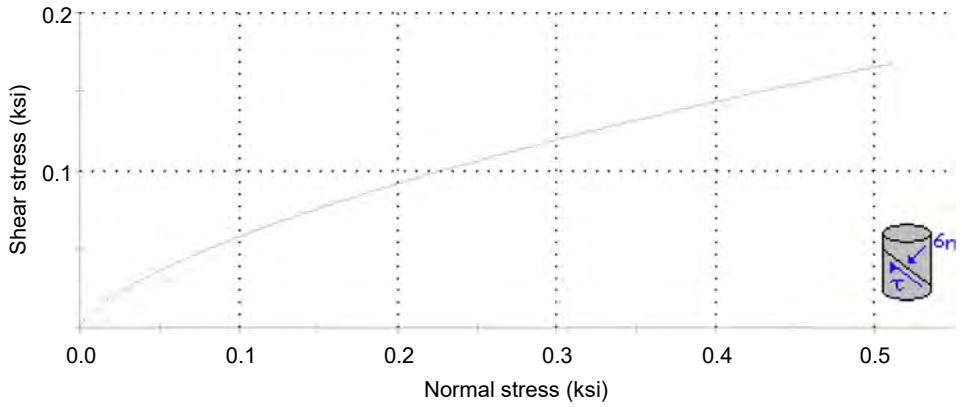
Mohr-Coulomb Fit

cohesion = 0.028 ksi friction angle = 16.13 deg

Rock Mass Parameters

tensile strength = -0.000412 ksi
uniaxial compressive strength = 0.007 ksi
global strength = 0.076 ksi
deformation modulus = 4.92 ksi





N.B. Pier 2. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 4.35 ksi
GSI = 65 mi = 18 Disturbance factor (D) = 0
intact modulus (Ei) = 391.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

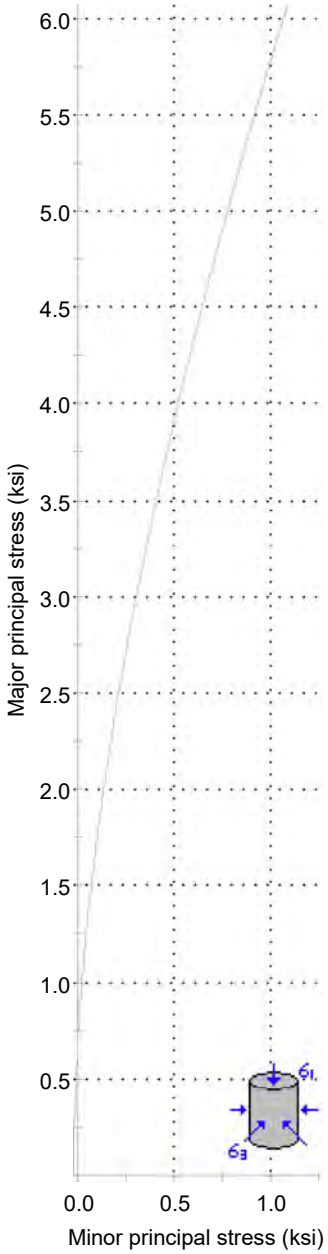
mb = 5.157 s = 0.0205 a = 0.502

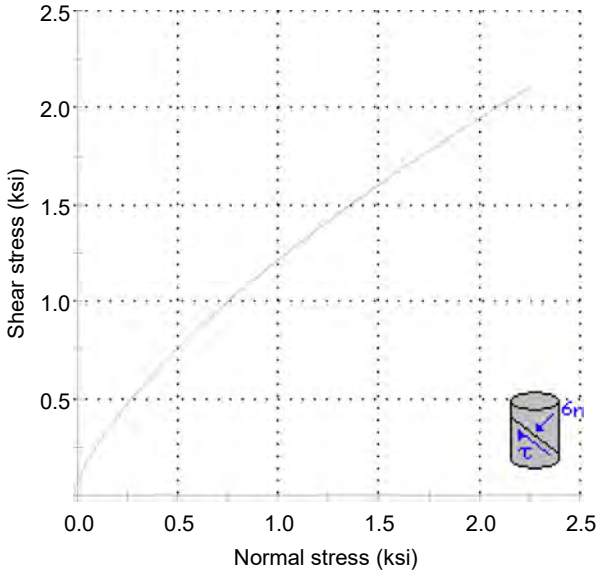
Mohr-Coulomb Fit

cohesion = 0.322 ksi friction angle = 40.07 deg

Rock Mass Parameters

tensile strength = -0.017 ksi
uniaxial compressive strength = 0.618 ksi
global strength = 1.383 ksi
deformation modulus = 247.32 ksi





N.B. Pier 2. Rock-4

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 3.8 ksi
GSI = 65 mi = 8 Disturbance factor (D) = 0
intact modulus (Ei) = 342 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

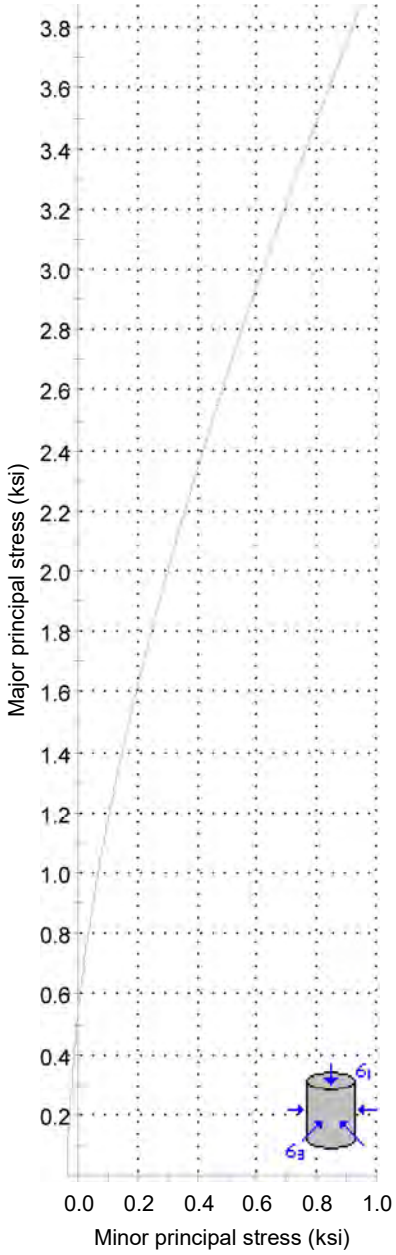
mb = 2.292 s = 0.0205 a = 0.502

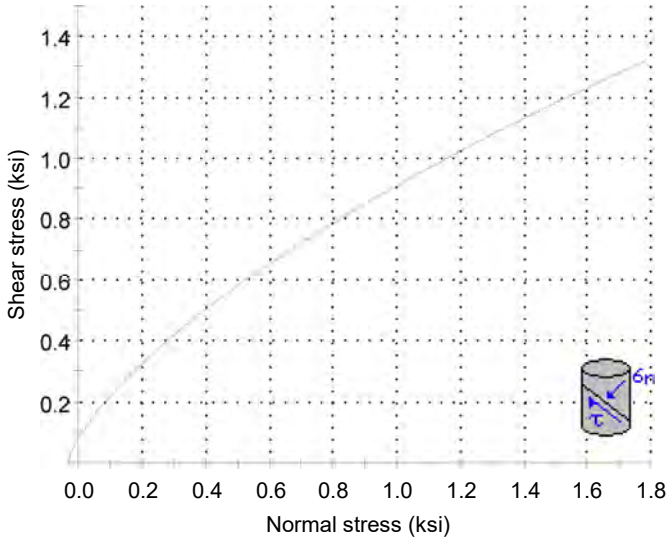
Mohr-Coulomb Fit

cohesion = 0.233 ksi friction angle = 32.93 deg

Rock Mass Parameters

tensile strength = -0.034 ksi
uniaxial compressive strength = 0.539 ksi
global strength = 0.856 ksi
deformation modulus = 216.05 ksi





Pier 3 N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 533+38, 43' RT.	EXPLORATION ID B-011-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 872.6 (MSL) EOB: 71.0 ft.	PAGE 1 OF 3
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.088750, -81.500946	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.6	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
ASPHALT (4.0") & BASE (7.0")	871.7																	
VERY STIFF TO HARD, GRAYISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**		1–4	12 11 8	26	100	SS-1	2.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@5.0' TO 6.5'; CHANGES TO MEDIUM STIFF TO VERY STIFF, GREENISH BROWN AND GRAYISH BROWN, CONTAINS CINDERS	865.1	5–7	3 2 3	7	100	SS-2	0.75 - 2.75	24	15	21	27	13	24	17	7	15	A-4a (1)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP	862.6	8–9	7 5 3	11	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
MEDIUM DENSE, ORANGISH BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST	860.6	10–11	3 4 5	12	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
HARD, GRAYISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	858.1	13	15 50/4"	-	80	SS-5	4.0 - 4.25	30	16	16	24	14	25	17	8	11	A-4a (1)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, (SILTSTONE), DAMP	855.1	15	50/5"	-	80	SS-6	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	853.1	18–19	9 21 50/5"	-	59	SS-7	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTSTONE), WET	850.6	20–21	19 7 18	34	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	847.6	23–24	6 27 28	75	67	SS-9	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FISSILE. TR		25–26	39 17 28	61	100	SS-10	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		28	20 50/4"	-	90	SS-11	-	-	-	-	-	-	-	-	-	12	Rock (V)	
	843.1																	

STRATA R1:
1. RQD = 5 (Assumed)
2. Qu = 200 psi
3. GSI = 5

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+38, 43' RT.	START: 4/3/17	END: 4/4/17	PG 2 OF 3	B-011-2-16

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
SILTSTONE, GRAY, HIGHLY WEATHERED. *(continued)*	842.6	31	50/3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	16	Rock (V)	
	840.8																	
INTERBEDDED SILTSTONE (54%) AND SHALE (46%), RQD 42%, REC. 100%; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, CONTAINS CLAY SEAMS, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 37.4' - 37.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; **SHALE**, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, FISSILE.		32 33 34 35 36 37 38 39 40 41	38		100	NQ2-1											CORE	
			47		100	NQ2-2												
	830.6																	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. @44.1'; Qu = 3331 PSI (SHALE) @48.1'; Qu = 10278 PSI (SILTSTONE) @52.9'; Qu = 8084 PSI (SILTSTONE)		42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61	39		99	NQ2-3											CORE	
			60		100	NQ2-4											CORE	
			55		100	NQ2-5											CORE	
			73		100	NQ2-6											CORE	

STRATA R2:
1. RQD = 42
2. Qu = (3331X(10.2X0.46+4X0.72) +(10278+8084)/2X(10.2X0.54 +4X0.28))/14.2=6062 psi
3. GSI = 40

STRATA R3:
1. RQD = 60
2. Qu = (3331X0.72)+(10278 +8084)/2X0.28)=4969 psi
3. GSI = 50

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+38, 43' RT.	START: 4/3/17	END: 4/4/17	PG 3 OF 3	B-011-2-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. *(continued)*	810.5	63 64 65 66	42		100	NQ2-7												CORE	
		67 68 69 70	72		100	NQ2-8												CORE	
	801.6	EOB 71																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 1 BAG ASPHALT PATCH; PUMPED 65 GAL. BENTONITE GROUT

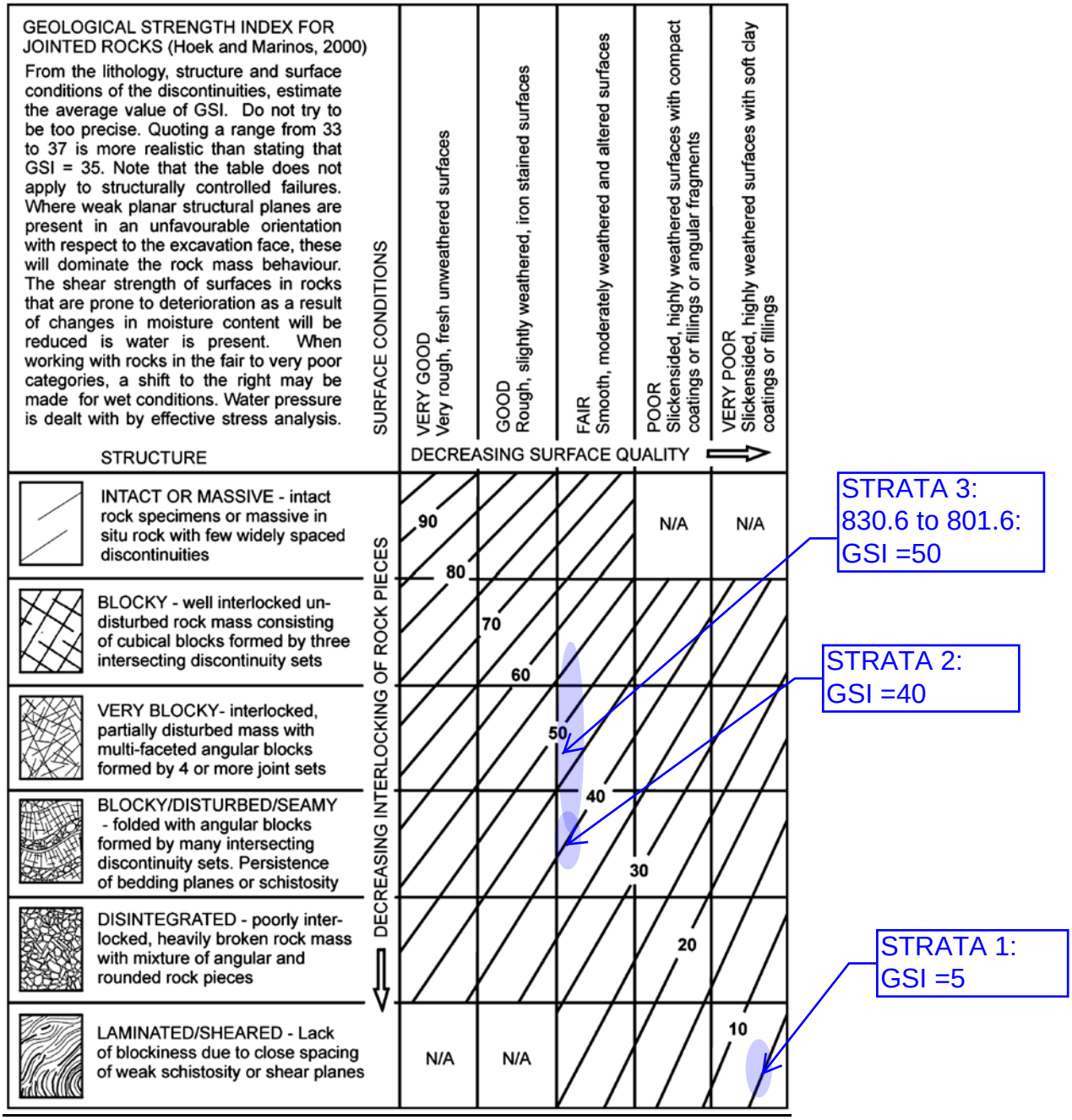


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:26 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 533+69, 6' RT.	EXPLORATION ID B-011-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 873.8 (MSL) EOB: 45.5 ft.	PAGE 1 OF 2
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.088868, -81.501030	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (6.0")	873.3																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW CINDERS, MOIST **(FILL)**	872.2	1	4	22	39	SS-1A	2.0 - 4.5+	-	-	-	-	-	-	-	-	19	A-4a (V)	
		2	6 10			SS-1B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	870.8	3																
		4	3 3 4	9	72	SS-2	1.5 - 3.5	25	13	19	28	15	25	18	7	14	A-4a (2)	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, DAMP **(FILL)**	868.3	5																
		6																
LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW CINDERS, DAMP **(FILL)**	865.8	7	2 2 2	5	61	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
		8																
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST **(FILL)**	862.8	9	2 2 3	7	72	SS-4	1.1 - 2.75	-	-	-	-	-	-	-	-	14	A-4a (V)	
		10																
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS CINDERS, MOIST **(FILL)**	860.8 W	11	3 5 9	19	56	SS-5	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
		12																
VERY LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET	859.4	13	1 1 14	20	83	SS-6A	-	-	-	-	-	-	-	-	-	29	A-3a (V)	
		14				SS-6B	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
MEDIUM DENSE TO VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE AND SHALE), DAMP		15																
		16	13 17 20	50	67	SS-7	-	48	13	14	17	8	21	16	5	10	A-1-b (0)	
		17																
		18																
		19	31 50/5"	-	73	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		20																
		21	50/3"	-	67	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	851.3	22																
HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP	849.3	23																
		24	18 28 50/5"	-	88	SS-10A	4.3 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
						SS-10B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		25																
		26	50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	846.3	27																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, CONTAINS 1.0" BY 2.0" COARSE GRAVEL PIECE, MOIST	843.8	28																
		29	36 50/5"	-	82	SS-12	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	

PID: 91710	SFN:7700370/7700371 (P	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+69, 6' RT.	START: 4/3/17	END: 4/4/17	PG 2 OF 2	B-011-3-16

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, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY (STONE FRAGMENTS ARE SILTSTONE)	843.8	31 32 33																
	839.8	TR 34	50/6"	-	67	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
SILTSTONE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK.	838.3	35																
INTERBEDDED SHALE (57%) AND SILTSTONE (43%), RQD 47%, REC. 99%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, DISINTEGRATED FROM 36.3' - 36.5', GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG, JOINT DISCONTINUITY: HIGH ANGLE FROM 38.8' - 39.0'.		36 37 38 39 40 41 42 43 44 45	47		99	NX-1													
	828.3	EOB																

STRATA R1:
1. RQD = 5 (Assumed)
2. Qu = 360 psi (Assumed)
3. GSI = 10

STRATA R2:
1. RQD = 47
2. Qu = 3331X0.57+ (10278+8084)/2X0.43 (B-011-2-16) =5847 psi
3. GSI = 55

NOTES: GROUNDWATER ENCOUNTERED AT 13.0' DURING DRILLING, 16.1' AFTER DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 55 GAL. BENTONITE GROUT

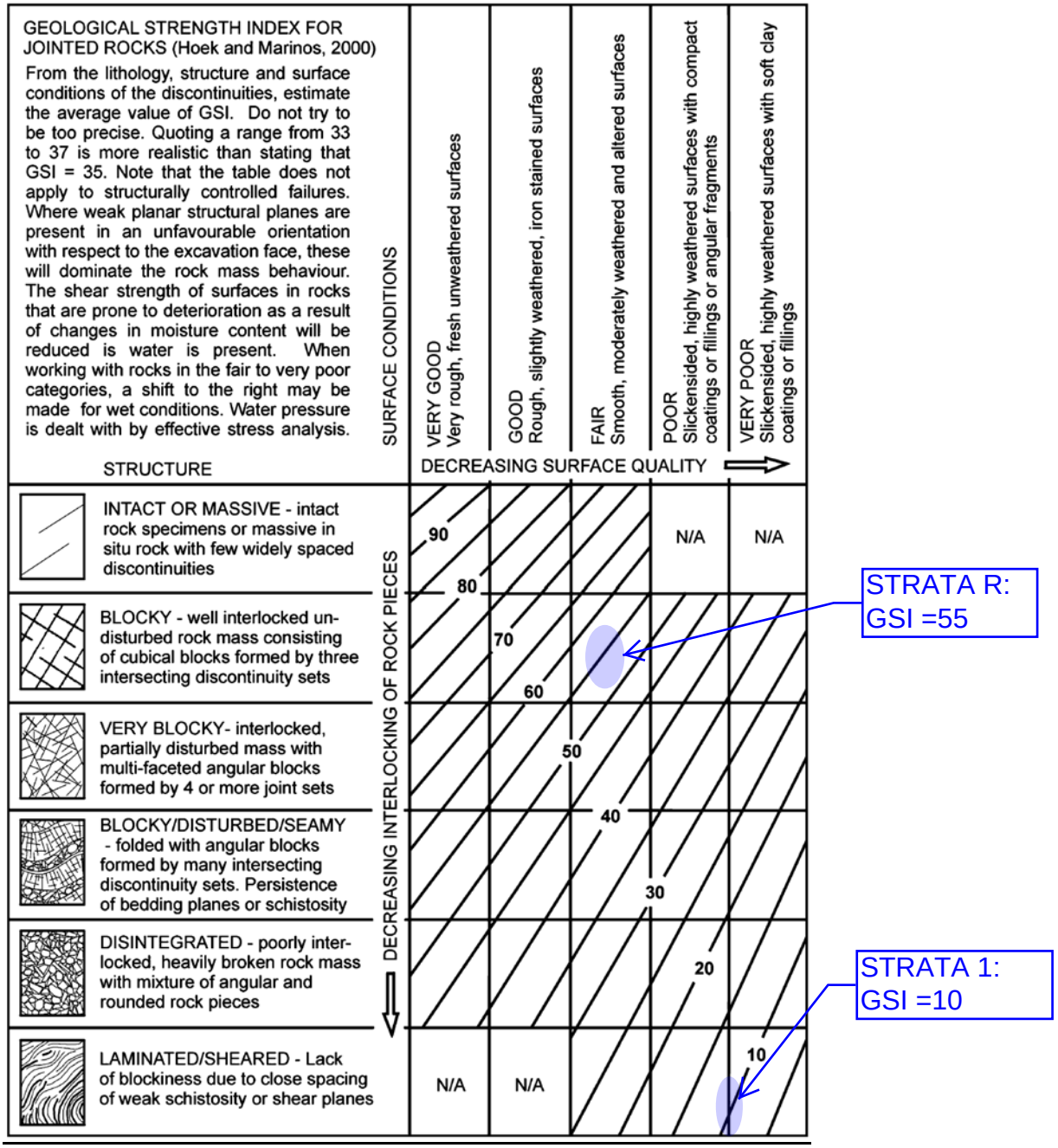


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

N.B. Pier 3. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.2 ksi
GSI = 6 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 18 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

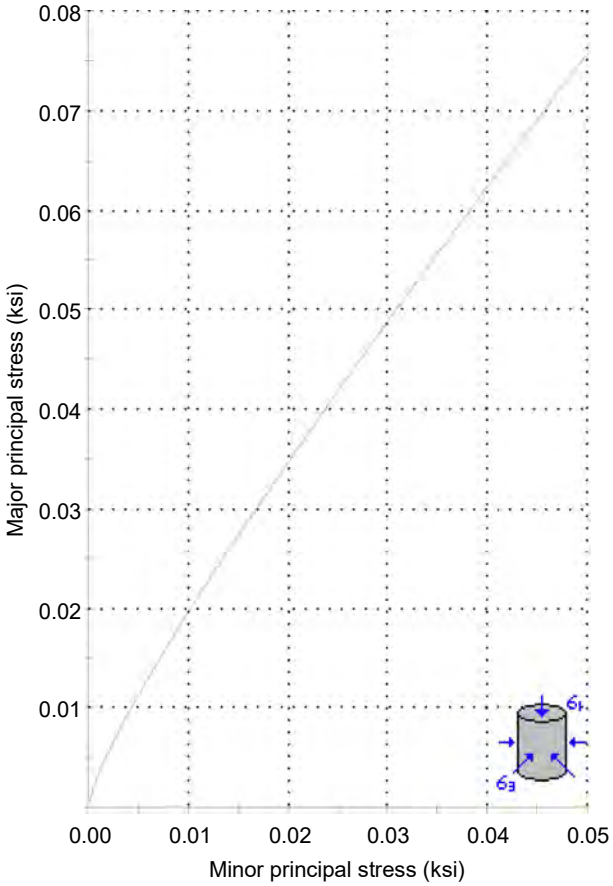
mb = 0.139 s = 2.91e-5 a = 0.612

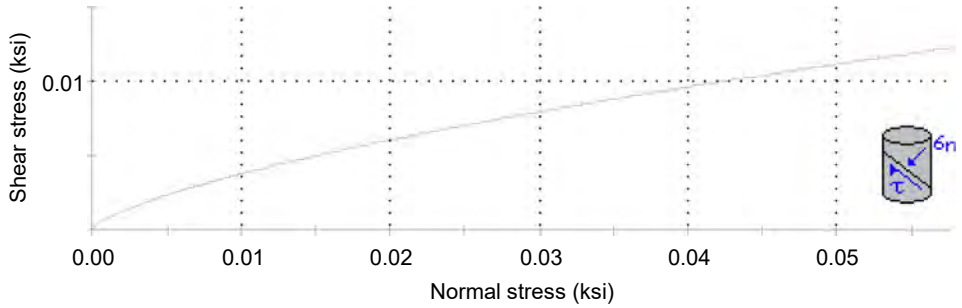
Mohr-Coulomb Fit

cohesion = 0.002 ksi friction angle = 10.53 deg

Rock Mass Parameters

tensile strength = -4.18e-5 ksi
uniaxial compressive strength = 0.000337 ksi
global strength = 0.005 ksi
deformation modulus = 0.49 ksi





N.B. Pier 3. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 5.95 ksi
GSI = 46 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 535.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

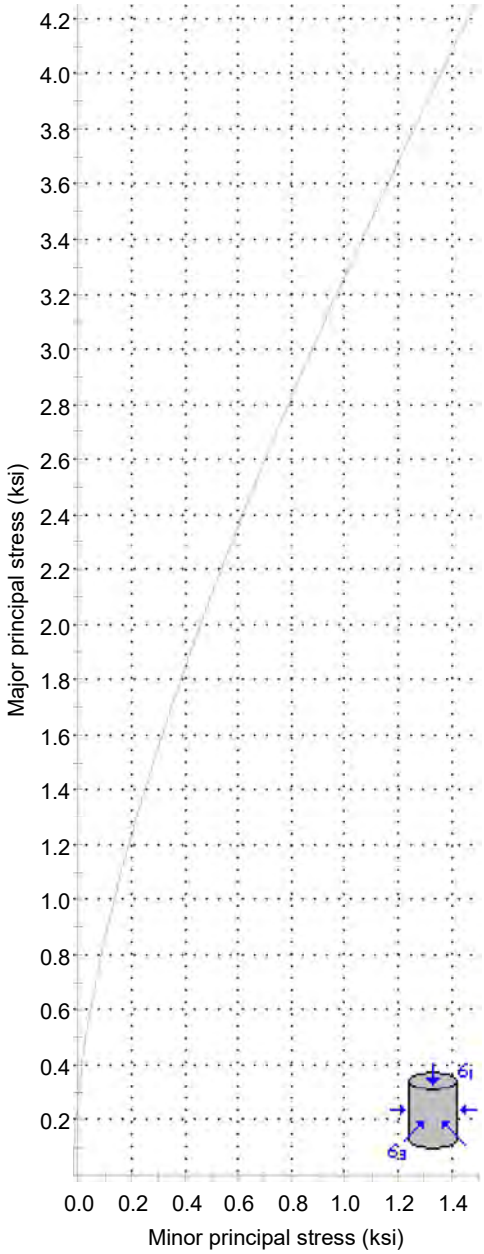
mb = 0.872 s = 0.0025 a = 0.508

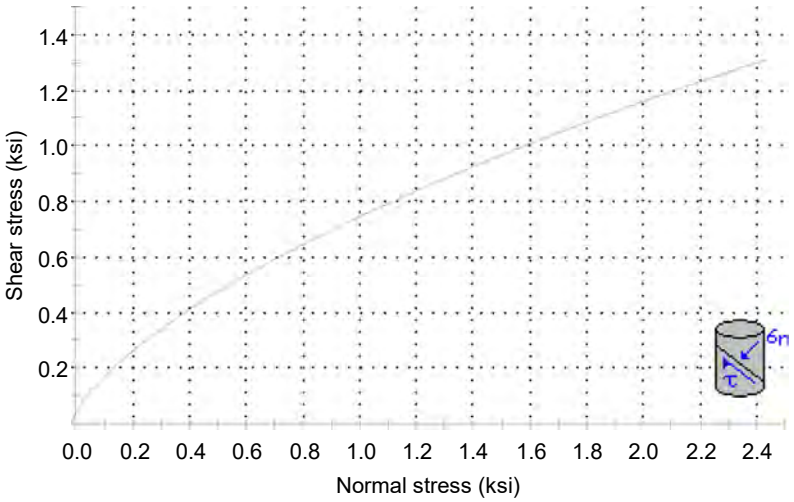
Mohr-Coulomb Fit

cohesion = 0.236 ksi friction angle = 25.16 deg

Rock Mass Parameters

tensile strength = -0.017 ksi
uniaxial compressive strength = 0.283 ksi
global strength = 0.745 ksi
deformation modulus = 127.87 ksi





N.B. Pier 3. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 4.95 ksi
GSI = 50 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 445.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

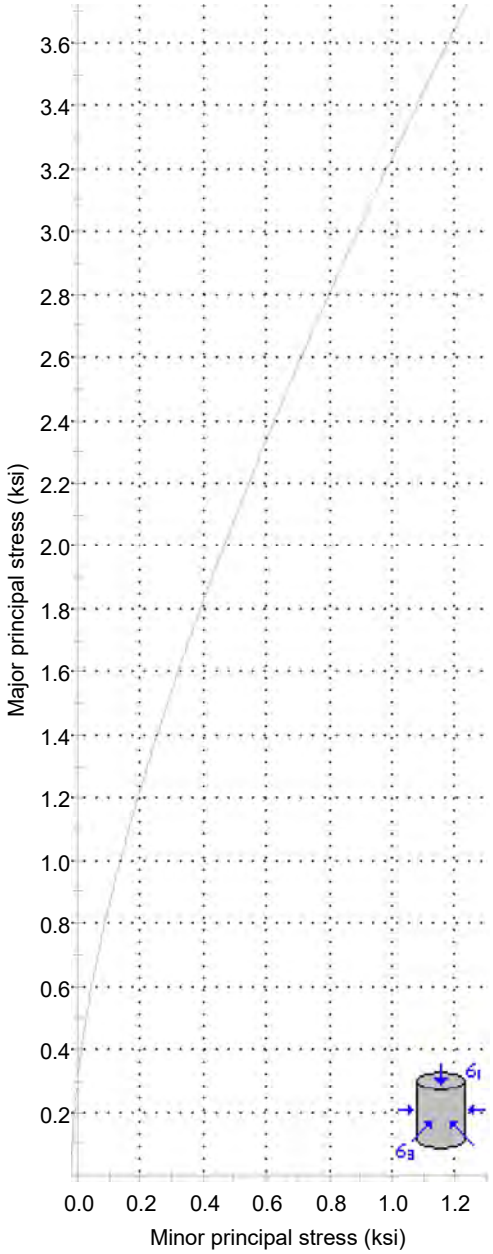
mb = 1.006 s = 0.0039 a = 0.506

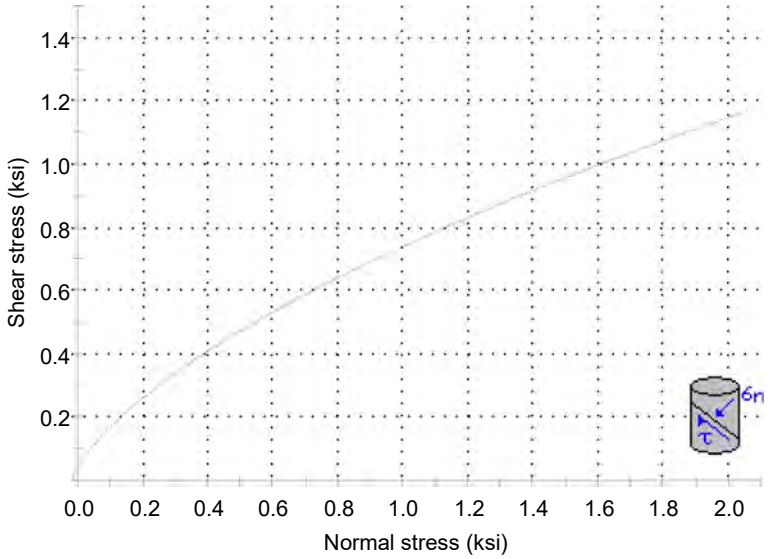
Mohr-Coulomb Fit

cohesion = 0.211 ksi friction angle = 26.28 deg

Rock Mass Parameters

tensile strength = -0.019 ksi
uniaxial compressive strength = 0.298 ksi
global strength = 0.681 ksi
deformation modulus = 136.85 ksi





Pier 4 N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 536+16, 44' RT.	EXPLORATION ID B-013-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/7/15	ELEVATION: 880.5 (MSL) EOB: 85.0 ft.	PAGE 1 OF 3
START: 3/30/17 END: 3/31/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089458, -81.500570	

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, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW PORCELAIN FRAGMENTS, DAMP **(FILL)**	880.5	1	4 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	877.5	2																
VERY LOOSE, DARK BROWN AND BLACK, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS TRACE BLACK ORGANICS, LOI = 1.8% ASH, MOIST **(FILL)**		3	1 2 1	4	39	SS-2	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	875.0	4																
VERY LOOSE TO LOOSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST **(FILL)** @6.0' TO 7.5'; CONTAINS 2.0" SILTY CLAY SEAM		5	2 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
	870.0	6																
LOOSE TO MEDIUM DENSE, GRAY AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST TO WET		7	1 1 1	3	39	SS-4	-	-	-	-	-	-	-	-	-	19	A-3a (V)	
		8																
		9	2 3 3	9	83	SS-5	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		10																
		11	6 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		12																
		13	3 4 4	12	100	SS-7	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		14																
		15	3 3 2	7	100	SS-8	-	38	31	12	14	5	NP	NP	NP	17	A-1-b (0)	
	860.0	16																
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		17	3 5 14	28	100	SS-9	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
	856.8	18																
VERY STIFF TO HARD, GRAY, **SILT AND CLAY**, SOME GRAVEL, SOME SAND, RELIC SHALE STRUCTURE, DAMP		19	7 13 15	42	100	SS-10	3.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
		20																
		21	10 23 27	75	100	SS-11	4.5+	28	16	8	27	21	30	17	13	11	A-6a (4)	
		22																
	851.5	23																
		TR	20 30 45	112	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 2 OF 3	B-013-2-16

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, GRAY, SEVERELY WEATHERED, VERY WEAK TO WEAK, BECOMES MORE INDURATED WITH DEPTH. *(continued)*	850.5	31																
		32																
		33																
		34	15 34 50/5"	-	100	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		35																
		36																
		37																
		38																
		39	18 20 34	81	100	SS-14	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		40																
		41																
		42																
		43																
	836.8	44	60/3"	-	100	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS.		45	29		100	NQ2-1												CORE	
		46																
		47	16		77	NQ2-2												:ORE
		48																
		49																
		50																
		51																
		52	29		84	NQ2-3												CORE
		53																
		54																
		55																
		56																
		57	61		100	NQ2-4												CORE
		58																
		59																
		60																
		61																

STRATA R1:
1. RQD = 1 (Assumed)
2. Qu = 360 psi
3. GSI = 5

STRATA R2:
1. RQD = 23
2. Qu = 683 psi
3. GSI = 45

@53.4'; Qu = 683 PSI (SHALE INTERBEDDED WITH SILTSTONE)

@55.8'; Qu = 11709 PSI (SILTSTONE)

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 3 OF 3	B-013-2-16

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
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS. *(continued)* @63.4'; Qu = 942 PSI (SHALE)	818.4	63	79		100	NQ2-5											CORE	
		65	55		100	NQ2-6											CORE	
		70	87		98	NQ2-7											CORE	
		75	95		100	NQ2-8											CORE	
		80	98		100	NQ2-9											CORE	
	795.5	EOB 85																

STRATA R3:
1. RQD = (1 X14.7+64X41.3)/56=47
2. Qu = 942X0.84+11709X0.16= 2665 psi
3. GSI = 65

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 85 GAL. BENTONITE GROUT

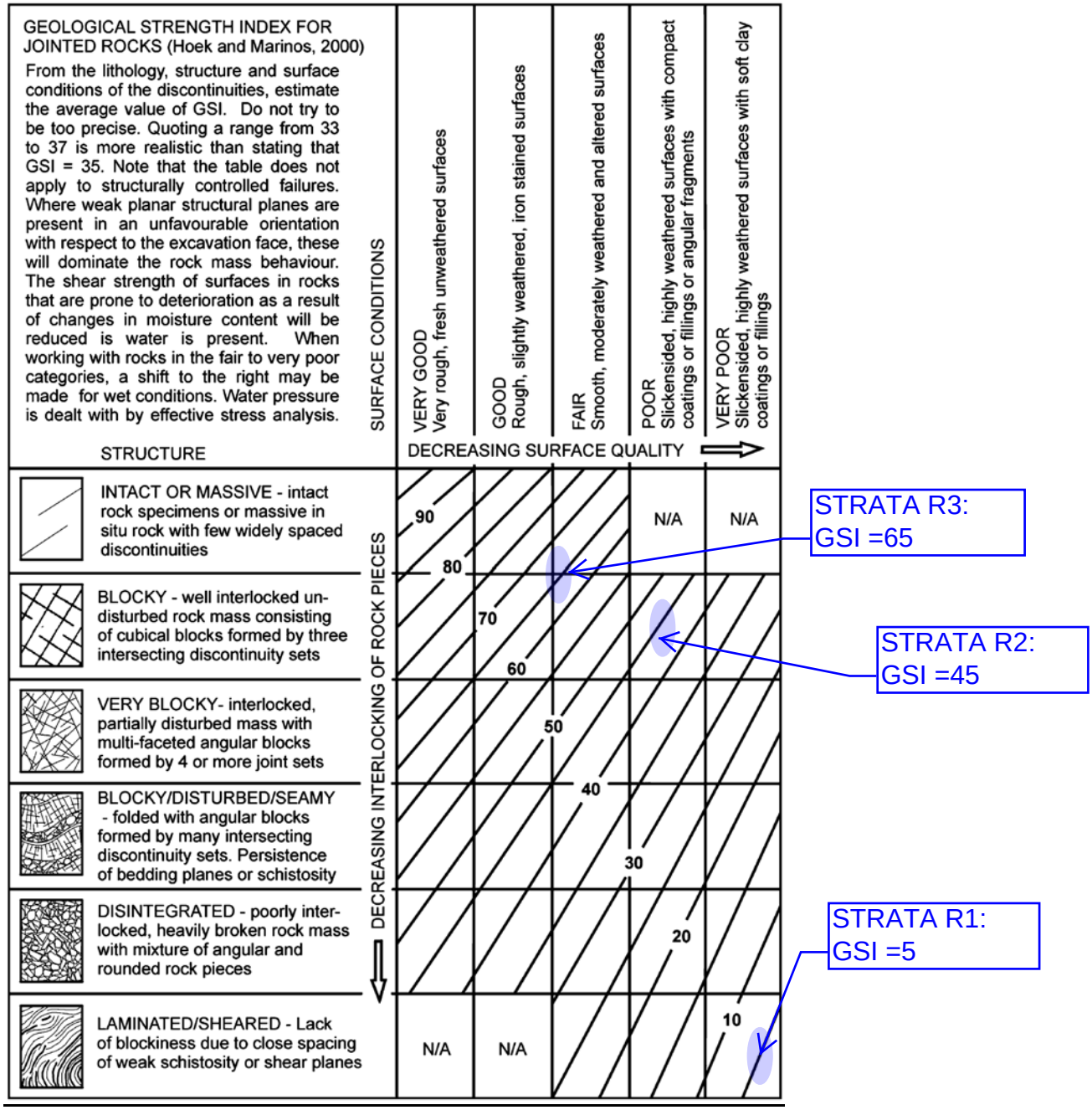


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:27 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 536+52, 6' RT.	EXPLORATION ID B-013-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 56.0 ft.	PAGE 1 OF 2
START: 3/27/17 END: 3/28/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089588, -81.500652	

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, DARK BROWN CHANGING TO BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST **FILL** @1.0' TO 2.5'; CONTAINS CONCRETE AND ANTHRACITE COAL FRAGMENTS	885.5		7 6 6	16	89	SS-1	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	881.6		7 7 5	16	61	SS-2A SS-2B	- -	- -	- -	- -	- -	- -	- -	- -	- -	8 8	A-1-b (V) A-3a (V)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, DAMP **FILL** @6.0' TO 7.5'; CONTAINS 1.0" GRAY SILTY CLAY SEAM	877.5		6 11 13	32	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
LOOSE, DARK BROWN CHANGING TO DARK BROWN WITH BLACK AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE TO SOME SILT, TRACE CLAY, STONE FRAGMENTS ARE SANDSTONE, DAMP TO WET **FILL** @8.5' TO 10.0'; CONTAINS TRACE ANTHRACITE COAL FRAGMENTS @11.0' TO 12.5'; CONTAINS TRACE BLACK ROOTS	872.0		3 3 4	9	78	SS-4	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
			6 3 3	8	56	SS-5	-	-	-	-	-	-	-	-	-	26	A-1-b (V)	
MEDIUM STIFF TO STIFF, BLACK AND GRAY, **SILT AND CLAY**, "AND" SAND, ORGANIC, CONTAINS TRACE BLACK ROOTS, LOI = 7.2% ASH, MOIST	870.0	▼ 24 hr	3 2 1	4	72	SS-6	0.75 - 1.7	0	6	42	38	14	38	24	14	32	A-6a (5)	
MEDIUM DENSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST	867.5	W	5 3 5	11	67	SS-7	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, TRACE TO LITTLE SAND, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE SILTSTONE, WET	865.0		9 11 7	24	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-a (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET		W	20 20 20	54	72	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
			20 16 16	43	72	SS-10	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			12 18 20	51	67	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
@28.5' TO 30.0'; GRAVEL IS ROUNDED TO SUBROUNDED			9 14 14	38	61	SS-12	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+52, 6' RT.	START: 3/27/17	END: 3/28/17	PG 2 OF 2	B-013-3-16

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, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET *(continued)*	855.5	31 32 33 34 35 36 37 38 39 40 41 42 43	12 22 24	62	67	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			8 43 33	103	72	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	842.0	TR																
SILTSTONE, GRAY, SEVERLY WEATHERED, MODERATELY ARGILLACEOUS.		44	84/6"	-	33	SS-15	-	-	-	-	-	-	-	-	-	13	Rock (V)	
	839.5	45 46																
SILTSTONE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, PYRITIC, MODERATELY ARGILLACEOUS, CONTAINS FEW THIN SHALE SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 47.1' - 47.5', FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD TO VERY GOOD SURFACE CONDITION; RQD 78.4%, REC 99.3%.	836.9	47 48	65														CORE	
INTERBEDDED SHALE (69%) AND SILTSTONE (31%), RQD 26.1%, REC. 77.7%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BECOMES FISSILE AT 53.0', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURES FROM 50.8' - 51.0', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, POOR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG. @51.3'; Qu = 10916 PSI (SILTSTONE)		49 50 51 52 53 54 55 56	11		72														
	829.5	EOB	52		91	NX-3											CORE	

STRATA R1
Neglect silt stone, use data from B-013-2-16

STRATA R2:
1. RQD = (11X3+65X1)/4=24
2. Qu = 683 psi (shale from B-013-2-16)
GSI = 35

STRATA R3:
1. RQD = 52
2. Qu = 683X0.69+10916X0.31=3855 psi
GSI = 60

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING, 23.5' BEFORE CORING, 15.0' UPON COMPLETION. CAVE DEPTH 29.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 80 GAL. BENTONITE GROUT

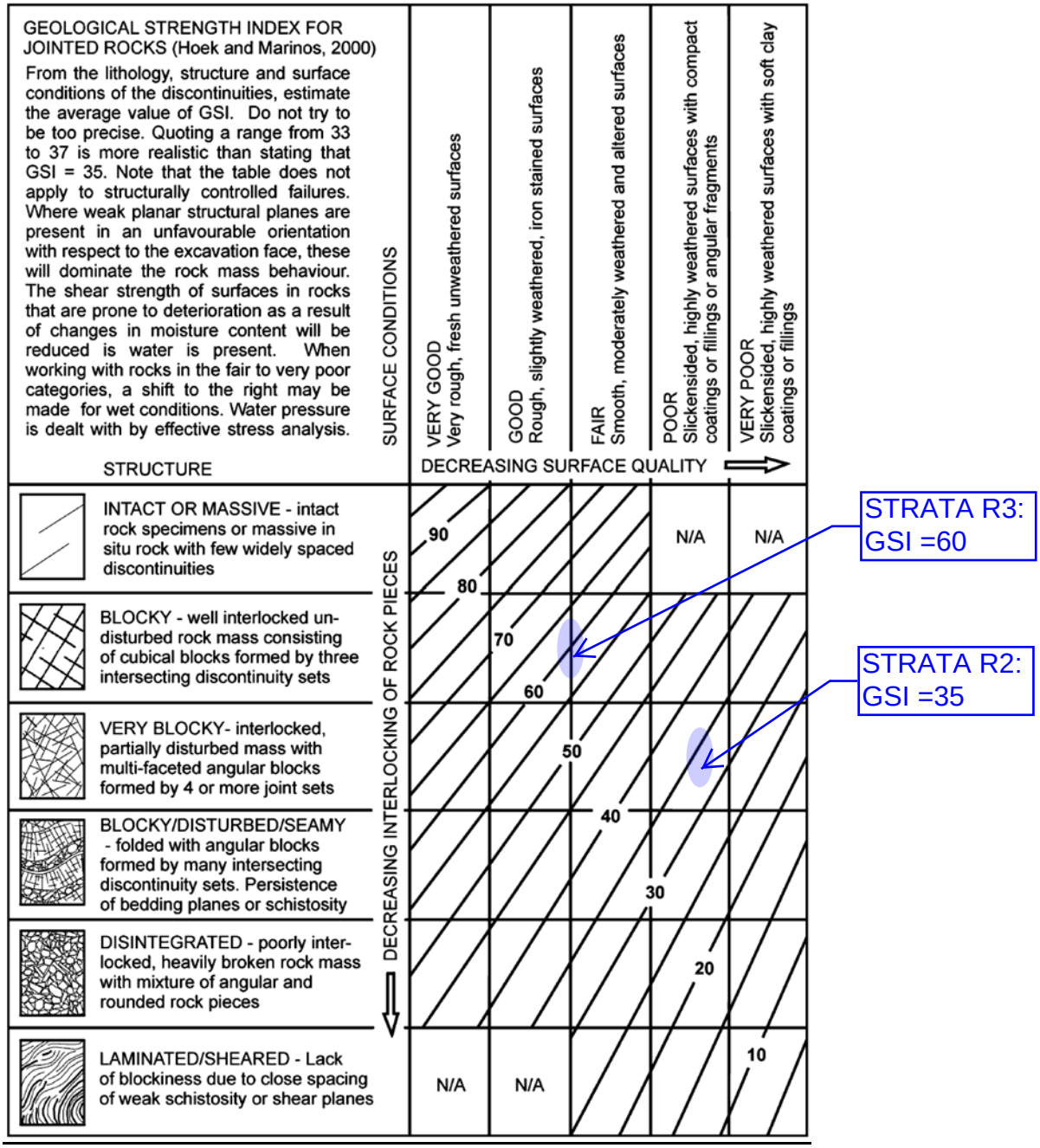


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

N.B. Pier 4. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.35 ksi
GSI = 5 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 31.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

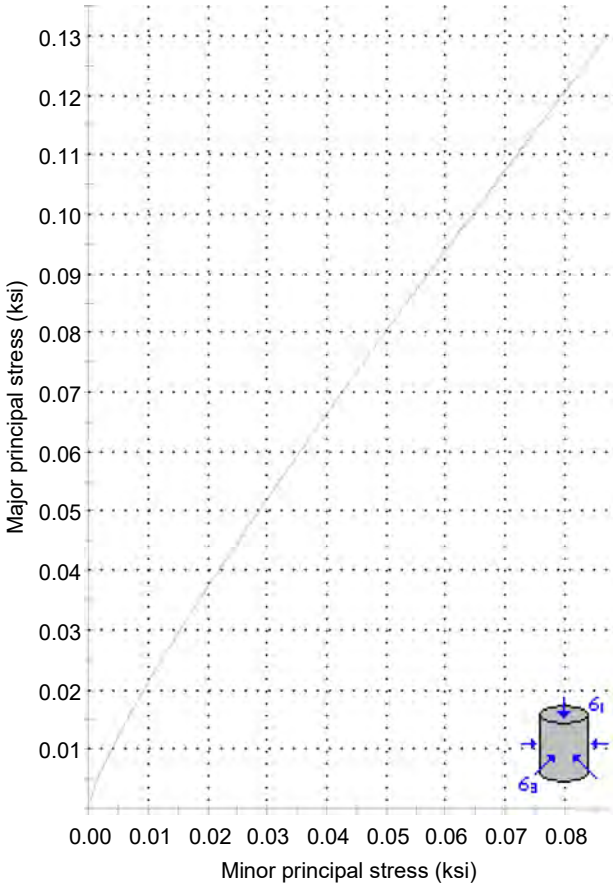
mb = 0.134 s = 2.6e-5 a = 0.619

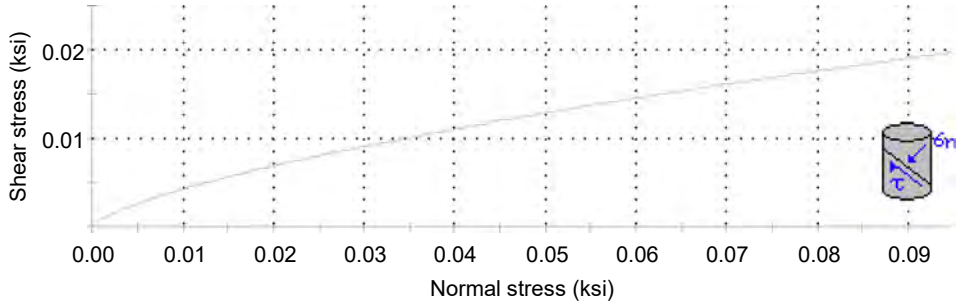
Mohr-Coulomb Fit

cohesion = 0.003 ksi friction angle = 10.16 deg

Rock Mass Parameters

tensile strength = -6.78e-5 ksi
uniaxial compressive strength = 0.001 ksi
global strength = 0.008 ksi
deformation modulus = 0.84 ksi





N.B. Pier 4. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.65 ksi
GSI = 42 mi = 5 Disturbance factor (D) = 0
intact modulus (Ei) = 58.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

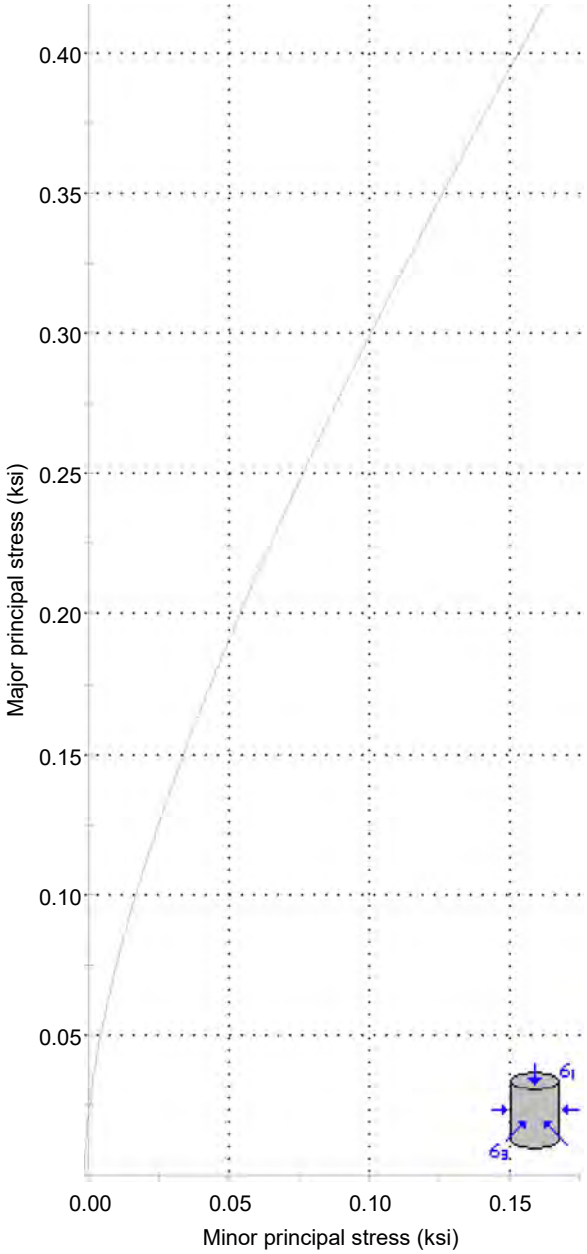
mb = 0.630 s = 0.0016 a = 0.510

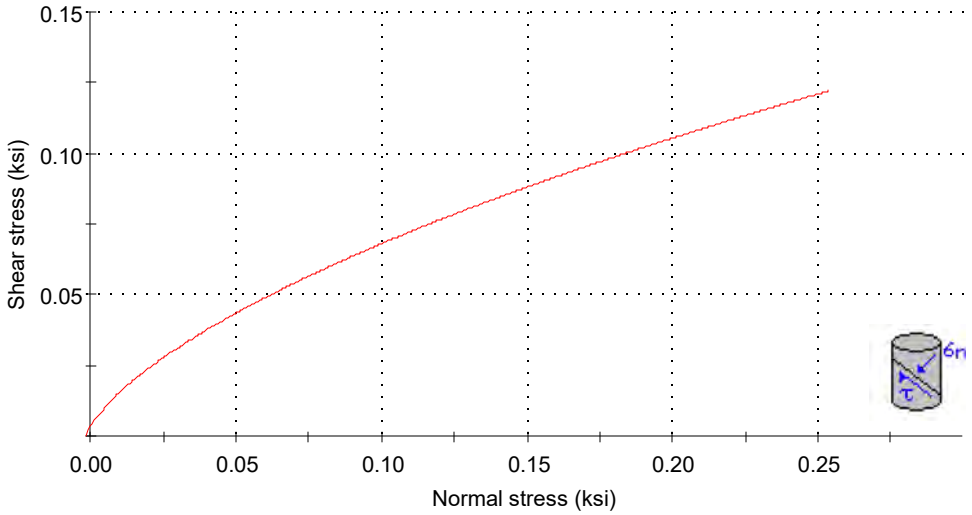
Mohr-Coulomb Fit

cohesion = 0.023 ksi friction angle = 22.64 deg

Rock Mass Parameters

tensile strength = -0.002 ksi
uniaxial compressive strength = 0.024 ksi
global strength = 0.068 ksi
deformation modulus = 10.70 ksi





N.B. Pier 4. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 2.75 ksi
GSI = 65 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 247.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

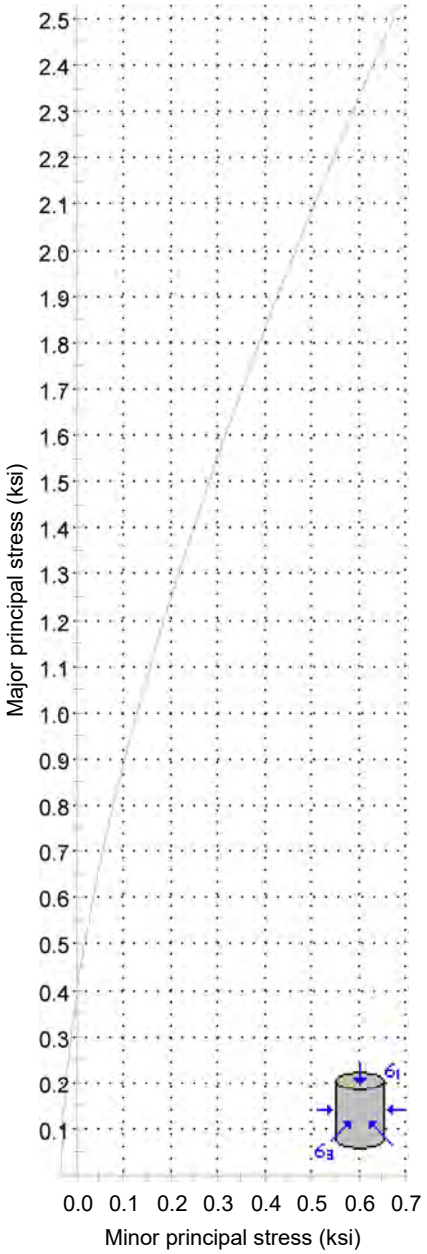
mb = 1.719 s = 0.0205 a = 0.502

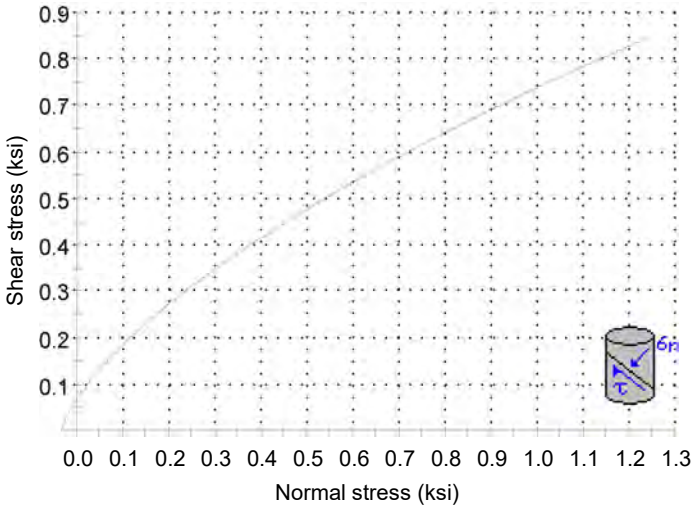
Mohr-Coulomb Fit

cohesion = 0.159 ksi friction angle = 30.41 deg

Rock Mass Parameters

tensile strength = -0.033 ksi
uniaxial compressive strength = 0.390 ksi
global strength = 0.555 ksi
deformation modulus = 156.35 ksi





R. ABT. S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 225+00, 78' LT.	EXPLORATION ID B-005-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1012.5 (MSL) EOB: 25.7 ft.	PAGE 1 OF 1
START: 12/28/16 END: 12/28/16	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086773, -81.502733	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1012.5	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
TOPSOIL (4.0")	1012.2		4 4 5	13	83	SS-1	-	11	21	37	18	13	NP	NP	NP	21	A-3a (0)	
MEDIUM DENSE, DARK GRAY AND DARK BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE CLAY, LITTLE GRAVEL, CONTAIN FEW ROOTS, @0.3' TO 1.5'; CONTAINS SLAG AND CINDERS, WET																		
(FILL)	1009.2		4 5 8	19	67	SS-2A	-	-	-	-	-	-	-	-	-	27	A-3a (V)	
						SS-2B	-	-	-	-	-	-	-	-	-	5	A-3a (V)	
MEDIUM DENSE TO DENSE, BROWN AND LIGHT BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, DRY TO DAMP			18 10 7	25	100	SS-3	-	13	21	49	11	6	NP	NP	NP	4	A-3a (0)	
STRATA R1: 1. RQD = 10 (Assumed) 2. Qu = 1500 psi (Assumed) 3. GSI = 30			9 9 8	25	83	SS-4	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
@10.0' TO 11.5'; BECOMES SOME GRAVEL			9 12 10	32	67	SS-5	-	-	-	-	-	-	-	-	-	3	A-3a (V)	
	1000.0	TR																
SANDSTONE, BROWN TO PINKISH BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.			24 50/3"	-	78	SS-6	-	-	-	-	-	-	-	-	-	3	Rock (V)	
	996.8		34 50/2"	-	75	SS-7	-	-	-	-	-	-	-	-	-	2	Rock (V)	
SANDSTONE, ORANGISH BROWN AND LIGHT BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, VERY THIN TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY TO SLIGHTLY FRACTURED, NARROW TO OPEN, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, GOOD SURFACE CONDITION; RQD 31%, REC 85%.																		
STRATA R2: 1. RQD = 31 2. Qu = 4111 psi 3. GSI = 65			31		85	NQ2-1											CORE	
@25.2'; Qu = 4111 PSI	986.8	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/26/17 12:04 - W:\082368- MS-SUM-8-1.75\E_PRJ WRKE_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

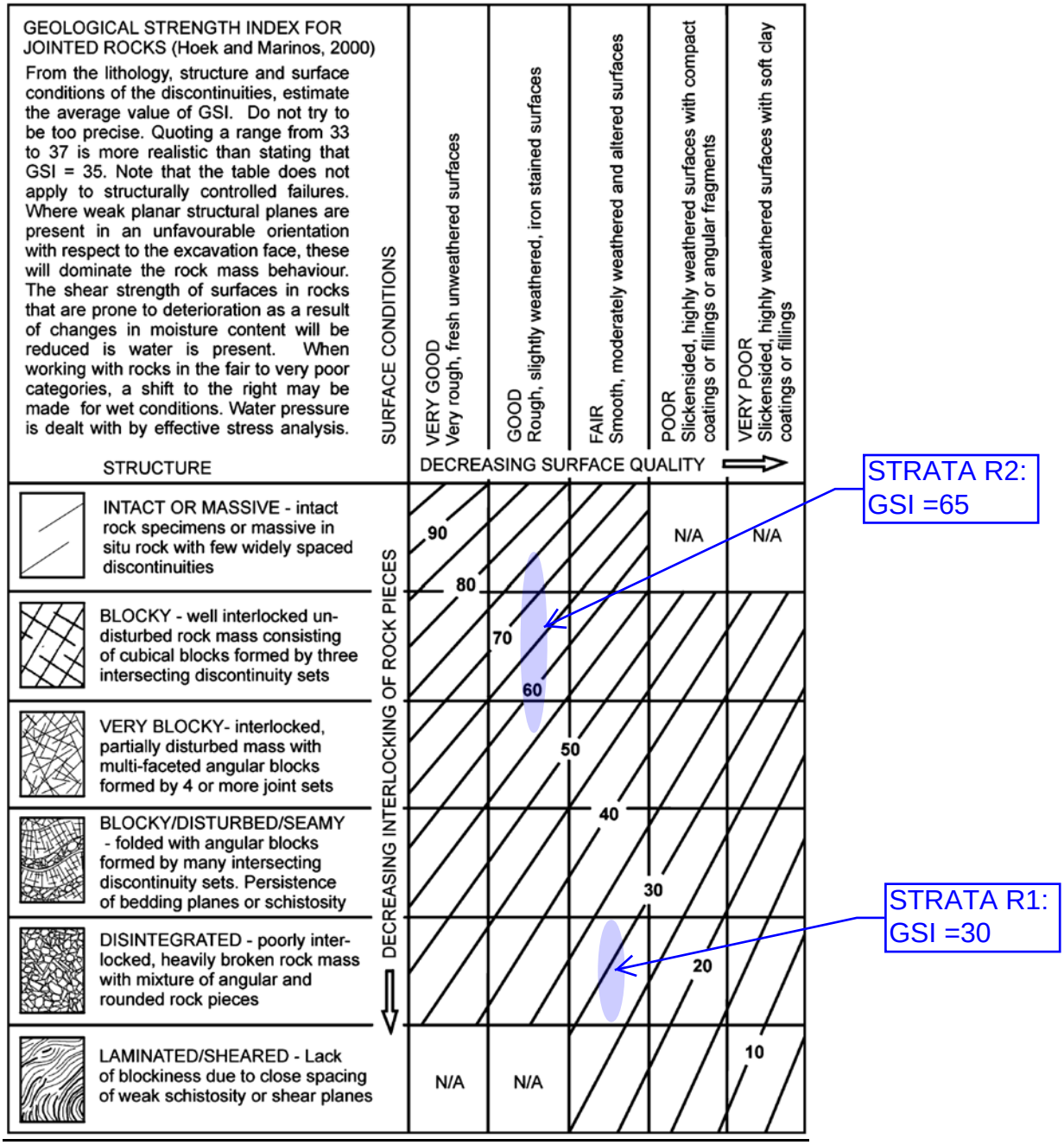
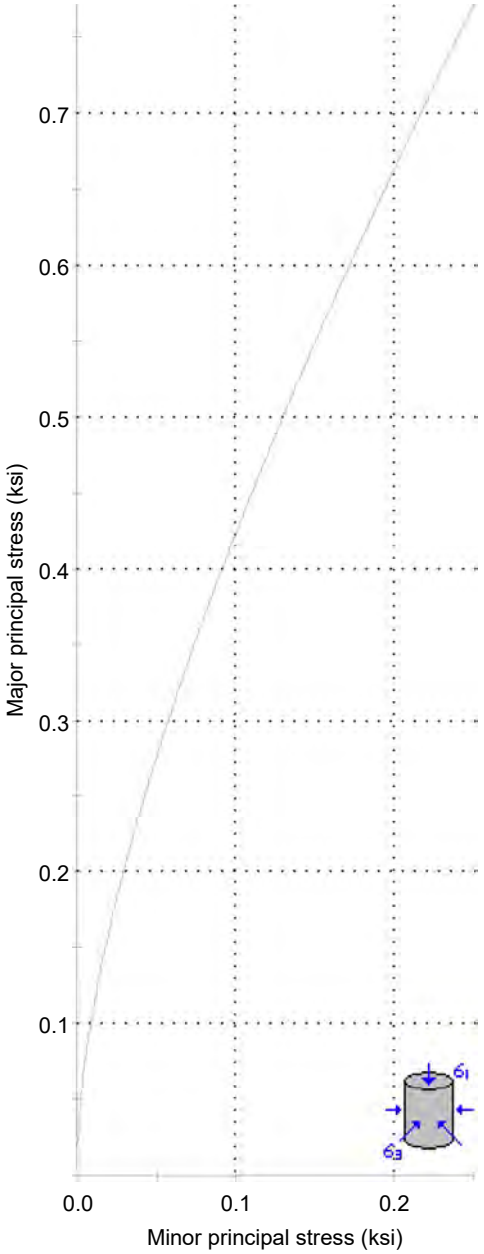


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

S.B. R. ABT. Rock-1



Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 1 ksi
GSI = 30 mi = 14 Disturbance factor (D) = 0
intact modulus (Ei) = 90 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

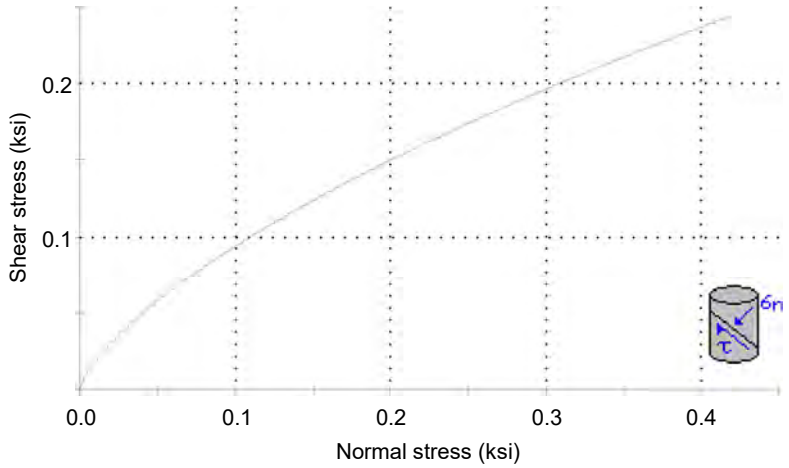
mb = 1.149 s = 0.0004 a = 0.522

Mohr-Coulomb Fit

cohesion = 0.040 ksi friction angle = 27.36 deg

Rock Mass Parameters

tensile strength = -0.000365 ksi
uniaxial compressive strength = 0.017 ksi
global strength = 0.130 ksi
deformation modulus = 7.32 ksi



S.B. R. ABT. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 4.1 ksi
GSI = 65 mi = 15 Disturbance factor (D) = 0
intact modulus (Ei) = 369 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

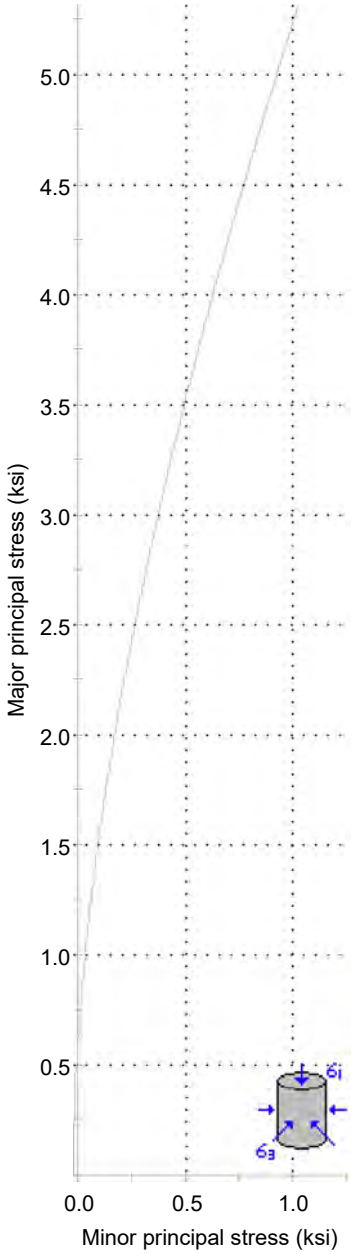
mb = 4.298 s = 0.0205 a = 0.502

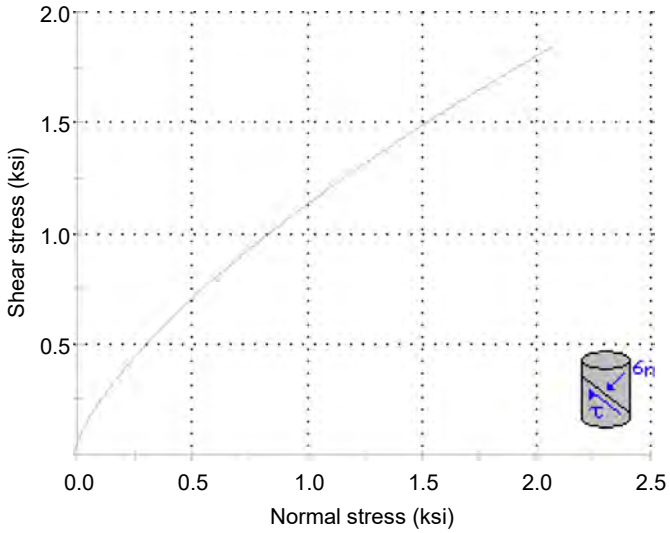
Mohr-Coulomb Fit

cohesion = 0.290 ksi friction angle = 38.47 deg

Rock Mass Parameters

tensile strength = -0.020 ksi
uniaxial compressive strength = 0.582 ksi
global strength = 1.202 ksi
deformation modulus = 233.10 ksi





Pier 1. S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 227+43, 33' LT.	EXPLORATION ID B-008-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 960.3 (MSL) EOB: 52.0 ft.	PAGE 1 OF 2
START: 6/25/15 END: 6/25/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.087357, -81.502220	

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 AND STONE FRAGMENTS WITH SAND**, DRY	960.3	1	10 12 16	37	100	SS-1	-	31	21	40	-	8 -	NP	NP	NP	4	A-1-b (0)	
	955.7	4	12 12 7	25	83	SS-2	2.50	10	5	10	42	33	44	19	25	16	A-7-6 (15)	
VERY STIFF, GRAY, **CLAY**, SOME GRAVEL, DRY	954.3	6	50/6"	-	50	SS-3	-	-	-	-	-	-	-	-	-	-	A-2-7 (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, (WEATHERED SHALE), DRY		9	0		13	NX-1											CORE	
		11	0		58	NX-2											CORE	
@ 12.0'; SILTSTONE BOULDER		13	0		25	NX-3											CORE	
		17	0		25	NX-4											CORE	
STARTING @ 18.3'; MANY SANDSTONE COBBLES AND GRAVEL		19	0		25	NX-5											CORE	
	931.3	TR 29	0		42	NX-6											CORE	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 15:40 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 2015.GPJ

PID: 91710	SFN: 7700369	PROJECT: SUM-8-1.75	STATION / OFFSET: 227+43, 33' LT.	START: 6/25/15	END: 6/25/15	PG 2 OF 2	B-008-0-15

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, GRAY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY FINE GRAINED, LAMINATED; RQD 45%, REC 100%. *(continued)*	930.3	31	0		100	NX-7											CORE	
STRATA R1: 1. RQD = 11 2. Qu = 750 psi 3. GSI = 25		32 33 34 35 36 37	17		100	NX-8											CORE	
STRATA R2: 1. RQD = 64 2. Qu = 5130 psi 3. GSI = 50		38 39 40 41 42	62		100	NX-9											CORE	
@44.7' TO 45.5'; Qu = 5,130 PSI		43 44 45 46 47	62		100	NX-10											CORE	
	908.3	EOB 48 49 50 51 52	68		100	NX-11											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 88 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

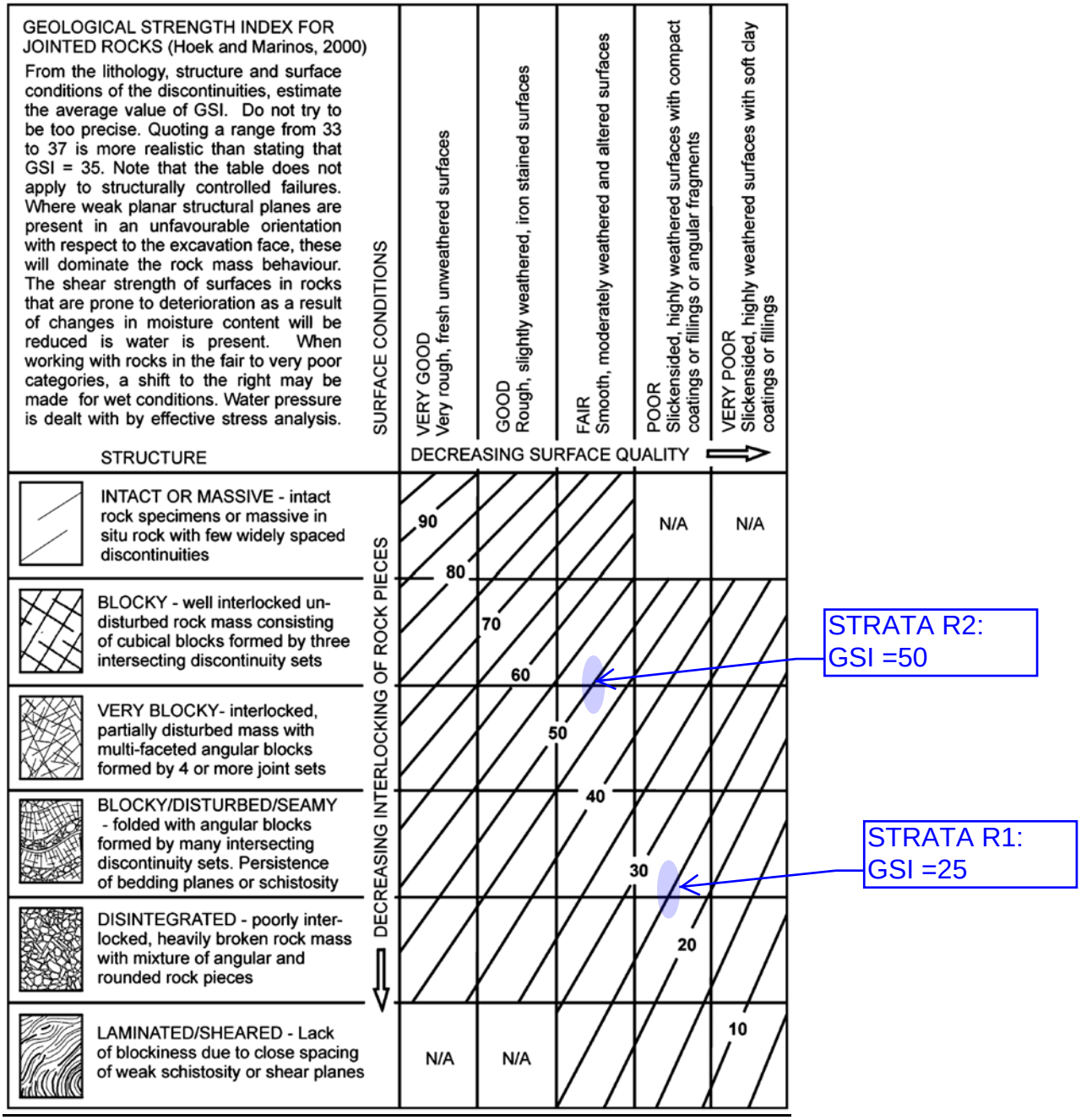


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:26 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+80, 6' LT.	EXPLORATION ID B-009-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 957.7 (MSL) EOB: 77.5 ft.	PAGE 1 OF 3
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087417, -81.502115	

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, BROWN, DARK GRAYISH BLACK, AND REDDISH BROWN, **SANDY SILT**, SOME GRAVEL (SANDSTONE FRAGMENTS), TRACE CLAY, CONTAINS FEW ROOT HAIRS AND TRACE COAL FRAGMENTS, DAMP NO HP SAMPLE FELL APART **(FILL)**	957.7	1	5 11 4	22	50	SS-1	-	-	-	-	-	-	-	-	-	14	A-4a (V)	
	955.7	2																
DENSE, BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT , TRACE TO LITTLE CLAY, LITTLE GRAVEL, DAMP **(FILL)**	953.2	3	12 14 10	35	72	SS-2	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
VERY STIFF TO HARD, GRAY WITH ORANGISH BROWN AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		4																
		5	2 6 7	19	100	SS-3	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
		6																
		7																
		8	2 3 4	10	44	SS-4	2.6 - 3.5	18	14	18	30	20	23	15	8	11	A-4a (3)	
		9																
@10.0' to 17.0'; BECOMES SOME GRAVEL		10	3 5 6	16	56	SS-5	3.1 - 4.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
		11																
		12																
@12.5' to 17.0'; BECOMES GRAY		13	2 5 6	16	50	SS-6	2.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		14																
		15	3 4 12	23	78	SS-7	3.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	940.7	16																
		17																
MEDIUM DENSE, ORANGISH BROWN BECOMING BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, 17.5' TO 21.5' CONTAINS 1.0" TO 1.5" SILTY CLAY LENSES, MOIST TO WET		18	5 7 5	18	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
		19																
		20	3 4 6	15	89	SS-9	-	51	16	10	14	9	NP	NP	NP	15	A-1-b (0)	
W		21																
		22																
		23	9 7 10	25	50	SS-10	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		24																
	932.3	25	9	-	82	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP		26	20 50/5"			SS-11	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
		27																
		28	15 50/4"	-	100	SS-12	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	
		29																

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 2 OF 3	B-009-1-16

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, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP *(continued)*	927.7	31	50/3"	-	78	SS-13	-	-	-	-	-	-	-	-	-	14	A-2-6 (V)	
	922.7	35	50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK, FRAGMENTED.	920.7																	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.			13		38	NQ2-1												CORE	
			16		92	NQ2-2											CORE	
@47.7'; Qu = 18462 PSI (SILTSTONE)			36		99	NQ2-3											CORE	
			30		100	NQ2-4											CORE	
Weak Layer @ 55' to 60'			7		78	NQ2-5											CORE	

STRATA R1:
1. RQD = (13X3+16X5)/10=12
2. Qu = 1125 psi
3. GSI = 25

STRATA R2:
1. RQD = 33
2. Qu = (5130X0.72) +(18462X0.28)=8862.96 psi (use 8000 psi)
3. GSI = 40

STRATA R3 :
1. RQD = 7
2. Qu = 750 psi
3. GSI = 25

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 3 OF 3	B-009-1-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS. *(continued)* @62.4'; Qu = 9789 PSI (SILTSTONE)	895.6	63 64 65 66 67 68 69 70 71 72 73 74 75 76 77	39		97	NQ2-6												CORE	
			49		100	NQ2-7												CORE	
			46		98	NQ2-8												CORE	
	880.2	EOB	15		83	NQ2-9												CORE	

STRATA R4:
1. RQD = 33
2. Qu = (5130X0.72) +(9789X0.28)=6434 psi
3. GSI = 40

NOTES: GROUNDWATER ENCOUNTERED AT 22.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 65 GAL. BENTONITE GROUT

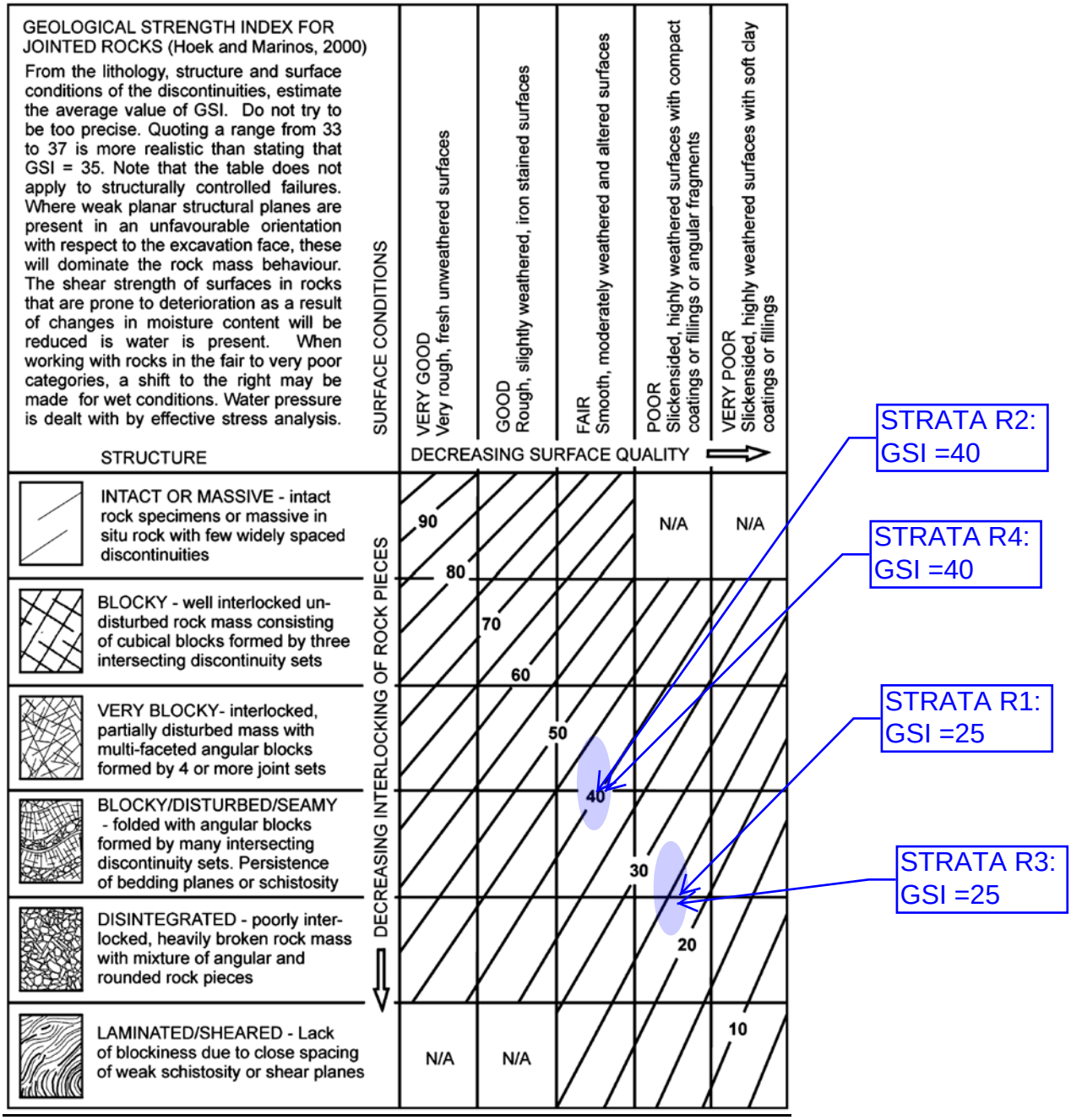


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

S.B. Pier 1. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.95 ksi
GSI = 25 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 85.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

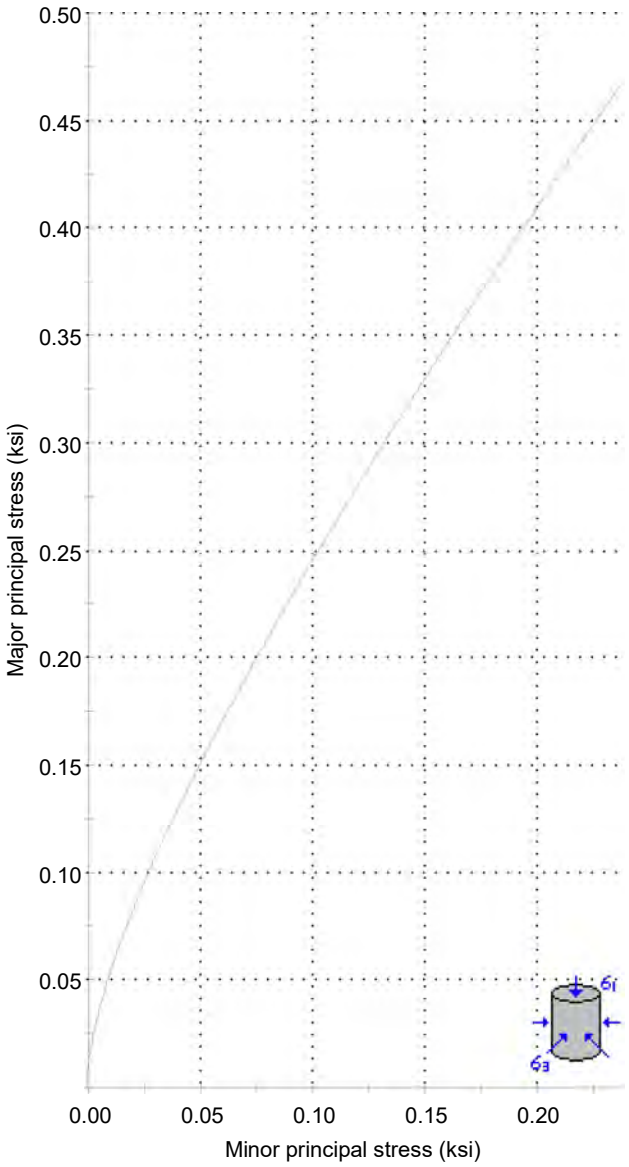
mb = 0.275 s = 0.0002 a = 0.531

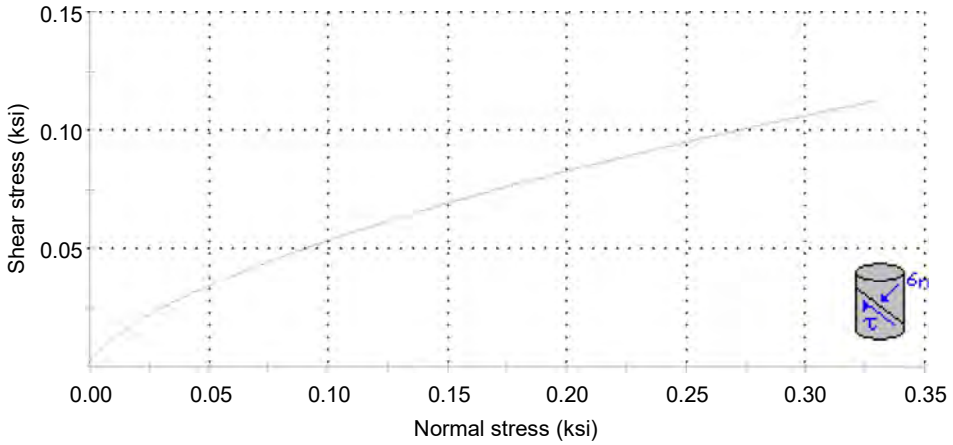
Mohr-Coulomb Fit

cohesion = 0.021 ksi friction angle = 16.47 deg

Rock Mass Parameters

tensile strength = -0.001 ksi
uniaxial compressive strength = 0.011 ksi
global strength = 0.056 ksi
deformation modulus = 5.12 ksi





S.B. Pier 1. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 6.25 ksi
GSI = 46 mi = 6 Disturbance factor (D) = 0
intact modulus (Ei) = 562.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

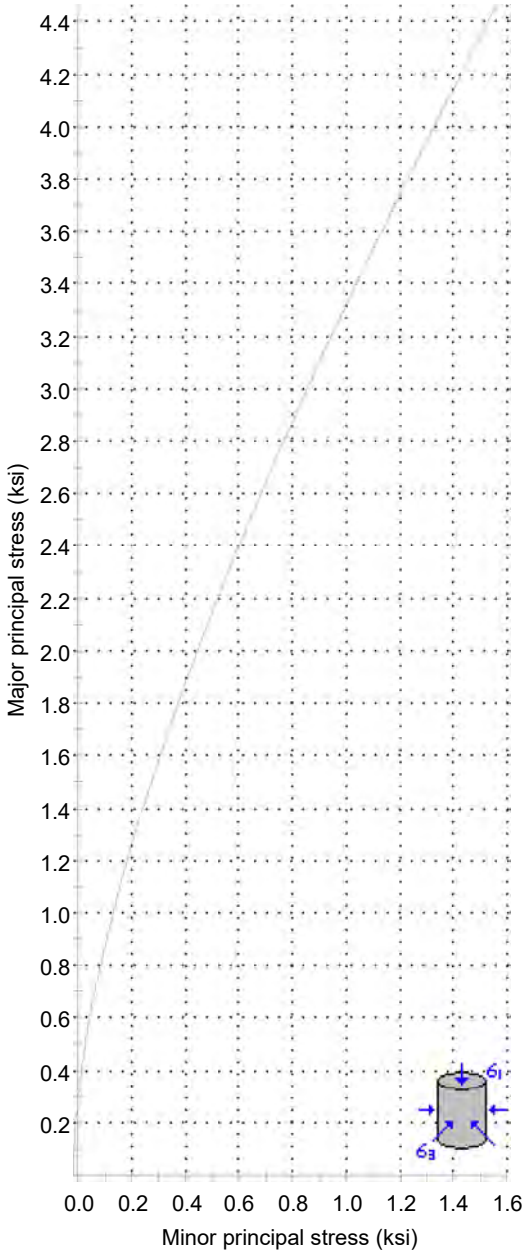
mb = 0.872 s = 0.0025 a = 0.508

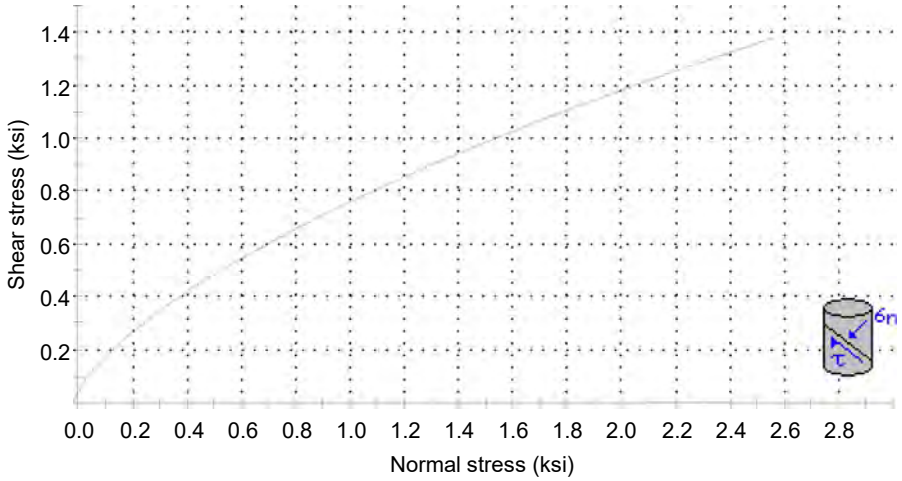
Mohr-Coulomb Fit

cohesion = 0.248 ksi friction angle = 25.16 deg

Rock Mass Parameters

tensile strength = -0.018 ksi
uniaxial compressive strength = 0.297 ksi
global strength = 0.782 ksi
deformation modulus = 134.32 ksi





S.B. Pier 1. Rock-3

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.75 ksi
GSI = 25 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 67.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

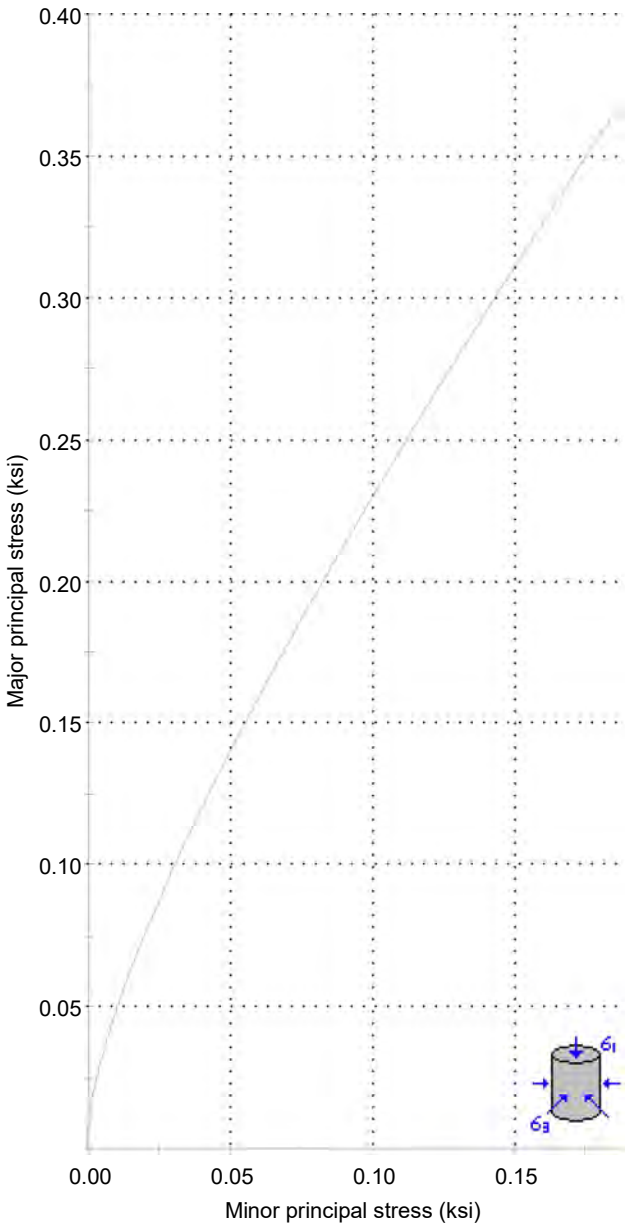
mb = 0.275 s = 0.0002 a = 0.531

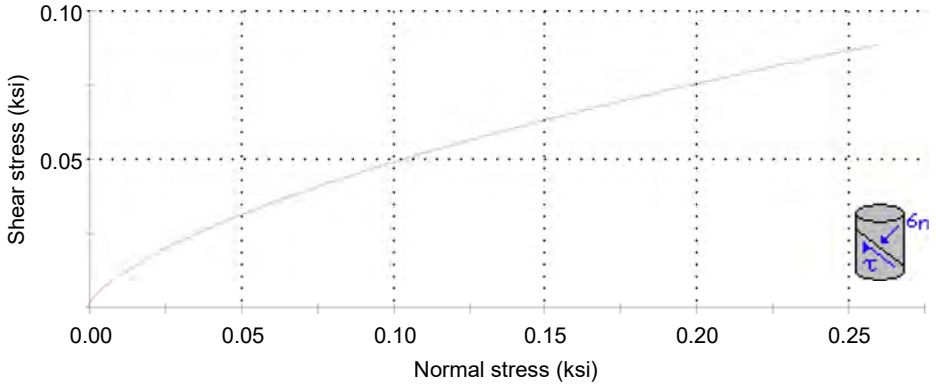
Mohr-Coulomb Fit

cohesion = 0.017 ksi friction angle = 16.47 deg

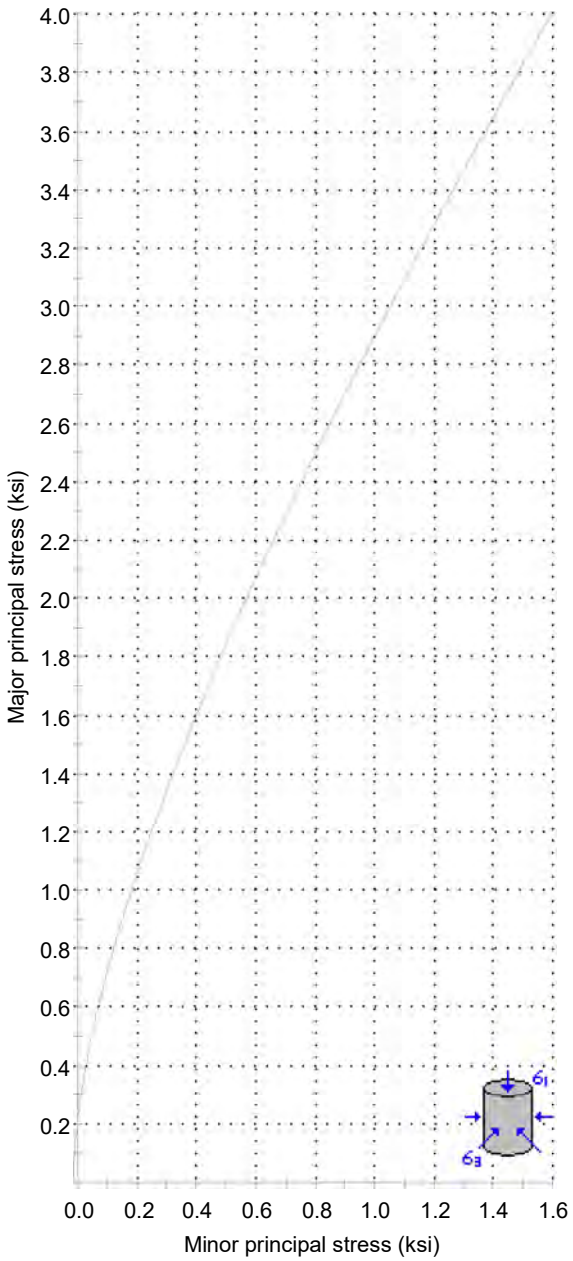
Rock Mass Parameters

tensile strength = -0.001 ksi
uniaxial compressive strength = 0.009 ksi
global strength = 0.044 ksi
deformation modulus = 4.04 ksi





S.B. Pier 1. Rock-4



Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 6.4 ksi
GSI = 40 mi = 5 Disturbance factor (D) = 0
intact modulus (Ei) = 576 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

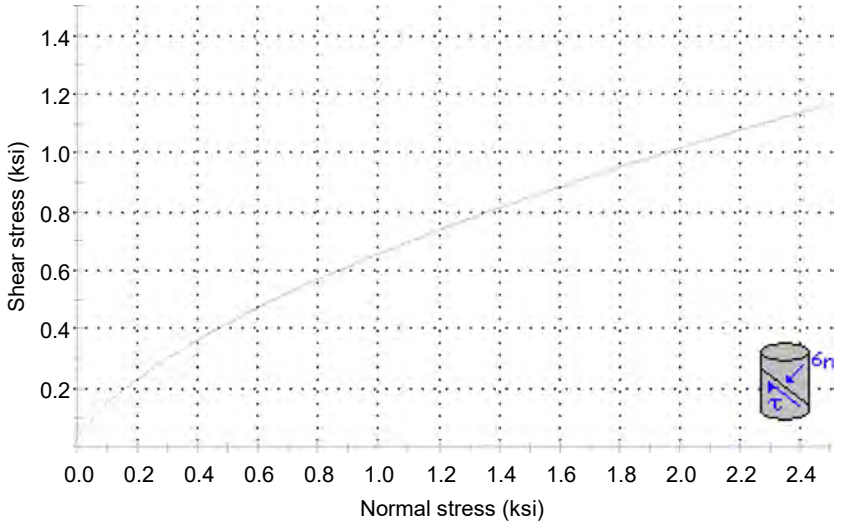
mb = 0.587 s = 0.0013 a = 0.511

Mohr-Coulomb Fit

cohesion = 0.214 ksi friction angle = 22.10 deg

Rock Mass Parameters

tensile strength = -0.014 ksi
uniaxial compressive strength = 0.212 ksi
global strength = 0.637 ksi
deformation modulus = 91.96 ksi



Pier 2. S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 231+23, 36' LT.	EXPLORATION ID B-011-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 50.0 ft.	PAGE 1 OF 2
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089053, -81.501252	

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
UNCONTROLLED FILL (ROCK AND BOULDERS)	879.2																	
	877.2																	
MEDIUM STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND AND GRAVEL, MOIST TO WET		1 2 3 4 5	2 3 31	45	72	SS-1	1.00	14	7	12	36	31	41	20	21	36	A-7-6 (11)	
	873.7																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK AND GRAVEL, WET @ 6.0' TO 7.0'; HARSH PETROLEUM SMELL)		6 7 8 9 10	2 3 2	7	78	SS-2	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
			5 7 6	17	67	SS-3	1.25	14	7	19	33	27	35	24	11	29	A-6a (5)	
	868.2	TR																
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.		11 12 13 14 15 16 17 18 19 20 21 22 23	11 13 23	48	72	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			15 9 13	29	78	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			42 50	-	83	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			38 50/6"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	855.5																	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 26.3' TO 26.9'; Qu = 3,840 PSI (SANDSTONE)		24 25 26 27 28 29	50/3"	-	-	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			96		100	NX-1											CORE	
			93		97	NX-2											CORE	

STRATA R1:
1. RQD = 10 (Assumed)
2. Qu = 200 psi (Assumed)
3. GSI = 5

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:42 - W:\062368- MS-SUM-8-1.75\E. PRJ WRK\E. ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 2015.GPJ

PID: 91710	SFN: 7700369	PROJECT: SUM-8-1.75	STATION / OFFSET: 231+23, 36' LT.	START: 6/26/15	END: 6/26/15	PG 2 OF 2	B-011-0-15

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
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. *(continued)*	849.2	31																
		32																
		33																
		34	93		100	NX-3											CORE	
		35																
		36																
		37																
		38																
		39	98		98	NX-4											CORE	
		40																
		41																
		42																
		43																
		44	100		100	NX-5											CORE	
		45																
		46																
		47																
		48																
		49	100		100	NX-6											CORE	
	829.2	50 EOB																

STRATA R2:
1. RQD = 97
2. Qu = (3840+3910)/2= 3875 psi
3. GSI = 70

@ 47.2' TO 47.8'; Qu = 3,910 PSI (SHALE)

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 50 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

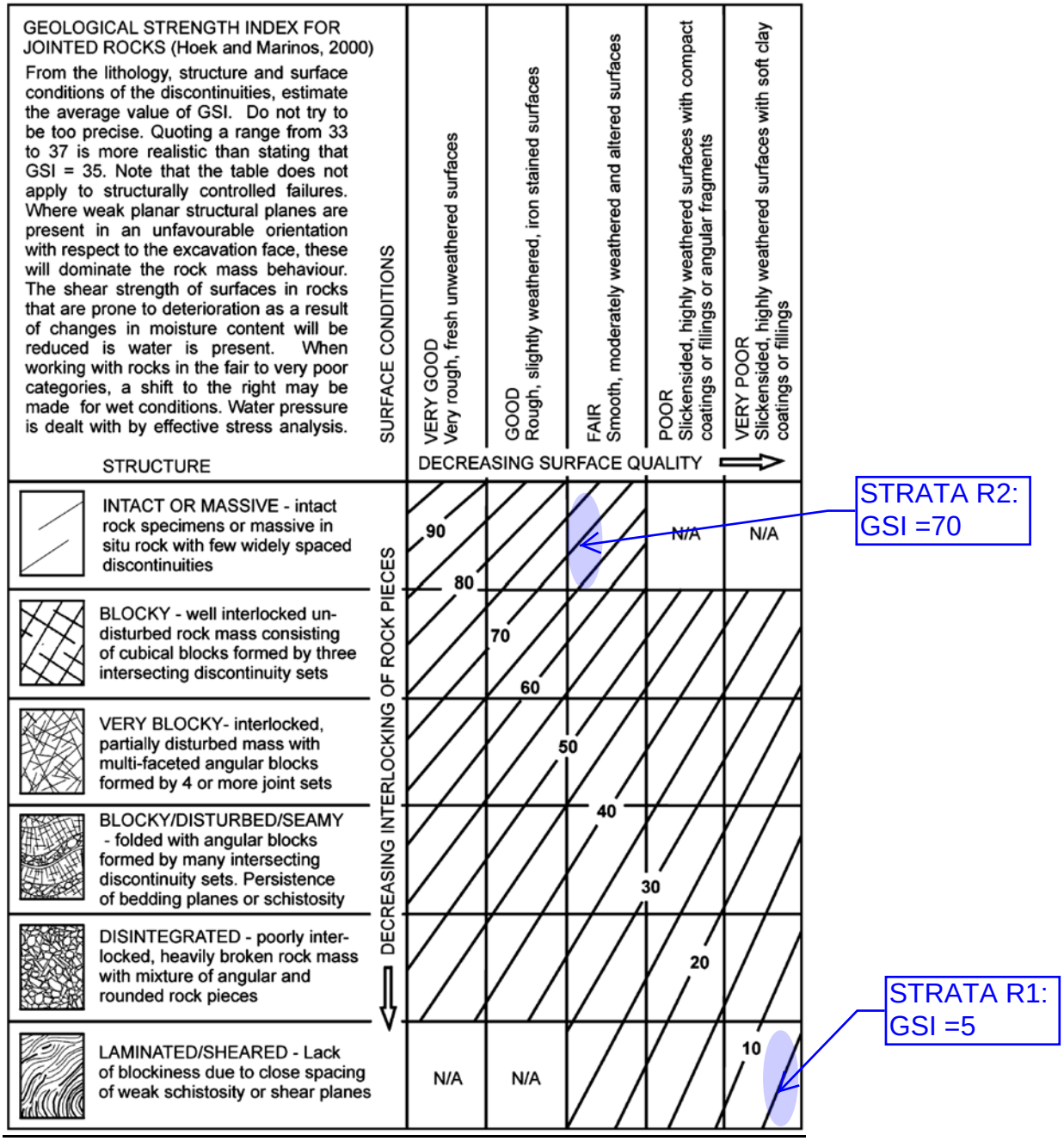


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 231+15, 100' LT.	EXPLORATION ID B-009-4-16
TYPE: UNDERGROUND UTILITY	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 882.7 (MSL) EOB: 40.2 ft.	PAGE 1 OF 2
START: 2/1/17 END: 2/1/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.088367, -81.501986	

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 VERY STIFF, BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, @0.0' TO 1.5'; CONTAIN ROOTS AND BRICK FRAGMENTS, DAMP TO MOIST **(FILL)**	882.7		1 2 7	13	78	SS-1	1.25 - 1.5	-	-	-	-	-	-	-	-	22	A-4a (V)	
			5 6 8	21	100	SS-2	2.25 - 2.75	17	14	30	26	13	19	16	3	13	A-4a (1)	
MEDIUM STIFF TO STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL AND STONE FRAGMENTS, DAMP TO MOIST	872.7	W	1 2 3	7	56	SS-3	0.5 - 1.0	-	-	-	-	-	-	-	-	11	A-6b (V)	
	866.4	TR	2 6 50/3"	-	60	SS-4	0.75 - 1.25	-	-	-	-	-	-	-	-	15	A-6b (V)	
SHALE, GRAY, MODERATELY WEATHERED, EASILY AUGERED.			6 11 48	87	100	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
			18 50/5"	-	73	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	

STRATA R 1:
1. RQD = 10 (Assumed)
2. Qu = 200 psi
3. GSI = 5

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 231+15, 100' LT.	START: 2/1/17	END: 2/1/17	PG 2 OF 2	B-009-4-16

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
@30.0' to 30.2'; NO RECOVERY	852.7		50/2"	-	0	SS-7	-	-	-	-	-	-	-	-	-	-		
SHALE, GRAY AND DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, LAMINATED TO THIN BEDDED, MODERATELY FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 34.1' - 34.3' AND 36.9' - 37.1', SLIGHTLY TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 94%.	852.5	31																
@32.3'; Qu = 7964 PSI (SHALE)		32																
STRATA R2:		33																
1. RQD = 75		34																
2. Qu = 7964 psi		35	75		94	NQ2-1											CORE	
3. GSI = 65		36																
		37																
		38																
		39																
	842.5	EOB 40																

NOTES: GROUNDWATER ENCOUNTERED AT 14.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 45 GAL. BENTONITE GROUT

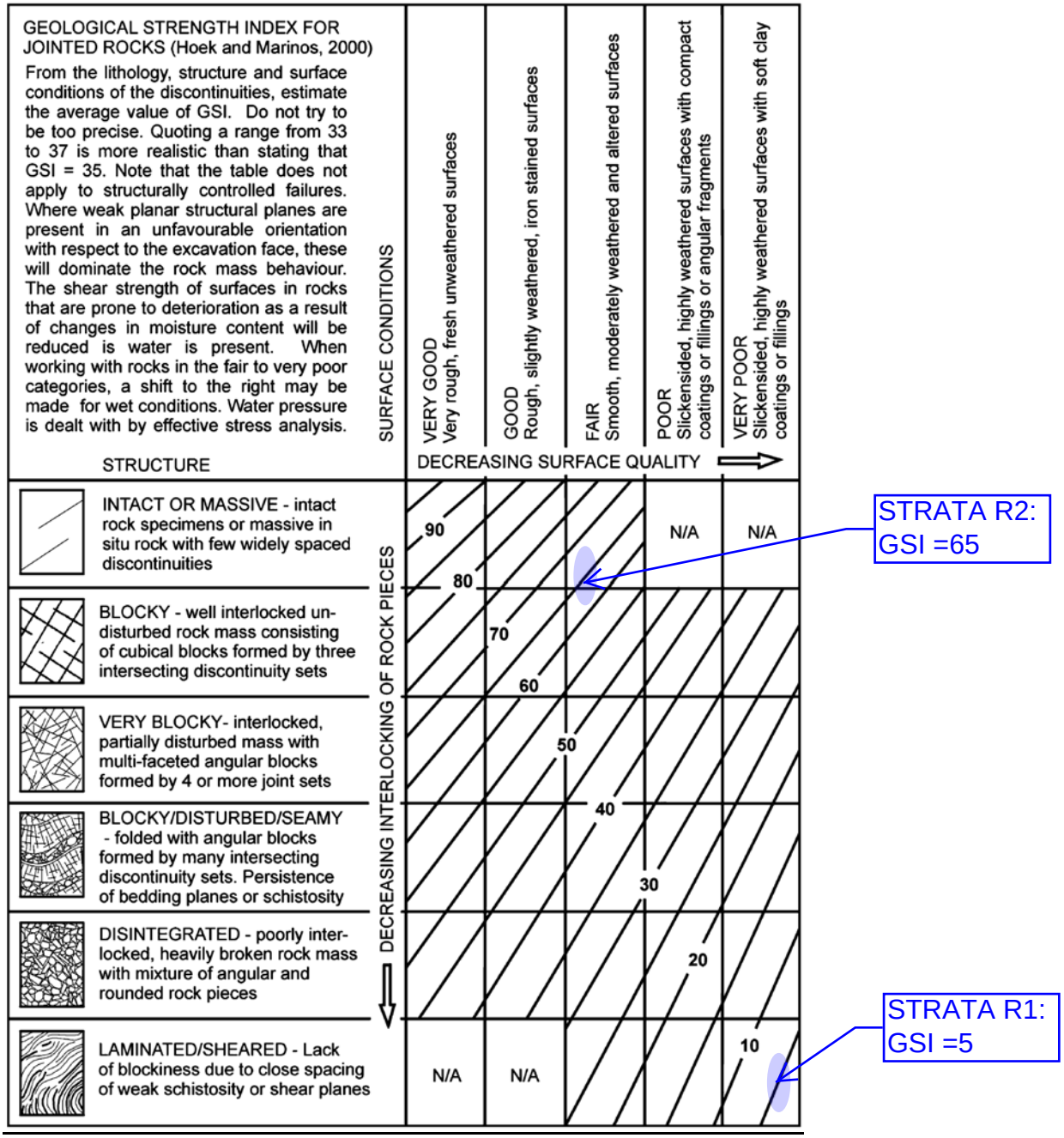


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

S.B. Pier 2. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.2 ksi
GSI = 5 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 18 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

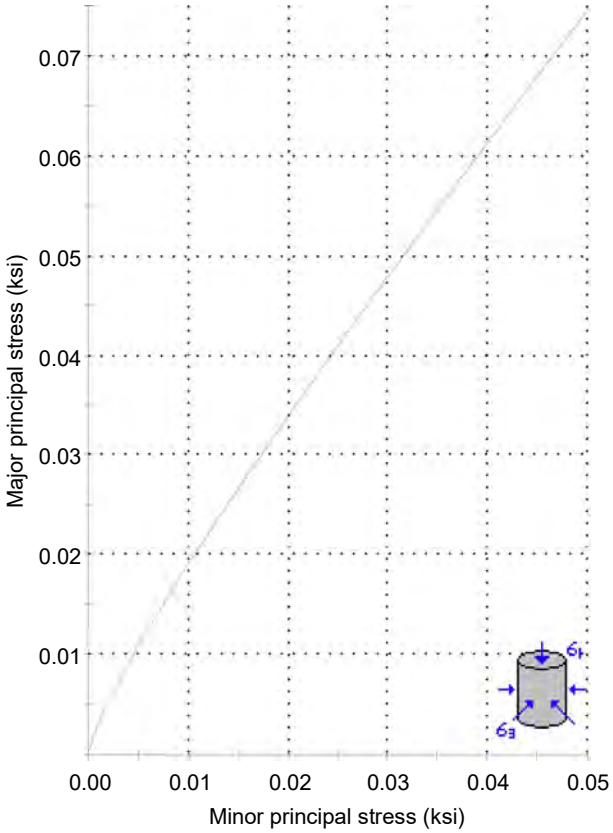
mb = 0.134 s = 2.6e-5 a = 0.619

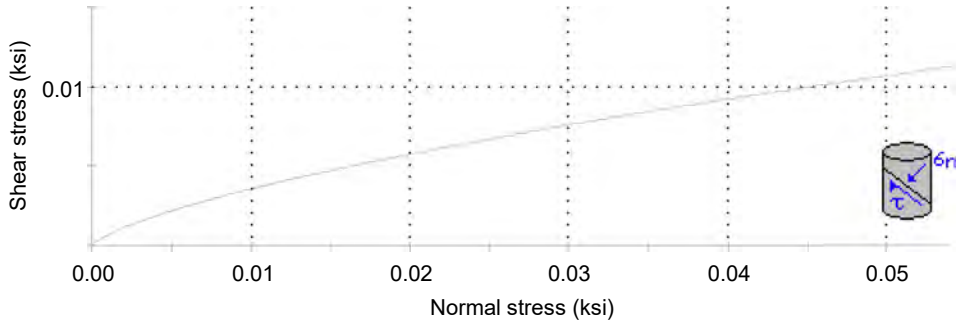
Mohr-Coulomb Fit

cohesion = 0.002 ksi friction angle = 10.16 deg

Rock Mass Parameters

tensile strength = -3.87e-5 ksi
uniaxial compressive strength = 0.00029 ksi
global strength = 0.004 ksi
deformation modulus = 0.48 ksi





S.B. Pier 2. Rock-2

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 5 ksi
GSI = 69 mi = 8 Disturbance factor (D) = 0
intact modulus (Ei) = 450 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

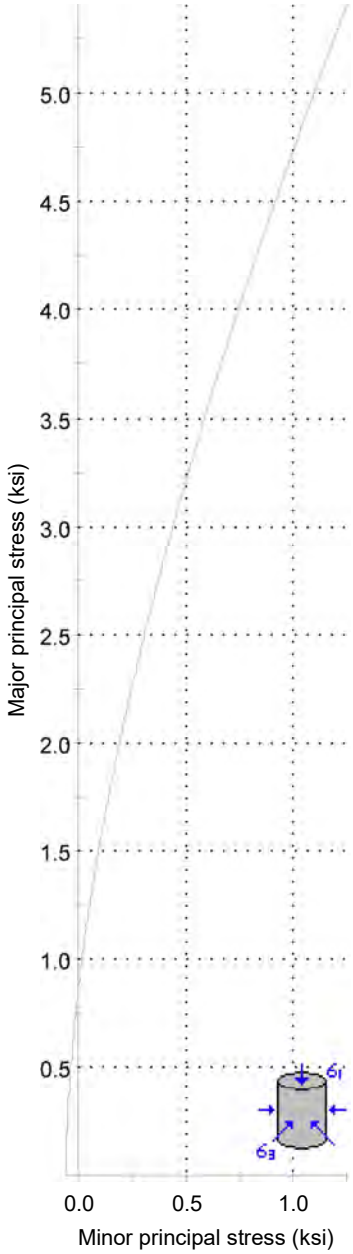
mb = 2.644 s = 0.0319 a = 0.501

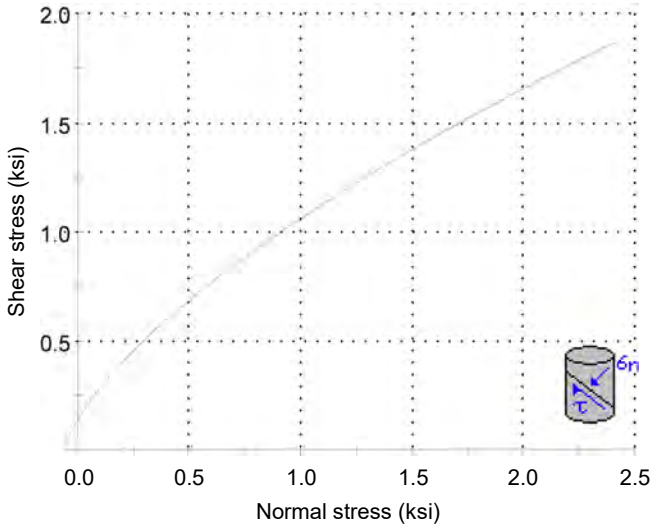
Mohr-Coulomb Fit

cohesion = 0.334 ksi friction angle = 34.04 deg

Rock Mass Parameters

tensile strength = -0.060 ksi
uniaxial compressive strength = 0.889 ksi
global strength = 1.258 ksi
deformation modulus = 321.23 ksi





Pier 3 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 234+26, 15' LT.	EXPLORATION ID B-011-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 875.0 (MSL) EOB: 55.0 ft.	PAGE 1 OF 2
START: 3/31/17 END: 4/3/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089076, -81.501281	

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, GRAYISH BROWN AND BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING (STONE FRAGMENTS ARE SILTSTONE), DAMP **(FILL)**	875.0	1	14 13 14	37	67	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	872.0	2																
MEDIUM DENSE, GRAYISH BROWN AND BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**		3																
		4	6 9 12	28	78	SS-2	-	-	-	-	-	-	-	-	-	12	A-2-4 (V)	
@6.0' TO 7.5'; CHANGES TO VERY DENSE, GRAY AND ORANGISH BROWN		5																
		6																
		7	9 27 38	88	78	SS-3	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
	867.0 ▼	8																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		9	10 13 44	77	61	SS-4	-	51	10	5	21	13	28	19	9	7	A-2-4 (0)	
		10																
	W	11																
		12	19 22 22	60	89	SS-5	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
	862.0	13																
VERY DENSE, GRAY, **STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), DRY	861.0	14	50/6"	-	67	SS-6	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		15																
		16																
		17	10 24 50/2"	-	79	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	857.0	18																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		19	13 22 50/4"	-	94	SS-8	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	854.5	20																
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP		21																
	852.5	22	15 29 50	107	78	SS-9	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
		23																
HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP @23.5' TO 24.4'; NO HP, SAMPLE CRUMBLED		24	10 50/5"	-	91	SS-10	-	37	17	8	21	17	30	20	10	10	A-4a (1)	
		25																
	849.0	26																
VERY DENSE, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC		27	20 36 32	92	78	SS-11	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
		28																
		29	31 23 14	50	89	SS-12	-	-	-	-	-	-	-	-	-	16	A-4a (V)	

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+26, 15' LT.	START: 3/31/17	END: 4/3/17	PG 2 OF 2	B-011-4-16

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, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC *(continued)*	845.0																	
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), MOIST	842.0		50/5"	-	80	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, (SILTSTONE COBBLE), DRY	840.0		0		18	NX-1										1	CORE	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	835.0		26 29 32	83	67	SS-14	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
SHALE, GRAY, SEVERELY WEATHERED.	832.2	TR	50/3"	-	33	SS-15	-	-	-	-	-	-	-	-	-	14	Rock (V)	
INTERBEDDED SHALE (63%) AND SILTSTONE (37%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO SLICKENSIDED, INTACT TO BLOCKY, GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG. @50.0'; Qu = 2492 PSI (SHALE)	830.0		76		98	NX-2											CORE	
	820.0	EOB																

STRATA R1:
1. RQD = 10 (Assumed)
2. Qu = 200 psi
3. GSI = 5

STRATA R2:
1. RQD = 76
2. Qu = 2492X0.63 +12128(B-011-5-16)X0.37=6057 psi
3. GSI = 65

NOTES: GROUNDWATER ENCOUNTERED AT 11.0' BEFORE DRILLING ON 4/3/2017, 8.0' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 66 GAL. BENTONITE GROUT

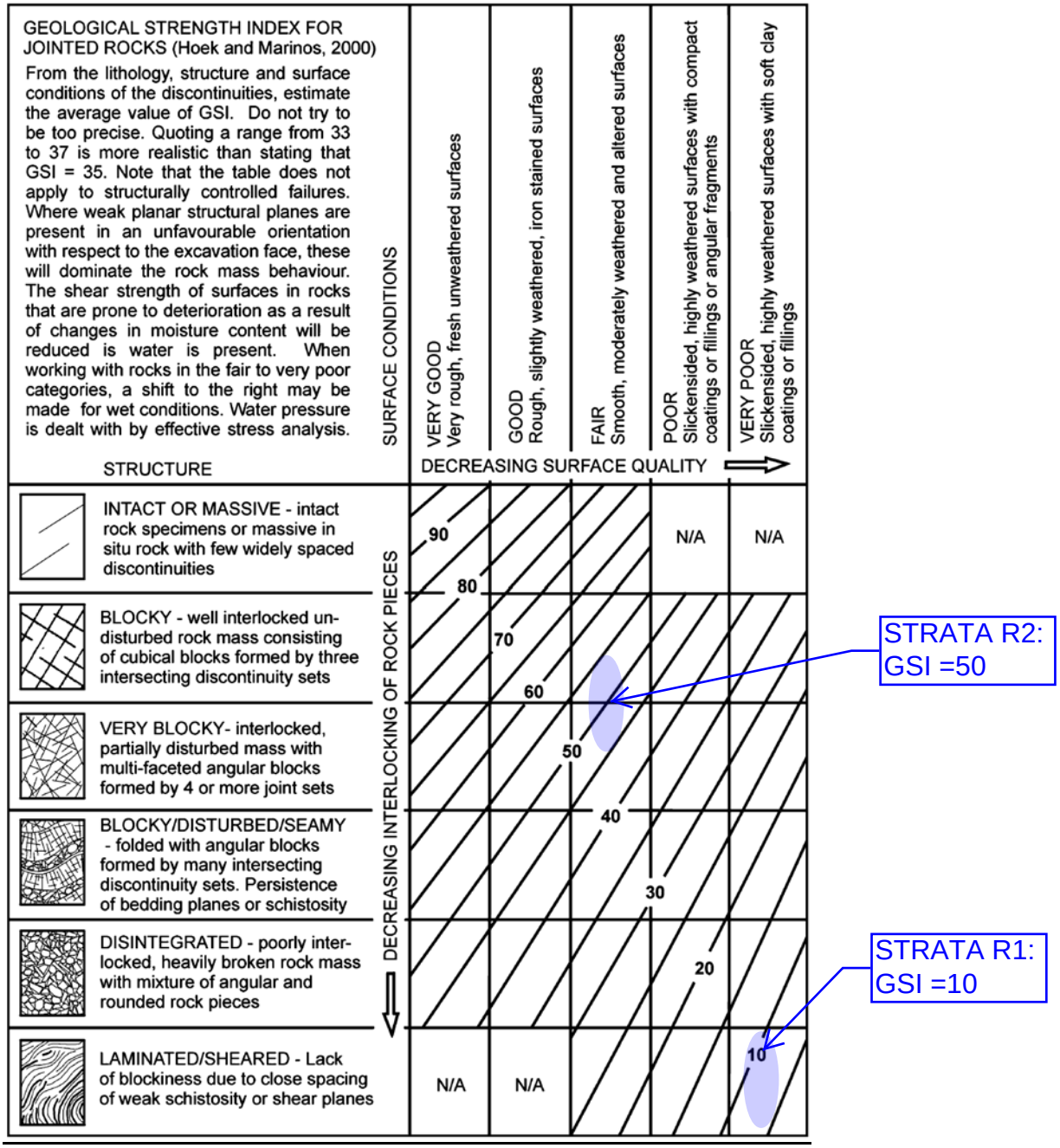


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 234+65, 60' LT.	EXPLORATION ID B-011-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 875.2 (MSL) EOB: 80.0 ft.	PAGE 1 OF 3
START: 4/3/17 END: 4/3/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089221, -81.501383	

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
DARK BROWN AND BLACK, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	875.2 / 874.2	1	4 7 8	22	100	SS-1	3.9 - 4.5+	-	-	-	-	-	-	-	-	22	A-4a (V)	
VERY STIFF TO HARD, DARK GRAY AND GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS COAL AND BRICK FRAGMENTS, FEW ROOTS AND MANY WOOD FRAGMENTS, MOIST **(FILL)**	872.2	2 3 4 5	1 2 2	6	83	SS-2	1.9 - 2.9	-	-	-	-	-	-	-	-	19	A-4a (V)	
STIFF TO VERY STIFF, GRAYISH BROWN MOTTLED WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS DECAYED ROOT, MOIST	869.7	6 7	5 3 6	13	67	SS-3	-	2	4	24	56	14	NP	NP	NP	25	A-4b (7)	
MEDIUM DENSE, GRAY MOTTLED WITH BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW IRON STAINS, WET	867.2 W	8 9 10	5 5 4	13	78	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
MEDIUM DENSE, GRAY WITH BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST	865.2	11 12 13	4 14 13	40	44	SS-5	3.9 - 4.5+	31	11	10	36	12	23	18	5	13	A-4a (3)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL AND STONE FRAGMENTS (SHALE), LITTLE CLAY, DAMP @13.5' to 15.0'; BECOMES "AND" GRAVEL AND STONE FRAGMENTS	860.2	14 15	6 11 12	34	50	SS-6	3.4 - 4.5+	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	857.2	16 17 18	11 18 18	54	78	SS-7	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS**, (SHALE), DAMP	854.7	19 20	11 14 15	43	83	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE CLAY, TRACE SILT, DAMP	852.2	21 22 23	14 18 31	73	100	SS-9	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	850.2	24 25	11 23 38	91	78	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP		26 27 28	10 15 19	51	33	SS-11	4.5+	22	17	7	27	27	32	20	12	9	A-6a (5)	
		29	9 15 18	49	78	SS-12	4.5+	-	-	-	-	-	-	-	-	9	A-6a (V)	

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 2 OF 3	B-011-5-16

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, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP *(continued)*	845.2	31 32 33																
		34	11 14 25	58	89	SS-13	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
		35 36 37																
	837.7	TR																
SHALE, GRAY, HIGHLY WEATHERED, FRAGMENTED.		38																
		39	50/3"	-	33	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
	835.2	40																
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. @48.7'; Qu = 1384 PSI (SHALE)		41 42 43 44 45	40		99	NQ-1												CORE	
		46 47 48 49 50	61		96	NQ-2												CORE	
@54.8'; Qu = 12128 PSI (SILTSTONE)		51 52 53 54 55	79		100	NQ-3												CORE	
		56 57 58 59 60 61																

STRATA R1:
1. RQD = 30
2. Qu = 1125 psi (Assumed)
3. GSI = 10

STRATA R2:
1. RQD = 82
2. Qu = 1384X0.75+12128X0.25=4070 psi
3. GSI = 50

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 3 OF 3	B-011-5-16

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
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. *(continued)*	813.1	63 64 65 66 67 68 69 70	80		98	NQ-4											CORE	
SHALE, DARK GRAY, UNWEATHERED, WEAK TO MODERATELY STRONG, THINLY LAMINATED TO LAMINATED, FISSILE, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, INTACT, GOOD TO VERY GOOD SURFACE CONDITION; RQD 100%, REC 100%.	802.6	71 72 73 74 75 76 77 78 79	97		100	NQ-5											CORE	
	795.2	EOB 80																

NOTES: GROUNDWATER ENCOUNTERED AT 8.0' DURING DRILLING, 11.3' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 54 GAL. BENTONITE GROUT

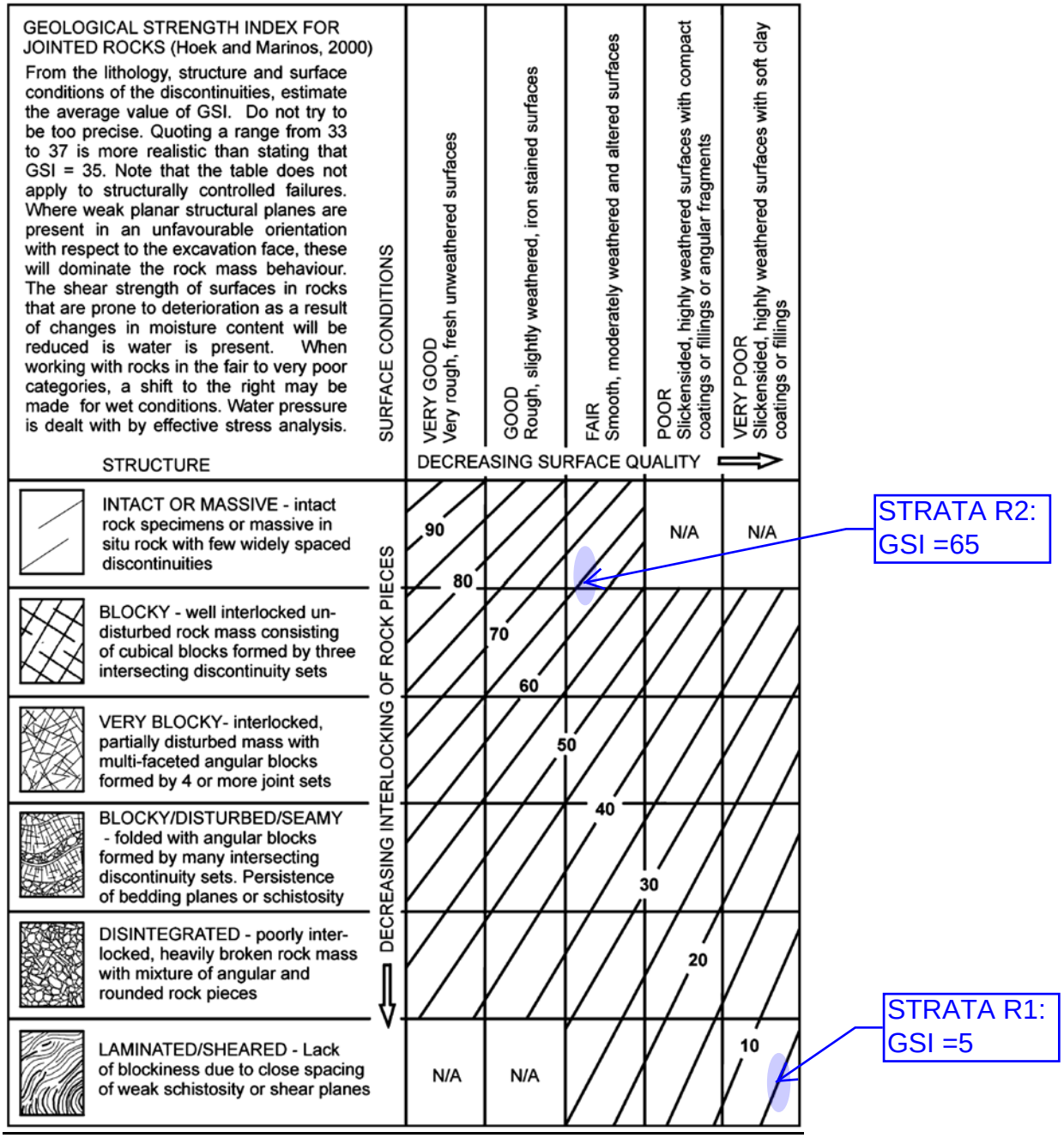


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

S.B. Pier 3. Rock-1

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.95 ksi
GSI = 9 mi = 5 Disturbance factor (D) = 0
intact modulus (Ei) = 85.5 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

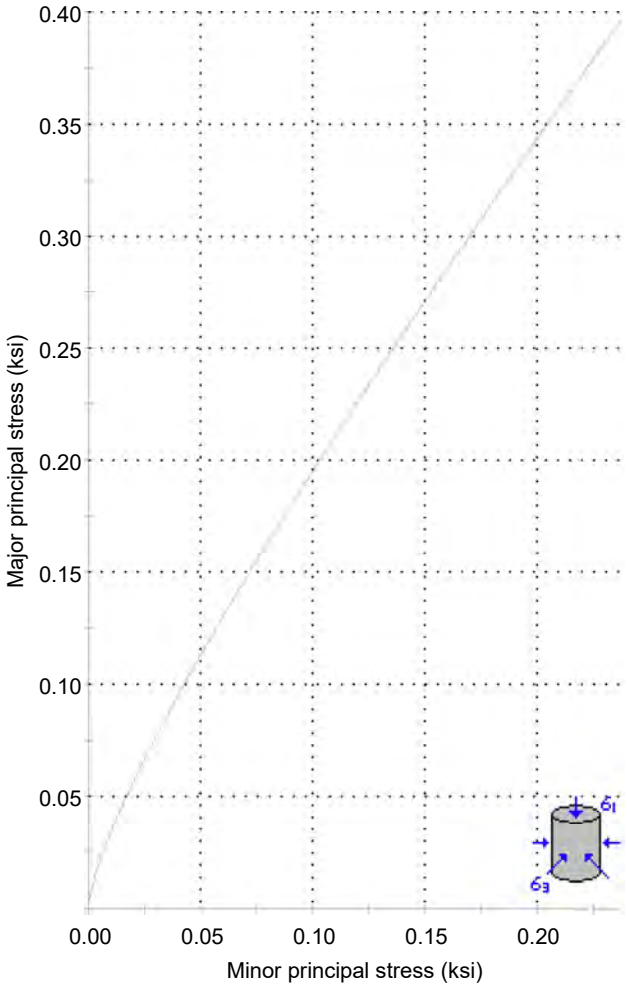
mb = 0.194 s = 4.06e-5 a = 0.591

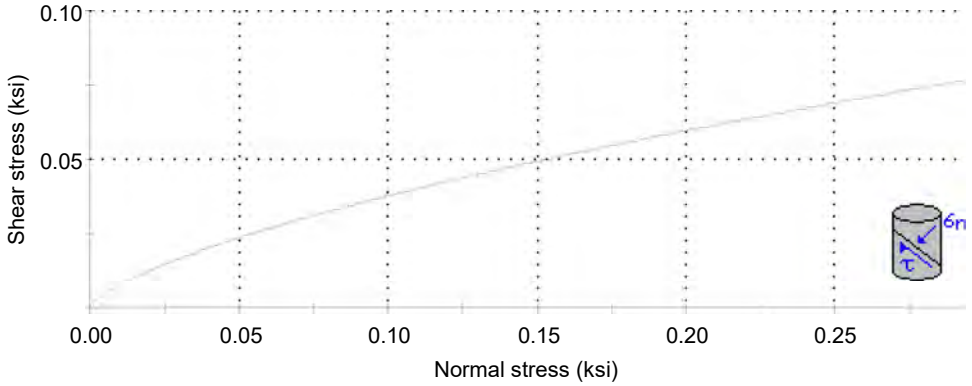
Mohr-Coulomb Fit

cohesion = 0.013 ksi friction angle = 12.90 deg

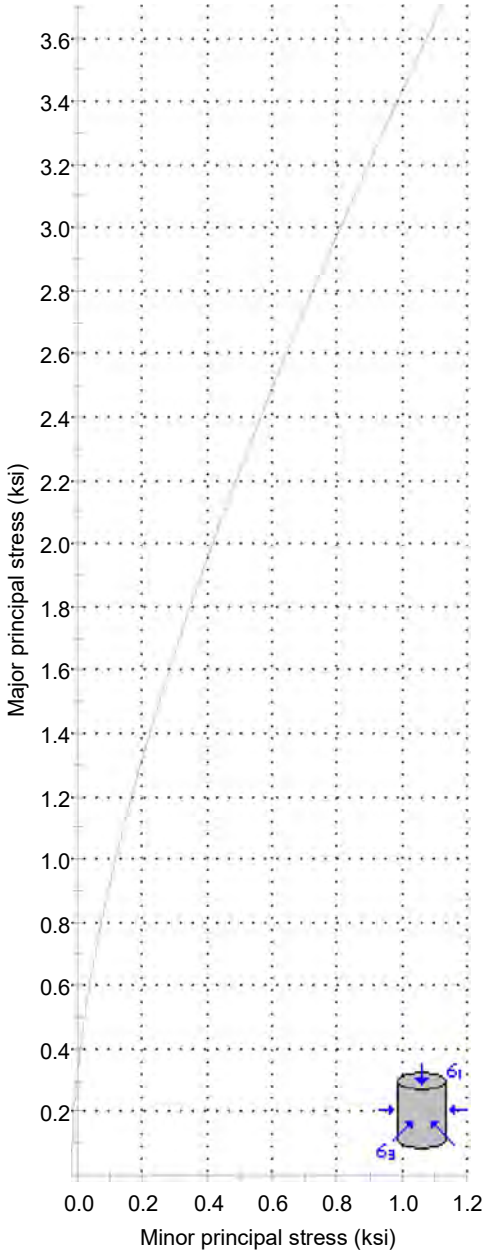
Rock Mass Parameters

tensile strength = -0.000199 ksi
uniaxial compressive strength = 0.002 ksi
global strength = 0.032 ksi
deformation modulus = 2.53 ksi





S.B. Pier 3. Rock-2



Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 4.5 ksi
GSI = 53 mi = 7 Disturbance factor (D) = 0
intact modulus (Ei) = 405 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

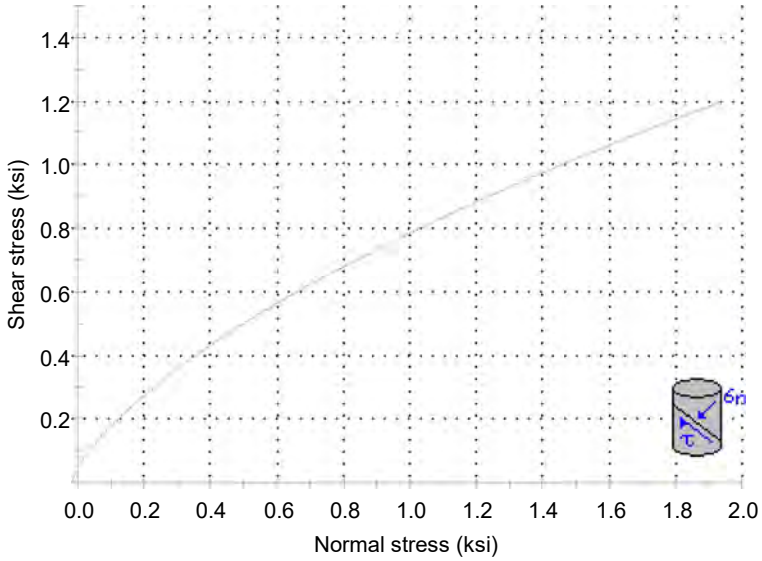
mb = 1.306 s = 0.0054 a = 0.505

Mohr-Coulomb Fit

cohesion = 0.212 ksi friction angle = 28.39 deg

Rock Mass Parameters

tensile strength = -0.019 ksi
uniaxial compressive strength = 0.323 ksi
global strength = 0.712 ksi
deformation modulus = 148.26 ksi



Pier 4 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 236+44, 2' RT.	EXPLORATION ID B-013-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 85.5 ft.	PAGE 1 OF 3
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089616, -81.500934	

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 WITH DARK GRAY AND GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, CONTAINS FEW ROOTS, DAMP **(FILL)**	885.5	1–2	4 6 5	16	67	SS-1	3.2 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
	883.0																	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST		3–5	3 3 2	7	100	SS-2	1.25 - 2.2	-	-	-	-	-	-	-	-	16	A-4a (V)	
	880.0																	
VERY LOOSE TO LOOSE, ORANGISH BROWN BECOMING ORANGISH BROWN WITH LIGHT GRAY, **SILT**, SOME SAND, LITTLE CLAY, LITTLE GRAVEL, MOIST TO WET		6–7	1 1 1	3	97	SS-3	-	12	12	12	51	13	NP	NP	NP	17	A-4b (6)	
	875.0	8–10	2 2 3	7	100	SS-4	-	-	-	-	-	-	-	-	-	22	A-4b (V)	
VERY LOOSE TO MEDIUM DENSE, YELLOWISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, 11.0' TO 15.0' CONTAINS FEW ROOTS, MOIST TO WET @11.0' TO 17.5'; NO HP, NON PLASTIC		11–12	2 1 2	4	100	SS-5	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@13.5' TO 15.0'; BECOMES GRAYISH BROWN WITH ORANGISH BROWN, TRACE CLAY		13–15	2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@16.0' TO 17.5'; BECOMES ORANGISH BROWN		16–17	3 5 5	15	94	SS-7	-	0	12	47	23	18	NP	NP	NP	23	A-4a (1)	
	867.5	W																
LOOSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, LITTLE CLAY, WET		18–20	3 3 3	9	72	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
	865.0																	
MEDIUM DENSE, GRAY, **SANDY SILT**, TRACE CLAY, WET @21.0' TO 22.5'; NO HP, NON PLASTIC		21–22	4 4 6	15	100	SS-9	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
	862.5																	
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP		24–25	6 10 7	25	67	SS-10	-	47	11	9	24	9	NP	NP	NP	14	A-2-4 (0)	
	860.0																	
DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		26–27	11 15 15	45	83	SS-11	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		29	6 11 11	33	83	SS-12	-	37	28	18	13	4	NP	NP	NP	12	A-1-b (0)	

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, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	855.5	31																
		32	10 10 15	37	78	SS-13	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		33																
		34	10 18 18	54	78	SS-14	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		35																
		36	10 21 15	54	94	SS-15	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		37																
		38	19 19 25	66	83	SS-16	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		39																
	844.5	40																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP		41																
		42																
		43																
	841.1	44	17 50/5"	-	100	SS-17	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
INTERBEDDED SHALE (65%) AND SILTSTONE (35%), RQD 76%, REC. 98%;		TR 45																
SHALE, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION;		46																
		47																
		48	64		95	NQ-1											CORE	
		49																
		50																
		51																
SILTSTONE, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. @47.8'; Qu = 12151 PSI (SILTSTONE)		52																
		53	70		99	NQ-2											CORE	
		54																
		55																
		56																
		57																
		58																
		59																
		60	62		99	NQ-3											CORE	
		61																

STRATA R:
1. RQD = 76
2. Qu = 3028X0.65
+12151X0.35=6221 psi
3. GSI = 65

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 3 OF 3	B-013-4-16

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
@62.1'; Qu = 11803 PSI (SILTSTONE) **INTERBEDDED SHALE (65%) AND SILTSTONE (35%)**, RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. *(continued)* @68.5'; Qu = 3028 PSI (SHALE)	823.3	63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85	88		99	NQ-4											CORE	
	800.0 EOB		89		100	NQ-5											CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 75 GAL. BENTONITE GROUT

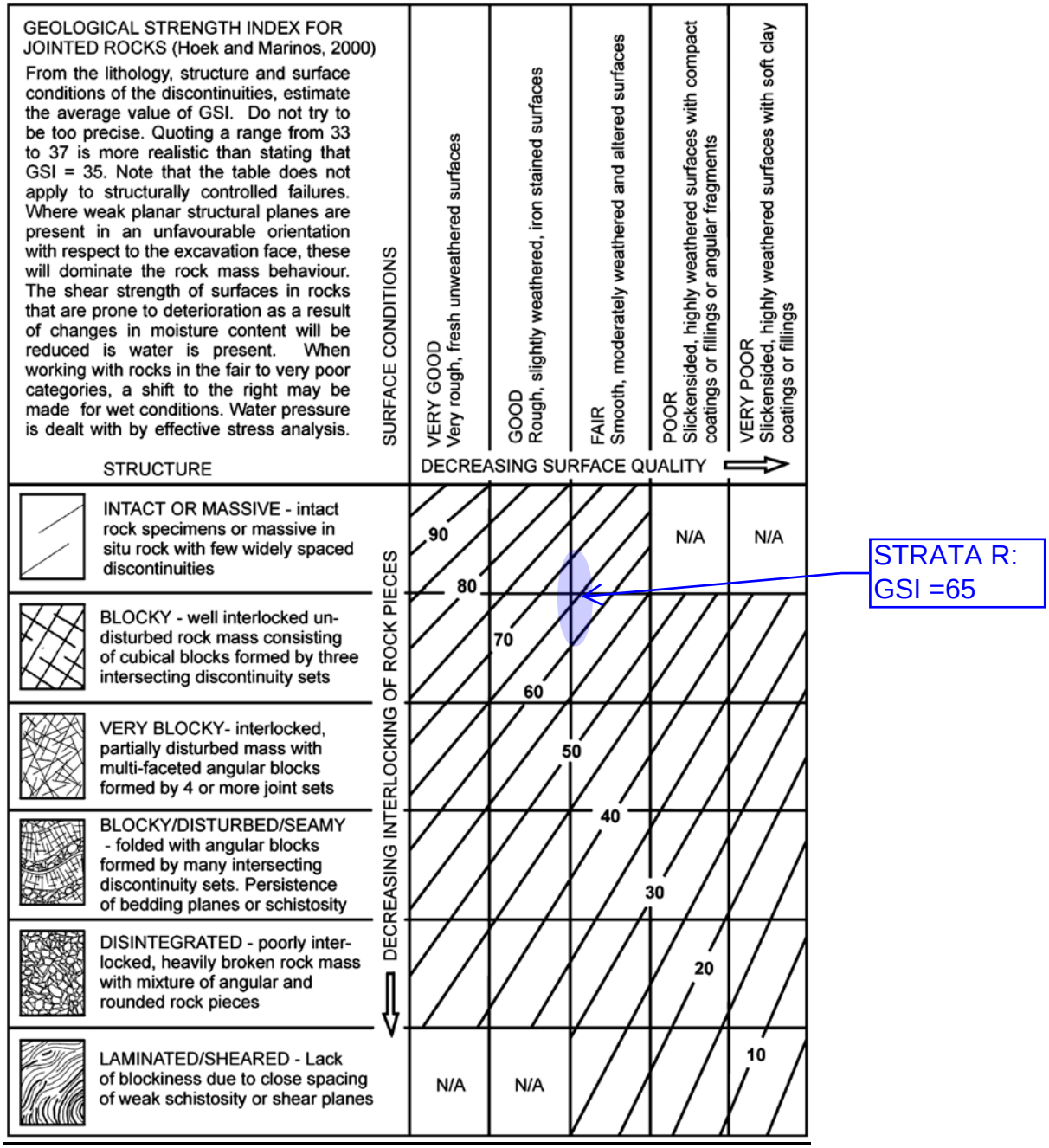


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 236+87, 43' LT.	EXPLORATION ID B-013-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 913.5 (MSL) EOB: 77.0 ft.	PAGE 1 OF 3
START: 3/29/17 END: 3/30/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089770, -81.501026	

MATERIAL DESCRIPTION AND NOTES	ELEV. 913.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**			4 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
@3.5' TO 5.0'; CHANGES TO VERY LOOSE			2 1 1	3	72	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	908.0																	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE), CONTAINS IRON STAINING, DAMP **(FILL)**	906.0	▼ 24 hr	5 5 5	14	61	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
STIFF TO HARD, ORANGISH BROWN BECOMING ORANGISH BROWN MOTTLED WITH GRAY, **SILT**, TRACE SAND, TRACE CLAY, CONTAINS IRON STAINING, WET			3 3 5	11	78	SS-4	1.1 - 2.6	-	-	-	-	-	-	-	-	27	A-4b (V)	
			3 4 8	16	100	SS-5	1.0 - 2.6	0	2	8	80	10	27	24	3	29	A-4b (8)	
			3 7 9	22	89	SS-6	1.25 - 3.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
			2 7 9	22	100	SS-7	2.0 - 3.6	-	-	-	-	-	-	-	-	29	A-4b (V)	
			5 8 11	26	100	SS-8	1.25 - 4.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
			5 6 9	20	89	SS-9	2.0 - 4.5+	-	-	-	-	-	-	-	-	32	A-4b (V)	
			3 5 7	16	100	SS-10	1.75 - 3.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
	888.0																	
MEDIUM STIFF TO VERY STIFF, ORANGISH BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, WET	886.0	W	3 8 11	26	100	SS-11	0.5 - 3.2	-	-	-	-	-	-	-	-	30	A-6a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET			8 10 11	28	100	SS-12	1.25 - 3.9	-	-	-	-	-	-	-	-	31	A-4b (V)	

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 VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET *(continued)*	883.5																	
@31.0' TO 32.5'; BROWN WITH ORANGISH BROWN AND GRAY, NO HP, NO SOIL PLUG	880.5	31	2 11 11	30	56	SS-13	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE GRAVEL, TRACE CLAY, DAMP	878.0	32																
MEDIUM STIFF, GRAY, **SILT**, TRACE TO LITTLE SAND, TRACE TO LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, WET		33																
		34	6 8 10	24	89	SS-14	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
		35																
		36																
		37	1 2 3	7	83	SS-15	0.5 - 0.8	-	-	-	-	-	-	-	-	39	A-4b (V)	
		38																
@38.5' TO 39.3'; STIFF TO VERY STIFF, ORANGISH BROWN,	874.2	39	5 10 11	28	100	SS-16A	1.8 - 3.5	-	-	-	-	-	-	-	-	33	A-4b (V)	
MEDIUM DENSE, DARK BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP	873.0					SS-16B	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		40																
VERY SOFT TO SOFT, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, WET		41																
@41.0' TO 42.5'; NO HP, NO SOIL PLUG	870.5	42	1 1 1	3	100	SS-17	-	0	0	14	75	11	18	16	2	29	A-4b (8)	
LOOSE TO MEDIUM DENSE, GRAY, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, TRACE GRAVEL, WET		43																
		44	3 3 4	9	100	SS-18	-	-	-	-	-	-	-	-	-	26	A-3 (V)	
		45																
W		46																
		47	1 2 6	11	89	SS-19	-	-	-	-	-	-	-	-	-	24	A-3 (V)	
	865.5	48																
DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST		49	6 9 14	31	78	SS-20	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
		50																
		51																
		52	13 16 17	45	78	SS-21	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
	860.0	53																
MEDIUM STIFF TO STIFF, GRAY, **SILT**, TRACE SAND, TRACE CLAY, TRACE GRAVEL, WET		54	5 8 10	24	89	SS-22	0.75 - 1.7	-	-	-	-	-	-	-	-	31	A-4b (V)	
		55																
		56																
		57																
	855.0	58																
MEDIUM DENSE TO DENSE, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET		59	6 6 8	19	100	SS-23	-	0	1	19	66	14	NP	NP	NP	25	A-4b (8)	
		60																
		61																

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+87, 43' LT.	START: 3/29/17	END: 3/30/17	PG 3 OF 3	B-013-5-16

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, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET *(continued)*	851.4	63																
		64	4 7 19	35	94	SS-24	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
	848.6	65																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTY SHALE AND GRANITE), MOIST		66																
		67																
		68																
		69	12 23 17	54	50	SS-25	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		70																
		71																
@71.0': ENCOUNTERED GRANITE BOULDER (GLACIAL ERRATIC)	842.0	TR																
INTERBEDDED SILTSTONE (85%) AND SHALE (15%), RQD 20%, REC. 76%; **SILTSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THINLY LAMINATED, MODERATELY ARGILLACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 75.4' - 75.6', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO VERY BLOCKY, DISINTEGRATED FROM 73.9' - 74.8', FAIR TO GOOD SURFACE CONDITION; **SHALE**, GRAY, MODERATELY STRONG, SILTY, PYRITIC. @71.6'; Qu = 9267 PSI (SILTSTONE) @75.0'; Qu = 24283 PSI (SILTSTONE)		72	31		67	NX-1												CORE	
		73																
		74	0		81	NX-2												CORE
		75																
		76	25		81	NX-3												CORE
	836.5	EOB 77																

Ignore Silt Stone, use data from B-013-4-16

NOTES: GROUNDWATER ENCOUNTERED AT 45.5' DURING DRILLING, 27.0' BEFORE CORING, 7.5' AFTER DRILLING. CAVE DEPTHS 7.7' AND 70.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 100 GAL. BENTONITE GROUT

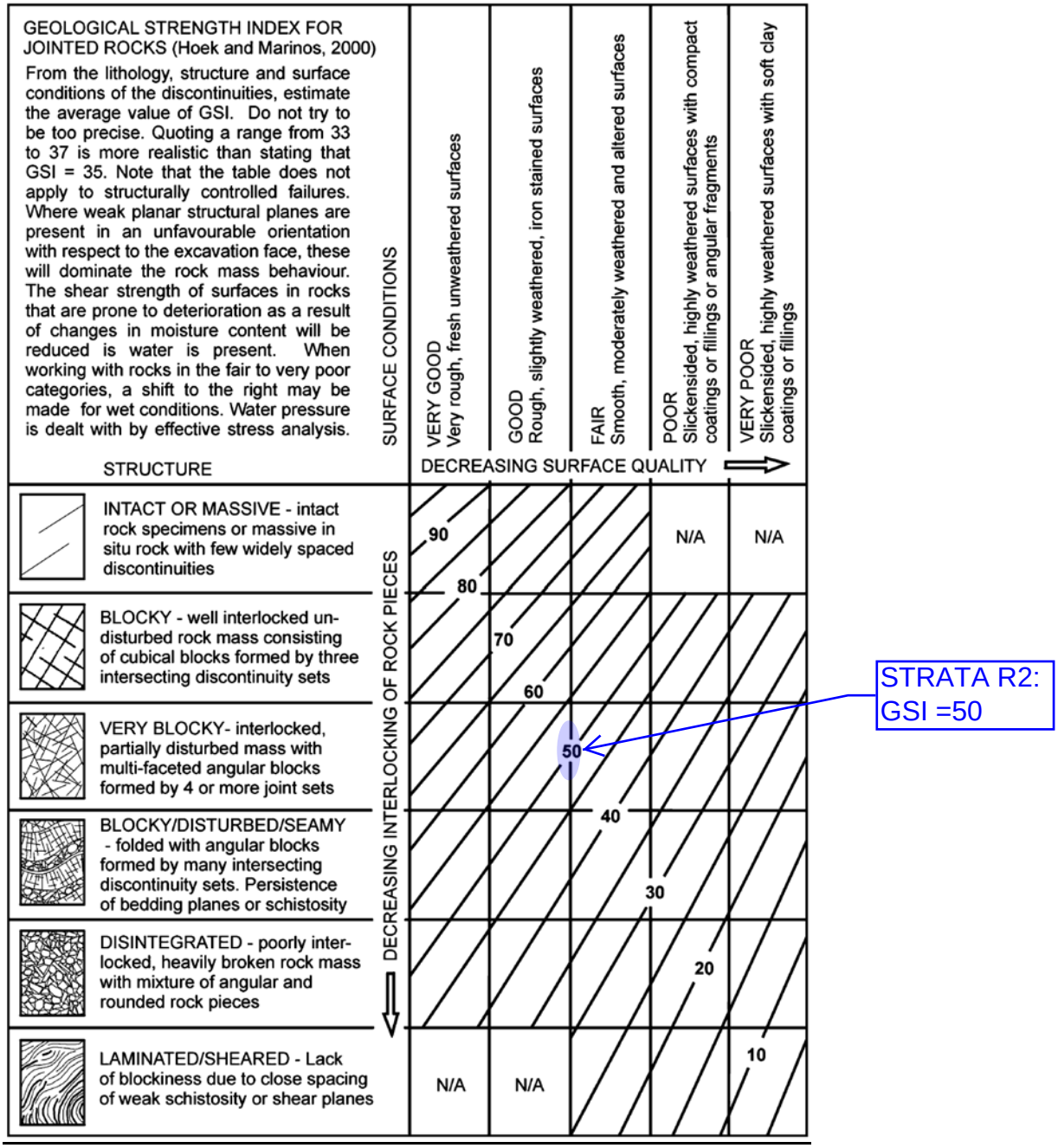
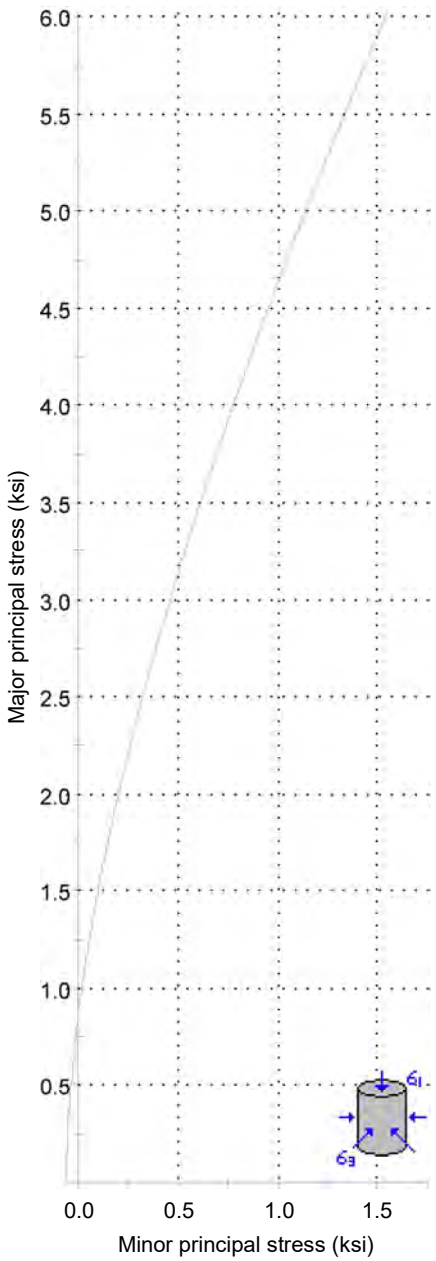


Figure 10.4.6.4-1—Determination of *GSI* for Jointed Rock Mass (Hoek and Marinos, 2000)

S.B. Pier 4. Rock-1



Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 6.2 ksi
GSI = 65 mi = 7 Disturbance factor (D) = 0
intact modulus (Ei) = 558 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

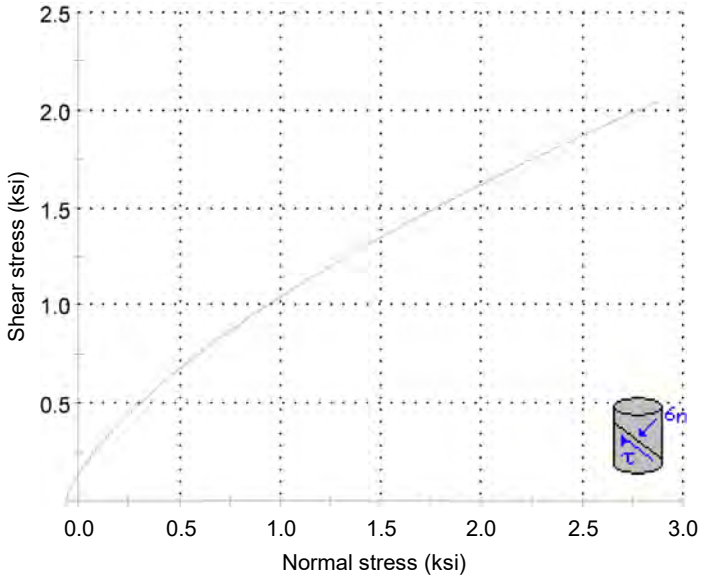
mb = 2.006 s = 0.0205 a = 0.502

Mohr-Coulomb Fit

cohesion = 0.369 ksi friction angle = 31.76 deg

Rock Mass Parameters

tensile strength = -0.063 ksi
uniaxial compressive strength = 0.880 ksi
global strength = 1.326 ksi
deformation modulus = 352.50 ksi



Appendix F.1-1

SUM-8-0199 Subsurface Profile

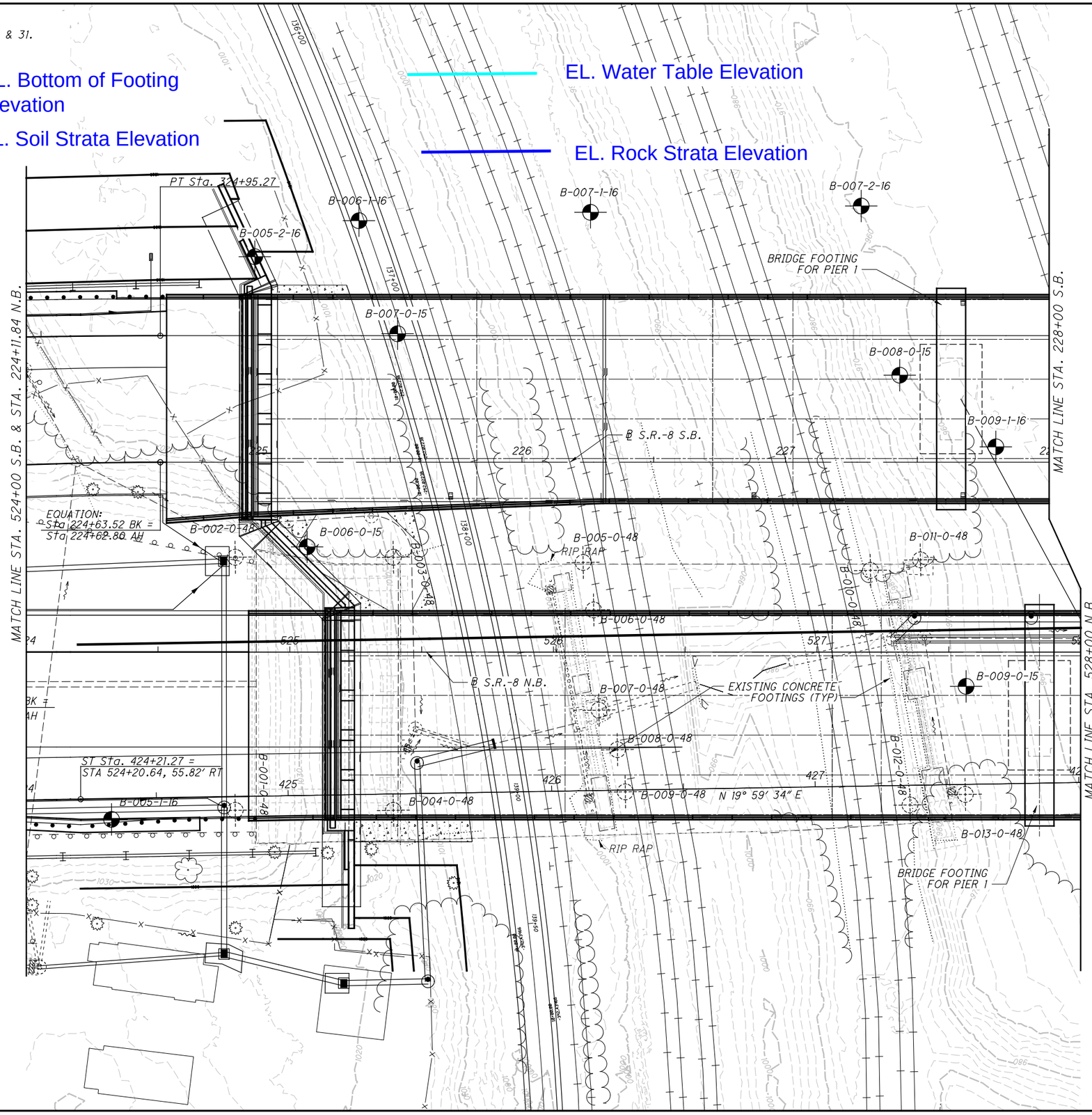
FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEET NOS. 30 & 31.
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEET NOS. 47 & 48.

EL. Bottom of Footing Elevation

EL. Soil Strata Elevation

EL. Water Table Elevation

EL. Rock Strata Elevation



HORIZONTAL SCALE IN FEET
0 10 20 40

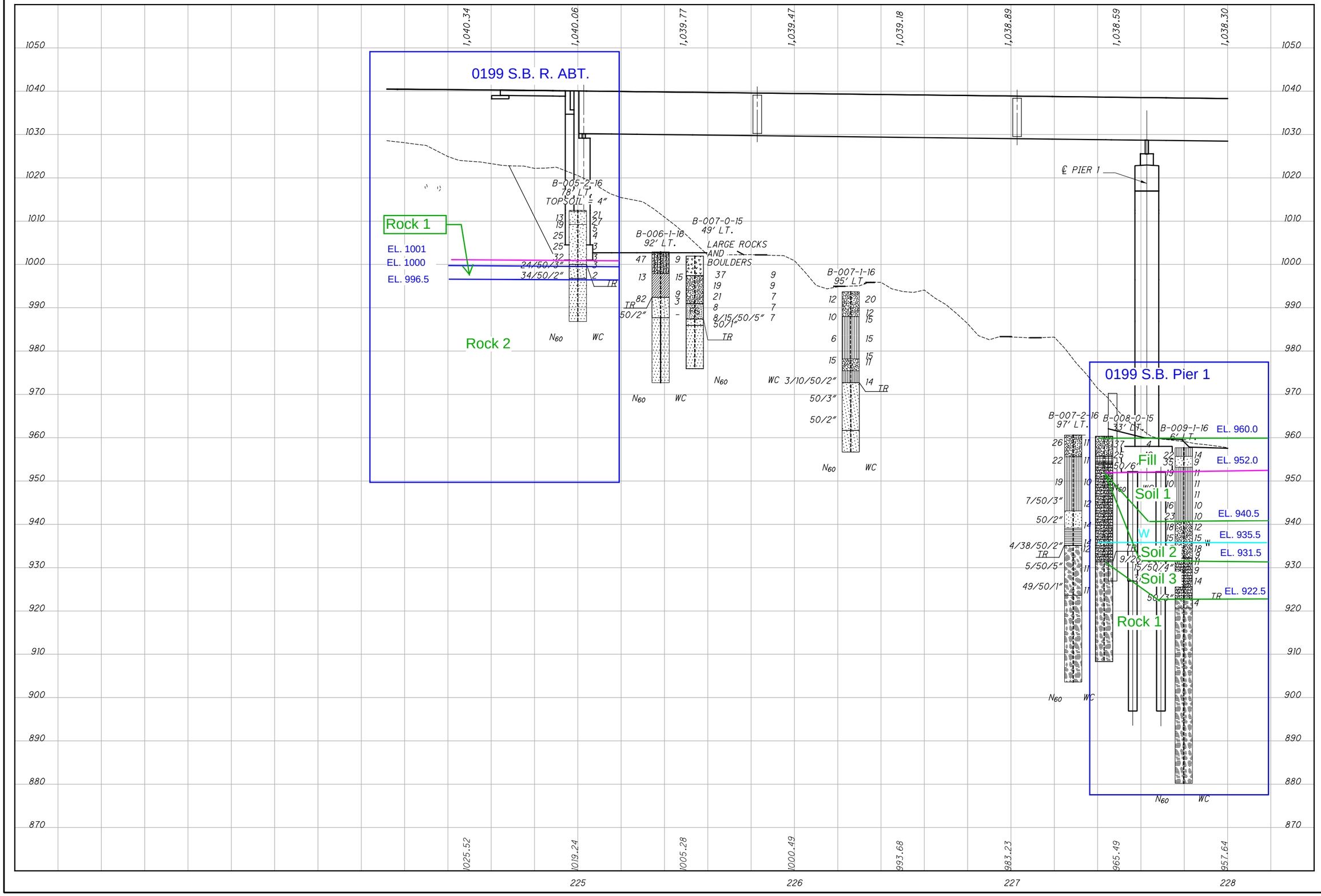
DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 524-00 TO STA 528-00 S.R. 8 N.B. & STA 224-11.84 TO STA 228-00 S.R. 8 S.B.

SUM-8-1.75

31 / 128



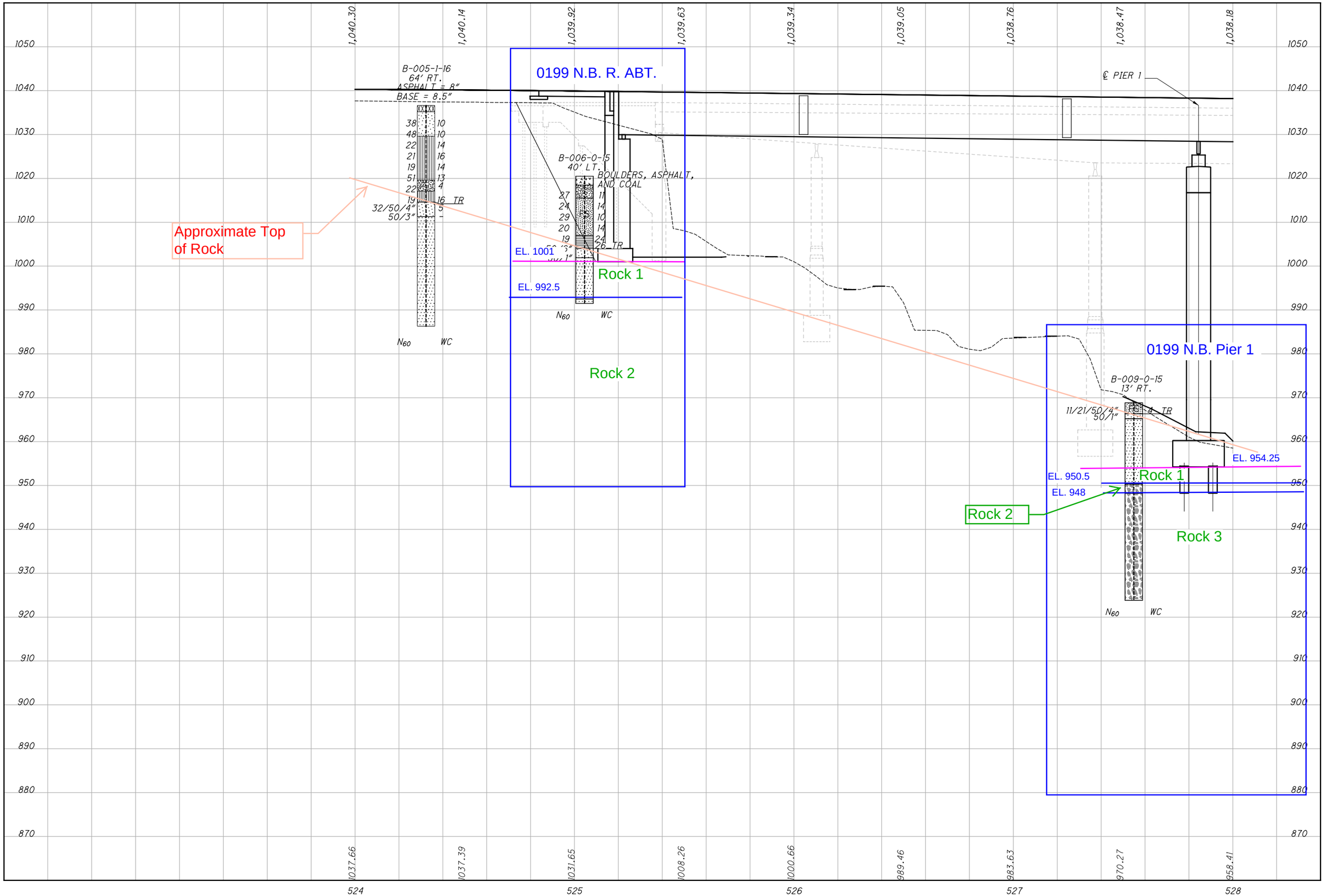
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199, STA 224+11.84 TO STA 228+00 S.R. 8 S.B.

SUM-8-1.75

32/128



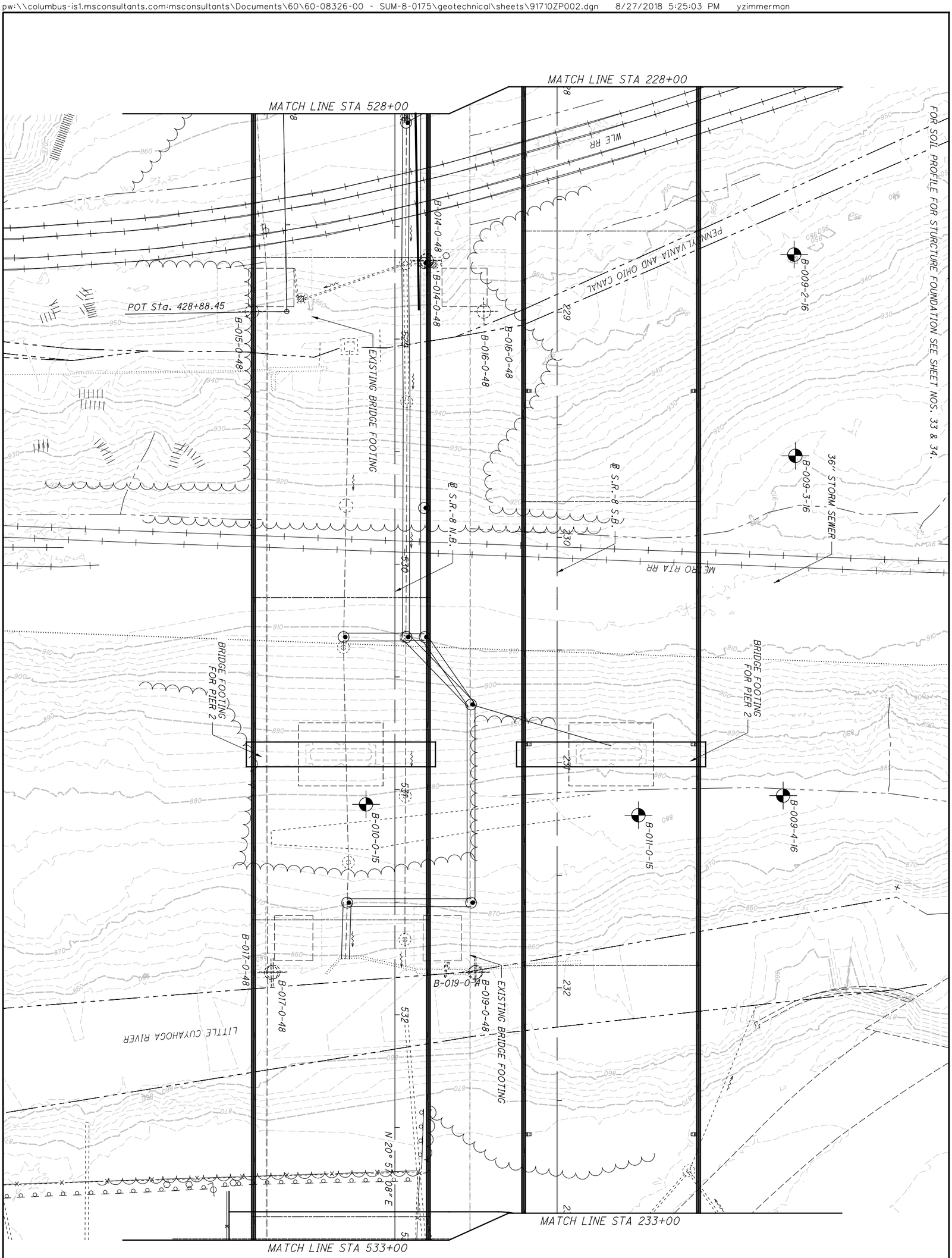
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 524+00 TO STA 528+00 S.R. 8 N.B.

SUM-8-1.75



34/128	SUM-8-1.75	STRUCTURE FOUNDATION EXPLORATION BRIDGE NO. SUM-8-0199, STA 528+00 TO STA 533+00 S.R. 8 N.B. & STA 228+00 TO STA 233+00 S.R. 8 S.B.	DRAWN YLZ CHECKED TLM	0 10 20 40 HORIZONTAL SCALE IN FEET	N

1038.30 1038.01 1037.71 1037.42 1037.13 1036.83 1036.54 1036.25 1035.95 1035.66 1035.37

℄ PIER 2

B-009-2-16
105' LT.

4	20
7	13
6	21
16	23
21	13
34	6
25	9
34	10
18	13
N_{60}	WC

B-009-3-16
106' LT.

7	17
13	15
10	21
13	24
13	21
12	13
3/24/50/4"	16 TR
37/42/50/6"	13
N_{60}	WC

0199 S.B. PIER 2

B-009-4-16
100' LT.

13	22
21	13
7	11
27/50/3"	15
7	
18/50/5"	
50/2"	
N_{60}	WC

B-011-0-15
36' LT.

ROCKS AND BOULDERS	
45	36
7	28
17 TR	29
48	
29	
42/50/6"	
38/50/6"	
50/2"	
50/3"	
N_{60}	WC

EL. 874.25
Soil 1
EL. 866.5
Rock 1
EL. 852.5
Rock 2

1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860 850 840

957.64 955.44 947.17 938.54 911.88 910.10 881.42 875.90 856.06 868.19 873.34

228 229 230 231 232 233

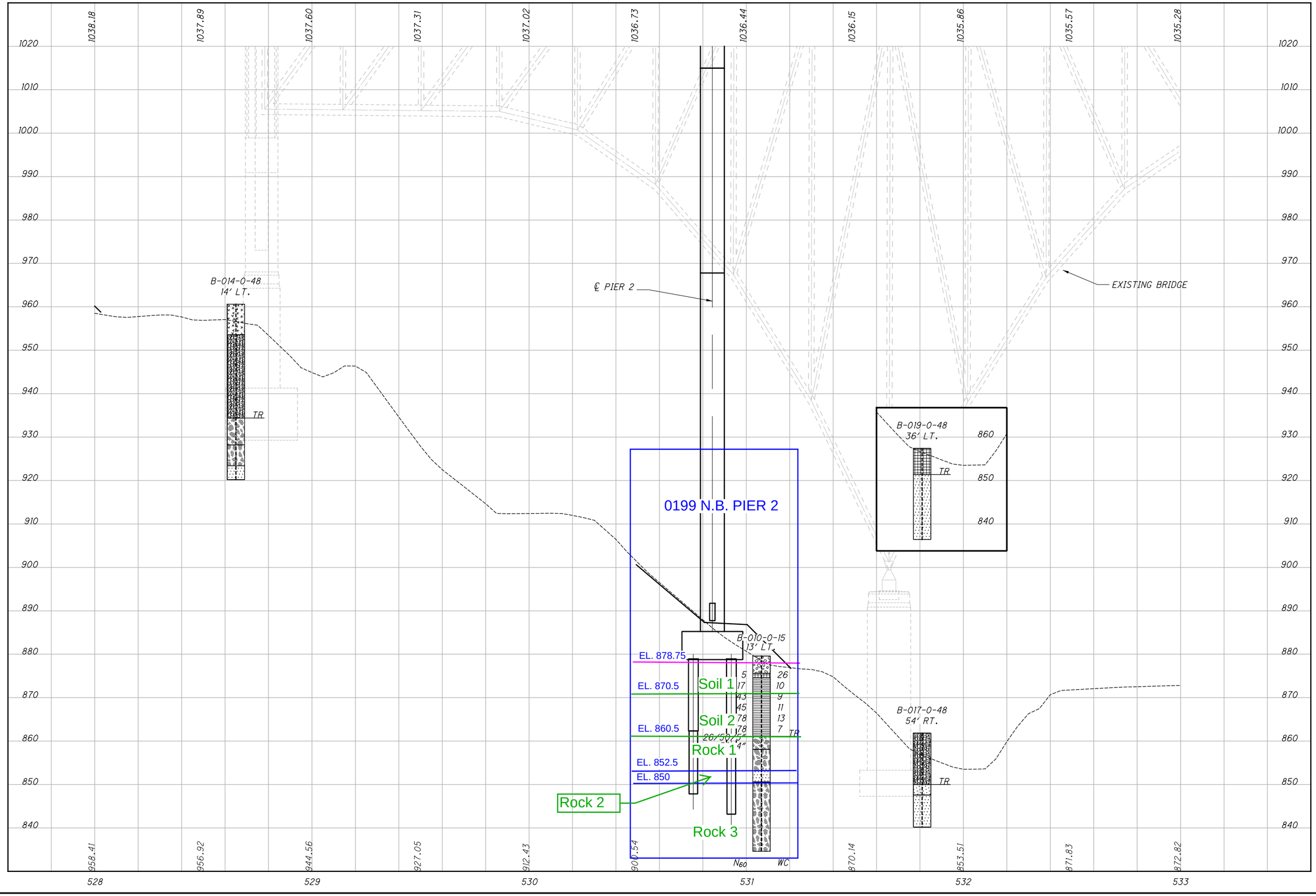
0 10 20 40 HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 228+00 TO STA 233+00 S.R. 8 S.B.

SUM-8-1.75



0 10 20 40
HORIZONTAL SCALE IN FEET

DRAWN YLZ | CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 528+00 TO STA 533+00 S.R. 8 N.B.

SUM-8-1.75

FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEET NOS. 36 & 37.

MATCH LINE STA 233+00

MATCH LINE STA 238+00

MATCH LINE STA 533+00

MATCH LINE STA 538+00

BRIDGE FOOTING FOR PIER 3

BRIDGE FOOTING FOR PIER 4

1 STORY CONC. BLOCK GARAGE COMM. 415

BLOCK GARAGE

STORAGE TRAILER

ASPHALT

1 STORY CONC. BLOCK COMM. 451

EXISTING BRIDGE FOOTING

℄ S.R.-8 S.B.

℄ S.R.-8 N.B.

N 20° 57′ 08″ E

N 20° 56′ 45″ E

B-011-5-16

B-011-1-15

B-011-4-16

B-011-3-16

B-011-2-16

B-010-2-15

B-010-1-15

B-021-0-48

B-022-0-48

B-013-1-15

B-013-5-16

B-013-0-15

B-013-4-16

B-013-3-16

B-012-0-15

B-013-2-16

B-024-0-48

234 235 236 237 534 535 536 537

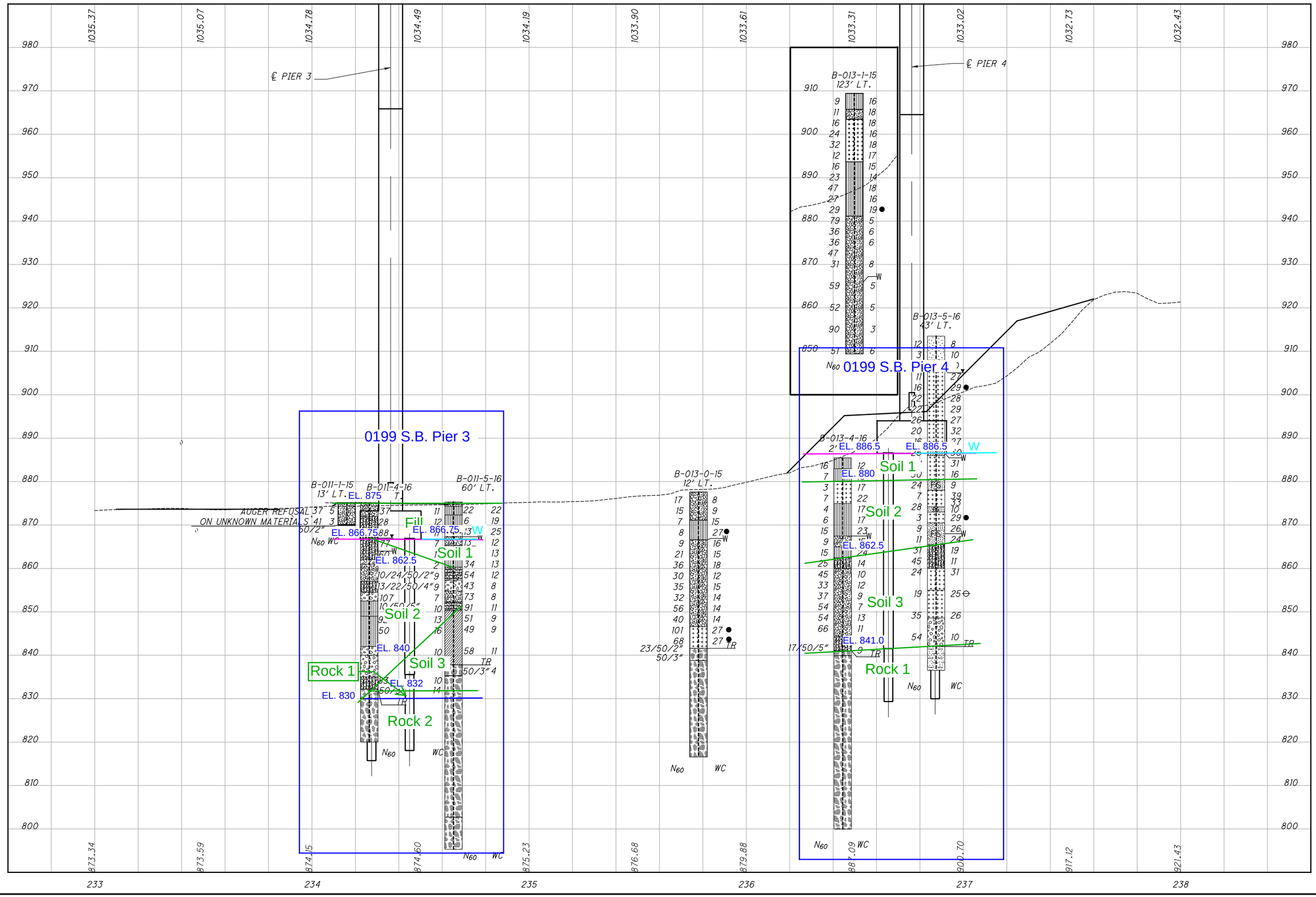
DRAWN YLZ

CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO SUM-8-0199, STA 533+00 TO STA 538+00 S.R. 8 N.B. & STA 233+00 TO STA 238+00 S.R. 8 S.B.

SUM-8-1.75



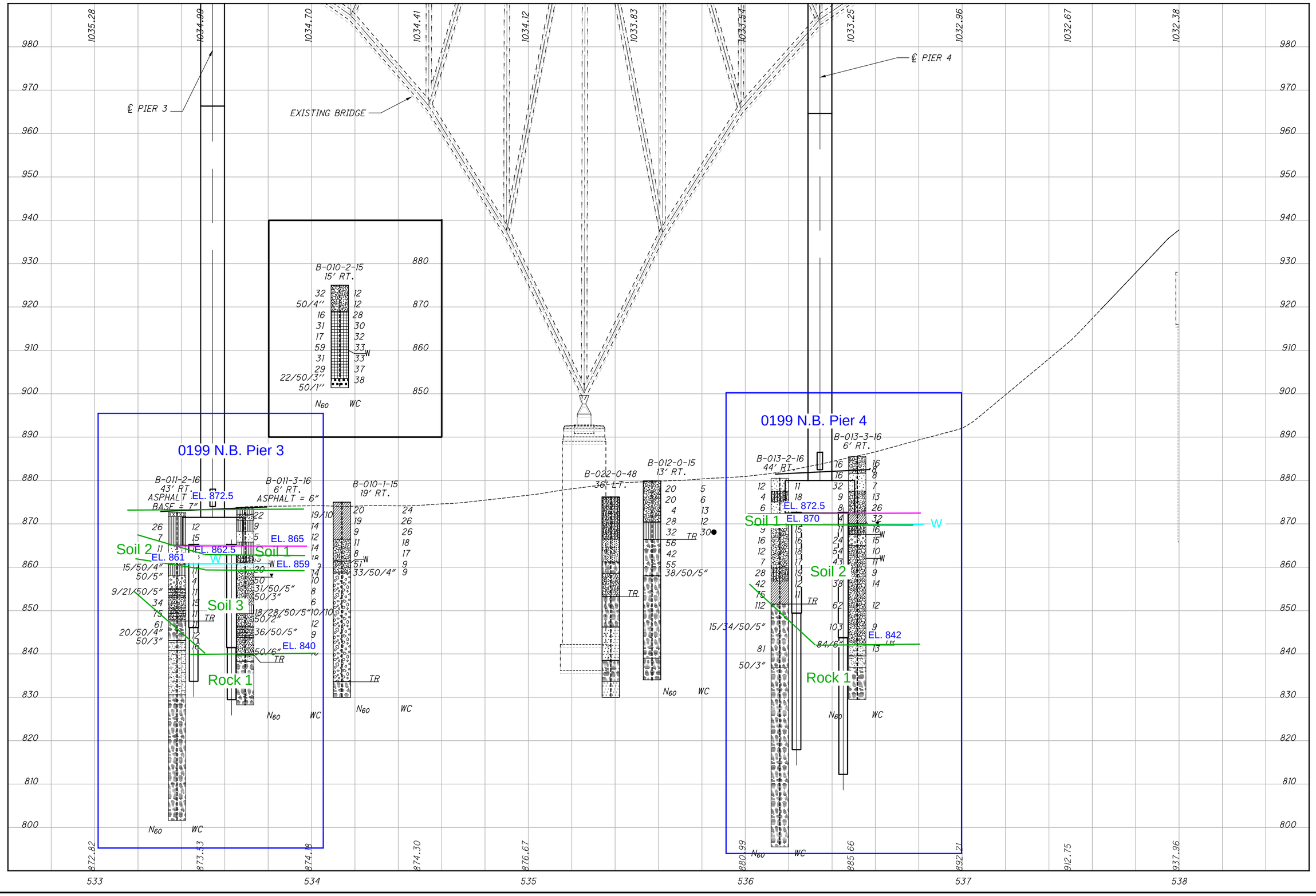
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO SUM-8-0199, STA 233+00 TO STA 238+00 S.R. 8 S.B.

SUM-8-1.75



HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO SUM-8-0199, STA 533+00 TO STA 538+00 S.R. 8 N.B.

SUM-8-1.75

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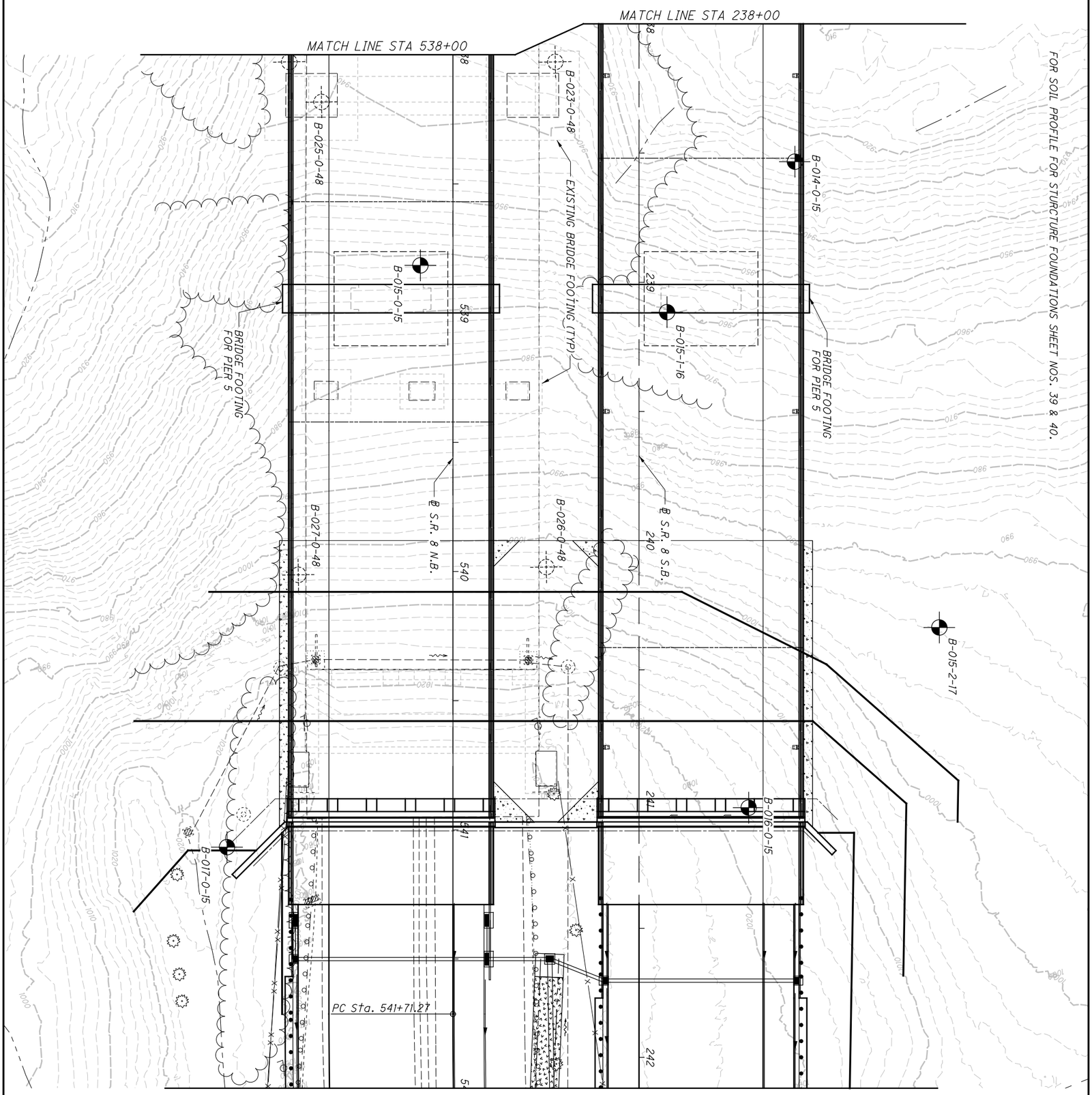
pw:\\columbus-is1.msconsultants.com:msconsultants\Documents\60\60-08326-00 - SUM-8-0175\geotechnical\sheets\917102P003.dgn 8/27/2018 5:25:50 PM yzimmerman



MATCH LINE STA. 542+00 N.B. & STA. 242+12 S.B.

	40/128	**SUM-8-1.75**	**STRUCTURE FOUNDATION EXPLORATION** BRIDGE NO. SUM-8-0199, STA 538+00 TO STA 542+00 S.R. 8 N.B. & STA 238+00 TO STA 242+12 S.R. 8 S.B.	DRAWN YLZ CHECKED TLM	0 20 10 40 HORIZONTAL SCALE IN FEET

1032.43 1032.14 1031.85 1031.55 1031.26 1030.97 1030.67 1030.38 1030.09 1029.79 1029.50

1040 1030 1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860

℄ PIER 5

0199 S.B. PIER 5

B-015-1-16
11' LT.

EL. 955.2
UF
(Trash Zone)
EL. 944.0
Soil 1
EL. 917.5
W
EL. 914.0
Soil 2
EL. 873.5
Soil 3
EL. 857.5
Soil 4

6	22	
16	–	
51	–	
51	–	
13	–	
13	20	
25	13	
8	8	
6	8	
15	6	
25	11	
57	7	
13	6	
25	6	
27	8	
30	7	
13	6	
21	15	
13	31	
12	33	
9	29	
9	28	
15	25	
7	31	
7	33	
7	33	
16	30	
22	27	
31	20	
31	24	
30	21	
67	12	
81	10	
152	12	
N_{60}	WC	

B-014-0-15
60' LT.

5	26	
1/12"/1	28	
13	29	
19	30	
19	34	
16	35	
12	33	
15	36	
20	34	
15	36	
27	37	
31	38	
44	33	
47	15	
62	22	
56	37	
79	20	
67	21	
99	22	
N_{60}	WC	

0199 S.B. F. ABT

B-016-0-15
42' LT.

EL. 1011
Soil 1
EL. 988.5
Soil 2
W
EL. 965.5
EL. 964.0
Soil 3
EL. 948.0
Soil 4
EL. 929.5
Soil 5

28	6	
24/50/5"	8	
30	5	
5	3	
3	3	
23	2	
9	2	
8	5	
5	5	
8	4	
15	20	
23	12	
39	11	
42	10	
55	11	
44	11	
32	11	
32	7	
35	29	
31	16	
34	27	
54	29	
67	14	
38	8	
38	15	
13	26	
32	37	
38	38	
N_{60}	WC	

0

238 239 240 241 242 243

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199, STA 238+00 TO STA 242+12 S.R. 8 S.B.

SUM-8-1.75

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STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 538+00 TO STA 542+00 S.R. 8 N.B.

SUM-8-1.75

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

1032.38 1032.09 1031.80 1031.51 1031.22 1030.93 1030.64 1030.35 1030.06 1029.77 1029.48

1040 1030 1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860

℄ PIER 5

EXISTING BRIDGE

B-025-0-48
51' RT.

0199 N.B. PIER 5

B-015-0-15
15' RT.
EL. 965.2
ROCK FRAGMENTS
Soil 1
EL. 943
W
EL. 939
Soil 2
EL. 898.5
Soil 3
N_{60} WC

0199 N.B. F. ABT

B-017-0-15
87' RT.
EL. 1011
Soil 1
EL. 992.5
Soil 2
EL. 966.5
W
N_{60} WC

937.96 946.72 970.52 984.38 1004.79 1022.12 1029.49 1029.34 1029.15 1028.97 1028.76

538 539 540 541 542 543

Appendix F.2

SUM-8-0199 Foundation of Friction Pile Design

PURPOSE:

The purpose of this calculation is to evaluate Cast in Place (CIP) Displacement (i.e. close end) piles for the SUM-8-01.75 NB and SB Pier 5 and Forward Abutment. This calculation determines the static analysis per ODOT BDM and AASHTO LRFD. A drivability analysis is performed for each substructure using the depth and stratum determined in the static analysis.

The static analysis is performed with APILE by Ensoft, and the drivability is performed with GRLWEAP from PDI.

CODES/STANDARDS:

LRFD *Bridge Design Specifications Eighth Edition 2017 (LRFD)*

ODOT *Bridge Design Manual,* January 2007 (BDM)

ODOT *Construction Materials Specification* 2016 (CMS)

SOURCE OF DATA:

1. The loading case is provided by GF's Structure group;

Table 1: SUM-8-0199 Friction Pile Foundation Size, Spacing, and Loading

Substructure	Bottom Footing Elevation (ft.)	Diameter (inch)	Thickness (inch)	Thickness after Degradation[1] (inch)	Steel Grade	Strength Load (kips)	UBV (kips)	Structural Resistance Pr[3] (kips)
NB Pier 5	965.2	16	0.625	0.389	3	446	638	820
NB Forward Abutment	1010.5	14	0.25	NA	3	DTGR[2]	390	510
SB Pier 5	955.2	16	0.625	0.389	3	479	685	820
SB Forward Abutment	1010.5	14	0.25	NA	3	DTGR[2]	390	510

Note:

1. This is a resulting thickness after 100 years of section loss in polluted natural soils (degradation loss per Skyline Steel pipe pile literature);

2. DTGR – All piles for forward abutment are assumed to be driven to recommended maximum geotechnical resistance, that is 390 kips for 14'' pipe pile;

3. Structural Resistance for pile at abutment is from BDM C305.33-1; the structural resistance at pier is calculated based on pile thickness after degradation (see attachment).

2. The drivability soil parameters are taken from GRLWEAP recommended values based on the pile type;

Table 2: Recommended Quake Values for Impact Driven Piles*

Quake	Soil Type	Pile Type or Size	Quake (in)
Shaft Quake	All soil types	All Types	0.10
Toe Quake	Very soft, Soft, Loose and very loose	Displacement Pipe Pile	D/60
	Medium Stiff, Stiff, Medium Dense	Displacement Pipe Pile	D/80
	Very Stiff, Dense	Displacement Pipe Pile	D/100
	Hard, Very Dense	Displacement Pipe Pile	D/120

Table 3: Recommended Damping Values for Impact Driven Piles

	Soil Type	Damping Factor s/ft
Shaft Damping	Non-cohesive soils*	0.05
	Cohesive soils*	0.20
Toe damping	In all soil types	0.15

* For mixed soils, intermediate values may be appropriate.

3. The soil parameters for the APILE analyses were prepared and checked by GF. The values for each substructure are summarized in Table 5 (Refer to Appendix F.1 for details). The soil model for GRLWEAP used the N_{60} values and the unit weight of each soil layer.

4. The Steel Properties are according to ASTM 252.

TABLE 4: Steel Properties

Steel Grade	Tension (PSI)	F'y (PSI)	Max Compression (PSI) $\sigma_{dr} = 0.9\varphi_d f'_y$ $\varphi_d = 1$
Grade 1	50,000	30,000	27,000
Grade 2	60,000	35,000	31,500
Grade 3	66,000	45,000	40,500

Table 5: SUM-8-0199 Driven Pile Static Analysis Design Parameters

Sub-structure	Soil Strata	Setup Model for Soil Type	Bottom Elevation (depth)	γ* (pcf)	γ' (pcf)	N_{60}	$N1_{60}$	Φ**	C
NB Pier 5 Bottom of Footing 965.2	1	Sand	943 (22.2)	121.5	121.5	6	6	28.5	0
	1S	Sand	939 (26.2)	126.5	64.0	6	6	28.5	0
	2	Clay	898.5 (66.7)	140	77.5	16	13	0	1300
	3	Sand	865 (100.2)	150	87.5	47	26	36.5	0
NB Forward Abutment Bottom of Footing 1011	1	Sand-Gravel	992.5 (18.5)	128	128	15	14	33.5	0
	2	Sand-Gravel	966.5 (44.5)	140.5	140.5	43	27	37	0
	2S	Sand-Gravel	930 (81)	145.5	83	43	27	37	0
SB Pier 5 Bottom of Footing 955.2	1***	Clay	944 (11.2)	80	80	1	1	1	0
	2	Sand	917.5 (37.7)	134	134	18	14	33	0
	2S	Sand	914 (41.2)	139	76.5	18	14	33	0
	3	Silt (NP)	873.5 (81.7)	140	77.5	12	7	28.5	0
	4	Sand	857.5 (97.7)	148	85.5	31	15	32	0
	5	Sand-Gravel	830 (125.2)	150	87.5	60	43	40.5	0
SB Forward Abutment Bottom of Footing 1011	1	Sand-Gravel	988.5 (22.5)	124	124	8	7	32	0
	2	Sand	965.5 (45.5)	140.5	140.5	38	27	35	0
	2S	Sand	964 (47)	145.5	83	38	27	35	0
	3	Clay	948 (63)	150	87.5	33	19		3900
	4	Sand-Gravel	929.5 (81.5)	150	87.5	48	24	37.5	0
	5	Clay	910 (101)	146.5	84	28	12		2300

Notes:

* γ refers to the total unit weight of the soil stratum, it equals to the moist unit weight above the water table, and the saturated unit weight below the water table;

** The internal angle of friction is calculated AASHTO Eq. 10.8.3.5.2b-3 (ref. 1) in the soil parameter calculation (Refer to Appendix E.1);

*** Trash zone exists between Elv. 955.2 and Elv. 944 near pier 5 (Stratum 1 for Pier 5). The unit weight of the soil layer is assumed to be 80 pcf, the shear strength of the soil layer is ignored from the calculation (assume φ= 1 degree).

TABLE 6: GRLWEAP INPUTS

ODOT Classification	Depth	Unit Shaft Resistance	Unit Toe Resistance	Skin Quake	Toe Quake	Skin Damping	Toe Damping	Setup Factor	Limit Distance	Setup Time	Toe Area
	(ft)	(ksf)	(ksf)	(in)	(in)	(s/ft)	(s/ft)		(ft)	(hr)	(in^2)
NB Pier 5											
A-3	0	0.000	25.063	0.1	0.267	0.05	0.15	1.2	6.562	24	201.062
A-3	22.2	0.506	25.063	0.1	0.267	0.05	0.15	1.2	6.562	24	201.062
A-3	22.2	0.517	25.063	0.1	0.267	0.05	0.15	1.2	6.562	24	201.062
A-3	26.2	0.566	25.063	0.1	0.267	0.05	0.15	1.2	6.562	24	201.062
A-6B*/A-4A	26.2	0.962	18.045	0.1	0.200	0.2	0.15	2.0	6.562	168	201.062
A-6B*/A-4A	66.7	1.566	18.045	0.1	0.200	0.2	0.15	2.0	6.562	168	201.062
A-3A*/A-2-4	66.7	1.113	196.323	0.1	0.160	0.05	0.15	1.2	6.562	1	201.062
A-3A*/A-2-4	100.2	1.649	196.323	0.1	0.160	0.05	0.15	1.2	6.562	1	201.062
NB Forward Abutment											
A-1-B*/A-3	0	0.000	31.328	0.1	0.175	0.05	0.15	1.0	6.562	1	153.938
A-1-B*/A-3	18.5	0.687	31.328	0.1	0.175	0.05	0.15	1.0	6.562	1	153.938
A-1-B*/A-3	18.5	0.787	89.807	0.1	0.140	0.05	0.15	1.0	6.562	1	153.938
A-1-B*/A-3	44.5	2.001	89.807	0.1	0.140	0.05	0.15	1.0	6.562	1	153.938
A-1-B*/A-3	44.5	1.804	89.807	0.1	0.140	0.05	0.15	1.0	6.562	1	153.938
A-1-B*/A-3	81	2.712	89.807	0.1	0.140	0.05	0.15	1.0	6.562	1	153.938
SB Pier 5											
Uncontrolled Fill**	0	0.000	0.000	0.1	0.267	0.2	0.15	2	6.562	168	201.062
Uncontrolled Fill**	11.2	0.000	0.000	0.1	0.267	0.2	0.15	2	6.562	168	201.062
A-3	11.2	0.306	79.365	0.1	0.200	0.05	0.15	1.2	6.562	24	201.062
A-3	37.7	0.984	79.365	0.1	0.200	0.05	0.15	1.2	6.562	24	201.062
A-3	37.7	0.919	79.365	0.1	0.200	0.05	0.15	1.2	6.562	24	201.062
A-3	41.2	0.961	79.365	0.1	0.200	0.05	0.15	1.2	6.562	24	201.062
A-4B	41.2	2.530	125.313	0.1	0.200	0.15	0.15	1.5	6.562	72	201.062
A-4B	81.7	4.101	125.313	0.1	0.200	0.15	0.15	1.5	6.562	72	201.062
A-3*/A-4B	81.7	1.559	129.490	0.1	0.160	0.05	0.15	1.2	6.562	24	201.062
A-3*/A-4B	97.7	1.819	129.490	0.1	0.160	0.05	0.15	1.2	6.562	24	201.062
A-1-B*/A-4A	97.7	2.850	125.313	0.1	0.133	0.05	0.15	1	6.562	1	201.062
A-1-B*/A-4A	125.2	3.567	125.313	0.1	0.133	0.05	0.15	1	6.562	1	201.062
SB Forward Abutment											
A-1-B	0	0.000	16.708	0.1	0.233	0.05	0.15	1	6.562	1	153.938
A-1-B	22.5	0.778	16.708	0.1	0.233	0.05	0.15	1	6.562	1	153.938
A-3	22.5	0.493	158.729	0.1	0.140	0.05	0.15	1.2	6.562	24	153.938
A-3	45.5	1.065	158.729	0.1	0.140	0.05	0.15	1.2	6.562	24	153.938
A-3	45.5	1.105	158.729	0.1	0.140	0.05	0.15	1.2	6.562	24	153.938
A-3	47	1.128	158.729	0.1	0.140	0.05	0.15	1.2	6.562	24	153.938
A-6B*/A-1-B	47	1.566	37.218	0.1	0.175	0.2	0.15	2	6.562	168	153.938
A-6B*/A-1-B	63	1.566	37.218	0.1	0.175	0.2	0.15	2	6.562	168	153.938
A-1-B	63	2.256	100.250	0.1	0.140	0.05	0.15	1	6.562	1	153.938
A-1-B	81.5	2.740	100.250	0.1	0.140	0.05	0.15	1	6.562	1	153.938
A-6B*/A-4A	81.5	1.566	31.579	0.1	0.175	0.2	0.15	2	6.562	168	153.938
A-6B*/A-4A	101	1.566	31.579	0.1	0.175	0.2	0.15	2	6.562	168	153.938

Note: * refers to the major component

** Trash zone exists between Elv. 955.2 and Elv. 944 near pier 5 (Stratum 1 for Pier 5). The unit weight of the soil layer is assumed to be 80 pcf, the toe quake is assumed to be 0.267 in, the skin damping is assumed to be 0.2 s/ft, setup factor is assumed to be 2, and the setup time is assumed to be 168 hrs for calculation purpose.

ASSUMPTIONS/PROJECT BACKGROUND:

All piles are Closed-End Piles. The piers will use 16-inch diameter piles and the abutments 14-inch diameter piles. All the abutment pipes wall thicknesses are analyzed at 0.25 inches to be more cost-efficient. The Pier 5 piles will be specified with 0.625" steel walls. The steel wall is thicker to provide increased capacity, including against unbraced buckling length, after 100 years of section loss in polluted natural soils (degradation loss per Skyline Steel pipe pile literature). The resulting 0.389" thick pipe wall results in adequate resistance to design loads after 100 years (including the buckling of the unbraced length through landfill).

The energy of the hammer used in the analysis for all the forward abutments is 43.240 kip-ft/kW (Delmag D-19-42). Pier 5 for both bridges require a heavier hammer due impart to longer pile length and the need to penetrate the trash. Both bridges use a Delmag D-30-32 for SB Pier 5. The energy of the hammer used in the analysis for NB Pier 5 is 51.216 kip-ft/kW. The energy of the hammer used for SB Pier 5 is 75.438 kip-ft/kW.

While the abutment piles are assumed to be loaded to recommended maximum geotechnical resistance (per BDM 202.2.3.2.b) and the pier piles are assumed to be loaded to the ultimate bearing value required to support the maximum strength load in Table 1.

Trash zone exists between Elv. 955.2 and Elv. 944 near pier 5 (Stratum 1 for Pier 5). As for static analysis, this stratum has been modeled as very loose sand, and resistance of this layer is ignored from calculation; as for the drivability analysis, this stratum has been modelled as clay. All the design parameters have been as listed in Table 1 and Table 6.

Formula:

UBV= EOID +R_{Ssu} (BDM C 305.3.2-3)

EOID = R_n + R_{Ssc} – R_{ssu} (BDM C 305.3.2-2)

Rn = Q_p/φ_{dyn} (BDM C 305.3.2-4)

No scour (R_{Ssc} = 0), no setup (Rssu = 0), φ_{dyn} = 0.7

Therefore UBV = Q_p/0.7

Definition Drawing:

See Pier Definition Drawing in Appendix F.1.1

Computer Programs Used:

GRLWEAP 2010-4

APILE 2015

Attachment

LPILE Output

GRLWEAP Output

Structural Resistance calculation

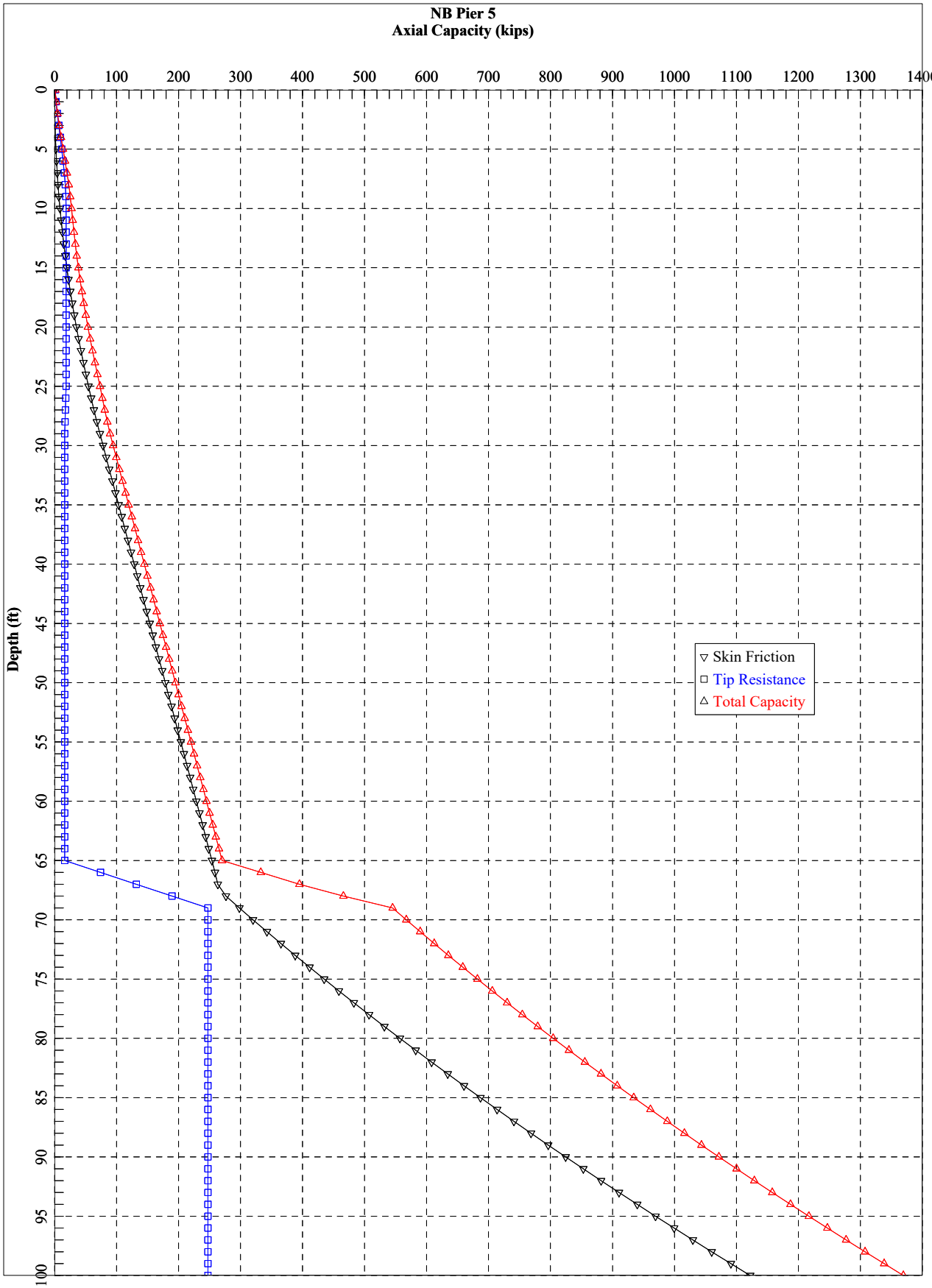
Results:

Table 7: SUM-8-0199 Driven Pile Design Results

Sub-structure	Pile Size (inch)	Ultimate Bearing Value (Kips)	Estimated Pile Cutoff Elevation	Estimated Pile Tip Elevation (Depth below Footing)	Estimated Pile Length Depth (ft.)	Order Length (ft.)	Recommended Steel Grade for Pipe
NB Pier 5	16	658.6	966.2	891.2 (74)	75	80	3
NB Forward Abutment	14	390	1012	978 (33)	35	40	3
SB Pier 5	16	693.3	956.2	871.2 (84)	85	90	3
SB Forward Abutment	14	390	1012	958 (53)	55	60	3

1 NB Pier 5 and SB Pier 5 will utilize 16'' pip pile with minimum pipe thickness of 0.625 inches. The unfactored strength of the pile (maximum ultimate bearing value) is higher than the standard limit of 450-kip. All piles for pier 5 are recommended driven to the maximum strength load.

2 Based on drivability results, Grade 3 steel is required for the NB Pier 5. All the piles are recommended to use ASTM D 252 Grade 3 steel to be consistent.


NB Pier 5
Axial Capacity (kips)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Skin Friction
Tip Resistance
Total Capacity

```
=========================================================================

                 APILE for Windows, Version 2015.7.7

                  Serial Number :  139305292

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

=========================================================================

     This program is licensed to :

     Gannett Fleming, Inc.
     Columbus, OH

     Path to file locations      : W:\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Friction
Pile\APILE\NB Pier 5\
     Name of input data file     : SUM-8 NB PIER 5.ap7d
     Name of output file         : SUM-8 NB PIER 5.ap7o
     Name of plot output file    : SUM-8 NB PIER 5.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  February 28, 2019     Time:  13:33:30



1
          **********************
          * INPUT INFORMATION *
          **********************



          SUM-8-0199 NB Pier 5_12 inch

          DESIGNER   : TLM checked YLZ

          JOB NUMBER : 062368


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION


          PILE TYPE :

          Steel pipe pile or non-tapered portion of monotube pile
```

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 19.60 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 15.20 IN.
- TOTAL PILE LENGTH, TL = 100.00 FT.
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 100.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 15.20 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	121.50	28.50	0.00
22.20	SAND	0.00	121.50	28.50	0.00
22.20	SAND	0.00	63.00	28.50	0.00
26.20	SAND	0.00	63.00	28.50	0.00
26.20	CLAY	0.00	77.50	0.00	0.00
66.70	CLAY	0.00	77.50	0.00	0.00
66.70	SAND	0.00	87.50	36.50	0.00
105.00	SAND	0.00	87.50	36.50	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.30	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1.30	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
22.20	1.000	1.000
22.20	1.000	1.000
26.20	1.000	1.000
26.20	1.000	1.000
66.70	1.000	1.000
66.70	1.000	1.000
105.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.1	1.1
1.00	0.1	2.3	2.4
2.00	0.4	4.3	4.6
3.00	0.8	6.8	7.6
4.00	1.4	9.1	10.5
5.00	2.2	11.4	13.6
6.00	3.2	13.7	16.9
7.00	4.3	15.7	20.0
8.00	5.6	17.2	22.9
9.00	7.1	18.2	25.3
10.00	8.8	18.6	27.4
11.00	10.6	18.6	29.2
12.00	12.7	18.6	31.3
13.00	14.9	18.6	33.5
14.00	17.2	18.6	35.8
15.00	19.8	18.6	38.4
16.00	22.5	18.6	41.1
17.00	25.4	18.6	44.0
18.00	28.5	18.6	47.1
19.00	31.8	18.6	50.4
20.00	35.2	18.6	53.8
21.00	38.8	18.6	57.4
22.00	42.6	18.6	61.2
23.00	46.5	18.6	65.1
24.00	50.6	18.6	69.2
25.00	54.8	18.6	73.4
26.00	59.1	18.0	77.1
27.00	63.4	17.5	80.9
28.00	68.2	16.9	85.1
29.00	73.2	16.3	89.5
30.00	78.2	16.3	94.5
31.00	83.2	16.3	99.6
32.00	88.2	16.3	104.6
33.00	93.3	16.3	109.6
34.00	98.3	16.3	114.6
35.00	103.3	16.3	119.6
36.00	108.3	16.3	124.6
37.00	113.3	16.3	129.7

38.00	118.3	16.3	134.7
39.00	123.4	16.3	139.7
40.00	128.4	16.3	144.7
41.00	133.4	16.3	149.7
42.00	138.4	16.3	154.8
43.00	143.4	16.3	159.8
44.00	148.5	16.3	164.8
45.00	153.5	16.3	169.8
46.00	158.5	16.3	174.8
47.00	163.5	16.3	179.9
48.00	168.5	16.3	184.9
49.00	173.6	16.3	189.9
50.00	178.6	16.3	194.9
51.00	183.6	16.3	199.9
52.00	188.6	16.3	204.9
53.00	193.6	16.3	210.0
54.00	198.6	16.3	215.0
55.00	203.7	16.3	220.0
56.00	208.7	16.3	225.0
57.00	213.7	16.3	230.0
58.00	218.7	16.3	235.1
59.00	223.7	16.3	240.1
60.00	228.8	16.3	245.1
61.00	233.8	16.3	250.1
62.00	238.8	16.3	255.1
63.00	243.8	16.3	260.2
64.00	248.8	16.3	265.2
65.00	253.9	16.3	270.2
66.00	258.7	74.1	332.7
67.00	263.3	131.8	395.1
68.00	276.4	189.5	465.9
69.00	298.1	247.3	545.4
70.00	320.2	247.3	567.4
71.00	342.5	247.3	589.8
72.00	365.2	247.3	612.4
73.00	388.1	247.3	635.3
74.00	411.3	247.3	658.6
75.00	434.9	247.3	682.1
76.00	458.7	247.3	706.0
77.00	482.9	247.3	730.1
78.00	507.4	247.3	754.6
79.00	532.1	247.3	779.4
80.00	557.2	247.3	804.4
81.00	582.6	247.3	829.8
82.00	608.2	247.3	855.5
83.00	634.2	247.3	881.4
84.00	660.5	247.3	907.7
85.00	687.1	247.3	934.3
86.00	713.9	247.3	961.2
87.00	741.1	247.3	988.4
88.00	768.6	247.3	1015.9
89.00	796.4	247.3	1043.6
90.00	824.5	247.3	1071.7
91.00	852.9	247.3	1100.1
92.00	881.6	247.3	1128.8
93.00	910.6	247.3	1157.8
94.00	939.9	247.3	1187.1
95.00	969.5	247.3	1216.8
96.00	999.4	247.3	1246.7
97.00	1029.6	247.3	1276.9
98.00	1060.1	247.3	1307.4
99.00	1091.0	247.3	1338.2
100.00	1122.1	247.3	1369.3

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN

IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.4375E-01	0.1000E-01
			0.8749E-01	0.2000E-01
			0.1750E+00	0.4000E-01
			0.2625E+00	0.6000E-01
			0.3500E+00	0.8000E-01
			0.3937E+00	0.9000E-01
			0.4375E+00	0.1000E+00
			0.4375E+00	0.5000E+00
			0.4375E+00	0.2000E+01
2	10	0.1113E+02		
			0.0000E+00	0.0000E+00
			0.3500E+00	0.1000E-01
			0.6999E+00	0.2000E-01
			0.1400E+01	0.4000E-01
			0.2100E+01	0.6000E-01
			0.2800E+01	0.8000E-01
			0.3150E+01	0.9000E-01
			0.3500E+01	0.1000E+00
			0.3500E+01	0.5000E+00
			0.3500E+01	0.2000E+01
3	10	0.2216E+02		
			0.0000E+00	0.0000E+00
			0.6673E+00	0.1000E-01
			0.1335E+01	0.2000E-01
			0.2669E+01	0.4000E-01
			0.4004E+01	0.6000E-01
			0.5338E+01	0.8000E-01
			0.6005E+01	0.9000E-01
			0.6673E+01	0.1000E+00
			0.6673E+01	0.5000E+00
			0.6673E+01	0.2000E+01
4	10	0.2220E+02		
			0.0000E+00	0.0000E+00
			0.6673E+00	0.1000E-01
			0.1335E+01	0.2000E-01
			0.2669E+01	0.4000E-01
			0.4004E+01	0.6000E-01
			0.5338E+01	0.8000E-01
			0.6005E+01	0.9000E-01
			0.6673E+01	0.1000E+00
			0.6673E+01	0.5000E+00
			0.6673E+01	0.2000E+01
5	10	0.2423E+02		
			0.0000E+00	0.0000E+00
			0.7010E+00	0.1000E-01
			0.1402E+01	0.2000E-01
			0.2804E+01	0.4000E-01
			0.4206E+01	0.6000E-01
			0.5608E+01	0.8000E-01
			0.6309E+01	0.9000E-01
			0.7010E+01	0.1000E+00

```
                                    0.7010E+01      0.5000E+00
                                    0.7010E+01      0.2000E+01
 6          10      0.2616E+02
                                    0.0000E+00      0.0000E+00
                                    0.7527E+00      0.1000E-01
                                    0.1505E+01      0.2000E-01
                                    0.3011E+01      0.4000E-01
                                    0.4516E+01      0.6000E-01
                                    0.6021E+01      0.8000E-01
                                    0.6774E+01      0.9000E-01
                                    0.7527E+01      0.1000E+00
                                    0.7527E+01      0.5000E+00
                                    0.7527E+01      0.2000E+01
 7          10      0.2620E+02
                                    0.0000E+00      0.0000E+00
                                    0.2258E+01      0.2560E-01
                                    0.3763E+01      0.4960E-01
                                    0.5645E+01      0.9120E-01
                                    0.6774E+01      0.1280E+00
                                    0.7527E+01      0.1600E+00
                                    0.6774E+01      0.3200E+00
                                    0.6774E+01      0.4800E+00
                                    0.6774E+01      0.8000E+00
                                    0.6774E+01      0.3200E+01
 8          10      0.4648E+02
                                    0.0000E+00      0.0000E+00
                                    0.2496E+01      0.2560E-01
                                    0.4160E+01      0.4960E-01
                                    0.6240E+01      0.9120E-01
                                    0.7489E+01      0.1280E+00
                                    0.8321E+01      0.1600E+00
                                    0.7489E+01      0.3200E+00
                                    0.7489E+01      0.4800E+00
                                    0.7489E+01      0.8000E+00
                                    0.7489E+01      0.3200E+01
 9          10      0.6666E+02
                                    0.0000E+00      0.0000E+00
                                    0.4408E+01      0.2560E-01
                                    0.7346E+01      0.4960E-01
                                    0.1102E+02      0.9120E-01
                                    0.1322E+02      0.1280E+00
                                    0.1469E+02      0.1600E+00
                                    0.1322E+02      0.3200E+00
                                    0.1322E+02      0.4800E+00
                                    0.1322E+02      0.8000E+00
                                    0.1322E+02      0.3200E+01
10          10      0.6670E+02
                                    0.0000E+00      0.0000E+00
                                    0.1469E+01      0.1000E-01
                                    0.2939E+01      0.2000E-01
                                    0.5877E+01      0.4000E-01
                                    0.8816E+01      0.6000E-01
                                    0.1175E+02      0.8000E-01
                                    0.1322E+02      0.9000E-01
                                    0.1469E+02      0.1000E+00
                                    0.1469E+02      0.5000E+00
                                    0.1469E+02      0.2000E+01
11          10      0.8588E+02
                                    0.0000E+00      0.0000E+00
                                    0.4482E+01      0.1000E-01
                                    0.8964E+01      0.2000E-01
                                    0.1793E+02      0.4000E-01
                                    0.2689E+02      0.6000E-01
                                    0.3585E+02      0.8000E-01
                                    0.4034E+02      0.9000E-01
                                    0.4482E+02      0.1000E+00
                                    0.4482E+02      0.5000E+00
```

0.4482E+02 0.2000E+01

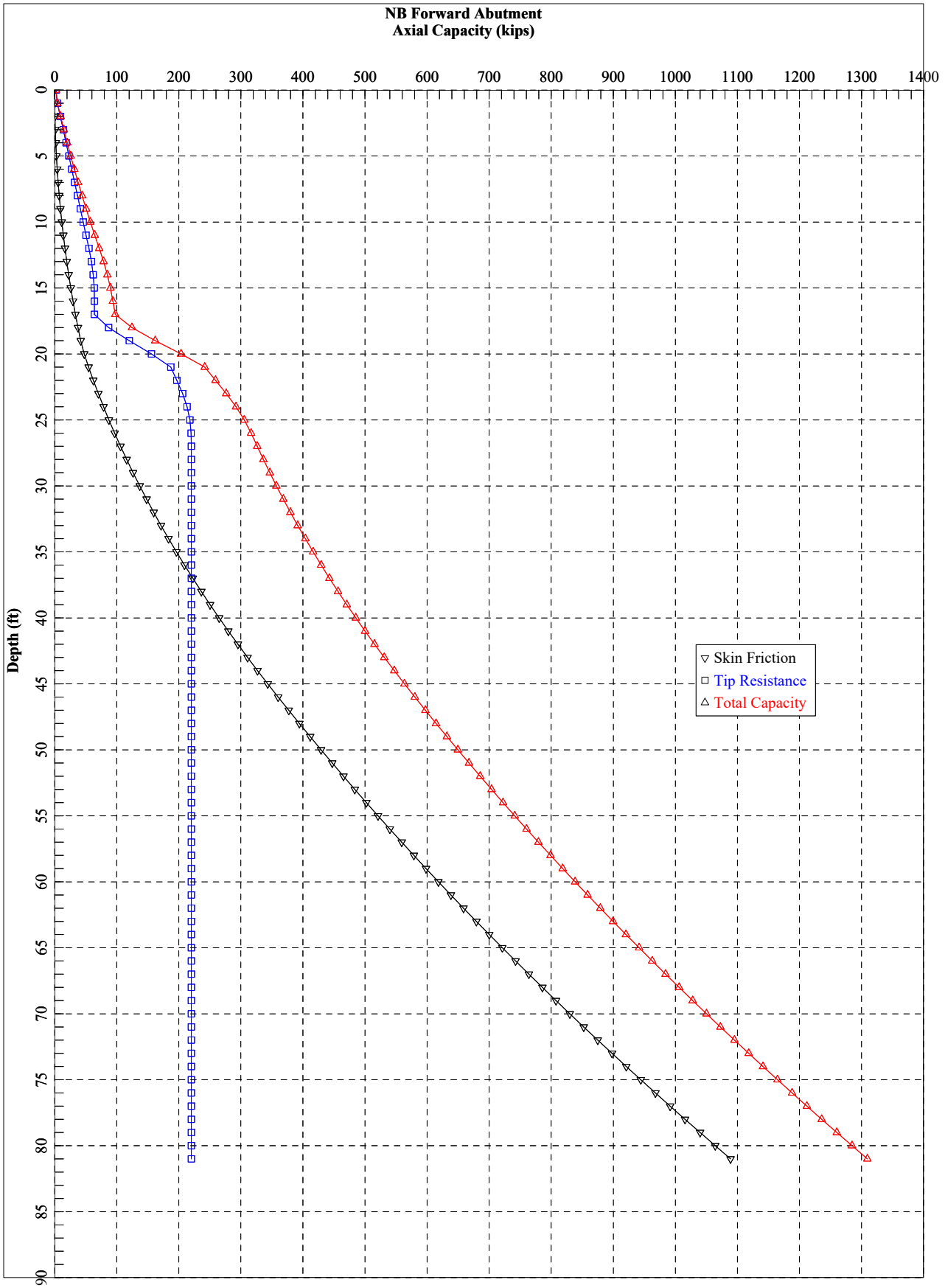
12 10 0.1050E+03

0.0000E+00 0.0000E+00
0.5160E+01 0.1000E-01
0.1032E+02 0.2000E-01
0.2064E+02 0.4000E-01
0.3096E+02 0.6000E-01
0.4128E+02 0.8000E-01
0.4644E+02 0.9000E-01
0.5160E+02 0.1000E+00
0.5160E+02 0.5000E+00
0.5160E+02 0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1545E+02	0.8000E-02
0.3091E+02	0.1600E-01
0.6181E+02	0.3200E-01
0.1236E+03	0.2080E+00
0.1854E+03	0.6720E+00
0.2225E+03	0.1168E+01
0.2473E+03	0.1600E+01
0.2473E+03	0.2400E+01
0.2473E+03	0.3200E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1259E+02	0.1086E-01	0.1932E+00	0.1000E-03
0.1264E+03	0.1098E+00	0.1932E+01	0.1000E-02
0.3608E+03	0.4057E+00	0.9658E+01	0.5000E-02
0.5139E+03	0.6600E+00	0.1932E+02	0.1000E-01
0.9778E+03	0.1563E+01	0.6813E+02	0.5000E-01
0.1111E+04	0.1883E+01	0.8569E+02	0.1000E+00
0.1188E+04	0.2445E+01	0.1625E+03	0.5000E+00
0.1235E+04	0.3045E+01	0.2100E+03	0.1000E+01
0.1273E+04	0.4124E+01	0.2473E+03	0.2000E+01


NB Forward Abutment
Axial Capacity (kips)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Skin Friction
Tip Resistance
Total Capacity

```
=========================================================================

                 APILE for Windows, Version 2015.7.7

                  Serial Number :  139305292

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

=========================================================================

     This program is licensed to :

     Gannett Fleming, Inc.
     Columbus, OH

     Path to file locations      : W:\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Friction
Pile\APILE\NB Abutment\
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     Name of plot output file    : SUM-8-0199 NB ABUTMENT.ap7p

     -------------------------------------------------------------------------
                          Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  February 28, 2019     Time:  13:43:48



1
          **********************
          * INPUT INFORMATION *
          **********************



          SUM-8-0199 NB Forward Abutment

          DESIGNER   : YLZ Checked TLM

          JOB NUMBER : 062368


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION


          PILE TYPE :

          Steel pipe pile or non-tapered portion of monotube pile
```

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 10.80 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
- INTERNAL DIAMETER, ID = 13.50 IN.
- TOTAL PILE LENGTH, TL = 81.00 FT.
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 81.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 13.50 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	128.00	33.50	0.00
18.50	SAND	0.00	128.00	33.50	0.00
18.50	SAND	0.00	140.50	37.00	0.00
44.50	SAND	0.00	140.50	37.00	0.00
44.50	SAND	0.00	83.00	37.00	0.00
85.00	SAND	0.00	83.00	37.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING

0.00	1.000	1.000
18.50	1.000	1.000
18.50	1.000	1.000
44.50	1.000	1.000
44.50	1.000	1.000
85.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.0	2.0
1.00	0.1	4.3	4.4
2.00	0.5	9.2	9.7
3.00	1.0	13.8	14.8
4.00	1.9	18.4	20.3
5.00	2.9	23.0	25.9
6.00	4.2	27.6	31.8
7.00	5.7	32.2	37.9
8.00	7.4	36.8	44.2
9.00	9.4	41.4	50.8
10.00	11.6	46.0	57.6
11.00	14.0	50.6	64.6
12.00	16.7	55.2	71.9
13.00	19.6	59.3	78.9
14.00	22.7	62.2	85.0
15.00	26.1	63.8	89.9
16.00	29.7	64.1	93.8
17.00	33.5	64.1	97.7
18.00	37.6	87.1	124.7
19.00	41.9	120.2	162.1
20.00	47.6	156.0	203.6
21.00	54.8	187.1	241.9
22.00	62.4	196.8	259.2
23.00	70.4	206.1	276.5
24.00	78.8	213.4	292.2
25.00	87.5	218.0	305.6
26.00	96.7	219.9	316.6
27.00	106.2	220.3	326.5
28.00	116.1	220.3	336.4
29.00	126.4	220.3	346.7
30.00	137.1	220.3	357.3
31.00	148.2	220.3	368.4
32.00	159.6	220.3	379.9
33.00	171.4	220.3	391.7
34.00	183.6	220.3	403.9
35.00	196.2	220.3	416.5
36.00	209.2	220.3	429.5
37.00	222.6	220.3	442.8
38.00	236.3	220.3	456.6
39.00	250.5	220.3	470.7
40.00	265.0	220.3	485.2
41.00	279.9	220.3	500.2
42.00	295.2	220.3	515.4
43.00	310.8	220.3	531.1

44.00	326.9	220.3	547.2
45.00	343.3	220.3	563.6
46.00	360.1	220.3	580.3
47.00	377.1	220.3	597.3
48.00	394.2	220.3	614.5
49.00	411.7	220.3	631.9
50.00	429.3	220.3	649.6
51.00	447.2	220.3	667.5
52.00	465.3	220.3	685.6
53.00	483.6	220.3	703.9
54.00	502.2	220.3	722.5
55.00	521.0	220.3	741.2
56.00	540.0	220.3	760.3
57.00	559.2	220.3	779.5
58.00	578.7	220.3	799.0
59.00	598.4	220.3	818.6
60.00	618.3	220.3	838.6
61.00	638.5	220.3	858.7
62.00	658.8	220.3	879.1
63.00	679.4	220.3	899.7
64.00	700.2	220.3	920.5
65.00	721.3	220.3	941.6
66.00	742.6	220.3	962.8
67.00	764.1	220.3	984.3
68.00	785.8	220.3	1006.1
69.00	807.8	220.3	1028.0
70.00	830.0	220.3	1050.2
71.00	852.4	220.3	1072.6
72.00	875.0	220.3	1095.3
73.00	897.9	220.3	1118.2
74.00	921.0	220.3	1141.2
75.00	944.3	220.3	1164.6
76.00	967.9	220.3	1188.1
77.00	991.6	220.3	1211.9
78.00	1015.6	220.3	1235.9
79.00	1039.9	220.3	1260.1
80.00	1064.3	220.3	1284.6
81.00	1089.0	220.3	1309.3

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E-01
			0.6592E-01	0.1000E-01
			0.1318E+00	0.2000E-01
			0.2637E+00	0.4000E-01
			0.3955E+00	0.6000E-01
			0.5274E+00	0.8000E-01
			0.5933E+00	0.9000E-01
			0.6592E+00	0.1000E+00
			0.6592E+00	0.5000E+00
			0.6592E+00	0.2000E+01

2	10	0.9275E+01		
			0.0000E+00	0.0000E+00
			0.4395E+00	0.1000E-01
			0.8789E+00	0.2000E-01
			0.1758E+01	0.4000E-01
			0.2637E+01	0.6000E-01
			0.3516E+01	0.8000E-01
			0.3955E+01	0.9000E-01
			0.4395E+01	0.1000E+00
			0.4395E+01	0.5000E+00
			0.4395E+01	0.2000E+01
3	10	0.1846E+02		
			0.0000E+00	0.0000E+00
			0.9483E+00	0.1000E-01
			0.1897E+01	0.2000E-01
			0.3793E+01	0.4000E-01
			0.5690E+01	0.6000E-01
			0.7586E+01	0.8000E-01
			0.8534E+01	0.9000E-01
			0.9483E+01	0.1000E+00
			0.9483E+01	0.5000E+00
			0.9483E+01	0.2000E+01
4	10	0.1850E+02		
			0.0000E+00	0.0000E+00
			0.9483E+00	0.1000E-01
			0.1897E+01	0.2000E-01
			0.3793E+01	0.4000E-01
			0.5690E+01	0.6000E-01
			0.7586E+01	0.8000E-01
			0.8534E+01	0.9000E-01
			0.9483E+01	0.1000E+00
			0.9483E+01	0.5000E+00
			0.9483E+01	0.2000E+01
5	10	0.3153E+02		
			0.0000E+00	0.0000E+00
			0.2205E+01	0.1000E-01
			0.4410E+01	0.2000E-01
			0.8820E+01	0.4000E-01
			0.1323E+02	0.6000E-01
			0.1764E+02	0.8000E-01
			0.1985E+02	0.9000E-01
			0.2205E+02	0.1000E+00
			0.2205E+02	0.5000E+00
			0.2205E+02	0.2000E+01
6	10	0.4446E+02		
			0.0000E+00	0.0000E+00
			0.3143E+01	0.1000E-01
			0.6287E+01	0.2000E-01
			0.1257E+02	0.4000E-01
			0.1886E+02	0.6000E-01
			0.2515E+02	0.8000E-01
			0.2829E+02	0.9000E-01
			0.3143E+02	0.1000E+00
			0.3143E+02	0.5000E+00
			0.3143E+02	0.2000E+01
7	10	0.4450E+02		
			0.0000E+00	0.0000E+00
			0.3143E+01	0.1000E-01
			0.6287E+01	0.2000E-01
			0.1257E+02	0.4000E-01
			0.1886E+02	0.6000E-01
			0.2515E+02	0.8000E-01
			0.2829E+02	0.9000E-01
			0.3143E+02	0.1000E+00
			0.3143E+02	0.5000E+00
			0.3143E+02	0.2000E+01
8	10	0.6478E+02		

			0.0000E+00	0.0000E+00
			0.4010E+01	0.1000E-01
			0.8021E+01	0.2000E-01
			0.1604E+02	0.4000E-01
			0.2406E+02	0.6000E-01
			0.3208E+02	0.8000E-01
			0.3609E+02	0.9000E-01
			0.4010E+02	0.1000E+00
			0.4010E+02	0.5000E+00
			0.4010E+02	0.2000E+01
9	10	0.8496E+02		
			0.0000E+00	0.0000E+00
			0.4677E+01	0.1000E-01
			0.9353E+01	0.2000E-01
			0.1871E+02	0.4000E-01
			0.2806E+02	0.6000E-01
			0.3741E+02	0.8000E-01
			0.4209E+02	0.9000E-01
			0.4677E+02	0.1000E+00
			0.4677E+02	0.5000E+00
			0.4677E+02	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1377E+02	0.7000E-02
0.2753E+02	0.1400E-01
0.5506E+02	0.2800E-01
0.1101E+03	0.1820E+00
0.1652E+03	0.5880E+00
0.1982E+03	0.1022E+01
0.2203E+03	0.1400E+01
0.2203E+03	0.2100E+01
0.2203E+03	0.2800E+01

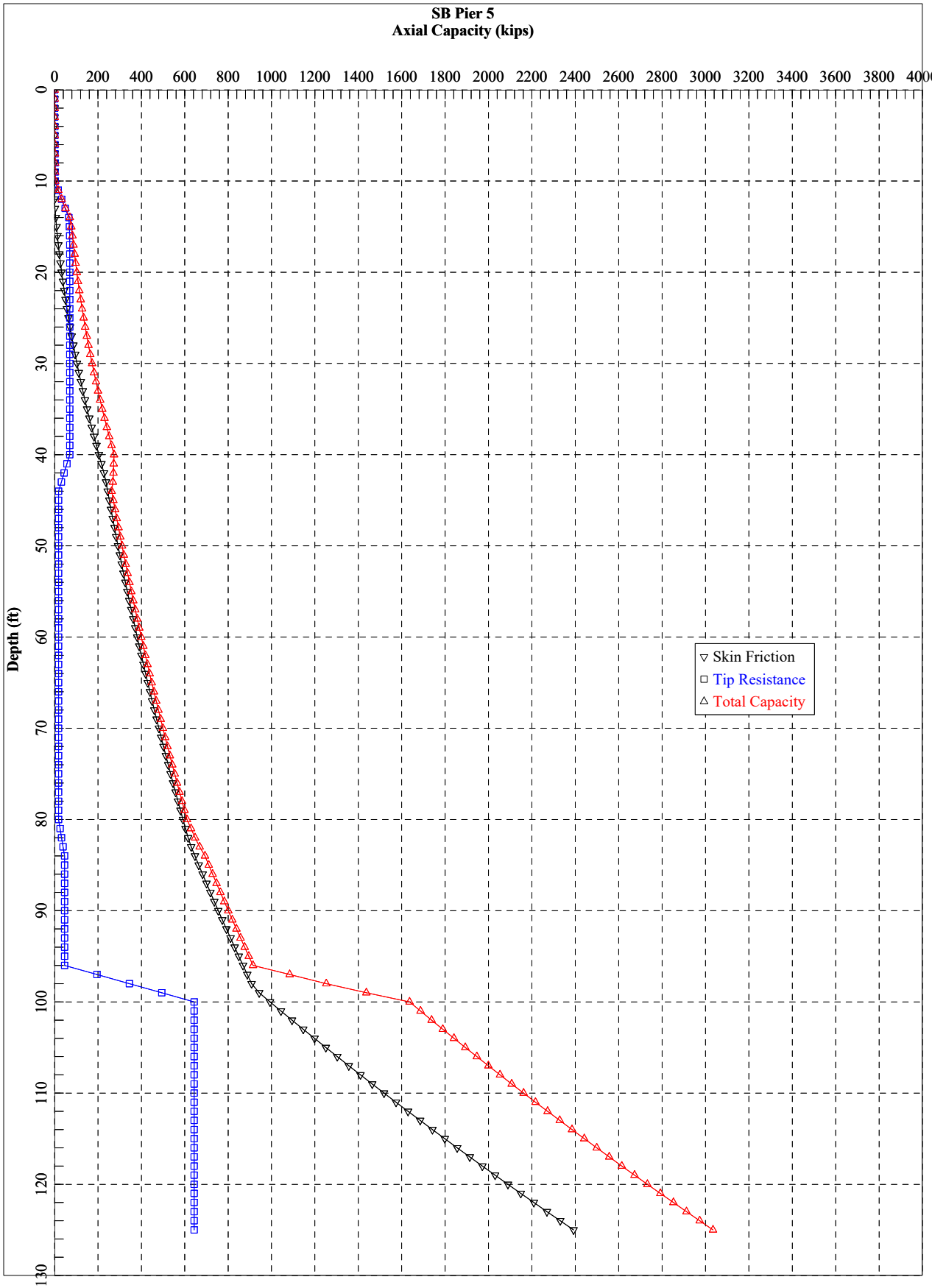
LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3205E+02	0.3477E-01	0.1967E+00	0.1000E-03
0.2694E+03	0.3344E+00	0.1967E+01	0.1000E-02
0.5968E+03	0.9617E+00	0.9833E+01	0.5000E-02
0.7521E+03	0.1334E+01	0.1967E+02	0.1000E-01
0.1082E+04	0.2274E+01	0.6293E+02	0.5000E-01
0.1168E+04	0.2582E+01	0.8081E+02	0.1000E+00
0.1240E+04	0.3207E+01	0.1533E+03	0.5000E+00
0.1284E+04	0.3841E+01	0.1966E+03	0.1000E+01
0.1307E+04	0.4915E+01	0.2203E+03	0.2000E+01

****
* COMPUTE INTERNALLY-GENERATED LOAD-TRANSFER *
* (t-z) CURVES FOR VERIFICATION *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.

```
1         10      0.0000E+00
                                  0.0000E+00      0.0000E+00
                                  0.6592E-01      0.1000E-01
                                  0.1318E+00      0.2000E-01
                                  0.2637E+00      0.4000E-01
                                  0.3955E+00      0.6000E-01
                                  0.5274E+00      0.8000E-01
                                  0.5933E+00      0.9000E-01
                                  0.6592E+00      0.1000E+00
                                  0.6592E+00      0.5000E+00
                                  0.6592E+00      0.2000E+01
```


SB Pier 5
Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Skin Friction
Tip Resistance
Total Capacity

```
=========================================================================

                 APILE for Windows, Version 2015.7.7

                  Serial Number :  139305292

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

=========================================================================

     This program is licensed to :

     Gannett Fleming, Inc.
     Columbus, OH

     Path to file locations      : W:\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Friction
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     Name of plot output file    : SUM-8-0199 SB PIER 5.ap7p

     -------------------------------------------------------------------------
                         Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  February 28, 2019     Time:  11:34:09



1
          **********************
          * INPUT INFORMATION *
          **********************



          SUM-8-0199 SB Pier 5

          DESIGNER   : YLZ checked TLM

          JOB NUMBER : 062368


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION


          PILE TYPE :

          Steel pipe pile or non-tapered portion of monotube pile
```

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 19.60 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 16.00 IN.
- INTERNAL DIAMETER, ID = 15.20 IN.
- TOTAL PILE LENGTH, TL = 125.00 FT.
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED
  END SECTION = 125.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION = 15.20 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	110.00	1.00	0.00
11.20	SAND	0.00	110.00	1.00	0.00
11.20	SAND	0.00	134.00	33.00	0.00
37.70	SAND	0.00	134.00	33.00	0.00
37.70	SAND	0.00	76.50	33.00	0.00
41.20	SAND	0.00	76.50	33.00	0.00
41.20	SAND	0.00	77.50	28.50	0.00
81.70	SAND	0.00	77.50	28.50	0.00
81.70	SAND	0.00	85.50	32.00	0.00
97.70	SAND	0.00	85.50	32.00	0.00
97.70	SAND	0.00	87.50	40.50	0.00
130.00	SAND	0.00	87.50	40.50	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

0.10E+08* 0.10E+08* 0.00 0.00 0.00 0.00 0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	0.000	1.000
11.20	0.000	1.000
11.20	1.000	1.000
37.70	1.000	1.000
37.70	1.000	1.000
41.20	1.000	1.000
41.20	1.000	1.000
81.70	1.000	1.000
81.70	1.000	1.000
97.70	1.000	1.000
97.70	1.000	1.000
130.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.1	0.1
1.00	0.0	0.3	0.3
2.00	0.0	0.5	0.5
3.00	0.0	0.8	0.8
4.00	0.0	1.1	1.1
5.00	0.0	1.3	1.3
6.00	0.0	1.6	1.6
7.00	0.0	1.9	1.9
8.00	0.0	2.2	2.2
9.00	0.0	2.4	2.4
10.00	0.0	2.7	2.7
11.00	0.0	16.9	16.9
12.00	0.1	32.4	32.5
13.00	1.8	48.9	50.6
14.00	5.3	65.6	70.8
15.00	9.1	68.3	77.3
16.00	13.2	69.5	82.7
17.00	17.6	69.8	87.4
18.00	22.4	69.8	92.2
19.00	27.4	69.8	97.2
20.00	32.7	69.8	102.6
21.00	38.4	69.8	108.2
22.00	44.4	69.8	114.2
23.00	50.7	69.8	120.5
24.00	57.2	69.8	127.1
25.00	64.1	69.8	134.0

26.00	71.3	69.8	141.2
27.00	78.9	69.8	148.7
28.00	86.7	69.8	156.5
29.00	94.8	69.8	164.6
30.00	103.2	69.8	173.1
31.00	112.0	69.8	181.8
32.00	121.0	69.8	190.9
33.00	130.4	69.8	200.2
34.00	140.1	69.8	209.9
35.00	150.1	69.8	219.9
36.00	160.3	69.8	230.2
37.00	170.9	69.8	240.8
38.00	181.8	69.8	251.7
39.00	193.0	69.8	262.8
40.00	204.3	69.8	274.1
41.00	215.8	57.0	272.8
42.00	227.5	44.2	271.7
43.00	237.1	31.4	268.5
44.00	244.7	18.6	263.3
45.00	252.4	18.6	271.0
46.00	260.2	18.6	278.8
47.00	268.1	18.6	286.7
48.00	276.1	18.6	294.7
49.00	284.2	18.6	302.8
50.00	292.5	18.6	311.1
51.00	300.8	18.6	319.4
52.00	309.3	18.6	327.9
53.00	317.8	18.6	336.4
54.00	326.5	18.6	345.1
55.00	335.3	18.6	353.9
56.00	344.3	18.6	362.9
57.00	353.3	18.6	371.9
58.00	362.4	18.6	381.0
59.00	371.7	18.6	390.3
60.00	381.0	18.6	399.6
61.00	390.5	18.6	409.1
62.00	400.1	18.6	418.7
63.00	409.8	18.6	428.4
64.00	419.6	18.6	438.2
65.00	429.5	18.6	448.1
66.00	439.6	18.6	458.2
67.00	449.7	18.6	468.3
68.00	460.0	18.6	478.6
69.00	470.3	18.6	488.9
70.00	480.8	18.6	499.4
71.00	491.4	18.6	510.0
72.00	502.1	18.6	520.7
73.00	512.9	18.6	531.5
74.00	523.9	18.6	542.5
75.00	534.9	18.6	553.5
76.00	546.1	18.6	564.7
77.00	557.4	18.6	576.0
78.00	568.7	18.6	587.3
79.00	580.2	18.6	598.8
80.00	591.8	18.6	610.4
81.00	603.6	25.5	629.0
82.00	615.4	32.3	647.7
83.00	629.9	39.2	669.1
84.00	647.2	46.1	693.3
85.00	664.7	46.1	710.8
86.00	682.4	46.1	728.4
87.00	700.2	46.1	746.3
88.00	718.2	46.1	764.3
89.00	736.4	46.1	782.5
90.00	754.8	46.1	800.8
91.00	773.3	46.1	819.4
92.00	792.0	46.1	838.1

93.00	810.9	46.1	857.0
94.00	830.0	46.1	876.1
95.00	849.3	46.1	895.3
96.00	868.7	46.1	914.8
97.00	888.3	195.3	1083.6
98.00	908.1	344.6	1252.7
99.00	943.0	493.8	1436.8
100.00	993.0	643.1	1636.1
101.00	1043.6	643.1	1686.6
102.00	1094.6	643.1	1737.6
103.00	1146.0	643.1	1789.1
104.00	1197.9	643.1	1840.9
105.00	1250.2	643.1	1893.3
106.00	1303.0	643.1	1946.1
107.00	1356.3	643.1	1999.3
108.00	1409.9	643.1	2053.0
109.00	1464.1	643.1	2107.2
110.00	1518.7	643.1	2161.8
111.00	1573.7	643.1	2216.8
112.00	1629.2	643.1	2272.3
113.00	1685.2	643.1	2328.3
114.00	1741.6	643.1	2384.7
115.00	1798.4	643.1	2441.5
116.00	1855.8	643.1	2498.8
117.00	1913.5	643.1	2556.6
118.00	1971.7	643.1	2614.8
119.00	2030.4	643.1	2673.4
120.00	2089.5	643.1	2732.5
121.00	2149.0	643.1	2792.1
122.00	2209.1	643.1	2852.1
123.00	2269.5	643.1	2912.6
124.00	2330.4	643.1	2973.5
125.00	2391.8	643.1	3034.9

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.1225E-02	0.1000E-01
			0.2450E-02	0.2000E-01
			0.4900E-02	0.4000E-01
			0.7350E-02	0.6000E-01
			0.9800E-02	0.8000E-01
			0.1102E-01	0.9000E-01
			0.1225E-01	0.1000E+00
			0.1225E-01	0.5000E+00
			0.1225E-01	0.2000E+01
2	10	0.5625E+01		
			0.0000E+00	0.0000E+00
			0.4900E-02	0.1000E-01
			0.9800E-02	0.2000E-01
			0.1960E-01	0.4000E-01

```
                                  0.2940E-01      0.6000E-01
                                  0.3920E-01      0.8000E-01
                                  0.4410E-01      0.9000E-01
                                  0.4900E-01      0.1000E+00
                                  0.4900E-01      0.5000E+00
                                  0.4900E-01      0.2000E+01
3         10      0.1116E+02
                                  0.0000E+00      0.0000E+00
                                  0.1459E+00      0.1000E-01
                                  0.2918E+00      0.2000E-01
                                  0.5835E+00      0.4000E-01
                                  0.8753E+00      0.6000E-01
                                  0.1167E+01      0.8000E-01
                                  0.1313E+01      0.9000E-01
                                  0.1459E+01      0.1000E+00
                                  0.1459E+01      0.5000E+00
                                  0.1459E+01      0.2000E+01
4         10      0.1120E+02
                                  0.0000E+00      0.0000E+00
                                  0.1459E+00      0.1000E-01
                                  0.2918E+00      0.2000E-01
                                  0.5835E+00      0.4000E-01
                                  0.8753E+00      0.6000E-01
                                  0.1167E+01      0.8000E-01
                                  0.1313E+01      0.9000E-01
                                  0.1459E+01      0.1000E+00
                                  0.1459E+01      0.5000E+00
                                  0.1459E+01      0.2000E+01
5         10      0.2448E+02
                                  0.0000E+00      0.0000E+00
                                  0.1169E+01      0.1000E-01
                                  0.2337E+01      0.2000E-01
                                  0.4675E+01      0.4000E-01
                                  0.7012E+01      0.6000E-01
                                  0.9349E+01      0.8000E-01
                                  0.1052E+02      0.9000E-01
                                  0.1169E+02      0.1000E+00
                                  0.1169E+02      0.5000E+00
                                  0.1169E+02      0.2000E+01
6         10      0.3766E+02
                                  0.0000E+00      0.0000E+00
                                  0.1828E+01      0.1000E-01
                                  0.3656E+01      0.2000E-01
                                  0.7312E+01      0.4000E-01
                                  0.1097E+02      0.6000E-01
                                  0.1462E+02      0.8000E-01
                                  0.1645E+02      0.9000E-01
                                  0.1828E+02      0.1000E+00
                                  0.1828E+02      0.5000E+00
                                  0.1828E+02      0.2000E+01
7         10      0.3770E+02
                                  0.0000E+00      0.0000E+00
                                  0.1828E+01      0.1000E-01
                                  0.3656E+01      0.2000E-01
                                  0.7312E+01      0.4000E-01
                                  0.1097E+02      0.6000E-01
                                  0.1462E+02      0.8000E-01
                                  0.1645E+02      0.9000E-01
                                  0.1828E+02      0.1000E+00
                                  0.1828E+02      0.5000E+00
                                  0.1828E+02      0.2000E+01
8         10      0.3948E+02
                                  0.0000E+00      0.0000E+00
                                  0.1892E+01      0.1000E-01
                                  0.3784E+01      0.2000E-01
                                  0.7568E+01      0.4000E-01
                                  0.1135E+02      0.6000E-01
```

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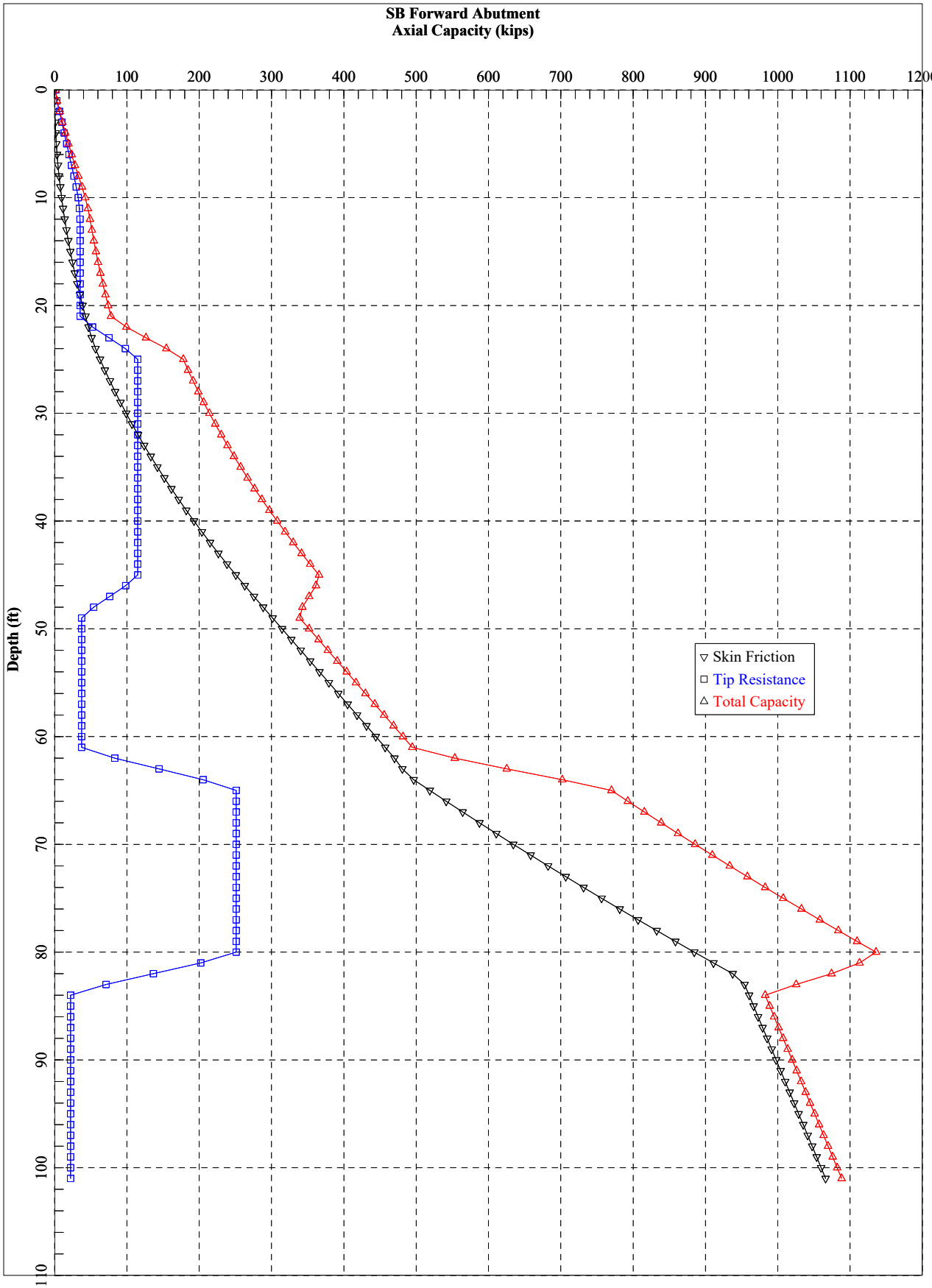
                                  0.1514E+02      0.8000E-01
                                  0.1703E+02      0.9000E-01
                                  0.1892E+02      0.1000E+00
                                  0.1892E+02      0.5000E+00
                                  0.1892E+02      0.2000E+01
 9          10      0.4116E+02
                                  0.0000E+00      0.0000E+00
                                  0.1767E+01      0.1000E-01
                                  0.3533E+01      0.2000E-01
                                  0.7067E+01      0.4000E-01
                                  0.1060E+02      0.6000E-01
                                  0.1413E+02      0.8000E-01
                                  0.1590E+02      0.9000E-01
                                  0.1767E+02      0.1000E+00
                                  0.1767E+02      0.5000E+00
                                  0.1767E+02      0.2000E+01
10          10      0.4120E+02
                                  0.0000E+00      0.0000E+00
                                  0.1767E+01      0.1000E-01
                                  0.3533E+01      0.2000E-01
                                  0.7067E+01      0.4000E-01
                                  0.1060E+02      0.6000E-01
                                  0.1413E+02      0.8000E-01
                                  0.1590E+02      0.9000E-01
                                  0.1767E+02      0.1000E+00
                                  0.1767E+02      0.5000E+00
                                  0.1767E+02      0.2000E+01
11          10      0.6148E+02
                                  0.0000E+00      0.0000E+00
                                  0.1599E+01      0.1000E-01
                                  0.3197E+01      0.2000E-01
                                  0.6395E+01      0.4000E-01
                                  0.9592E+01      0.6000E-01
                                  0.1279E+02      0.8000E-01
                                  0.1439E+02      0.9000E-01
                                  0.1599E+02      0.1000E+00
                                  0.1599E+02      0.5000E+00
                                  0.1599E+02      0.2000E+01
12          10      0.8166E+02
                                  0.0000E+00      0.0000E+00
                                  0.2187E+01      0.1000E-01
                                  0.4374E+01      0.2000E-01
                                  0.8747E+01      0.4000E-01
                                  0.1312E+02      0.6000E-01
                                  0.1749E+02      0.8000E-01
                                  0.1968E+02      0.9000E-01
                                  0.2187E+02      0.1000E+00
                                  0.2187E+02      0.5000E+00
                                  0.2187E+02      0.2000E+01
13          10      0.8170E+02
                                  0.0000E+00      0.0000E+00
                                  0.2187E+01      0.1000E-01
                                  0.4374E+01      0.2000E-01
                                  0.8747E+01      0.4000E-01
                                  0.1312E+02      0.6000E-01
                                  0.1749E+02      0.8000E-01
                                  0.1968E+02      0.9000E-01
                                  0.2187E+02      0.1000E+00
                                  0.2187E+02      0.5000E+00
                                  0.2187E+02      0.2000E+01
14          10      0.8973E+02
                                  0.0000E+00      0.0000E+00
                                  0.3060E+01      0.1000E-01
                                  0.6119E+01      0.2000E-01
                                  0.1224E+02      0.4000E-01
                                  0.1836E+02      0.6000E-01
                                  0.2448E+02      0.8000E-01
```

			0.2754E+02	0.9000E-01
			0.3060E+02	0.1000E+00
			0.3060E+02	0.5000E+00
			0.3060E+02	0.2000E+01
15	10	0.9766E+02		
			0.0000E+00	0.0000E+00
			0.4530E+01	0.1000E-01
			0.9060E+01	0.2000E-01
			0.1812E+02	0.4000E-01
			0.2718E+02	0.6000E-01
			0.3624E+02	0.8000E-01
			0.4077E+02	0.9000E-01
			0.4530E+02	0.1000E+00
			0.4530E+02	0.5000E+00
			0.4530E+02	0.2000E+01
16	10	0.9770E+02		
			0.0000E+00	0.0000E+00
			0.4530E+01	0.1000E-01
			0.9060E+01	0.2000E-01
			0.1812E+02	0.4000E-01
			0.2718E+02	0.6000E-01
			0.3624E+02	0.8000E-01
			0.4077E+02	0.9000E-01
			0.4530E+02	0.1000E+00
			0.4530E+02	0.5000E+00
			0.4530E+02	0.2000E+01
17	10	0.1139E+03		
			0.0000E+00	0.0000E+00
			0.9388E+01	0.1000E-01
			0.1878E+02	0.2000E-01
			0.3755E+02	0.4000E-01
			0.5633E+02	0.6000E-01
			0.7510E+02	0.8000E-01
			0.8449E+02	0.9000E-01
			0.9388E+02	0.1000E+00
			0.9388E+02	0.5000E+00
			0.9388E+02	0.2000E+01
18	10	0.1300E+03		
			0.0000E+00	0.0000E+00
			0.1017E+02	0.1000E-01
			0.2035E+02	0.2000E-01
			0.4070E+02	0.4000E-01
			0.6104E+02	0.6000E-01
			0.8139E+02	0.8000E-01
			0.9156E+02	0.9000E-01
			0.1017E+03	0.1000E+00
			0.1017E+03	0.5000E+00
			0.1017E+03	0.2000E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.4019E+02	0.8000E-02
0.8038E+02	0.1600E-01
0.1608E+03	0.3200E-01
0.3215E+03	0.2080E+00
0.4823E+03	0.6720E+00
0.5788E+03	0.1168E+01
0.6431E+03	0.1600E+01
0.6431E+03	0.2400E+01
0.6431E+03	0.3200E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2483E+03	0.2143E+00	0.5024E+00	0.1000E-03
0.7889E+03	0.1005E+01	0.5024E+01	0.1000E-02
0.1316E+04	0.2121E+01	0.2512E+02	0.5000E-02
0.1617E+04	0.2826E+01	0.5024E+02	0.1000E-01
0.2336E+04	0.4651E+01	0.1772E+03	0.5000E-01
0.2510E+04	0.5153E+01	0.2229E+03	0.1000E+00
0.2710E+04	0.6080E+01	0.4227E+03	0.5000E+00
0.2833E+04	0.6906E+01	0.5461E+03	0.1000E+01
0.2930E+04	0.8162E+01	0.6431E+03	0.2000E+01


SB Forward Abutment
Axial Capacity (kips)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Skin Friction
Tip Resistance
Total Capacity

```
=========================================================================

                 APILE for Windows, Version 2015.7.7

                  Serial Number :  139305292

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2015
                      All Rights Reserved

=========================================================================

     This program is licensed to :

     Gannett Fleming, Inc.
     Columbus, OH

     Path to file locations      : W:\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Friction
Pile\APILE\SB Abutment\
     Name of input data file     : SUM-8-0199 SB F ABT.ap7d
     Name of output file         : SUM-8-0199 SB F ABT.ap7o
     Name of plot output file    : SUM-8-0199 SB F ABT.ap7p

     -------------------------------------------------------------------------
                         Time and Date of Analysis
     -------------------------------------------------------------------------

               Date:  February 28, 2019     Time:  13:50:08



1
          **********************
          * INPUT INFORMATION *
          **********************



          SUM-8-0199 SB Forward Abutment

          DESIGNER   : YLZ Checked TLM

          JOB NUMBER : 062368


          METHOD FOR UNIT LOAD TRANSFERS :

          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.



          COMPUTATION METHOD(S) FOR PILE CAPACITY :

          - FHWA (Federal Highway Administration)


          TYPE OF LOADING :
          - COMPRESSION


          PILE TYPE :

          Steel pipe pile or non-tapered portion of monotube pile
```

- Close-Ended Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 10.80 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 14.00 IN.
- INTERNAL DIAMETER, ID = 13.50 IN.
- TOTAL PILE LENGTH, TL = 101.00 FT.
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 101.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 13.50 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Internal Pile Plug Calculated by Program

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	124.00	32.00	0.00
22.50	SAND	0.00	124.00	32.00	0.00
22.50	SAND	0.00	140.50	35.00	0.00
45.50	SAND	0.00	140.50	35.00	0.00
45.50	SAND	0.00	83.00	35.00	0.00
47.00	SAND	0.00	83.00	35.00	0.00
47.00	CLAY	0.00	87.50	0.00	0.00
63.00	CLAY	0.00	87.50	0.00	0.00
63.00	SAND	0.00	87.50	37.50	0.00
82.00	SAND	0.00	87.50	37.50	0.00
82.00	CLAY	0.00	84.00	0.00	0.00
105.00	CLAY	0.00	84.00	0.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.90	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	3.90	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.30	0.00	0.00	0.00	0.00

0.10E+08* 0.10E+08* 2.30 0.00 0.00 0.00 0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
22.50	1.000	1.000
22.50	1.000	1.000
45.50	1.000	1.000
45.50	1.000	1.000
47.00	1.000	1.000
47.00	1.000	1.000
63.00	1.000	1.000
63.00	1.000	1.000
82.00	1.000	1.000
82.00	1.000	1.000
105.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.5	1.5
1.00	0.1	3.1	3.2
2.00	0.4	6.7	7.1
3.00	0.9	10.1	10.9
4.00	1.6	13.4	15.0
5.00	2.4	16.8	19.2
6.00	3.5	20.1	23.6
7.00	4.7	23.5	28.2
8.00	6.2	26.8	33.0
9.00	7.9	30.0	37.9
10.00	9.7	32.7	42.4
11.00	11.7	34.4	46.1
12.00	14.0	35.1	49.1
13.00	16.4	35.3	51.7
14.00	19.0	35.3	54.3
15.00	21.8	35.3	57.1
16.00	24.8	35.3	60.1
17.00	28.0	35.3	63.3
18.00	31.4	35.3	66.7
19.00	35.0	35.3	70.3
20.00	38.8	35.3	74.1
21.00	42.7	35.3	78.0
22.00	46.9	52.4	99.3
23.00	51.3	75.2	126.4
24.00	56.6	97.9	154.5
25.00	62.9	115.0	178.0

26.00	69.6	115.0	184.6
27.00	76.5	115.0	191.5
28.00	83.7	115.0	198.7
29.00	91.2	115.0	206.2
30.00	99.0	115.0	214.0
31.00	107.0	115.0	222.1
32.00	115.4	115.0	230.4
33.00	124.0	115.0	239.1
34.00	133.0	115.0	248.0
35.00	142.2	115.0	257.3
36.00	151.8	115.0	266.8
37.00	161.6	115.0	276.6
38.00	171.7	115.0	286.7
39.00	182.1	115.0	297.1
40.00	192.8	115.0	307.8
41.00	203.8	115.0	318.8
42.00	215.0	115.0	330.0
43.00	226.6	115.0	341.6
44.00	238.4	115.0	353.5
45.00	250.6	115.0	365.6
46.00	263.0	98.4	361.4
47.00	275.7	76.3	351.9
48.00	288.5	54.1	342.7
49.00	301.5	37.5	339.0
50.00	314.5	37.5	352.0
51.00	327.4	37.5	365.0
52.00	340.4	37.5	377.9
53.00	353.4	37.5	390.9
54.00	366.3	37.5	403.9
55.00	379.3	37.5	416.8
56.00	392.3	37.5	429.8
57.00	405.2	37.5	442.8
58.00	418.2	37.5	455.7
59.00	431.2	37.5	468.7
60.00	444.1	37.5	481.7
61.00	457.1	37.5	494.6
62.00	470.1	83.3	553.4
63.00	481.0	144.4	625.3
64.00	496.5	205.4	701.9
65.00	518.9	251.2	770.1
66.00	541.5	251.2	792.7
67.00	564.3	251.2	815.5
68.00	587.4	251.2	838.7
69.00	610.8	251.2	862.0
70.00	634.4	251.2	885.6
71.00	658.3	251.2	909.5
72.00	682.4	251.2	933.6
73.00	706.8	251.2	958.0
74.00	731.4	251.2	982.6
75.00	756.3	251.2	1007.5
76.00	781.4	251.2	1032.7
77.00	806.8	251.2	1058.1
78.00	832.5	251.2	1083.7
79.00	858.4	251.2	1109.6
80.00	884.6	251.2	1135.8
81.00	911.0	202.1	1113.1
82.00	937.6	136.7	1074.3
83.00	954.1	71.2	1025.4
84.00	960.4	22.1	982.5
85.00	966.6	22.1	988.7
86.00	972.8	22.1	994.9
87.00	979.0	22.1	1001.2
88.00	985.3	22.1	1007.4
89.00	991.5	22.1	1013.6
90.00	997.7	22.1	1019.8
91.00	1003.9	22.1	1026.1
92.00	1010.2	22.1	1032.3

93.00	1016.4	22.1	1038.5
94.00	1022.6	22.1	1044.7
95.00	1028.8	22.1	1051.0
96.00	1035.1	22.1	1057.2
97.00	1041.3	22.1	1063.4
98.00	1047.5	22.1	1069.6
99.00	1053.7	22.1	1075.9
100.00	1060.0	22.1	1082.1
101.00	1066.2	22.1	1088.3

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5510E-01	0.1000E-01
			0.1102E+00	0.2000E-01
			0.2204E+00	0.4000E-01
			0.3306E+00	0.6000E-01
			0.4408E+00	0.8000E-01
			0.4959E+00	0.9000E-01
			0.5510E+00	0.1000E+00
			0.5510E+00	0.5000E+00
			0.5510E+00	0.2000E+01
2	10	0.1128E+02		
			0.0000E+00	0.0000E+00
			0.4408E+00	0.1000E-01
			0.8816E+00	0.2000E-01
			0.1763E+01	0.4000E-01
			0.2645E+01	0.6000E-01
			0.3526E+01	0.8000E-01
			0.3967E+01	0.9000E-01
			0.4408E+01	0.1000E+00
			0.4408E+01	0.5000E+00
			0.4408E+01	0.2000E+01
3	10	0.2246E+02		
			0.0000E+00	0.0000E+00
			0.9175E+00	0.1000E-01
			0.1835E+01	0.2000E-01
			0.3670E+01	0.4000E-01
			0.5505E+01	0.6000E-01
			0.7340E+01	0.8000E-01
			0.8258E+01	0.9000E-01
			0.9175E+01	0.1000E+00
			0.9175E+01	0.5000E+00
			0.9175E+01	0.2000E+01
4	10	0.2250E+02		
			0.0000E+00	0.0000E+00
			0.9175E+00	0.1000E-01
			0.1835E+01	0.2000E-01
			0.3670E+01	0.4000E-01
			0.5505E+01	0.6000E-01
			0.7340E+01	0.8000E-01

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                                0.8258E+01      0.9000E-01
                                0.9175E+01      0.1000E+00
                                0.9175E+01      0.5000E+00
                                0.9175E+01      0.2000E+01
 5          10      0.3403E+02
                                0.0000E+00      0.0000E+00
                                0.1778E+01      0.1000E-01
                                0.3555E+01      0.2000E-01
                                0.7110E+01      0.4000E-01
                                0.1067E+02      0.6000E-01
                                0.1422E+02      0.8000E-01
                                0.1600E+02      0.9000E-01
                                0.1778E+02      0.1000E+00
                                0.1778E+02      0.5000E+00
                                0.1778E+02      0.2000E+01
 6          10      0.4546E+02
                                0.0000E+00      0.0000E+00
                                0.2377E+01      0.1000E-01
                                0.4755E+01      0.2000E-01
                                0.9510E+01      0.4000E-01
                                0.1426E+02      0.6000E-01
                                0.1902E+02      0.8000E-01
                                0.2140E+02      0.9000E-01
                                0.2377E+02      0.1000E+00
                                0.2377E+02      0.5000E+00
                                0.2377E+02      0.2000E+01
 7          10      0.4550E+02
                                0.0000E+00      0.0000E+00
                                0.2377E+01      0.1000E-01
                                0.4755E+01      0.2000E-01
                                0.9510E+01      0.4000E-01
                                0.1426E+02      0.6000E-01
                                0.1902E+02      0.8000E-01
                                0.2140E+02      0.9000E-01
                                0.2377E+02      0.1000E+00
                                0.2377E+02      0.5000E+00
                                0.2377E+02      0.2000E+01
 8          10      0.4628E+02
                                0.0000E+00      0.0000E+00
                                0.2418E+01      0.1000E-01
                                0.4835E+01      0.2000E-01
                                0.9671E+01      0.4000E-01
                                0.1451E+02      0.6000E-01
                                0.1934E+02      0.8000E-01
                                0.2176E+02      0.9000E-01
                                0.2418E+02      0.1000E+00
                                0.2418E+02      0.5000E+00
                                0.2418E+02      0.2000E+01
 9          10      0.4696E+02
                                0.0000E+00      0.0000E+00
                                0.2418E+01      0.1000E-01
                                0.4835E+01      0.2000E-01
                                0.9671E+01      0.4000E-01
                                0.1451E+02      0.6000E-01
                                0.1934E+02      0.8000E-01
                                0.2176E+02      0.9000E-01
                                0.2418E+02      0.1000E+00
                                0.2418E+02      0.5000E+00
                                0.2418E+02      0.2000E+01
10          10      0.4700E+02
                                0.0000E+00      0.0000E+00
                                0.7340E+01      0.2240E-01
                                0.1223E+02      0.4340E-01
                                0.1835E+02      0.7980E-01
                                0.2202E+02      0.1120E+00
                                0.2447E+02      0.1400E+00
                                0.2202E+02      0.2800E+00
```

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                                  0.2202E+02      0.4200E+00
                                  0.2202E+02      0.7000E+00
                                  0.2202E+02      0.2800E+01
11          10      0.5503E+02
                                  0.0000E+00      0.0000E+00
                                  0.7371E+01      0.2240E-01
                                  0.1228E+02      0.4340E-01
                                  0.1843E+02      0.7980E-01
                                  0.2211E+02      0.1120E+00
                                  0.2457E+02      0.1400E+00
                                  0.2211E+02      0.2800E+00
                                  0.2211E+02      0.4200E+00
                                  0.2211E+02      0.7000E+00
                                  0.2211E+02      0.2800E+01
12          10      0.6296E+02
                                  0.0000E+00      0.0000E+00
                                  0.7519E+01      0.2240E-01
                                  0.1253E+02      0.4340E-01
                                  0.1880E+02      0.7980E-01
                                  0.2256E+02      0.1120E+00
                                  0.2506E+02      0.1400E+00
                                  0.2256E+02      0.2800E+00
                                  0.2256E+02      0.4200E+00
                                  0.2256E+02      0.7000E+00
                                  0.2256E+02      0.2800E+01
13          10      0.6300E+02
                                  0.0000E+00      0.0000E+00
                                  0.3589E+01      0.1000E-01
                                  0.7179E+01      0.2000E-01
                                  0.1436E+02      0.4000E-01
                                  0.2154E+02      0.6000E-01
                                  0.2871E+02      0.8000E-01
                                  0.3230E+02      0.9000E-01
                                  0.3589E+02      0.1000E+00
                                  0.3589E+02      0.5000E+00
                                  0.3589E+02      0.2000E+01
14          10      0.7253E+02
                                  0.0000E+00      0.0000E+00
                                  0.4643E+01      0.1000E-01
                                  0.9286E+01      0.2000E-01
                                  0.1857E+02      0.4000E-01
                                  0.2786E+02      0.6000E-01
                                  0.3715E+02      0.8000E-01
                                  0.4179E+02      0.9000E-01
                                  0.4643E+02      0.1000E+00
                                  0.4643E+02      0.5000E+00
                                  0.4643E+02      0.2000E+01
15          10      0.8196E+02
                                  0.0000E+00      0.0000E+00
                                  0.4090E+01      0.1000E-01
                                  0.8180E+01      0.2000E-01
                                  0.1636E+02      0.4000E-01
                                  0.2454E+02      0.6000E-01
                                  0.3272E+02      0.8000E-01
                                  0.3681E+02      0.9000E-01
                                  0.4090E+02      0.1000E+00
                                  0.4090E+02      0.5000E+00
                                  0.4090E+02      0.2000E+01
16          10      0.8200E+02
                                  0.0000E+00      0.0000E+00
                                  0.6461E+01      0.2240E-01
                                  0.1077E+02      0.4340E-01
                                  0.1615E+02      0.7980E-01
                                  0.1938E+02      0.1120E+00
                                  0.2154E+02      0.1400E+00
                                  0.1938E+02      0.2800E+00
                                  0.1938E+02      0.4200E+00
```

			0.1938E+02	0.7000E+00
			0.1938E+02	0.2800E+01
17	10	0.9353E+02		
			0.0000E+00	0.0000E+00
			0.3539E+01	0.2240E-01
			0.5898E+01	0.4340E-01
			0.8847E+01	0.7980E-01
			0.1062E+02	0.1120E+00
			0.1180E+02	0.1400E+00
			0.1062E+02	0.2800E+00
			0.1062E+02	0.4200E+00
			0.1062E+02	0.7000E+00
			0.1062E+02	0.2800E+01
18	10	0.1050E+03		
			0.0000E+00	0.0000E+00
			0.3539E+01	0.2240E-01
			0.5898E+01	0.4340E-01
			0.8847E+01	0.7980E-01
			0.1062E+02	0.1120E+00
			0.1180E+02	0.1400E+00
			0.1062E+02	0.2800E+00
			0.1062E+02	0.4200E+00
			0.1062E+02	0.7000E+00
			0.1062E+02	0.2800E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1383E+01	0.7000E-02
0.2766E+01	0.1400E-01
0.5532E+01	0.2800E-01
0.1106E+02	0.1820E+00
0.1660E+02	0.5880E+00
0.1992E+02	0.1022E+01
0.2213E+02	0.1400E+01
0.2213E+02	0.2100E+01
0.2213E+02	0.2800E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3949E+02	0.4636E-01	0.1976E-01	0.1000E-03
0.2915E+03	0.4123E+00	0.1976E+00	0.1000E-02
0.5495E+03	0.9849E+00	0.9879E+00	0.5000E-02
0.6869E+03	0.1358E+01	0.1976E+01	0.1000E-01
0.9864E+03	0.2302E+01	0.6322E+01	0.5000E-01
0.1038E+04	0.2528E+01	0.8119E+01	0.1000E+00
0.1042E+04	0.2948E+01	0.1540E+02	0.5000E+00
0.1046E+04	0.3465E+01	0.1975E+02	0.1000E+01
0.1049E+04	0.4474E+01	0.2213E+02	0.2000E+01

****
* COMPUTE INTERNALLY-GENERATED LOAD-TRANSFER *
* (t-z) CURVES FOR VERIFICATION *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.5510E-01	0.1000E-01
			0.1102E+00	0.2000E-01
			0.2204E+00	0.4000E-01
			0.3306E+00	0.6000E-01
			0.4408E+00	0.8000E-01
			0.4959E+00	0.9000E-01
			0.5510E+00	0.1000E+00
			0.5510E+00	0.5000E+00
			0.5510E+00	0.2000E+01

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

Input File: Z:\062368- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\50 CALCULATIONS\2019\FRICTION PILE\WEAP\SUM-8-0199_NB PIER5_16IN.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

SUM-8-0199_NB Pier5_16in

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.185	32.185	201.060	16.000	Pipe

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
75.000	30.18	30000.0	492.000	4.188	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 30-32	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
6.60	123.20	16.51	13.73	11.43	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
1.36	28.15	16.51	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.03	309.10	0.001	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1400.00	1260.00	1134.00	1021.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
11.4300	0.8000	1400.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.265	0.181	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.00	0.00	34.99	0.10	0.27	0.05	0.15	1.20	6.56	24.0
22.20	0.51	34.99	0.10	0.27	0.05	0.15	1.20	6.56	24.0
22.20	0.52	34.99	0.10	0.27	0.05	0.15	1.20	6.56	24.0
26.20	0.57	34.99	0.10	0.27	0.05	0.15	1.20	6.56	24.0
26.20	0.96	25.20	0.10	0.20	0.20	0.15	2.00	6.56	168.0
66.70	1.57	25.20	0.10	0.20	0.20	0.15	2.00	6.56	168.0
66.70	1.11	274.12	0.10	0.16	0.05	0.15	1.20	6.56	1.0
75.00	1.25	274.12	0.10	0.16	0.05	0.15	1.20	6.56	1.0

Gain/Loss factors: shaft and toe

0.50000	0.00000	0.00000	0.00000	0.00000
1.00000	0.00000	0.00000	0.00000	0.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
6.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

24.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
42.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
48.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
52.33	0.00	0.00	0.000	0.000	0.000	0.000	0.000
55.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 11.43000 13.73000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

SUM-8-0199_NB Pier5_16in

Hammer Model: D 30-32 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	1.320				
2	1.320	251965.7	1.000	0.0100	
3	1.320	251965.7	1.000	0.0100	
4	1.320	251965.7	1.000	0.0100	
5	1.320	251965.7	1.000	0.0100	
Imp Block	1.360	117606.2	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0098	9.6
Combined Pile Top		23138.0			

HAMMER OPTIONS:

Hammer File ID No.	15	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	6.60	Ram Length	(inch)	123.20
Maximum Stroke	(ft)	13.73			
Rated Stroke	(ft)	11.43	Efficiency		0.800
Maximum Pressure	(psi)	1400.00	Actual Pressure	(psi)	1400.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	16.51			
Combustion Delay	(s)	0.00100	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

SUM-8-0199_NB Pier5_16in 09/13/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

Depth (ft)	6.0		
Shaft Gain/Loss Factor	0.500	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area (in2)	201.060	Pile Type	Pipe
Pile Size (inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	30.18	30000.	492.0	4.2	0	16807.	53.9
75.0	30.18	30000.	492.0	4.2	0	16807.	53.9

Wave Travel Time 2L/c (ms) 8.925

Pile and Soil Model — Total Capacity Rut (kips) 36.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.336	23138	0.010	0.000	0.85	0.0	0.000	0.100	3.26	4.2	30.2
2	0.336	23138	0.000	0.000	1.00	0.0	0.000	0.100	6.52	4.2	30.2
22	0.336	23138	0.000	0.000	1.00	0.3	0.050	0.100	71.74	4.2	30.2
23	0.336	23138	0.000	0.000	1.00	1.1	0.050	0.100	75.00	4.2	30.2
Toe						35.0	0.150	0.267			

7.734 kips total unreduced pile weight (g= 32.17 ft/s2)
7.737 kips total reduced pile weight (g= 32.19 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	1.077

Driveability Analysis

Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0

Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.185 32.185
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
6.00	11.43	1.00	0.800

SUM-8-0199_NB Pier5_16in 01/27/2020
Gannett Fleming, Inc. GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	36.4	1.4	35.0	1.8	15.748	-3.260	4.53	41.3
12.0	40.7	5.7	35.0	1.9	15.967	-3.289	4.56	41.0
18.0	47.9	12.9	35.0	2.1	16.730	-3.649	4.66	40.3
24.0	57.9	22.9	35.0	2.5	18.297	-4.165	4.87	39.6
30.0	60.2	35.0	25.2	2.7	19.449	-4.789	4.98	39.1
36.0	73.6	48.4	25.2	3.7	21.319	-4.680	5.32	37.4
42.0	88.1	62.9	25.2	4.8	22.699	-4.200	5.64	36.0
48.0	103.7	78.5	25.2	6.1	23.959	-3.454	5.91	34.6
52.3	115.7	90.5	25.2	7.1	24.927	-3.117	6.13	34.0
55.0	123.3	98.1	25.2	7.8	25.457	-2.951	6.27	33.7
70.0	421.6	147.5	274.1	45.8	33.554	-0.268	8.67	32.2
75.0	442.6	168.5	274.1	50.0	33.801	-0.113	8.73	31.9

Total Driving Time 19 minutes; Total No. of Blows 821
Starting at penetration 6.0 ft

SUM-8-0199_NB Pier5_16in 01/27/2020
Gannett Fleming, Inc. GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
6.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
12.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
18.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
24.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
30.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
36.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
42.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
48.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
52.33	75.00	0.00	11.43	0.96	0.80	1.00	1.00
55.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
70.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00
75.00	75.00	0.00	11.43	0.96	0.80	1.00	1.00

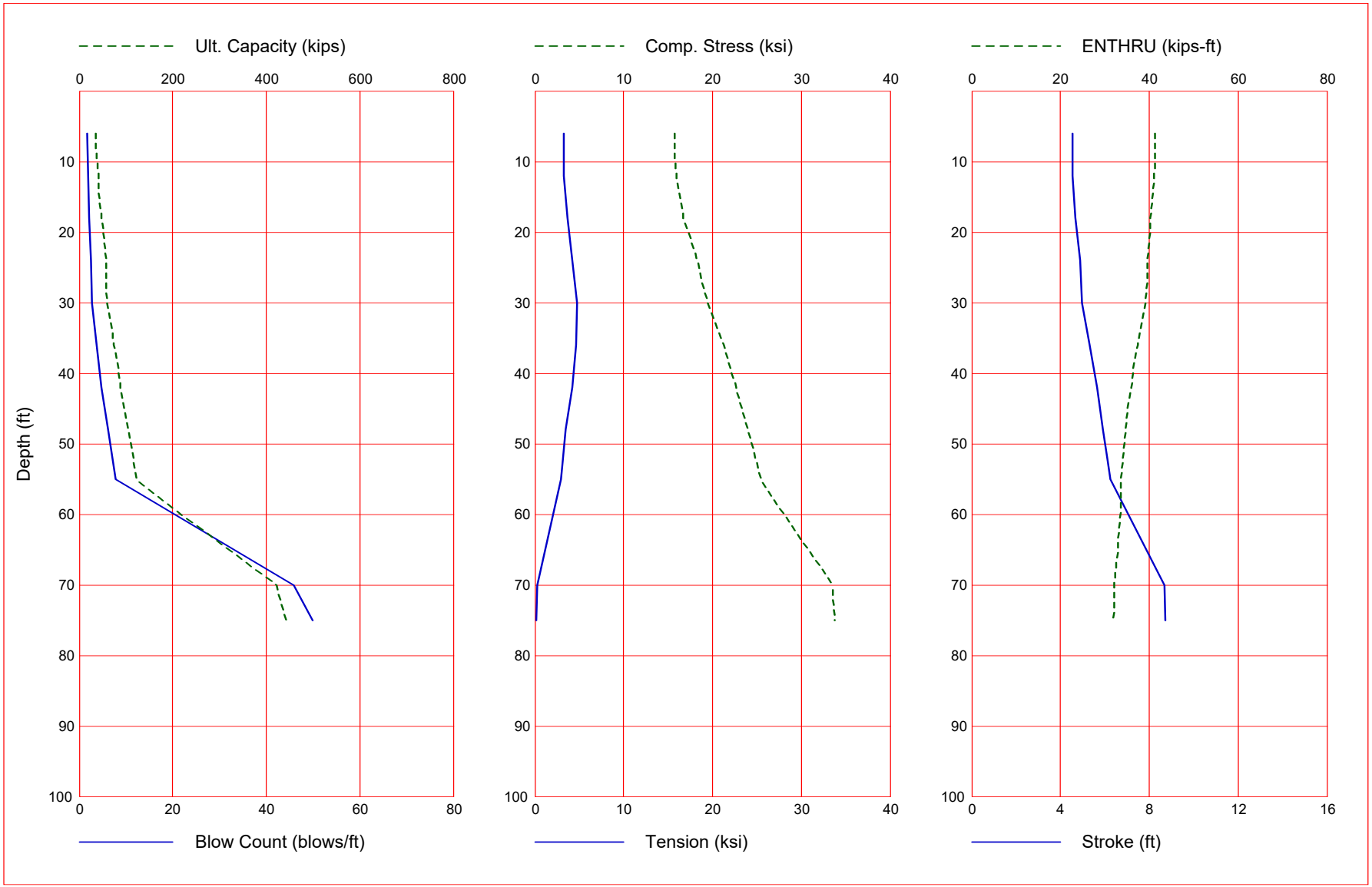
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.00	0.00	34.99	0.100	0.267	0.050	0.150	0.333	6.560	24.000
22.20	0.51	34.99	0.100	0.267	0.050	0.150	0.333	6.560	24.000
22.20	0.52	34.99	0.100	0.267	0.050	0.150	0.333	6.560	24.000
26.20	0.57	34.99	0.100	0.267	0.050	0.150	0.333	6.560	24.000
26.20	0.96	25.20	0.100	0.200	0.200	0.150	1.000	6.560	168.000
66.70	1.57	25.20	0.100	0.200	0.200	0.150	1.000	6.560	168.000
66.70	1.11	274.12	0.100	0.160	0.050	0.150	0.333	6.560	1.000
75.00	1.25	274.12	0.100	0.160	0.050	0.150	0.333	6.560	1.000

Gannett Fleming, Inc.
SUM-8-0199_NB Pier5_16in

Jan 21 2020
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.500 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

Input File: Z:\062368- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\50 CALCULATIONS\2019\FRICTION PILE\WEAP\SUM-8-0199_SB PIER5_16IN.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW

Hammer File Version: 2003 (2/22/2013)

Input File Contents

SUM-8-0199_SB Pier5_16in

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.185	32.185	201.060	16.000	Pipe

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
3.900	415.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
85.000	30.18	30000.0	492.000	4.188	0	0.850	0.010

FFatigue	F0	0-Bottom
0	0.000	0.000

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 30-32	1	3

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
6.60	123.20	16.51	13.73	11.43	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
1.36	28.15	16.51	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.03	309.10	0.0005	0.0020	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1460.00	1315.00	1185.00	1065.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
11.4300	0.8000	1400.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.265	0.050	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug

0.000	0.000	0.000	0.000	0.000	0.000

Research Toe Plug: RD plug toe: m, d

0.000	0.000

Research Toe Plug: New Toe Plug Model is NOT applied

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimL	TSf0
0.00	0.00	0.00	0.10	0.27	0.20	0.15	2.00	6.56	168.000
11.20	0.00	0.00	0.10	0.27	0.20	0.15	2.00	6.56	168.000

11.20	0.31	110.81	0.10	0.20	0.05	0.15	1.20	6.56	24.000
37.70	0.98	110.81	0.10	0.20	0.05	0.15	1.20	6.56	24.000
37.70	0.92	110.81	0.10	0.20	0.05	0.15	1.20	6.56	24.000
41.20	0.96	110.81	0.10	0.20	0.05	0.15	1.20	6.56	24.000
41.20	2.53	174.97	0.10	0.20	0.15	0.15	1.50	6.56	72.000
81.70	4.10	174.97	0.10	0.20	0.15	0.15	1.50	6.56	72.000
81.70	1.56	180.80	0.10	0.16	0.05	0.15	1.20	6.56	24.000
85.00	1.61	180.80	0.10	0.16	0.05	0.15	1.20	6.56	24.000

Gain/Loss factors: shaft and toe

0.83300	0.00000	0.00000	0.00000	0.00000
1.00000	0.00000	0.00000	0.00000	0.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
6.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
12.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
18.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
24.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
36.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
42.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
48.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
60.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
66.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
67.33	0.00	0.00	0.000	0.0	0.000	0.000	0.000
70.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
75.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
85.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.0	0.000	0.000	0.000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

SUM-8-0199_SB Pier5_16in

Hammer Model: D 30-32 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	2.200				
2	2.200	151179.4	1.000	0.0000	
3	2.200	151179.4	1.000	0.0000	
Imp Block	1.360	89695.7	0.900	0.0100	
Helmet	3.900	109975.0	0.800	0.0098	10.9
Combined Pile Top		23078.8			

HAMMER OPTIONS:

Hammer File ID No.	15	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	6.60	Ram Length	(inch)	123.20
Maximum Stroke	(ft)	13.73			
Rated Stroke	(ft)	11.43	Efficiency		0.800
Maximum Pressure	(psi)	1460.00	Actual Pressure	(psi)	1400.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	16.51			
Combustion Delay	(s)	0.00050	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	415.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	109975.0	Stiffness	(kips/in)	0.0

SUM-8-0199_SB Pier5_16in 01/27/2020
Gannett Fleming, Inc. GRLWEAP Version 2010

Depth	(ft)	6.0	Standard Soil Setup		
Shaft Gain/Loss Factor		0.833	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	201.060	Pile Type		Pipe
Pile Size	(inch)	16.000			

L b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	30.18	30000.	492.0	4.2	0	16807.	53.9
85.0	30.18	30000.	492.0	4.2	0	16807.	53.9

Wave Travel Time 2L/c (ms) 10.115

Pile and Soil Model — Total Capacity Rut (kips) 0.0

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.337	23079	0.010	0.000	0.85	0.0	0.000	0.100	3.27	4.2	30.2
2	0.337	23079	0.000	0.000	1.00	0.0	0.000	0.100	6.54	4.2	30.2
25	0.337	23079	0.000	0.000	1.00	0.0	0.200	0.100	81.73	4.2	30.2
26	0.337	23079	0.000	0.000	1.00	0.0	0.200	0.100	85.00	4.2	30.2
Toe						0.0	0.150	0.267			

8.765 kips total unreduced pile weight (g= 32.17 ft/s2)
8.769 kips total reduced pile weight (g= 32.19 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile			Pile Segments: Automatic		
No. of Slacks/Splices		0	Pile Damping	(%)	1
			Pile Damping Fact.(k/ft/s)		1.077
Driveability Analysis					
Soil Damping Option		Smith			
Max No Analysis Iterations		0	Time Increment/Critical		160
Output Time Interval		1	Analysis Time-Input	(ms)	0
Output Level: Normal					
Gravity Mass, Pile, Hammer:		32.170	32.185	32.185	
Output Segment Generation: Automatic					

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
6.00	11.43	0.96	0.800

SUM-8-0199_SB Pier5_16in 03/13/2019

Gannett Fleming, Inc. GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.833 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	0.0	0.0	0.0	0.0	0.000	0.000	11.43	0.0
12.0	111.8	1.0	110.8	6.7	21.321	0.000	5.82	35.4
18.0	121.4	10.6	110.8	7.2	21.687	0.000	5.90	35.1
24.0	134.6	23.8	110.8	7.9	22.063	0.000	5.95	34.4
30.0	151.4	40.6	110.8	8.7	22.818	-0.672	6.07	34.0
36.0	171.9	61.1	110.8	9.8	23.422	-1.459	6.22	33.7
42.0	263.2	88.2	175.0	17.2	25.764	-2.360	6.91	33.4
48.0	322.9	148.0	175.0	22.4	27.000	-2.995	7.33	34.1
54.0	387.9	213.0	175.0	30.2	27.936	-4.098	7.67	34.7
60.0	458.1	283.1	175.0	41.4	28.764	-5.132	8.01	35.7
66.0	533.5	358.5	175.0	61.5	29.479	-5.644	8.32	36.4
67.3	550.9	375.9	175.0	69.4	29.486	-5.748	8.32	36.2
70.0	586.6	411.7	175.0	86.1	29.901	-5.788	8.52	36.7
75.0	656.3	481.3	175.0	140.0	30.543	-5.352	8.83	37.4
85.0	781.9	601.1	180.8	648.6	31.055	-4.553	9.16	37.9

Total Driving Time 147 minutes; Total No. of Blows 5898

SUM-8-0199_SB Pier5_16in 03/13/2019

Gannett Fleming, Inc. GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
6.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
12.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
18.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
24.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
30.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
36.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
42.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
48.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
54.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
60.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
66.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
67.33	85.00	0.00	11.43	1.00	0.80	1.00	1.00
70.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
75.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00
85.00	85.00	0.00	11.43	1.00	0.80	1.00	1.00

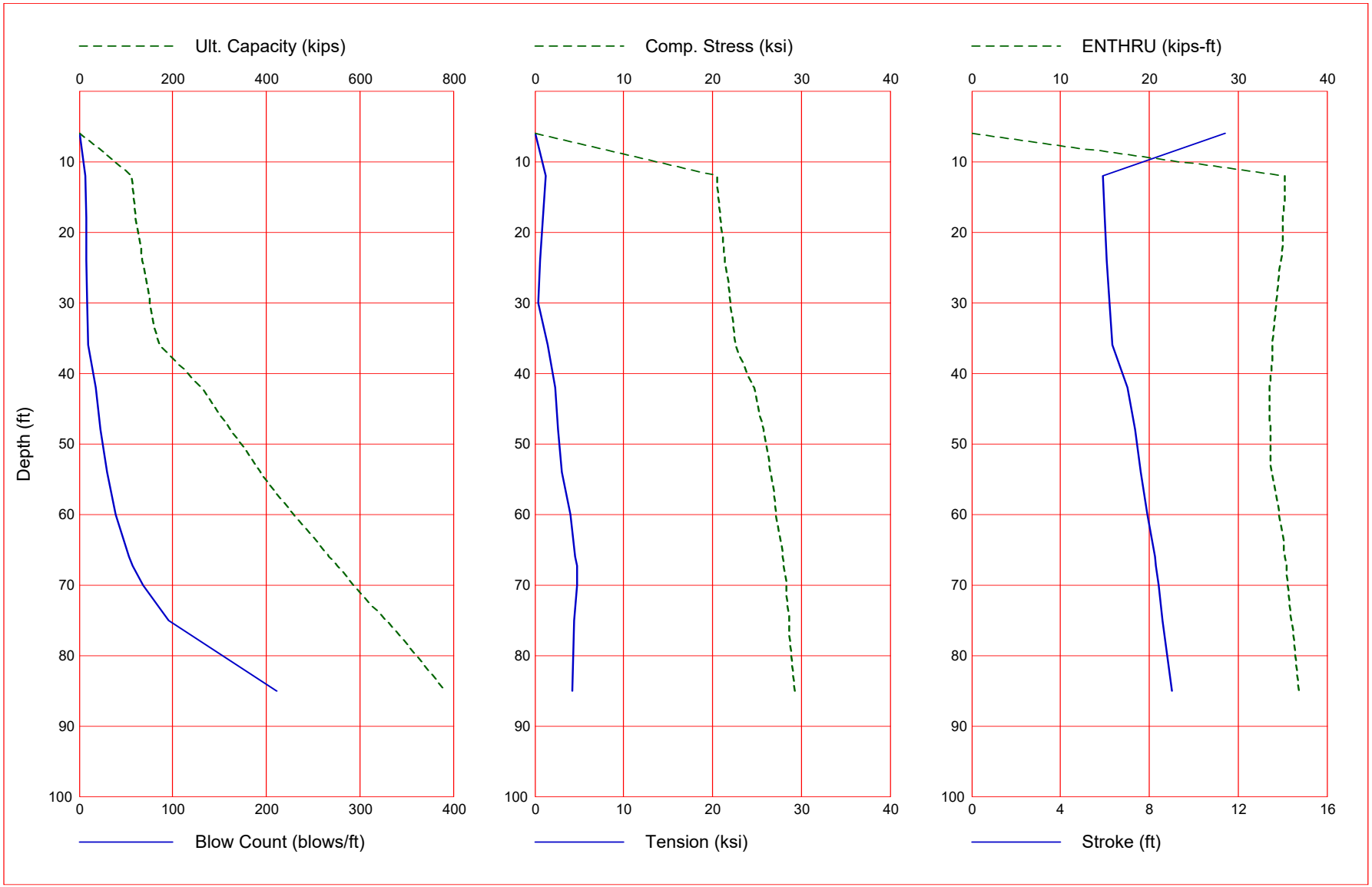
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.00	0.00	0.00	0.100	0.267	0.200	0.150	1.000	6.560	168.000
11.20	0.00	0.00	0.100	0.267	0.200	0.150	1.000	6.560	168.000
11.20	0.31	110.81	0.100	0.200	0.050	0.150	0.333	6.560	24.000
37.70	0.98	110.81	0.100	0.200	0.050	0.150	0.333	6.560	24.000
37.70	0.92	110.81	0.100	0.200	0.050	0.150	0.333	6.560	24.000
41.20	0.96	110.81	0.100	0.200	0.050	0.150	0.333	6.560	24.000
41.20	2.53	174.97	0.100	0.200	0.150	0.150	0.667	6.560	72.000
81.70	4.10	174.97	0.100	0.200	0.150	0.150	0.667	6.560	72.000
81.70	1.56	180.80	0.100	0.160	0.050	0.150	0.333	6.560	24.000
85.00	1.61	180.80	0.100	0.160	0.050	0.150	0.333	6.560	24.000

Gannett Fleming, Inc.
SUM-8-0199_SB Pier5_16in

Jan 21 2020
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

Input File: W:\062368- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\50 CALCULATIONS\2018\FRICTION PILE\WEAP\SUM-8-0199_NB FABT_14IN.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

SUM-8-0199_NB FABT_14in

OUT	OSG	HAM	STR	FUL	PEL	N SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.185	32.185	153.930	14.000	Pipe

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
35.000	10.79	30000.0	492.000	3.665	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.231	0.050	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.00	0.00	33.49	0.10	0.17	0.05	0.15	1.00	6.56	1.0
18.50	0.69	33.49	0.10	0.17	0.05	0.15	1.00	6.56	1.0
18.50	0.79	96.01	0.10	0.14	0.05	0.15	1.00	6.56	1.0
35.00	1.56	96.01	0.10	0.14	0.05	0.15	1.00	6.56	1.0

Gain/Loss factors: shaft and toe

0.83300	0.00000	0.00000	0.00000	0.00000
1.00000	0.00000	0.00000	0.00000	0.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
6.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
30.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

```
    32.67      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    35.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
     0.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
          1           0   10.81000       11.86000
```

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

SUM-8-0199_NB FABT_14in

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0098	5.8
Combined Pile Top		8477.9			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

SUM-8-0199_NB FABT_14in 04/12/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

Depth	(ft)	6.0			
Shaft Gain/Loss Factor		0.833	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	153.930	Pile Type		Pipe
Pile Size	(inch)	14.000			

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	10.79	30000.	492.0	3.7	0	16807.	19.3
	35.0	10.79	30000.	492.0	3.7	0	16807.	19.3

Wave Travel Time 2L/c (ms) 4.165

Pile and Soil Model — Total Capacity Rut (kips) 35.5

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.117	8478	0.010	0.000	0.85	0.0	0.000	0.100	3.18	3.7	10.8
2	0.117	8478	0.000	0.000	1.00	0.0	0.000	0.100	6.36	3.7	10.8
10	0.117	8478	0.000	0.000	1.00	0.5	0.050	0.100	31.82	3.7	10.8
11	0.117	8478	0.000	0.000	1.00	1.6	0.050	0.100	35.00	3.7	10.8
Toe						33.5	0.150	0.175			

1.290 kips total unreduced pile weight (g= 32.17 ft/s2)
1.291 kips total reduced pile weight (g= 32.19 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.385
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.185	32.185
Output Segment Generation: Automatic			

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
6.00	10.81	1.00	0.800

SUM-8-0199_NB FABT_14in 04/12/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.833 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	35.5	2.0	33.5	3.4	16.346	0.000	4.16	22.1
12.0	41.7	8.2	33.5	3.9	17.539	0.000	4.31	21.5
18.0	51.9	18.4	33.5	4.7	19.454	0.000	4.59	21.1
24.0	130.8	34.8	96.0	15.3	28.239	0.000	6.49	17.9
30.0	152.5	56.5	96.0	18.0	28.959	-0.324	6.73	17.5
32.7	163.8	67.7	96.0	19.4	29.305	-0.217	6.84	17.4
35.0	174.4	78.4	96.0	20.7	29.728	-0.108	6.95	17.4

Total Driving Time 7 minutes; Total No. of Blows 315

SUM-8-0199_NB FABT_14in 04/12/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
6.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00
12.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00
18.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00
24.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00
30.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00
32.67	35.00	0.00	10.81	1.00	0.80	1.00	1.00
35.00	35.00	0.00	10.81	1.00	0.80	1.00	1.00

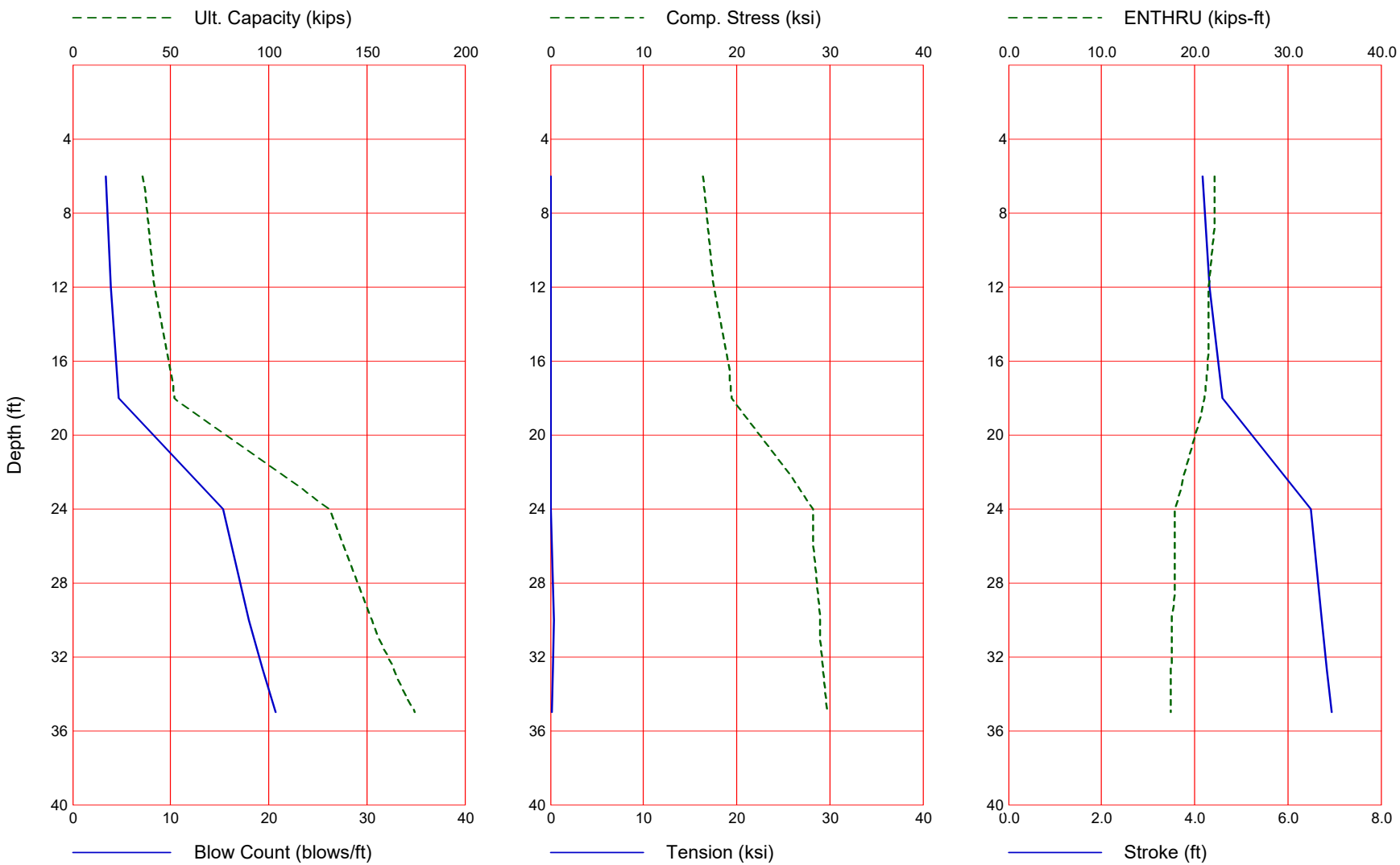
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.00	0.00	33.49	0.100	0.175	0.050	0.150	1.000	6.560	1.000
18.50	0.69	33.49	0.100	0.175	0.050	0.150	1.000	6.560	1.000
18.50	0.79	96.01	0.100	0.140	0.050	0.150	1.000	6.560	1.000
35.00	1.56	96.01	0.100	0.140	0.050	0.150	1.000	6.560	1.000

Gannett Fleming, Inc.
SUM-8-0199_NB FABT_14in

Apr 12 2019
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.833 / 1.000



GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

Input File: W:\062368- MS-SUM-8-1.75\E. PRJ WRK\E_ENG\GEO\50 CALCULATIONS\2018\FRICTION PILE\WEAP\SUM-8-0199_SB FABT_14IN.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

SUM-8-0199_SB FABT_14in

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.185	32.185	153.930	14.000	Pipe

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
55.000	10.79	30000.0	492.000	3.665	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
8.2700	0.8000	1175.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.231	0.200	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.00	0.00	17.86	0.10	0.23	0.05	0.15	1.00	6.56	1.0
22.50	0.78	17.86	0.10	0.23	0.05	0.15	1.00	6.56	1.0
22.50	0.49	169.69	0.10	0.14	0.05	0.15	1.20	6.56	24.0
45.50	1.07	169.69	0.10	0.14	0.05	0.15	1.20	6.56	24.0
45.50	1.11	169.69	0.10	0.14	0.05	0.15	1.20	6.56	24.0
47.00	1.13	169.69	0.10	0.14	0.05	0.15	1.20	6.56	24.0
47.00	1.57	39.79	0.10	0.17	0.20	0.15	2.00	6.56	168.0
55.00	1.57	39.79	0.10	0.17	0.20	0.15	2.00	6.56	168.0

Gain/Loss factors: shaft and toe

0.50000	0.00000	0.00000	0.00000	0.00000
1.00000	0.00000	0.00000	0.00000	0.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
6.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

```
    12.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    18.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    24.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    30.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    36.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    42.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    48.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    52.67      0.00      0.00     0.000     0.000     0.000     0.000     0.000
    55.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
     0.00      0.00      0.00     0.000     0.000     0.000     0.000     0.000
          1           0   8.270000       11.86000

        GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
                              Version 2010
                            English Units

                 SUM-8-0199_SB FABT_14in
                 _______________________________________

          Hammer Model:   D 19-42              Made by:      DELMAG

          No.    Weight    Stiffn       CoR     C-Slk     Dampg
                   kips    k/inch                  ft    k/ft/s
            1     0.800
            2     0.800  140046.7     1.000    0.0100
            3     0.800  140046.7     1.000    0.0100
            4     0.800  140046.7     1.000    0.0100
            5     0.800  140046.7     1.000    0.0100
     Imp Block    0.753   70735.6     0.900    0.0100
     Helmet       1.700   60155.0     0.800    0.0098       5.8
     Combined Pile Top     8337.7

HAMMER OPTIONS:
  Hammer File ID No.              41  Hammer Type               OE Diesel
  Stroke Option            FxdP-VarS  Stroke Convergence Crit.      0.010
  Fuel Pump Setting          Maximum

HAMMER DATA:
  Ram Weight          (kips)    4.00  Ram Length          (inch)   129.10
  Maximum Stroke        (ft)   11.86
  Rated Stroke          (ft)   10.81  Efficiency                    0.800

  Maximum Pressure     (psi) 1520.00  Actual Pressure      (psi) 1175.00
  Compression Exponent         1.350  Expansion Exponent           1.250
  Ram Diameter        (inch)   12.60
  Combustion Delay       (s) 0.00200  Ignition Duration      (s) 0.00200

          The Hammer Data Includes Estimated (NON-MEASURED) Quantities
          ____________________________________________________________


  HAMMER CUSHION                       PILE CUSHION
  Cross Sect. Area     (in2)  227.00  Cross Sect. Area     (in2)     0.00
  Elastic-Modulus      (ksi)   530.0  Elastic-Modulus      (ksi)      0.0
  Thickness           (inch)    2.00  Thickness           (inch)     0.00
  Coeff of Restitution            0.8  Coeff of Restitution            1.0
  RoundOut              (ft)      0.0  RoundOut              (ft)      0.0
  Stiffness        (kips/in) 60155.0  Stiffness        (kips/in)      0.0
```

SUM-8-0199_SB FABT_14in 04/12/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

Depth	(ft)	6.0			
Shaft Gain/Loss Factor		0.500	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	153.930	Pile Type		Pipe
Pile Size	(inch)	14.000			

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	10.79	30000.	492.0	3.7	0	16807.	19.3
	55.0	10.79	30000.	492.0	3.7	0	16807.	19.3

Wave Travel Time 2L/c (ms) 6.545

Pile and Soil Model — Total Capacity Rut (kips) 20.1

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.119	8338	0.010	0.000	0.85	0.0	0.000	0.100	3.24	3.7	10.8
2	0.119	8338	0.000	0.000	1.00	0.0	0.000	0.100	6.47	3.7	10.8
16	0.119	8338	0.000	0.000	1.00	0.5	0.050	0.100	51.76	3.7	10.8
17	0.119	8338	0.000	0.000	1.00	1.8	0.050	0.100	55.00	3.7	10.8
Toe						17.9	0.150	0.233			

2.028 kips total unreduced pile weight (g= 32.17 ft/s2)
2.029 kips total reduced pile weight (g= 32.19 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.385
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.185	32.185
Output Segment Generation: Automatic			

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
6.00	8.27	0.77	0.800

SUM-8-0199_SB FABT_14in 04/12/2019
Gannett Fleming, Inc. GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
6.0	20.1	2.3	17.9	Hammer did not run				
12.0	27.0	9.1	17.9	Hammer did not run				
18.0	38.4	20.5	17.9	4.0	11.705	0.000	3.44	14.7
24.0	204.1	34.4	169.7	40.9	31.246	-2.348	5.93	13.1
30.0	215.2	45.5	169.7	45.6	29.993	-3.118	5.93	13.0
36.0	229.0	59.3	169.7	51.6	29.432	-2.917	6.04	13.1
42.0	245.6	75.9	169.7	60.7	29.855	-2.278	6.16	13.2
48.0	134.6	94.8	39.8	20.6	23.242	-0.437	5.03	11.7
52.7	148.0	108.2	39.8	24.7	24.209	-0.227	5.28	11.7
55.0	154.7	114.9	39.8	27.1	24.544	-0.102	5.35	11.5

Total Driving Time 30 minutes; Total No. of Blows 1442

SUM-8-0199_SB FABT_14in 04/12/2019
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Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
6.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
12.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
18.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
24.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
30.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
36.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
42.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
48.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00
52.67	55.00	0.00	8.27	0.77	0.80	1.00	1.00
55.00	55.00	0.00	8.27	0.77	0.80	1.00	1.00

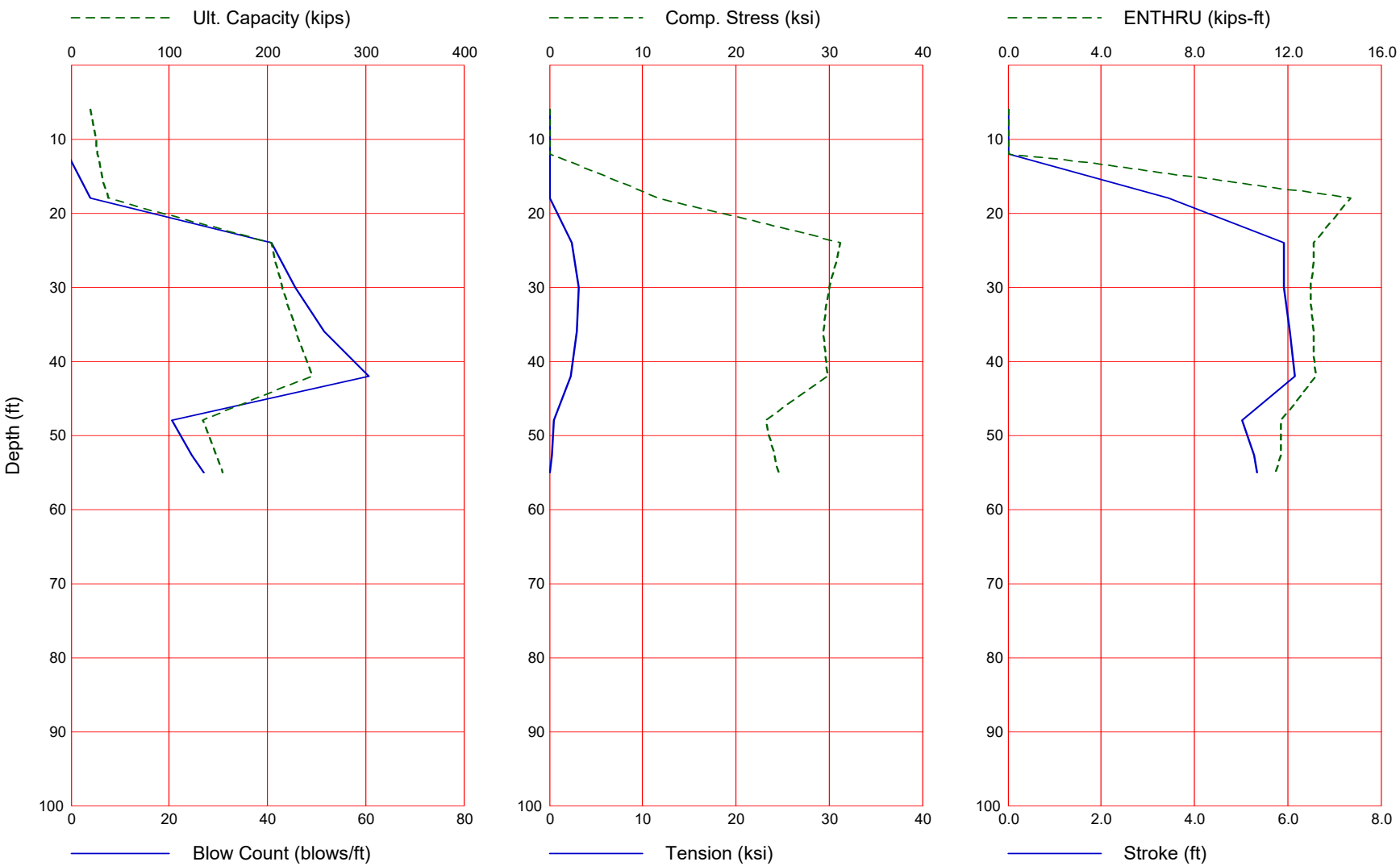
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.00	0.00	17.86	0.100	0.233	0.050	0.150	0.000	6.560	1.000
22.50	0.78	17.86	0.100	0.233	0.050	0.150	0.000	6.560	1.000
22.50	0.49	169.69	0.100	0.140	0.050	0.150	0.333	6.560	24.000
45.50	1.07	169.69	0.100	0.140	0.050	0.150	0.333	6.560	24.000
45.50	1.11	169.69	0.100	0.140	0.050	0.150	0.333	6.560	24.000
47.00	1.13	169.69	0.100	0.140	0.050	0.150	0.333	6.560	24.000
47.00	1.57	39.79	0.100	0.175	0.200	0.150	1.000	6.560	168.000
55.00	1.57	39.79	0.100	0.175	0.200	0.150	1.000	6.560	168.000

Gannett Fleming, Inc.
SUM-8-0199_SB FABT_14in

Apr 12 2019
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.500 / 1.000



Gannett Fleming

SUBJECT SUM-B PIER 5 PILES SHEET NO. 1 OF 1

BY CTM DATE 12/21 CHKD. BY YLZ DATE 12/21 JOB NO.

COMPARE NOMINAL STRUCTURAL RESISTANCE TO UBV

OUTER DIAMETER $= 16" - (0.625 - 0.389) \times 2 = 15.528$ IN

INNER DIAMETER $= 16" - (0.625) \times 2 = 14.75$ IN

$A_s = \pi(15.528)^2/4 - \pi(14.75)^2/4 = 18.5\ in^2$

$A_c = \pi(14.75)^2/4 = 170.87\ in^2$

$F_e = F_y + 0.85 f'_c (A_c/A_s)$ LRFD 6.9.5.1-4

$F_e = 45 + 0.85(4)\left(\frac{170.87}{18.5}\right) = 76.4$ KSI

$E_c = 120000 K_1 w_c^2 f'^{0.33}_c$ LRFD 5.4.2.4-1

$E_c = 120000(1)(0.15)^2(4)^{0.33} = 4266$ KSI

$n = E/E_c = 29000/4266 = 6.8$ LRFD 6.10.1.1.1b-1

$E_e = E\left[1 + (C_3/n)(A_c/A_s)\right]$ LRFD 6.9.5.1-5

$E_e = 29000\left[1 + 0.4/6.8\left(170.87/18.5\right)\right] = 44756$ KSI

$\lambda = \left(\frac{Kl}{r_s \pi}\right)^2 (F_e/E_e)$ LRFD 6.9.5.1-3

$\lambda = \left[\frac{0.65(180)}{5.53\pi}\right]^2 \left(76.4/44756\right) = 0.0774$ ASSUMES 15' UNBRACED PILE LENGTH

$\therefore P_n = 0.66^{\lambda} F_e A_s$ LRFD 6.9.5.1-1

$P_n = 0.66^{.0774}(76.4)(18.5) = 1368$ KIPS

$P_r = \phi_c P_n = 0.6(1368) = 820$ KIPS

820 KIPS > 685 KIP MAX UBV @ PIER 5 ✓

Appendix F.3

Drilled Shaft

OBJECTIVE:

The purpose of these calculations is to estimate the Tip Resistance (R_P) and Side Resistance (R_S) of drilled shafts bearing on rock for SUM-8-0199 South Bound (NB) and South Bound (SB) Pier 1 to Pier 4 design.

SOURCE OF DATA:

1. Boring Logs from the 2015, 2016, and 2019 exploration;
2. Unconfined compressive strength of rock from 2015, 2016, and 2019 Lab Testing Results;
3. Axial Capacity and Uplift Force is based on the results from FB-Multipier analysis;

ASSUMPTIONS:

1. Assume compressive strength of concrete is 4,000 psi (ODOT, Construction and Material Specification CMS 2016);
2. The actual top of rock varies across the pier foundation. At piers with multiple borings, the Top of Rock is assumed at the highest elevation of the borings analyzed and the Top of Competent Rock is assumed at the lowest elevation of the boring analyzed;
3. Between "top of rock elevation" and "top of competent rock elevation", weak rock parameter were used for determining the side resistance of the drilled shaft rock socket based on AASHTO 10.8.3.5.4b-2;
4. The Unit tip resistance of the drilled shaft is based on AASHTO Eq.10.8.3.5.4c−1.

CODES AND STANDARDS:

1. AASHTO LRFD Bridge Design Specification, Eighth Edition, 2017;
2. ODOT Specification for Geotechnical Explorations (SGE);
3. ODOT Bridge Design Manual (BDM, 2007 LRFD).

Parameter	Unit	Definition of Parameter	Remarks
Bridge		South Bound (SB) or North Bound (NB)	
Substructure		Pier Number (No.)	
Bottom of footing EL.	FT.	Elevation of the Proposed Bottom of Footing	
Est. Top of Competent Rock EL.	FT.	Estimated top of rock below the substructure, it is also the top of rock socket when Bottom of footing is above top of rock.	Appendix F.1-1 SUM-8-0199 Subsurface Profile
Est. Top of Rock EL.	FT.	Estimated top of sound rock below the substructure	Based on plan, Boring Logs and coring photos
Min. Bearing EL.	FT.	lowest elevation between (Top of Rock EL. - 1.5 X B) and estimated top of sound rock elevation.	AASHTO LRFD requirements
Design Bearing EL.	FT.	Design Data Input	
Bottom of Bearing Influced Area EL.	FT.	Elevation of 2B below base of the drilled shaft	AASHTO LRFD requirements
Design Bearing EL. Check		Check if the Design Bearing EL. satisfy the minimum bearing El. Requrements.	
Shaft Length Above Rock, L_S	FT.	L_S = Bottom of footing EL. - min(Top of Rock EL., Bottom of footing EL.)	Length between bottom of footing and top of rock socket
Unconfined Compressive Strength of Base Rock q_{ub}	KSI	The average unconfined compressive rock strength of rock strata between base of the drilled shaft to a depth of 2B below tip according to strata depth.	Based on Boring Logs and Lab Testing Results, See Appendix F.1 for rock strata elevation and design pramaters.
Unit tip resistance factor, φ_{qp}	DIM	0.5	(AASHTO Table10.5.5.2.4-1)
Base Rock Condition (Tightly Jointed or Open Jointed)		Rock condition at base of the drilled shaft to a depth of 2B below tip.	From Boring Logs and Rock Core Photos
Unit tip resistance q_p (Tightly Jointed Rock)	KSF	q_p = 2.5 X q_{ub}	(AASHTO Eq.10.8.3.5.4 −1)
Unit tip resistance q_p (Open Jointed Rock)	KSF	$q_p = A + q_{ub}\left[m_b\left(\frac{A}{q_{ub}}\right)+s\right]^a$ $A = \sigma_{vb} + q_{ub}\left[m_b\left(\frac{\sigma_{vb}}{q_{ub}}\right)+s\right]^a$ $\sigma_{vb} = \sigma_{vs} + (top\ of\ Rock\ Socket\ EL. - Design\ Bearing\ EL.) \times \gamma_R$ $m_b = m_i \times e^{\left(\frac{GSI-100}{28-14D}\right)}$ $s = e^{\left(\frac{GSI-100}{9-3D}\right)}$ $a = \frac{1}{2}+\frac{1}{6}\left(e^{\left(\frac{-GSI}{15}\right)} - e^{\left(\frac{-20}{3}\right)}\right)$	$(AASHTO\ Eq.\ 10.8.3.5.4c-2)$ $(AASHTO\ Eq.\ 10.8.3.5.4c-3)$ $(vertical\ effective\ stress\ at\ the\ socket\ bearing\ elevation)$ $(AASHTO\ Eq.\ 10.4.6.4-4)$ $(AASHTO\ Eq.\ 10.4.6.4-2)$ $(AASHTO\ Eq.\ 10.4.6.4-3)$
Geological Strength Index, GSI	DIM	The average GSI of rock strata between base of the drilled shaft to a depth of 2B below tip according to strata depth.	Based on Boring Logs and Lab Testing Results, See Appendix F.1 for rock strata elevation and design pramaters.
Value of Constant, m_i	DIM	based on Base Rock Type	(AASHTO Table 10.4.6.4-1)
Disturbance Factor, D	DIM	based on excavation method of coring, choose 0.1 to be conservative	range between 0 (coring) to 1 (blasting)
Vertical effective stress at top of Rock EL, σ_{vs}	KSF	See Appendix F.1 for detailed calculation.	
Side Rock Type (Unfracutred or Tightly Jointed or Open Jointed)		The rock condtion between Est. Top of Sound Rock EL. and Design bearing EL.,	From Boring Logs and Rock Core Photos
Weighted RQD of Side Rock	%	The weighted average of Unit RQD between Est. Top of Sound Rock EL. and Design bearing EL., poor rock is ignored.	
Joint Modification Factor α_E		Based on RQD of side rock and side rock type (tightly jointed or open jointed)	(AASHTO Table 10.8.3.5.4b −1)
Unconfined Compressive Strength of Side Rock q_{us}	KSI	The average unconfined compressive rock strength of rock strata between top to the tip of rock socket according to strata depth.	Based on Boring Logs and Lab Testing Results, See Appendix F.1 for rock strata elevation and design pramaters.
Unit side resistance factor, φ_{qs}	DIM	0.5 or 0.55 based on the which unit side resistance equation is used	(AASHTO Table 10.5.5.2.4-1)
Unit side resistance, q_s	KSF	$\frac{q_s}{p_a} = C\sqrt{\frac{q_u}{p_a}} \quad (C = 1\ for\ normal\ condition)$	(AASHTO Eq. 10.8.3.5.4b-1)
Unit side resistance, q_s (Fractured Rock)	KSF	$\frac{q_s}{p_a} = 0.65\alpha_E\sqrt{\frac{q_u}{p_a}} \quad (C = 1\ for\ normal\ condition)$	(AASHTO 10.8.3.5.4b-2)
Atmospheric Pressure, P_a	KSF	2.12	
Rock Socket Diameter, B	FT.	4	
Rock Socket Length, L_R	FT.	L_R = Top of Rock Socket EL. - Design Bearing EL.	
Effective Rock Socket Length in Fractured Rock, ESL1	FT.	ESL1 = Max[(Top of Rock EL. - Top of Competent Rock EL. - 2ft.), 0]	Neglect the contribution of skin friction by the top 2 feet of the rock socket. (BDM 2007)
Effective Rock Socket Length in Competent Rock, ESL2	FT.	ESL2 = Min[(Top of Competent Rock EL. - Design Bearing EL.), (Top of Rock EL. - Design Bearing EL. - 2ft.)]	
Factored Tip Resistance R_p	Kip	R_p = q_p X π X (B/2)^2 X φ_{qp}	
Factored Side Resistance R_s	Kip	R_s = q_s X π X (B) X ESL X φ_{qs}	
Total Factored Resistance R_n	Kip	R_n = R_p + R_s	
Concrete Strength F'c	KSI	4	ODOT, CMS
Axial Max Compression Strength Load	Kip	Maximum Axial Compression Load in Strength Limit State	Results from FB-Multipier
Uplift Resistance Factor, φ_{up}	DIM	0.4	(AASHTO Table 10.5.5.2.4-1)
Factored Uplift Resistance R_{up}	Kip	R_s = q_s X π X (B) X ESL X φ_{up}	
Axial Max Uplift Strength Load	Kip	Maximum Axial Uplift Load in Strength Limit State	Results from FB-Multipier
Uplift Check		Check if the Factored Side Resistance is greater than the uplift load	
Axial Capacity Check		Check if the Total Resistance is greater than the Axial Strength Load.	

Bridge		NB	NB	NB	NB	SB	SB	SB	SB
Substructure		Pier 1	Pier 2	Pier 3	Pier 4	Pier 1	Pier 2	Pier 3	Pier 4
Bottom of footing EL.	FT.	954.25	878.75	865	872.5	952	874.25	866.75	886.5
Est. Top of Competent Rock EL.[1]	FT.	951.8	853	838.3	836.8	920.7	855.5	832.2	840
Est. Top of Rock EL.	FT.	958.8	855.7	844.6	851.5	933	862.7	837.7	841.1
Min. Bearing EL.	FT.	948.25	849.7	838.3	836.8	920.7	855.5	831.7	835.1
Design Bearing EL.[2]	FT.	948.25	849.7	836.6	830.5	917	855.2	831.2	834.6
Bottom of Bearing Influced Area EL.	FT.	940.25	841.7	828.6	822.5	909	847.2	823.2	826.6
Design Bearing EL. Check		OK	OK	OK	OK	OK	OK	OK	OK
Shaft Length Above Rock, L_S	FT.	0	23.05	20.4	21	19	11.55	29.05	45.4
Unconfined Compressive Strength of Base Rock q_{up}	KSI	4.87	2.89	3.01	1.68	2.20	2.46	5.12	6.22
Unit tip resistance factor, φ_{qp}	dim	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Base Rock Condition (Tightly Jointed or Open Jointed)		T	T	T	T	T	T	T	T
Unit tip resistance q_p (Tightly Jointed Rock)	KSF	1753.2	1038.6	1082.2	603.2	793.8	887.4	1843.4	2239.6
Unit tip resistance q_p (Open Jointed Rock)	KSF	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Weighted RQD of Side Rock	%	10	52	10	10	10	10	10	10
Joint Modification Factor α_E	dim	0.23	0.55	0.23	0.23	0.23	0.23	0.23	0.23
Unconfined Compressive Strength of Side Rock q_{us} (Fractured Rock)	KSI	0.50	1.50	0.40	0.20	0.24	0.20	0.20	0.30
Unconfined Compressive Strength of Side Rock qus (Competent Rock)	KSI	4.87	4.24	3.01	0.68	2.04	2.64	5.06	6.22
Unit side resistance factor, φ_{qs}	dim	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Unit side resistance, q_s	KSF	34.9	34.9	30.3	14.4	25.0	28.4	34.9	34.9
Unit side resistance, q_s (Fractured Rock)	KSF	1.8	7.7	1.6	1.1	1.3	1.1	1.1	1.4
Rock Socket Diameter, B	FT.	4	4	4	4	4	4	4	4
Rock Socket Length, L_R	FT.	6	6	8	21	16	7.5	6.5	6.5
Effective Rock Socket Length in Fractured Rock, ESL1	FT.	0.45	0.7	4.3	12.7	10.3	5.2	3.5	0
Effective Rock Socket Length in Competent Rock, ESL2	FT.	3.55	3.3	1.7	6.3	3.7	0.3	1	4.5
Factored Tip Resistance R_p	Kip	11016	6526	6799	3790	4987	5576	11582	14072
Factored Side Resistance R_s	Kip	920	834	404	729	728	100	269	1087
Total Factored Resistance R_n	Kip	11936	7360	7203	4519	5715	5675	11852	15158
Axial Max Compression Strength Load	Kip	5011	4044	4439	4288	4590	4546	4152	3749
Uplift Resistance Factor, φ_{up}	dim	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Factored Uplift Resistance R_{up}	Kip	669	607	294	530	529	73	196	790
Axial Max Uplift Strength Load	Kip	453	0	267	52	500	0	0	179
Uplift Check		OK	OK	OK	OK	OK	OK	OK	OK
Axial Capacity Check		OK	OK	OK	OK	OK	OK	OK	OK

Bridge	NB			
Substructure	Pier 1	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	Dry	Btm FT.	954.25	
Bottom of footing EL.	954.25	1	938.8	4.87
Base Rock Type	Shale	2	933.8	0.627
Est. Top of Competent Rock EL.1	951.8	3	900	1.166
Est. Top of Rock EL.	958.8	4		
Min. Bearing EL.	948.25		Ave Side Qu =	4.87
Design Bearing EL.2	948.25		Ave Tip Qu =	4.9
Bottom of Bearing Influced Area EL.	940.25			

Bridge	NB			
Substructure	Pier 2	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	Dry	Btm FT.	878.75	
Bottom of footing EL.	878.75	1	850	4.38
Base Rock Type	Shale	2	830	2.885
Est. Top of Competent Rock EL.1	853	3		
Est. Top of Rock EL.	855.7	4		
Min. Bearing EL.	849.7		Ave Side Qu =	4.24
Design Bearing EL.2	849.7		Ave Tip Qu =	2.9
Bottom of Bearing Influced Area EL.	841.7			

Bridge	NB			
Substructure	Pier 3	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	861	Btm FT.	865	
Bottom of footing EL.	865	1	827.6	3.006
Base Rock Type	Shale/ Siltstone	2	800	4.969
Est. Top of Competent Rock EL.1	838.3	3		
Est. Top of Rock EL.	844.6	4		
Min. Bearing EL.	838.3		Ave Side Qu =	3.01
Design Bearing EL.2	836.6		Ave Tip Qu =	3.0
Bottom of Bearing Influced Area EL.	828.6			

Bridge	NB			
Substructure	Pier 4	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	870	Btm FT.	872.5	
Bottom of footing EL.	872.5	1	825.5	0.683
Base Rock Type	Shale/ Siltstone	2	800	3.33
Est. Top of Competent Rock EL.1	836.8	3		
Est. Top of Rock EL.	851.5	4		
Min. Bearing EL.	836.8		Ave Side Qu =	0.68
Design Bearing EL.2	830.5		Ave Tip Qu =	1.7
Bottom of Bearing Influced Area EL.	822.5			

Bridge	SB			
Substructure	Pier 1	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	935.5	Btm FT.	920.7	
Bottom of footing EL.	952	1	912.7	2.043
Base Rock Type	Shale/ Siltstone	2	902.7	2.393
Est. Top of Competent Rock EL.1	920.7	3	897.7	0.8
Est. Top of Rock EL.	933	4	875	2.804
Min. Bearing EL.	920.7		Ave Side Qu =	2.04
Design Bearing EL.2	917		Ave Tip Qu =	2.2
Bottom of Bearing Influced Area EL.	909			

Bridge	SB				
Substructure	Pier 2	**Rock Stra.**		**Btm Elv**	**Qu**
Water Table EL.	Dry	Btm	FT.	874.25	
Bottom of footing EL.	874.25	1		848.5	2.638
Base Rock Type	Shale/ Sandstone	2		825	1.573
Est. Top of Competent Rock EL.1	855.5	3			
Est. Top of Rock EL.	862.7	4			
Min. Bearing EL.	855.5		Ave Side Qu =		2.64
Design Bearing EL.2	855.2		Ave Tip Qu =		2.5
Bottom of Bearing Influced Area EL.	847.2				

Bridge	SB				
Substructure	Pier 3	**Rock Stra.**		**Btm Elv**	**Qu**
Water Table EL.	867	Btm	FT.	866.75	
Bottom of footing EL.	866.75	1		825.7	5.064
Base Rock Type	Shale/ Siltstone	2		795	5.245
Est. Top of Competent Rock EL.1	832.2	3			
Est. Top of Rock EL.	837.7	4			
Min. Bearing EL.	831.7		Ave Side Qu =		5.06
Design Bearing EL.2	831.2		Ave Tip Qu =		5.1
Bottom of Bearing Influced Area EL.	823.2				

Bridge	SB			
Substructure	Pier 4	**Rock Stra.**	**Btm Elv**	**Qu**
Water Table EL.	886.5	Btm FT.	886.5	
Bottom of footing EL.	886.5	1	820	6.221
Base Rock Type	Shale/ Siltstone	2		
Est. Top of Competent Rock EL.1	840	3		
Est. Top of Rock EL.	841.1	4		
Min. Bearing EL.	835.1		Ave Side Qu =	6.22
Design Bearing EL.2	834.6		Ave Tip Qu =	6.2
Bottom of Bearing Influced Area EL.	826.6			

Objective:

The purpose of these calculations is to determine the subsurface rock strata based on project boring logs and coring photos to provide geotechnical design parameters for the drilled shaft foundations of Sum-8-0199 Northbound and Southbound bridge.

Source of Data:

1. Boring Logs are from the 2015 and 2016 exploration;
2. Unconfined compressive strength tests and Point Load Test results.

Assumptions:

1. Top of Rock Elevation at the center of the pier footing is estimated as the highest top of rock elevation among the relative project borings, and top of Competent Rock Elevation was also estimated based on relative project borings;
2. Between "top of rock elevation" and "top of competent rock elevation", weak rock parameter were used for determining the side resistance of the drilled shaft rock socket. RQD of the weak rock layer is assumed as 10 if no rock coring data is available, and the uncomfined compressive strength is assumed to be 200 psi for very weak shale, 500 psi for very weak sandstone and siltstone;
3. When both point test and comprssive strength test are available for the same rock stratum, Qu is estimated based on the comressive strength test result;

SUM-8-0199 N.B. Rock Subsurface Profile Summary Table

Structure	Strata	Boring No.	Type	Top. Elv.	RQD (%)	Q_u (psi)	Fractured Unfractured
Pier 1	R1	B-009-5-19	Sandstone	958.8	10	500	F
	R2		Sandstone&Shale	951.8		4870	U
	R3		Sandstone&Shale	938.8		627	
	R4		Sandstone&Shale	933.8		1166	
Pier 2	R1	B-010-0-15	Shale W	855.7	52	1500	F
	R2	B-009-7-19	Sandstone	853.2		4380	U
		B-010-0-15	Sandstone	852.8		4380	
		Avg.	Sandstone	853.0		4380	
	R3	B-009-7-19	Sandstone & Shale	850.1		1927	
		B-010-0-15	Shale	850.2		3840	
		Avg.	Shale	850.0		2885	
Pier 3	R1	B-011-2-16	Shale/Siltstone	844.6	10	400	F
		B-011-3-16	Shale/Siltstone	843.8	10	500	
		B-011-7-19	Shale/Siltstone	843.9	10	500	
		Avg.	Shale/Siltstone	844.6	10	471	
	R2	B-011-2-16	Shale/Siltstone	840.8		3006	U
		B-011-3-16	Shale/Siltstone	838.3		3006	
		B-011-7-19	Shale/Siltstone	839.4		3006	
		Avg.	Shale/Siltstone	838.3		3006	
	R3	B-011-2-16	Shale/Siltstone	830.6		4969	
		B-011-7-19	Shale/Siltstone	827.6		4969	
		Avg.	Shale/Siltstone	827.6		4969	
Pier 4	R1	B-013-2-16	Shale W	851.5	10	200	F
	R2	B-013-2-16	Shale/Siltstone	836.8		683	U
		B-013-3-16	Shale/Siltstone	836.9		683	
		Avg.	Shale/Siltstone	836.8		683	
	R3	B-013-2-16	Shale/Siltstone	825.5		2665	
		B-013-3-16	Shale/Siltstone	832.3		3855	
		Avg.	Shale/Siltstone	825.5		3330	

SUM-8-0199 S.B. Rock Subsurface Profile Summary Table

Structure	Strata	Boring No.	Type	Top. Elv.	RQD (%)	Q_u (psi)	Fractured Unfractured
Pier 1	R1	B-008-1-19	Shale/Siltstone W	933	10	300	F
		B-009-1-16	Shale W	931.7	10	200	
		Avg.	Shale/Siltstone W	933.0	10	241	
	R2	B-008-1-19	Shale/Siltstone	925.3		2043	U
		B-009-1-16	Shale/Siltstone	920.7		2043	
		Avg.	Shale/Siltstone	920.7		2043	
	R3	B-008-1-19	Shale/Siltstone	915.7		2393	
		B-009-1-16	Shale/Siltstone	912.7		2393	
		Avg.	Shale/Siltstone	912.7		2393	
	R3A	B-009-1-16	Shale/Siltstone	902.7		800	
	R4	B-008-1-19	Shale/Siltstone	905.7		2804	
		B-009-1-16	Shale/Siltstone	897.7		2804	
		Avg.	Shale/Siltstone	897.7		2804	
Pier 2	R1	B-011-0-15	Shale W	862.7	10	200	F
	R2	B-011-0-15	Shale/Sandstone	855.5		2638	U
		B-009-6-19	Shale/Sandstone	858.9		2638	
		Avg.	Shale/Sandstone	855.5		2638	
	R3	B-009-6-19	Shale/Sandstone	848.5		1573	
Pier 3	R1	B-011-5-16	Shale W	837.7	10	200	F
	R2	B-011-4-16	Shale/Sandstone	832.2		6057	U
		B-011-5-16	Shale/Sandstone	835.2		4070	
		B-011-8-19	Siltstone	835.0			
		Avg.	Shale/Sandstone	832.2		5064	
	R3	B-011-8-19	Shale/Siltstone	825.7		5245	
Pier 4	R1	B-013-4-16	Shale/Siltstone W	841.1	10	300	U
	R2		Shale/Siltstone	840		6221	F

Pier 1. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 527+89, 29' RT.	EXPLORATION ID B-009-5-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 960.3 (MSL) EOB: 41.5 ft.	PAGE 1 OF 1
START: 6/26/19 END: 7/1/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087362, -81.501727	

MATERIAL DESCRIPTION AND NOTES	ELEV. 960.3	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
BROWN, **SILT AND CLAY**, SOME STONE FRAGMENT, SOME SAND, DAMP	958.8	TR																
SANDSTONE, BROWNISH GRAY AND LIGHT GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, MEDIUM TO COARSE GRAINED. NOTE: AUGERS ADVANCED TO SET CORE BARREL			60/2"	-	100	SS-1	-	-	-	-	-	-	-	-	-	3	Rock (V)	
@6.0' - 8.5'; FINE TO MEDIUM GRAINED			60/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	2	Rock (V)	
	951.8		60/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY TO SLIGHTLY WEATHERED, MODERATELY STRONG, MEDIUM TO GRAVEL GRAINED, THIN BEDDED, SLIGHTLY FRIABLE, OCCASSIONAL RUST STAINING, CONTAINS LAYERS OF MEDIUM TO COARSE GRAINED, BLOCKY, GOOD; RQD 75%, REC 100%.			56		100	NQ2-1										7	CORE	
@14.9' - 15.3'; γ = 142 pcf; Qu = 4,630 psi			78		100	NQ2-2											CORE	
@16.4'; LIGHT GRAY WITH BROWN, MEDIUM TO COARSE GRAINED WITH OCCASIONAL GRAVEL																		
@17.6' - 18.0'; γ = 142 pcf; Qu = 5,110 psi																		
@18.4'; GRAY	941.7																	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 37%, REC. 90%; **SHALE**, GRAYISH BLACK, HIGHLY TO MODERATELY WEATHERED, VERY WEAK TO WEAK, LAMINATED TO VERY THIN BEDDED, CONTAINS SLIGHTLY ARENACESOUS LAYERS, RANGES IN THICKNESS 0.5" TO 10", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 4".			40		87	NQ2-3											CORE	
@21.3' - 21.9'; HIGH ANGLE FRACTURE @21.8' - 22.7'; SHALE Sc = 627 psi @22.6' - 24.6'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS			10		75	NQ2-4											CORE	
@26.1' - 27.8'; VERY BROKEN INCLUDING HIGH ANGLE FRACTURE, PROBABLE CORE LOSS @27.5'; MODERATELY WEATHERED, BLOCKY, GOOD			37		95	NQ2-5											CORE	
@29.6' - 30.6'; HIGH ANGLE FRACTURE @30.6'; SLIGHTLY WEATHERED @30.6' - 31.4'; SHALE Sc = 1,184 psi @31.8' - 32.8'; SHALE Sc = 1,286 psi			52		98	NQ2-6											CORE	
@32.8' - 33.4'; HIGH ANGLE FRACTURE @36.8' - 37.5'; HIGH ANGLE FRACTURE @38.0' - 39.4'; SHALE Sc = 1,028 psi			72		100	NQ2-7											CORE	
	918.8	EOB																

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 500 psi

STRATA R2 (Unfractured):
Qu = (4630+5110)=4870 psi

STRATA R3 (Unfractured):
Qu = 627 psi

STRATA R4 (Unfractured):
Qu = (1184+1286+1028)/3
=1166 psi

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 1 BAG BENTONITE GROUT; TREMIED 1 BAG CEMENT; TREMIED 50 GAL. WATER

Pier 2. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 530+84, 30' RT.	EXPLORATION ID B-009-7-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 885.2 (MSL) EOB: 55.0 ft.	PAGE 1 OF 1
START: 6/4/19 END: 6/5/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088116, -81.501328	

MATERIAL DESCRIPTION AND NOTES	ELEV. 885.2	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
Topsoil - 5"	884.9																	
LOOSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	881.7		4 3 2	7	56	SS-1	-	35	16	17	19	13	21	16	5	11	A-2-4 (0)	
MEDIUM STIFF, GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP	879.2		2 2 3	7	39	SS-2	0.50	29	12	16	24	19	25	17	8	14	A-4a (2)	
LOOSE, BLACK WITH BROWN, **STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET			2 2 3	7	39	SS-3	-	59	13	16	8	4	NP	NP	NP	20	A-1-a (0)	
@8.5'; MEDIUM DENSE, CONTAINS COBBLES AND BOULDERS	874.2		2 7 3	14	22	SS-4	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
MEDIUM DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS ROOTS, MODERATELY ORGANIC (LOI=7.5%), WET	871.7		6 6 3	12	50	SS-5	-	48	5	15	12	20	NP	NP	NP	55	A-2-4 (0)	
DENSE, DARK GRAY WITH BLACK, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP	869.2		4 12 19	42	11	SS-6	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, DAMP	866.7		11 15 15	41	67	SS-7	3.50	48	7	8	22	15	27	18	9	11	A-4a (0)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, (BOULDER ZONE: COBBLES AND BOULDERS) @ 18.5' - 25.0'; ENCOUNTERED COBBLES AND BOULDERS	860.2		13 39 50	120	72	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
			31 33 33	89	100	SS-9	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
			43 48 60	146	39	SS-10	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE CLAY, CONTAINS COBBLES AND BOULDERS, DAMP	853.2						-	60	3	6	17	14	24	15	9	12	A-2-4 (0)	
			0		68	NQ2-1	-	-	-	-	-	-	-	-	-	-	CORE	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, BLOCKY, GOOD; RQD 79%, REC 100% @ 33.7' - 34.1'; SANDSTONE γ = 150 pcf; Qu = 13,112 psi	850.1	TR	43		55	NQ2-2											CORE	
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 85%, REC. 99%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 1" TO 6", BLOCKY, GOOD; **SHALE**, DARK GRAY, SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5". @36.3' - 39.0'; SHALE Sc = 1,753 psi @36.4' - 36.8'; γ = 163 pcf; Qu = 1,783 psi @39.0' - 39..2'; MODERATELY WEATHERED			90		100	NQ2-3											CORE	
@43.8' - 44.0'; MODERATELY WEATHERED			83		100	NQ2-4											CORE	
@47.7'; VERY THIN CLAY SEAM			87		100	NQ2-5											CORE	
@49.4' - 49.9'; γ = 158 pcf; Qu = 1,985 psi @50.4' - 50.9'; MODERATELY WEATHERED, WITH LOSS @51.1' - 51.6'; LIMESTONE, VERY STRONG, THIN BEDDED @51.1' - 51.6'; LIMESTONE Sc = 28,950 psi @52.5' - 52.9'; γ = 162 pcf; Qu = 2,012 psi			80		97	NQ2-6											CORE	
@54.7' - 55.0'; LIMESTONE, VERY STRONG, THIN BEDDED	830.2	EOB																

STRATA R2 (Unfractured):
Qu = 4380psi
(Based on B-010-0-15)

STRATA R3 (Unfractured):
Qu = (1783+1985+2012)/3
=1927 psi

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; TREMIED 30 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 8/24/19 17:19 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-82019\BORING LOGS\SUM-8-01.75 2019 ODOT.GPJ

Pier 2. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 531+07, 13' LT.	EXPLORATION ID B-010-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.088190, -81.501356	

MATERIAL DESCRIPTION AND NOTES	ELEV. 879.2	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
LOOSE, GRAVEL, DAMP (FILL)			3 2 2	5	44	SS-1	1.00	10	6	6	40	38	45	21	24	26	A-7-6 (15)	
	875.2																	
MEDIUM STIFF, BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL AND SAND, MOIST	874.2																	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, CONTAINS SHALE FRAGMENTS, (SEVERELY WEATHERED SHALE), MOIST			6 6 7	17	78	SS-2	-	-	-	-	-	-	-	-	-	10	A-6b (V)	
			7 7 25	43	67	SS-3	-	5	7	7	53	28	39	19	20	9	A-6b (12)	
			13 14 20	45	72	SS-4	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
			22 28 30	78	78	SS-5	-	-	-	-	-	-	-	-	-	13	A-6b (V)	
			25 28 30	78	100	SS-6	-	-	-	-	-	-	-	-	-	7	A-6b (V)	
	860.7																	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, (BOULDER ZONE), DAMP			26 50/5"	-	-	SS-7	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
			50/4"	-	-	SS-8	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
	855.7	TR	0		33	NX-1											CORE	
SHALE, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED, ARGILLACEOUS, RQD 31%, REC 63%.			46		75	NX-2											CORE	
	852.8																	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, INTACT; RQD 63%, REC 98%.			63		98	NX-3											CORE	
@ 28.5' TO 29.0'; Qu = 4,380 PSI	850.2																	
SHALE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, LAMINATED, ARGILLACEOUS; RQD 94%, REC 100%.			94		100	NX-4											CORE	
			98		100	NX-5											CORE	
@ 41.8' TO 42.2'; Qu = 3,840 PSI			100		100	NX-6											CORE	
	834.2	EOB																

STRATA R1 (Fractured):
1. RQD = (1.5*46+0.9*63)/2.4 =52
2. Qu = 1500 psi (Slight Strong Shale)

STRATA R2 (Unfractured):
. Qu = 4380psi

STRATA R3 (Unfractured):
Qu = 3840 psi

NOTES: CAVE @ 14'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 47 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 8/22/19 15:41 - C:\USERS\ZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

Pier 3. N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 533+38, 43' RT.	EXPLORATION ID B-011-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 872.6 (MSL) EOB: 71.0 ft.	PAGE 1 OF 2
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.088750, -81.500946	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.6	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
ASPHALT (4.0") & BASE (7.0")	871.7																	
VERY STIFF TO HARD, GRAYISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)**			12 11 8	26	100	SS-1	2.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@5.0' TO 6.5'; CHANGES TO MEDIUM STIFF TO VERY STIFF, GREENISH BROWN AND GRAYISH BROWN, CONTAINS CINDERS	865.1		3 2 3	7	100	SS-2	0.75 - 2.75	24	15	21	27	13	24	17	7	15	A-4a (1)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP	862.6		7 5 3	11	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
MEDIUM DENSE, ORANGISH BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST	860.6		3 4 5	12	56	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
HARD, GRAYISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS IRON STAINING, DAMP	858.1		15 50/4"	-	80	SS-5	4.0 - 4.25	30	16	16	24	14	25	17	8	11	A-4a (1)	
VERY DENSE, GRAY, **STONE FRAGMENTS**, (SILTSTONE), DAMP	855.1		50/5"	-	80	SS-6	-	-	-	-	-	-	-	-	-	4	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	853.1		9 21 50/5"	-	59	SS-7	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTSTONE), WET	850.6		19 7 18	34	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (STONE FRAGMENTS ARE SILTSTONE), MOIST	847.6		6 27 28	75	67	SS-9	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE, SHALE), DAMP	844.6		39 17 28	61	100	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
TR			20 50/4"	-	90	SS-11A	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
						SS-11B	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK, FISSILE.	843.1																	
SILTSTONE, GRAY, HIGHLY WEATHERED.	840.8		50/3"	-	100												Rock (V)	
INTERBEDDED SILTSTONE (54%) AND SHALE (46%), RQD 42%, REC. 100%; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, CONTAINS CLAY SEAMS, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 37.4' - 37.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY/DISTURBED/SEAMY, GOOD SURFACE CONDITION; **SHALE**, DARK GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, FISSILE.			38		100	NQ2-1											CORE	
			47		100	NQ2-2											CORE	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. @44.1'; Qu = 3331 PSI (SHALE) @48.1'; Qu = 10278 PSI (SILTSTONE) @52.9'; Qu = 8084 PSI (SILTSTONE)	830.6		39		99	NQ2-3											CORE	
			60		100	NQ2-4											CORE	
			55		100	NQ2-5											CORE	
			73		100	NQ2-6											CORE	

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 400 psi (Assumed)

STRATA R2 (Unfractured):
Qu = 3006 psi (Based on B-011-7-19)

STRATA R3 (Unfractured):
Qu = 3331*.72+(10278 +8084)/2*0.28=4969 psi

Pier 3. N.B.

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 533+38, 43' RT.	START: 4/3/17	END: 4/4/17	PG 2 OF 2	B-011-2-16

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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 57%, REC. 100%;	812.6																	
SHALE, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, THIN TO THINLY LAMINATED, PYRITIC, CONTAINS CLAY SEAMS, FISSILE, FOSSILIFEROUS, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 49.4' - 49.6' AND 59.4' - 59.9', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, FAIR TO GOOD SURFACE CONDITION;		61 62 63 64 65 66	42		100	NQ2-7												CORE	
SILTSTONE, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG. *(continued)*		67 68 69 70	72		100	NQ2-8												CORE	
	801.6	EOB 71																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 1 BAG ASPHALT PATCH; PUMPED 65 GAL. BENTONITE GROUT

Pier 3. N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 533+69, 6' RT.	EXPLORATION ID B-011-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 873.8 (MSL) EOB: 45.5 ft.	PAGE 1 OF 1
START: 4/3/17 END: 4/4/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.088868, -81.501030	

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
ASPHALT (6.0")	873.3																	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, CONTAINS FEW CINDERS, MOIST **(FILL)**	872.2		4 6 10	22	39	SS-1A	2.0 - 4.5+	-	-	-	-	-	-	-	-	19	A-4a (V)	
						SS-1B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	870.8																	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME STONE FRAGMENTS, LITTLE CLAY, DAMP **(FILL)**	868.3		3 3 4	9	72	SS-2	1.5 - 3.5	25	13	19	28	15	25	18	7	14	A-4a (2)	
LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW CINDERS, DAMP **(FILL)**	865.8		2 2 2	5	61	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST **(FILL)**	862.8		2 2 3	7	72	SS-4	1.1 - 2.75	-	-	-	-	-	-	-	-	14	A-4a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, CONTAINS CINDERS, MOIST **(FILL)**	860.8	W 860.8	3 5 9	19	56	SS-5	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
VERY LOOSE, BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET	859.4		1 1 14	20	83	SS-6A	-	-	-	-	-	-	-	-	-	29	A-3a (V)	
						SS-6B	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
MEDIUM DENSE TO VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE AND SHALE), DAMP			13 17 20	50	67	SS-7	-	48	13	14	17	8	21	16	5	10	A-1-b (0)	
			31 50/5"	-	73	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	851.3		50/3"	-	67	SS-9	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
HARD, GRAY, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP	849.3		18 28 50/5"	-	88	SS-10A	4.3 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
						SS-10B	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST	846.3		50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, CONTAINS 1.0" BY 2.0" COARSE GRAVEL PIECE, MOIST	843.8		36 50/5"	-	82	SS-12	-	-	-	-	-	-	-	-	-	9	A-2-6 (V)	
		TR																
SILTSTONE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK.	838.3		50/6"	-	67	SS-13	-	-	-	-	-	-	-	-	-	10	Rock (V)	
INTERBEDDED SHALE (57%) AND SILTSTONE (43%), RQD 47%, REC. 99%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, DISINTEGRATED FROM 36.3' - 36.5', GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG, JOINT DISCONTINUITY: HIGH ANGLE FROM 38.8' - 39.0'.	828.3	EOB	47		99	NX-1											CORE	

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 500 psi (Assumed)

STRATA R2 (Unfractured):
Qu = 3006 psi (Based on B-011-7-19)

NOTES: GROUNDWATER ENCOUNTERED AT 13.0' DURING DRILLING, 16.1' AFTER DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 55 GAL. BENTONITE GROUT

Pier 3. N.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 533+54, 26' RT.	EXPLORATION ID B-011-7-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 NB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 872.6 (MSL) EOB: 50.0 ft.	PAGE 1 OF 1
START: 6/28/19 END: 6/28/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.088809, -81.500980	

MATERIAL DESCRIPTION AND NOTES	ELEV. 872.6	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
MOIST ASPHALT (3.0") & BASE (9.0")	871.6																	
LIGHT BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	871.1						-	-	-	-	-	-	-	-	-	-	A-3a (V)	
	870.6						-	-	-	-	-	-	-	-	-	-	A-4a (V)	
LIGHT BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, (FILL), MOIST	869.9						-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
BLACK, **COARSE AND FINE SAND**, BRICK FRAGMENTS, (FILL), MOIST					100		1.00	-	-	-	-	-	-	-	-	-	A-4a (V)	
STIFF, GREY, **SANDY SILT**, SOME CLAY, SOME ROCK FRAGMENTS, COAL FRAGMENTS, (FILL), MOIST @ 5.0'; GREY TO BROWN, LITTLE GRAVEL, TRACE TERRACOTTA PIPE	863.6				100		1.50	-	-	-	-	-	-	-	-	-	A-4a (V)	
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, BRICK FRAGMENTS, LITTLE SILT, TRACE CLAY, (FILL), MOIST TO WET @ 10.0' TO 12.0'; WET	860.1						-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, MOIST TO DAMP @ 15.0'; BROWN AND ORANGE MOTTLING					70		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
	851.0				92		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
GREY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE TO SOME CLAY, (BOULDER ZONE), MOIST TO DAMP @ 21.6'; 5" (DIA.) WELL ROUNDED COBBLE @ 23.5'; "AND" CLAY					88		-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
	847.6						-	-	-	-	-	-	-	-	-	-	A-2-4 (V)	
HARD, GREY, **SILT AND CLAY**, LITTLE GRAVEL, (BOULDER ZONE), DAMP TO MOIST	846.8						-	-	-	-	-	-	-	-	-	-	A-6a (V)	
GREY, **STONE FRAGMENTS**, SOME SILT, (BOULDER ZONE: SILTSTONE AND SHALE), DRY	843.9	TR			92		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
INTERBEDDED SILTSTONE (80%) AND SHALE (20%); **SILTSTONE**, LIGHT GREY, HIGHLY WEATHERED, WEAK; **SHALE**, GREY, HIGHLY WEATHERED, WEAK.	842.6						-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SILTSTONE (67%) AND SHALE (33%), RQD 40%, REC. 66%; **SILTSTONE**, LIGHT GREY, UNWEATHERED, MODERATELY STRONG TO STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED TO MODERATELY FRACTURED; **SHALE**, DARK GREY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS. @ 30.6' TO 31.0'; QU = 13,190 PSI (SILTSTONE)	840.1				40												CORE	
LIMESTONE, LIGHT GREY, UNWEATHERED, VERY STRONG, THIN BEDDED; RQD 40%, REC 66%. @ 32.5' TO 32.9'; QU = 19,920 PSI (LIMESTONE)	839.4																	
INTERBEDDED SHALE (56%) AND SILTSTONE (44%), RQD 31%, REC. 85%; **SHALE**, DARK GREY, MODERATELY WEATHERED, WEAK TO MODERATELY STRONG, LAMINATED TO THIN BEDDED, MICACEOUS, SLIGHTLY ARGILLACEOUS, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, FRACTURED TO MODERATELY FRACTURED. @ 36.3' TO 37.6'; AVG SC VALUE = 3006 PSI (SHALE AND SILTSTONE) @ 42.9' TO 43.3'; GREY CLAY INFILLING @ 44.1' TO 44.2'; GREY CLAY INFILLING					14	76	NX-2										CORE	
					23	88	NX-3										CORE	
@ 46.0' TO 49.0'; SANDSTONE INTERBEDS @ 49.0'; 70 DEGREE, HIGH ANGLE FRACTURE @ 49.6' TO 50.0'; HIGHLY FRACTURED, GREY CLAY INFILLING	822.6	EOB			54	98	NX-4										CORE	

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 500 psi (Assumed)

Neglect the high strength bedrock section between 842.6 and 839.4 in the calculation (not found in other boring)

STRATA R2 (Unfractured):
Qu = 3006 psi

STRATA R3 (Unfractured):
Qu = 4969 psi (Based on B-011-2-16)

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE PELLETS

Pier 4 N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 536+16, 44' RT.	EXPLORATION ID B-013-2-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 5/7/15	ELEVATION: 880.5 (MSL) EOB: 85.0 ft.	PAGE 1 OF 3
START: 3/30/17 END: 3/31/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089458, -81.500570	

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, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, CONTAINS FEW PORCELAIN FRAGMENTS, DAMP **(FILL)**	880.5	1	4 3 5	12	100	SS-1	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	877.5	2																
VERY LOOSE, DARK BROWN AND BLACK, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, CONTAINS TRACE BLACK ORGANICS, LOI = 1.8% ASH, MOIST **(FILL)**		3	1 2 1	4	39	SS-2	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	875.0	4																
VERY LOOSE TO LOOSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST **(FILL)** @6.0' TO 7.5'; CONTAINS 2.0" SILTY CLAY SEAM		5	2 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
		6																
		7	1 1 1	3	39	SS-4	-	-	-	-	-	-	-	-	-	19	A-3a (V)	
	870.0	8																
LOOSE TO MEDIUM DENSE, GRAY AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST TO WET		9	2 3 3	9	83	SS-5	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		10																
		11	6 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		12																
		13	3 4 4	12	100	SS-7	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		14																
		15	3 3 2	7	100	SS-8	-	38	31	12	14	5	NP	NP	NP	17	A-1-b (0)	
	860.0	16																
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		17	3 5 14	28	100	SS-9	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
	856.8	18																
VERY STIFF TO HARD, GRAY, **SILT AND CLAY**, SOME GRAVEL, SOME SAND, RELIC SHALE STRUCTURE, DAMP		19	7 13 15	42	100	SS-10	3.75 - 4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
		20																
		21	10 23 27	75	100	SS-11	4.5+	28	16	8	27	21	30	17	13	11	A-6a (4)	
	851.5	22																
		23	20 30 45	112	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		24	TR															
		25																
		26																
		27																
		28																
		29																

Pier 4 N.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 2 OF 3	B-013-2-16

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, GRAY, SEVERELY WEATHERED, VERY WEAK TO WEAK, BECOMES MORE INDURATED WITH DEPTH. *(continued)*	850.5	31–34	15 34 50/5"	-	100	SS-13	-	-	-	-	-	-	-	-	-	-	Rock (V)	
STRATA R1 (Fractured): 1. RQD = 10 (Assumed) 2. Qu = 200 psi (Very Weak Shale)		34–39	18 20 34	81	100	SS-14	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		39–43																
	836.8	43	60/3"	-	100	SS-15	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS.		43–44	29		100	NQ2-1											CORE	
		44–50	16		77	NQ2-2											CORE	
STRATA R2 (Unfractured): Qu = 683 psi		50–53	29		84	NQ2-3											CORE	
@53.4'; Qu = 683 PSI (SHALE INTERBEDDED WITH SILTSTONE)		53–58	61		100	NQ2-4											CORE	
@55.8'; Qu = 11709 PSI (SILTSTONE)		58–61																

Pier 4 N.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+16, 44' RT.	START: 3/30/17	END: 3/31/17	PG 3 OF 3	B-013-2-16

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
INTERBEDDED SHALE (84%) AND SILTSTONE (16%), RQD 64%, REC. 95%; **SHALE**, GRAY TO DARK GRAY, UNWEATHERED TO MODERATELY WEATHERED, VERY WEAK TO SLIGHTLY STRONG, VERY THIN TO THINLY LAMINATED, HIGHLY WEATHERED FROM 46.6' - 47.0' AND 47.6' - 50.5', PYRITIC, SILTY, FISSILE, FOSSILIFEROUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY TO HIGHLY FRACTURED, SLIGHTLY FRACTURED FROM 81.0' - 82.8', OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 46.6' - 47.0' AND 47.6' - 50.5', GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY TO LIGHT GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, SLIGHTLY ARGILLACEOUS. *(continued)* @63.4'; Qu = 942 PSI (SHALE)	818.4	63	79		100	NQ2-5											CORE	
		65	55		100	NQ2-6											CORE	
		70	87		98	NQ2-7											CORE	
		75	95		100	NQ2-8											CORE	
		80	98		100	NQ2-9											CORE	
	795.5	EOB 85																

STRATA R3 ((Unfractured):

Qu = 942X0.84+11709X0.16= 2665 psi

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 85 GAL. BENTONITE GROUT

Pier 4 N.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 536+52, 6' RT.	EXPLORATION ID B-013-3-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 56.0 ft.	PAGE 1 OF 2
START: 3/27/17 END: 3/28/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089588, -81.500652	

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, DARK BROWN CHANGING TO BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST **FILL** @1.0' TO 2.5'; CONTAINS CONCRETE AND ANTHRACITE COAL FRAGMENTS	885.5		7 6 6	16	89	SS-1	-	-	-	-	-	-	-	-	-	16	A-1b (V)	
	881.6		7 7 5	16	61	SS-2A SS-2B	- -	- -	- -	- -	- -	- -	- -	- -	- -	8 8	A-1b (V) A-3a (V)	
MEDIUM DENSE TO DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, DAMP **FILL** @6.0' TO 7.5'; CONTAINS 1.0" GRAY SILTY CLAY SEAM	877.5		6 11 13	32	67	SS-3	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
LOOSE, DARK BROWN CHANGING TO DARK BROWN WITH BLACK AND ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE TO SOME SILT, TRACE CLAY, STONE FRAGMENTS ARE SANDSTONE, DAMP TO WET **FILL** @8.5' TO 10.0'; CONTAINS TRACE ANTHRACITE COAL FRAGMENTS @11.0' TO 12.5'; CONTAINS TRACE BLACK ROOTS	872.0		3 3 4	9	78	SS-4	-	-	-	-	-	-	-	-	-	13	A-1b (V)	
			6 3 3	8	56	SS-5	-	-	-	-	-	-	-	-	-	26	A-1b (V)	
MEDIUM STIFF TO STIFF, BLACK AND GRAY, **SILT AND CLAY**, "AND" SAND, ORGANIC, CONTAINS TRACE BLACK ROOTS, LOI = 7.2% ASH, MOIST	870.0	▼ 24 hr	3 2 1	4	72	SS-6	0.75 - 1.7	0	6	42	38	14	38	24	14	32	A-6a (5)	
MEDIUM DENSE, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST	867.5	W	5 3 5	11	67	SS-7	-	-	-	-	-	-	-	-	-	16	A-2-4 (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS**, TRACE TO LITTLE SAND, TRACE SILT, TRACE CLAY, STONE FRAGMENTS ARE SILTSTONE, WET	865.0		9 11 7	24	50	SS-8	-	-	-	-	-	-	-	-	-	15	A-1a (V)	
DENSE TO VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET			20 20 20	54	72	SS-9	-	-	-	-	-	-	-	-	-	10	A-1b (V)	
		W	20 16 16	43	72	SS-10	-	-	-	-	-	-	-	-	-	11	A-1b (V)	
			12 18 20	51	67	SS-11	-	-	-	-	-	-	-	-	-	9	A-1b (V)	
@28.5' TO 30.0'; GRAVEL IS ROUNDED TO SUBROUNDED			9 14 14	38	61	SS-12	-	-	-	-	-	-	-	-	-	14	A-1b (V)	

Pier 4 N.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 536+52, 6' RT.	START: 3/27/17	END: 3/28/17	PG 2 OF 2	B-013-3-16

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, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, STONE FRAGMENTS ARE SILTSTONE AND SHALE, MOIST TO WET *(continued)*	855.5	31 32 33 34 35 36 37 38 39 40 41 42 43	12 22 24	62	67	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			8 43 33	103	72	SS-14	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	842.0	TR																
SILTSTONE, GRAY, SEVERLY WEATHERED, MODERATELY ARGILLACEOUS.		44	84/6"	-	33	SS-15	-	-	-	-	-	-	-	-	-	13	Rock (V)	
	839.5	45 46																
SILTSTONE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, PYRITIC, MODERATELY ARGILLACEOUS, CONTAINS FEW THIN SHALE SEAMS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITIES: HIGH ANGLE FROM 47.1' - 47.5', FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, INTACT TO BLOCKY, GOOD TO VERY GOOD SURFACE CONDITION; RQD 78.4%, REC 99.3%.	836.9	47 48	65														CORE	
INTERBEDDED SHALE (69%) AND SILTSTONE (31%), RQD 26.1%, REC. 77.7%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, BECOMES FISSILE AT 53.0', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURES FROM 50.8' - 51.0', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, VERY BLOCKY TO INTACT, POOR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG. @51.3'; Qu = 10916 PSI (SILTSTONE)		49 50 51 52 53 54 55 56	11		7													
	829.5	EOB	52		91	NX-3											CORE	

STRATA R1 (Fractured):
Neglect silt stone, use data from B-013-2-16

STRATA R2 (Unfractured)::

Qu = 683 psi (shale from B-013-2-16)

STRATA R3 (Unfractured)::
Qu = 683X0.69+10916X0.31=3855 psi

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING, 23.5' BEFORE CORING, 15.0' UPON COMPLETION. CAVE DEPTH 29.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 80 GAL. BENTONITE GROUT

Pier 1. S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 227+64, 24' LT.	EXPLORATION ID B-008-1-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / BRODIE	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 5/1/19	ELEVATION: 958.3 (MSL) EOB: 68.0 ft.	PAGE 1 OF 2
START: 6/24/19 END: 6/25/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 89	LAT / LONG: 41.087395, -81.502198	

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, BLACK, BROWN AND GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WITH WOOD FRAGMENTS, MOIST	958.3																	
		1																
		2	9 19 28	70	78	SS-1	-	41	19	23	13	4	NP	NP	NP	29	A-1-b (0)	
	954.8	3																
HARD, GRAY, **SILT AND CLAY**, "AND" STONE FRAGMENTS, LITTLE SAND, WITH WOOD FRAGMENTS, (NOT ENOUGH MATERIAL TO TEST), DAMP		4	9 9 11	30	33	SS-2	4.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
		5																
		6	8 10 14	36	33	SS-3	4.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
		7																
@8.5'; STIFF		8	6 9 11	30	22	SS-4	1.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
		9																
@11.0'; VERY STIFF		10	7 8 11	28	17	SS-5	2.00	-	-	-	-	-	-	-	-	8	A-6a (V)	
	944.8	11																
MEDIUM DENSE TO DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, MOIST		12	10 10 11	31	78	SS-6	-	34	14	19	21	12	NP	NP	NP	16	A-2-4 (0)	
		13																
@16.0'; WITH WOOD FRAGMENTS		14	7 7 7	21	17	SS-7	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	939.8	15																
MEDIUM DENSE, REDDISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS BOULDERS, WET		16	3 5 6	16	56	SS-8	-	22	44	15	13	6	18	14	4	17	A-1-b (0)	
		17																
		18	11 16 24	59	33	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		19																
		20	60	-	100	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	933.0	21																
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 97%; **SHALE**, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR; **SANDSTONE**, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10".	TR	22	0		83	NQ2-1												CORE	
		23																
		24																
		25																
		26	0		90	NQ2-2												CORE
	925.3	27																
		28																
		29																
		30																
		31																
		32																
		33	30		97	NQ2-3												CORE
		34																
		35																
		36																
		37																
		38																
@39.3' - 40.3'; SHALE Sc = 1719 psi		39																
		40																
@40.6' - 41.2'; HIGH ANGLE FRACTURE		41	18		100	NQ2-4												CORE
@41.2' - 41.6'; SANDSTONE γ = 160 pcf; Qu = 2,800 psi	915.7	42																
		43																
		44																
@44.8' - 47.3'; SANDSTONE		45																
@45.4'; VERY THIN CLAY SEAM		46	70		97	NQ2-5												CORE
@46.6' - 47.0'; SANDSTONE γ = 161 pcf; Qu = 6,090 psi		47																
@47.4' - 47.7'; SHALE γ = 161 pcf; Qu = 808 psi		48																
@48.3' - 50.1'; SHALE Sc = 1642 psi		49																
		50																
		51	52		95	NQ2-6												CORE
@51.2' - 52.2'; HIGH ANGLE FRACTURE	905.7	52																
@52.4' - 53.4'; HIGH ANGLE FRACTURE		53																
		54																
@54.2' - 54.6'; SANDSTONE γ = 159 pcf; Qu = 6,320 ps		55																
@54.7' - 55.1'; SANDSTONE γ = 159 pcf; Qu = 5,450 psi		56	68		95	NQ2-7												CORE
		57																
		58																
@58.1' - 58.5'; SHALE γ = 160 pcf; Qu = 1,379 psi		59																
@58.6' - 59.1'; HIGH ANGLE FRACTURE																		
@59.5' - 59.9'; SHALE γ = 161 pcf; Qu = 1,587 psi																		

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 300 psi (Assumed)

STRATA R2 (Unfractured):
Qu = 1719*0.7+2800*0.3=2043 psi

STRATA R3 (Unfractured):
Qu = 808*0.7+6090*0.3=2393 psi

STRATA R4 (Unfractured):
Qu = (1379+1587)/2*0.7+(6320 +5450)/2*0.3=2804 psi

Pier 1. S.B.

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 227+64, 24' LT.	START: 6/24/19	END: 6/25/19	PG 2 OF 2	B-008-1-19

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
	898.3																	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 97%;		61	77		97	NQ2-8											CORE	
SHALE, GRAYISH BLACKISH, HIGHLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, LAMINATED TO VERY THIN BEDDED, CONTAINS ARENACEOUS LAYERS, RANGES IN THICKNESS 0.5" TO 7", BLOCKY, POOR TO FAIR;		62																
		63																
SANDSTONE, LIGHT GRAY AND BROWNISH GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, MICACEOUS, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 10". *(continued)*		64																
		65	75		93	NQ2-9											CORE	
@61.9'; VERY THIN CLAY SEAM		66																
		67																
	890.3	EOB 68																

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 2 BAGS BENTONITE GROUT; TREMIED 3 BAGS CEMENT; TREMIED 120 GAL. WATER

Pier 1. S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / J. HODGES	DRILL RIG: CME 55X	STATION / OFFSET: 227+80, 6' LT.	EXPLORATION ID B-009-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / J.HODGES	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 957.7 (MSL) EOB: 77.5 ft.	PAGE 1 OF 2
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.087417, -81.502115	

MATERIAL DESCRIPTION AND NOTES	ELEV. 957.7	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
MEDIUM DENSE, BROWN, DARK GRAYISH BLACK, AND REDDISH BROWN, **SANDY SILT**, SOME GRAVEL (SANDSTONE FRAGMENTS), TRACE CLAY, CONTAINS FEW ROOT HAIRS AND TRACE COAL FRAGMENTS, DAMP NO HP SAMPLE FELL APART **(FILL)**	955.7	1	5 11 4	22	50	SS-1	-	-	-	-	-	-	-	-	-	14	A-4a (V)	
DENSE, BROWN AND GRAY, **COARSE AND FINE SAND**, LITTLE SILT , TRACE TO LITTLE CLAY, LITTLE GRAVEL, DAMP **(FILL)**	953.2	3	12 14 10	35	72	SS-2	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
VERY STIFF TO HARD, GRAY WITH ORANGISH BROWN AND BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		6	2 6 7	19	100	SS-3	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
		8	2 3 4	10	44	SS-4	2.6 - 3.5	18	14	18	30	20	23	15	8	11	A-4a (3)	
@10.0' to 17.0'; BECOMES SOME GRAVEL		11	3 5 6	16	56	SS-5	3.1 - 4.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
@12.5' to 17.0'; BECOMES GRAY		13	2 5 6	16	50	SS-6	2.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
	940.7	16	3 4 12	23	78	SS-7	3.0 - 4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
MEDIUM DENSE, ORANGISH BROWN BECOMING BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, 17.5' TO 21.5' CONTAINS 1.0" TO 1.5" SILTY CLAY LENSES, MOIST TO WET		18	5 7 5	18	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	W 935.7	21	3 4 6	15	89	SS-9	-	51	16	10	14	9	NP	NP	NP	15	A-1-b (0)	
		23	9 7 10	25	50	SS-10	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
	931.7	26	9 20 50/5"	-	82	SS-11	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK, FRAGMENTED.	TR					SS-11	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		28	15 50/4"	-	100	SS-12	-	-	-	-	-	-	-	-	-	9	Rock (V)	
STRATA R1 (Fractured): 1. RQD = 10 (Assumed) 2. Qu = 200 psi (Very Weak Shale)		31	31 50/3"	-	78	SS-13	-	-	-	-	-	-	-	-	-	14	Rock (V)	
		36	50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
	920.7																	
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS.	912.7	41	13		38	NQ2-1											CORE	
STRATA R2 (Unfractured): Qu = 1719*0.7+2800*0.3=2043 psi (Based on B-008-1-19)		46	16		92	NQ2-2											CORE	
@47.7'; Qu = 18462 PSI (SILTSTONE)		51	36		99	NQ2-3											CORE	
STRATA R3 (Unfractured): Qu = 808*0.7+6090*0.3=2393 psi (Based on B-008-1-19)	902.7	56	30		100	NQ2-4											CORE	
STRATA R3A (Unfractured): Qu = 2400/3=800 psi (Assumed)		58	7		78	NQ2-5											CORE	

Pier 1. S.B.

PID: 91710	SFN: 7700370/7700371 (P)	PROJECT: SUM-8-01.75	STATION / OFFSET: 227+80, 6' LT.	START: 4/4/17	END: 4/5/17	PG 2 OF 2	B-009-1-16

MATERIAL DESCRIPTION AND NOTES	ELEV. 897.7	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
INTERBEDDED SHALE (72%) AND SILTSTONE (28%), RQD 29%, REC. 90%; **SHALE**, GRAY AND DARK GRAY, HIGHLY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, FISSILE, SEVERELY WEATHERED FROM 50.0' - 51.3', BEDDING DISCONTINUITIES: LOW ANGLE, JOINT DISCONTINUITIES: HIGH ANGLE FROM 57.7' - 58.9' AND 67.9' - 68.3', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, BLOCKY TO BLOCKY/DISTURBED/SEAMY, DISINTEGRATED FROM 42.0' - 42.4', 52.0' - 52.2', 57.4 - 59.0', 60.0 - 60.5', 61.3' - 61.6', AND 67.1' - 67.4', POOR TO FAIR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, MODERATELY ARGILLACEOUS. *(continued)* @62.4'; Qu = 9789 PSI (SILTSTONE)	897.7	61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77	39		97	NQ2-6											CORE	
			49		100	NQ2-7											CORE	
STRATA R4 (Unfractured): Qu = (1379+1587)/2*0.7+(6320+5450)/2*0.3=2804 psi (Based on B-008-1-19)			46		98	NQ2-8											CORE	
			15		83	NQ2-9											CORE	
	880.2	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 22.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 65 GAL. BENTONITE GROUT

Pier 2. S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: ODOT / LEWIS	DRILL RIG: CME 850R TRACKED	STATION / OFFSET: 230+96, 20' LT.	EXPLORATION ID B-009-6-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / MCINTOSH	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: 3.75" HSA / NQ2	CALIBRATION DATE: 6/1/17	ELEVATION: 881.3 (MSL) EOB: 42.5 ft.	PAGE 1 OF 1
START: 6/5/19 END: 6/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.088239, -81.501739	

MATERIAL DESCRIPTION AND NOTES	ELEV. 881.3	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
BROWN, **SILT AND CLAY**, CONTAINS COBBLES AND BOULDERS	879.8	1																
MEDIUM DENSE, GRAY AND BLACK, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	875.3	2 3 4 5	6 4 7	15	44	SS-1	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
			4 5 4	12	44	SS-2	-	44	17	25	10	4	NP	NP	NP	16	A-1-b (0)	
DENSE, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGEMENTS, LITTLE CLAY, MODERATELY ORGANIC (LOI=4.1%), WET		6 7 8	0 18 24	57	56	SS-3	-	30	8	19	30	13	NP	NP	NP	43	A-4a (2)	
@8.5'; VERY LOOSE, GRAYISH BROWN, NO ORGANICS	870.3	9 10	1 1 2	4	67	SS-4	-	-	-	-	-	-	-	-	-	18	A-4a (V)	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, LITTLE STONE FRAGMENTS, MOIST	867.8	11 12 13	6 6 9	20	67	SS-5	1.00	10	7	26	30	27	29	18	11	20	A-6a (5)	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, DAMP	865.3	14 15 16	10 7 9	22	33	SS-6	4.5+	30	5	8	32	25	27	17	10	14	A-4a (4)	
HARD, BROWN AND GRAY, **SANDY SILT**, SOME STONE FRAGMENTS, SOME CLAY, (BOULDER ZONE: COBBLES AND BOULDERS), DAMP		17 18	37 41 40	109	56	SS-7	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
		19 20	48 63	-	83	SS-8	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
	858.9	21 22	0		22	NQ2-1											CORE	
TR																		
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), RQD 45%, REC. 88%; **SHALE**, DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, VERY WEAK TO WEAK, LAMINATED, SLIGHTLY ARENACEOUS, RANGES IN THICKNESS 0.5" TO 4", BLOCKY, GOOD; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 1.5". @23.2' - 24.2'; SHALE, Sc = 842 psi @24.7' 25.3'; BROKEN, HIGHLY TO MODERATELY WEATHERED WITH CORE LOSS @27.5' - 28.4'; SHALE, Sc = 1,220 psi		23 24 25 26 27	43		88	NQ2-2											CORE	
		28 29 30 31 32	72		100	NQ2-3											CORE	
@30.5' - 30.9'; SANDSTONE γ = 159 pcf; Qu = 6,387 psi	850.4																	
SANDSTONE, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY FINE TO FINE GRAINED, THIN BEDDED, ARGILLACEOUS, INTACT, VERY GOOD; RQD ~~100%, REC 100%~~. @31.0' - 31.4'; SANDSTONE γ = 152 pcf; Qu = 12,996 psi	848.5	33 34 35	92		100	NQ2-4											CORE	
INTERBEDDED SANDSTONE (60%) AND SHALE (40%), RQD 91%, REC. 100%; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, VERY THIN TO THIN BEDDED, ARGILLACEOUS, RANGES IN THICKNESS 0.5" TO 11", BLOCKY, GOOD; **SHALE**, DARK GRAY AND GRAYISH BLACK, SLIGHTLY WEATHERED, WEAK, LAMINATED TO VERY THIN BEDDED, SLIGHTLY ARENACEOUS, SLIGHTLY PYRITIC, RANGES IN THICKNESS 0.5" TO 5". @35.2' - 35.6'; γ = 160 pcf; Qu = 1,240 psi @35.7' - 36.1'; γ = 161 pcf; Qu = 1,656 psi @39.5' - 39.9'; γ = 161 pcf; Qu = 1,823 psi		36 37 38 39 40 41 42	90		100	NQ2-5											CORE	
	838.8	EOB																

STRATA R2 (Unfractured): Qu = (842+1220)/2*0.7 +6387*0.3=2638 psi

STRATA R3 (Unfractured): Qu = (1240+1656 +1823)/3=1573 psi

NOTES: LAT/LONG/ELEV FROM CONSULTANT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; PLACED 120 IN. TRIM PIPE; TREMIED 30 GAL. WATER

Pier 2. S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / R.M.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 231+23, 36' LT.	EXPLORATION ID B-011-0-15
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / M. HILTY	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700370/7700371 (P)	DRILLING METHOD: 4.25" HSA / NX	CALIBRATION DATE: 4/4/15	ELEVATION: 879.2 (MSL) EOB: 50.0 ft.	PAGE 1 OF 1
START: 6/26/15 END: 6/26/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.25	LAT / LONG: 41.089047, -81.501288	

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
UNCONTROLLED FILL (ROCK AND BOULDERS)	879.2																	
MEDIUM STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND AND GRAVEL, MOIST TO WET	877.2		2 3 31	45	72	SS-1	1.00	14	7	12	36	31	41	20	21	36	A-7-6 (11)	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE ROCK AND GRAVEL, WET @ 6.0' TO 7.0'; HARSH PETROLEUM SMELL	873.7		2 3 2	7	78	SS-2	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
VERY DENSE, GRAY, **SILT AND CLAY**, (BOULDER ZONE, SHALE), DAMP	868.2		5 7 6	17	67	SS-3	1.25	14	7	19	33	27	35	24	11	29	A-6a (5)	
	862.7		11 13 23	48	72	SS-4	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
			15 9 13	29	78	SS-5	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED.		TR	42 50/6"	-	83	SS-6A / SS-6B	-	-	-	-	-	-	-	-	-	-	A-6a (V) / Rock (V)	
			38 50/6"	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
			50/2"	-	89	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	855.5		50/3"	-	-	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
INTERBEDDED SHALE (60%) AND SANDSTONE (40%), RQD 97%, REC. 99%; **SHALE**, DARK GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, VERY FINE GRAINED, LAMINATED; **SANDSTONE**, GRAY, SLIGHTLY WEATHERED, STRONG, FINE GRAINED, VERY THIN BEDDED. @ 26.3' TO 26.9'; Qu = 3,840 PSI (SANDSTONE)			96		100	NX-1											CORE	
			93		97	NX-2											CORE	
			93		100	NX-3											CORE	
			98		98	NX-4											CORE	
			100		100	NX-5											CORE	
@ 47.2' TO 47.8'; Qu = 3,910 PSI (SHALE)	829.2	EOB	100		100	NX-6											CORE	

STRATA R1 (Fractured):
1. RQD = 10 (Assumed)
2. Qu = 200 psi (Assumed)

STRATA R2 and R3 is based on B-009-6-19

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 50 LB. BENTONITE CHIPS; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 8/22/19 15:41 - C:\USERS\YZIMMERMAN\DESKTOP\SUM-8\2019\BORING LOGS\SUM-8-1.75 2015.GPJ

Pier 3 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 234+26, 15' LT.	EXPLORATION ID B-011-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 875.0 (MSL) EOB: 55.0 ft.	PAGE 1 OF 2
START: 3/31/17 END: 4/3/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089076, -81.501281	

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, GRAYISH BROWN AND BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING (STONE FRAGMENTS ARE SILTSTONE), DAMP **(FILL)**	875.0	1	14 13 14	37	67	SS-1	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	872.0	2																
MEDIUM DENSE, GRAYISH BROWN AND BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**		3																
		4	6 9 12	28	78	SS-2	-	-	-	-	-	-	-	-	-	12	A-2-4 (V)	
@6.0' TO 7.5'; CHANGES TO VERY DENSE, GRAY AND ORANGISH BROWN		5																
		6																
		7	9 27 38	88	78	SS-3	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
	867.0 ▼	8																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		9	10 13 44	77	61	SS-4	-	51	10	5	21	13	28	19	9	7	A-2-4 (0)	
		10																
	W	11																
		12	19 22 22	60	89	SS-5	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
	862.0	13																
VERY DENSE, GRAY, **STONE FRAGMENTS**, TRACE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), DRY	861.0	14	50/6"	-	67	SS-6	-	-	-	-	-	-	-	-	-	2	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		15																
		16																
		17	10 24 50/2"	-	79	SS-7	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
	857.0	18																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP		19	13 22 50/4"	-	94	SS-8	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	854.5	20																
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP		21																
	852.5	22	15 29 50	107	78	SS-9	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	
		23																
HARD, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, SHALE LIKE STRUCTURE, DAMP @23.5' TO 24.4'; NO HP, SAMPLE CRUMBLED		24	10 50/5"	-	91	SS-10	-	37	17	8	21	17	30	20	10	10	A-4a (1)	
		25																
	849.0	26																
VERY DENSE, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC		27	20 36 32	92	78	SS-11	-	-	-	-	-	-	-	-	-	13	A-4a (V)	
		28																
		29	31 23 14	50	89	SS-12	-	-	-	-	-	-	-	-	-	16	A-4a (V)	

Pier 3 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+26, 15' LT.	START: 3/31/17	END: 4/3/17	PG 2 OF 2	B-011-4-16

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, GRAY, **SANDY SILT**, "AND" GRAVEL AND STONE FRAGMENTS, LITTLE CLAY, NO HP, NON PLASTIC *(continued)*	845.0																	
VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (SILTSTONE), MOIST	842.0		50/5"	-	80	SS-13	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, (SILTSTONE COBBLE), DRY	840.0		0		18	NX-1										1	CORE	
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	835.0		26 29 32	83	67	SS-14	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
SHALE, GRAY, SEVERELY WEATHERED.	832.2	TR	50/3"	-	33	SS-15	-	-	-	-	-	-	-	-	-	14	Rock (V)	
INTERBEDDED SHALE (63%) AND SILTSTONE (37%), RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, MODERATELY SILTY, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH TO SLICKENSIDED, INTACT TO BLOCKY, GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG. @50.0'; Qu = 2492 PSI (SHALE)	830.0		76		98	NX-2											CORE	
STRATA R2 (Unfractured): Qu = 2492X0.63 +12128(B-011-5-16)X0.37=6057 psi	820.0	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 11.0' BEFORE DRILLING ON 4/3/2017, 8.0' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 66 GAL. BENTONITE GROUT

Pier 3 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 234+65, 60' LT.	EXPLORATION ID B-011-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 875.2 (MSL) EOB: 80.0 ft.	PAGE 1 OF 3
START: 4/3/17 END: 4/3/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089221, -81.501383	

MATERIAL DESCRIPTION AND NOTES	ELEV. 875.2	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
DARK BROWN AND BLACK, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP **(FILL)**	874.2		4 7 8	22	100	SS-1	3.9 - 4.5+	-	-	-	-	-	-	-	-	22	A-4a (V)	
VERY STIFF TO HARD, DARK GRAY AND GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS COAL AND BRICK FRAGMENTS, FEW ROOTS AND MANY WOOD FRAGMENTS, MOIST **(FILL)**	872.2		1 2 2	6	83	SS-2	1.9 - 2.9	-	-	-	-	-	-	-	-	19	A-4a (V)	
STIFF TO VERY STIFF, GRAYISH BROWN MOTTLED WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS DECAYED ROOT, MOIST	869.7		5 3 6	13	67	SS-3	-	2	4	24	56	14	NP	NP	NP	25	A-4b (7)	
MEDIUM DENSE, GRAY MOTTLED WITH BROWN AND ORANGISH BROWN, **SILT**, SOME SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS FEW IRON STAINS, WET	867.2	W	5 5 4	13	78	SS-4	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
MEDIUM DENSE, GRAY WITH BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, MOIST	865.2		4 14 13	40	44	SS-5	3.9 - 4.5+	31	11	10	36	12	23	18	5	13	A-4a (3)	
VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL AND STONE FRAGMENTS (SHALE), LITTLE CLAY, DAMP																		
@13.5' to 15.0'; BECOMES "AND" GRAVEL AND STONE FRAGMENTS	860.2		6 11 12	34	50	SS-6	3.4 - 4.5+	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	857.2		11 18 18	54	78	SS-7	-	-	-	-	-	-	-	-	-	12	A-2-6 (V)	
DENSE, GRAY, **STONE FRAGMENTS**, (SHALE), DAMP	854.7		11 14 15	43	83	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE CLAY, TRACE SILT, DAMP	852.2		14 18 31	73	100	SS-9	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (SHALE), MOIST	850.2		11 23 38	91	78	SS-10	-	-	-	-	-	-	-	-	-	11	A-2-6 (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP			10 15 19	51	33	SS-11	4.5+	22	17	7	27	27	32	20	12	9	A-6a (5)	
			9 15 18	49	78	SS-12	4.5+	-	-	-	-	-	-	-	-	9	A-6a (V)	

Pier 3 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 2 OF 3	B-011-5-16

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, **SILT AND CLAY**, SOME SAND, SOME STONE FRAGMENTS (SILTSTONE AND SHALE), DAMP *(continued)*	845.2		11 14 25	58	89	SS-13	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
SHALE, GRAY, HIGHLY WEATHERED, FRAGMENTED.	837.7	TR	50/3"	-	33	SS-14	-	-	-	-	-	-	-	-	-	4	Rock (V)	
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. @48.7'; Qu = 1384 PSI (SHALE)	835.2		40		99	NQ-1											CORE	
			61		96	NQ-2											CORE	
@54.8'; Qu = 12128 PSI (SILTSTONE)			79		100	NQ-3											CORE	

STRATA R1: (Fractured)
1. RQD = 10 (Assumed)
2. Qu = 200 psi (Assumed)

STRATA R2 (Unfractured):
Qu = 1384X0.75+12128X0.25=4070 psi

STRATA R3 (Unfractured):
ased on R2 from B-011-8-19

Pier 3 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 234+65, 60' LT.	START: 4/3/17	END: 4/3/17	PG 3 OF 3	B-011-5-16

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
INTERBEDDED SHALE (75%) AND SILTSTONE (25%), RQD 71%, REC. 99%; **SHALE**, GRAY TO DARK GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK TO MODERATELY STRONG, VERY THIN TO THINLY LAMINATED, FISSILE, PYRITIC, MODERATELY SILTY, FROM 41.4' - 67.8' CONTAINS MANY 0.2" TO 1.5" THICK ZONES OF SEVERELY WEATHERED, VERY WEAK SHALE, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, JOINT DISCONTINUITY: HIGH ANGLE FROM 51.3' - 51.6', HIGHLY TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY/DISTURBED/SEAMY, GOOD TO POOR SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, VERY THIN TO THIN BEDDED, JOINT DISCONTINUITY: HIGH ANGLE FROM 47.9' - 48.3', INTACT. *(continued)*	813.1	63 64 65 66 67 68 69 70	80		98	NQ-4											CORE	
SHALE, DARK GRAY, UNWEATHERED, WEAK TO MODERATELY STRONG, THINLY LAMINATED TO LAMINATED, FISSILE, PYRITIC, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, INTACT, GOOD TO VERY GOOD SURFACE CONDITION; RQD 100%, REC 100%.	802.6	71 72 73 74 75 76 77 78 79	97		100	NQ-5											CORE	
	795.2	EOB 80																

NOTES: GROUNDWATER ENCOUNTERED AT 8.0' DURING DRILLING, 11.3' UPON COMPLETION. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 54 GAL. BENTONITE GROUT

Pier 3 S.B.

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: FRONTZ / R.H.	DRILL RIG: SONIC VERSA	STATION / OFFSET: 234+36, 19' LT.	EXPLORATION ID B-011-8-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: GF / J. YEAKLEY	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-8 SB	
PID: 91710 SFN: 7700370/7700371(P)	DRILLING METHOD: SONIC / NX	CALIBRATION DATE: 6/20/19	ELEVATION: 875.0 (MSL) EOB: 70.0 ft.	PAGE 1 OF 2
START: 6/28/19 END: 7/1/19	SAMPLING METHOD: HQ/NX	ENERGY RATIO (%): 80	LAT / LONG: 41.089106, -81.501282	

MATERIAL DESCRIPTION AND NOTES	ELEV. 875.0	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
GRAVEL BASE (12") @ 0.6'; "AND" SAND	874.0																	
BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, DRY @ 2.5'; GREY AND BROWN ROCK FRAGMENTS @ 3.0'; SOME VERY STIFF SANDY SILT, LITTLE CLAY	871.0				100		-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP							-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
@ 6.3'; COLOR CHANGE TO GREY, BOULDERS					94		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					92		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	859.0						-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
ORANGE AND GREY MOTTLED, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, (BOULDER ZONE), DAMP @ 16.6'; HARD SILT AND CLAY WITH ROCK FRAGMENTS @ 16.9'; ROCK FRAGMENTS, SAND AND SILT; SILTSTONE (BOULDER) @ 17.2'; SILTSTONE (BOULDER) @ 17.6'; SILTSTONE (BOULDER) @ 19.0'; GREY SILT AND CLAY WITH ROCK FRAGMENTS				100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	854.0				75		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
GREY, **GRAVEL**, (BOULDER ZONE), MOIST					16		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
@ 26.0'; ROCK FRAGMENTS, LITTLE SAND, TRACE SILT AND CLAY, WET @ 26.0' TO 28.4'; WET	847.0				100		-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
GREY, **STONE FRAGMENTS WITH SAND AND SILT**, (BOULDER ZONE), WET TO MOIST @ 29.0'; 5" (DIA.) SILTSTONE COBBLE							-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					100		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
					96		-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	835.0	TR																
SILTSTONE, GREY, HIGHLY WEATHERED, WEAK, VERY THIN BEDDED.					100		-	-	-	-	-	-	-	-	-	-	Rock (V)	
					96		-	-	-	-	-	-	-	-	-	-	Rock (V)	
	825.7																	
INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%), RQD 22%, REC. 74.5%; **SHALE**, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. @ 51.9' TO 52.7'; QU = 5,380 PSI (SHALE AND SILTSTONE) @ 54.9'; MECHANICAL BREAK @ 55.0'; VERY WEAK SHALE @ 55.2' TO 55.9'; 8" GREY CLAY @ 55.9' TO 59.6'; MODERATELY STRONG @ 56.4' TO 57.6'; QU = 5,110 PSI (SHALE AND SILTSTONE)			32	74													
			30	92	NX-2												CORE	

STRATA R2 (Unfractured):
Based on R2 from B-011-4-16 and B-011-5-16

STRATA R3 (Unfractured):
Qu = (5380+5110)/2=5245 psi

Pier 3 S.B.

PID: 91710	SFN: 7700370/7700371(P)	PROJECT: SUM-8-1.75	STATION / OFFSET: 234+36, 19' LT.	START: 6/28/19	END: 7/1/19	PG 2 OF 2	B-011-8-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 815.0	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
@ 59.6'; HIGHLY WEATHERED, VERY WEAK, VERY BLOCKY WITH CLAY INFILLING **INTERBEDDED SHALE (45%) AND SILTSTONE (40%) AND CLAYSTONE (15%)**, RQD 22%, REC. 74.5%; **SHALE**, DARK GREY, MODERATELY TO HIGHLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY THIN TO LAMINATED, LOW ANGLE FRACTURES, HIGHLY FRACTURED; **SILTSTONE**, LIGHT GREY, UNWEATHERED TO SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, MICACEOUS, LOW ANGLE FRACTURES, MODERATELY FRACTURED TO FRACTURED; **CLAYSTONE**, GREY, MODERATELY TO HIGHLY WEATHERED, WEAK, VERY THIN BEDDED. *(continued)* @ 60.1' TO 61.2'; CLAY INFILLED SHALE, HIGHLY WEATHERED, VERY WEAK, HIGHLY FRACTURED @ 61.2' TO 65.0'; FRACTURED TO VERY FRACTURED @ 65.0' TO 66.1'; SLIGHTLY STRONG @ 65.1' TO 65.7'; QU = 5140 PSI (SHALE AND SILTSTONE) @ 66.1' TO 69.6'; WEAK, HIGHLY FRACTURED. @ 69.6' TO 69.9'; VERY STRONG	805.0	61 62 63 64 65 66 67 68 69 EOB 70	0		58	NX-3											CORE	
			26		74	NX-4											CORE	

NOTES: BORE HOLE WAS ADVANCED BY SONIC DRILLING AND NO SPT NOR N60 IS AVAILABLE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 6 BAGS BENTONITE PELLETS

Pier 4 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / HEPNER	DRILL RIG: MOBILE B-57	STATION / OFFSET: 236+44, 2' RT.	EXPLORATION ID B-013-4-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 5/7/15	ELEVATION: 885.5 (MSL) EOB: 85.5 ft.	PAGE 1 OF 3
START: 4/4/17 END: 4/5/17	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 89.7	LAT / LONG: 41.089616, -81.500934	

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 WITH DARK GRAY AND GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, CONTAINS FEW ROOTS, DAMP **(FILL)**	885.5	1–2	4 6 5	16	67	SS-1	3.2 - 4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
	883.0																	
STIFF TO VERY STIFF, ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, MOIST		3–5	3 3 2	7	100	SS-2	1.25 - 2.2	-	-	-	-	-	-	-	-	16	A-4a (V)	
	880.0																	
VERY LOOSE TO LOOSE, ORANGISH BROWN BECOMING ORANGISH BROWN WITH LIGHT GRAY, **SILT**, SOME SAND, LITTLE CLAY, LITTLE GRAVEL, MOIST TO WET		6–7	1 1 1	3	97	SS-3	-	12	12	12	51	13	NP	NP	NP	17	A-4b (6)	
	875.0	8–10	2 2 3	7	100	SS-4	-	-	-	-	-	-	-	-	-	22	A-4b (V)	
VERY LOOSE TO MEDIUM DENSE, YELLOWISH BROWN WITH ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, 11.0' TO 15.0' CONTAINS FEW ROOTS, MOIST TO WET @11.0' TO 17.5'; NO HP, NON PLASTIC		11–12	2 1 2	4	100	SS-5	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@13.5' TO 15.0'; BECOMES GRAYISH BROWN WITH ORANGISH BROWN, TRACE CLAY		13–15	2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
@16.0' TO 17.5'; BECOMES ORANGISH BROWN		16–17	3 5 5	15	94	SS-7	-	0	12	47	23	18	NP	NP	NP	23	A-4a (1)	
	867.5	W																
LOOSE, BROWN, **GRAVEL WITH SAND**, LITTLE SILT, LITTLE CLAY, WET		18–20	3 3 3	9	72	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
	865.0																	
MEDIUM DENSE, GRAY, **SANDY SILT**, TRACE CLAY, WET @21.0' TO 22.5'; NO HP, NON PLASTIC		21–22	4 4 6	15	100	SS-9	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
	862.5																	
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP		24–25	6 10 7	25	67	SS-10	-	47	11	9	24	9	NP	NP	NP	14	A-2-4 (0)	
	860.0																	
DENSE TO VERY DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST		26–27	11 15 15	45	83	SS-11	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		29	6 11 11	33	83	SS-12	-	37	28	18	13	4	NP	NP	NP	12	A-1-b (0)	

Pier 4 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 2 OF 3	B-013-4-16

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, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST *(continued)*	855.5	31	10 10 15	37	78	SS-13	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	
		32																
		33																
		34	10 18 18	54	78	SS-14	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
		35																
		36																
		37	10 21 15	54	94	SS-15	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
		38																
		39	19 19 25	66	83	SS-16	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		40																
VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	844.5	41																
		42																
		43																
	841.1	44	17 50/5"	-	100	SS-17	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
INTERBEDDED SHALE (65%) AND SILTSTONE (35%), RQD 76%, REC. 98%;	TR	45																
SHALE, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. @47.8'; Qu = 12151 PSI (SILTSTONE)	840	46	64		95	NQ-1											CORE	
		47																
		48																
		49																
		50																
		51	70		99	NQ-2											CORE	
		52																
		53																
		54																
		55																
		56	62		99	NQ-3											CORE	
		57																
		58																
		59																
		60																
		61																

STRATA R1 (Fractured):
Qu = 300 psi (Assumed)
RQD +10 (Assumed)

STRATA R2:
Qu = 3028X0.65+12151X0.35=6221 psi

Pier 4 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+44, 2' RT.	START: 4/4/17	END: 4/5/17	PG 3 OF 3	B-013-4-16

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
@62.1'; Qu = 11803 PSI (SILTSTONE) **INTERBEDDED SHALE (65%) AND SILTSTONE (35%)**, RQD 76%, REC. 98%; **SHALE**, GRAY AND DARK GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, THIN TO THINLY LAMINATED, PYRITIC, MODERATELY SILTY, FISSILE, FOSSILIFEROUS, MODERATELY WEATHERED FROM 45.5' - 46.1', BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, MODERATELY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO BLOCKY, DISINTEGRATED FROM 45.5' - 46.1', FAIR TO GOOD SURFACE CONDITION; **SILTSTONE**, GRAY AND BROWNISH GRAY, STRONG TO VERY STRONG, PYRITIC, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 45.6' - 46.4' AND 75.9' - 76.4'. *(continued)* @68.5'; Qu = 3028 PSI (SHALE)	823.3	63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85	88		99	NQ-4												CORE	
	800.0	EOB	89		100	NQ-5												CORE	

NOTES: GROUNDWATER ENCOUNTERED AT 18.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 75 GAL. BENTONITE GROUT

Pier 4 S.B.

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: OTB / MINCHAK	DRILL RIG: DIETRICH D-50	STATION / OFFSET: 236+87, 43' LT.	EXPLORATION ID B-013-5-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / WESTERVILLER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NX	CALIBRATION DATE: 5/7/15	ELEVATION: 913.5 (MSL) EOB: 77.0 ft.	PAGE 1 OF 3
START: 3/29/17 END: 3/30/17	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.2	LAT / LONG: 41.089770, -81.501026	

MATERIAL DESCRIPTION AND NOTES	ELEV. 913.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE TO LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP **(FILL)**			4 5 4	12	78	SS-1	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
@3.5' TO 5.0'; CHANGES TO VERY LOOSE			2 1 1	3	72	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	908.0																	
MEDIUM DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SANDSTONE), CONTAINS IRON STAINING, DAMP **(FILL)**	906.0	▼ 24 hr	5 5 5	14	61	SS-3	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
STIFF TO HARD, ORANGISH BROWN BECOMING ORANGISH BROWN MOTTLED WITH GRAY, **SILT**, TRACE SAND, TRACE CLAY, CONTAINS IRON STAINING, WET			3 3 5	11	78	SS-4	1.1 - 2.6	-	-	-	-	-	-	-	-	27	A-4b (V)	
			3 4 8	16	100	SS-5	1.0 - 2.6	0	2	8	80	10	27	24	3	29	A-4b (8)	
			3 7 9	22	89	SS-6	1.25 - 3.25	-	-	-	-	-	-	-	-	28	A-4b (V)	
			2 7 9	22	100	SS-7	2.0 - 3.6	-	-	-	-	-	-	-	-	29	A-4b (V)	
			5 8 11	26	100	SS-8	1.25 - 4.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
			5 6 9	20	89	SS-9	2.0 - 4.5+	-	-	-	-	-	-	-	-	32	A-4b (V)	
			3 5 7	16	100	SS-10	1.75 - 3.0	-	-	-	-	-	-	-	-	27	A-4b (V)	
	888.0																	
MEDIUM STIFF TO VERY STIFF, ORANGISH BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS IRON STAINING, WET	886.0	W	3 8 11	26	100	SS-11	0.5 - 3.2	-	-	-	-	-	-	-	-	30	A-6a (V)	
STIFF TO VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET			8 10 11	28	100	SS-12	1.25 - 3.9	-	-	-	-	-	-	-	-	31	A-4b (V)	

Pier 4 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+87, 43' LT.	START: 3/29/17	END: 3/30/17	PG 2 OF 3	B-013-5-16

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 VERY STIFF, ORANGISH BROWN WITH TRACE GRAY MOTTLES, **SILT**, LITTLE SAND, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP TO WET *(continued)*	883.5																	
@31.0' TO 32.5'; BROWN WITH ORANGISH BROWN AND GRAY, NO HP, NO SOIL PLUG	880.5	31	2 11 11	30	56	SS-13	-	-	-	-	-	-	-	-	-	16	A-4b (V)	
MEDIUM DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE GRAVEL, TRACE CLAY, DAMP	878.0	32																
MEDIUM STIFF, GRAY, **SILT**, TRACE TO LITTLE SAND, TRACE TO LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, WET		33																
		34	6 8 10	24	89	SS-14	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
		35																
		36																
		37	1 2 3	7	83	SS-15	0.5 - 0.8	-	-	-	-	-	-	-	-	39	A-4b (V)	
		38																
@38.5' TO 39.3'; STIFF TO VERY STIFF, ORANGISH BROWN,	874.2	39	5 10 11	28	100	SS-16A	1.8 - 3.5	-	-	-	-	-	-	-	-	33	A-4b (V)	
MEDIUM DENSE, DARK BROWN, **FINE SAND**, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP	873.0					SS-16B	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		40																
VERY SOFT TO SOFT, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, WET		41																
@41.0' TO 42.5'; NO HP, NO SOIL PLUG	870.5	42	1 1 1	3	100	SS-17	-	0	0	14	75	11	18	16	2	29	A-4b (8)	
LOOSE TO MEDIUM DENSE, GRAY, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, TRACE GRAVEL, WET		43																
		44	3 3 4	9	100	SS-18	-	-	-	-	-	-	-	-	-	26	A-3 (V)	
		45																
W		46																
		47	1 2 6	11	89	SS-19	-	-	-	-	-	-	-	-	-	24	A-3 (V)	
		48																
		49	6 9 14	31	78	SS-20	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
		50																
		51																
		52	13 16 17	45	78	SS-21	-	-	-	-	-	-	-	-	-	11	A-2-4 (V)	
DENSE, GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST	865.5	53																
	860.0	54	5 8 10	24	89	SS-22	0.75 - 1.7	-	-	-	-	-	-	-	-	31	A-4b (V)	
MEDIUM STIFF TO STIFF, GRAY, **SILT**, TRACE SAND, TRACE CLAY, TRACE GRAVEL, WET		55																
		56																
		57																
		58																
	855.0	59	6 6 8	19	100	SS-23	-	0	1	19	66	14	NP	NP	NP	25	A-4b (8)	
MEDIUM DENSE TO DENSE, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET		60																
		61																

Pier 4 S.B.

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 236+87, 43' LT.	START: 3/29/17	END: 3/30/17	PG 3 OF 3	B-013-5-16

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, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, WET *(continued)*	851.4	63																
		64	4 7 19	35	94	SS-24	-	-	-	-	-	-	-	-	-	26	A-4b (V)	
	848.6	65																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, (STONE FRAGMENTS ARE SILTY SHALE AND GRANITE), MOIST		66																
		67																
		68																
		69	12 23 17	54	50	SS-25	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		70																
		71																
@71.0': ENCOUNTERED GRANITE BOULDER (GLACIAL ERRATIC)	842.0	TR																
INTERBEDDED SILTSTONE (85%) AND SHALE (15%), RQD 20%, REC. 76%; **SILTSTONE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, STRONG TO VERY STRONG, VERY THIN TO THINLY LAMINATED, MODERATELY ARGILLACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURE, JOINT DISCONTINUITIES: HIGH ANGLE FRACTURE FROM 75.4' - 75.6', HIGHLY FRACTURED TO MODERATELY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH, INTACT TO VERY BLOCKY, DISINTEGRATED FROM 73.9' - 74.8', FAIR TO GOOD SURFACE CONDITION; **SHALE**, GRAY, MODERATELY STRONG, SILTY, PYRITIC. @71.6'; Qu = 9267 PSI (SILTSTONE) @75.0'; Qu = 24283 PSI (SILTSTONE)		72	31		67	NX-1												CORE	
		73																
		74	0		81	NX-2												CORE
		75																
		76	25		81	NX-3												CORE
	836.5	EOB 77																

Ignore Silt Stone, use data from B-013-4-16

NOTES: GROUNDWATER ENCOUNTERED AT 45.5' DURING DRILLING, 27.0' BEFORE CORING, 7.5' AFTER DRILLING. CAVE DEPTHS 7.7' AND 70.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 100 GAL. BENTONITE GROUT

Appendix F.4

FB-Multipier Analyses
(Submit Separately)

Appendix F.5

Overall Stability Analysis

Appendix F.5.1

Embankment at SB Forward Abutment

PURPOSE:

The purpose of this calculation is to analyze the overall stability of the proposed embankment near SUM-8-0199 SB forward abutment.

CODES/STANDARDS/PROCEDURE:

The code used in this analysis is AASHTO LRFD Bridge Design Specifications Eighth Edition 2017 (LRFD). The following references were used:

- Load Factors are taken from *AASHTO LRFD Bridge Design Specifications* Eighth Edition 2017 (LRFD).
- Resistance Factors are taken from *AASHTO LRFD Bridge Design Specifications* Eighth Edition 2017 (LRFD).

SOURCE OF DATA

Attached is a summary of the parameters used based on project borings of Boring B-018-0-15 and B-019-0-15. The existing soils were classified as ODOT A-1, A-2, and A-3 series) with an average N60 value of 18 and N160 value of 20. The dominance of granular soil gives GF the confidence to model the existing soil as a layer of granular material with a long term and effective internal angle of friction of 33 degrees and no cohesion. While a borrow pit his not been identified, it is generally assumed that fill will be composed of soil like the site material. Based on the OGE's recommendation, the embankment material is assumed to be with a short-term shear strength of 1500 pounds per square foot (psf) cohesion (c) and 0 degrees internal angle of friction (φ), and the long-term shear strength of 250 psf effective cohesion (c') and 26 degrees effective internal angle of friction (φ'). The soil parameter calculation can be found in the Attachment (Appendix A). The values are summarized below:

		Design Values Parameters				
Strata	Soil Type	γ_{moist} (pcf)	ϕ degrees	C psf	Φ' degrees	C' psf
1	Proposed Embankment	120	-	1500	26	200
2	Granular Soil	125	33	-	33	-

ASSUMPTIONS/PROJECT BACKGROUND:

- Slope Stability were examined for overall stability failures in both short term and long-term conditions;
- The existing valley slopes were observed to be, in general, stable. Even though many of the existing valley slopes appear to be more steeply sloped than the standard ODOT two horizontal to one vertical slope;
- It is generally assumed that earthwork projects will utilize soil with similar characteristics as the in-situ soil. With 69% of the soil being classified as granular (ODOT series A-1, A-2, A-3, A-3a) or low plasticity sandy silt (ODOT A-4a), properly compacted embankment may be assumed to have a high shear strength;
- The distributed load was assumed to be 240 psf; and
- Ground water table is assumed to be deep in the analysis because shallow groundwater was not encountered at the site, and most of the borings did not encounter the water table.

Definition Drawing:

See Attached (Appendix B)

Computer Programs Used:

Excel Spread Sheets to develop soil parameters.

SLIDE Version 2018 8. 020 for the overall stability analysis

Calculations

The overall stability calculation is attached in Appendix C.

Results:

Case	Factor of Safety
Proposed Embankment near SUM-8-0199 SB Forward Abutment	
1: Short Term	2.2
2: Long Term	1.6

Conclusion:

Based on these criteria and the slope geometry, the minimum safety factor is 1.6. Therefore, it is GF's opinion that if construction recommendations from Section 200 of ODOT's CMS and ODOT GB2, are followed, the embankments should be stable.

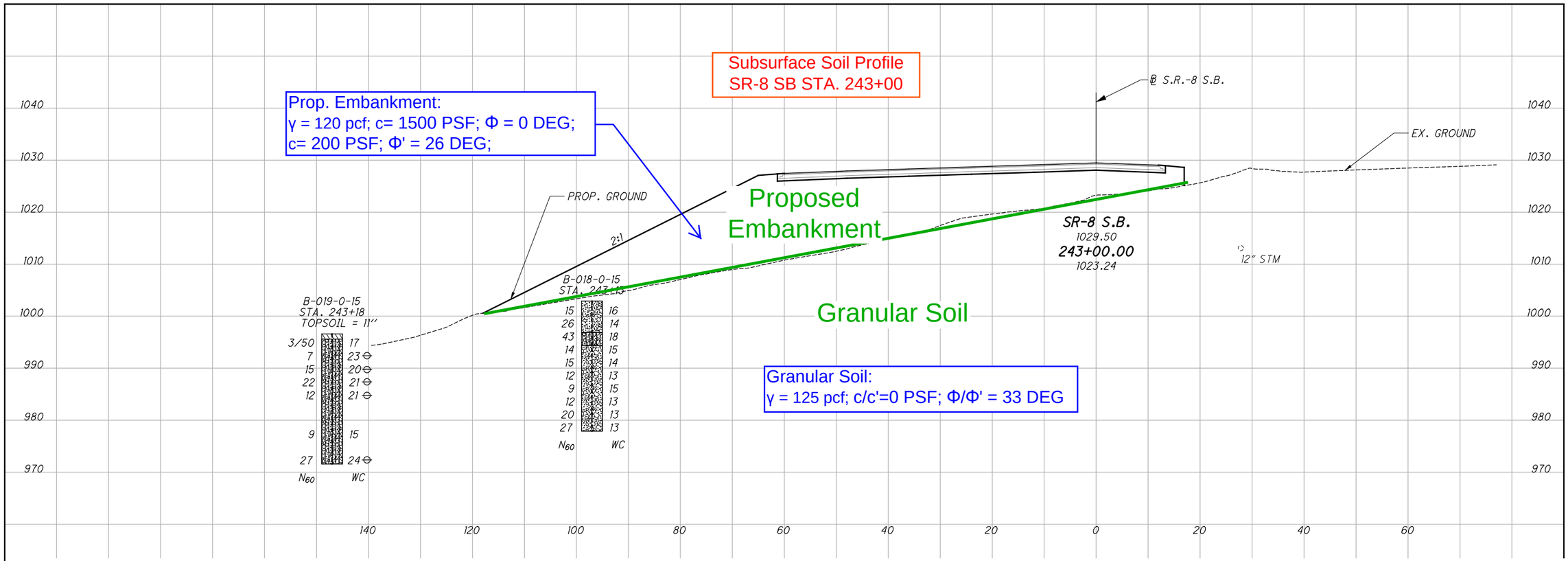
B-018-0-15 1002.9 Sur. Elv. Water table = 970 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)
1	1001.9	1.5	2.5	0.120	15	0.210	1.755	26	A-1-b	
3.5	999.4	2.5	5.0	0.120	26	0.510	1.459	38	A-1-b	
6	996.9	2.5	7.5	0.125	43	0.819	1.300	56	A-2-4	
8.5	994.4	2.5	10.0	0.125	14	1.131	1.192	17	A-1-b	
11	991.9	2.5	12.5	0.130	15	1.453	1.109	17	A-1-b	
13.5	989.4	2.5	15.0	0.130	12	1.778	1.041	12	A-1-b	
16	986.9	2.5	17.5	0.125	9	2.094	0.986	9	A-1-b	
18.5	984.4	2.5	20.0	0.130	12	2.415	0.939	11	A-1-b	
21	981.9	2.5	22.5	0.135	20	2.749	0.895	18	A-1-b	
23.5	979.4	2.5	25.0	0.135	27	3.086	0.857	23	A-1-b	

B-019-0-15 996.6 Sur. Elv. Water table = 970 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)
1	995.6	1.5	2.5	0.125	50	0.219	1.742	87	A-2-4	
3.5	993.1	2.5	5.0	0.115	7	0.514	1.456	10	A-2-4	
6	990.6	2.5	7.5	0.125	15	0.819	1.300	20	A-2-4	
8.5	988.1	2.5	10.0	0.125	22	1.131	1.192	26	A-2-4	
11	985.6	2.5	12.5	0.130	12	1.453	1.109	13	A-2-4	
18.5	978.1	7.5	20.0	0.125	9	2.394	0.942	8	A-2-4	
23.5	973.1	5	25.0	0.135	27	3.061	0.859	23	A-2-4	

Strata No.	B-018-0-15 & B-019-0-15								
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'2 (deg.)	C=HP/2 (psf.)
Granular Soil	G	0	23.5	23.5	18	20	126.9	33	



HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

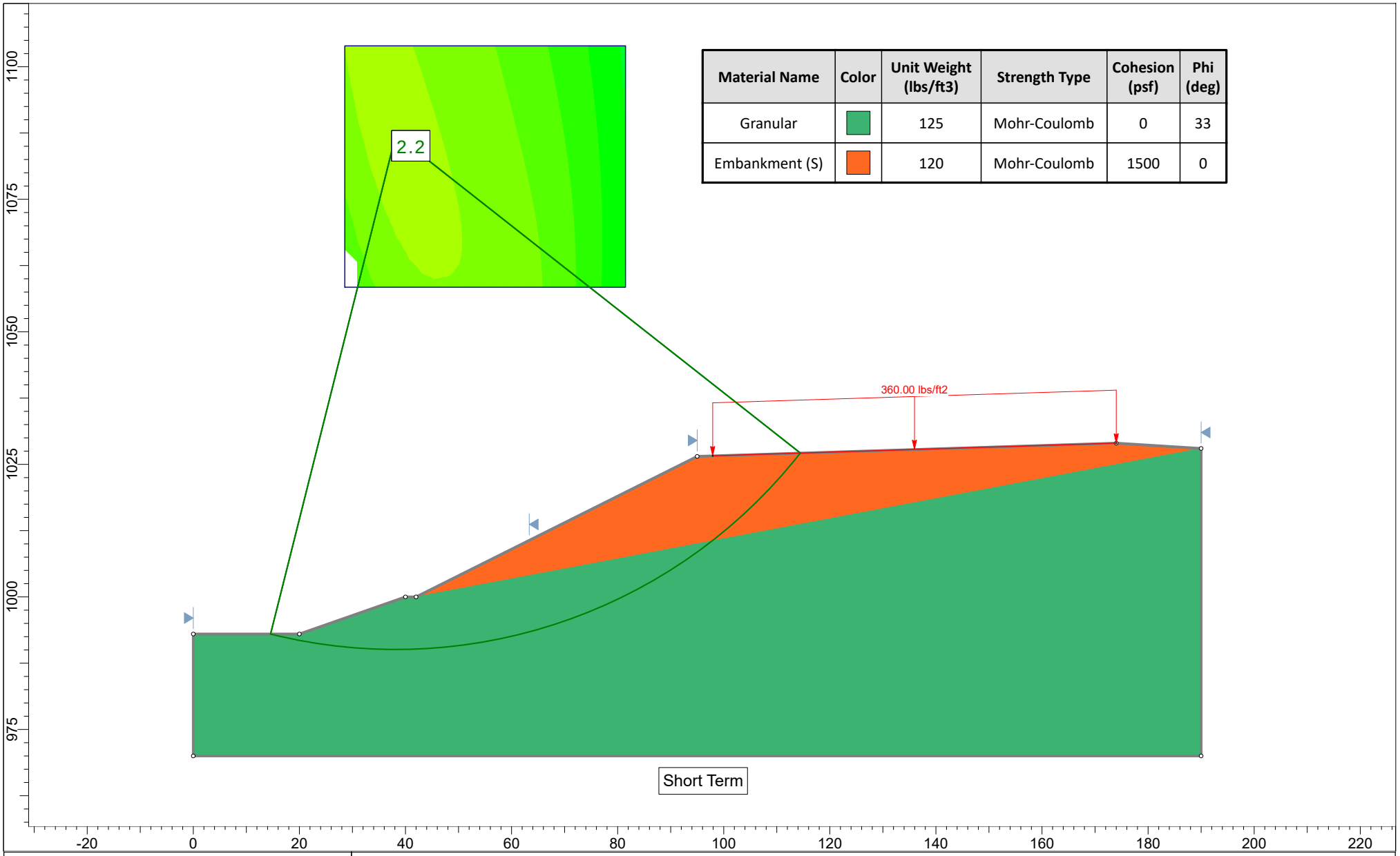
SOIL PROFILE
STA 243+00 SB SR-8 & STA 525+00 NB SR-8

CROSS SECTION STA

SUM-8-1.75

68/156

pw:\\columbus-ist.msconsultants.com:msconsultants\Documents\60\60-08326-00 - SUM-8-0175\geotechnical\sheets\91710IX002.dgn 4/4/2019 12:29:54 PM yzimmerman

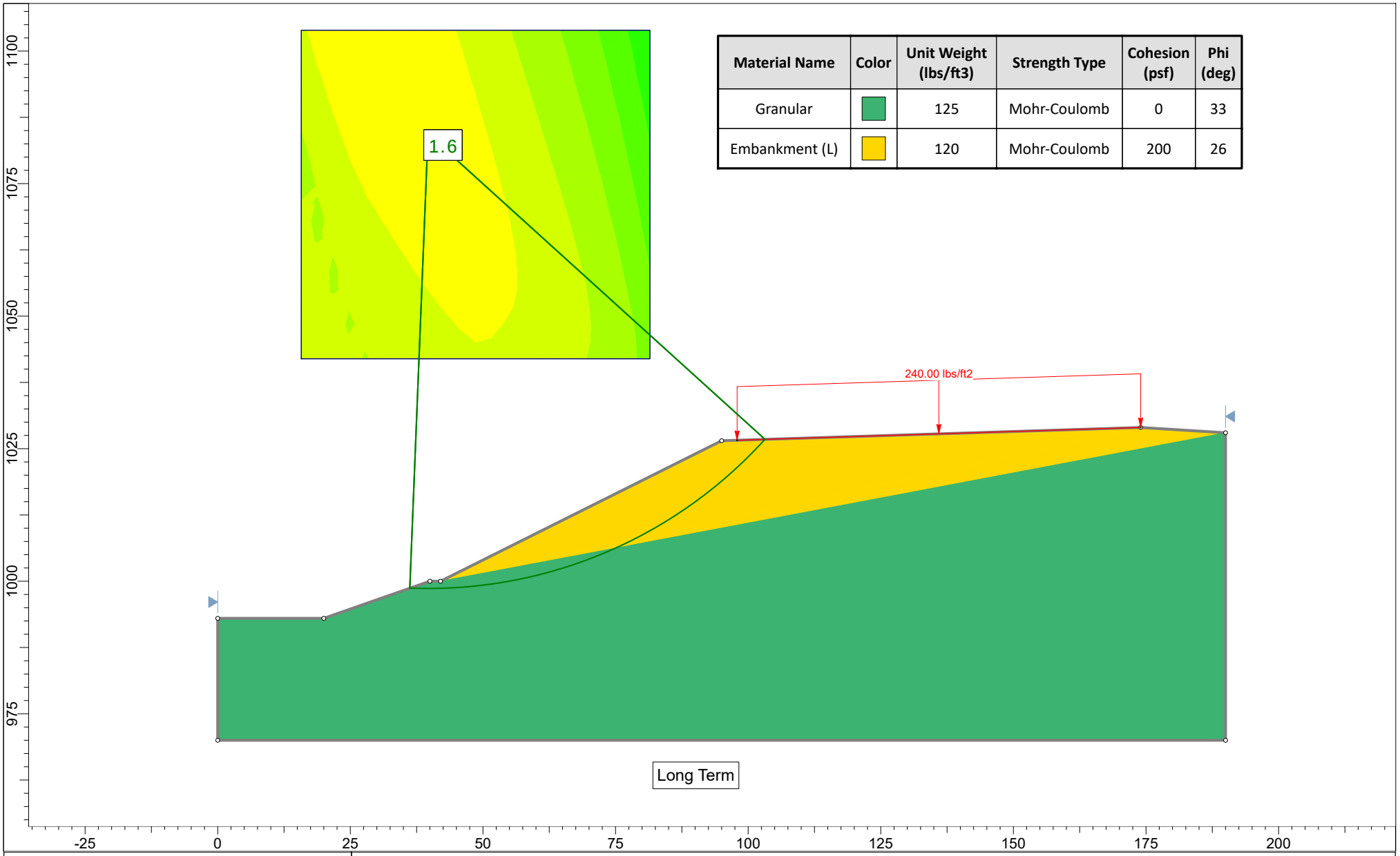


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Granular		125	Mohr-Coulomb	0	33
Embankment (S)		120	Mohr-Coulomb	1500	0

Gannett Fleming

SLIDEINTERPRET 8.020

Project	sum-8-1.75 STA. 243+00/543+00			
Analysis Description	Embankment Stability			
Calc By	YLZ	*Date*	April/2019	*Scale* 1:300
Chk'd By	TLM	*Date*	April/2019	*File Name* 62368_SUM-8_Em Overal Stb_V2.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Granular		125	Mohr-Coulomb	0	33
Embankment (L)		120	Mohr-Coulomb	200	26

Gannett Fleming

SLIDEINTERPRET 8.020

Project	sum-8-1.75 STA. 243+00/543+00				
Analysis Description	Embankment Stability				
Calc By	YLZ	*Date*	April/2019	*Scale*	1:300
Chk'd By	TLM	*Date*	April/2019	*File Name*	62368_SUM-8_Em Overal Stb_V2.slmd

Slide Analysis Information

62368_SUM-8_Em Overal Stb_V2

Project Summary

File Name:	62368_SUM-8_Em Overal Stb_V2.slmd
Slide Modeler Version:	8.02
Project Title:	sum-8-1.75 STA. 243+00/543+00
Analysis:	Embankment Stability
Author:	YLZ
Company:	Gannett Fleming
Date Created:	April/2019
Comments	
	TLM
	April/2019
	April/2019

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Group 1	Long Term	Bishop Simplified: 1.621660 Janbu Simplified: 1.557110	00h:00m:05.917s
	Short Term	Bishop Simplified: 2.180700 Janbu Simplified: 2.136410	00h:00m:05.936s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

All Open Scenarios

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

All Open Scenarios	
Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	200
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

All Open Scenarios	
Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Group 1 - Long Term		Group 1 - Short Term	
• 1 Distributed Load present		• 1 Distributed Load present	
Distributed Load 1		**Distributed Load 1**	
Distribution:	Constant	Distribution:	Constant
Magnitude [psf]:	240	Magnitude [psf]:	360
Orientation:	Vertical	Orientation:	Vertical

Materials

Property	Granular	Embankment (L)	Embankment (S)
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	120	120
Cohesion [psf]	0	200	1500
Friction Angle [°]	33	26	0
Water Surface	Assigned per scenario	Assigned per scenario	Assigned per scenario
Ru Value	0	0	0

Materials In Use

Material	Long Term	Short Term
Granular	✓	✓
Embankment (L)	✓	✗
Embankment (S)	✗	✓

Global Minimums

Group 1 - Long Term		Group 1 - Short Term	
Method: bishop simplified		**Method: bishop simplified**	
FS	**1.621660**	**FS**	**2.180700**
Center:	39.662, 1084.366	Center:	38.187, 1087.164
Radius:	85.756	Radius:	97.080
Left Slip Surface Endpoint:	36.225, 998.679	Left Slip Surface Endpoint:	14.571, 993.000
Right Slip Surface Endpoint:	103.188, 1026.759	Right Slip Surface Endpoint:	114.468, 1027.116
Resisting Moment:	3.18273e+06 lb-ft	Resisting Moment:	1.16527e+07 lb-ft
Driving Moment:	1.96264e+06 lb-ft	Driving Moment:	5.34356e+06 lb-ft
Total Slice Area:	460.138 ft2	Total Slice Area:	1227.79 ft2
Surface Horizontal Width:	66.9625 ft	Surface Horizontal Width:	99.8971 ft
Surface Average Height:	6.87158 ft	Surface Average Height:	12.2905 ft
Method: janbu simplified		**Method: janbu simplified**	
FS	**1.557110**	**FS**	**2.136410**
Center:	45.637, 1071.322	Center:	40.592, 1077.581
Radius:	72.298	Radius:	88.732
Left Slip Surface Endpoint:	38.283, 999.399	Left Slip Surface Endpoint:	13.769, 993.000
Right Slip Surface Endpoint:	102.552, 1026.739	Right Slip Surface Endpoint:	113.557, 1027.087
Resisting Horizontal Force:	34097.8 lb	Resisting Horizontal Force:	109783 lb
Driving Horizontal Force:	21898.1 lb	Driving Horizontal Force:	51386.7 lb
Total Slice Area:	486.893 ft2	Total Slice Area:	1329.71 ft2
Surface Horizontal Width:	64.2696 ft	Surface Horizontal Width:	99.7876 ft
Surface Average Height:	7.57579 ft	Surface Average Height:	13.3254 ft

Valid/Invalid Surfaces

Group 1 - Long Term	Group 1 - Short Term
Method: bishop simplified	**Method: bishop simplified**
Number of Valid Surfaces: 89516	Number of Valid Surfaces: 88905
Number of Invalid Surfaces: 2944	Number of Invalid Surfaces: 3555
Error Codes:	**Error Codes:**
Error Code -103 reported for 2932 surfaces	Error Code -101 reported for 91 surfaces
Error Code -106 reported for 9 surfaces	Error Code -103 reported for 2861 surfaces
Error Code -108 reported for 3 surfaces	Error Code -1000 reported for 603 surfaces
Method: janbu simplified	**Method: janbu simplified**
Number of Valid Surfaces: 89444	Number of Valid Surfaces: 88811
Number of Invalid Surfaces: 3016	Number of Invalid Surfaces: 3649
Error Codes:	**Error Codes:**
Error Code -103 reported for 2932 surfaces	Error Code -101 reported for 91 surfaces
Error Code -106 reported for 9 surfaces	Error Code -103 reported for 2861 surfaces
Error Code -108 reported for 40 surfaces	Error Code -108 reported for 94 surfaces
Error Code -111 reported for 35 surfaces	Error Code -1000 reported for 603 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-1000 = No valid slip surface is generated

Slice Data

Group 1 - Long Term

- Global Minimum Query (bishop simplified) - Safety Factor: 1.62166

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.33885	42.8284	-1.8491	Granular	0	33	12.9779	21.0457	32.4075	0	32.4075	31.9885	31.9885
2	1.33885	126.734	-0.954281	Granular	0	33	38.1613	61.8847	95.2938	0	95.2938	94.6581	94.6581
3	1.33885	205.859	-0.0596912	Granular	0	33	61.5993	99.8932	153.822	0	153.822	153.758	153.758
4	1.33885	230.661	0.834884	Granular	0	33	68.5921	111.233	171.284	0	171.284	172.283	172.283
5	1.33885	251.421	1.72966	Granular	0	33	74.3035	120.495	185.546	0	185.546	187.79	187.79
6	1.33885	346.795	2.62486	Granular	0	33	101.86	165.182	254.358	0	254.358	259.028	259.028
7	1.33885	444.013	3.52071	Granular	0	33	129.616	210.193	323.669	0	323.669	331.643	331.643
8	1.33885	537.713	4.41741	Granular	0	33	156.011	252.996	389.58	0	389.58	401.632	401.632
9	1.33885	627.883	5.3152	Granular	0	33	181.063	293.622	452.139	0	452.139	468.984	468.984
10	1.33885	714.508	6.21431	Granular	0	33	204.791	332.101	511.39	0	511.39	533.689	533.689
11	1.33885	797.572	7.11495	Granular	0	33	227.21	368.458	567.375	0	567.375	595.736	595.736
12	1.33885	877.055	8.01736	Granular	0	33	248.336	402.717	620.129	0	620.129	655.107	655.107
13	1.33885	952.935	8.92178	Granular	0	33	268.183	434.901	669.688	0	669.688	711.789	711.789
14	1.33885	1025.19	9.82845	Granular	0	33	286.76	465.028	716.081	0	716.081	765.759	765.759
15	1.33885	1093.78	10.7376	Granular	0	33	304.082	493.118	759.338	0	759.338	817.002	817.002
16	1.33885	1158.68	11.6495	Granular	0	33	320.157	519.186	799.474	0	799.474	865.481	865.481
17	1.33885	1219.86	12.5644	Granular	0	33	334.993	543.245	836.523	0	836.523	911.184	911.184
18	1.33885	1277.28	13.4826	Granular	0	33	348.599	565.309	870.499	0	870.499	954.079	954.079
19	1.33885	1330.89	14.4043	Granular	0	33	360.98	585.387	901.414	0	901.414	994.127	994.127
20	1.33885	1380.65	15.3299	Granular	0	33	372.142	603.487	929.287	0	929.287	1031.3	1031.3
21	1.33885	1426.52	16.2595	Granular	0	33	382.089	619.618	954.129	0	954.129	1065.57	1065.57
22	1.33885	1468.42	17.1936	Granular	0	33	390.824	633.783	975.938	0	975.938	1096.87	1096.87
23	1.33885	1506.31	18.1324	Granular	0	33	398.349	645.987	994.73	0	994.73	1125.18	1125.18
24	1.33885	1540.13	19.0763	Granular	0	33	404.666	656.231	1010.5	0	1010.5	1150.45	1150.45
25	1.33885	1569.8	20.0256	Granular	0	33	409.775	664.515	1023.26	0	1023.26	1172.62	1172.62
26	1.33885	1595.25	20.9807	Granular	0	33	413.674	670.838	1033	0	1033	1191.64	1191.64
27	1.33885	1616.41	21.9419	Granular	0	33	416.361	675.196	1039.71	0	1039.71	1207.44	1207.44
28	1.33885	1633.17	22.9097	Granular	0	33	417.834	677.585	1043.39	0	1043.39	1219.97	1219.97
29	1.33885	1645.47	23.8844	Granular	0	33	418.088	677.997	1044.03	0	1044.03	1229.16	1229.16
30	1.3398	1655.58	24.8669	Embankment (L)	200	26	434.464	704.553	1034.48	0	1034.48	1235.85	1235.85
31	1.3398	1661.16	25.8576	Embankment (L)	200	26	433.145	702.414	1030.1	0	1030.1	1240.03	1240.03
32	1.3398	1662.13	26.8566	Embankment (L)	200	26	430.879	698.74	1022.57	0	1022.57	1240.75	1240.75
33	1.3398	1658.35	27.8646	Embankment (L)	200	26	427.656	693.512	1011.85	0	1011.85	1237.94	1237.94
34	1.3398	1649.7	28.882	Embankment (L)	200	26	423.461	686.71	997.902	0	997.902	1231.49	1231.49
35	1.3398	1636.04	29.9096	Embankment (L)	200	26	418.283	678.312	980.689	0	980.689	1221.3	1221.3
36	1.3398	1617.21	30.9478	Embankment (L)	200	26	412.104	668.293	960.14	0	960.14	1207.25	1207.25
37	1.3398	1593.03	31.9974	Embankment (L)	200	26	404.91	656.626	936.223	0	936.223	1189.21	1189.21
38	1.3398	1563.34	33.0592	Embankment (L)	200	26	396.681	643.282	908.864	0	908.864	1167.06	1167.06
39	1.3398	1527.93	34.134	Embankment (L)	200	26	387.4	628.231	878.005	0	878.005	1140.63	1140.63
40	1.3398	1486.58	35.2226	Embankment (L)	200	26	377.043	611.436	843.57	0	843.57	1109.77	1109.77
41	1.3398	1439.05	36.3261	Embankment (L)	200	26	365.59	592.862	805.486	0	805.486	1074.29	1074.29
42	1.3398	1385.08	37.4454	Embankment (L)	200	26	353.014	572.468	763.672	0	763.672	1034.01	1034.01
43	1.3398	1324.38	38.5817	Embankment (L)	200	26	339.288	550.21	718.036	0	718.036	988.709	988.709
44	1.3398	1256.01	39.7363	Embankment (L)	200	26	324.273	525.86	668.11	0	668.11	937.674	937.674
45	1.3398	1119.8	40.9106	Embankment (L)	200	26	297.287	482.099	578.386	0	578.386	836.001	836.001
46	1.3398	935.946	42.1061	Embankment (L)	200	26	262.216	425.225	461.78	0	461.78	698.761	698.761
47	1.3398	743.842	43.3246	Embankment (L)	200	26	278.811	452.137	516.957	0	516.957	779.922	779.922
48	1.3398	542.984	44.5682	Embankment (L)	200	26	244.934	397.199	404.317	0	404.317	645.586	645.586
49	1.3398	332.804	45.8389	Embankment (L)	200	26	206.39	334.695	276.165	0	276.165	488.689	488.689
50	1.3398	112.654	47.1393	Embankment (L)	200	26	166.816	270.518	144.584	0	144.584	324.347	324.347

- Glo

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	B Ma
1	1.98222	58.8564	-13.4778	G
2	1.98222	171.156	-12.2776	G
3	1.98222	278.559	-11.0829	G
4	1.98222	494.458	-9.89301	G
5	1.98222	746.799	-8.70745	G
6	1.98222	988.755	-7.52564	G
7	1.98222	1220.41	-6.34703	G
8	1.98222	1441.86	-5.17113	G
9	1.98222	1653.14	-3.9974	G
10	1.98222	1854.33	-2.82535	G
11	1.98222	2045.44	-1.65448	G
12	1.98222	2226.51	-0.484308	G
13	1.98222	2395.03	0.685665	G
14	1.98222	2446.31	1.85592	G
15	1.98222	2580.82	3.02696	G
16	1.98222	2789.28	4.19926	G
17	1.98222	2987.62	5.37333	G
18	1.98222	3175.79	6.54966	G
19	1.98222	3353.73	7.72878	G
20	1.98222	3521.37	8.9112	G
21	1.98222	3678.6	10.0975	G
22	1.98222	3825.32	11.2881	G
23	1.98222	3961.4	12.4837	G
24	1.98222	4086.7	13.6849	G
25	1.98222	4201.07	14.8922	G
26	1.98222	4304.32	16.1064	G
27	1.98222	4396.26	17.328	G
28	1.98222	4476.66	18.5578	G
29	1.98222	4545.29	19.7965	G
30	1.98222	4601.87	21.045	G
31	1.98222	4646.12	22.304	G
32	1.98222	4677.69	23.5745	G
33	1.98222	4696.23	24.8574	G
34	1.98222	4701.33	26.1538	G
35	1.98222	4692.57	27.4647	G
36	1.98222	4669.43	28.7914	G
37	1.98222	4631.38	30.1353	G
38	1.98222	4577.82	31.4977	G
39	1.98222	4508.06	32.8803	G
40	1.98222	4421.36	34.2848	G
41	1.98222	4296.94	35.7132	G
42	1.98222	3989.4	37.1677	G
43	2.08049	3801.79	38.6884	Emba
44	2.08049	3390.16	40.2797	Emba
45	2.08049	2953.41	41.9095	Emba
46	2.08049	2489.59	43.5821	Emba
47	2.08049	1996.4	45.3025	Emba
48	2.08049	1471.13	47.077	Emba
49	2.08049	910.472	48.9127	Emba
50	2.08049	310.425	50.8188	Emba

- Glo

- Global Minimum Query (janbu simplified) - Safety Factor: 1.55711

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.2954	46.4788	-5.32267	Granular	0	33	15.5692	24.243	37.331	0	37.331	35.8804	35.8804
2	1.2954	120.854	-4.29239	Granular	0	33	40.1673	62.5449	96.3108	0	96.3108	93.296	93.296
3	1.2954	139.471	-3.26351	Granular	0	33	45.9975	71.6231	110.29	0	110.29	107.667	107.667
4	1.2954	213.133	-2.23567	Granular	0	33	69.7555	108.617	167.255	0	167.255	164.532	164.532
5	1.2954	321.711	-1.20855	Granular	0	33	104.496	162.712	250.554	0	250.554	248.349	248.349
6	1.2954	426.528	-0.181826	Granular	0	33	137.504	214.109	329.699	0	329.699	329.263	329.263
7	1.2954	527.585	0.844843	Granular	0	33	168.819	262.87	404.785	0	404.785	407.275	407.275
8	1.2954	624.882	1.87178	Granular	0	33	198.477	309.051	475.896	0	475.896	482.382	482.382
9	1.2954	718.414	2.89933	Granular	0	33	226.51	352.701	543.112	0	543.112	554.583	554.583
10	1.2954	808.173	3.9278	Granular	0	33	252.948	393.868	606.504	0	606.504	623.871	623.871
11	1.2954	894.145	4.95755	Granular	0	33	277.819	432.595	666.137	0	666.137	690.236	690.236
12	1.2954	976.316	5.98891	Granular	0	33	301.148	468.92	722.073	0	722.073	753.666	753.666
13	1.2954	1054.67	7.02221	Granular	0	33	322.956	502.878	774.362	0	774.362	814.143	814.143
14	1.2954	1129.17	8.05782	Granular	0	33	343.265	534.502	823.057	0	823.057	871.653	871.653
15	1.2954	1199.8	9.09609	Granular	0	33	362.093	563.819	868.207	0	868.207	926.18	926.18
16	1.2954	1266.53	10.1374	Granular	0	33	379.456	590.855	909.841	0	909.841	977.688	977.688
17	1.2954	1329.32	11.1821	Granular	0	33	395.369	615.633	947.989	0	947.989	1026.15	1026.15
18	1.2954	1388.12	12.2305	Granular	0	33	409.844	638.172	982.697	0	982.697	1071.54	1071.54
19	1.2954	1442.9	13.2832	Granular	0	33	422.892	658.489	1013.98	0	1013.98	1113.82	1113.82
20	1.2954	1493.6	14.3404	Granular	0	33	434.522	676.598	1041.87	0	1041.87	1152.95	1152.95
21	1.2954	1540.16	15.4026	Granular	0	33	444.741	692.51	1066.37	0	1066.37	1188.89	1188.89
22	1.2954	1582.53	16.4703	Granular	0	33	453.554	706.234	1087.5	0	1087.5	1221.6	1221.6
23	1.2954	1620.64	17.544	Granular	0	33	460.967	717.777	1105.28	0	1105.28	1251.01	1251.01
24	1.2954	1654.41	18.624	Granular	0	33	466.982	727.142	1119.7	0	1119.7	1277.07	1277.07
25	1.2954	1683.76	19.7109	Granular	0	33	471.599	734.331	1130.77	0	1130.77	1299.73	1299.73
26	1.2954	1708.61	20.8053	Granular	0	33	474.817	739.343	1138.49	0	1138.49	1318.9	1318.9
27	1.2954	1728.85	21.9076	Granular	0	33	476.635	742.173	1142.84	0	1142.84	1334.52	1334.52
28	1.2954	1744.38	23.0186	Granular	0	33	477.048	742.816	1143.84	0	1143.84	1346.51	1346.51
29	1.2954	1755.1	24.1388	Granular	0	33	476.051	741.263	1141.44	0	1141.44	1354.78	1354.78
30	1.2954	1760.86	25.2689	Granular	0	33	473.635	737.502	1135.66	0	1135.66	1359.23	1359.23
31	1.2954	1761.54	26.4097	Granular	0	33	469.793	731.519	1126.44	0	1126.44	1359.74	1359.74
32	1.26906	1722.7	27.55	Embankment (L)	200	26	475.851	740.953	1109.12	0	1109.12	1357.36	1357.36
33	1.26906	1716.04	28.6904	Embankment (L)	200	26	471.19	733.695	1094.24	0	1094.24	1352.11	1352.11
34	1.26906	1704.35	29.8434	Embankment (L)	200	26	465.435	724.733	1075.86	0	1075.86	1342.89	1342.89
35	1.26906	1687.46	31.0099	Embankment (L)	200	26	458.566	714.037	1053.93	0	1053.93	1329.57	1329.57
36	1.26906	1665.17	32.1908	Embankment (L)	200	26	450.562	701.574	1028.38	0	1028.38	1312.01	1312.01
37	1.26906	1637.29	33.3873	Embankment (L)	200	26	441.399	687.307	999.125	0	999.125	1290.03	1290.03
38	1.26906	1603.57	34.6005	Embankment (L)	200	26	431.052	671.196	966.097	0	966.097	1263.47	1263.47
39	1.26906	1563.77	35.8317	Embankment (L)	200	26	419.494	653.199	929.194	0	929.194	1232.1	1232.1
40	1.26906	1517.59	37.0823	Embankment (L)	200	26	406.693	633.265	888.323	0	888.323	1195.7	1195.7
41	1.26906	1464.72	38.3539	Embankment (L)	200	26	392.615	611.344	843.383	0	843.383	1154.05	1154.05
42	1.26906	1404.81	39.6483	Embankment (L)	200	26	377.223	587.377	794.238	0	794.238	1106.84	1106.84
43	1.26906	1337.46	40.9674	Embankment (L)	200	26	360.475	561.3	740.772	0	740.772	1053.77	1053.77
44	1.26906	1262.22	42.3134	Embankment (L)	200	26	342.328	533.043	682.841	0	682.841	994.482	994.482
45	1.26906	1137.65	43.6889	Embankment (L)	200	26	314.959	490.426	595.461	0	595.461	896.326	896.326
46	1.26906	954.613	45.0967	Embankment (L)	200	26	276.975	431.28	474.193	0	474.193	752.104	752.104
47	1.26906	761.8	46.5401	Embankment (L)	200	26	274.756	427.826	467.112	0	467.112	757.051	757.051
48	1.26906	558.538	48.0231	Embankment (L)	200	26	253.292	394.403	398.585	0	398.585	680.122	680.122
49	1.26906	343.906	49.5501	Embankment (L)	200	26	210.99	328.535	263.535	0	263.535	511.01	511.01
50	1.26906	116.812	51.1265	Embankment (L)	200	26	167.411	260.678	124.408	0	124.408	332.08	332.08

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	M
1	1.98214	74.7288	-16.9264	
2	1.98214	217.986	-15.5931	
3	1.98214	348.96	-14.2683	
4	1.98214	530.924	-12.9513	
5	1.98214	808.102	-11.6412	
6	1.98214	1075.37	-10.3373	
7	1.98214	1331.11	-9.03879	
8	1.98214	1575.46	-7.74493	
9	1.98214	1808.52	-6.45504	
10	1.98214	2030.41	-5.16842	
11	1.98214	2241.18	-3.88441	
12	1.98214	2440.9	-2.60236	
13	1.98214	2629.61	-1.3216	
14	1.98214	2756.87	-0.0415099	
15	1.98214	2825.1	1.23856	
16	1.98214	3041.39	2.51925	
17	1.98214	3253.72	3.8012	
18	1.98214	3455	5.08507	
19	1.98214	3645.18	6.37149	
20	1.98214	3824.18	7.66116	
21	1.98214	3991.9	8.95474	
22	1.98214	4148.24	10.2529	
23	1.98214	4293.06	11.5565	
24	1.98214	4426.21	12.8661	
25	1.98214	4547.52	14.1827	
26	1.98214	4656.78	15.5069	
27	1.98214	4753.78	16.8397	
28	1.98214	4838.26	18.1819	
29	1.98214	4909.94	19.5345	
30	1.98214	4968.5	20.8986	
31	1.98214	5013.6	22.2752	
32	1.98214	5044.85	23.6655	
33	1.98214	5061.81	25.0708	
34	1.98214	5064	26.4923	
35	1.98214	5050.87	27.9317	
36	1.98214	5021.83	29.3906	
37	1.98214	4976.17	30.8707	
38	1.98214	4913.15	32.374	
39	1.98214	4831.9	33.9028	
40	1.98214	4731.44	35.4596	
41	1.98214	4610.6	37.0471	
42	1.98214	4353.72	38.6686	
43	1.98214	3967.41	40.3277	
44	2.07938	3727.17	42.0716	Emb
45	2.07938	3259.69	43.9079	Emb
46	2.07938	2759.58	45.8028	Emb
47	2.07938	2223.44	47.7647	Emb
48	2.07938	1647.07	49.8037	Emb
49	2.07938	1025.21	51.9328	Emb
50	2.07938	351.082	54.1686	Emb

Interslice Data

Group 1 - Long Term

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.62166**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	36.2254	998.679	0	0	0
2	37.5643	998.636	18.7624	0	0
3	38.9031	998.613	71.9391	0	0
4	40.242	998.612	154.56	0	0
5	41.5808	998.631	242.98	0	0
6	42.9197	998.672	334.88	0	0
7	44.2586	998.733	455.534	0	0
8	45.5974	998.816	602.271	0	0
9	46.9363	998.919	770.686	0	0
10	48.2751	999.044	956.59	0	0
11	49.614	999.189	1156	0	0
12	50.9528	999.357	1365.14	0	0
13	52.2917	999.545	1580.42	0	0
14	53.6305	999.755	1798.44	0	0
15	54.9694	999.987	2015.97	0	0
16	56.3082	1000.24	2229.98	0	0
17	57.6471	1000.52	2437.6	0	0
18	58.9859	1000.82	2636.13	0	0
19	60.3248	1001.14	2823.05	0	0
20	61.6636	1001.48	2995.99	0	0
21	63.0025	1001.85	3152.77	0	0
22	64.3413	1002.24	3291.35	0	0
23	65.6802	1002.65	3409.88	0	0
24	67.019	1003.09	3506.65	0	0
25	68.3579	1003.55	3580.14	0	0
26	69.6968	1004.04	3629	0	0
27	71.0356	1004.56	3652.04	0	0
28	72.3745	1005.09	3648.27	0	0
29	73.7133	1005.66	3616.87	0	0
30	75.0522	1006.25	3557.22	0	0
31	76.392	1006.87	3496.46	0	0
32	77.7318	1007.52	3407.44	0	0
33	79.0716	1008.2	3290.51	0	0
34	80.4114	1008.91	3146.31	0	0
35	81.7512	1009.65	2975.69	0	0
36	83.091	1010.42	2779.83	0	0
37	84.4308	1011.22	2560.18	0	0
38	85.7706	1012.06	2318.51	0	0
39	87.1103	1012.93	2056.99	0	0
40	88.4501	1013.84	1778.15	0	0
41	89.7899	1014.79	1484.96	0	0
42	91.1297	1015.77	1180.89	0	0
43	92.4695	1016.8	869.923	0	0
44	93.8093	1017.87	556.667	0	0
45	95.1491	1018.98	246.666	0	0
46	96.4889	1020.14	-26.8565	0	0
47	97.8287	1021.35	-234.972	0	0
48	99.1685	1022.62	-514.973	0	0
49	100.508	1023.94	-720.672	0	0
50	101.848	1025.32	-825.374	0	0
51	103.188	1026.76	0	0	0

- **Global Minimum Query (janbu simplified) - Safety Factor: 1.55711**

Group 1 - Short Term

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.1807**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	14.5708	993	0	0	0
2	16.553	992.525	34.0597	0	0
3	18.5352	992.094	128.377	0	0
4	20.5174	991.705	274.393	0	0
5	22.4996	991.36	520.628	0	0
6	24.4819	991.056	873.436	0	0
7	26.4641	990.794	1315.84	0	0
8	28.4463	990.574	1832.04	0	0
9	30.4285	990.394	2407.31	0	0
10	32.4107	990.256	3027.94	0	0
11	34.3929	990.158	3681.14	0	0
12	36.3752	990.101	4355	0	0
13	38.3574	990.084	5038.44	0	0
14	40.3396	990.108	5720.42	0	0
15	42.3218	990.172	6363.29	0	0
16	44.304	990.277	6985.41	0	0
17	46.2863	990.422	7597.68	0	0
18	48.2685	990.609	8189.6	0	0
19	50.2507	990.836	8751.3	0	0
20	52.2329	991.105	9273.55	0	0
21	54.2151	991.416	9747.7	0	0
22	56.1974	991.769	10165.7	0	0
23	58.1796	992.165	10520	0	0
24	60.1618	992.604	10803.7	0	0
25	62.144	993.086	11010.3	0	0
26	64.1262	993.613	11134.1	0	0
27	66.1084	994.186	11169.7	0	0
28	68.0907	994.804	11112.3	0	0
29	70.0729	995.47	10957.7	0	0
30	72.0551	996.183	10702.2	0	0
31	74.0373	996.946	10342.9	0	0
32	76.0195	997.759	9877.14	0	0
33	78.0018	998.624	9303.23	0	0
34	79.984	999.542	8620	0	0
35	81.9662	1000.52	7827.03	0	0
36	83.9484	1001.55	6924.67	0	0
37	85.9306	1002.64	5914.12	0	0
38	87.9128	1003.79	4797.48	0	0
39	89.8951	1005	3577.89	0	0
40	91.8773	1006.28	2259.6	0	0
41	93.8595	1007.63	848.141	0	0
42	95.8417	1009.06	-642.612	0	0
43	97.8239	1010.56	-2141.17	0	0
44	99.9044	1012.23	-3411.02	0	0
45	101.985	1013.99	-4460.79	0	0
46	104.065	1015.86	-5200.86	0	0
47	106.146	1017.84	-5556.74	0	0
48	108.226	1019.94	-5439.62	0	0
49	110.307	1022.18	-4742.26	0	0
50	112.387	1024.56	-3333.3	0	0
51	114.468	1027.12	0	0	0

- **Global Minimum Query (janbu simplified) - Safety Factor: 2.13641**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	38.2825	999.399	0	0	0
2	39.5779	999.278	24.6822	0	0
3	40.8733	999.181	86.1006	0	0
4	42.1687	999.107	153.857	0	0
5	43.4641	999.057	252.714	0	0
6	44.7595	999.029	394.981	0	0
7	46.0549	999.025	574.534	0	0
8	47.3503	999.044	785.581	0	0
9	48.6457	999.087	1022.65	0	0
10	49.9411	999.152	1280.56	0	0
11	51.2365	999.241	1554.42	0	0
12	52.5319	999.353	1839.6	0	0
13	53.8273	999.489	2131.74	0	0
14	55.1227	999.649	2426.71	0	0
15	56.4181	999.832	2720.62	0	0
16	57.7135	1000.04	3009.81	0	0
17	59.0089	1000.27	3290.82	0	0
18	60.3043	1000.53	3560.44	0	0
19	61.5997	1000.81	3815.63	0	0
20	62.8951	1001.11	4053.58	0	0
21	64.1905	1001.45	4271.66	0	0
22	65.4859	1001.8	4467.45	0	0
23	66.7813	1002.19	4638.73	0	0
24	68.0767	1002.59	4783.47	0	0
25	69.3721	1003.03	4899.84	0	0
26	70.6675	1003.5	4986.21	0	0
27	71.9629	1003.99	5041.17	0	0
28	73.2583	1004.51	5063.49	0	0
29	74.5537	1005.06	5052.19	0	0
30	75.8491	1005.64	5006.5	0	0
31	77.1445	1006.25	4925.88	0	0
32	78.4399	1006.89	4810.04	0	0
33	79.709	1007.56	4679.9	0	0
34	80.9781	1008.25	4518.15	0	0
35	82.2471	1008.98	4325.75	0	0
36	83.5162	1009.74	4103.97	0	0
37	84.7852	1010.54	3854.44	0	0
38	86.0543	1011.38	3579.18	0	0
39	87.3234	1012.25	3280.64	0	0
40	88.5924	1013.17	2961.76	0	0
41	89.8615	1014.13	2626.04	0	0
42	91.1306	1015.13	2277.59	0	0
43	92.3996	1016.18	1921.23	0	0
44	93.6687	1017.29	1562.62	0	0
45	94.9377	1018.44	1208.35	0	0
46	96.2068	1019.65	886.358	0	0
47	97.4759	1020.93	634.186	0	0
48	98.7449	1022.27	357.461	0	0
49	100.014	1023.68	116.801	0	0
50	101.283	1025.16	-7.6042	0	0
51	102.552	1026.74	0	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	13.7691	993	0	0	0
2	15.7513	992.397	50.022	0	0
3	17.7334	991.844	188.703	0	0
4	19.7155	991.34	399.537	0	0
5	21.6977	990.884	703.876	0	0
6	23.6798	990.475	1142.87	0	0
7	25.662	990.114	1695.73	0	0
8	27.6441	989.798	2342.37	0	0
9	29.6262	989.529	3064.2	0	0
10	31.6084	989.305	3844.06	0	0
11	33.5905	989.125	4666.02	0	0
12	35.5726	988.991	5515.38	0	0
13	37.5548	988.901	6378.48	0	0
14	39.5369	988.855	7242.68	0	0
15	41.5191	988.854	8080.94	0	0
16	43.5012	988.896	8871.46	0	0
17	45.4833	988.984	9649.63	0	0
18	47.4655	989.115	10405	0	0
19	49.4476	989.292	11125.9	0	0
20	51.4298	989.513	11801.5	0	0
21	53.4119	989.78	12421.5	0	0
22	55.394	990.092	12976.6	0	0
23	57.3762	990.45	13457.9	0	0
24	59.3583	990.856	13857.3	0	0
25	61.3404	991.309	14167.2	0	0
26	63.3226	991.809	14380.7	0	0
27	65.3047	992.359	14491.6	0	0
28	67.2869	992.959	14494.2	0	0
29	69.269	993.61	14383.5	0	0
30	71.2511	994.314	14155.1	0	0
31	73.2333	995.07	13805.3	0	0
32	75.2154	995.882	13331	0	0
33	77.1975	996.751	12730	0	0
34	79.1797	997.678	12000.6	0	0
35	81.1618	998.666	11142.1	0	0
36	83.144	999.717	10154.8	0	0
37	85.1261	1000.83	9039.7	0	0
38	87.1082	1002.02	7799.05	0	0
39	89.0904	1003.28	6436.24	0	0
40	91.0725	1004.61	4956.06	0	0
41	93.0547	1006.02	3364.82	0	0
42	95.0368	1007.52	1670.65	0	0
43	97.0189	1009.1	-70.4921	0	0
44	99.0011	1010.78	-1961.61	0	0
45	101.08	1012.66	-3358.61	0	0
46	103.16	1014.66	-4411.02	0	0
47	105.239	1016.8	-5022.09	0	0
48	107.319	1019.09	-5072.29	0	0
49	109.398	1021.55	-4411.16	0	0
50	111.477	1024.21	-2845.12	0	0
51	113.557	1027.09	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	970
	190	970
	190	1028
	174	1029
	95	1026.5
	42	1000
	40	1000
	20	993
	0	993

	X	Y
Material Boundary	42	1000
	190	1028

Scenario-based Entities

Type	Coordinates		Long Term	Short Term
	X	Y	Constant Distribution	Constant Distribution
Distributed Load	174	1029	Orientation: Vertical	Orientation: Vertical
	97.9158	1026.59	Magnitude: 240 lbs/ft2	Magnitude: 360 lbs/ft2
			Creates Excess Pore Pressure: No	Creates Excess Pore Pressure: No

Appendix F.5.2

Access Roads

PURPOSE:

The purpose of this calculation is to analyze the overall stability of the access road for SUM-8-1.75. The analysis was performed using the sections through the probable locations of the access roads provided by MS.

CODES/STANDARDS/PROCEDURE:

The code used in this analysis is AASHTO LRFD Bridge Design Specifications Eighth Edition 2017 (LRFD). The following references were used:

- Load Factors are taken from *AASHTO LRFD Bridge Design Specifications* Eighth Edition 2017 (LRFD).
- Resistance Factors are taken from *AASHTO LRFD Bridge Design Specifications* Eighth Edition 2017 (LRFD).

SOURCE OF DATA

The geotechnical parameters of subsurface soil used in the analysis were developed based on project borings near each location. And the shear strength of subsurface rock was generalized according to the rock type. The geotechnical parameters calculation can be found in the Attachment.

The shear strength of $c' = 250$ psf and $\phi' = 26$ degrees were assumed for embankment material for overall stability analysis.

ASSUMPTIONS/PROJECT BACKGROUND:

- The stability analyses were performed on the most critical sections for each Access Road: STA. 13+00 for Access Road 1; STA. 32+00 and STA. 49+00 for Access Road 2A; STA. 52+00 and STA. 56+00 for Access Road 5A; STA. 66+00 for Access Road 6; and STA. 44+00 for Access Road 8. The most critical sections were chosen based on the following factors:
    - Proximity of the road to the slope,
    - Proposed wall height (if any),
    - The steepness of the geometry of the road.
- The Access Road 3A is located along the toe of the existing slope with not earth work proposed for the slope, it presents very little risk of overall stability failure and, therefore no stability analysis was performed on Access Road 3A;
- The Slope Stability of two cases were examined for both existing condition and the proposed grade after loading. To the extent the slopes could be observed due to vegetation during the field reconnaissance, all the cross sections were observed to be stable in existing conditions. All the existing models were found to have a Factor of Safety (FoS) equal to or greater than 1.2, based on drained shear strength and soil properties developed for each site, except for STA. 56+00 at Access Road 5A. Here the near surface material consists of uncontrolled fill (trash), we purposefully reduced the shear strength of the material;
- The distributed load was assumed to be 360 psf.

Definition Drawing:

See Attachment

Computer Programs Used:

Excel Spread Sheets to develop soil parameters.

Graphic SLIDE output (full output files are available but omitted due to space.)

Results:

Access Road	Factor of Safety	
	Existing Condition	Finished Grade W/ Load
ACR 1		
STA. 13+00	1.5	1.5
ACR 2A		
STA. 32+00	1.4	1.3
STA. 49+00	1.3	1.5 (Wall)
ACR 5A.		
STA. 52+00	1.2	1.5 (Road)
		1.2 (Downslope)
		1.3 (Wall_Downslope)
STA. 56+00	1.0	1.6 (Road)
		1.4 (Upslope)
ACR 6		
STA. 66+00	1.8	1.5
ACR 8		
STA. 44+00	1.5	1.5 (Wall)
		1.5 (Downslope)
		1.3 (Upslope)

In general, the slopes of the site were observed to be stable where heavy vegetation did not obscure direct observation. Therefore, soil properties were determined based on the index properties, standard blow counts, and pocket penetrometer readings. The effect of the installed access road was compared to the calculated existing slope stability. If there was a reduction in the Factor of Safety, a remediation is suggested. If there was no change or an improvement in the stability due to embankment placement, no remediation was suggested. This procedure was used even when the Factor of Safety was less than 1.3 down slope of the access road. This is due to the inherit uncertainty of calculating an un-failed slope's stability. Embankment placement was not shown with the required special benching to represent a "worst-case" scenario. In all cases of filling on slopes, the ODOT GB2 requirement should be followed.

Access Road (ACR) 1: One critical section was identified. The analysis shows the access road has no net effect on the slope's Factor of Safety (FoS).

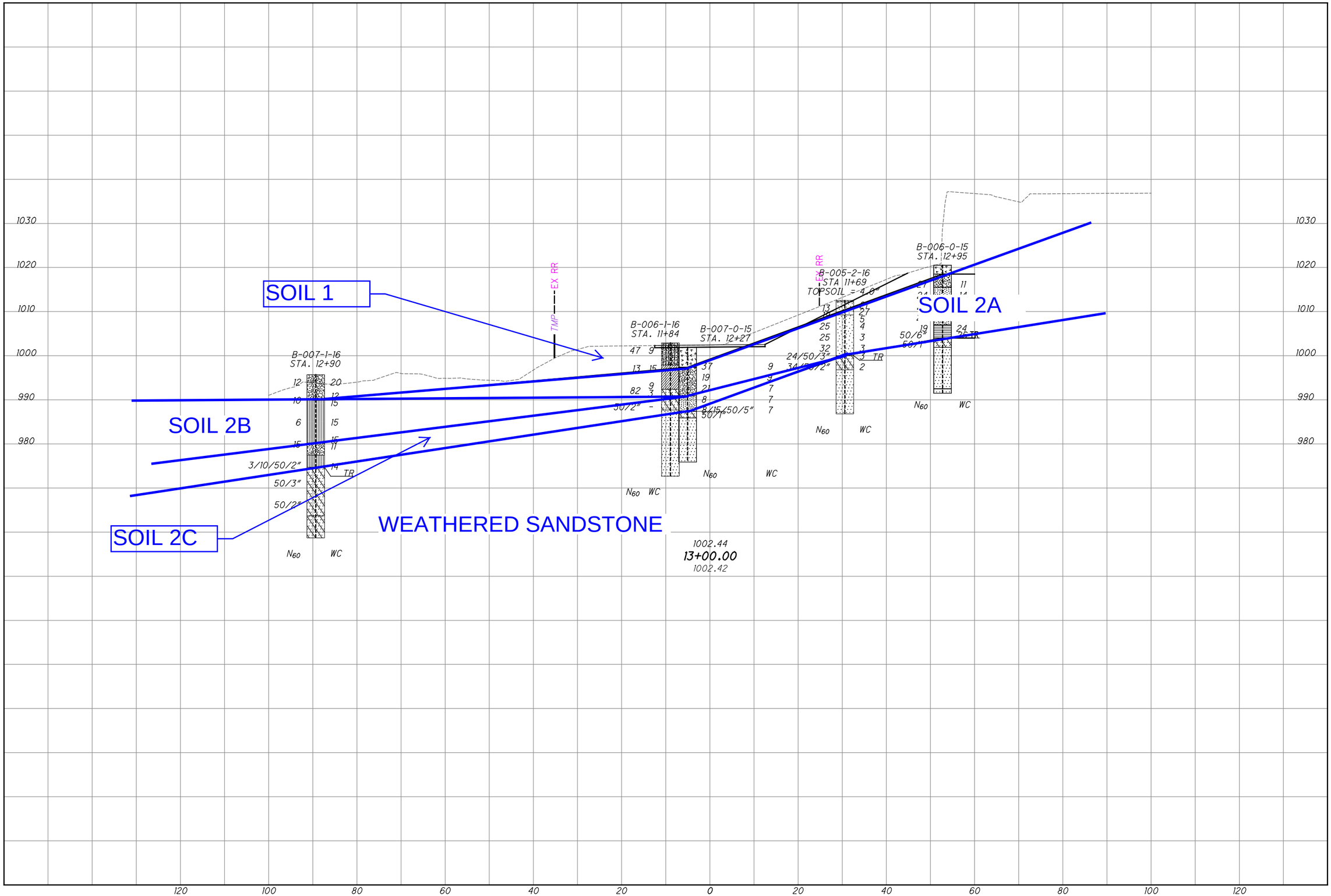
ACR 2A: Two critical sections were identified. At station 32+00, due to a slight steepening of the slope above the access road, the FoS drops from 1.5 to 1.4. This is still acceptable by AASHTO and ODOT standards. At station 49+00 a wall is needed to construct the road in the desired location. A soldier pile wall is assumed with a lateral load due to overall stability of 25 kips per pile. The spacing of the soldier piles was assumed to be 8 feet center to center. The load due to active pressure needs to be calculated by the contractor with the greatest of the two loads controlling the design.

ACR 5A: Two critical sections were identified. At STA. 52+00 the FoS is 1.2 and is unchanged by the access road. A soldier pile wall is proposed to be constructed in the desired location to achieve a FoS of 1.3 downslope. The soldier pile wall is assumed with a lateral load due to overall stability of 10 kips per pile. The spacing of the soldier piles was assumed to be 8 feet center to center. The FoS of the road (failure through the road) is 1.5.

The overall stability analysis of the existing conditions shows the cross section of STA. 56+00 at ACR 5A in equilibrium (FoS equals to 1.0). This is contrary to what was observed during the field reconnaissance. The reconnaissance found the slope heavily vegetated, but, where it was observable, the slope was stable. However, the near surface material is uncontrolled fill (trash) therefore, we purposefully reduced the shear strength of the material. According to the analysis, the proposed embankment acts like a toe berm. It increases the factor of safety along the access road to 1.6 or an increase of 60% (1.6/1.0-1). The embankment also increases the upslope stability to 1.4 or by 40%. Since This does bring the stability FoS to the desired 1.3 up slope of the access road;, GF recommends no improvements be performed up slope of the access road, as the access road is currently proposed. GF also recommends that the access road utilize geotextile or geogrid over areas underlain by the trash to minimize rutting. The exact configuration of the geotextile/geogrid should be determined by the contractor based on their estimated traffic and expected service life.

ACR 6: One critical section was identified. Due to steepening of the slope below the access road, the FoS drops from 1.8 to 1.5. This is still acceptable by AASHTO and ODOT standards.

ACR 8: One critical section was identified. The walls in this section were suggested by MS. GF evaluated the lateral load on the walls for global stability. Active pressure loads should be determined by the contractor based on the actual configuration of the walls. GF determined that the upslope wall will need to carry a lateral load of 175 kips for acceptable global stability. The downslope stability is unchanged and the upslope the FoS is 1.3.



HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 13+00 ACCESS ROAD 1

SUM-8-1.75

1
7

STA 32+00

SOIL 2

SOIL1

SOIL 4

SOIL 3

B-037-0-17
21.0' RT.
TOPSOIL = 3"

16	14
9	18
7	16
20	10
WOH	26
11	26
8	27
4	28
4	19
4	28
11	26
17	22
23	24
24	24
27	22
27	17
N_{60}	WC

B-038-0-17
113.5' LT.
TOPSOIL = 6"

12	19
1	9
7	30
16	25
40	21
32	9
16/32/50/5"	8
32/50/3"	7
79	8
80	16
16/35/50/3"	8
N_{60}	WC

960 950 940 930 920 910 900 890 880 870 860 850 840

30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

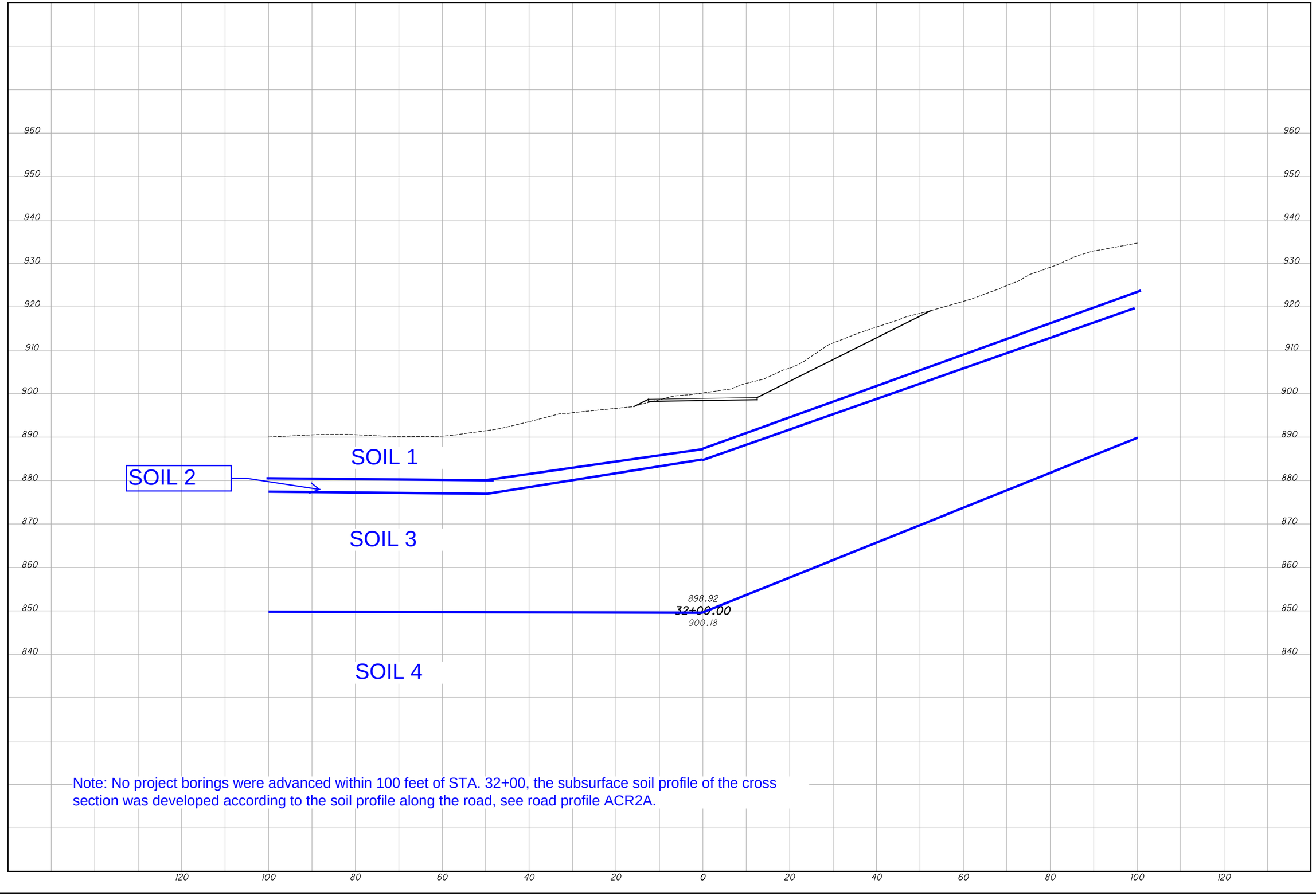
0 25 50 100
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
STA. 31+00 TO 44+00 ACCESS ROAD 2A

SUM-8-1.75

2A
7



Note: No project borings were advanced within 100 feet of STA. 32+00, the subsurface soil profile of the cross section was developed according to the soil profile along the road, see road profile ACR2A.

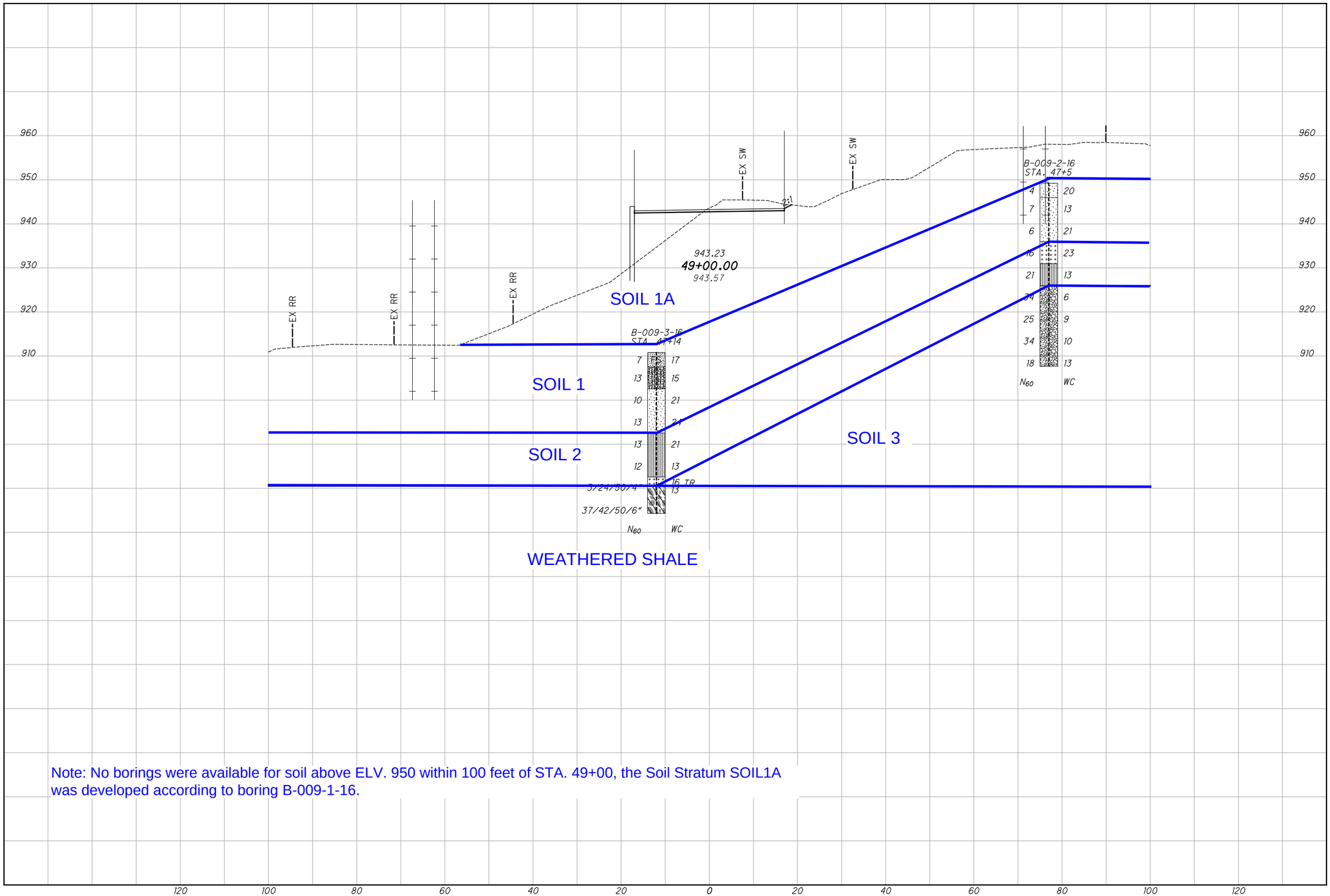
HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 32+00 ACCESS ROAD 2A

SUM-8-1.75

2
7



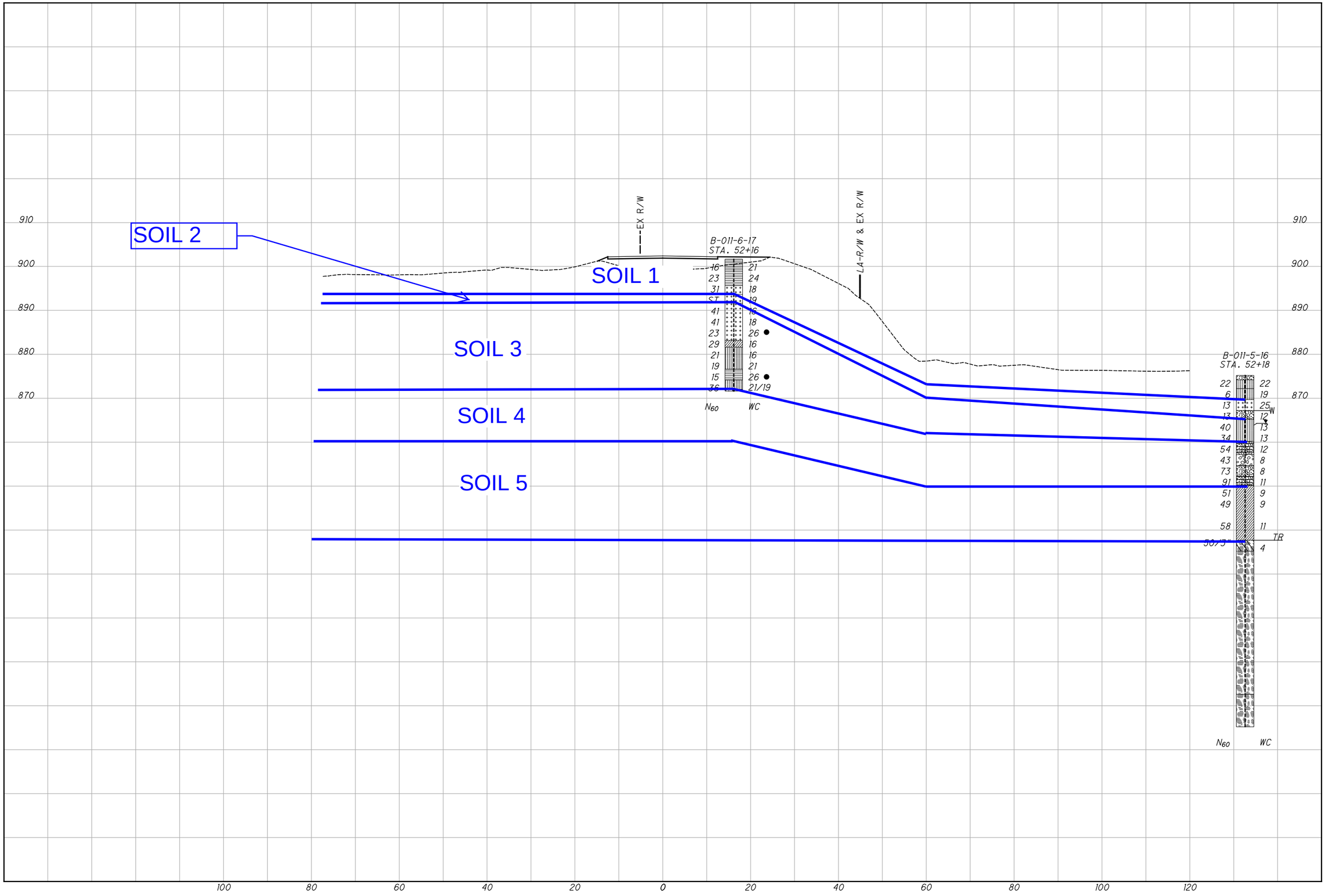
Note: No borings were available for soil above ELV. 950 within 100 feet of STA. 49+00, the Soil Stratum SOIL1A was developed according to boring B-009-1-16.

0 5 10 20
HORIZONTAL SCALE IN FEET

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 49+00 ACCESS ROAD 2A

SUM-8-1.75



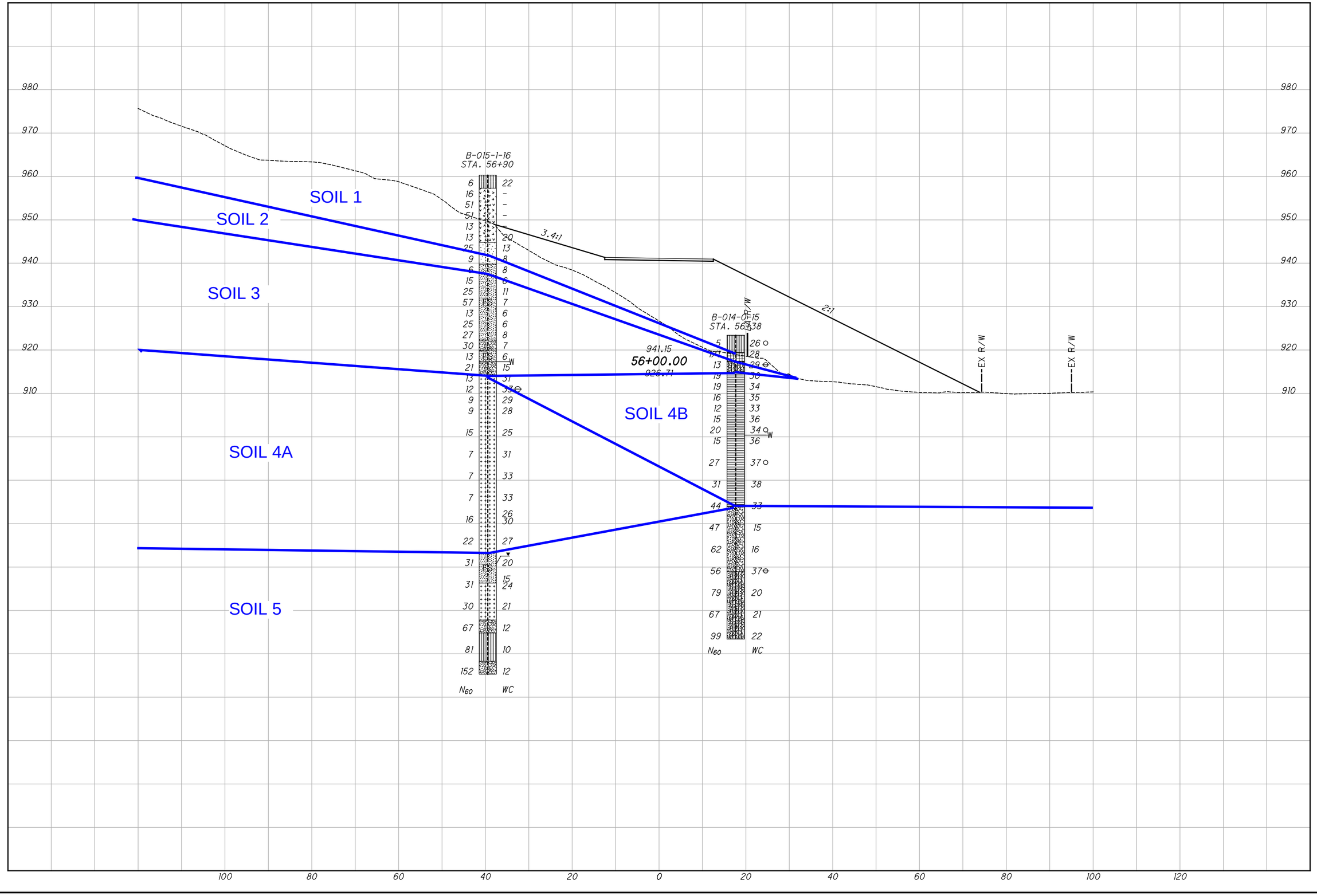
HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 52+00 ACCESS ROAD 5A

SUM-8-1.75

4
7



HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 56+00 ACCESS ROAD 5A

SUM-8-1.75

5
7

HORIZONTAL SCALE IN FEET
0 5 10 20

DRAWN YLZ
CHECKED TLM

SOIL PROFILE
CROSS SECTION STA. 66+00 ACCESS ROAD 6

SUM-8-1.75

7
6
7

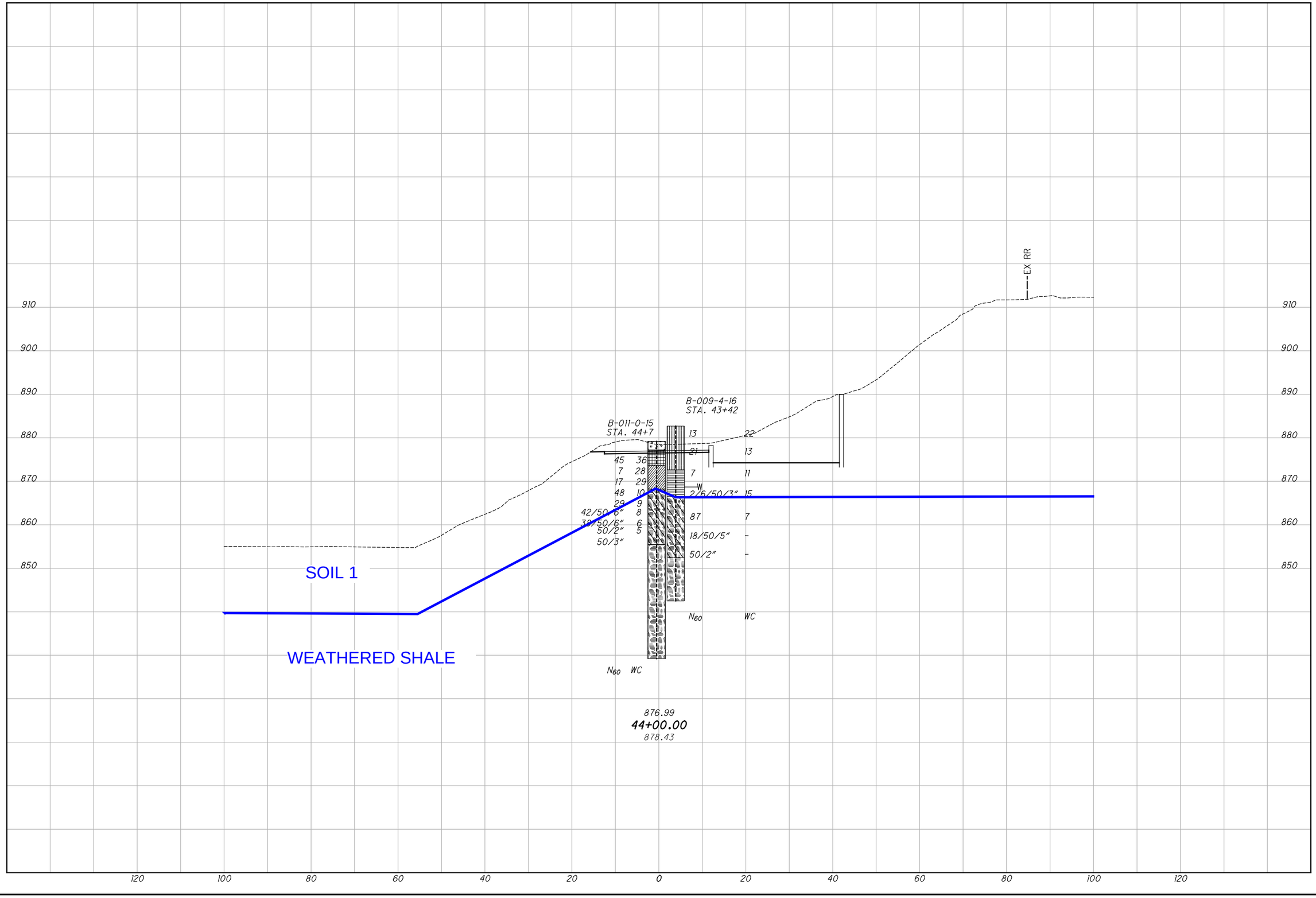
SOIL PROFILE
CROSS SECTION SECTION STA. 44+00 ACCESS ROAD 8

SUM-8-1.75

7
7

DRAWN YLZ
CHECKED TLM

HORIZONTAL SCALE IN FEET
0 5 10 20



Objective:

The purpose of these calculations is to determine the soil strata based on project boring logs and lab testing resutls to provide geotechnical design parameters for stability analyses models for Access Roads 1, 2A, 5A, 6, and 8.

Source of Data:

1. Boring Logs are from the 2015, 2016, 2017 exploration;
2. Unconfined compressive strength and Shear Strength under Consolidated and Undrained condition were taken from lab testing results.

Assumptions:

1. When water table was not encountered during drilling exploration, the water table was assumed to be below bore hole with an approximate number for calculation purpose;
2. The saturated unit weight of soil is assumed to be the moist unit weight of soil plus 5 pcf; the unit weight of rock is assumed to be 150 pcf;
3. For all the split spoon samples with SPT >= 50, SPT = WOH, and shelby tube samples, an approximate N_{60} number has been assumed for calculation purpose;
4. The drained shear strength value for cohesive material was obtained according to Table 2: *Properties for Cohesive Soils "Typical" Long-Term Strength Values in GB#7* (Ref. 1);
5. For any subsurface profile contains rock, the rock strata was generalized into one layer, with the Qu = 1000 psi, GSI = 20 for sandstone layer, and Qu = 500 psi, GSI = 10 for shale layer, the internal friction angle and cohesion was obtained from RocLab.

Reference:

1. Geotechnical Bulletin 7: Drilled Shaft and Landslide Stabilization Design, Ohio Department of Transportation, Division of Geotechnical Engineering, November 2014.
2. GEOTECH CIRCULAR No. 5 Evaluation of Soil & Rock Properties: FHWA-IF-02-034, Ohio Department of Transportation, GeoSyntec Consultants, April 2002.
3. Drilled Shaft: Construction Procedures and LRFD Design Methods, FHWA-NHI-10-016 FHWA GEC 010, Department of Transportation Federal Highway Administration, May 2010.
4. AASHTO LRFD Bridge Design Specification, Eighth Edition, 2017.

Definition of parameters:

Depth	Depth of top of the Spoon
Sample Interval	Length between the bottoms of last spoon and this spoon
γ	Moist weight of soil sample obtained based on blow count N_{60} according to Table 1 ref. 1
γ'	Effective unit weight of soil sample obtained based on γ and water table and strata depths
N_{60}	N_{60} is the SPT N-value corrected for field procedures and apparatus N_{60} = blow counts X energy ratio/ 60% = (ER/60%)N
σ'_v	Vertical effective stress at the location of the SPT N-value (KSF)
C_N	C_N = [0.77 log10 (40/σ'v)], CN < 2.0
$N1_{60}$	$N1_{60} = C_N X (N_{60})$
CLASF.	AASHTO Soil Classification (ODOT)
HP	Hand penetrometer readings
ϕ'1 (Clean Sand)	Drained friction angle based on SPT for clean sand ϕ' = (15.4X($N1_{60}$))^(0.5)+20° (*Sabatini et al.* , 2002, N_{60} value equivalent Per *Mayerhof* , 1956, See Eq. 72 Ref. 2)
ϕ'1 (Silty Sand*)	Drained friction angle based on SPT for saturated silty sand (N_{60}>15) ϕ' = (15.4X(15+((N_{60})-15)/2)*C_N)^(0.5)+20° (*Sabatini et al.* , 2002, N_{60} value equivalent Per *Mayerhof* , 1956, See Eq. 72 Ref. 2)
S_u	Undrained shear strength from In-situ Tests (*Stroud,* 1974 & 1989, See Table 33 Ref. 2) $S_u = (f_1(N_{60})P_a)/100$ f_1 = 4.5 for PI = 50; f_1 = 5.5 for PI = 15 Pa = atmospheric pressure, 2116 psf
PI	Plastic Index
Type	Soil Type: G denotes granular material; C denotes cohesive material;
ϕ'2	Drained friction angle developed based on $N1_{60}$ according to *AASHTO Table 10.4.6.2.4-1*
ϕ'_{PI}	Drained friction angle based on PI (*Terzaghi, Peck, and Mesri, 1996, See Fig. 74 Ref. 2*)
RQD	Weighted RQD of each rock stratum;
Q_u	Uncomfined compressive strength of rock in each stratum
GSI	GSI index of each rock stratum (*AASHTO Table 10.4.6.4-1*)
Rock ϕ	Internal friction angle of rock, obtained from Roclab analysis
Rock C	Cohesion of rock, obtained from Roclab analysis

Table 10.4.6.2.4-1—Correlation of $SPT N1_{60}$ Values to Drained Friction Angle of Granular Soils (ϕ_f modified after Bowles, 1977)

$N1_{60}$	ϕ_f
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

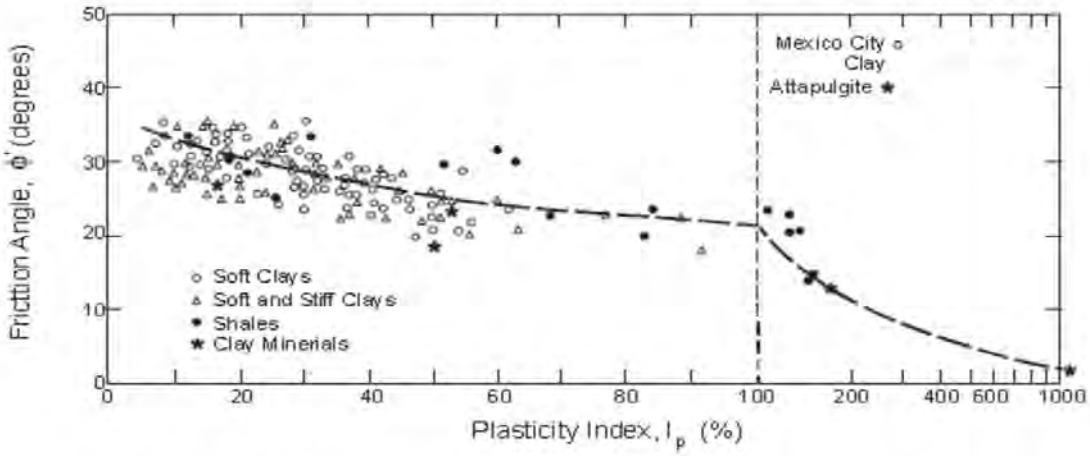


Figure 74. Relationship between ϕ' and PI (Terzaghi, Peck, and Mesri, 1996).

B-006-0-15 1020.5 Sur. Elv. Water table = 990 DRY

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
3.5	1017.0	1.5	5.0	0.125	27	0.531	1.445	39	A-1-b		44.5		
6	1014.5	2.5	7.5	0.125	24	0.844	1.290	31	A-3		41.8		
8.5	1012.0	2.5	10.0	0.125	29	1.156	1.185	34	A-3		43.0		
11	1009.5	2.5	12.5	0.130	20	1.478	1.103	22	A-3		38.4		
13.5	1007.0	2.5	15.0	0.130	19	1.803	1.037	20	A-6b	4.5			2211

Strata No.	B-006-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 2A	G	2.0	16.5	14.5	24	29	127.0	41.9	35		

B-007-0-15 1001.9 Sur. Elv. Water table = 970 DRY

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
3.5	998.4	1.5	5.0	0.125	37	0.531	1.445	53	A-1-b		48.7		
6	995.9	2.5	7.5	0.125	19	0.844	1.290	25	A-1-b		39.4		
8.5	993.4	2.5	10.0	0.125	21	1.156	1.185	25	A-1-b		39.6		
11	990.9	2.5	12.5	0.120	8	1.460	1.107	9	A-3		31.7		

Strata No.	B-007-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 2A	G	4	11.0	7.0	26	34	125.0	43	36.0		
Strata 2C	G	11.0	14.5	3.5	8	9	120.0	32	30.0		

B-011-0-15 879.2 Sur. Elv. Water table = 825 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
3.5	875.7	1.5	5.0	0.125	45	0.531	1.445	65	A-7-6	1			5,237
6	873.2	2.5	7.5	0.120	7	0.835	1.294	9	A-6a	1.25			815
8.5	870.7	2.5	10.0	0.125	17	1.144	1.189	20	A-6a	1.25			1,978

Strata No.	B-011-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	C	2	11.0	9.0	23	31	123.3			1200	2,700

B-014-0-15 923.4 Sur. Elv. Water table = 900

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
1	922.4	1.5	2.5	0.110	5	0.193	1.785	9	A-4a			36.6	581.9
3.5	919.9	2.5	5.0	0.105	2	0.459	1.494	3	A-7-6	0.50			233
6	917.4	2.5	7.5	0.125	13	0.756	1.327	17	A-2-4		36.2		
8.5	914.9	2.5	10.0	0.125	19	1.069	1.211	23	A-6b	0.40			2211
11	912.4	2.5	12.5	0.130	19	1.390	1.123	21	A-6b	2.25			2211
13.5	909.9	2.5	15.0	0.130	16	1.715	1.053	17	A-6b	2.00			1862
16	907.4	2.5	17.5	0.125	12	2.031	0.997	12	A-6b	1.00			1397
18.5	904.9	2.5	20.0	0.125	15	2.344	0.949	14	A-6b	0.50			1746
21	902.4	2.5	22.5	0.135	20	2.674	0.905	18	A-6b	0.50			2328
23.5	899.9	2.5	25.0	0.068	15	2.893	0.878	13	A-6b	0.75			1746
28.5	894.9	5	30.0	0.073	27	3.253	0.839	23	A-6b	0.50			3142
33.5	889.9	5	35.0	0.078	31	3.637	0.802	25	A-6b	0.40			3608
38.5	884.9	5	40.0	0.078	44	4.025	0.768	34	A-6b	0.25			5121
43.5	879.9	5	45.0	0.078	47	4.413	0.737	35	A-1-b		43.2		
48.5	874.9	5	50.0	0.088	62	4.843	0.706	44	A-1-b		46.0		
53.5	869.9	5	55.0	0.088	56	5.281	0.677	38	A-2-4			39.2	
58.5	864.9	5	60.0	0.088	79	5.719	0.650	51	A-2-4			41.7	
63.5	859.9	5	65.0	0.088	67	6.157	0.626	42	A-2-4			39.9	
68.5	854.9	5	70.0	0.088	99	6.595	0.603	60	A-2-4			43.0	

Strata No.	B-014-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 2	G/C	4	6.0	2.0	2	3	105.0			500	200
Strata 3	G	6.0	8.5	2.5	13	17	125.0	36	33.0		
Strata 4B	C	8.5	39.5	31.0	22	20	131.5			900	2500
Strata 5	G	39.5	70.0	30.5	68	45	148.3	42	40.0		

B-018-0-15 1002.9 Sur. Elv. Water table = 970 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
1	1001.9	1.5	2.5	0.120	15	0.210	1.755	26	A-1-b		40.0		
3.5	999.4	2.5	5.0	0.120	26	0.510	1.459	38	A-1-b		44.2		
6	996.9	2.5	7.5	0.125	43	0.819	1.300	56	A-2-4		49.4		
8.5	994.4	2.5	10.0	0.125	14	1.131	1.192	17	A-1-b		36.2		
11	991.9	2.5	12.5	0.130	15	1.453	1.109	17	A-1-b		36.2		
13.5	989.4	2.5	15.0	0.130	12	1.778	1.041	12	A-1-b		33.6		
16	986.9	2.5	17.5	0.125	9	2.094	0.986	9	A-1-b		31.8		
18.5	984.4	2.5	20.0	0.130	12	2.415	0.939	11	A-1-b		33.0		
21	981.9	2.5	22.5	0.135	20	2.749	0.895	18	A-1-b		36.6		
23.5	979.4	2.5	25.0	0.135	27	3.086	0.857	23	A-1-b		38.8		

Strata No.	B-018-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1A	G	0.0	8.5	8.5	28	40	121.7	44.5	37		
Strata 2	G	8.5	21.0	12.5	12	13	128.0	34.1	31		
Strata 3	G	21.0	25.0	4.0	24	21	135.0	37.7	34		

B-019-0-15 996.6 Sur. Elv. Water table = 970 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
1	995.6	1.5	2.5	0.125	50	0.219	1.742	87	A-2-4		56.6		
3.5	993.1	2.5	5.0	0.115	7	0.514	1.456	10	A-2-4		32.4		
6	990.6	2.5	7.5	0.125	15	0.819	1.300	20	A-2-4		37.5		
8.5	988.1	2.5	10.0	0.125	22	1.131	1.192	26	A-2-4		40.0		
11	985.6	2.5	12.5	0.130	12	1.453	1.109	13	A-2-4		34.1		
18.5	978.1	7.5	20.0	0.125	9	2.394	0.942	8	A-2-4		31.1		
23.5	973.1	5	25.0	0.135	27	3.061	0.859	23	A-2-4		38.8		

Strata No.	B-019-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	3	5.0	2.0	7	10	115.0	32.4	31		
Strata 2	G	5.0	23.0	18.0	15	17	126.3	35.7	33		
Strata 3	G	23.0	25.0	2.0	27	23	135.0	38.8	34		

B-020-0-15 1015.3 Sur. Elv. Water table = 980 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
1	995.6	1.5	2.5	0.115	0	0.201	1.770	0	A-1-b		20.0		
3.5	993.1	2.5	5.0	0.115	4	0.489	1.473	6	A-1-b		29.6		
6	990.6	2.5	7.5	0.125	15	0.794	1.311	20	A-4a	2			1,746
8.5	988.1	2.5	10.0	0.125	15	1.106	1.200	18	A-1-b		36.6		
11	985.6	2.5	12.5	0.130	15	1.428	1.115	17	A-1-b		36.2		
13.5	983.1	2.5	15.0	0.130	11	1.753	1.046	12	A-1-b		33.6		

Strata No.	B-020-0-15										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	1	6.0	5.0	2	3	115.0	31.2	26		
Strata 2	G	1	15.0	14.0	14	17	127.5	35.5	33		

B-005-2-16 1012.5 Sur. Elv. Water table = 980 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	1012.5	1.5	1.5	0.120	13	0.090	2.000	26	A-3a (Fill)		40.0		
2.5	1010.0	2.5	4.0	0.120	19	0.390	1.548	29	A-3a		41.1		
5	1007.5	2.5	6.5	0.125	25	0.699	1.353	34	A-3a		42.9		
7.5	1005.0	2.5	9.0	0.125	25	1.011	1.230	31	A-3a		41.8		
10	1002.5	2.5	11.5	0.130	32	1.333	1.138	36	A-3a		43.5		

Strata No.	B-005-2-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0	3.3	3.3	13	26	120.0	40.0	35.0		
Strata 2A	G	3.3	12.5	9.2	25	33	125.0	42.4	36.0		

B-007-1-16 993.7 Sur. Elv. Water table = 960 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	993.7	1.5	1.5	0.120	12	0.090	2.000	24	A-1-b		39.2		
5	988.7	5	6.5	0.120	10	0.690	1.358	14	A-4a		34.7		
10	983.7	5	11.5	0.125	6	1.311	1.143	7	A-4a		30.4		
15	978.7	5	16.5	0.130	15	1.958	1.009	15	A-1-b		35.2		
20	973.7	5	21.5	0.130	15	2.608	0.913	14	A-4a	4.5			1,746

Strata No.	B-007-1-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	C	1	5.8	4.8	12	24	120.0	39.2	34		
Strata 2B	G	5.8	15.5	9.7	8	11	122.5	32.5	31		
Strata 2C	G	15.5	21.0	5.5	15	15	130.0	35.2		4500	1700

B-009-1-16 957.7 Sur. Elv. Water table = 935.7

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	957.7	1.5	1.5	0.120	22	0.090	2.000	44	A-4a		46.0		
2.5	955.2	3.5	5.0	0.125	35	0.461	1.492	52	A-3a		48.3		

Strata No.	B-009-1-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1A	C	0	5	5.0	29	48	122.5	47.2	40		

B-009-2-16 949.2 Sur. Elv. Water table = 900 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	949.2	1.5	1.5	0.115	4	0.086	2.000	8	A-3a		31.1		
5	944.2	5.0	6.5	0.120	7	0.683	1.361	10	A-3a		32.4		
10	939.2	5.0	11.5	0.125	6	1.304	1.145	7	A-3a		30.4		
15	934.2	5.0	16.5	0.130	16	1.950	1.010	16	A-4b		35.7		
20	929.2	5.0	21.5	0.135	21	2.621	0.911	19	A-4a	2.75			2444
25	924.2	5.0	26.5	0.135	34	3.296	0.835	28	A-1-b		40.8		
30	919.2	5.0	31.5	0.135	25	3.971	0.772	19	A-1-b		37.1		
35	914.2	5.0	36.5	0.135	34	4.646	0.720	24	A-1-b		39.2		
40	909.2	5.0	41.5	0.140	18	5.493	0.664	12	A-1-b		33.6		

Strata No.	B-009-2-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0.0	13.3	13.3	6	8	120.0	31.3	29.0		
Strata 2	G/C	13.3	23.3	10.0	19	18	132.5	35.7	33.0	2800	2400
Strata 3	G	23.3	41.5	18.2	28	21	136.3	37.7	34.0		

B-009-3-16 910.8 Sur. Elv. Water table = 865 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	910.8	1.5	1.5	0.115	7	0.086	2.000	14	A-3a		34.7		
5	905.8	5.0	6.5	0.125	13	0.704	1.351	18	A-2-4		36.6		
10	900.8	5.0	11.5	0.125	10	1.329	1.139	11	A-3a		33.0		
15	895.8	5.0	16.5	0.130	13	1.975	1.006	13	A-3a		34.1		
20	890.8	5.0	21.5	0.130	13	2.625	0.911	12	A-4a	1.75			1513
25	885.8	5.0	26.5	0.135	12	3.296	0.835	10	A-4a	3.25	32.4		
30	880.8	5.0	31.5	0.140	70	3.993	0.771	54	Shale				
35	875.8	5.0	36.5	0.140	90	4.693	0.717	64	Shale				

Strata No.	B-009-3-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0.0	18.3	18.3	11	14	123.8	34.6	32.0		
Strata 2	G/C	18.3	30.3	12.0	13	11	132.5	32.4	31.0	2500	1500

B-009-4-16 882.7 Sur. Elv. Water table = 868.7

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
0	882.7	1.5	1.5	0.120	13	0.090	2.000	26	A-4a	1.25			1513
5	877.7	5.0	6.5	0.125	21	0.711	1.348	28	A-4a	2.5			2444
10	872.7	5.0	11.5	0.120	7	1.315	1.142	8	A-6b	0.75			815
15	867.7	5.0	16.5	0.063	12	1.671	1.062	13	A-6b	1			1397

Strata No.	B-009-4-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0.0	16.3	16.3	13	19	122.5			1400	1500

B-011-5-16 875.2 Sur. Elv. Water table = 867.2

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
1	874.2	1.5	2.5	0.125	22	0.219	1.742	38	A-4a	4			2560
3.5	871.7	2.5	5.0	0.110	6	0.505	1.462	9	A-4a	2.25			698
6	869.2	2.5	7.5	0.125	13	0.806	1.306	17	A-4b		36.2		
8.5	866.7	2.5	10.0	0.063	13	1.010	1.230	16	A-1-b		35.7		
11	864.2	2.5	12.5	0.073	40	1.184	1.177	47	A-4a	4			4655
13.5	861.7	2.5	15.0	0.073	34	1.365	1.130	38	A-4a	4			3957
16	859.2	2.5	17.5	0.078	54	1.555	1.086	59	A-2-6			44.0	
18.5	856.7	2.5	20.0	0.068	43	1.732	1.050	45	A-1-a		46.3		
21	854.2	2.5	22.5	0.078	73	1.918	1.016	74	A-1-b		53.8		
23.5	851.7	2.5	25.0	0.078	91	2.112	0.984	90	A-2-6			48.3	
26	849.2	2.5	27.5	0.078	51	2.306	0.954	49	A-6a	4.5			5935
28.5	846.7	2.5	30.0	0.078	49	2.500	0.927	45	A-6a	4.5			5703
33.5	841.7	5	35.0	0.078	58	2.888	0.879	51	A-6a	4.5			6750

Strata No.	B-011-5-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	C	1.0	5.5	4.5	14	24	117.5			3100	1600
Strata 2	G	5.5	10.0	4.5	13	17	125.0	35.9	31.0		
Strata 3	C	10.0	15.0	5.0	65	67	135.0			4000	4300
Strata 4	G	15.0	25.0	10.0	53	48	137.5	48.1	38.0		
Strata 5	C	25.0	38.5	13.5	69	60	140.0			4500	6100

B-015-1-16 960.3 Sur. Elv.

Water table = 917.3

Depth	Ele. (Top of Spn.)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
1	959.3	1.5	2.5	0.115	6	0.201	1.770	11	A-4a			36.9	
3.5	956.8	2.5	5	0.120	16	0.498	1.467	23	UCF		38.8		
6	954.3	2.5	7.5	0.135	51	0.824	1.298	66	UCF		51.9		
8.5	951.8	2.5	10	0.135	51	1.161	1.184	60	UCF		50.4		
11	949.3	2.5	12.5	0.130	13	1.490	1.100	14	UCF		34.7		
13.5	946.8	2.5	15.0	0.130	13	1.815	1.034	13	UCF		34.1		
16	944.3	2.5	17.5	0.130	25	2.140	0.979	24	A-3a		39.2		
18.5	941.8	2.5	20.0	0.125	9	2.456	0.933	8	A-3a		31.1		
21	939.3	2.5	22.5	0.130	6	2.778	0.892	5	A-3		28.8		
23.5	936.8	2.5	25.0	0.135	15	3.111	0.854	13	A-3		34.1		
26	934.3	2.5	27.5	0.135	25	3.449	0.820	20	A-3		37.5		
28.5	931.8	2.5	30.0	0.140	57	3.795	0.788	45	A-3		46.3		
31	929.3	2.5	32.5	0.135	13	4.136	0.759	10	A-3		32.4		
33.5	926.8	2.5	35.0	0.135	25	4.474	0.733	18	A-3		36.6		
36	924.3	2.5	37.5	0.135	27	4.811	0.708	19	A-3		37.1		
38.5	921.8	2.5	40.0	0.135	30	5.149	0.686	21	A-1-b		38.0		
41	919.3	2.5	42.5	0.140	13	5.495	0.664	9	A-3		31.8		
43.5	916.8	2.5	45.0	0.078	21	5.736	0.649	14	A-1-b		34.7		
46	914.3	2.5	47.5	0.078	13	5.930	0.638	8	A-4b		31.1		
48.5	911.8	2.5	50.0	0.078	12	6.124	0.628	8	A-4b		31.1		
51	909.3	2.5	52.5	0.068	9	6.300	0.618	6	A-4b		29.6		
53.5	906.8	2.5	55.0	0.068	9	6.469	0.609	5	A-4b		28.8		
58.5	901.8	5	60.0	0.078	15	6.850	0.590	9	A-4b			31.7	
63.5	896.8	5	65.0	0.068	7	7.195	0.574	4	A-4b		27.8		
68.5	891.8	5	70.0	0.068	7	7.533	0.558	4	A-4b		27.8		
73.5	886.8	5	75.0	0.068	7	7.871	0.544	4	A-4b		27.8		
78.5	881.8	5	80.0	0.078	16	8.252	0.528	8	A-4b			31.2	
83.5	876.8	5	85.0	0.078	22	8.640	0.512	11	A-4b			32.1	
88.5	871.8	5	90.0	0.078	31	9.028	0.498	15	A-3		35.2		
93.5	866.8	5	95.0	0.078	31	9.416	0.484	15	A-4b			33.1	
98.5	861.8	5	100.0	0.078	30	9.804	0.470	14	A-4b			32.8	
103.5	856.8	5	105.0	0.088	67	10.234	0.456	31	A-1-b		41.8		
108.5	851.8	5	110.0	0.083	81	10.651	0.442	36	A-4a	3.25			9427
113.5	846.8	5	115.0	0.088	152	11.085	0.429	65	A-1-b		51.6		

Strata No.	B-015-1-16										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	10	18.0	8.0	17	17	130.0	36.0	33		
Strata 2	G/C	18.0	23.0	5.0	8	7	128.0	29.9	29		
Strata 3	G	23.0	46.0	23.0	25	19	137.0	36.5	33		
Strata 4A	G	46.0	87.0	41.0	12	7	135.0	30.0	29		
Strata 5	G	87.0	115.0	28.0	65	29	144.0	39.0	35		

B-011-6-17 901.6 Sur. Elv. Water table = 867.2

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
1	900.6	1.5	2.5	0.125	16	0.219	1.742	28	A-6B	1.5			1862
3.5	898.1	2.5	5.0	0.125	23	0.531	1.445	33	A-6B	1.5			2677
6	895.6	2.5	7.5	0.130	31	0.853	1.287	40	A-4b	1.75			3608
8	893.6	2.5	10.0	0.125	31	1.138	1.191	37	A-4b		43.9		
11	890.6	2.5	12.5	0.135	41	1.499	1.098	45	A-4b				4772
13.5	888.1	2.5	15.0	0.135	41	1.836	1.030	42	A-4b				4772
16	885.6	2.5	17.5	0.130	23	2.165	0.975	22	A-4b	2.5			2677
18.5	883.1	2.5	20.0	0.130	29	2.490	0.929	27	A-6A	1.5			3375
21	880.6	2.5	22.5	0.135	21	2.824	0.886	19	A-4A	1.25			2444
23.5	878.1	2.5	25.0	0.135	19	3.161	0.849	16	A-4A	1.75			2211
26	875.6	2.5	27.5	0.130	15	3.490	0.816	12	A-6B	2			1746
28.5	873.1	2.5	30.0	0.140	36	3.833	0.784	28	A-4A	1.5			4190

Strata No.	B-011-6-17										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	C	0.0	8.0	8.0	23	34	126.7			1600	2700
Strata 2	G	8.0	10.0	2.0	31	37	125.0	43.9	35.0		
Strata 3	C	10.0	30.0	20.0	23	26	133.8			1800	3300

B-037-0-17 926.8 Sur. Elv. Water table = 915.8

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand ϕ1'	Silty Sand ϕ1'	S_u (psf)
1	925.8	1.5	2.5	0.120	16	0.210	1.755	28	A-2-4		40.8		
3.5	923.3	2.5	5	0.115	9	0.501	1.465	13	A-1-b		34.1		
6	920.8	2.5	7.5	0.120	7	0.798	1.309	9	A-1-b		31.8		
8.5	918.3	2.5	10	0.125	20	1.106	1.200	24	A-3		39.2		
11	915.8	2.5	12.5	0.120	0	1.410	1.119	0	A-4a	NP	20.0		
13.5	913.3	2.5	15.0	0.063	11	1.610	1.074	12	A-4b	0.75			1280
16	910.8	2.5	17.5	0.058	8	1.757	1.045	8	A-6b	0.25			931
18.5	908.3	2.5	20.0	0.053	4	1.893	1.020	4	A-4b	0.5			466
21	905.8	2.5	22.5	0.058	4	2.033	0.996	4	A-4b	0.25			466
23.5	903.3	2.5	25.0	0.058	4	2.177	0.973	4	A-4b	0.5			466
26	900.8	2.5	27.5	0.068	11	2.338	0.950	10	A-4b	0.75			1280
28.5	898.3	2.5	30.0	0.073	17	2.516	0.925	16	A-4b	1.25			1978
31	895.8	2.5	32.5	0.073	25	2.698	0.902	23	A-4b	1.75			2910
33.5	893.3	2.5	35.0	0.073	24	2.879	0.880	21	A-4b	2			2793
36	890.8	2.5	37.5	0.073	27	3.061	0.860	23	A-4b	2.75			3142
38.5	888.3	2.5	40.0	0.073	27	3.242	0.840	23	A-6b	4.5			3142

Strata No.	B-037-0-17										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0	11.0	11.0	13	19	120.0	36.5	32		
Strata 2	G	11.0	13.0	2.0	0	0	120.0	20.0	25		
Strata 3	C	13.0	28.0	15.0	7	7	122.0			500	800
Strata 4	C	28.0	40.0	12.0	24	21	135.0			2500	2800

B-038-0-17 926.8 Sur. Elv. Water table = 925 dry

Depth	Elevation (Top of Spoon)	Sample Interval (ft.)	Depth (Btm. of Spoon)	γ' (kcf)	N_{60}	σ'_v	C_N	$N1_{60}$	CLASF.	HP (tsf)	Clean Sand $\phi 1'$	Silty Sand $\phi 1'$	S_u (psf)
1	925.8	1.5	2.5	0.120	12	0.210	1.755	21	A-4a		38.0		
3.5	923.3	2.5	5	0.115	4	0.501	1.465	6	A-3		29.6		
6	920.8	2.5	7.5	0.120	7	0.798	1.309	9	A-4b	1.25			814.7
8.5	918.3	2.5	10	0.125	16	1.106	1.200	19	A-4b	1.5			1862
11	915.8	2.5	12.5	0.135	40	1.436	1.113	45	A-4a	2.25			4655
13.5	913.3	2.5	15.0	0.073	32	1.665	1.063	34	A-4a	4.5			3724
16	910.8	2.5	17.5	0.073	82	1.846	1.029	84	A-4a	4.5			9543
18.5	908.3	2.5	20.0	0.073	100	2.028	0.997	100	A-4a				11638
21	905.8	2.5	22.5	0.078	79	2.218	0.967	76	A-4a	3			9194
23.5	903.3	2.5	25.0	0.078	80	2.412	0.939	75	A-6b				9310
26	900.8	2.5	27.5	0.078	85	2.606	0.913	78	A-4a	4.5			9892

Strata No.	B-038-0-17										
	Type (G/C)	Top Dep. (ft.)	Btm. Dep. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	$\phi'1$ (deg.)	$\phi'2$ (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)
Strata 1	G	0	3.5	3.5	12	21	120.0	38.0	32		
Strata 2	G	3.5	6.0	2.5	4	6	115.0	29.6	26		
Strata 3	C	6.0	11.0	5.0	12	14	123.0			1400	1300
Strata 4	C	11.0	27.5	16.5	71	70	137.0			3800	8300

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-005-2-16	3.3	13	26	120.0	40.0	35.0	0	0
	B-007-1-16	4.8	12	24	120.0	39.2	34.0	0	0
	Summary	8.1	12	25	120.0	39.5	34.4	0	0
2A	B-006-0-15	14.5	24	29	127.0	41.9	35.0	0	0
	B-007-0-15	7.0	26	34	125.0	42.6	36.0	0	0
	B-005-2-16	9.2	25	33	125.0	42.4	36.0	0	0
	Summary	30.7	25	31	125.9	42.2	35.5	0	0
2B	B-007-1-16	9.7	8	11	122.5	32.5	31.0	0	0
	Summary	9.7	8	11	122.5	32.5	31.0	0	0
2C	B-007-0-15	3.5	8	9	120.0	31.7	30.0	0	0
	B-007-1-16	5.5	15	15	130.0	35.2	0.0	4500	1700
	Summary	9.0	12	13	126.1	33.8	30.0	2750	1039

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	120.0	125.0	37.0	N/A	12	37.0	N/A
2A	125.0	130.0	39.0	N/A	25	39.0	N/A
2B	122.0	127.0	32.0	N/A	8	32.0	N/A
2C	128.0	133.0	32.0	1000	12	32.0	120

Note:

Soil stratum 2C contains both granular and cohesive material, a friction angle of 32 was assumed for both drained and undrained condition with a cohesion value of 1000 psf for undrained strength and 120 for drained condition.

Rock Design Values

Strata	γ (pcf)	Qu (psi)	GSI	ϕ (°)	C (ksi)	C (psf)
W/ST	150	1000	20	23.6	0.031	4464

Note: W/ST refers to weathered sandstone.

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-037-0-17	11.0	13	19	120.0	36.5	32.0	0	0
	B-038-0-17	3.5	12	21	120.0	38.0	32.0	0	0
	Summary	14.5	13	19	120.0	36.8	32.0	0	0
2	B-037-0-17	2.0	0	0	120.0	20.0	25.0	0	0
	B-038-0-17	2.5	4	6	115.0	29.6	26.0	0	0
	Summary	4.5	2	3	117.2	25.3	25.6	0	0
3	B-037-0-17	15.0	7	7	122.0	0.0	0.0	500	800
	B-038-0-17	5.0	12	14	123.0	0.0	0.0	1400	1300
	Summary	20.0	8	9	122.3	0.0	0.0	725	925
4	B-037-0-17	12.0	24	21	135.0	0.0	0.0	2500	2800
	B-038-0-17	16.5	71	70	137.0	0.0	0.0	3800	8300
	Summary	28.5	51	49	136.2	0.0	0.0	3253	5984

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	120.0	125.0	34.0	N/A	13	34.0	N/A
2	117.0	122.0	25.0	N/A	2	25.0	N/A
3	132.0	137.0	N/A	800	8	22.0	100
4	135.0	140.0	N/A	4000	51	28.0	250

Note:

Lab testing results show a friction angle of 33, cohesion of 300 psf for materials in stratum 3 (B-038-0-17 offset boring). Since the test result is for non-plastic silt with only two points, here a friction angle of 22 degrees, cohesion of 100 psf (based on Table 2 in GB#7) was assumed for the undrained shear strength for soil stratum 3 to be conservative in calculation.

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-009-2-16	13.3	6	8	120.0	31.3	29.0	0	0
	B-009-3-16	18.3	11	14	123.8	34.6	32.0	0	0
	Summary	31.6	9	11	122.2	33.2	30.7	0	0
1A	B-009-1-16	5.0	29	48	122.5	47.2	40.0	0	0
	Summary	5.0	29	48	122.5	47.2	40.0	0	0
2	B-009-2-16	10.0	19	18	132.5	35.7	33.0	2800	2400
	B-009-3-16	12.0	13	11	132.5	32.4	31.0	2500	1500
	Summary	22.0	16	14	132.5	33.9	31.9	3688	2962
3	B-009-2-16	18.2	28	21	136.3	37.7	34.0	0	0
	Summary	18.2	28	21	136.3	37.7	34.0	0	0

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	122.0	127.0	32.0	N/A	9	32.0	N/A
1A*	123.0	128.0	40.0	N/A	29	40.0	N/A
2	132.0	137.0	33.0	3000	16	25.0	150
3	135.0	140.0	36.0	N/A	28	36.0	N/A

Note: *The geotechnical design parameters for soil stratum 1A is developed based on soil Boring B-009-1-16, however, due to it is located outside of the design areas, all the other soil strata do not consider the boring data from B-009-1-16.

Rock Design Values

Strata	γ (pcf)	Qu (psi)	GSI	ϕ (°)	C (ksi)	C (psf)
W/SH	150	500	20	11.9	0.006	864

Note: W/SH refers to weathered sandstone.

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-011-5-16	4.5	14	24	117.5	0.0	0.0	3100	1600
	B-011-6-17	8.0	23	34	126.7	0.0	0.0	1600	2700
	Summary	12.5	20	30	123.4	0.0	0.0	2140	2304
2	B-011-5-16	4.5	13	17	125.0	35.9	31.0	0	0
	B-011-6-17	2.0	31	37	125.0	43.9	35.0	0	0
	Summary	6.5	19	23	125.0	38.4	32.2	0	0
3	B-011-5-16	5.0	65	67	135.0	0.0	0.0	4000	4300
	B-011-6-17	20.0	23	26	133.8	0.0	0.0	1800	3300
	Summary	25.0	31	34	134.0	0.0	0.0	2240	3500
4	B-011-5-16	10.0	53	48	137.5	48.1	38.0	0	0
	Summary	10.0	53	48	137.5	48.1	38.0	0	0
5	B-011-5-16	13.5	69	60	140.0	0.0	0.0	4500	6100
	Summary	13.5	69	60	140.0	0.0	0.0	4500	6100

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	123.5	128.5	N/A	2200	20	25.0	175
2	125.0	130.0	35.0	N/A	19	35.0	N/A
3	134.0	139.0	N/A	2900	31	26.0	200
4	137.5	142.5	43.0	N/A	53	43.0	N/A
5	140.0	145.0	N/A	5300	69	28.0	250

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-015-1-16	8.0	17	17	130.0	36.0	33.0	0	0
	Summary	8.0	17	17	130.0	36.0	33.0	0	0
2	B-014-0-15	2.0	2	3	105.0	0.0	0.0	500	200
	B-015-1-16	5.0	8	7	128.0	29.9	29.0	0	0
	Summary	7.0	6	6	121.4	29.9	29.0	500	200
3	B-014-0-15	2.5	13	17	125.0	36.2	33.0	0	0
	B-015-1-16	23.0	25	19	137.0	36.5	33.0	0	0
	Summary	25.5	24	19	135.8	36.5	33.0	0	0
4A	B-015-1-16	41.0	12	7	135.0	30.0	29.0	0	0
	Summary	41.0	12	7	135.0	30.0	29.0	0	0
4B	B-014-0-15	31.0	22	20	131.5	0.0	0.0	900	2500
	Summary	31.0	22	20	131.5	0.0	0.0	900	2500
5	B-014-0-15	30.5	68	45	148.3	42.2	40.0	0	0
	B-015-1-16	28.0	65	29	144.0	39.0	35.0	0	0
	Summary	58.5	67	37	146.3	40.7	33.1	0	0

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1*	80.0	85.0	27.0	N/A	17	27.0	N/A
2	120.0	125.0	29.5	250	6	25.0	75
3	135.0	140.0	34.5	N/A	24	34.5	N/A
4A	135.0	140.0	29.5	N/A	12	29.5	N/A
4B	130.0	135.0	N/A	1700	22	25.0	175
5	140.0	145.0	37.0	N/A	67	37.0	N/A

Note: *Soil Stratum 1 mostly consists of uncontrolled fill (trash), whose unit weight and shear strength vary largely according to the components, here a unit weight of 80 pcf (saturated unit weight of 85 pcf) and a friction angle of 27 is used as design parameters in the calculation to be conservative.

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-019-0-15	2.0	7	10	115.0	32.4	31.0	0	0
	B-020-0-15	5.0	2	3	115.0	31.2	26.0	0	0
	Summary	7.0	3	5	115.0	31.5	27.4	0	0
1A	B-018-0-15	8.5	28	40	121.7	44.5	37.0	0	0
	Summary	8.5	28	40	121.7	44.5	37.0	0	0
2	B-018-0-15	12.5	12	13	128.0	34.1	31.0	0	0
	B-019-0-15	18.0	15	17	126.3	35.7	33.0	0	0
	B-020-0-15	14.0	14	17	127.5	35.5	33.0	0	0
	Summary	44.5	14	16	127.1	35.2	32.4	0	0
3	B-018-0-15	4.0	24	21	135.0	37.7	34.0	0	0
	B-019-0-15	2.0	27	23	135.0	38.8	34.0	0	0
	Summary	6.0	25	22	135.0	38.1	34.0	0	0

Soil Design Values

Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	115.0	120.0	29.5	N/A	3	29.5	N/A
1A	120.0	125.0	40.0	N/A	28	40.0	N/A
2	125.0	130.0	34.0	N/A	14	34.0	N/A
3	135.0	140.0	36.0	N/A	25	36.0	N/A

Soil Profile Summary Table

Strata	Boring No.	Strata Depth (ft.)	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1	ϕ'_2	C_1 = HP/2 (psf)	C_2 = Su (psf)
1	B-011-0-15	9.0	23	31	123.3	0	0	1200	2700
	B-009-4-16	16.3	13	19	122.5	0	0	1400	1500
	Summary	25.3	17	23	122.8	0	0	2031	2095

Soil Design Values

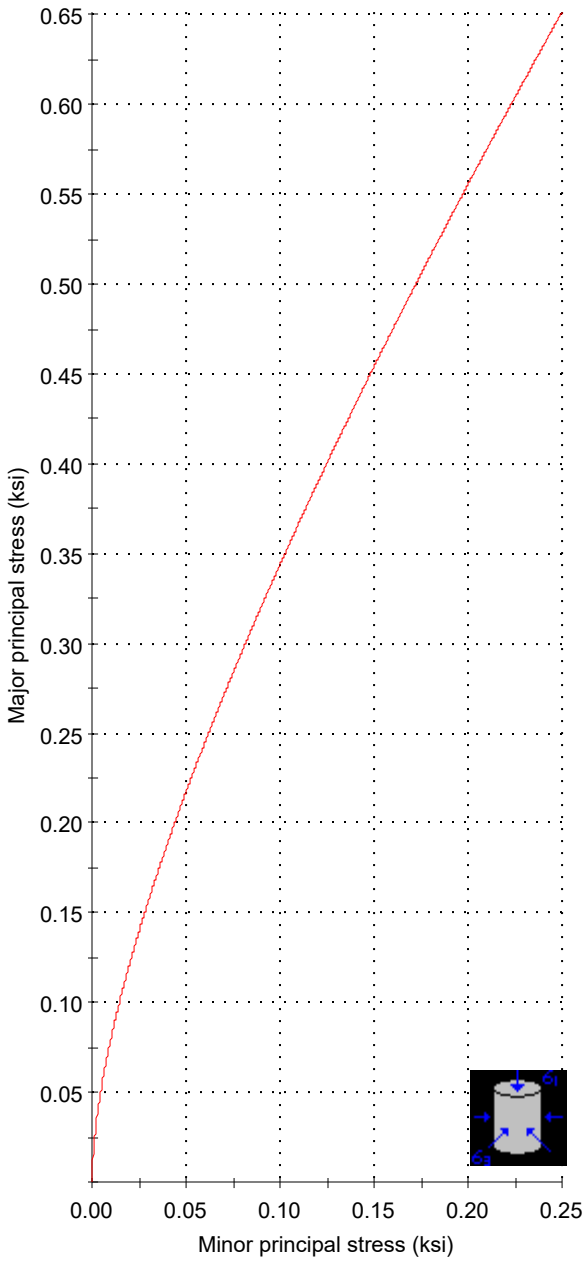
Strata	γ_m (pcf)	γ_{sat}(pcf)	ϕ (°)	C (psf)	N_{60}	ϕ' (°)	C' (psf)
1	132.0	137.0	N/A	2000	17	25.0	150

Rock Design Values

Strata	γ (pcf)	Qu (psi)	GSI	ϕ (°)	C (ksi)	C (psf)
W/SH	150	500	20	11.9	0.006	864

Note: W/SH refers to weathered sandstone.

SUM-8-1.75 Weathered Sandstone



Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 1 ksi
GSI = 20 mi = 13 Disturbance factor (D) = 0
intact modulus (Ei) = 90 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

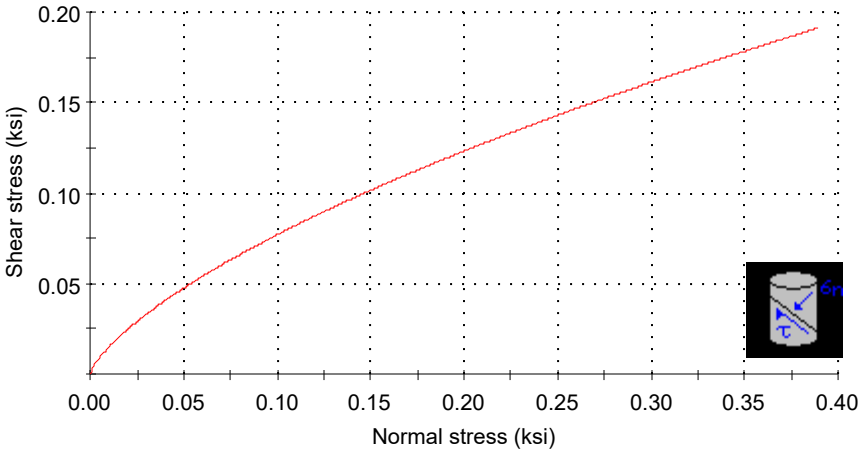
mb = 0.747 s = 0.0001 a = 0.544

Mohr-Coulomb Fit

cohesion = 0.031 ksi friction angle = 23.58 deg

Rock Mass Parameters

tensile strength = -0.000185 ksi
uniaxial compressive strength = 0.008 ksi
global strength = 0.094 ksi
deformation modulus = 4.11 ksi



SUM-8-1.75 Weathered Shale

Hoek-Brown Classification

intact uniaxial comp. strength (sigci) = 0.5 ksi
GSI = 10 mi = 4 Disturbance factor (D) = 0
intact modulus (Ei) = 45 ksi
modulus ratio (MR) = 90

Hoek-Brown Criterion

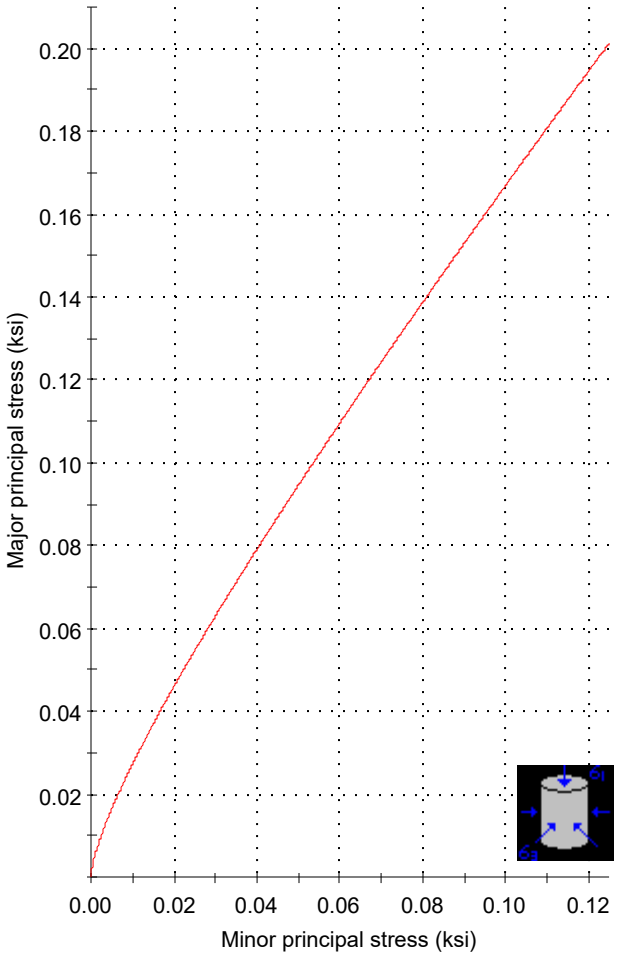
mb = 0.161 s = 4.54e-5 a = 0.585

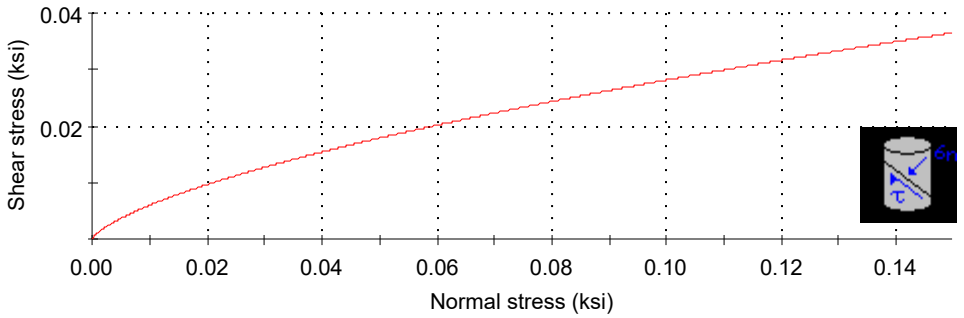
Mohr-Coulomb Fit

cohesion = 0.006 ksi friction angle = 11.94 deg

Rock Mass Parameters

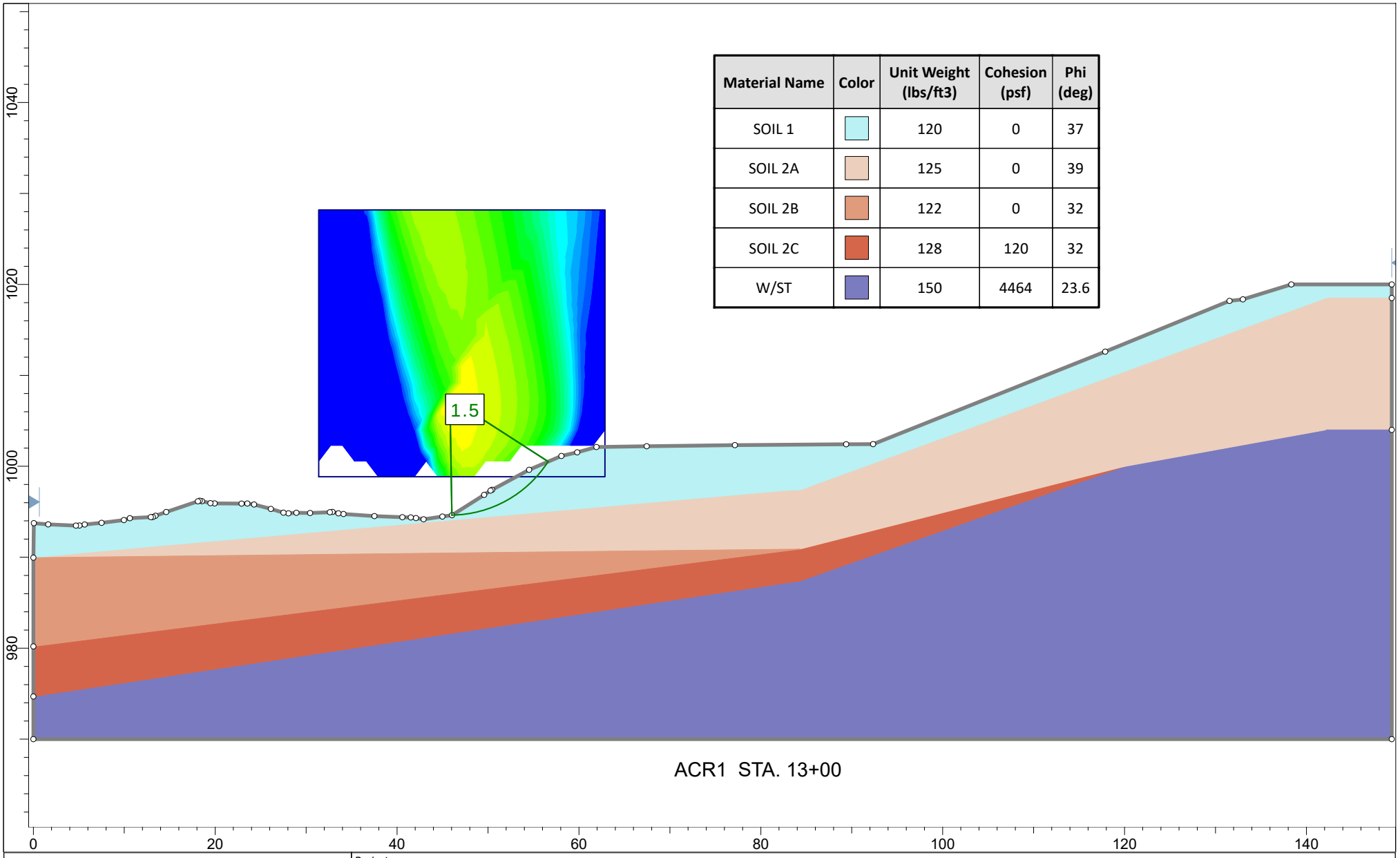
tensile strength = -0.000141 ksi
uniaxial compressive strength = 0.001 ksi
global strength = 0.015 ksi
deformation modulus = 1.37 ksi





Existing Condition

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		120	0	37
SOIL 2A		125	0	39
SOIL 2B		122	0	32
SOIL 2C		128	120	32
W/ST		150	4464	23.6



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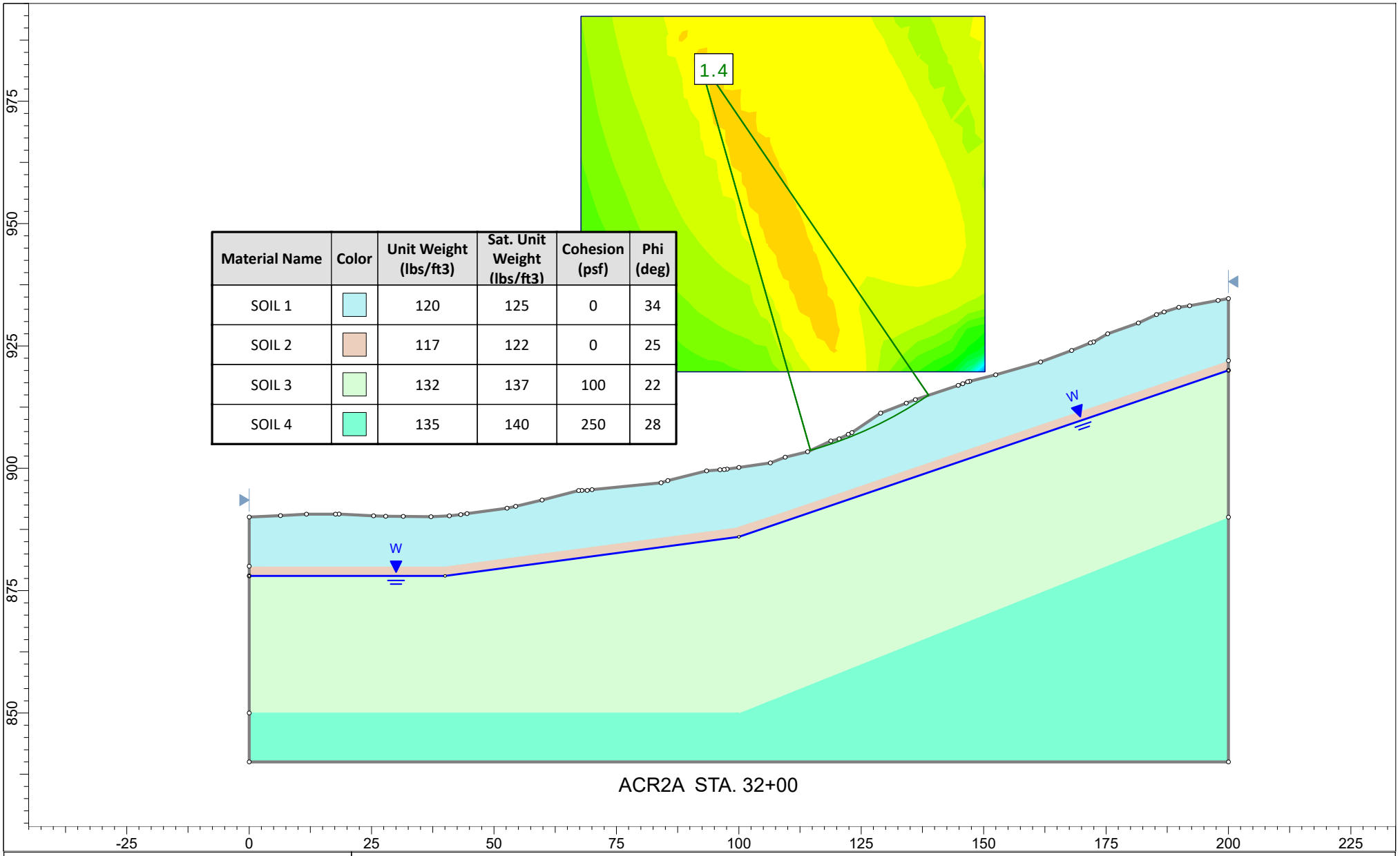
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR1 STA. 13+00				
Calc By	YLZ	Date	9/18	Scale	1:175
Chk'd By	JAY	Date	9/18	File Name	SUM-8-1.75_ACR1_EX.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		120	125	0	34
SOIL 2		117	122	0	25
SOIL 3		132	137	100	22
SOIL 4		135	140	250	28

ACR2A STA. 32+00

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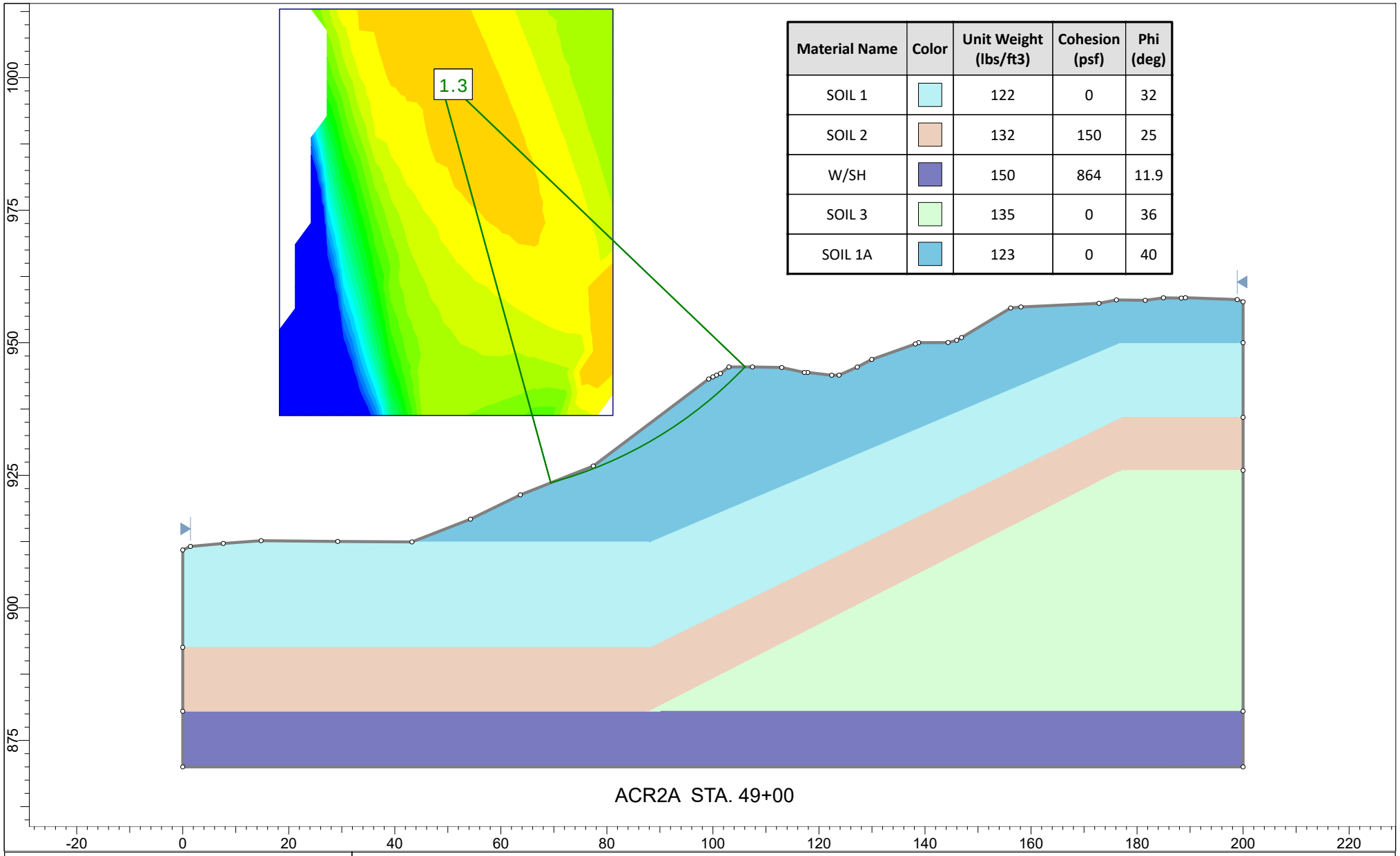
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR2A STA. 32+00 EX				
Calc By	YLZ	Date	5/18	Scale	1:325
Chk'd By	TLM	Date	5/18	File Name	SUM-8-1.75_ACR2A-1_EX.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		122	0	32
SOIL 2		132	150	25
W/SH		150	864	11.9
SOIL 3		135	0	36
SOIL 1A		123	0	40

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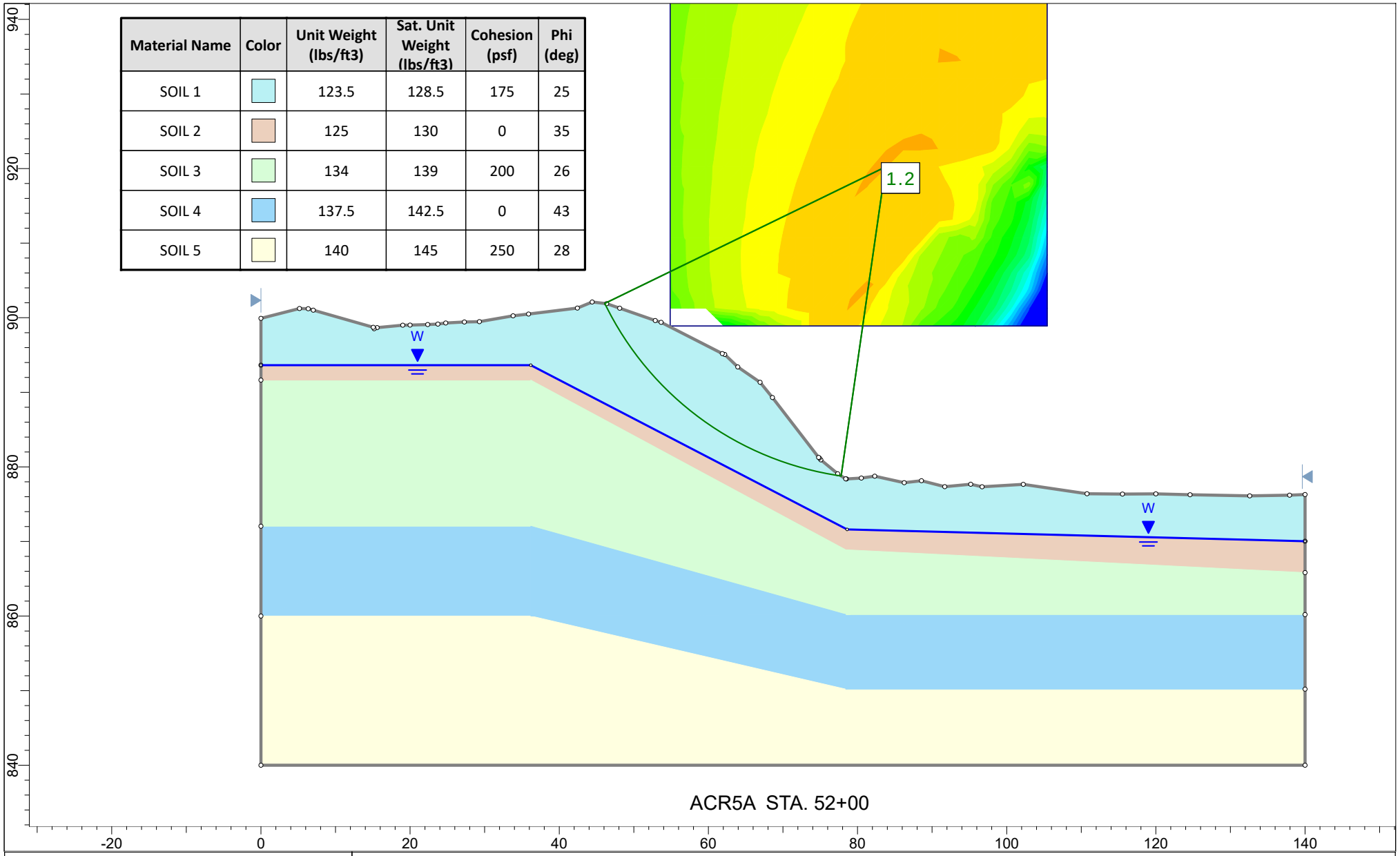
SLIDEINTERPRET 8.016

Project	SUM-8-1.75			
Analysis Description	ACR2A STA. 49+00			
Calc By	YLZ	Date	5/18	Scale 1:300
Chk'd By	TLM	Date	5/18	File Name SUM-8-1.75_ACR2A-2_EX.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		123.5	128.5	175	25
SOIL 2		125	130	0	35
SOIL 3		134	139	200	26
SOIL 4		137.5	142.5	0	43
SOIL 5		140	145	250	28



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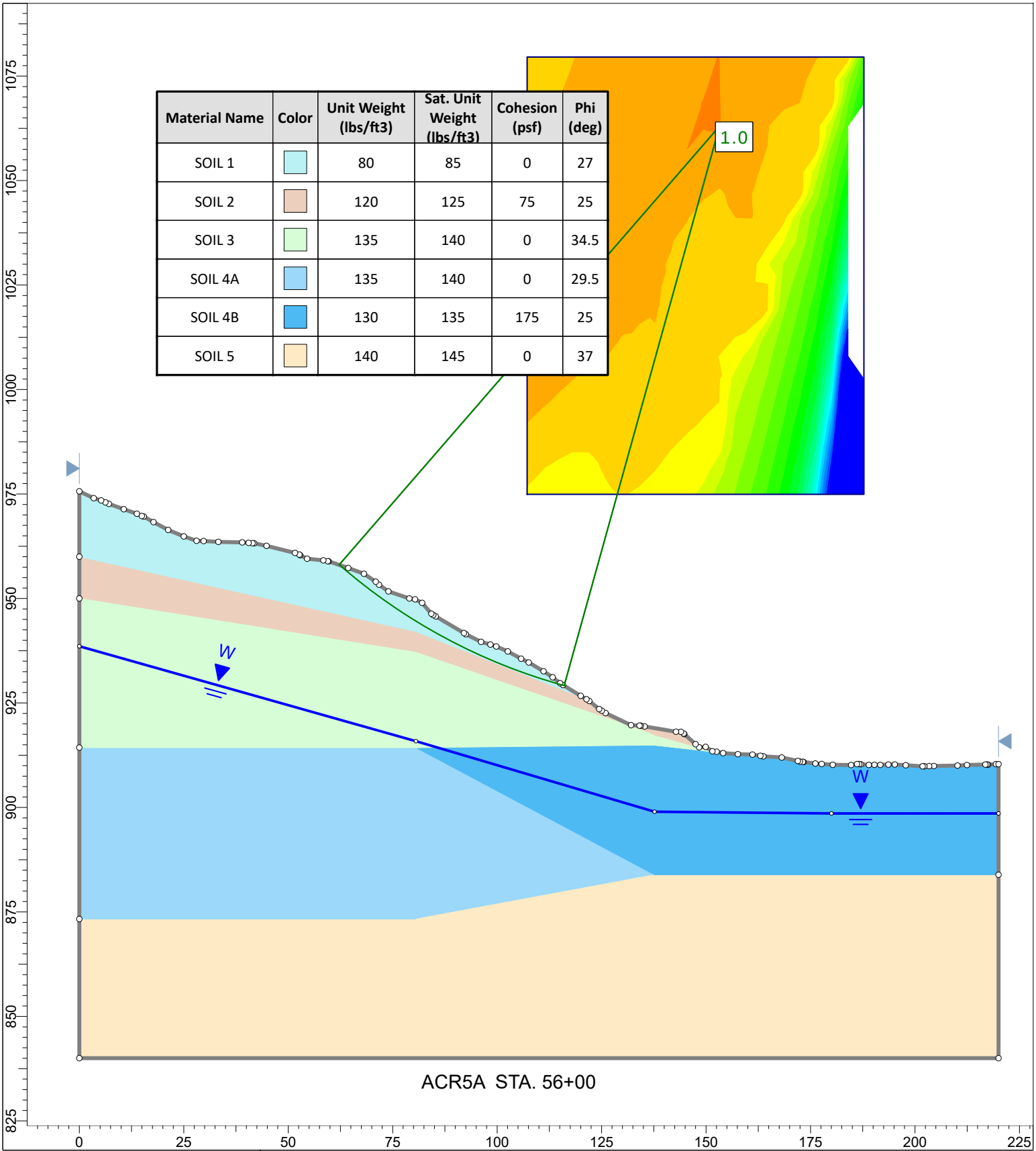
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR5A STA. 52+00_EX				
Calc By	YLZ	Date	5/18	Scale	1:213
Chk'd By	TLM	Date	5/18	File Name	SUM-8-1.75_ACR5A-1_EX.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		80	85	0	27
SOIL 2		120	125	75	25
SOIL 3		135	140	0	34.5
SOIL 4A		135	140	0	29.5
SOIL 4B		130	135	175	25
SOIL 5		140	145	0	37



ACR5A STA. 56+00

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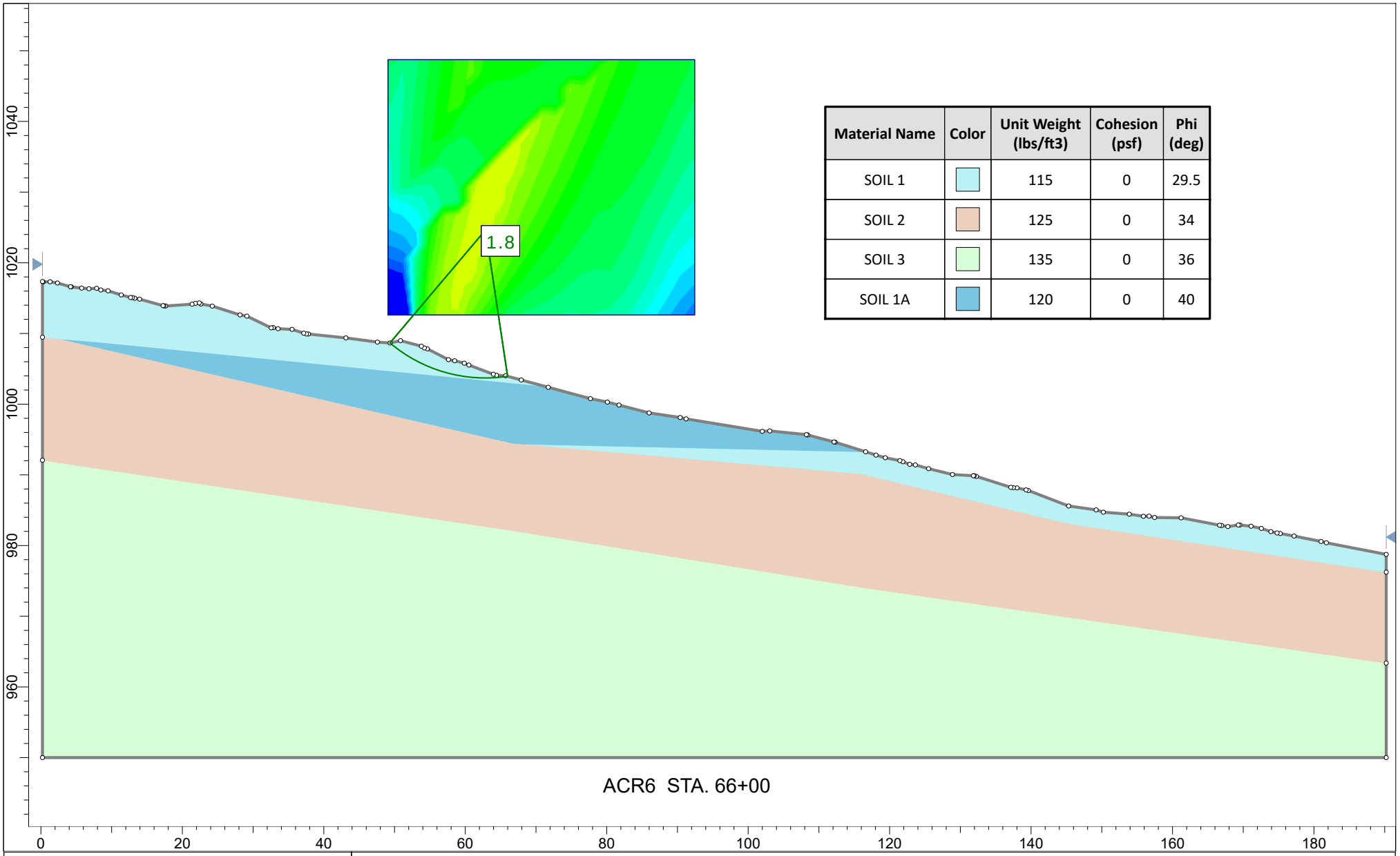
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR5A STA. 56+00				
Calc By	YLZ	Date	5/18	Scale	1:370
Chk'd By	TLM	Date	5/18	File Name	SUM-8-1.75_ACR5A-2_EX.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		115	0	29.5
SOIL 2		125	0	34
SOIL 3		135	0	36
SOIL 1A		120	0	40

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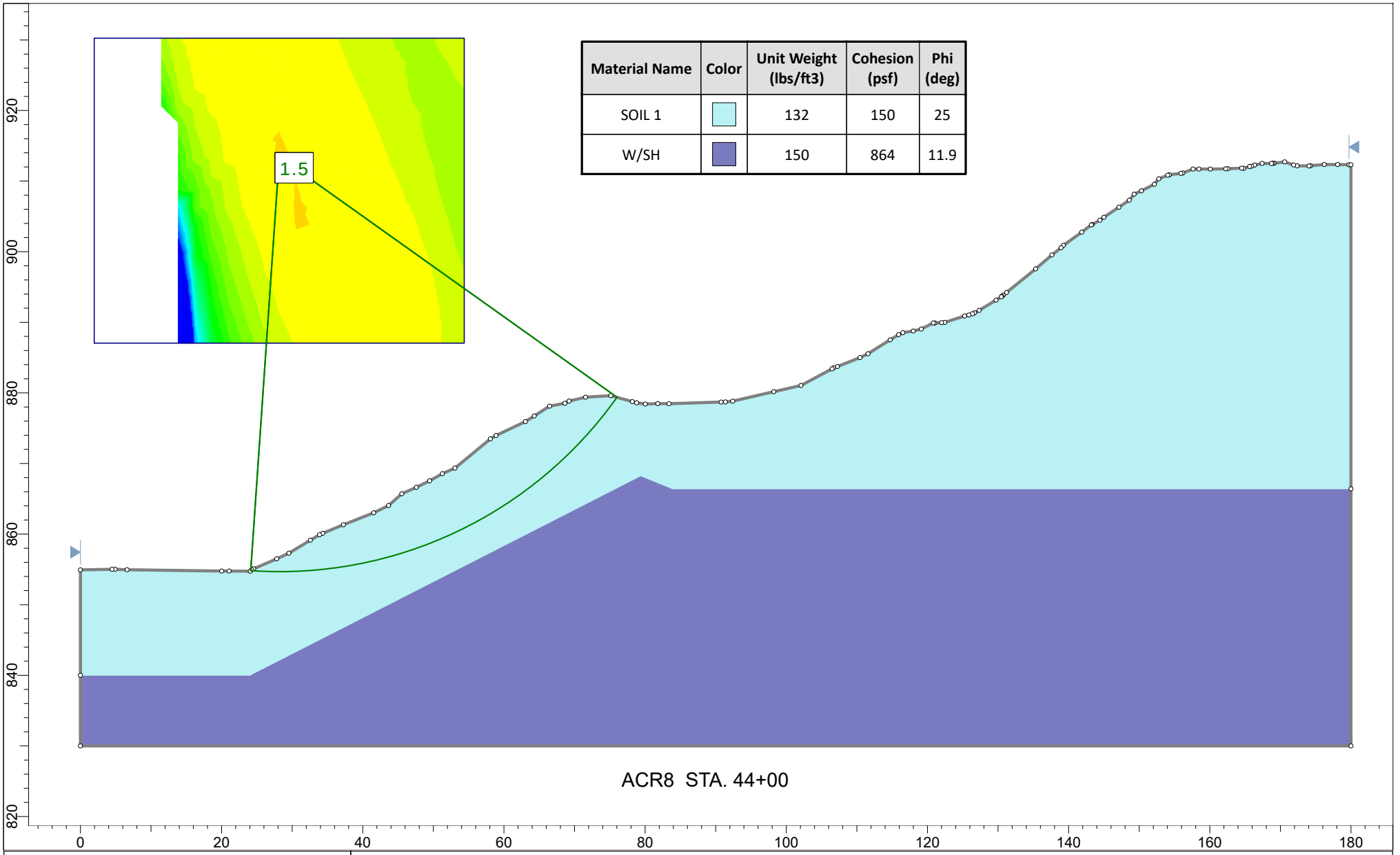
SLIDEINTERPRET 8.016

Project	SUM-8-1.75			
Analysis Description	ACR6 STA. 66+00			
Calc By	YLZ	Date	5/18	Scale 1:225
Chk'd By	TLM	Date	5/18	File Name SUM-8-1.75_ACR6_EX.slim



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		132	150	25
W/SH		150	864	11.9

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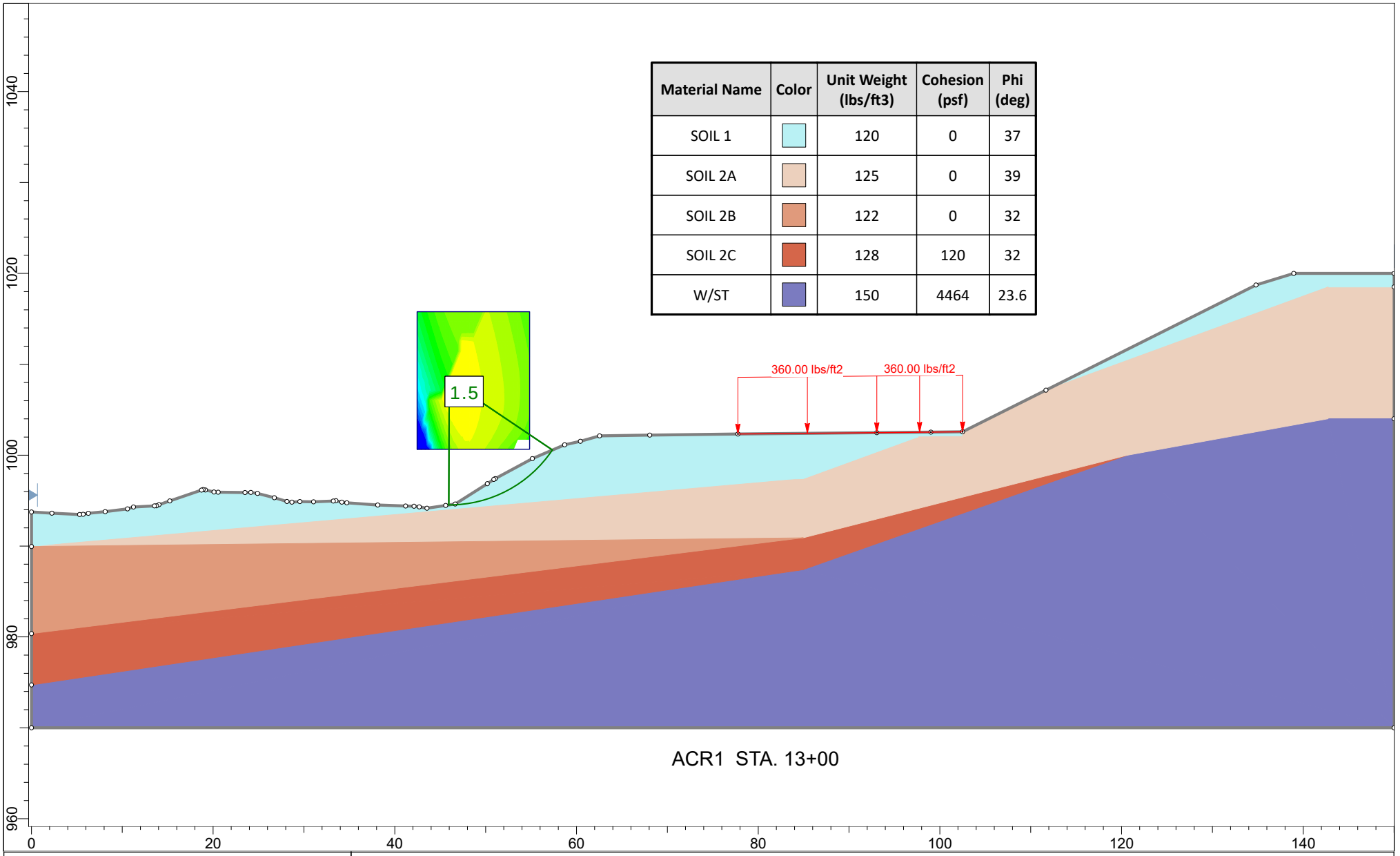
SLIDEINTERPRET 8.016

Project	SUM-8-1.75			
Analysis Description	ACR8 STA. 44+00			
Calc By	YLZ	Date	5/18	Scale 1:225
Chk'd By	TLM	Date	5/18	File Name SUM-8-1.75_ACR8_EX.slim

Proposed Grade W/ Loading

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		120	0	37
SOIL 2A		125	0	39
SOIL 2B		122	0	32
SOIL 2C		128	120	32
W/ST		150	4464	23.6



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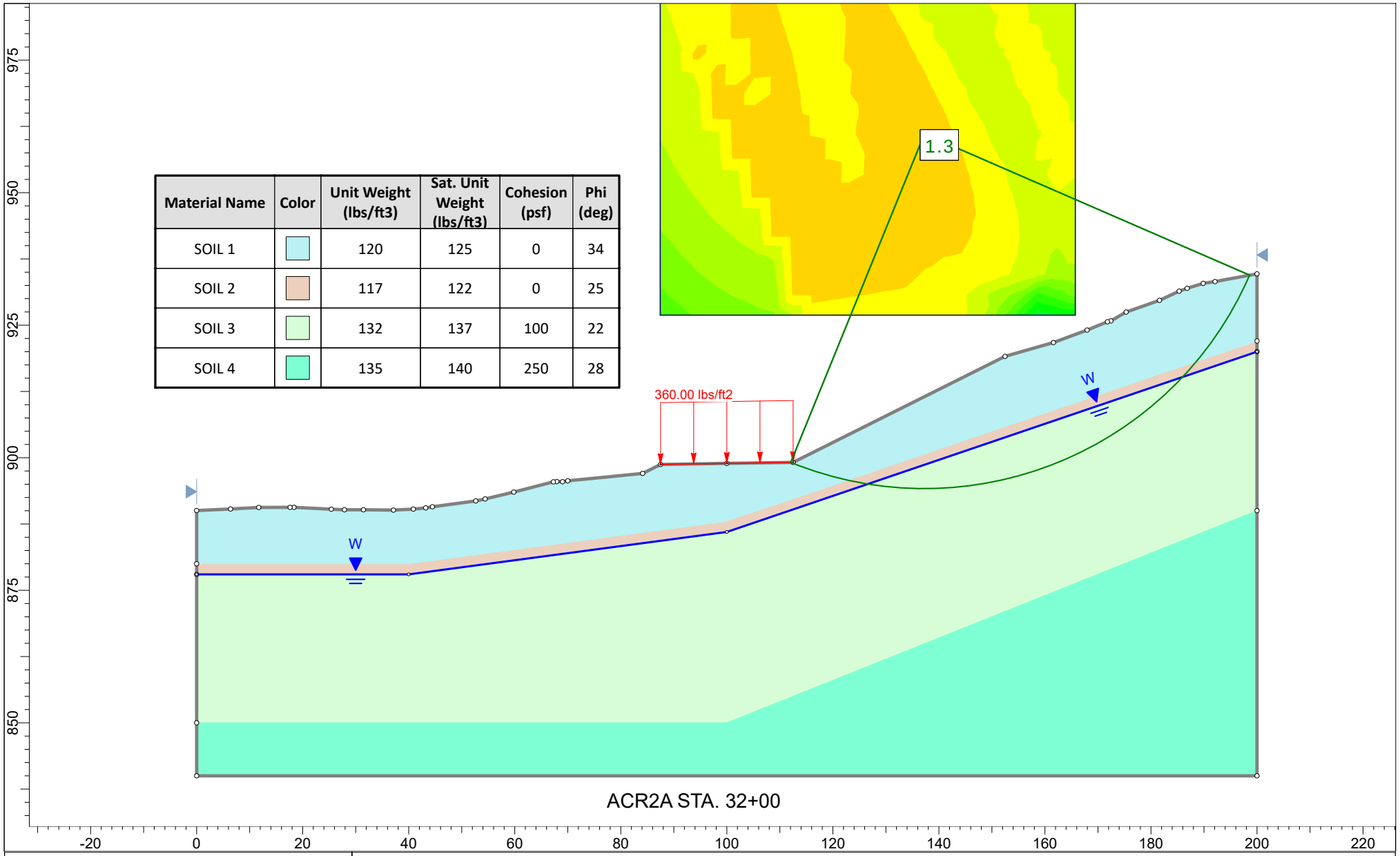
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR1 STA. 13+00_W/L				
Calc By	YLZ	Date	5/18	Scale	1:175
Chk'd By	TLM	Date	5/18	File Name	SUM-8-1.75_ACR1_WL.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		120	125	0	34
SOIL 2		117	122	0	25
SOIL 3		132	137	100	22
SOIL 4		135	140	250	28



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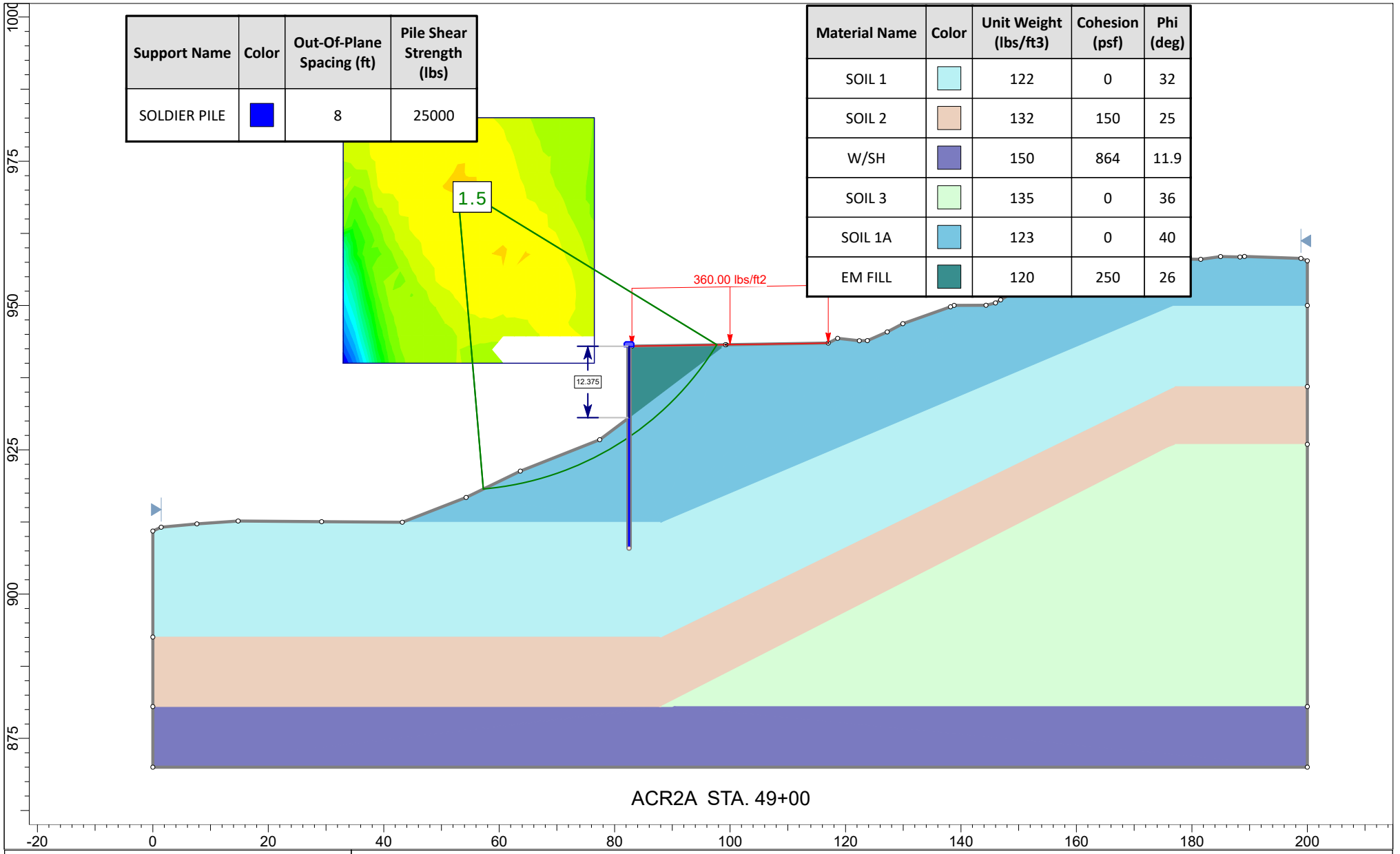
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	ACR2A STA. 32+00 EX				
Calc By	YLZ	Date	5/18	Scale	1:300
Chk'd By	TLM	Date	5/18	File Name	SUM-8-1.75_ACR2A-1_WL.slim

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
SOLDIER PILE		8	25000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		122	0	32
SOIL 2		132	150	25
W/SH		150	864	11.9
SOIL 3		135	0	36
SOIL 1A		123	0	40
EM FILL		120	250	26



ACR2A STA. 49+00

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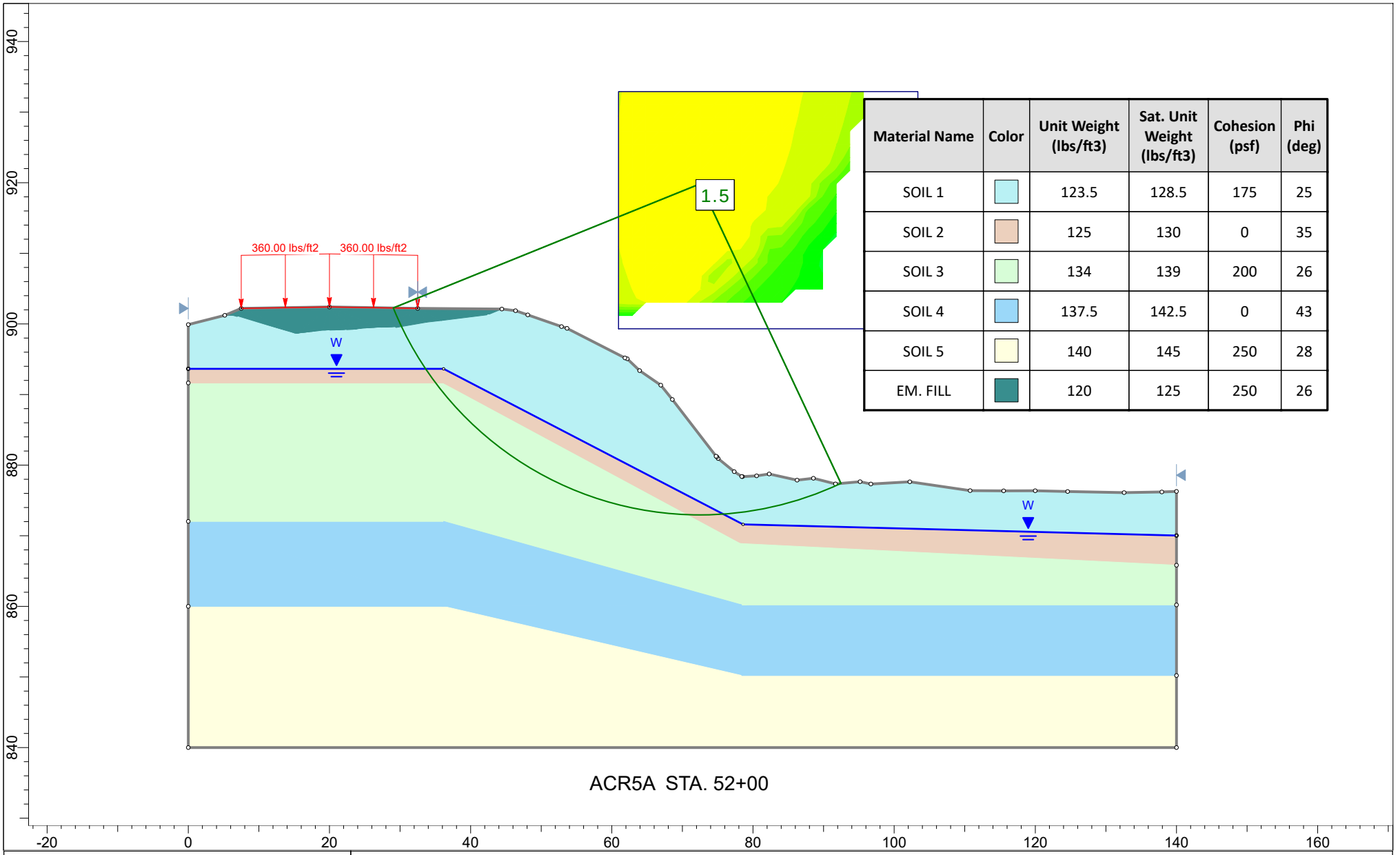
SLIDEINTERPRET 8.020

Project	SUM-8-1.75				
Analysis Description	ACR2A STA. 49+00_W/L				
Calc By	YLZ	Date	3/19	Scale	1:275
Chk'd By	TLM	Date	3/19	File Name	SUM-8-1.75_ACR2A-2_WL.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		123.5	128.5	175	25
SOIL 2		125	130	0	35
SOIL 3		134	139	200	26
SOIL 4		137.5	142.5	0	43
SOIL 5		140	145	250	28
EM. FILL		120	125	250	26

ACR5A STA. 52+00

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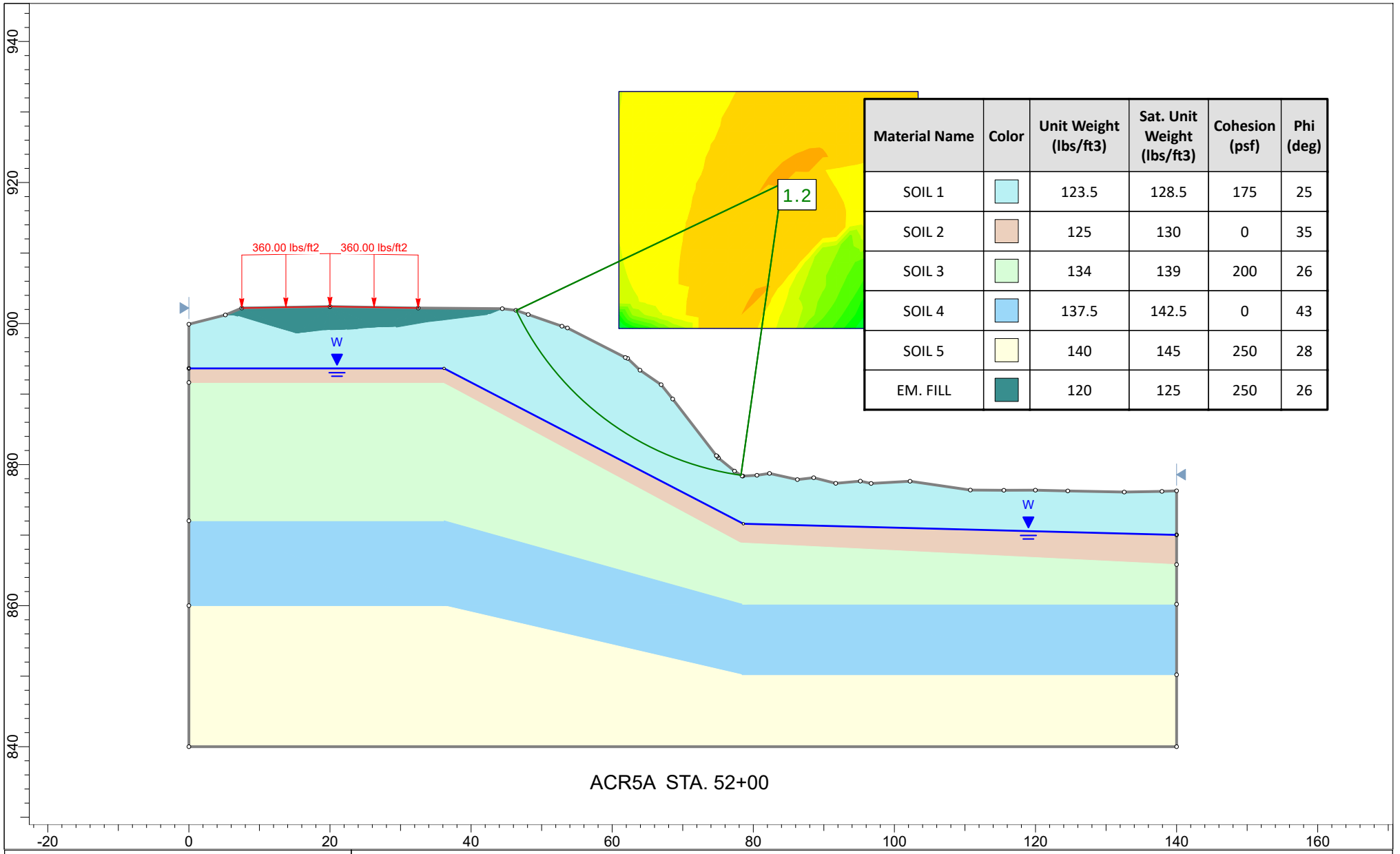
SLIDEINTERPRET 8.020

Project	SUM-8-1.75				
Analysis Description	ACR5A STA. 52+00_W/L_Road				
Calc By	YLZ	Date	3/19	Scale	1:225
Chk'd By	TLM	Date	3/19	File Name	SUM-8-1.75_ACR5A-1_WL_R.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		123.5	128.5	175	25
SOIL 2		125	130	0	35
SOIL 3		134	139	200	26
SOIL 4		137.5	142.5	0	43
SOIL 5		140	145	250	28
EM. FILL		120	125	250	26

ACR5A STA. 52+00

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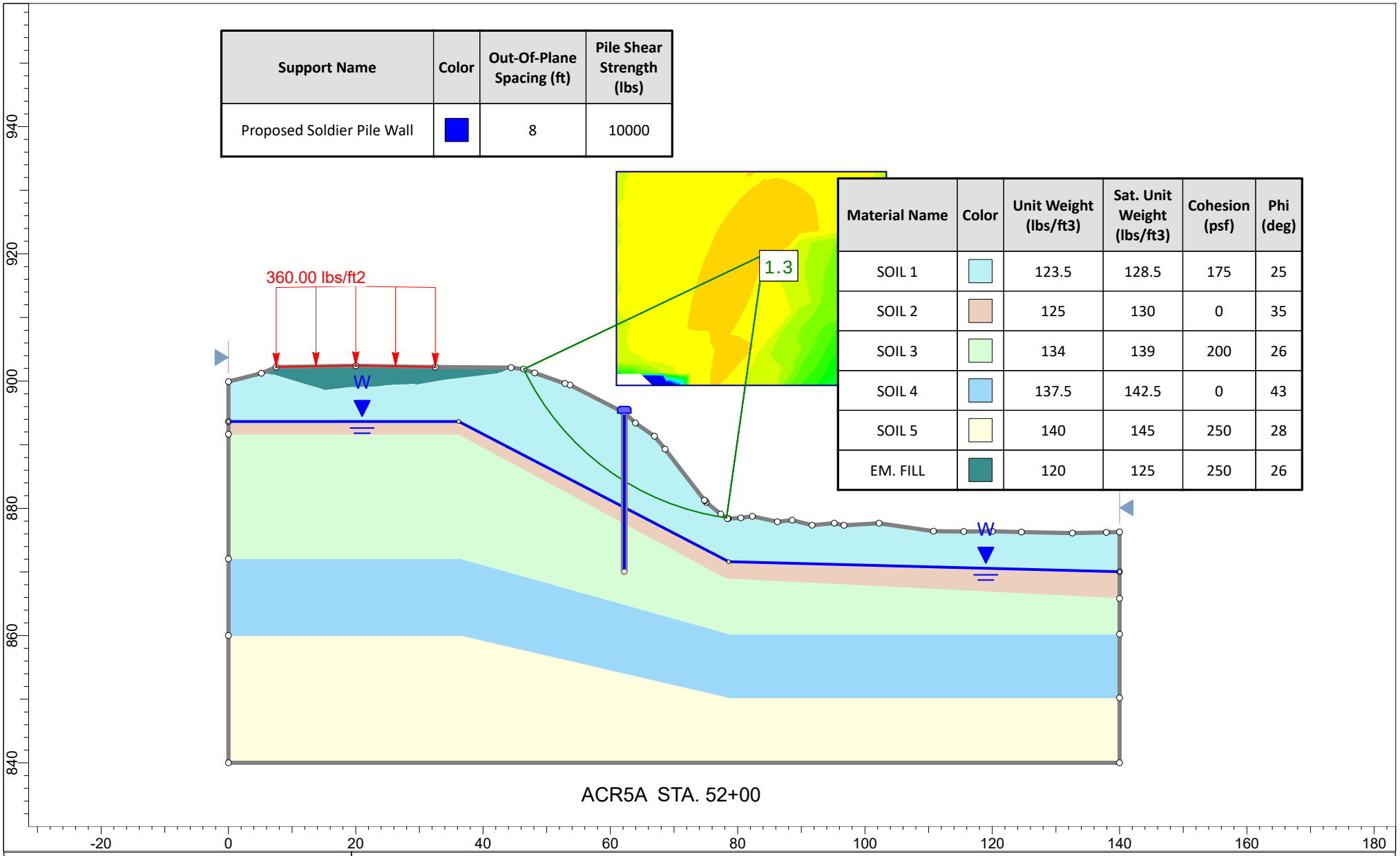
SLIDEINTERPRET 8.020

Project	SUM-8-1.75				
Analysis Description	ACR5A STA. 52+00_W/L_Downslope				
Calc By	YLZ	Date	3/19	Scale	1:225
Chk'd By	TLM	Date	3/19	File Name	SUM-8-1.75_ACR5A-1_WL -D.slim

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
Proposed Soldier Pile Wall		8	10000

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		123.5	128.5	175	25
SOIL 2		125	130	0	35
SOIL 3		134	139	200	26
SOIL 4		137.5	142.5	0	43
SOIL 5		140	145	250	28
EM. FILL		120	125	250	26



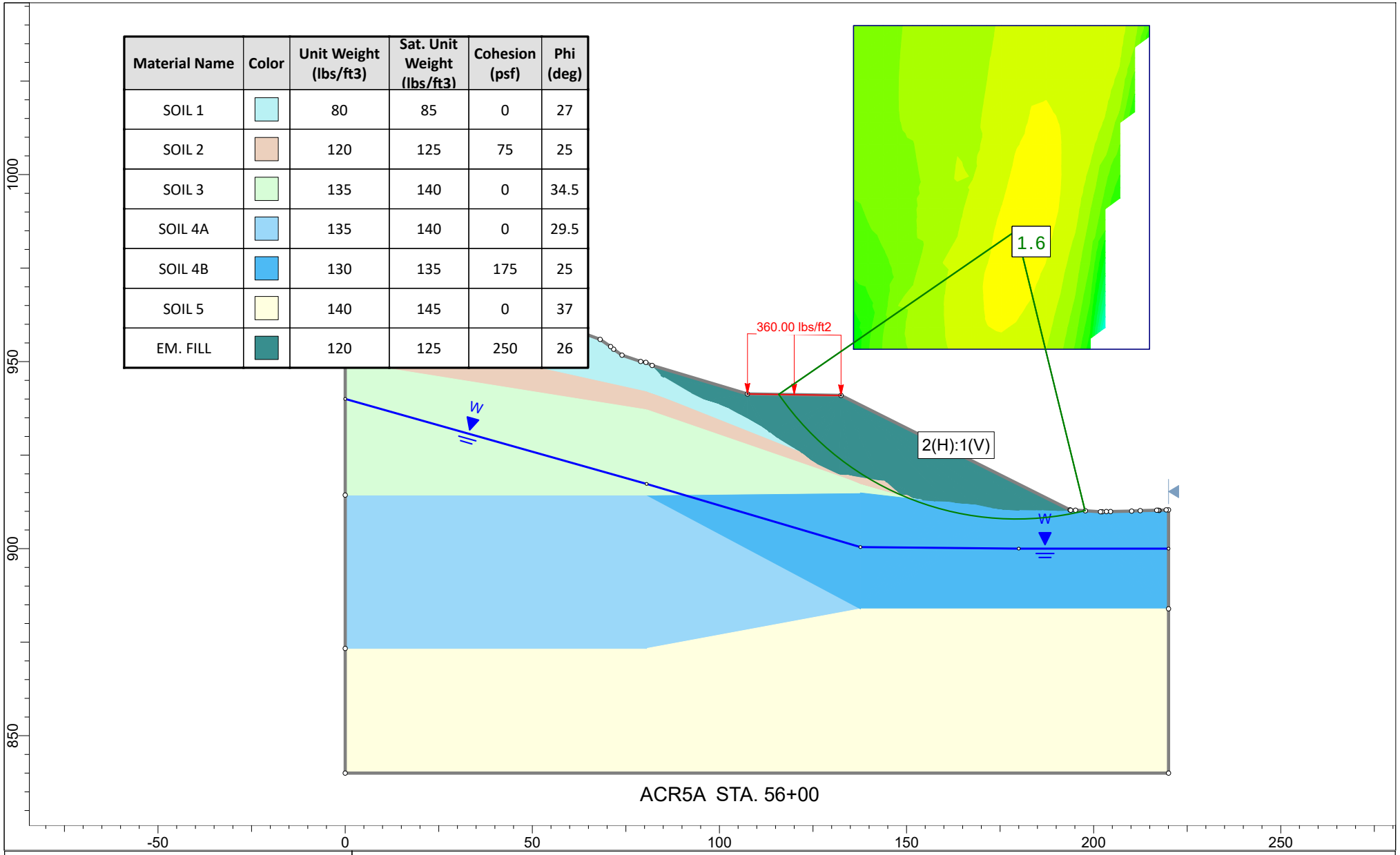
ACR5A STA. 52+00

Gannett Fleming

SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	SUM-8-1.75_ACR5A-1_WL - W.slim_SUM-8-1.75_ACR5A-1_WL - W.slim				
Calc By	YLZ	Date	8/19	Scale	1:250
Chk'd By	TLM	Date	8/19	File Name	SUM-8-1.75_ACR5A-1_WL - W.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		80	85	0	27
SOIL 2		120	125	75	25
SOIL 3		135	140	0	34.5
SOIL 4A		135	140	0	29.5
SOIL 4B		130	135	175	25
SOIL 5		140	145	0	37
EM. FILL		120	125	250	26

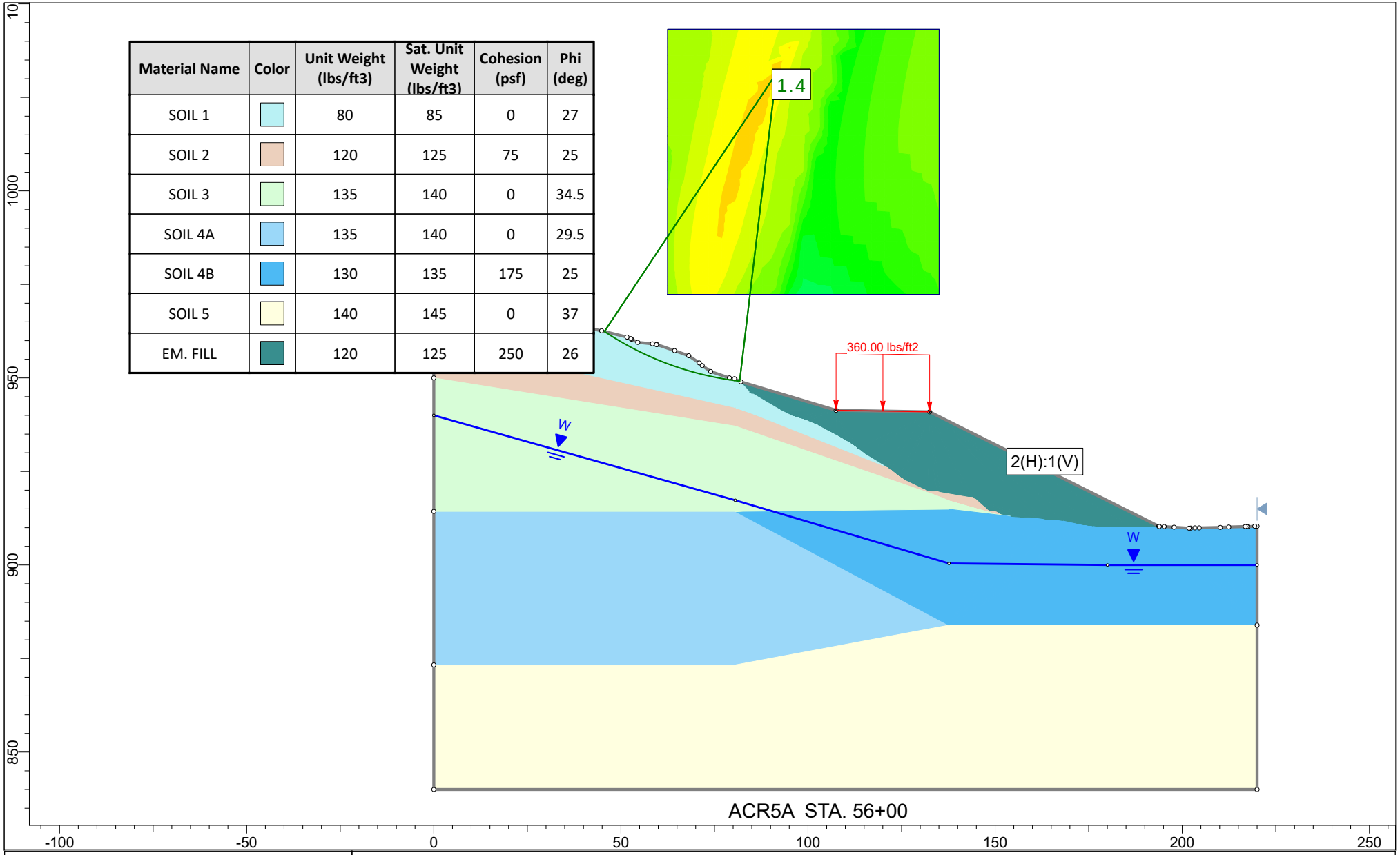


ACR5A STA. 56+00

Gannett Fleming	Project	SUM-8-1.75		
	Analysis Description	ACR5A STA. 56+00_W/L		
	Calc By: YLZ	Date: 3/19	Scale: 1:425	
	Chk'd By: TLM	Date: 3/19	File Name: SUM-8-1.75_ACR5A-2_WL.slim	

SLIDEINTERPRET 8.020

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		80	85	0	27
SOIL 2		120	125	75	25
SOIL 3		135	140	0	34.5
SOIL 4A		135	140	0	29.5
SOIL 4B		130	135	175	25
SOIL 5		140	145	0	37
EM. FILL		120	125	250	26

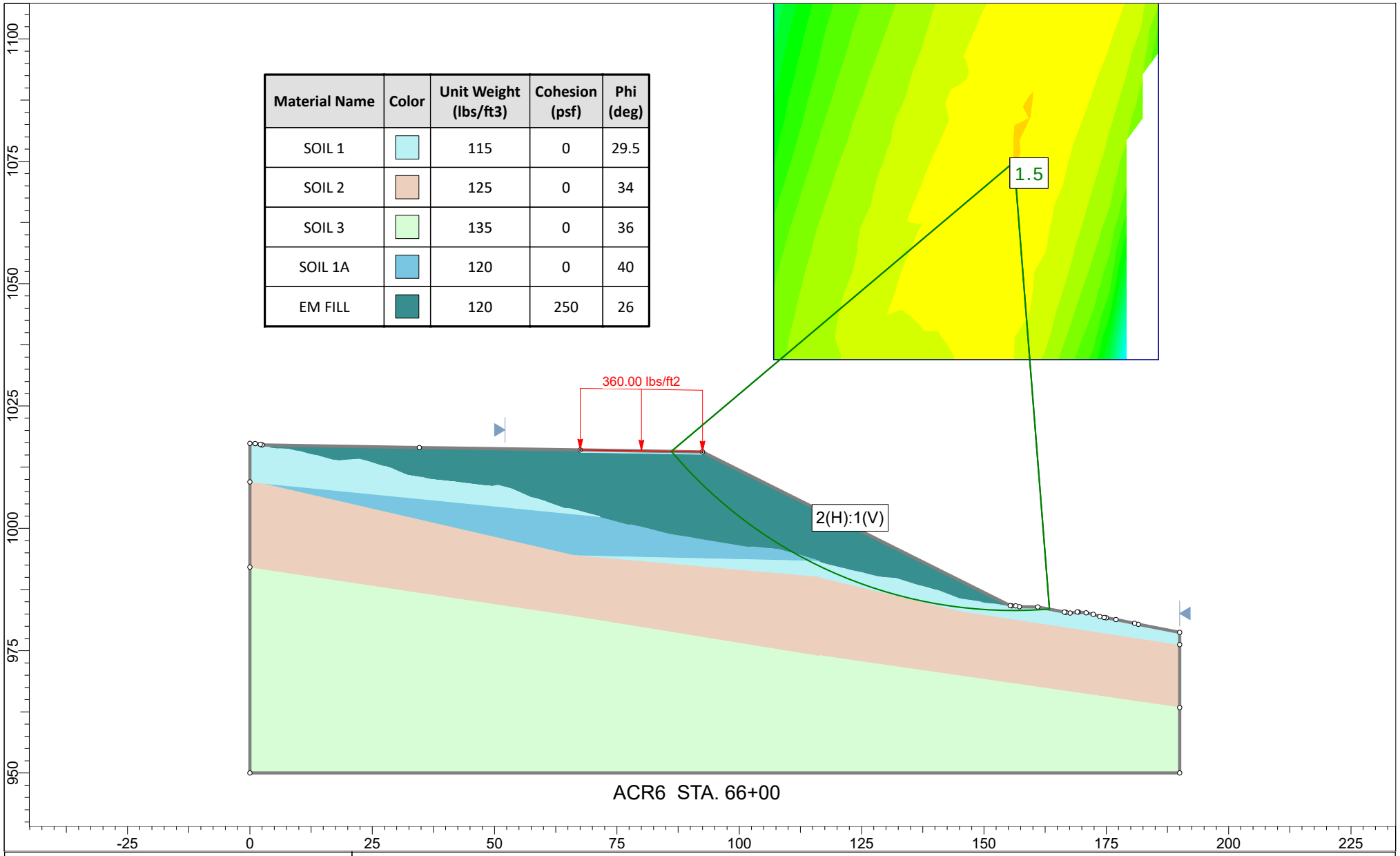


Gannett Fleming

SLIDEINTERPRET 8.020

Project	SUM-8-1.75			
Analysis Description	ACR5A STA. 56+00_W/L_Upslope			
Calc By	YLZ	Date	3/19	Scale 1:425
Chk'd By	TLM	Date	3/19	File Name SUM-8-1.75_ACR5A-2_WL - U.slim

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		115	0	29.5
SOIL 2		125	0	34
SOIL 3		135	0	36
SOIL 1A		120	0	40
EM FILL		120	250	26



ACR6 STA. 66+00

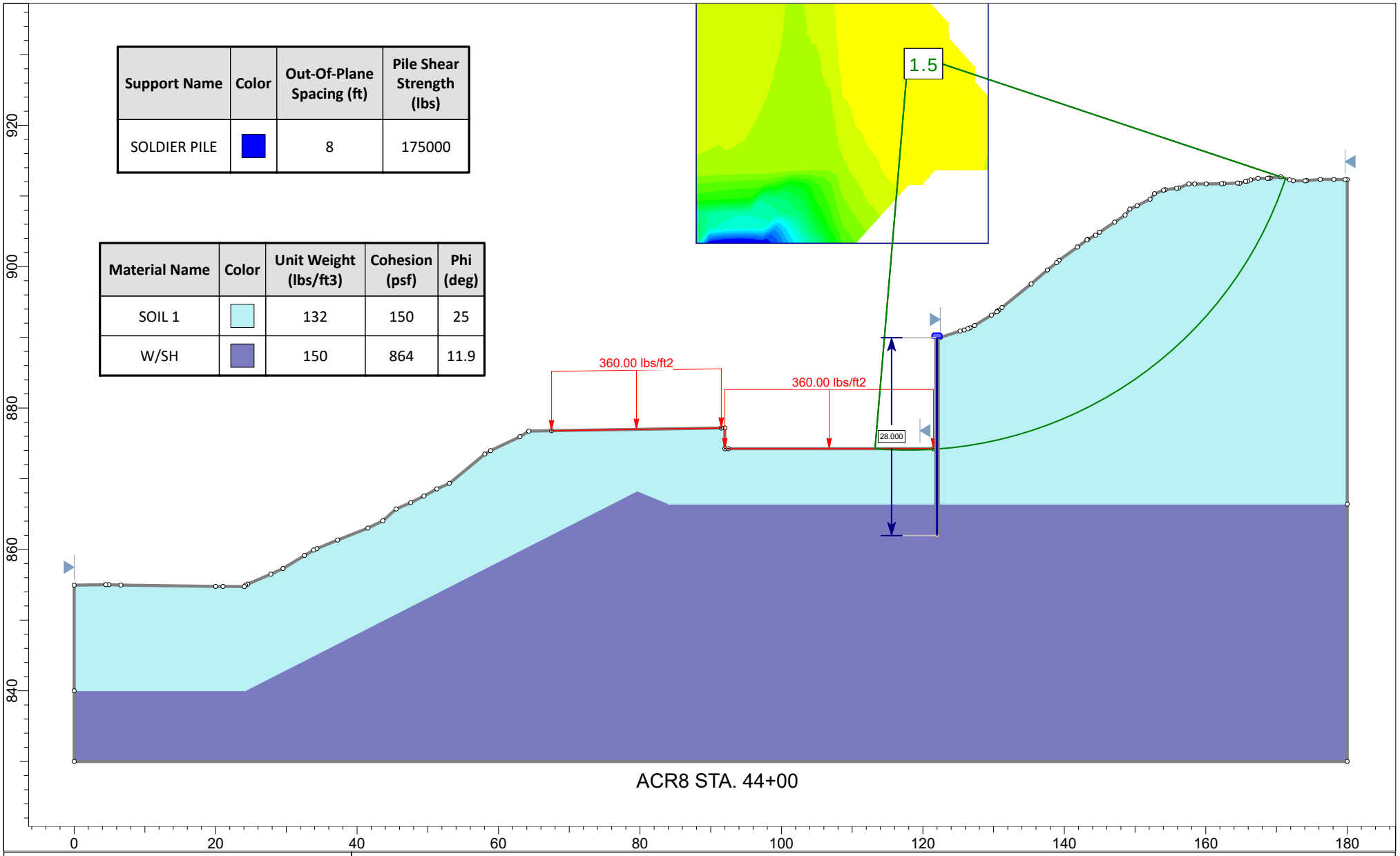
Gannett Fleming

SLIDEINTERPRET 8.020

Project	SUM-8-1.75				
Analysis Description	ACR6 STA. 66+00_W/L				
Calc By	YLZ	Date	3/19	Scale	1:325
Chk'd By	TLM	Date	3/19	File Name	SUM-8-1.75_ACR6_WL.slim

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
SOLDIER PILE		8	175000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		132	150	25
W/SH		150	864	11.9



ACR8 STA. 44+00

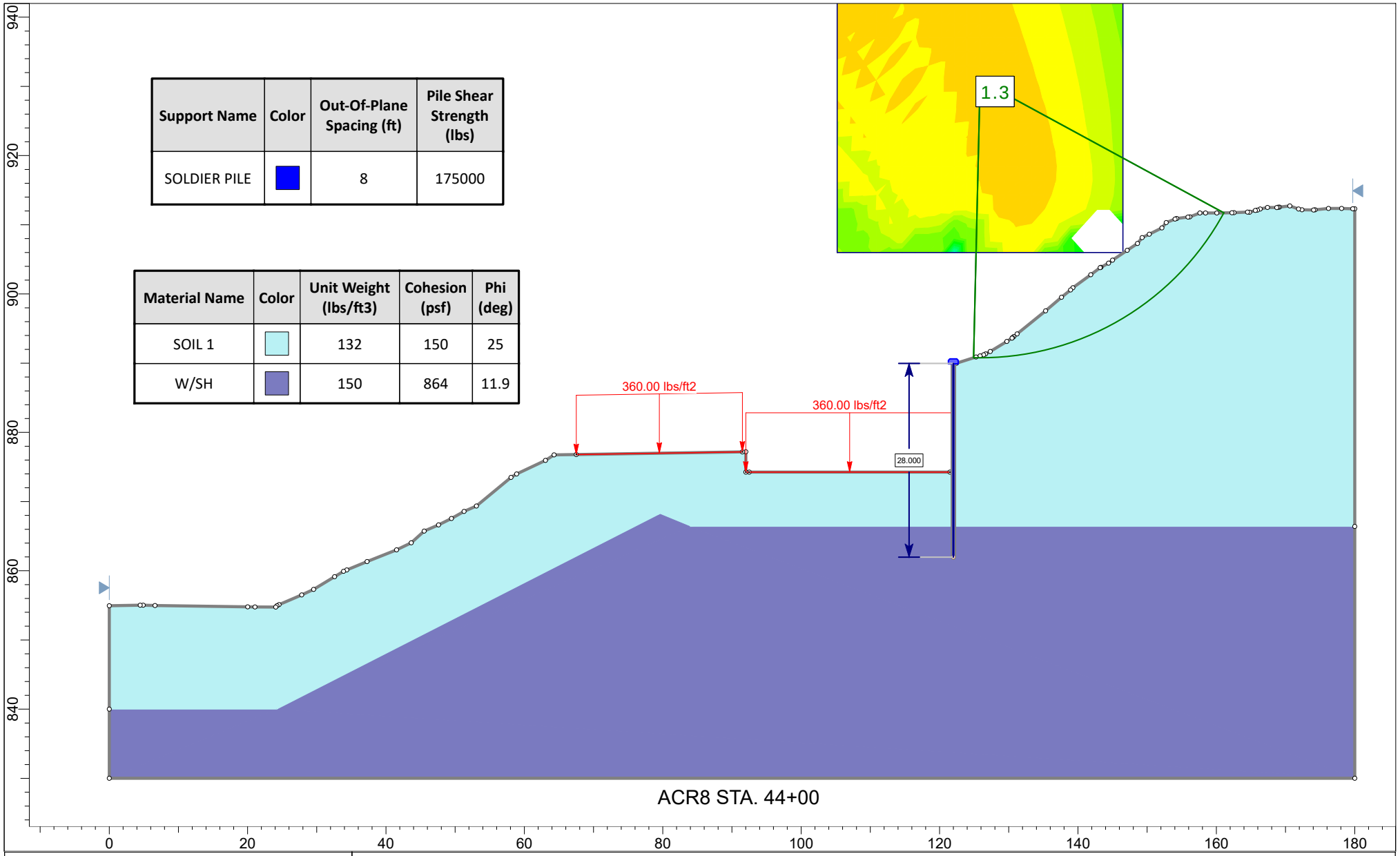
Gannett Fleming

SLIDEINTERPRET 8.016

Project	SUM-8-1.75			
Analysis Description	ACR8 STA. 44+00_W/L WALL			
Calc By	YLZ	Date	5/18	Scale 1:225
Chk'd By	TLM	Date	5/18	File Name SUM-8-1.75_ACR8_WL_W.slim

Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
SOLDIER PILE		8	175000

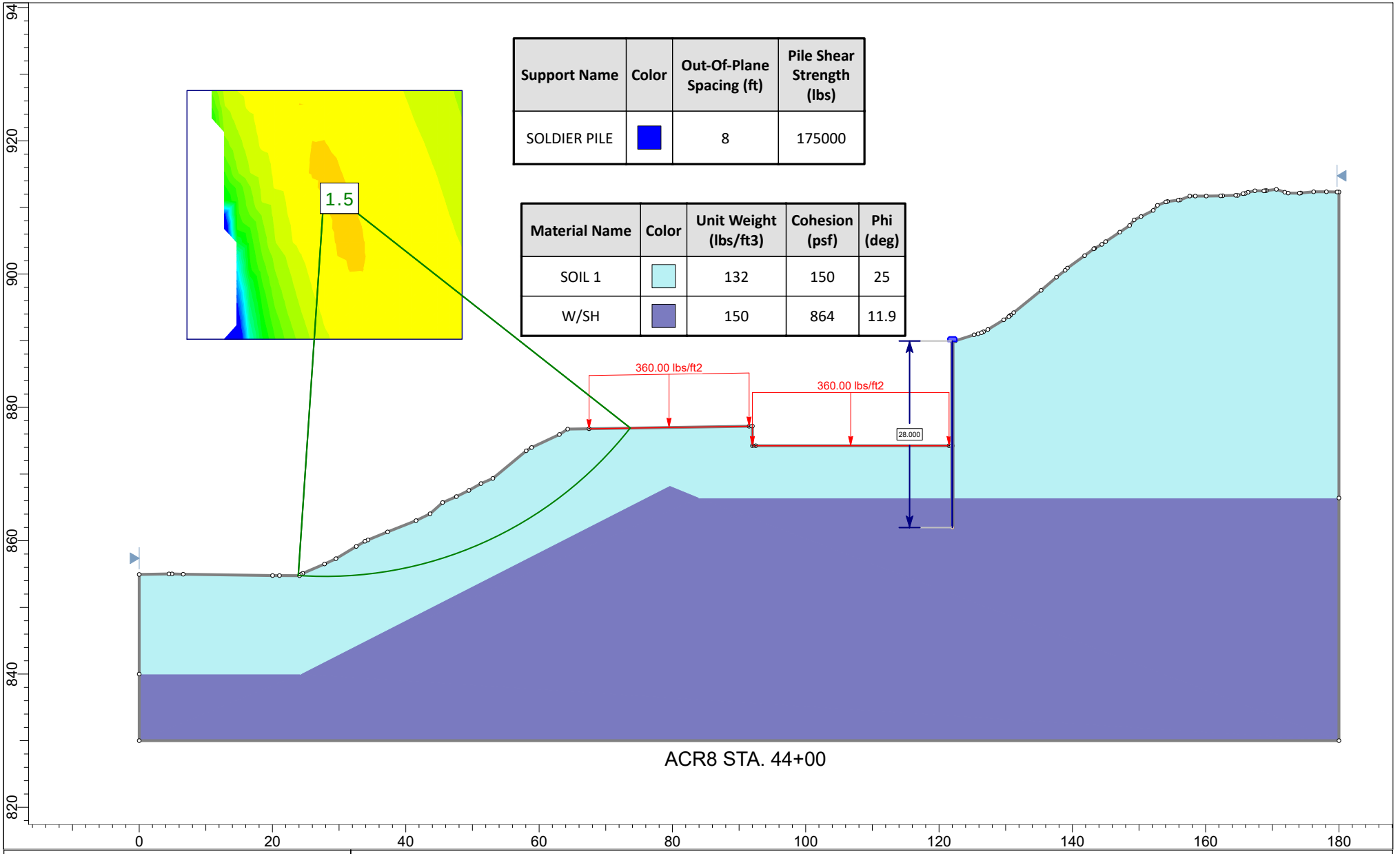
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		132	150	25
W/SH		150	864	11.9



ACR8 STA. 44+00

Gannett Fleming	Project	SUM-8-1.75		
	Analysis Description	ACR8 STA. 44+00_W/L US		
	Calc By	YLZ	Date 5/18	Scale 1:230
	Chk'd By	TLM	Date 5/18	File Name SUM-8-1.75_ACR8_WL_U.slim

SLIDEINTERPRET 8.016



Support Name	Color	Out-Of-Plane Spacing (ft)	Pile Shear Strength (lbs)
SOLDIER PILE		8	175000

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		132	150	25
W/SH		150	864	11.9

Gannett Fleming	Project	SUM-8-1.75		
	Analysis Description	ACR8 STA. 44+00_W/L DS		
	Calc By	YLZ	Date 5/18	Scale 1:238
	Chk'd By	TLM	Date 5/18	File Name SUM-8-1.75_ACR8_WL_D.slim

SLIDEINTERPRET 8.016

Appendix F.6

Allowable Bearing Capacity of Crane Pad and Tower Locations

Crane Pad and Tower

Allowable Bearing Capacity due to Bearing Failure

Objective:

The purpose of these calculations is to provide the bearing resistance for the proposed Crane Pad Location 1 through 11, and Tower 1 &2 due to the bearing capacity failure.

Codes/Standards:

The Design will be performed using LRFD methodology as outlined in LRFD Bridge Design Specifications Eighth Edition 2017 (LRFD).

Source of Data:

1. The location of each crane pad and tower is provided by MS Consultants, Inc;
2. The subsurface profile and geotechnical parameters of soil strata are developed by nearby borings, please see the attachments: Crane and Tower Location Plan & Profile as well as Crane and Tower geotechnical parameters.

Assumption:

1. The bearing depth is assumed to be 2 feet for all foundations;
2. The actual footing size for the crane pad location will be determined by contractor, here we use the 30'X30' in the calculation; and we will use the actual size of the tower crane location in the calculation, that is 16' X 16' for Tower 1 and 12' X 12' for Tower 2.
3. A vertical point load of 500 kips was assumed;
4. The groundwater depth is assumed to be at surface ($D_w = 0$) to simulate the short term rainfall condtion to be conservative, and the effective unit weigth of soil is assumed to be the submerged unit weight of soil;
5. All the pads will be supported by multi-layered soil profile, the design bearing resistance is based on the weaker layer within 20 feet of footing;
6. The crane operation time is assumed to be 2 to 3 weeks. For the footings supported on cohesive soils, the bearing resistance is therefore evaluated for short-duration live loading conditions using undrained soil shear strength parameters.
7. Linear interpolations are made for coefficients C_{wq} and $C_{w\gamma}$ for various groundwater depths in Table 10.6.3.1.2a-2 and depth correction factor d_q for friction angles and depth to width D_f/B in between those values shown in Table 10.6.3.1.2a-4.
8. Due to the fact that Table 10.6.3.1.2a-4 was developed to cover the indicated range of friction angle, ϕ_f from 32 to 42 degree, the depth correction factor is therefore assumed to be 1.0 when ϕ_f <32; and the the depth correction factor is the same as d_q with ϕ_f =42 degree, when ϕ_f >42.
9. Crane Pad Location 1 is located near rock outcrop zone. Crane Pad Locations 5 and 6, the estimated bearing elevation provided by MS is in a dense gravel/weathered rock strata. Therefore, no bearing and settlement calculations were completed for these structures. The assumed allowable bearing resistance of 20 ksf for these structures is based on typical engineering values for medium hard rock and IGM-like material. The settlement is anticipated to be acceptably small in this bearing layer.

Results:

Crane Pad	CL1 (ksf)	CL2[1] (ksf)	CL3 (ksf)	CL4 (ksf)	CL5[2] (ksf)	CL6[2] (ksf)	CL7 (ksf)	CL8 (ksf)	CL9 (ksf)	CL10 (ksf)	CL11 (ksf)
q_R	9.6	--	5.9	5.9	--	--	8.7	14.3	6.2	35.4	24.3
q_{all}	5.1	--	3.5	2.8	--	--	5.7	5.9	2.6	3.1	2.8
Dq_{all}	5.0	20.0	3.0	2.5	20.0	20.0	5.5	5.5	2.5	3.0	2.5

Location	TW1 (ksf)	TW2 (ksf)
q_R	7.2	11.2
q_{all}	18.5	7.3
Dq_{all}	7.0	7.0

Note: q_{all} Allowable bearing stress to obtain tolerable settlement (1.5 inch.);

q_R Factored bearing capacity from bearing resistance calculation;

Dq_{all} Design allowble bearing capacity based on the lower one of q_{all} and q_R, and rounded to 0.5 ksf.

(1) For CL2, the locations provided by MS is in rock outcrop zone.

(2) For CL5 and CL6, the bearing elevations provided by MS is in Strata 3 which is an IGM strata.

Structure:	**Crane Pad Location 1**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1265	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	S	
ϕ_f - Friction Angle of Soil:	41.5	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	41.5	83.900	73.900	130.200

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	41.5	1.881	0.600	1.885

Depth Correction Factors d_q			
the soils above the footing bearing elevation are as competent as the soils beneath the footing level?			N
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	41.5	0.1	1.010
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	41.5	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 1**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

	N_c	s_c	i_c	N_{cm}
	83.900	**1.881**	**1.000**	**157.80**

N_q	s_q	d_q	i_q	N_{qm}
73.90	**0.600**	**1.000**	**1.000**	**44.34**

N_γ	s_γ	i_γ	$N_{\gamma m}$
130.200	**1.885**	**1.000**	**245.39**

Therefore,

q_n	q_R
(ksf)	(ksf)
238.42	107.29

Structure:	**Crane Pad Location 1**
Soil Profile:	**Strata 2**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

(LRFD 10.5.5.2.2-1)

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1305	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	3.1	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	1+(B/L)(N_q/N_c)	1-0.4(B/L)	1+(B/L)(tanϕ_f)
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 1**
Soil Profile:	**Strata 2**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
19.25	9.63

Structure:	**Crane Pad Location 3/4**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.125	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	1.9	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.500	1.000	1.000	1.000

Structure:	**Crane Pad Location 3/4**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
11.84	5.92

Structure:	**Crane Pad Loaction 7**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree
Material Properties	**Value**	
γ - Total (Moist) Unit Weight of Soil:	0.1175	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	S	
ϕ_f - Friction Angle of Soil:	36.5	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	36.5	50.600	37.800	56.300

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	36.5	1.747	0.600	1.740

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			N
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	36.5	0.1	1.013
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	36.5	1.500	1.000	1.000	1.000

Structure:	**Crane Pad Loaction 7**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n$$ (LRFD 10.6.3.1.1-1)

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$$ (LRFD 10.6.3.1.2a-1)

	N_q	N_c	s_c	i_c	N_{cm}
		50.600	**1.747**	**1.000**	**88.40**

N_q	s_q	d_q	i_q	N_{qm}
37.80	**0.600**	**1.000**	**1.000**	**22.68**

N_γ	s_γ	i_γ	$N_{\gamma m}$
56.300	**1.740**	**1.000**	**97.96**

Therefore,

q_n	q_R
(ksf)	(ksf)
88.99	40.05

Structure:	**Crane Pad Location 7**
Soil Profile:	**Strata 2**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.135	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	2.8	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	1+(B/L)(N_q/N_c)	1-0.4(B/L)	1+(B/L)(tanϕ_f)
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.500	1.000	1.000	1.000

Structure:	**Crane Pad Location 7**
Soil Profile:	**Strata 2**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
17.41	8.70

Structure:	**Crane Pad Location 8**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.119	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	S	
ϕ_f - Friction Angle of Soil:	34.5	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	34.5	42.200	29.400	41.100

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	34.5	1.697	0.600	1.687

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	34.5	0.1	1.013
			d_q
Results			1.013

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	34.5	1.500	1.000	1.000	1.000

Structure:	**Crane Pad Location 8**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

	N_c	s_c	i_c	N_{cm}
	42.200	**1.697**	**1.000**	**71.60**

N_q	s_q	d_q	i_q	N_{qm}
29.40	**0.600**	**1.013**	**1.000**	**17.88**

N_γ	s_γ	i_γ	$N_{\gamma m}$
41.100	**1.687**	**1.000**	**69.35**

Therefore,

q_n	q_R
(ksf)	(ksf)
64.02	28.81

Structure:	**Crane Pad Location 8**
Soil Profile:	**Strata 2**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.139	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	4.6	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	1+(B/L)(N_q/N_c)	1-0.4(B/L)	1+(B/L)(tanϕ_f)
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 8**
Soil Profile:	**Strata 2**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
28.51	14.26

Structure:	**Crane Pad Location 9**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1215	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	S	
ϕ_f - Friction Angle of Soil:	34.5	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	34.5	42.200	29.400	41.100

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	34.5	1.697	0.600	1.687

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			N
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	34.5	0.1	1.013
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	34.5	1.500	1.000	1.000	1.000

Structure:	**Crane Pad Location 9**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

	N_c	s_c	i_c	N_{cm}
	42.200	**1.697**	**1.000**	**71.60**

N_q	s_q	d_q	i_q	N_{qm}
29.40	**0.600**	**1.000**	**1.000**	**17.64**

N_γ	s_γ	i_γ	$N_{\gamma m}$
41.100	**1.687**	**1.000**	**69.35**

Therefore,

q_n	q_R
(ksf)	(ksf)
65.34	29.40

Structure:	**Crane Pad Location 9**
Soil Profile:	**Strata 2**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.133	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	2	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 9**
Soil Profile:	**Strata 2**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
12.47	6.23

Structure:	**Crane Pad Location 10**
Soil Profile:	**Strata 2**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree
Material Properties	**Value**	
γ - Total (Moist) Unit Weight of Soil:	0.1235	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	S	
ϕ_f - Friction Angle of Soil:	35.5	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Note: Due to the soil stratum 1 presents higher shear strength (ϕ = 37 degree) than stratum 2, the bearing resistance analysis is only performed on stratum 2.

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	35.5	46.100	33.300	48.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	35.5	1.722	0.600	1.713

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	35.5	0.1	1.013
			d_q
Results			1.013

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	35.5	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 10**
Soil Profile:	**Strata 2**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

	N_c	s_c	i_c	N_{cm}
	46.100	**1.722**	**1.000**	**79.40**

N_q	s_q	d_q	i_q	N_{qm}
33.30	**0.600**	**1.013**	**1.000**	**20.25**

N_γ	s_γ	i_γ	$N_{\gamma m}$
48.000	**1.713**	**1.000**	**82.24**

Therefore,	q_n	q_R	
	(ksf)	(ksf)	
	78.67	35.40	

Structure:	**Crane Pad Location 11**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	30	ft
L - Footing Length:	30	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	500	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1195	kcf
Soil Type - Sand (S) /Clay (Clay)/ Rock):	S	
ϕ_f - Friction Angle of Soil:	33	deg
C - Cohesion of Soil	0	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	33	38.600	26.100	35.200

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	1-0.4(B/L)	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	33	1.676	0.600	1.649

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	33.0	0.1	1.013
			d_q
Results			1.013

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	30.0	30.0	0.0	500.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	33	1.5	1.000	1.000	1.000

Structure:	**Crane Pad Location 11**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.45**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

	N_c	s_c	i_c	N_{cm}
	38.600	**1.676**	**1.000**	**64.70**

N_q	s_q	d_q	i_q	N_{qm}
26.10	**0.600**	**1.013**	**1.000**	**15.87**

N_γ	s_γ	i_γ	$N_{\gamma m}$
35.200	**1.649**	**1.000**	**58.06**

Therefore,

q_n	q_R
(ksf)	(ksf)
53.93	24.27

Structure:	**Tower 1**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	16	ft
L - Footing Length:	16	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	650	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1225	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	2.3	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	$1+(B/L)(N_q/N_c)$	$1-0.4(B/L)$	$1+(B/L)(\tan\phi_f)$
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.1	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	16.0	16.0	0.0	650.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.500	1.000	1.000	1.000

Structure:	**Tower 1**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2-1)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
14.31	7.15

Structure:	**Tower 2**
Soil Profile:	**Strata 1**

General Notes:

1. *Yellow* Fields indicate user defined input is required, or may be left blank as applicable.
2. *Green* Fields indicate calculated or referenced fields *(should not be modified by user)*.

Input Parameters:

Dimensions of Culvert Foundation	Value	
D_f - footing embedment depth:	2	ft
B - Footing Width:	12	ft
L - Footing Length:	12	ft
Loading Condition		
H - Unfactored Horizontal Load:	0	kips
V - Unfactored Vertical Load:	350	kips
ϴ - Projected direction of load in the plane of the footing, measure from the side of length L	0	degree

Material Properties	Value	
γ - Total (Moist) Unit Weight of Soil:	0.1285	kcf
Soil Type - Sand (S) /Clay (C)/ Rock(R):	C	
ϕ_f - Friction Angle of Soil:	0	deg
C - Cohesion of Soil	3.6	ksf
D_w - Ground Water Depth	0	ft

Coefficients C_{wq} and C_{wy} for Various Groundwater Depth				
(LRFD Table 10.6.3.1.2a-2)		D_w	C_{wq}	C_{wy}
		0.0	0.5	0.5
		D_f	1.0	0.5
		>1.5B + D_f	1.0	1.0
	D_f	D_w	C_{wq}	C_{wy}
Results	2	0	0.500	0.500

Bearing Capacity Factors N_c, N_q and N_γ				
sed on LRFD Table 10.6.3.1.2a-1)				
	ϕ_f	N_c	N_q	N_γ
Results	0	5.140	1.000	0.000

Shape Correction Factors S_c, S_q and S_γ				
(LRFD Table 10.6.3.1.2a-3)	ϕ_f	S_c	S_q	S_γ
	0.0	1+(B/5L)	1.0	1.0
	>0.0	1+(B/L)(N_q/N_c)	1-0.4(B/L)	1+(B/L)(tanϕ_f)
	ϕ_f	S_c	S_q	S_γ
Results	0	1.200	1.000	1.000

Depth Correction Factors d_q			
the soils above the footing bearing elevation are ascompetent as the soils beneath the footing level?			Y
(Based on LRFD Table 10.6.3.1.2a-4)	ϕ_f	D_f/B	d_q
	0.0	0.2	1.000
			d_q
Results			1.000

Shape Correction Factors S_c, S_q and S_γ					
	B	L	H	V	Θ
	12.0	12.0	0.0	350.0	0.0
					(Based on LRFD Equation 10.6.3.1.2a-5 to 9)
	ϕ_f	n	i_c	i_q	i_γ
Results	0	1.5	1.000	1.000	1.000

Structure:	**Tower 2**
Soil Profile:	**Strata 1**

Bearing Capacity Calculation

$$q_R = \varphi_b \times q_n \quad \text{(LRFD 10.6.3.1.1-1)}$$

Resistance Factor:

ψ_b	**0.50**	(dim)	(LRFD 10.5.5.2.2)

nominal bearing resistance q_n

$$q_n = CN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma} \quad \text{(LRFD 10.6.3.1.2a-1)}$$

N_c	s_c	i_c	N_{cm}
5.140	**1.200**	**1.000**	**6.17**

N_q	s_q	d_q	i_q	N_{qm}
1.00	**1.000**	**1.000**	**1.000**	**1.00**

N_γ	s_γ	i_γ	$N_{\gamma m}$
0.000	**1.000**	**1.000**	**0.00**

Therefore,

q_n	q_R
(ksf)	(ksf)
22.33	11.17

Crane Pad and Tower

Allowable Bearing Capacity due to Settlement

OBJECTIVE:

The purpose of these calculations is to obtain the allowable bearing capacity of the crane pad locations and towers based on allowable settlement of the structures.

STANDARD/CODE:

The calculation will be performed using LRFD methodology.

SOURCE OF DATA:

1. The geotechnical parameters of soil strata are developed by nearby borings, please see the attachments: Crane and Tower Location Plan & Profile and Crane and Tower Geotechnical Parameters;
2. The loading case and dimension of crane pads and towers are provided by the MS Consultants, Inc.

ASSUMPTIONS:

1. The allowable bearing capacity is obtained by method of trial and error to obtain the tolerable settlement, which is assumed to be 1.5 inches;
2. Since rock outcrops are shown on the plans at Crane pad position 2, it is recommended that the crane pad bear on rock. Therefore, no settlement calculation was performed for Crane Pad Location 2;
3. For Crane Pad Locations 5 and 6, the estimated bearing elevation provided by MS is in a dense gravel/weathered rock (IGM) strata. Therefore, no bearing and settlement calculations were completed for these structures.The assumed allowable bearing resistance of 20 ksf for these structures is based on typical engineering values for an IGM-like material. The settlement is anticipated to be acceptably small in this bearing layer.
4. It is assumed that the foundations for each crane pad is 30' X 30', and the foundations will be bearing 2 feet down from the ground surface to account for a leveling pad consisting of granular material;
5. At Crane Pad Locations 1 through 4 no free/static water was encountered in nearby borings. Therefore, the water table at these locations was assumed at the top of rock;
6. Consolidation lab testing was not completed on any borings at the site. Therefore, over consolidation ratio OCR, the compression ratio Cc, and recompression ratio Cr are estimated based on typical values and are applied to all the cohesive soil strata in the subsurface profile.
   a) OCR - based on undrained shear strength (s_u) and effective overburden pressures (Ladd, 1977 in Ref. 4)
   b) Cc - based on Liquid Limit (LL) (Skempton, 1944 in Ref. 4)
   c) Cr - 0.1xCc (Ref. 4)
7. The distribution of Vertical Stress is assumed using 2:1 Method.

REFERENCES:

1. Geotechnical Bulletin 7: Drilled Shaft and Landslide Stabilization Design, Ohio Department of Transportation, Division of Geotechnical Engineering, November 2014.
2. NCHRP 24-31, LRFD DESIGN SPECIFICATIONS FOR SHALLOW FOUNDATIONS, S. Amatya, and etc., Sep 2009;
3. AASHTO LRFD Bridge Design Specifications, Eighth Edition, 2017
4. FHWA NHI-16-072: Geotechnical Engineering Circular No. 5 - Geotechnical Site Characterization, April 2017.

Structure: Crane Pad Location 1

Δσ	5.05	ksf	Applied Vertical Stress
GEL	1037	ft.	Ground Elevation
W	32	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata ksf	Top Depth ft.	Bottom Elv. ft.	Bottom Depth ft.	Below Water table? y/n	Effective Unit Weight of Soil, γ'_m kcf	Avg. N_{60} for Layer dim	S_u ksf	LL %	W_n %	Settlement ft.
4	STRATA 1	0.000	0.0	1035.0	2.0	n	0.120	30			12	0.02
4	STRATA 1	0.240	2.0	1018.0	19.0	n	0.125	30			12	0.10
4	STRATA1	2.615	19.0	1004.0	33.0	y	0.078	30			12	0.03
7	STRATA 2	5.176	33.0	1001.5	35.5	y	0.078	25	3.1	26	16	0.00

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Crane Pad Location 1

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c	Initial vertical effective stress at the midpoint of layer i, σ'_o	Effective pressure at midpoint of layer due to load $\Delta\sigma$	$N1_{60}$	Depth below footer of midpoint of the layer	2:1 Vertical Stress Distribution Effective footing area at mid point of layer	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$	Maxium Past Pressure σ'_p	(Skempton 1944) $C_c = 0.009$ (LL-10)	$C_r = C_c/10$	e_o	S_c
ft.	ksf	ksf	dim	ft.	ft^2.	dim	ksf	ksf	dim	dim	dim	ft.
2	0.120	5.050	58	0	900	NA	5.170	NA	NA	NA	0.572	NA
17	1.553	3.066	34	8.5	1482	NA	4.619	NA	NA	NA	0.510	NA
14	4.633	1.559	25	24	2916	NA	6.191	NA	NA	NA	0.398	NA
2.5	7.834	1.173	17	32.25	3875	1.776	9.006	13.909	0.144	0.014	0.448	0.002

Structure: Crane Pad Location 1

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.007	0.003	0.005	0.006	0.007	0.009	0.011	0.024	3	2	0.120
0.012	0.007	0.009	0.010	0.012	0.015	0.017	0.097	3	3	0.125
0.015	0.010	0.012	0.013	0.015	0.018	0.021	0.027	3	5	0.135
NA	0.013	0.015	0.016	0.019	0.022	0.026	NA	10	5	0.135

Structure: Crane Pad Location 3

Δσ	3.5	ksf	Applied Vertical Stress
GEL	930	ft.	Ground Elevation
W	23	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
7	STRATA 1	0.000	0.0	928.0	2.0	n	0.125	17	1.9	45	10	0.06
7	STRATA 1	0.250	2.0	920.0	10.0	n	0.125	17	1.9	45	10	0.10
7	STRATA 2	1.500	10.0	915.0	15.0	n	0.135	69	8	39	10	0.02
7	STRATA 2	3.525	15.0	910.0	20.0	n	0.135	69	8	39	10	0.01

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Crane Pad Location 3

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c	Initial vertical effective stress at the midpoint of layer i, σ'_o	Effective pressure at midpoint of layer due to load $\Delta\sigma$	$N1_{60}$	Depth below footer of midpoint of the layer	2:1 Vertical Stress Distribution Effective footing area at mid point of layer	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$	Maxium Past Pressure σ'_p	(Skempton 1944) C_c = 0.009 (LL-10)	$C_r = C_c/10$	e_o	S_c
ft.	ksf	ksf	dim	ft.	ft^2.	dim	ksf	ksf	dim	dim	dim	ft.
2	0.125	3.450	33	0	900	169.777	3.575	21.222	0.315	0.032	0.483	0.062
8	1.000	2.686	23	4	1156	12.619	3.686	12.619	0.315	0.032	0.483	0.096
5	3.188	1.893	71	10.5	1640	17.870	5.081	56.961	0.261	0.026	0.373	0.019
5	5.888	1.500	54	15.5	2070	8.299	7.387	48.860	0.261	0.026	0.373	0.009

Structure: Crane Pad Location 3

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
NA	0.007	0.009	0.011	0.012	0.015	0.017	NA	10	2	0.125
NA	0.011	0.013	0.013	0.016	0.019	0.022	NA	10	2	0.125
NA	0.002	0.004	0.005	0.006	0.008	0.009	NA	11	4	0.135
NA	0.004	0.005	0.007	0.008	0.010	0.011	NA	11	4	0.135

Structure: Crane Pad Location 4

Δσ	2.8	ksf	Applied Vertical Stress
GEL	880	ft.	Ground Elevation
W	16	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
7	STRATA 1	0.000	0.0	878.0	2.0	n	0.125	17	1.9	45	10	0.06
7	STRATA 1	0.250	2.0	865.0	15.0	n	0.125	17	1.9	45	10	0.11
7	STRATA 2	2.125	15.0	857.0	23.0	y	0.078	69	8	39	10	0.02

Settlement (ft.)	**0.13**
settlement (in.)	**1.50**

Structure: Crane Pad Location 4

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c	Initial vertical effective stress at the midpoint of layer i, σ'_o	Effective pressure at midpoint of layer due to load $\Delta\sigma$	$N1_{60}$	Depth below footer of midpoint of the layer	2:1 Vertical Stress Distribution Effective footing area at mid point of layer	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$	Maxium Past Pressure σ'_p	(Skempton 1944) C_c = 0.009 (LL-10)	$C_r = C_c/10$	e_o	S_c
ft.	ksf	ksf	dim	ft.	ft^2.	dim	ksf	ksf	dim	dim	dim	ft.
2	0.125	2.800	33	0	900	169.777	2.925	21.222	0.315	0.032	0.483	0.058
13	1.313	1.892	21	6.5	1332	8.982	3.204	11.789	0.315	0.032	0.483	0.107
8	3.599	1.141	65	17	2209	15.351	4.740	55.256	0.261	0.026	0.373	0.018

Structure: Crane Pad Location 4

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
NA	0.007	0.009	0.011	0.012	0.015	0.017	NA	10	2	0.125
NA	0.012	0.013	0.014	0.017	0.020	0.023	NA	10	3	0.125
NA	0.003	0.004	0.006	0.007	0.008	0.010	NA	11	4	0.135

Structure: Crane Pad Location 7

Δσ	5.7	ksf	Applied Vertical Stress
GEL	880	ft.	Ground Elevation
W	10	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
2	STRATA 1	0.000	0.0	878.0	2.0	n	0.120	16			13	0.03
2	STRATA 1	0.240	2.0	870.5	9.5	n	0.120	16			13	0.07
4	STRATA 2	1.380	9.5	865.0	15.0	y	0.078	32	2.8	28	30	0.02
4	STRATA 2	2.544	15.0	860.0	20.0	y	0.078	32	2.8	28	30	0.01
2	STRATA 3	4.096	20.0	851.0	29.0	y	0.083	60			1	0.01
2	STRATA 3	6.491	29.0	843.0	37.0	y	0.083	60			1	0.00

Settlement (ft.)	**0.13**
settlement (in.)	**1.50**

Structure: Crane Pad Location 7

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c	Initial vertical effective stress at the midpoint of layer i, σ'_o	Effective pressure at midpoint of layer due to load $\Delta\sigma$	$N1_{60}$	Depth below footer of midpoint of the layer	2:1 Vertical Stress Distribution Effective footing area at mid point of layer	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$	Maxium Past Pressure σ'_p	(Skempton 1944) C_c = 0.009 (LL-10)	$C_r = C_c/10$	e_o	S_c
ft.	ksf	ksf	dim	ft.	ft^2.	dim	ksf	ksf	dim	dim	dim	ft.
2	0.120	5.700	31	0	900	NA	5.820	NA	NA	NA	0.587	NA
7.5	0.930	4.504	22	3.75	1139	NA	5.434	NA	NA	NA	0.587	NA
5.5	2.331	3.167	34	10.25	1620	NA	5.497	NA	NA	NA	0.622	NA
5	3.902	2.478	29	15.5	2070	NA	6.380	NA	NA	NA	0.622	NA
9	6.120	1.861	44	22.5	2756	NA	7.981	NA	NA	NA	0.215	NA
8	9.217	1.379	35	31	3721	NA	10.596	NA	NA	NA	0.215	NA

Structure: Crane Pad Location 7

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.010	0.008	0.010	0.011	0.013	0.016	0.018	0.033	3	2	0.120
0.013	0.011	0.013	0.014	0.016	0.019	0.023	0.074	3	2	0.120
0.012	0.007	0.009	0.010	0.012	0.015	0.017	0.025	11	4	0.135
0.014	0.008	0.011	0.012	0.014	0.016	0.019	0.014	11	4	0.135
0.007	0.005	0.007	0.008	0.010	0.012	0.013	0.007	5	5	0.140
0.009	0.007	0.009	0.010	0.012	0.014	0.016	0.004	5	5	0.140

Structure: Crane Pad Location 8

Δσ	5.85	ksf	Applied Vertical Stress
GEL	880	ft.	Ground Elevation
W	10	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
2	STRATA 1	0	0.0	878.0	2.0	n	0.120	11			15	0.05
2	STRATA 1	0.240	2.0	870.5	9.5	n	0.120	11			15	0.09
7	STRATA 2	1.380	9.5	865.0	15.0	y	0.078	43	4.6	29	19	0.02
2	STRATA 3	2.544	15.0	857.5	22.5	y	0.083	60			1	0.01

Settlement (ft.)	**0.13**
settlement (in.)	**1.50**

Structure: Crane Pad Location 8

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.120	5.850	21	0	900	NA	5.970	NA	NA	NA	0.615	NA
7.5	0.930	4.622	15	3.75	1139	NA	5.552	NA	NA	NA	0.615	NA
5.5	2.331	3.250	46	10.25	1620	13.234	5.580	30.843	0.171	0.017	0.485	0.024
7.5	4.093	2.409	53	16.75	2186	NA	6.502	NA	NA	NA	0.215	NA

Structure: Crane Pad Location 8

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.013	0.012	0.013	0.014	0.017	0.020	0.023	0.045	3	2	0.120
0.016	0.014	0.016	0.017	0.020	0.023	0.028	0.093	3	2	0.120
NA	0.005	0.007	0.008	0.009	0.012	0.013	NA	11	4	0.135
0.006	0.004	0.006	0.007	0.008	0.010	0.011	0.008	5	4	0.140

Structure: Crane Pad Location 9

Δσ	2.55	ksf	Applied Vertical Stress
GEL	890	ft.	Ground Elevation
W	13	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
2	STRATA 1	0	0.0	888.0	2.0	n	0.120	12			15	0.03
2	STRATA 1	0.240	2.0	872.0	18.0	y	0.068	12			15	0.11
7	STRATA 2	2.854	18.0	865.0	25.0	y	0.078	32	2	34	17	0.01
2	STRATA 3	4.794	25.0	855.0	35.0	y	0.078	50			11	0.00
2	STRATA 3	7.510	35.0	842.0	48.0	y	0.078	50			11	0.00
2	STRATA 3	11.234	48.0	835.0	55.0	y	0.083	50			11	0.00
2	STRATA 3	15.777	55.0	825.0	65.0	y	0.083	50			11	0.00

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Crane Pad Location 9

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.120	2.550	23	0	900	NA	2.670	NA	NA	NA	0.615	NA
16	0.916	1.589	16	8	1444	NA	2.505	NA	NA	NA	0.550	NA
7	4.522	0.937	27	19.5	2450	2.040	5.459	9.226	0.216	0.022	0.460	0.008
10	7.122	0.682	34	28	3364	NA	7.804	NA	NA	NA	0.385	NA
13	10.730	0.475	27	39.5	4830	NA	11.205	NA	NA	NA	0.385	NA
7	15.488	0.363	21	49.5	6320	NA	15.851	NA	NA	NA	0.336	NA
10	20.733	0.296	15	58	7744	NA	21.030	NA	NA	NA	0.336	NA

Structure: Crane Pad Location 9

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.013	0.011	0.013	0.013	0.016	0.019	0.022	0.034	3	2	0.120
0.015	0.014	0.015	0.017	0.019	0.023	0.027	0.108	3	3	0.125
NA	0.009	0.011	0.012	0.014	0.017	0.020	NA	11	4	0.135
0.009	0.007	0.009	0.010	0.012	0.015	0.017	0.004	4	5	0.135
0.011	0.009	0.011	0.012	0.014	0.017	0.020	0.003	4	5	0.135
0.013	0.012	0.013	0.014	0.017	0.020	0.023	0.001	4	6	0.140
0.016	0.014	0.016	0.017	0.020	0.023	0.028	0.001	4	6	0.140

Structure: Crane Pad Location 10

Δσ	3.12	ksf	Applied Vertical Stress
GEL	890	ft.	Ground Elevation
W	5	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata ksf	Top Depth ft.	Bottom Elv. ft.	Bottom Depth ft.	Below Water table? y/n	Effective Unit Weight of Soil, γ'_m kcf	Avg. N_{60} for Layer dim	S_u ksf	LL %	W_n %	Settlement ft.
2	STRATA 1	0	0.0	888.0	2.0	n	0.120	16			14	0.03
2	STRATA 1	0.240	2.0	880.0	10.0	y	0.063	16			14	0.07
2	STRATA 1	0.866	10.0	872.0	18.0	y	0.073	16			14	0.03
2	STRATA 2	2.173	18.0	865.0	25.0	y	0.073	13			21	0.01
2	STRATA 3	3.988	25.0	852.0	38.0	y	0.078	50			11	0.01
2	STRATA 3	6.937	38.0	835.0	55.0	y	0.083	50			11	0.00
2	STRATA 3	11.480	55.0	815.0	75.0	y	0.083	50			11	0.00
2	STRATA 3	17.675	75.0	795.0	95.0	y	0.083	50			11	0.00

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Crane Pad Location 10

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.120	3.120	31	0	900	NA	3.240	NA	NA	NA	0.601	NA
8	0.616	2.429	24	4	1156	NA	3.045	NA	NA	NA	0.601	NA
8	1.882	1.592	19	12	1764	NA	3.474	NA	NA	NA	0.477	NA
7	3.734	1.146	12	19.5	2450	NA	4.880	NA	NA	NA	0.568	NA
13	6.432	0.793	37	29.5	3540	NA	7.225	NA	NA	NA	0.385	NA
17	10.778	0.506	28	44.5	5550	NA	11.283	NA	NA	NA	0.336	NA
20	16.849	0.325	20	63	8649	NA	17.173	NA	NA	NA	0.336	NA
20	24.696	0.220	13	83	12769	NA	24.916	NA	NA	NA	0.336	NA

Structure: Crane Pad Location 10

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.010	0.008	0.010	0.011	0.013	0.016	0.018	0.028	3	2	0.120
0.012	0.010	0.012	0.013	0.015	0.018	0.021	0.068	3	2	0.120
0.014	0.012	0.014	0.015	0.018	0.021	0.025	0.030	3	4	0.130
0.017	0.016	0.017	0.019	0.022	0.026	0.032	0.014	3	4	0.130
0.008	0.006	0.008	0.010	0.011	0.014	0.016	0.006	4	5	0.135
0.011	0.009	0.011	0.012	0.014	0.017	0.019	0.004	4	6	0.140
0.014	0.012	0.014	0.015	0.017	0.020	0.024	0.002	4	6	0.140
0.017	0.015	0.017	0.018	0.021	0.025	0.031	0.001	4	6	0.140

Structure: Crane Pad Location 11

Δσ	2.82	ksf	Applied Vertical Stress
GEL	1027	ft.	Ground Elevation
W	57	ft.	Water Table
L	30	ft.	Length of Footing
B	30	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata ksf	Top Depth ft.	Bottom Elv. ft.	Bottom Depth ft.	Below Water table? y/n	Effective Unit Weight of Soil, γ'_m kcf	Avg. N_{60} for Layer dim	S_u ksf	LL %	W_n %	Settlement ft.
2	STRATA 1	0	0.0	1025.0	2.0	n	0.115	7			12	0.05
2	STRATA 1	0.230	2.0	1003.5	23.5	n	0.125	7			12	0.11
3	STRATA 1A	3.168	23.5	992.5	34.5	n	0.135	23			14	0.01
2	STRATA 2	7.825	34.5	980.0	47.0	n	0.135	43			13	0.00
2	STRATA 2	14.170	47.0	966.5	60.5	y	0.083	43			13	0.00
2	STRATA 2	19.167	60.5	950.0	77.0	y	0.083	43			13	0.00
2	STRATA 2	25.528	77.0	940.0	87.0	y	0.083	43			13	0.00
2	STRATA 2	32.714	87.0	933.0	94.0	y	0.083	43			13	0.00

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Crane Pad Location 11

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.115	2.820	14	0	900	NA	2.935	NA	NA	NA	0.641	NA
21.5	1.824	1.528	8	10.75	1661	NA	3.352	NA	NA	NA	0.510	NA
11	7.083	0.781	18	27	3249	NA	7.864	NA	NA	NA	0.423	NA
12.5	13.326	0.537	22	38.75	4727	NA	13.863	NA	NA	NA	0.410	NA
13.5	18.610	0.380	14	51.75	6683	NA	18.990	NA	NA	NA	0.360	NA
16.5	24.846	0.271	10	66.75	9361	NA	25.117	NA	NA	NA	0.360	NA
10	32.301	0.210	6	80	12100	NA	32.510	NA	NA	NA	0.360	NA
7	40.189	0.181	3	88.5	14042	NA	40.370	NA	NA	NA	0.360	NA

Structure: Crane Pad Location 11

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.016	0.015	0.016	0.018	0.021	0.024	0.029	0.046	2	2	0.115
0.019	0.018	0.019	0.023	0.026	0.029	0.038	0.110	2	4	0.125
0.016	0.013	0.015	0.016	0.018	0.021	0.026	0.008	3	5	0.135
0.013	0.011	0.013	0.014	0.016	0.019	0.023	0.003	4	5	0.135
0.016	0.015	0.016	0.018	0.021	0.024	0.029	0.002	4	6	0.140
0.018	0.017	0.018	0.021	0.024	0.027	0.035	0.001	4	6	0.140
0.020	0.018	0.020	0.025	0.028	0.031	0.042	0.001	4	6	0.140
0.022	0.019	0.022	0.030	0.031	0.035	0.050	0.000	4	6	0.140

Structure: Tower 1A & 1B

Δσ	18.5	ksf	Applied Vertical Stress
GEL	872	ft.	Ground Elevation
W	13	ft.	Water Table
L	16	ft.	Length of Footing
B	16	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
7	STRATA 1	0	0.0	870.0	2.0	n	0.120	13	2.3	29	17	0.05
7	STRATA 1	0.240	2.0	866.5	5.5	n	0.120	13	2.3	29	17	0.05
2	STRATA 2	0.900	5.5	861.5	10.5	n	0.125	13			16	0.06
2	STRATA 2	2.213	10.5	859.0	13.0	n	0.135	83			10	0.00
2	STRATA 3	3.968	13.0	852.0	20.0	y	0.083	83			10	0.01

Settlement (ft.)	**0.13**
settlement (in.)	**1.50**

Structure: Tower 1A & 1B

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.120	18.500	25	0	256	226.860	18.620	27.223	0.171	0.017	0.643	0.046
3.5	0.690	15.032	20	1.75	315	25.478	15.722	17.580	0.171	0.017	0.643	0.049
5	1.900	9.785	15	6	484	NA	11.685	NA	NA	NA	0.563	NA
2.5	3.799	7.143	78	9.75	663	NA	10.941	NA	NA	NA	0.373	NA
7	5.330	5.091	62	14.5	930	NA	10.422	NA	NA	NA	0.324	NA

Structure: Tower 1A & 1B

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
NA	0.010	0.012	0.013	0.015	0.018	0.021	NA	9	2	0.120
NA	0.012	0.014	0.015	0.017	0.020	0.024	NA	9	2	0.120
0.016	0.014	0.016	0.017	0.020	0.023	0.028	0.063	3	3	0.125
0.003	0.002	0.003	0.004	0.005	0.007	0.008	0.004	5	3	0.135
0.004	0.003	0.004	0.006	0.007	0.009	0.010	0.009	5	4	0.140

Structure: Tower 2A

Δσ	7.3	ksf	Applied Vertical Stress
GEL	875	ft.	Ground Elevation
W	10	ft.	Water Table
L	12	ft.	Length of Footing
B	12	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
5	STRATA 1	0	0.0	873.0	2.0	n	0.125	27	3.6	35	27	0.04
5	STRATA 1	0.250	2.0	865.0	10.0	n	0.125	27	3.6	35	27	0.08
5	STRATA 1	1.500	10.0	855.0	20.0	y	0.073	27	3.6	35	27	0.04
2	STRATA 2	2.952	20.0	850.0	25.0	y	0.083	65			10	0.00
7	STRATA 3	5.017	25.0	840.0	35.0	y	0.083	53	5.3	32	10	0.01
7	STRATA 3	7.908	35.0	832.0	43.0	y	0.083	53	5.3	32	10	0.00

Settlement (ft.)	**0.13**
settlement (in.)	**1.50**

Structure: Tower 2A

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.125	7.300	52	0	144	NA	7.425	NA	NA	NA	0.712	NA
8	1.000	4.106	36	4	256	NA	5.106	NA	NA	NA	0.712	NA
10	2.589	1.682	28	13	625	NA	4.271	NA	NA	NA	0.646	NA
5	4.811	0.995	55	20.5	1056	NA	5.806	NA	NA	NA	0.324	NA
10	7.495	0.657	35	28	1600	3.668	8.152	27.493	0.198	0.020	0.324	0.005
8	11.129	0.438	28	37	2401	2.238	11.567	24.906	0.198	0.020	0.324	0.002

Structure: Tower 2A

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.010	0.004	0.006	0.007	0.008	0.010	0.012	0.037	10	2	0.125
0.014	0.007	0.009	0.010	0.011	0.014	0.016	0.079	10	2	0.125
0.017	0.009	0.011	0.012	0.014	0.017	0.019	0.036	10	4	0.130
0.005	0.004	0.005	0.007	0.008	0.010	0.011	0.002	5	5	0.140
NA	0.007	0.009	0.010	0.012	0.014	0.016	NA	11	5	0.140
NA	0.009	0.011	0.012	0.014	0.017	0.019	NA	11	5	0.140

Structure: Tower 2B

Δσ	7.5	ksf	Applied Vertical Stress
GEL	874	ft.	Ground Elevation
W	13	ft.	Water Table
L	12	ft.	Length of Footing
B	12	ft.	Width of Footing
D	2	ft.	Depth of Footing

Soil Type	Strata	Intital Pressure at top of strata	Top Depth	Bottom Elv.	Bottom Depth	Below Water table?	Effective Unit Weight of Soil, γ'_m	Avg. N_{60} for Layer	S_u	LL	W_n	Settlement
		ksf	ft.	ft.	ft.	y/n	kcf	dim	ksf	%	%	ft.
5	STRATA 1	0	0.0	872.0	2.0	n	0.125	27	3.6	35	27	0.04
5	STRATA 1	0.250	2.0	861.0	13.0	n	0.125	27	3.6	35	27	0.10
5	STRATA 1	1.875	13.0	853.0	21.0	y	0.073	27	3.6	35	27	0.02
2	STRATA 2	3.400	21.0	850.0	24.0	y	0.083	65			10	0.00
2	STRATA 2	5.382	24.0	840.0	34.0	y	0.083	65			10	0.00
2	STRATA 2	8.190	34.0	834.0	40.0	y	0.083	65			10	0.00

Settlement (ft.)	**0.12**
settlement (in.)	**1.50**

Structure: Tower 2B

General Calculations						Over Consolidated Clay						
Initial height of layer I, H_c ft.	Initial vertical effective stress at the midpoint of layer i, σ'_o ksf	Effective pressure at midpoint of layer due to load $\Delta\sigma$ ksf	$N1_{60}$ dim	Depth below footer of midpoint of the layer ft.	2:1 Vertical Stress Distribution Effective footing area at mid point of layer ft^2.	Ladd 1977 OCR = $(S_u/0.25*\sigma'_o)^{(1/0.8)}$ dim	Final Effective Pressure $\sigma'_f = \sigma'_o + \Delta\sigma$ ksf	Maxium Past Pressure σ'_p ksf	(Skempton 1944) C_c = 0.009 (LL-10) dim	$C_r = C_c/10$ dim	e_o dim	S_c ft.
2	0.125	7.500	52	0	144	NA	7.625	NA	NA	NA	0.712	NA
11	1.188	3.527	34	5.5	306	NA	4.714	NA	NA	NA	0.712	NA
8	3.109	1.481	26	15	729	NA	4.591	NA	NA	NA	0.646	NA
3	5.258	1.022	53	20.5	1056	NA	6.281	NA	NA	NA	0.324	NA
10	7.777	0.710	42	27	1521	NA	8.487	NA	NA	NA	0.324	NA
6	11.247	0.489	34	35	2209	NA	11.736	NA	NA	NA	0.324	NA

Structure: Tower 2B

Formulas for Granular Soil from NCHRP RPT 651 APPENDIX H								Unit Weight		
1/C'	Soil-1 Clean Uniform Sand	Soil-2 Well graded Silty Sand and Gravel	Soil-3 Clean well grade fine to coarse sand	Soil-4 Well Graded fine to medium Silty Sand	Soil-5 Sandy Clay	Soil-6 Inorganic Silt	elastic settlement of layer I, ΔH	Row	Depth column	γ (kcf)
dim	dim	dim	dim	dim	dim	dim	ft.	dim	dim	kcf
0.010	0.004	0.006	0.007	0.008	0.010	0.012	0.037	10	2	0.125
0.015	0.007	0.009	0.010	0.012	0.015	0.017	0.096	10	3	0.125
0.017	0.010	0.011	0.012	0.015	0.017	0.020	0.024	10	4	0.130
0.006	0.004	0.006	0.007	0.008	0.010	0.011	0.001	5	5	0.140
0.007	0.005	0.007	0.009	0.010	0.012	0.014	0.003	5	5	0.140
0.009	0.007	0.009	0.010	0.012	0.015	0.017	0.001	5	5	0.140

Crane Pad and Tower Overall Stability

Project: SUM-8-1.75				Sheet 1 of 2
Purpose: Overall Stability Analysis for Crane Pad Locations				Job No. : 062368
By: YLZ	Date: 10/12/2017	CHKD By: ERS	Date: 10/12/2017	

PURPOSE:

The purpose of this calculation is to determine the slope stability of the crane pad locations. The proposed grading to install the pad, and the load pad were evaluated. The pad location, elevation, and loading was provided by MS. The total time of crane operation is estimated to be 2-3 weeks.

CODES/STANDARDS/PROCEDURE:

AASHTO LRFD 11.6.2.3 Overall Stability requires evaluation of slopes at service loads (i.e. unfactored). Since there are no structures prior to construction a resistance factor of $\varphi=0.75$, is required. Since the crane use and set up time is estimated to be 2-3 weeks short term soil parameters are used. A reduction factor of equates to a Factor of Safety of 1.33.

SOURCE OF DATA

1. The location of the crane pad is provided by MS;

2. The subsurface profile and geotechnical parameters of soil strata are developed by nearby borings, please see the attachments: Crane and Tower Location Plan & Profile as well as Crane and Tower geotechnical parameters.

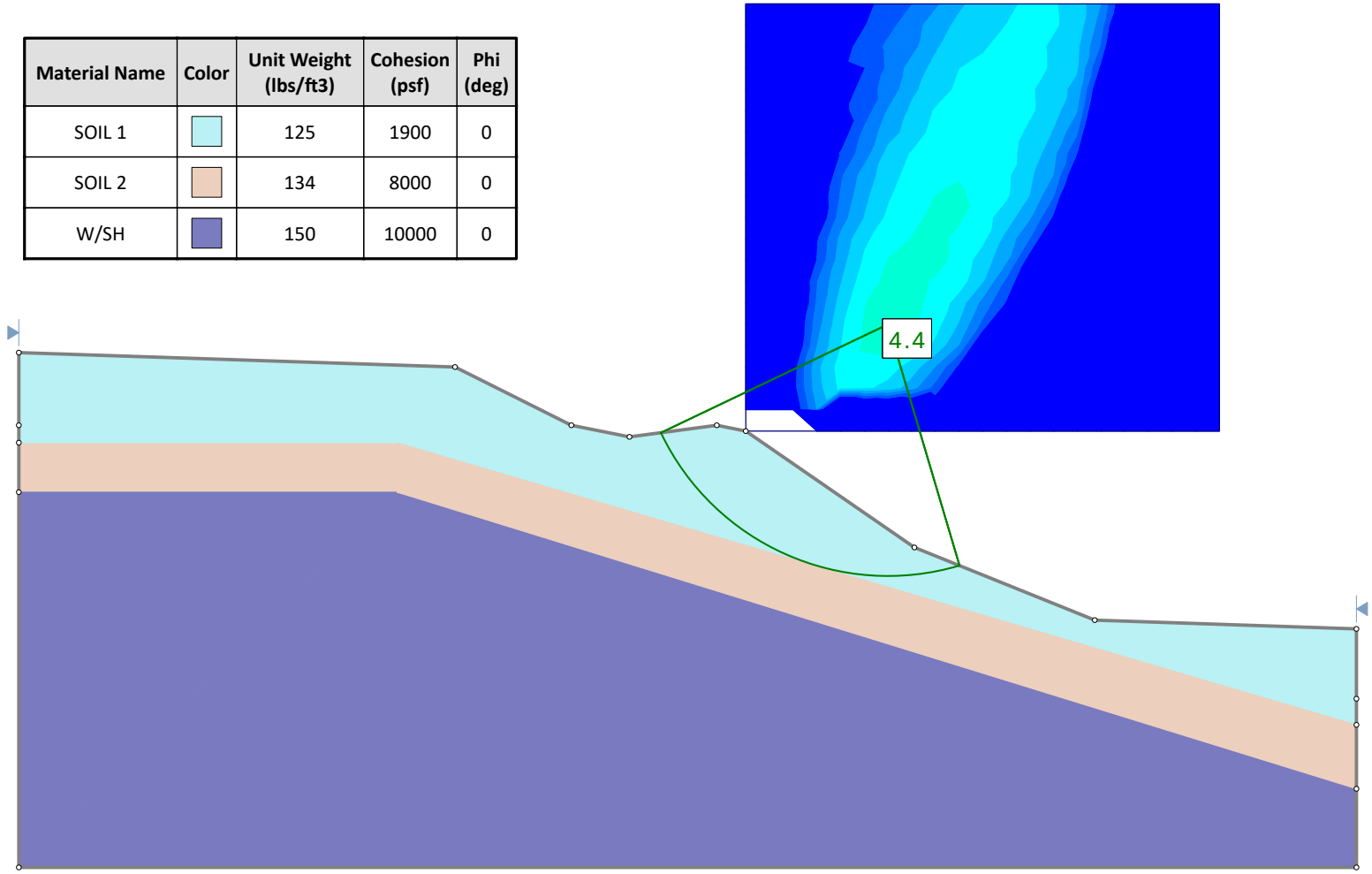
ASSUMPTIONS/PROJECT BACKGROUND:

- Due to the location of the crane pad, only crane pad location 3 is examined for overall stability, all the other locations present little risk of overall stability failure.
- Slope Stability of three cases were examined in two cases:
    - Case 1 Existing Condition
    - Case 2 Proposed Grade after Pad Installation with Crane Loading
- The crane pad is 30x63, located between STA 529+10 to 529+40, at elevation 930;
- In order to bringing the crane pad, the slope was cut flat between STA 529+10 to 529+46; and cut back between 239+40 to 240+00 to 1:1 for excavation purpose;
- The distributed load was assumed to be 2000 psf; and
- Short term parameters are used due to the short operation time

Results:

Case	Factor of Safety
Case 1 Existing Condition	4.4
Case 2 Proposed Grade after Pad Installation with Crane Loading	3.2

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		125	1900	0
SOIL 2		134	8000	0
W/SH		150	10000	0



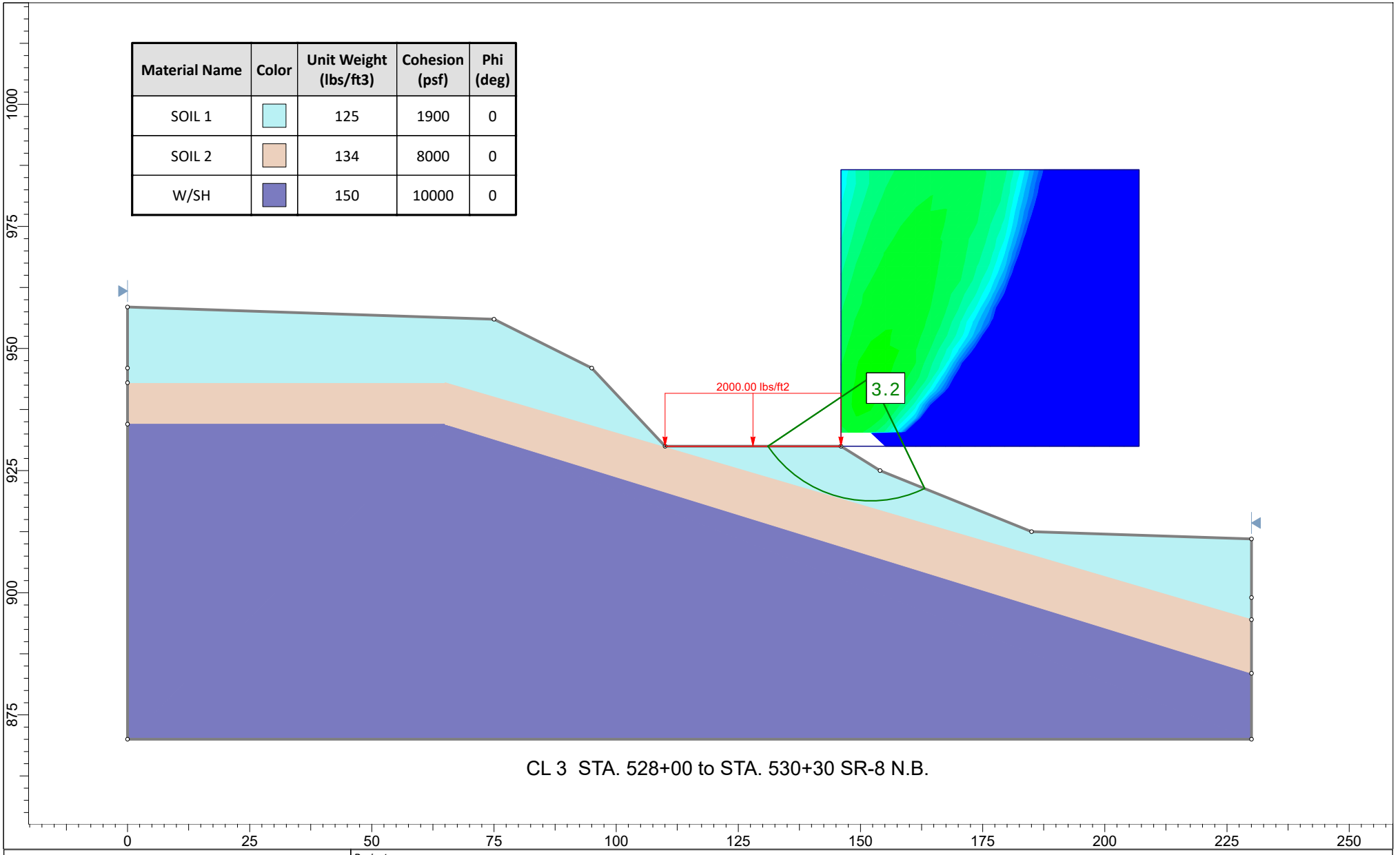
CL 3 STA. 528+00 to STA. 530+30 SR-8 N.B.

Gannett Fleming

SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	Crane Pad Location 3_Existing Condtion				
Calc By	YLZ	Date	9/18	Scale	1:350
Chk'd By	ERS	Date	9/18	File Name	SUM-8-1.75_CL3_EX.slim

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
SOIL 1		125	1900	0
SOIL 2		134	8000	0
W/SH		150	10000	0



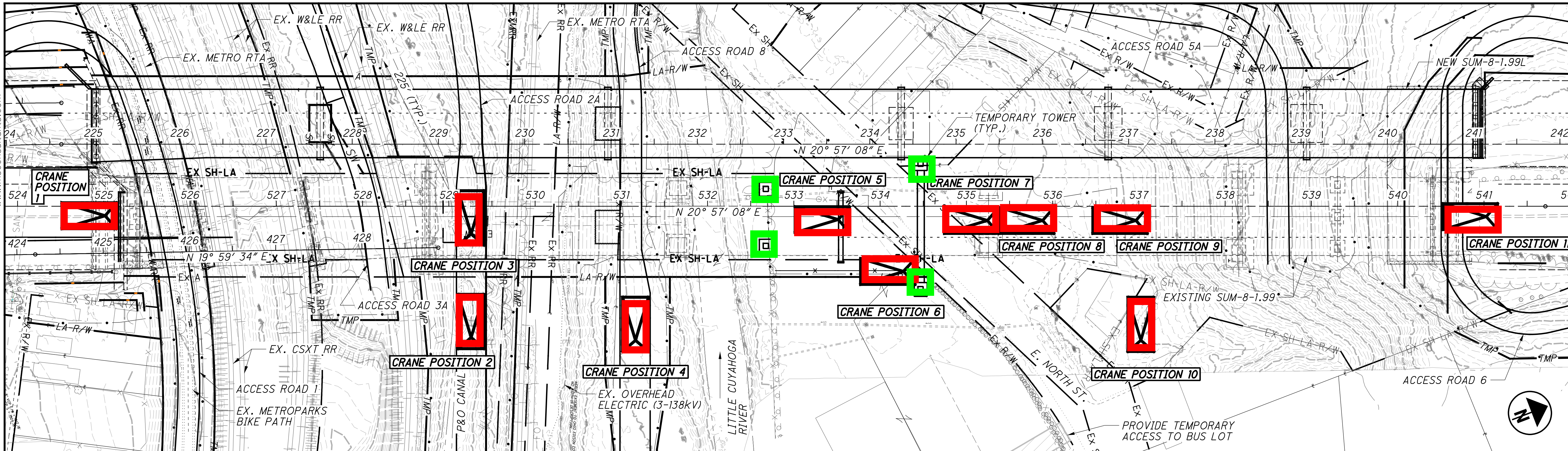
CL 3 STA. 528+00 to STA. 530+30 SR-8 N.B.

Gannett Fleming

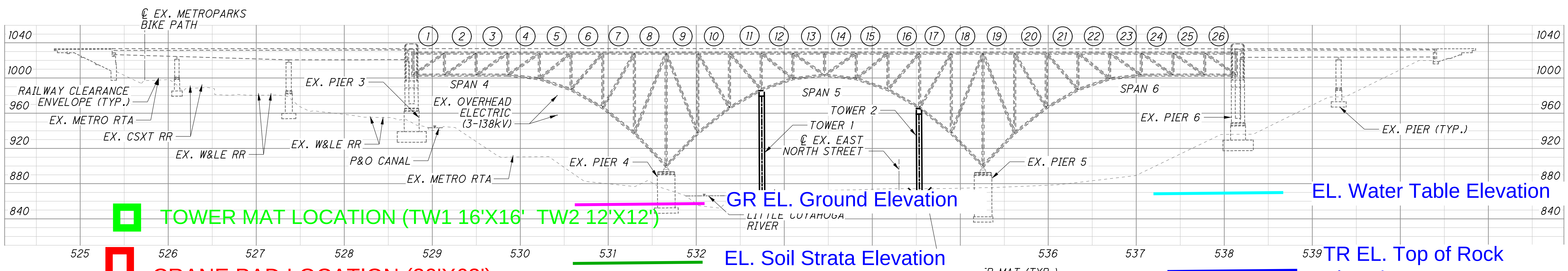
SLIDEINTERPRET 8.016

Project	SUM-8-1.75				
Analysis Description	Crane Pad Location 3_After Grading				
Calc By	YLZ	Date	9/18	Scale	1:325
Chk'd By	ERS	Date	9/18	File Name	SUM-8-1.75_CL3.slim

Crane Pad and Tower Location Plan and Profile



PLAN VIEW



PROFILE VIEW ALONG ℄ EXISTING BRIDGE

LEGEND

(*) DENOTES PANEL NUMBER

DEMOLITION SEQUENCE:

THE FOLLOWING IS A SUGGESTED TRUSS REMOVAL SEQUENCE. CONTRACTOR TO DETERMINE STATE OF STRESS WITHIN EACH MEMBER OF THE TRUSS AT EACH STAGE OF DEMOLITION AND LIMIT STRESSES TO ACCEPTABLE LEVELS.
TRUSS REMOVAL WILL AVOID IMPACT TO THE 138 kV OH TRANSMISSION LINE, TO REMAIN.

TRUSS APPROACH AND END SPANS CAN BE REMOVED USING CONVENTIONAL CONTRACTOR MEANS AND METHODS. EXPLOSIVE DEMOLITION IS NOT PERMITTED IN SPANS 1 TO 3.

TRUSS REMOVAL SEQUENCE:

1. INSTALL ACCESS ROUTES AND GRADE FOR CRANE POSITIONING.
2. INSTALL TEMPORARY TOWERS AT LOCATIONS SHOWN ON PLANS, INCLUDING ANY REQUIRED TEMPORARY SHORING.
3. WORKING IN EITHER DIRECTION, REMOVE DECK AND STRINGERS.
4. JACK STRUCTURE AT PIER 6 TO RELIEVE NORTH END DEAD LOAD REACTION (APPROX. 780 KIPS PER TRUSS).
5. SEPARATE TRUSS FROM BEARINGS AT PIER 6.
6. REMOVE STRUCTURAL STEEL ROCKERS AT PIER 6.
7. REMOVE JACKS AT PIER 6.
8. FROM CRANE POSITION 10, WORKING NORTH TO SOUTH, REMOVE PANEL 26 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
9. FROM CRANE POSITION 9 AND 10, WORKING NORTH TO SOUTH, REMOVE PANELS 25 TO 19 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
10. JACK STRUCTURE AT PIER 3 TO RELIEVE NORTH END DEAD LOAD REACTION (APPROX. 780 KIPS PER TRUSS).
11. SEPARATE TRUSS FROM BEARINGS AT PIER 3.
12. REMOVE STRUCTURAL STEEL ROCKERS AT PIER 3.
13. REMOVE JACKS AT PIER 3.
14. FROM CRANE POSITION 2 AND 3, WORKING SOUTH TO NORTH, REMOVE PANELS 1 TO 6 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
15. TEMPORARILY CLOSE E. NORTH ST. TO TRAFFIC; IMPLEMENT LOCAL TRAFFIC DETOUR.
16. JACK STRUCTURE AT TOWER 2 TO RELIEVE PIER 5 DEAD LOAD REACTION (APPROX. 490 KIPS PER TOWER PER TRUSS).
17. SEPARATE TRUSS FROM BEARINGS AT PIER 5.
18. REMOVE STRUCTURAL STEEL ROCKERS AT PIER 5.
19. FROM CRANE POSITION 8 AND 9, WORKING NORTH TO SOUTH, REMOVE PANELS 18 TO 17 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
20. JACK STRUCTURE AT TOWER 1 TO RELIEVE TOWER 2 DEAD LOAD REACTION (APPROX. 600 KIPS PER TOWER PER TRUSS).
21. FROM CRANE POSITION 8, WORKING NORTH TO SOUTH, REMOVE PANELS 16 TO 15 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
22. FROM CRANE POSITION 4, WORKING SOUTH TO NORTH, REMOVE PANELS 7 & 8 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
23. FROM CRANE POSITION 6 AND 7, WORKING NORTH TO SOUTH, REMOVE PANELS 14 TO 12 USING THE FOLLOWING REMOVAL SEQUENCE: FLOORBEAM, BRACING ELEMENTS, EAST TRUSS UPPER CHORD, EAST TRUSS SOUTH VERTICAL, EAST TRUSS DIAGONAL, EAST TRUSS LOWER CHORD, WEST TRUSS UPPER CHORD, WEST TRUSS SOUTH VERTICAL, WEST TRUSS DIAGONAL, WEST TRUSS LOWER CHORD.
24. FROM CRANE POSITION 5, REMOVE ALL ELEMENTS OF PANELS 9 TO 11 FROM THE TOP DOWN IN SEQUENCE; PROVIDE ADDITIONAL TEMPORARY SUPPORT AS NEEDED. PROTECT THE RIVER FROM DEMOLITION DEBRIS.
25. REMOVE EXISTING PIERS AS SHOWN ON SHEETS XX TO XX.

MAXIMUM LIFT:
30 KIPS AT 195' RADIUS
30 KIPS AT 195' RADIUS OVER RAILROAD

MAXIMUM TEMPORARY TOWER LOADS:
TOWER 1 = 650 KIPS
TOWER 2 = 350 KIPS

EXISTING BRIDGE DEMOLITION - WITHOUT EXPLOSIVES - OPTION 2
BRIDGE NO. SUM-8-0199L/R - OVER RAILROADS (CSXT, W&LE, AND METRO RTA), LITTLE CUYAHOGA RIVER, AND EAST NORTH STREET

DESIGN AGENCY
ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229

DESIGNED PEG | CHECKED ELP | DRAWN ABD | REVIEWED GLG | DATE NOV 18 | STRUCTURE FILE NUMBER 7700370/7700371

SUM-8-1.75
PID No. 91710

FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEET NOS. 30 & 31.
FOR SOIL PROFILE FOR CROSS SECTION SEE SHEET NOS. 47 & 48.

SUM-8-1.75

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 524+00 TO STA 528+00 S.R. 8 N.B. & STA 224+11.84 TO STA 228+00 S.R. 8 S.B.

DRAWN YLZ
CHECKED TLM

0 10 20 40
HORIZONTAL SCALE IN FEET

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 524+00 TO STA 528+00 S.R. 8 N.B.

SUM-8-1.75

33/128

FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEET NOS. 33 & 34.

36" STORM SEWER

B-009-2-16

B-009-3-16

B-009-4-16

BRIDGE FOOTING FOR PIER 2

B-011-0-15

PENNSYLVANIA AND OHIO CANAL

METRO RTA RR

WLE RR

℄ S.R.-8 S.B.

MATCH LINE STA 228+00

MATCH LINE STA 233+00

228

229

230

231

232

B-016-0-48

Crane Position 3

℄ S.R.-8 N.B.

B-014-0-48

EXISTING BRIDGE FOOTING

LR-2A

B-019-0-48

Tower 1A

N 20° 57' 08" E

Tower 1B

MATCH LINE STA 528+00

MATCH LINE STA 533+00

528

529

530

531

532

B-010-0-15

B-015-0-48

B-017-0-48

BRIDGE FOOTING FOR PIER 2

POT Sta. 428+88.45

Crane Position 2

Crane Position 4

LITTLE CUYAHOGA RIVER

HORIZONTAL SCALE IN FEET

0 10 20 40

DRAWN YLZ

CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 528+00 TO STA 533+00 S.R. 8 S.B.

BRIDGE NO. SUM-8-0175, STA 228+00 TO STA 233+00 S.R. 8 N.B.

SUM-8-1.75

34/128

STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 528+00 TO STA 533+00 S.R. 8 N.B.

SUM-8-1.75

DRAWN YLZ | CHECKED TLM

HORIZONTAL SCALE IN FEET
0 10 20 40

36 / 128

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Crane Location 3

Crane Location 4

Tower 1

B-014-0-48
14' LT.

B-019-0-48
36' LT.

B-010-0-15
3' LT.

B-017-0-48
54' RT.

℄ PIER 2

EXISTING BRIDGE

TR

GR EL. 930

EL. 920

TR EL.910

Approximate Top of Rock

Soil 1

Soil 2

GR EL. 880

EL. 865

TR EL. 857

GR EL. 872

EL. 866.5

EL. 861.5

EL. 859

TR EL. 852

Crane Location 2 is located where rock outcrop exists, place it on rock.

5 17 43 45 76 76 26/50/5" 50/4"

26 10 9 11 13 7

N_{60} WC

1038.18 1037.89 1037.60 1037.31 1037.02 1036.73 1036.44 1036.15 1035.86 1035.57 1035.28

958.41 956.92 944.56 927.05 912.43 900.54 870.14 853.51 871.83 872.82

1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860 850 840

860 850 840

528 529 530 531 532 533

FOR SOIL PROFILE FOR STURCTURE FOUNDATION SEE SHEET NOS. 36 & 37.

Cross Section
STA. 234+58.77
SR-8 S.B.

BRIDGE FOOTING FOR PIER 3

BRIDGE FOOTING FOR PIER 4

MATCH LINE STA 233+00

MATCH LINE STA 238+00

MATCH LINE STA 533+00

MATCH LINE STA 538+00

B-011-5-16

B-011-1-15

B-011-4-16

B-013-1-15

B-013-5-16

B-013-0-15

B-013-4-16

B-011-3-16

B-010-2-15

B-010-1-15

B-011-2-16

B-013-3-16

B-012-0-15

B-013-2-16

B-022-0-48

B-021-0-48

B-024-0-48

℄ S.R.-8 S.B.

S.R.-8 N.B.

N 20° 57′ 08″ E

20° 56′ 45″ E

EXISTING BRIDGE FOOTING

Tower 2A

Tower 2B

Crane Position 5

Crane Position 6

Crane Position 7

Crane Position 8

Crane Position 9

Crane Position 10

1 STORY CONC. BLOCK GARAGE COMM. 415

BLOCK GARAGE

STORAGE TRAILER

1 STORY CONC. BLOCK COMM. 451

ASPHALT

234 235 236 237 534 536 537

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO SUM-8-0199, STA 533+00 TO STA 538+00 S.R. 8 N.B. & STA 233+00 TO STA 238+00 S.R. 8 S.B.

SUM-8-1.75

37/128

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1035.28 1034.99 1034.70 1034.41 1034.12 1033.83 1033.54 1033.25 1032.96 1032.67 1032.38

℄ PIER 3 EXISTING BRIDGE ℄ PIER 4

B-010-2-15
15' RT.
32 12
50/4" 12
16 28
31 30
17 32
59 33 W
31 33
29 37
22/50/3" 38
50/1"
N_{60} WC

Tower 2

Crane Location 5 Crane Location 6 Crane Location 7 Crane Location 8 Crane Location 9 Crane Location 10

B-011-2-16
43' RT.
ASPHALT = 4"
BASE = 7"
GR EL. 860
Soil 2
EL. 863
Soil 1
EL. 859.5
Soil 3
TR EL.840
N_{60} WC

B-011-3-16
6' RT.
ASPHALT = 6"
EL. 863
Soil 1
EL. 859.5
Soil 3
TR EL.833.5
N_{60} WC

B-010-1-15
19' RT.
W
N_{60} WC

GR EL. 880
B-020-0-48
36' LT.
EL. 870.5
Soil 1
Soil 2
EL. 860
Soil 3
TR EL.843
B-012-0-15
13' RT.
EL. 870.5
EL. 865
TR EL.857.5
N_{60} WC

B-013-2-16
44' RT.
TR EL.857.5
N_{60} WC

B-013-3-16
6' RT.
GR EL. 890
Soil 1
W EL. 880
EL. 872
Soil 2
EL. 865
Soil 3
EL. 842
TR EL.825
N_{60} WC

Approximate Water Table

Approximate Top of Rock

872.82 873.53 874.18 876.67 880.99 885.66 892.21 912.75 937.96

533 534 535 536 537 538

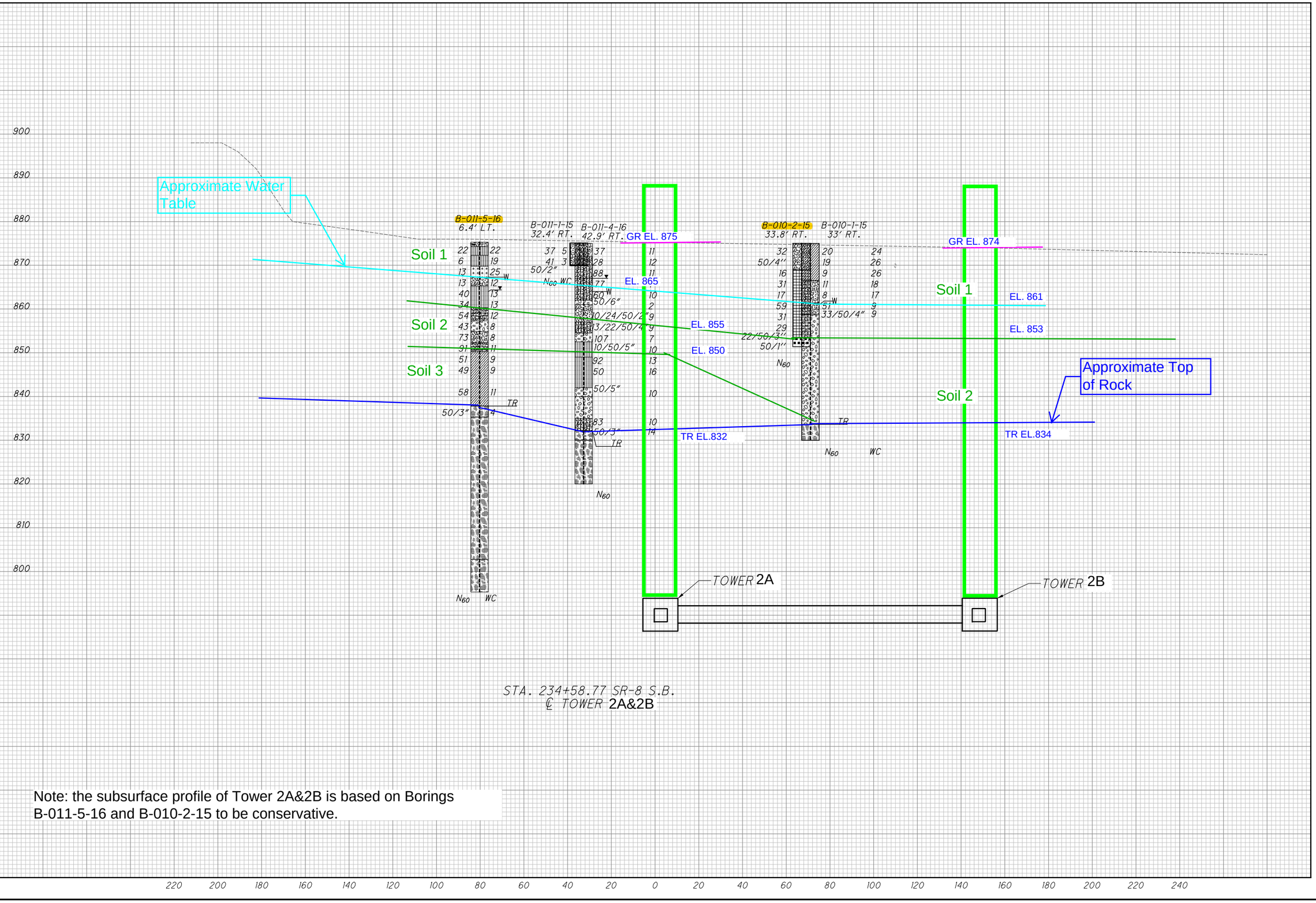
HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO SUM-8-0199, STA 533+00 TO STA 538+00 S.R. 8 N.B.

SUM-8-1.75

39 / 128



STA. 234+58.77 SR-8 S.B.
℄ TOWER 2A&2B

Note: the subsurface profile of Tower 2A&2B is based on Borings B-011-5-16 and B-010-2-15 to be conservative.

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

CROSS SECTION STA. 234+58.77
STRUCTURE FOUNDATION OF TOWER 3 & 4

SUM-8-1.75

FOR SOIL PROFILE FOR STURCTURE FOUNDATIONS SHEET NOS. 39 & 40.

B-015-2-17

B-014-0-15

BRIDGE FOOTING FOR PIER 5

B-016-0-15

MATCH LINE STA 238+00

B-015-1-16

℄ S.R. 8 S.B.

238 239 240 241 242

B-023-0-48

EXISTING BRIDGE FOOTING (TYP)

B-026-0-48

Crane Position 11

MATCH LINE STA. 542+00 N.B. & STA. 242+12 S.B.

538 539 540 541

℄ S.R. 8 N.B.

B-015-0-15

PC Sta. 541+71.27

MATCH LINE STA 538+00

B-025-0-48

B-027-0-48

BRIDGE FOOTING FOR PIER 5

B-017-0-15

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE NO. SUM-8-0199, STA 538+00 TO STA 542+00 S.R. 8 N.B. & STA 238+00 TO STA 242+12 S.R. 8 S.B.

SUM-8-1.75

40/128

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STRUCTURE FOUNDATION EXPLORATION

BRIDGE NO. SUM-8-0199, STA 538+00 TO STA 542+00 S.R. 8 N.B.

SUM-8-1.75

42/128

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN YLZ
CHECKED TLM

Crane Location 11

GR EL. 1037

℄ PIER 5

EXISTING BRIDGE

B-017-0-15
8' RT.
TOPSOIL = 5"

B-015-0-15
12' RT.

B-025-0-48
51' RT.

ROCK FRAGMENTS

Soil 1
Soil 1A
Soil 2
Soil 3

EL. 1003.5
EL. 992.5
EL. 956.5
EL. 954.5
EL. 943
EL. 939
EL. 898.5

W

N_{60} WC

1032.38 1032.09 1031.80 1031.51 1031.22 1030.93 1030.64 1030.35 1030.06 1029.77 1029.48

937.96 946.72 970.52 984.38 1004.79 1022.12 1029.49 1029.34 1029.15 1028.97 1028.76

538 539 540 541 542 543

1040 1030 1020 1010 1000 990 980 970 960 950 940 930 920 910 900 890 880 870 860

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Crane Pad and Tower Foundation Parameters

Objective:

The purpose of these calculations is to determine the subsurface soil strata based on project boring logs to provide geotechnical design parameters for design of foundation of crane pads and tower for SUM-8-1.75.

Source of Data:

1. Boring Logs are from the 2015 and 2016 exploration;
2. Crane pads and tower locations are provided by MS Consultants, Inc.

Assumptions:

1. Subsurface profiles were developed for each substructure, ground water has been assumed based on the borings logs;
2. The saturated unit weight of soil is assumed to be the wet unit weight of soil plus 5 pcf; the unit weight of water is assumed to be 62.5 psf; the unit weight of rock is assumed to be 150 psf;
3. For all the SPT >= 50, an approximate N60 number has been assumed for calculation purpose;
4. When calculated friction angle is larger than 43 degree, use 43 degree as design value;
5. All the data highlighted in yellow is possible outlier and neglected from calculation.

References:

1. Geotechnical Bulletin 7: Drilled Shaft and Landslide Stabilization Design, Ohio Department of Transportation, Division of Geotechnical Engineering, November 2014.
2. GEOTECH CIRCULAR No. 5 Evaluation of Soil & Rock Properties: FHWA-IF-02-034, Ohio Department of Transportation, GeoSyntec Consultants, April 2002.
3. Drilled Shaft: Construction Procedures and LRFD Design Methods, FHWA-NHI-10-016 FHWA GEC 010, Department of Transportation Federal Highway Administration, May 2010.

Definition of parameters:

Depth	Depth of top of the Spoon
Sample Interval	Length between the bottoms of last spoon and this spoon
γ	Moist weight of soil sample obtained based on blow count N_{60} according to Table 1 ref. 1
γ'	effective unit weight of soil sample obtained based on γ and water table and strata depths
N_{60}	N_{60} is the SPT N-value corrected for field procedures and apparatus N_{60} = blow counts X energy ratio/ 60% = (ER/60%)N
σ'_v	Vertical effective stress at the location of the SPT N-value (TSF)
C_N	$C_N = [0.77 \log10 (40/\sigma'v)]$, CN < 2.0
$N1_{60}$	$N1_{60} = C_N X (N_{60})$
CLASF.	AASHTO Soil Classification (ODOT)
HP	hAND penetrometer readings
ϕ'1 (Clean Sand)	Drained friction angle based on SPT for clean sand ϕ' = (15.4X($N1_{60}$))^(0.5)+20° (*Sabatini et al.* , 2002, N_{60} value equivalent Per *Mayerhof* , 1956, See Eq. 72 Ref. 2)
ϕ'1 (Silty Sand*)	drained friction angle based on SPT for saturated silty sand (N_{60}>15) ϕ' = (15.4X(15+((N_{60})-15)/2)*C_N)^(0.5)+20° (*Sabatini et al.* , 2002, N_{60} value equivalent Per *Mayerhof* , 1956, See Eq. 72 Ref. 2)
S_u	Undrained shear strength from In-situ Tests (*Stroud,* 1974 & 1989, See Table 33 Ref. 2) $S_u = (f_{1(}N_{60})P_a)/100$ f_1 = 4.5 for PI = 50; f_1 = 5.5 for PI = 15 Pa = atmospheric pressure, 2116 psf
PI	Plastic Index
W_n	Moisture content
ϕ'2	Drained friction angle developed based on $N1_{60}$ according to *AASHTO Table 10.4.6.2.4-1*
ϕ'_{PI}	Drained friction angle based on PI (*Terzaghi, Peck, and Mesri, 1996, See Fig. 74 Ref. 2*)

Table 10.4.6.2.4-1—Correlation of $SPT\ N1_{60}$ Values to Drained Friction Angle of Granular Soils (ϕ_d modified after Bowles, 1977)

N_{60}	ϕ_d
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

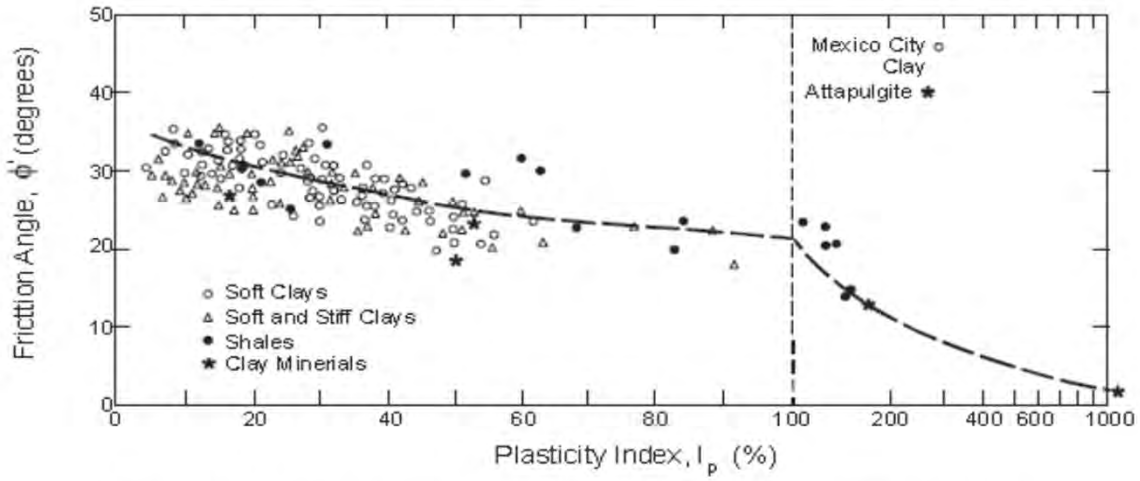


Figure 74. Relationship between ϕ' and PI (Terzaghi, Peck, and Mesri, 1996).

B-006-0-15 **Surface Elevation=** 1020.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
3.5	1017.0	1.5	5.0	0.125	27	0.53125	1.44511	39	A-1-b		44.5					11
6	1014.5	2.5	7.5	0.125	24	0.84375	1.2904	31	A-3		41.8					14
8.5	1012.0	2.5	10.0	0.125	29	1.15625	1.18504	34	A-3		43.0					10
11	1009.5	2.5	12.5	0.13	20	1.4775	1.10305	22	A-3		38.4					14
13.5	1007.0	2.5	15.0	0.13	19	1.8025	1.03656	20	A-6b	4.5			2211.2	16	36	24

Strata No.	B-006-0-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	S	0	13.5	1007.0	13.5	25	32	126	42	38						12
Strata 2	C	13.5	16.5	1004.0	3.0	19	20	130			4,500	2,211	16	31.0	36	24

B-010-0-15 **Surface Elevation=** 879.2 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	Wn (%)
3.5	875.7	1.5	5.0	0.11	5	0.4675	1.48785	7	A-7-6	1			582	24	45	26
6	873.2	2.5	7.5	0.125	17	0.76875	1.32153	22	A-6b				1978			10
8.5	870.7	2.5	10.0	0.13	43	1.09	1.20477	52	A-6b				5004	20	39	9
11	868.2	2.5	12.5	0.135	45	1.42375	1.11544	50	A-6b				5237			11
13.5	865.7	2.5	15.0	0.135	78	1.76125	1.0443	81	A-6b				9078			13
16	863.2	2.5	17.5	0.135	78	2.09875	0.98568	77	A-6b				9078			7

Strata No.	B-010-0-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. $N_{60.}$ (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	6.7	8.5	870.7	1.8	17	22	125				1,978			45	10
Strata 2	C	8.5	18.5	860.7	10.0	69	71	134				8,007	20	30.5	39	10

B-010-1-15 **Surface Elevation=** 875 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	Wn (%)
1	874.0	1.5	2.5	0.125	20	0.219	1.742	35	A-6a	4			2,328			24
3.5	871.5	2.5	5.0	0.125	19	0.531	1.445	27	A-6a	4			2,211			26
6	869.0	2.5	7.5	0.125	9	0.84375	1.2904	12	A-6a	4			1,047	14	37	26
8.5	866.5	2.5	10.0	0.125	11	1.15625	1.18504	13	A-1-b		34.1					18
11	864.0	2.5	12.5	0.12	8	1.46	1.10703	9	A-1-b		31.8					17
13.5	861.5	2.5	15.0	0.135	51	1.78625	1.03959	53	A-1-b		48.6					9
16	859.0	2.5	17.5	0.135	83	2.12375	0.98172	81	A-1-b		55.3					9

Strata No.	B-010-1-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	C=S_u (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	0	8.5	866.5	8.5	16	25	125			4000	1,862	14	31.5	37	25
Strata 2	G	8.5	13.5	861.5	5.0	10	11	123	33	36						18
Strata 3	G	13.5	16.3	858.7	2.8	67	67	135	52	44						9

B-010-2-15 **Surface Elevation=** 875 **Water Dep. (ft.)=** 14.9 Water Elv. = 860.1

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	Wn (%)
1	874.0	1.5	2.5	0.125	32	0.219	1.742	56	A-1-b		49.4					12
3.5	871.5	2.5	5.0	0.125	100	0.531	1.445	145	A-1-b		67.3					12
6	869.0	2.5	7.5	0.125	16	0.84375	1.2904	21	A-7-6	2.5			1,862			28
8.5	866.5	2.5	10.0	0.13	31	1.165	1.18252	37	A-7-6	3			3,608			30
11	864.0	2.5	12.5	0.13	17	1.49	1.10023	19	A-7-6	3			1,978			32
13.5	861.5	2.5	15.0	0.135	59	1.82375	1.03264	61	A-7-6	4.5			6,866	22	42	33
16	859.0	2.5	17.5	0.0776	31	2.0608	0.99178	31	A-7-6	3.5			3,608			33
18.5	856.5	2.5	20.0	0.0726	29	2.24605	0.96299	28	A-7-6	4			3,375			37
21	854.0	2.5	22.5	0.0826	100	2.44505	0.9346	93	A-7-6	4			11,638			38

Strata No.	B-010-2-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	C=S_u (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	0	21.5	853.5	21.5	31	36	131			3500	4,345	22	30.0	42	33

B-012-0-15 **Surface Elevation=** 880.2 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	Wn (%)
1	879.2	1.5	2.5	0.125	20	0.219	1.742	35	A-1-b		43.2					5
3.5	876.7	2.5	5.0	0.125	20	0.531	1.445	29	A-1-b		41.1					6
6	874.2	2.5	7.5	0.11	4	0.8175	1.30097	5	A-1-b		28.8					13
8.5	871.7	2.5	10.0	0.125	28	1.11875	1.19606	33	A-1-b		42.5					12
11	869.2	2.5	12.5	0.135	32	1.44875	1.10962	36	A-4a	2			3,724	7	28	30
13.5	866.7	2.5	15.0	0.135	56	1.78625	1.03959	58	A-1-a		49.9					
16	864.2	2.5	17.5	0.135	42	2.12375	0.98172	41	A-1-a		45.1					
18.5	861.7	2.5	20.0	0.135	55	2.46125	0.9324	51	A-1-a		48.0					
21	859.2	2.5	22.5	0.14	88	2.8075	0.88838	78	A-1-a		54.7					

Strata No.	B-012-0-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	G	0	9.5	870.7	9.5	16	19	118	36	38						13
Strata 2	C	9.5	13.5	866.7	4.0	32	36	135			2000	3,724	7	33.0	28	30
Strata 3	G	13.5	22.0	858.2	8.5	60	57	136	49	43						

B-017-0-15 **Surface Elevation=** 1024.4 **Water Dep. (ft.)=** 58 Water Elv. = 966.4

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	Wn (%)
1	1023.4	1.5	2.5	0.12	12	0.21	1.75548	21	A-1-b		38.0					13
3.5	1020.9	2.5	5.0	0.11	7	0.4925	1.47043	10	A-1-b		32.4					12
6	1018.4	2.5	7.5	0.12	7	0.785	1.31454	9	A-1-b		31.8					12
8.5	1015.9	2.5	10.0	0.12	7	1.085	1.20631	8	A-1-b		31.1					14
11	1013.4	2.5	12.5	0.12	7	1.385	1.12467	8	A-1-b		31.1					12
13.5	1010.9	2.5	15.0	0.12	7	1.685	1.0591	7	A-1-b		30.4					11
16	1008.4	2.5	17.5	0.125	9	1.99375	1.00284	9	A-1-b		31.8					10
18.5	1005.9	2.5	20.0	0.12	8	2.2975	0.95542	8	A-1-b		31.1					11
21	1003.4	2.5	22.5	0.13	15	2.615	0.91213	14	A-1-b		34.7					12
23.5	1000.9	2.5	25.0	0.14	32	2.9575	0.87097	28	A-3		40.8					13
26.0	998.4	2.5	27.5	0.14	32	3.3075	0.83357	27	A-3		40.4					15
28.5	995.9	2.5	30.0	0.13	11	3.64	0.80154	9	A-3		31.8					17
31.0	993.4	2.5	32.5	0.14	55	3.9825	0.77147	42	A-1-b		45.4					14
33.5	990.9	2.5	35.0	0.14	54	4.3325	0.7433	40	A-1-b		44.8					12
36.0	988.4	2.5	37.5	0.14	44	4.6825	0.71732	32	A-1-b		42.2					12
38.5	985.9	2.5	40.0	0.14	34	5.0325	0.69321	24	A-3		39.2					15
43.5	980.9	5	45.0	0.145	94	5.75375	0.64842	61	A-1-b		50.6					12
48.5	975.9	5	50.0	0.145	32	6.47875	0.60874	19	A-1-b		37.1					12
53.5	970.9	5	55.0	0.145	35	7.20375	0.57327	20	A-4a	4.25			4,073			17
58.5	965.9	5	60.0	0.0876	38	7.6848	0.55165	21	A-3			35.0				14
63.5	960.9	5	65.0	0.0876	35	8.1228	0.53311	19	A-3			34.3				9
68.5	955.9	5	70.0	0.0876	59	8.5608	0.51555	30	A-1-b		41.5					10

Strata No.	B-017-0-15															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	Avg. N_{60} (dim.)	Avg $N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	C=S_u (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	G	0	21.0	1003.4	21.0	7	8	119	31.4	34.7						12
Strata 1A	S	21.0	31.5	992.9	10.5	23	20	135	36.9	35.9						14
Strata 2	S	31.5	70.0	954.4	38.5	43	27	143	40.0	37.2						13

B-005-1-16 **Surface Elevation=** 1036.6 **Water Dep. (ft.)=** Dry Water Elv. =

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Dry Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
2.5	1034.1	1.5	4.0	0.125	38	0.406	1.535	58	A-3a		49.9					10
5	1031.6	2.5	6.5	0.13	48	0.728	1.340	64	A-3a		51.4					10
7.5	1029.1	2.5	9.0	0.125	22	1.044	1.219	27	A-4a	3.25			2,560			14
10	1026.6	2.5	11.5	0.13	21	1.365	1.130	24	A-4a	1.5			2,444	10	26	16
12.5	1024.1	2.5	14.0	0.13	19	1.690	1.058	20	A-4a	4			2,211			14
15	1021.6	2.5	16.5	0.135	51	2.024	0.998	51	A-4a	3.25			5,935	6	22	13
17.5	1019.1	2.5	19.0	0.13	22	2.353	0.948	21	A-1-b		38.0					4
20	1016.6	2.5	21.5	0.135	19	2.686	0.903	17	A-4a(NP)		36.2					16

Strata No.	B-005-1-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	S	1.5	7.0	1029.6	5.5	43	61	128	50.6	41.0						10
Strata 2	C	7.0	22.0	1014.6	15.0	26	27	131			3000	3288	8	33	24	15

B-011-3-16 **Surface Elevation=** 873.8 **Water Dep. (ft.)=** 13 Water Elv. = 861

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
1	872.8	1.5	2.5	0.125	22	0.219	1.742	38	A-4a	3			2,560			15
3.5	870.3	2.5	5.0	0.12	9	0.523	1.451	13	A-4a	2.5			1,047	7	25	14
6	867.8	2.5	7.5	0.12	5	0.823	1.299	6	A-3a		29.6					12
8.5	865.3	2.5	10.0	0.12	7	1.123	1.195	8	A-4a	1.75			815			14
11	862.8	2.5	12.5	0.13	19	1.440	1.112	21	A-2-4		38.0					18
13.5	860.3	2.5	15.0	0.0726	20	1.665	1.063	21	A-3a		38.0					22
16	857.8	2.5	17.5	0.0776	50	1.855	1.027	51	A-1-b		48.0			5	21	10
18.5	855.3	2.5	20.0	0.0776	100	2.049	0.994	99	A-1-b		59.0					8
21	852.8	2.5	22.5	0.0826	100	2.252	0.962	96	A-1-b		58.4					6
23.5	850.3	2.5	25.0	0.0826	78	2.458	0.933	73	A-4a	4.3			9,078			10
26	847.8	2.5	27.5	0.0826	100	2.665	0.906	91	A-1-b		57.4					12
28.5	845.3	2.5	30.0	0.0826	100	2.871	0.881	88	A-2-6			47.9				9
33.5	840.3	5.5	35.5	0.0826	100	3.305	0.834	83	A-1-b		55.8					10

Strata No.	B-011-3-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	0.5	11.0	862.8	10.5	7	9	120			2420	1474	7	33	25	14
Strata 2	G/SL	11.0	14.5	859.3	3.5	20	21	130	38.0	37.3						20
Strata 3	G	14.5	35.5	838.3	21.0	90	83	139	54.4	45.0						9

B-011-2-16 **Surface Elevation=** 872.6 **Water Dep. (ft.)=** Dry Water Elv. = 861

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
2.5	870.1	1.5	4.0	0.125	26	0.406	1.535	40	A-4a	3.5			3,026			12
5	867.6	2.5	6.5	0.12	7	0.710	1.348	9	A-4a	1.5			815	7	24	15
7.5	865.1	2.5	9.0	0.125	11	1.019	1.227	14	A-3a		34.7					12
10	862.6	2.5	11.5	0.125	12	1.331	1.138	14	A-1-b		34.7					12
12.5	860.1	2.5	14.0	0.0776	100	1.561	1.085	108	A-4a	4			11,638	8	25	11
15	857.6	2.5	16.5	0.0776	100	1.755	1.046	105	A-1-a		60.2					4
17.5	855.1	2.5	19.0	0.0776	70	1.949	1.010	71	A-2-6			45.7				11
20	852.6	2.5	21.5	0.0826	34	2.152	0.977	33	A-1-b		42.5					15
22.5	850.1	2.5	24.0	0.0826	75	2.358	0.947	71	A-2-6			45.6				11

Strata No.	B-011-2-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	1	7.5	865.1	6.5	17	25	123			2500	1920	7	33	24	14
Strata 2	G	7.5	12	860.6	4.5	12	14	125	34.7	36.9						12
Strata 3	G/SL	12	25.0	847.6	13.0	76	78	137	48.5	43.4						12

B-011-5-16 **Surface Elevation=** 875.2 **Water Dep. (ft.)=** 8 Water Elv. = 867.2

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
1	874.2	1.5	2.5	0.125	22	0.219	1.742	38	A-4a	4			2560			22
3.5	871.7	2.5	5.0	0.11	6	0.505	1.462	9	A-4a	2.25			698			19
6	869.2	2.5	7.5	0.125	13	0.806	1.306	17	A-4b(NP)		36.2					25
8.5	866.7	2.5	10.0	0.0676	13	1.018	1.228	16	A-1-b		35.7					12
11	864.2	2.5	12.5	0.0776	40	1.205	1.171	47	A-4a	4			4655	5	23	13
13.5	861.7	2.5	15.0	0.0776	34	1.399	1.121	38	A-4a	4			3957			13
16	859.2	2.5	17.5	0.0776	54	1.593	1.078	58	A-2-6			43.9				12
18.5	856.7	2.5	20.0	0.0776	43	1.787	1.039	45	A-1-a		46.3					8
21	854.2	2.5	22.5	0.0826	73	1.990	1.004	73	A-1-b		53.5					8
23.5	851.7	2.5	25.0	0.0826	91	2.196	0.971	88	A-2-6			48.1				11
26	849.2	2.5	27.5	0.0826	51	2.403	0.940	48	A-6a	4.5			5935	12	32	9
28.5	846.7	2.5	30.0	0.0826	49	2.609	0.913	45	A-6a	4.5			5703			9
33.5	841.7	5	35.0	0.0826	58	3.022	0.864	50	A-6a	4.5			6750			11

Strata No.	B-011-5-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	C	1.0	15.0	860.2	14.0	21	28	126			3563	2968	5	34.0	23	17
Strata 2	G/SL	15.0	25.0	850.2	10.0	65	66	138	48.0	42.6						10
Strata 3	C	25.0	37.5	837.7	12.5	53	48	140			4500	6129	12	32.0	32	10

B-013-2-16 **Surface Elevation=** 880.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
1	879.5	1.5	2.5	0.12	12	0.21	1.755477	21	A-3a		38.0					11
3.5	877.0	2.5	5.0	0.105	4	0.48375	1.476428	6	A-2-4		29.6					18
6	874.5	2.5	7.5	0.12	6	0.7725	1.319904	8	A-3a		31.1					12
8.5	872.0	2.5	10.0	0.11	3	1.055	1.215682	4	A-3a		27.8					19
11	869.5	2.5	12.5	0.125	9	1.35625	1.131685	10	A-1-b		32.4					15
13.5	867.0	2.5	15.0	0.13	16	1.6775	1.060596	17	A-1-b		36.2					16
16	864.5	2.5	17.5	0.125	12	1.99375	1.00284	12	A-1-b		33.6					18
18.5	862.0	2.5	20.0	0.12	7	2.2975	0.955419	7	A-1-b		30.4					17
21	859.5	2.5	22.5	0.135	28	2.62375	0.911016	26	A-2-4		40.0					19
23.5	857.0	2.5	25.0	0.14	42	2.97	0.869564	37	A-6a	4			4888			12
26	854.5	2.5	27.5	0.14	75	3.32	0.83231	62	A-6a	4.5			8729	13	30	11

Strata No.	B-013-2-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	G/SL	0	20.5	860.0	20.5	9	11	119	32.4	34.6						16
Strata 2	C	20.5	29.0	851.5	8.5	48	42	138			4250	6808	13	31.5	30	14

B-013-3-16 **Surface Elevation=** 885.5 **Water Dep. (ft.)=** 15 Water Elv. = 870.5

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	H.P. (tsf.)	Clean Sand ϕ1' (deg.)	Silty Sand ϕ1' (deg.)	S_u (psf.)	PI (%)	LL (%)	W_n (%)
1	884.5	1.5	2.5	0.125	16	0.21875	1.741826	28	A-1-b		40.8					16
3.5	882.0	2.5	5.0	0.125	16	0.53125	1.445106	23	A-3a		38.8					8
6	879.5	2.5	7.5	0.13	32	0.8525	1.286952	41	A-3a		45.1					7
8.5	877.0	2.5	10.0	0.125	9	1.16875	1.181441	11	A-1-b		33.0					13
11	874.5	2.5	12.5	0.12	8	1.4725	1.104184	9	A-1-b		31.8					26
13.5	872.0	2.5	15.0	0.115	4	1.76375	1.04383	4	A-6a	1			466	14	38	32
16	869.5	2.5	17.5	0.0676	11	1.9683	1.007136	11	A-2-4		33.0					16
18.5	867.0	2.5	20.0	0.0726	24	2.14605	0.978224	23	A-1-a		38.8					15
21	864.5	2.5	22.5	0.0826	54	2.34505	0.948569	51	A-1-b		48.0					10
23.5	862.0	2.5	25.0	0.0826	43	2.55155	0.920347	40	A-1-b		44.8					11
26	859.5	2.5	27.5	0.0826	51	2.75805	0.894323	46	A-1-b		46.6					9
28.5	857.0	2.5	30.0	0.0826	38	2.96455	0.870178	33	A-1-b		42.5					14
33.5	852.0	5	35.0	0.0826	62	3.37755	0.826563	51	A-1-b		48.0					12
38.5	847.0	5	40.0	0.0826	103	3.79055	0.787985	81	A-1-b		55.3					9

Strata No.	B-013-3-16															
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	N_{60} (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	ϕ'1 (deg.)	ϕ'2 (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)	LL (%)	W_n (%)
Strata 1	S	0	13.5	872.0	13.5	16	22	125.0	37.9	36.3						14
Strata 2	G/SL	13.5	20.5	865.0	7.0	13	13	123.3	35.9	35.3	1000	466	14	31.5	38	21
Strata 3	G	20.5	44.5	841.0	24.0	50	44	138.6	46.0	41.9						11

SUM-8-1.75 Crane Pad and Tower Subsurface Soil Profile Summary Table

Structure	Boring No.	Strata No.	Type	Bot Elv.	Str Dep	N_{60}	$N1_{60}$	γ (pcf)	ϕ'_1 (deg)	ϕ'_2 (deg)	C_1 = HP/2 (psf)	C_2 = Su (psf)	ϕ'_{IP} (deg)	LL (%)	W_n (%)
CL 1	B-005-1-16	Strata 1	S	1029.6	5.5	43	61	127.5	50.6	41.0					10
	B-006-0-15		S	1007.0	13.5	25	32	126.3	41.9	38.0					12
	Avg.		S			30	40	126.6	44.5	38.8					12
	B-005-1-16	Strata 2	C	1014.6	15.0	26	27	130.8			3000	3288	33.0	24	15
	B-006-0-15		C	1004.0	3.0	19	20	130.0			4500	2211	31.0	36	24
	Avg.		C			25	26	130.7			3250	3108	32.7	26	16
CL 3/4	B-010-0-15	Strata 1	C	870.7	1.8	17	22	125.0				1978		45	10
		Strata 2	C	860.7	10.0	69	71	133.8				8007	30.5	39	10
CL 5/6 Tower 1	B-010-1-15	Strata 1	C	866.5	8.5	16	25	125.0			4000	1862	31.5	37	25
	B-011-2-16		C	865.1	6.5	17	25	122.5			2500	1920	33.0	24	14
	B-011-3-16		C	862.8	10.5	7	9	120.0			2420	1474	33.0	25	14
	Avg.		C			13	18	122.3			2967	1717	32.5	29	17
	B-010-1-15	Strata 2	G	861.5	5.0	10	11	122.5	33.0	35.9					18
	B-011-2-16		G	860.6	4.5	12	14	125.0	34.7	36.9					12
	B-011-3-16		G/SL	859.3	3.5	20	21	130.0	38.0	37.3					20
	Avg.		G/SL			13	15	125.4	34.9	36.6					16
	B-010-1-15	Strata 3	G	858.7	2.8	67	67	135.0	51.9	43.9					9
	B-011-2-16		G/SL	847.6	13.0	76	78	137.0	48.5	43.4					12
	B-011-3-16		G	838.3	21.0	90	83	138.6	54.4	45.0					9
	Avg.		G/SL			83	80	137.7	52.1	44.4					10
CL7	B-012-0-15	Strata 1	G	870.7	9.5	16	19	117.5	35.7	38.2					13
		Strata 2	C	866.7	4.0	32	36	135.0			2000	3724	33.0	28	30
		Strata 3	G	858.2	8.5	60	57	136.3	49.4	43.1					
CL 8	B-012-0-15	Strata 1	G	870.7	9.5	16	19	117.5	35.7	38.2					13
	B-013-2-16		G/SL	860.0	20.5	9	11	119.4	32.4	34.6					16
	Avg.		G/SL			11	14	118.8	33.4	35.8					15
	B-012-0-15	Strata 2	C	866.7	4.0	32	36	135.0			2000	3724	33.0	28	30
	B-013-2-16		C	851.5	8.5	48	42	138.3			4250	6808	31.5	30	14
	Avg.		C			43	40	137.3			3530	5821	32.0	29	19
	B-012-0-15	Strata 3	G	858.2	8.5	60	57	136.3	49.4	43.1					
CL 9	B-013-2-16	Strata 1	G/SL	860.0	20.5	9	11	119.4	32.4	34.6					16
	B-013-3-16		S	872.0	13.5	16	22	125.0	37.9	36.3					14
	Avg.		S			12	15	121.6	34.6	35.3					15
	B-013-2-16	Strata 2	C	851.5	8.5	48	42	138.3			4250	6808	31.5	30	14
	B-013-3-16		G/SL	865.0	7.0	13	13	123.3	35.9	35.3	1000	466	31.5	38	21
	Avg.		C			32	29	131.6			2782	3944	31.5	34	17
	B-013-3-16	Strata 3	G	841.0	24.0	50	44	138.6	46.0	41.9					11
CL 10	B-013-3-16	Strata 1	S	872.0	13.5	16	22	125.0	37.9	36.3					14
		Strata 2	G/SL	865.0	7.0	13	13	123.3	35.9	35.3	1000	466	31.5	38	21
		Strata 3	G	841.0	24.0	50	44	138.6	46.0	41.9					11
CL 11	B-017-0-15	Strata 1	G	1003.4	21.0	7	8	119.4	31.4	34.7					12
		Strata 1A	S	992.9	10.5	23	20	135.0	36.9	35.9					14
		Strata 2	S	954.4	38.5	43	27	143.0	40.0	37.2					13
Tower 2	B-010-2-15	Strata 1	C	853.5	21.5	31	36	130.6			3500	4345	30.0	42	33
	B-011-5-16		C	860.2	14	21	28	125.8			3563	2968	34.0	23	17
	Avg.		C			27	33	128.7			3525	3802	31.6	35	27
	B-011-5-16	Strata 2	G/SL	850.2	10	65	66	137.5	48.0	42.6					10
	B-011-5-16	Strata 3	C	837.7	12.5	53	48	140.0			4500	6129	32.0	32	10

SUM-8-1.75 Crane Pad and Tower Subsurface Geotechnical Design Paramters Summary Table

Structure	Strata No.	Type	N_{60}	$N1_{60}$	γ_m (pcf)	γ_{sat} (pcf)	γ' (pcf)	ϕ' (deg)	C (psf)	ϕ'_{IP} (deg)	LL (%)	W_n (%)
CL 1	Strata 1	S	30	40	126.5	131.5	69.0	41.5				12
	Strata 2	C	25	26	130.5	135.5	73.0		3100	32.5	26	16
CL 3/4	Strata 1	C	17	22	125.0	130.0	67.5		1900		45	10
	Strata 2	C	69	71	134.0	139.0	76.5		8000	30.5	39	10
CL 5/6 Tower 1	Strata 1	C	13	18	122.5	127.5	65.0		2300	32.5	29	17
	Strata 2	G/SL	13	15	125.5	130.5	68.0	35.5				16
	Strata 3	G/SL	83	80	137.5	142.5	80.0	43.0				10
CL7	Strata 1	G	16	19	117.5	122.5	60.0	36.5				13
	Strata 2	C	32	36	135.0	140.0	77.5		2800	33.0	28	30
	Strata 3	G	60	57	136.5	141.5	79.0	43.0				1
CL 8	Strata 1	G/SL	11	14	119.0	124.0	61.5	34.5				15
	Strata 2	C	43	40	137.5	142.5	80.0		4600	31.5	29	19
	Strata 3	G	60	57	136.5	141.5	79.0	43.0				1
CL 9	Strata 1	S	12	15	121.5	126.5	64.0	34.5				15
	Strata 2	C	32	29	131.5	136.5	74.0		2000	31.5	34	17
	Strata 3	G	50	44	138.5	143.5	81.0	43.0				11
CL10	Strata 1	S	16	22	125.0	130.0	67.5	37.0				14
	Strata 2	G/SL	13	13	123.5	128.5	66.0	35.5				21
	Strata 3	G	50	44	138.5	143.5	81.0	43.0				11
CL11	Strata 1	G	7	8	119.5	124.5	62.0	33.0				12
	Strata 1A	S	23	20	135.0	140.0	77.5	36.0				14
	Strata 2	S	43	27	143.0	148.0	85.5	38.5				13
Tower 2	Strata 1	C	27	33	128.5	133.5	71.0		3600	30	35	27
	Strata 2	G/SL	65	66	137.5	142.5	80.0	43.0				10
	Strata 3	C	53	48	140	145	82.5		5300	32	32	10

Note:
1. The design parameter of Strata 2 of CL 8 is developed based on Borings B-013-2-16 and B-013-3-16, the soil profile consists both cohesive and granular material, the shear strength of soil is modeled as a cohesive layer with C = 2000 psf to be conservative;
2. Due to the existence of small amount of cohesive material in strata 2 of CL 10, the design friction angle is reduced to be 37 degree to be conservative.

Appendix F.7

Noise Barrier Foundation Design

OBJECTIVE:

The purpose of these calculations is to determine the drilled shafts depth for 1A, 1B, 2A, 2B, 3 and

SOURCE OF DATA:

1. Boring Logs from the 2015 and 2016 exploration;
2. The Soil Parameters Summary prepared and checked by GF based on the project borings;
3. Noise Barrier Supper structure layout and ground grading are provided by GF roadway group.

ASSUMPTIONS:

1. For Wall height is less than or equal to 20 feet, the foundation shaft length is calculated based on ODOT BDM Section 800;
2. Assume all propsed fill to be granular with a corrected SPT N-value of 20;
3. Assume weaker bedrock based off of unconfined compressive strength tests <7500 psi and 5 feet rock socket will be applied if bedrock is anticipated within drilled shaft length required;
4. For Wall height is over 20 feet, the foundation shaft length is calculate based on p-y analysis by using LPILE (See attachment for detailed calculation).

CODES AND STANDARDS:

1. ODOT Bridge Design Manual (BDM, 2007 LRFD).

ATTACHMENT:

1. SUM-8 Noise Barriers Boring Data;

NOISE WALL 1A														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Post ELEV	Max Barrier Height	Bottom of Post ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
1	00+80.00	8	1028.00	5.00	1023.00	1022.75	NA	7.50	0.00	2:1	B-021-2-16	Granular	20	
2	00+88.00	8	1032.00	9.00	1023.00	1022.70	NA	7.50	0.00	2:1	B-021-2-16	Granular	20	
3	00+96.00	8	1036.00	13.00	1023.00	1022.70	NA	10.00	0.00	2:1	B-021-2-16	Granular	14	
4	01+04.00	24	1040.00	17.00	1023.00	1022.55	NA	19.00	0.00	2:1	B-021-2-16	Granular	14	7.5' Fill
5	01+28.00	24	1040.00	17.00	1023.00	1022.55	NA	19.00	0.00	2:1	B-021-2-16	Granular	14	
6	01+52.00	24	1040.00	17.00	1023.00	1022.55	NA	19.00	0.00	2:1	B-021-2-16	Granular	14	
7	01+76.00	24	1040.00	17.00	1023.00	1022.55	NA	19.00	0.00	2:1	B-021-2-16	Granular	14	
8	02+00.00	24	1041.00	19.00	1022.00	1021.55	NA	20.00	0.00	2:1	B-023-0-15	Granular	4	
9	02+24.00	24	1041.00	19.00	1022.00	1021.55	NA	20.00	0.00	2:1	B-023-0-15	Granular	4	
10	02+48.00	24	1042.00	20.00	1022.00	1021.55	NA	20.00	0.00	2:1	B-023-0-15	Granular	4	
11	02+72.00	24	1043.00	21.00	1022.00	1021.55	NA	20.00	0.00	2:1	B-023-0-15	Granular	NA	
12	02+96.00	24	1043.00	21.00	1022.00	1021.55	NA	20.00	0.00	2:1	B-023-0-15	Granular	NA	
13	03+20.00	24	1043.00	21.00	1022.00	1021.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
14	03+44.00	16	1043.00	21.00	1022.00	1021.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
15	03+60.00	16	1043.00	21.00	1022.00	1021.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
16	03+76.00	16	1043.00	21.00	1022.00	1021.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
17	03+92.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
18	04+16.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-025-0-15	Granular	NA	
19	04+40.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-025-3-16	Granular	NA	
20	04+64.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-025-3-16	Granular	NA	
21	04+88.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-025-3-16	Granular	NA	
22	05+12.00	24	1043.00	22.00	1021.00	1020.55	21.50	20.00	0.00	2:1	B-026-0-15	Granular	NA	
23	05+36.00	24	1042.00	21.00	1021.00	1020.55	27.00	20.00	0.00	2:1	B-026-0-15	Granular	NA	
24	05+60.00	24	1042.00	21.00	1021.00	1020.55	27.00	20.00	0.00	2:1	B-026-0-15	Granular	NA	
25	05+84.00	24	1042.00	22.00	1020.00	1019.55	27.00	20.00	0.00	2:1	B-026-0-15	Granular	NA	
26	06+08.00	24	1041.00	21.00	1020.00	1019.55	27.00	20.00	0.00	2:1	B-026-0-15	Granular	NA	
27	06+32.00	24	1041.00	21.00	1020.00	1019.55	27.00	20.00	0.00	2:1	B-026-0-15	Granular	NA	
28	06+56.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
29	06+80.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
30	07+04.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
31	07+28.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
32	07+52.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
33	07+76.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
34	08+00.00	24	1041.00	21.00	1020.00	1019.55	24.00	15.00	0.00	2:1	B-030-1-16	Granular	NA	
35	08+24.00	24	1041.00	21.00	1020.00	1019.55	11.00	10.00	0.00	2:1	B-031-1-16	Granular	NA	
36	08+48.00	24	1041.00	21.00	1020.00	1019.55	11.00	10.00	0.00	2:1	B-031-1-16	Granular	NA	
37	08+72.00	8	1041.00	21.00	1020.00	1019.55	11.00	10.00	0.00	2:1	B-031-1-16	Granular	NA	
38	08+80.00	8	1037.00	17.00	1020.00	1019.70	11.00	10.00	0.00	2:1	B-031-1-16	Cohesive	25	
39	08+88.00	8	1033.00	13.00	1020.00	1019.70	11.00	6.00	0.00	2:1	B-031-1-16	Cohesive	20	4' Cut
40	08+96.00	8	1029.00	9.00	1020.00	1019.75	11.00	6.00	0.00	2:1	B-031-1-16	Cohesive	20	

* Shaft Length is calculated based on p-y analysis by using LPILE

Note: * The Wall height for Shaft No. 8 to 10 is less than or equal to 20 feet, the shaft length can be calculated according to BDM Section 800. However, detailed p-y analysis has been performed for this section (Shaft No. 8 to 12), the shaft length is based on the p-y analysis.

NOISE WALL 1B														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Post ELEV	Max Barrier Height	Bottom of Post ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
1	10+00.00	24	1040.00	17.00	1023.00	1022.65	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
2	10+24.00	24	1040.00	17.00	1023.00	1022.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
3	10+48.00	24	1040.00	16.00	1024.00	1023.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
4	10+72.00	24	1041.00	17.00	1024.00	1023.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
5	10+96.00	24	1041.00	17.00	1024.00	1023.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
6	11+20.00	24	1042.00	18.00	1024.00	1023.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
7	11+44.00	24	1042.00	17.00	1025.00	1024.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
8	11+68.00	24	1043.00	17.00	1026.00	1025.55	16.50	9.50	0.00	3:1	B-031-1-16	Cohesive	20	
9	11+92.00	24	1043.00	17.00	1026.00	1025.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
10	12+16.00	24	1044.00	17.00	1027.00	1026.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
11	12+40.00	24	1044.00	17.00	1027.00	1026.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
12	12+64.00	24	1045.00	17.00	1028.00	1027.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
13	12+88.00	24	1046.00	18.00	1028.00	1027.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
14	13+12.00	24	1046.00	17.00	1029.00	1028.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
15	13+36.00	24	1047.00	17.00	1030.00	1029.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
16	13+60.00	24	1047.00	16.00	1031.00	1030.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
17	13+84.00	24	1048.00	17.00	1031.00	1030.55	5.00	10.00	5.00	3:1	B-031-3-16	Rock	64	
18	14+08.00	24	1049.00	17.00	1032.00	1031.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
19	14+32.00	24	1049.00	17.00	1032.00	1031.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
20	14+56.00	24	1049.00	17.00	1032.00	1031.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
21	14+80.00	24	1049.00	18.00	1031.00	1030.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
22	15+04.00	24	1049.00	18.00	1031.00	1030.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
23	15+28.00	24	1050.00	19.00	1031.00	1030.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
24	15+52.00	24	1050.00	19.00	1031.00	1030.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
25	15+76.00	24	1050.00	20.00	1030.00	1029.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
26	16+00.00	24	1050.00	20.00	1030.00	1029.55	21.50	9.50	0.00	3:1	B-033-0-16	Cohesive	51	
27	16+24.00	24	1050.00	21.00	1029.00	1028.55	21.50	9.00	0.00	3:1	B-033-0-16	Cohesive	NA	Shaft Length is calculated based on p-y analysis by using LPILE
28	16+48.00	16	1051.00	22.00	1029.00	1028.55	21.50	9.00	0.00	3:1	B-033-0-16	Cohesive	NA	
29	16+64.00	16	1052.00	23.00	1029.00	1028.55	21.50	9.00	0.00	3:1	B-033-0-16	Cohesive	NA	
30	16+80.00	16	1053.00	24.00	1029.00	1028.55	21.50	9.00	0.00	3:1	B-034-0-16	Cohesive	NA	
31	16+96.00	24	1053.00	22.00	1031.00	1030.55	21.50	9.00	0.00	3:1	B-034-0-16	Cohesive	NA	

NOISE WALL 1B														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Post ELEV	Max Barrier Height	Bottom of Post ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
32	17+20.00	24	1053.00	20.00	1033.00	1032.55	21.50	15.00	0.00	3:1	B-034-0-16	Cohesive	11	
33	17+44.00	24	1053.00	19.00	1034.00	1033.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
34	17+68.00	24	1053.00	19.00	1034.00	1033.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
35	17+92.00	24	1053.00	17.00	1036.00	1035.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
36	18+16.00	24	1053.00	17.00	1036.00	1035.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
37	18+40.00	24	1053.00	17.00	1036.00	1035.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
38	18+64.00	24	1053.00	17.00	1036.00	1035.55	21.50	13.00	0.00	Level	B-034-0-16	Cohesive	11	
39	18+88.00	24	1053.00	17.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
40	19+12.00	24	1053.00	17.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
41	19+36.00	24	1053.00	17.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
42	19+60.00	24	1054.00	18.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
43	19+84.00	24	1054.00	18.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
44	20+08.00	24	1054.00	18.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
45	20+32.00	24	1054.00	18.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
46	20+56.00	24	1054.00	18.00	1036.00	1035.55	19.00	9.00	0.00	Level	B-035-0-16	Cohesive	25	
47	20+80.00	24	1054.00	18.00	1036.00	1035.55	19.00	12.00	0.00	Level	B-036-0-16	Granular	13	
48	21+04.00	24	1054.00	19.00	1035.00	1034.55	19.00	12.00	0.00	Level	B-036-0-16	Granular	13	
49	21+28.00	8	1054.00	19.00	1035.00	1034.55	19.00	9.50	0.00	Level	B-036-0-16	Granular	13	
50	21+36.00	8	1052.00	17.00	1035.00	1034.70	19.00	9.50	0.00	Level	B-036-0-16	Granular	13	
51	21+44.00	8	1048.00	13.00	1035.00	1034.70	19.00	8.00	0.00	Level	B-036-0-16	Granular	13	
52	21+52.00	8	1044.00	9.00	1035.00	1034.75	19.00	6.50	0.00	Level	B-036-0-16	Granular	16	

NOISE WALL 2A														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Wall ELEV	Max Barrier Height	Bottom of Wall ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
1	30+96.00	8	1034.00	6.00	1028.00	1027.75	NA	7.00	0.00	2:1	B-021-3-16	Granular	30	
2	31+04.00	8	1038.00	10.00	1028.00	1027.70	NA	7.00	0.00	2:1	B-021-3-16	Granular	30	
3	31+12.00	8	1041.00	13.00	1028.00	1027.70	NA	10.00	0.00	2:1	B-021-3-16	Granular	16	3.5' Fill
4	31+20.00	24	1041.00	14.00	1027.00	1026.70	NA	12.00	0.00	2:1	B-021-3-16	Granular	16	
5	31+44.00	24	1041.00	14.00	1027.00	1026.70	NA	12.00	0.00	2:1	B-021-3-16	Granular	16	
6	31+68.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-021-3-16	Granular	20	
7	31+92.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-021-3-16	Granular	20	
8	32+16.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-021-3-16	Granular	20	
9	32+40.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-021-3-16	Granular	20	
10	32+64.00	24	swAQ	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
11	32+88.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
12	33+12.00	24	1041.00	14.00	1027.00	1026.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	9' Fill
13	33+36.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
14	33+60.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
15	33+84.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
16	34+08.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
17	34+32.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-025-1-16	Granular	20	
18	34+56.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
19	34+80.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
20	35+04.00	24	1040.00	14.00	1026.00	1025.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
21	35+28.00	24	1039.00	14.00	1025.00	1024.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	9.5' Fill
22	35+52.00	24	1039.00	14.00	1025.00	1024.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
23	35+76.00	24	1039.00	14.00	1025.00	1024.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
24	36+00.00	24	1039.00	14.00	1025.00	1024.70	NA	11.50	0.00	2:1	B-027-0-15	Granular	20	
25	36+24.00	24	1039.00	14.00	1025.00	1024.70	24.50	10.00	0.00	2:1	B-029-1-16	Granular	34	
26	36+48.00	24	1039.00	15.00	1024.00	1023.70	24.50	16.00	0.00	2:1	B-029-1-16	Granular	20	
27	36+72.00	24	1039.00	15.00	1024.00	1023.70	24.50	16.00	0.00	2:1	B-029-1-16	Granular	20	
28	36+96.00	24	1039.00	15.00	1024.00	1023.70	24.50	16.00	0.00	2:1	B-029-1-16	Granular	20	7' Fill
29	37+20.00	24	1039.00	15.00	1024.00	1023.70	24.50	14.00	0.00	3:1	B-029-1-16	Granular	20	
30	37+44.00	24	1039.00	15.00	1024.00	1023.70	24.50	14.00	0.00	3:1	B-029-1-16	Granular	20	
31	37+68.00	24	1039.00	16.00	1023.00	1022.70	24.50	14.50	0.00	4:1	B-031-2-16	Cohesive	14	

NOISE WALL 2A														
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*TOP of Wall ELEV*	*Max Barrier Height*	*Bottom of Wall ELEV*	*TOP OF DRILLED SHAFT ELEVATION*	*TOP OF ROCK DEPTH (feet)*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected N160*	*Remark*
32	*37+92.00*	*24*	*1039.00*	*16.00*	*1023.00*	*1022.70*	*24.50*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	*2.5' Fill*
33	*38+16.00*	*24*	*1039.00*	*17.00*	*1022.00*	*1021.55*	*24.50*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
34	*38+40.00*	*24*	*1039.00*	*17.00*	*1022.00*	*1021.55*	*24.50*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
35	*38+64.00*	*24*	*1039.00*	*17.00*	*1022.00*	*1021.55*	*24.50*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
36	*38+88.00*	*24*	*1039.00*	*17.00*	*1022.00*	*1021.55*	*24.50*	*14.50*	*0.00*	*4:1*	*B-031-2-16*	*Cohesive*	*14*	
37	*39+12.00*	*8*	*1039.00*	*17.00*	*1022.00*	*1021.55*	*13.00*	*10.50*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	*1.5' Cut*
38	*39+20.00*	*8*	*1035.00*	*13.00*	*1022.00*	*1021.70*	*13.00*	*9.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	
39	*39+28.00*	*8*	*1031.00*	*9.00*	*1022.00*	*1021.70*	*13.00*	*7.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	
40	*39+36.00*	*8*	*1027.00*	*5.00*	*1022.00*	*1021.75*	*13.00*	*7.00*	*0.00*	*4:1*	*B-031-4-16*	*Granular*	*14*	

NOISE WALL 2B														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Post ELEV	Max Barrier Height	Bottom of Post ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark:
1	40+48.00	24	1041.00	15.00	1026.00	1025.75	22.00	14.00	0.00	5:1	B-031-2-16	Cohesive	14	
2	40+72.00	24	1042.00	16.00	1026.00	1025.70	22.00	14.00	0.00	5:1	B-031-2-16	Cohesive	14	
3	40+96.00	24	1043.00	15.00	1028.00	1027.70	22.00	14.00	0.00	5:1	B-031-2-16	Cohesive	14	
4	41+20.00	24	1043.00	14.00	1029.00	1028.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
5	41+44.00	24	1044.00	13.00	1031.00	1030.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
6	41+68.00	24	1044.00	12.00	1032.00	1031.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
7	41+92.00	24	1045.00	12.00	1033.00	1032.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
8	42+16.00	24	1045.00	11.00	1034.00	1033.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
9	42+40.00	24	1046.00	11.00	1035.00	1034.70	14.50	10.00	0.00	5:1	B-031-4-16	Granular	10	
10	42+64.00	24	1046.00	10.00	1036.00	1035.70	14.50	8.50	0.00	5:1	B-031-4-16	Granular	10	
11	42+88.00	16	1046.00	10.00	1036.00	1035.70	7.50	12.50	5.00	5:1	B-032-2-16	Granular	18	
12	43+04.00	16	1046.00	12.00	1034.00	1033.70	7.50	12.50	5.00	2:1	B-032-2-16	Granular	18	
13	43+20.00	16	1046.00	12.00	1034.00	1033.70	7.50	12.50	5.00	2:1	B-032-2-16	Granular	18	
14	43+36.00	16	1046.00	12.00	1034.00	1033.70	7.50	12.50	5.00	2:1	B-032-2-16	Granular	18	
15	43+52.00	16	1047.00	12.00	1035.00	1034.70	7.50	12.50	5.00	2:1	B-032-2-16	Granular	18	
16	43+68.00	16	1048.00	13.00	1035.00	1034.70	7.50	12.50	5.00	2:1	B-032-2-16	Granular	18	
17	43+84.00	16	1049.00	13.00	1036.00	1035.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
18	44+00.00	16	1050.00	14.00	1036.00	1035.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
19	44+16.00	16	1051.00	14.00	1037.00	1036.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
20	44+32.00	16	1052.00	13.00	1039.00	1038.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
21	44+48.00	16	1053.00	13.00	1040.00	1039.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
22	44+64.00	16	1054.00	14.00	1040.00	1039.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
23	44+80.00	16	1054.00	13.00	1041.00	1040.70	7.50	12.50	5.00	Level	B-032-2-16	Granular	18	
24	44+96.00	8	1054.00	12.00	1042.00	1041.70	7.50	6.50	0.00	Level	B-032-2-16	Granular	18	
25	45+04.00	8	1051.00	9.00	1042.00	1041.70	7.50	6.50	0.00	Level	B-032-2-16	Granular	18	
26	45+12.00	8	1047.00	5.00	1042.00	1041.75	7.50	6.50	0.00	Level	B-032-2-16	Granular	18	

NOISE WALL 3														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Wall ELEV	Max Barrier Height	Bottom of Wall ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
1	51+04.00	8	1065.00	6.00	1059.00	1058.75	6.50	6.00	0.00	2:1	B-001-5-16	Cohesive	26	
2	51+12.00	8	1068.00	9.00	1059.00	1058.70	6.50	6.00	0.00	2:1	B-001-5-16	Cohesive	26	
3	51+20.00	24	1071.00	12.00	1059.00	1058.70	6.50	11.50	5.00	2:1	B-001-5-16	Cohesive	26	0.5' Cut
4	51+44.00	24	1071.00	13.00	1058.00	1057.70	6.50	11.50	5.00	2:1	B-001-5-16	Cohesive	26	
5	51+68.00	24	1071.00	13.00	1058.00	1057.70	6.50	11.50	5.00	2:1	B-001-5-16	Cohesive	26	
6	51+92.00	24	1071.00	14.00	1057.00	1056.70	6.50	11.50	5.00	2:1	B-001-5-16	Cohesive	26	
7	52+16.00	24	1071.00	15.00	1056.00	1055.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
8	52+40.00	8	1070.00	15.00	1055.00	1054.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
9	52+48.00	8	1069.00	15.00	1054.00	1053.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
10	52+56.00	8	1069.00	17.00	1052.00	1051.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
11	52+64.00	24	1069.00	17.00	1052.00	1051.55	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
12	52+88.00	24	1068.00	16.00	1052.00	1051.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	2' Cut
13	53+12.00	24	1067.00	14.00	1053.00	1052.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
14	53+36.00	24	1066.00	13.00	1053.00	1052.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
15	53+60.00	24	1066.00	13.00	1053.00	1052.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
16	53+84.00	24	1066.00	14.00	1052.00	1051.70	4.50	9.50	5.00	2:1	B-003-4-16	Cohesive	6	
17	54+08.00	24	1066.00	15.00	1051.00	1050.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
18	54+32.00	24	1065.00	15.00	1050.00	1049.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
19	54+56.00	24	1064.00	15.00	1049.00	1048.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
20	54+80.00	24	1063.00	14.00	1049.00	1048.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
21	55+04.00	24	1062.00	14.00	1048.00	1047.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
22	55+28.00	24	1061.00	14.00	1047.00	1046.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
23	55+52.00	24	1060.00	14.00	1046.00	1045.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
24	55+76.00	24	1059.00	13.00	1046.00	1045.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
25	56+00.00	24	1058.00	12.00	1046.00	1045.70	5.50	10.50	5.00	2:1	B-003-8-16	Cohesive	33	
26	56+24.00	24	1058.00	13.00	1045.00	1044.70	5.00	10.00	5.00	2:1	B-004-2-16	Cohesive	6	
27	56+48.00	24	1058.00	14.00	1044.00	1043.70	5.00	10.00	5.00	2:1	B-004-2-16	Cohesive	6	
28	56+72.00	24	1057.00	15.00	1042.00	1041.70	5.00	10.00	5.00	2:1	B-004-2-16	Cohesive	6	
29	56+96.00	24	1056.00	16.00	1040.00	1039.70	5.00	10.00	5.00	Level	B-004-2-16	Cohesive	6	
30	57+20.00	24	1055.00	15.00	1040.00	1039.70	5.00	10.00	5.00	Level	B-004-2-16	Cohesive	6	
31	57+44.00	24	1055.00	14.00	1041.00	1040.70	5.00	10.00	5.00	3:1	B-004-2-16	Cohesive	6	4' Fill
32	57+68.00	24	1055.00	14.00	1041.00	1040.70	8.00	13.00	5.00	2:1	B-004-2-16	Cohesive	6	
33	57+92.00	24	1055.00	14.00	1041.00	1040.70	24.00	11.50	0.00	2:1	B-004-6-16	Granular	20	
34	58+16.00	24	1055.00	14.00	1041.00	1040.70	24.00	11.50	0.00	2:1	B-004-6-16	Granular	20	20' Fill

NOISE WALL 3														
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*TOP of Wall ELEV*	*Max Barrier Height*	*Bottom of Wall ELEV*	*TOP OF DRILLED SHAFT ELEVATION*	*TOP OF ROCK DEPTH (feet)*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected N160*	*Remark*
35	*58+40.00*	*24*	*1054.00*	*14.00*	*1040.00*	*1039.70*	*24.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	*20' Fill*
36	*58+64.00*	*24*	*1054.00*	*14.00*	*1040.00*	*1039.70*	*24.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	
37	*58+88.00*	*24*	*1053.00*	*13.00*	*1040.00*	*1039.70*	*33.00*	*11.50*	*0.00*	*2:1*	*B-004-6-16*	*Granular*	*20*	
38	*59+12.00*	*24*	*1053.00*	*13.00*	*1040.00*	*1039.70*	*41.50*	*11.50*	*0.00*	*2:1*	*B-005-2-16*	*Granular*	*20*	*29' Fill*
39	*59+36.00*	*24*	*1053.00*	*13.00*	*1040.00*	*1039.75*	*41.50*	*11.50*	*0.00*	*2:1*	*B-005-2-16*	*Granular*	*20*	

NOISE WALL 4														
DRILLED SHAFT NO.	WORKPOINT STATION	Post Spacing	TOP of Wall ELEV	Max Barrier Height	Bottom of Wall ELEV	TOP OF DRILLED SHAFT ELEVATION	TOP OF ROCK DEPTH (feet)	SHAFT LENGTH (feet)	Length of Rock Socket (feet)	Slope	Applicable Boring	Primary Soil Type	Design Depth Corrected N160	Remark
1	70+00.00	8	1058.00	7.00	1051.00	1050.75	8.00	6.00	0.00	2:1	B-001-3-16	Cohesive	22	
2	70+08.00	8	1060.00	9.00	1051.00	1050.70	8.00	6.00	0.00	2:1	B-001-3-16	Cohesive	22	
3	70+16.00	8	1062.00	11.00	1051.00	1050.70	8.00	6.00	0.00	2:1	B-001-3-16	Cohesive	22	1' Cut
4	70+24.00	24	1064.00	12.00	1052.00	1051.70	8.00	7.00	0.00	2:1	B-001-3-16	Cohesive	22	
5	70+48.00	24	1065.00	12.00	1053.00	1052.70	8.00	7.00	0.00	2:1	B-001-3-16	Cohesive	22	
6	70+72.00	24	1066.00	12.00	1054.00	1053.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
7	70+96.00	24	1067.00	12.00	1055.00	1054.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
8	71+20.00	24	1068.00	13.00	1055.00	1054.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
9	71+44.00	24	1068.00	13.00	1055.00	1054.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
10	71+68.00	24	1068.00	13.00	1055.00	1054.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
11	71+92.00	24	1068.00	13.00	1055.00	1054.70	6.50	11.50	5.00	2:1	B-001-4-15	Cohesive	22	
12	72+16.00	24	1068.00	15.00	1053.00	1052.70	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
13	72+40.00	24	1068.00	16.00	1052.00	1051.70	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
14	72+64.00	24	1068.00	17.00	1051.00	1050.55	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
15	72+88.00	24	1068.00	19.00	1049.00	1048.55	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	8' Cut
16	73+12.00	24	1067.00	19.00	1048.00	1047.55	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
17	73+36.00	24	1067.00	20.00	1047.00	1046.55	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
18	73+60.00	24	1066.00	20.00	1046.00	1045.55	0.50	5.50	5.00	2:1	B-003-1-15	Rock	NA	
19	73+84.00	24	1066.00	21.00	1045.00	1044.55	3.00	8.00	5.00	2:1	B-003-5-15	Rock	NA	
20	74+08.00	24	1065.00	20.00	1045.00	1044.55	3.00	8.00	5.00	2:1	B-003-5-15	Rock	NA	7' Cut
21	74+32.00	24	1065.00	21.00	1044.00	1043.55	3.00	8.00	5.00	2:1	B-003-5-15	Rock	NA	
22	74+56.00	24	1064.00	20.00	1044.00	1043.55	3.00	8.00	5.00	2:1	B-003-5-15	Rock	NA	
23	74+80.00	24	1063.00	19.00	1044.00	1043.55	1.00	6.00	5.00	2:1	B-003-6-15	Rock	NA	
24	75+04.00	24	1063.00	17.00	1046.00	1045.55	1.00	6.00	5.00	2:1	B-003-6-15	Rock	NA	
25	75+28.00	24	1063.00	16.00	1047.00	1046.70	1.00	6.00	5.00	2:1	B-003-6-15	Rock	NA	1' Cut
26	75+52.00	16	1063.00	15.00	1048.00	1047.70	1.00	6.00	5.00	2:1	B-003-6-15	Rock	NA	
27	75+68.00	16	1062.00	15.00	1047.00	1046.70	1.00	6.00	5.00	2:1	B-003-6-15	Rock	NA	
28	75+84.00	16	1061.00	16.00	1045.00	1044.70	4.50	9.50	5.00	2:1	B-004-1-16	Rock	NA	
29	76+00.00	16	1060.00	16.00	1044.00	1043.70	4.50	9.50	5.00	2:1	B-004-1-16	Rock	NA	
30	76+16.00	16	1059.00	18.00	1041.00	1040.70	4.50	9.50	5.00	2:1	B-004-1-16	Rock	NA	
31	76+32.00	16	1058.00	19.00	1039.00	1038.70	4.50	9.50	5.00	2:1	B-004-1-16	Rock	NA	3' Cut

NOISE WALL 4														
DRILLED SHAFT NO.	*WORKPOINT STATION*	*Post Spacing*	*TOP of Wall ELEV*	*Max Barrier Height*	*Bottom of Wall ELEV*	*TOP OF DRILLED SHAFT ELEVATION*	*TOP OF ROCK DEPTH (feet)*	*SHAFT LENGTH (feet)*	Length of Rock Socket (feet)	*Slope*	*Applicable Boring*	*Primary Soil Type*	*Design Depth Corrected N160*	*Remark*
32	*76+48.00*	*16*	*1057.00*	*18.00*	*1039.00*	*1038.70*	*4.50*	*9.50*	*5.00*	*2:1*	*B-004-1-16*	*Rock*	*NA*	
33	*76+64.00*	*16*	*1056.00*	*18.00*	*1038.00*	*1037.70*	*4.50*	*9.50*	*5.00*	*Level*	*B-004-1-16*	*Rock*	*NA*	
34	*76+80.00*	*16*	*1055.00*	*17.00*	*1038.00*	*1037.70*	*4.50*	*9.50*	*5.00*	*Level*	*B-004-1-16*	*Rock*	*NA*	
35	*76+96.00*	*24*	*1054.00*	*17.00*	*1037.00*	*1036.55*	*7.50*	*12.50*	*5.00*	*Level*	*B-004-1-16*	*Granular*	*14*	
36	*77+20.00*	*24*	*1053.00*	*17.00*	*1036.00*	*1035.55*	*7.50*	*12.50*	*5.00*	*5:1*	*B-004-1-16*	*Granular*	*14*	
37	*77+44.00*	*24*	*1053.00*	*17.00*	*1036.00*	*1035.70*	*15.50*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
38	*77+68.00*	*24*	*1053.00*	*17.00*	*1036.00*	*1035.70*	*15.50*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
39	*77+92.00*	*24*	*1053.00*	*17.00*	*1036.00*	*1035.70*	*15.50*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
40	*78+16.00*	*24*	*1053.00*	*18.00*	*1035.00*	*1034.55*	*15.50*	*13.50*	*0.00*	*5:1*	*B-004-5-16*	*Granular*	*18*	
41	*78+40.00*	*24*	*1053.00*	*18.00*	*1035.00*	*1034.55*	*15.50*	*15.00*	*0.00*	*3:1*	*B-004-5-16*	*Granular*	*18*	
42	*78+64.00*	*24*	*1052.00*	*17.00*	*1035.00*	*1034.55*	*22.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
43	*78+88.00*	*24*	*1052.00*	*17.00*	*1035.00*	*1034.55*	*22.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
44	*79+12.00*	*24*	*1052.00*	*17.00*	*1035.00*	*1034.55*	*22.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
45	*79+36.00*	*24*	*1052.00*	*17.00*	*1035.00*	*1034.55*	*22.00*	*19.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*19*	
46	*79+60.00*	*24*	*1052.00*	*17.00*	*1035.00*	*1034.70*	*30.50*	*16.00*	*0.00*	*2:1*	*B-005-1-16*	*Granular*	*20*	*8.5 Fill*

B-021-2-16
STA 0+74 TO STA 1+94

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		7.5	20	20	Granular
SS - 1	1.5	9.0	9	14	Cohesive
SS - 2	4.0	11.5	16	22	Cohesive
SS - 3	6.5	14.0	31	37	Cohesive
SS - 4	9.0	16.5	48	53	Granular
SS - 5	11.5	19.0	43	47	Granular
SS - 6	14.0	21.5	60	60	Granular
SS - 7	16.5	24.0	43	41	Granular
SS - 8	19.0	26.5	35	32	Granular
SS - 9	21.5	29.0	28	25	Granular
SS - 10	24.0	31.5	12	10	Cohesive
SS - 11	26.5	34.0	13	11	Cohesive
		Design 10' Depth Shaft Design N =		14	Granular
		7.5' Depth Shaft Design N =		20	Granular
		19' Depth Shaft Design N =		14	Granular
		Full Depth Shaft Design N =		10	Granular

B-023-0-15
STA 1+94 TO STA 3+14

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		8.5	20	20	Granular
SS - 1	2.5	14.5	22	35	Granular
SS - 2	5.0	17.0	4	6	Cohesive
SS - 3	7.5	19.5	3	4	Cohesive
SS - 4	10.0	22.0	20	22	Cohesive
SS - 5	12.5	24.5	51	56	Granular
SS - 6	15.0	27.0	50	50	Granular
SS - 7	17.5	29.5	45	43	Granular
SS - 8	20.0	32.0	22	20	Granular
SS - 9	25.0	37.0	12	10	Cohesive
		Design Depth 14.5' Design N =		28	Granular
		7.5' Depth Shaft Design N =		20	Granular
		15.0' Depth Shaft Design N =		4	Granular
		Full Depth Shaft Design N =		4	Granular

B-031-1-16
STA 8+06 TO STA 9+02

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		4.0			
SS - 1	4.0	0.0	11	15	Cohesive
SS - 2	6.5	2.5	15	18	Cohesive
SS - 3	9.0	5.0	25	28	Granular
SS - 4	11.5	7.5	26	29	Cohesive
SS - 5	14.0	10.0	34	34	Cohesive
SS - 6	15.0	11.0			Rock Socket
		Design Depth 6' Design N =		20	Cohesive
		10' Depth Shaft Design N =		25	Cohesive
		15.0' Depth Shaft Design N =		25	Cohesive
		Full Depth Shaft Design N =		N/A	N/A

B-031-1-16
STA. 10+00 TO STA. 11+92

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	4.0	4.0	11	15	Cohesive
SS - 2	6.5	6.5	15	18	Cohesive
SS - 3	9.0	9.0	25	28	Granular
SS - 4	11.5	11.5	26	29	Cohesive
SS - 5	14.0	14.0	34	34	Cohesive
SS - 6	16.5	16.5			Rock Socket
	Design Depth 9.5' Design N =			20	Cohesive
	7.5' Depth Shaft Design N =			17	Cohesive
	15.0' Depth Shaft Design N =			25	Cohesive
	Full Depth Shaft Design N =			N/A	N/A

B-031-3-16
STA. 11+92 TO STA. 14+08

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	4.0	4.0	46	64	Granular
SS - 2	5.0	5.0			Rock Socket
	Design Depth 10' Design N =			N/A	N/A
	7.5' Depth Shaft Design N =			42	Granular
	15.0' Depth Shaft Design N =			N/A	N/A
	Full Depth Shaft Design N =			N/A	N/A

B-033-0-16
STA. 14+08 TO STA. 16+72

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	19	30	Cohesive
SS - 2	4.0	4.0	37	52	Cohesive
SS - 3	6.5	6.5	46	55	Cohesive
SS - 4	9.0	9.0	60	66	Cohesive
SS - 5	11.5	11.5	31	34	Granular
SS - 6	14.0	14.0	29	29	Cohesive
SS - 7	16.5	16.5	29	28	Granular
SS - 8	19.0	19.0	22	20	Granular
SS - 9	21.5	21.5			Rock Socket
	Design Depth 9' Design N =			51	Cohesive
	7.5' Depth Shaft Design N =			46	Cohesive
	15.0' Depth Shaft Design N =			29	Cohesive
	Full Depth Shaft Design N =			20	Cohesive

B-034-0-16
STA. 16+72 TO STA. 18+88

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	7	11	Cohesive
SS - 2	4.0	4.0	40	56	Cohesive
SS - 3	6.5	6.5	56	67	Cohesive
SS - 4	9.0	9.0	41	45	Cohesive
SS - 5	11.5	11.5	32	35	Cohesive
SS - 6	14.0	14.0	29	29	Cohesive
SS - 7	16.5	16.5	38	36	Granular
SS - 8	19.0	19.0	25	23	Granular
SS - 9	21.5	21.5			Rock Socket
	7.5' Depth Shaft Design N =			45	Cohesive
	15.0' Depth Shaft Design N =			11	Cohesive
	Full Depth Shaft Design N =			11	Cohesive

B-035-0-16
STA. 18+88 TO STA. 20+80

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	6	10	Cohesive
SS - 2	4.0	4.0	16	22	Cohesive
SS - 3	6.5	6.5	26	31	Cohesive
SS - 4	9.0	9.0	35	39	Cohesive
SS - 5	11.5	11.5	35	39	Cohesive
SS - 6	14.0	14.0	51	51	Granular
SS - 7	16.5	16.5	47	45	Granular
SS - 8	19.0	19.0			Rock Socket
	Design Depth 9' Design N =			25	Cohesive
	7.5' Depth Shaft Design N =			21	Cohesive
	15.0' Depth Shaft Design N =			32	Cohesive
	Full Depth Shaft Design N =			N/A	N/A

B-036-0-16
STA. 20+80 TO STA. 21+60

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	13	21	Granular
SS - 2	4.0	4.0	15	21	Cohesive
SS - 3	6.5	6.5	13	16	Granular
SS - 4	9.0	9.0	12	13	Granular
SS - 5	11.5	11.5	22	24	Granular
SS - 6	14.0	14.0	62	62	Granular
SS - 7	16.5	16.5	54	52	Granular
SS - 8	19.0	19.0			Rock Socket
	Design Depth 9' Design N =			13	Granular
	6.5' Depth Shaft Design N =			16	Granular
	12.0' Depth Shaft Design N =			13	Granular
	Full Depth Shaft Design N =			13	Granular

B-021-3-16
STA. 30+96 TO STA. 31+68

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		3.5	20	20	Granular
SS - 1	4.0	7.5	29	41	Cohesive
SS - 2	6.5	10.0	13	16	Cohesive
SS - 3	9.0	12.5	18	20	Cohesive
SS - 4	11.5	15.0	21	23	Cohesive
SS - 5	14.0	17.5	3	3	Cohesive
SS - 6	16.5	20.0	1	1	Granular
SS - 7	19.0	22.5	7	6	Granular
SS - 8	21.5	25.0	9	8	Granular
SS - 9	24.0	27.5	13	11	Granular
SS - 10	26.5	30.0	12	10	Granular
		Design Depth 10' Design N =		16	Cohesive
		7.5' Depth Shaft Design N =		30	Cohesive
		15.0' Depth Shaft Design N =		16	Cohesive
		Full Depth Shaft Design N =		1	Cohesive

B-021-3-16
STA. 31+88 TO STA. 32+68

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		9.0	20	20	Granular
SS - 1	4.0	13.0	29	41	Cohesive
SS - 2	6.5	15.5	13	16	Cohesive
SS - 3	9.0	18.0	18	20	Cohesive
SS - 4	11.5	20.5	21	23	Cohesive
SS - 5	14.0	23.0	3	3	Cohesive
SS - 6	16.5	25.5	1	1	Granular
SS - 7	19.0	28.0	7	6	Granular
SS - 8	21.5	30.5	9	8	Granular
SS - 9	24.0	33.0	13	11	Granular
SS - 10	26.5	35.5	12	10	Granular
		Design Depth 11.5' Design N =		20	Cohesive
		7.5' Depth Shaft Design N =		20	Cohesive
		15.0' Depth Shaft Design N =		16	Cohesive
		Full Depth Shaft Design N =		1	Cohesive

B-025-1-16
STA. 32+64 TO STA. 34+56

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		9.0	20	20	Granular
SS - 1	4.0	13.0	21	29	Cohesive
SS - 2	6.5	15.5	21	25	Cohesive
SS - 3	9.0	18.0	28	31	Granular
SS - 4	11.5	20.5	16	18	Granular
SS - 5	14.0	23.0	16	16	Cohesive
SS - 6	16.5	25.5	28	27	Granular
SS - 7	19.0	28.0	21	19	Cohesive
SS - 8	21.5	30.5	26	23	Cohesive
SS - 9	24.0	33.0	43	36	Granular
SS - 10	26.5	35.5	25	21	Granular
		Design Depth 11.5' Design N =		20	Granular
		7.5' Depth Shaft Design N =		20	Granular
		15.0' Depth Shaft Design N =		20	Granular
		Full Depth Shaft Design N =		16	Cohesive

B-027-0-15
STA. 34+56 TO STA. 36+24

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		9.5	20	20	Granular
SS - 1	2.5	12.0	33	53	Granular
SS - 2	5.0	14.5	31	43	Granular
SS - 3	7.5	17.0	52	62	Granular
SS - 4	10.0	19.5	51	56	Granular
SS - 5	12.5	22.0	43	47	Granular
SS - 6	15.0	24.5	45	45	Granular
SS - 7	17.5	27.0	13	12	Cohesive
SS - 8	20.0	29.5	23	21	Cohesive
SS - 9	25.0	34.5	29	24	Cohesive
		Design Depth 11.5' Design N =		20	Granular
		7.5' Depth Shaft Design N =		20	Granular
		15.0' Depth Shaft Design N =		20	Granular
		Full Depth Shaft Design N =		12	Granular

B-029-1-16
STA. 36+24 TO STA. 37+68

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		7.0	20	20	Granular
SS - 1	4.0	11.0	34	48	Granular
SS - 2	6.5	13.5	28	34	Granular
SS - 3	9.0	16.0	29	32	Granular
SS - 4	11.5	18.5	21	23	Cohesive
SS - 5	14.0	21.0	29	29	Cohesive
SS - 6	16.5	23.5	37	33	Granular
SS - 7	17.5	24.5			Rock Socket

Design Depth 10' Design N =	34	Granular
7.0' Depth Shaft Design N =	20	Granular
15.0' Depth Shaft Design N =	20	Granular
Full Depth Shaft Design N =	20	Granular

B-031-2-16
STA. 37+68 TO STA. 39+12

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		2.5	20	20	Granular
SS - 1	1.5	4.0	9	14	Cohesive
SS - 2	4.0	6.5	16	22	Cohesive
SS - 3	6.5	9.0	16	19	Cohesive
SS - 4	9.0	11.5	15	17	Cohesive
SS - 5	11.5	14.0	22	24	Cohesive
SS - 6	14.0	16.5	25	25	Cohesive
SS - 7	16.5	19.0	31	30	Cohesive
SS - 8	19.0	21.5	72	66	Cohesive
SS - 9	21.5	24.0	93	82	Cohesive
SS - 10	22.0	24.5			Rock Socket

7.5' Depth Shaft Design N =	14	Cohesive
15.0' Depth Shaft Design N =	14	Cohesive
Full Depth Shaft Design N =	14	Cohesive

B-031-4-16
STA. 39+12 TO STA. 39+44

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		1.5			
SS - 1	1.5	0.0	6	10	Cohesive
SS - 2	4.0	2.5	19	27	Granular
SS - 3	6.5	5.0	16	19	Granular
SS - 4	9.0	7.5	13	14	Cohesive
SS - 5	11.5	10.0	18	20	Cohesive
SS - 6	14.0	12.5	28	28	Granular
SS - 7	14.5	13.0			Rock Socket

Design Depth 10' Design N =	14	Granular
7.5' Depth Shaft Design N =	14	Granular
15.0' Depth Shaft Design N =	14	Granular
Full Depth Shaft Design N =	NA	Granular

B-031-2-16
STA. 40+48 TO STA. 40+96

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	9	14	Cohesive
SS - 2	4.0	4.0	16	22	Cohesive
SS - 3	6.5	6.5	16	19	Cohesive
SS - 4	9.0	9.0	15	17	Cohesive
SS - 5	11.5	11.5	22	24	Cohesive
SS - 6	14.0	14.0	25	25	Cohesive
SS - 7	16.5	16.5	31	30	Cohesive
SS - 8	19.0	19.0	72	66	Cohesive
SS - 9	21.5	21.5	93	82	Cohesive
SS - 10	22.0	22.0			Rock Socket
		7.5' Depth Shaft Design N =		14	Cohesive
		15.0' Depth Shaft Design N =		14	Cohesive
		Full Depth Shaft Design N =		14	Cohesive

B-031-4-16
STA. 40+96 TO STA. 42+88

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.0			
SS - 1	1.5	1.5	6	10	Cohesive
SS - 2	4.0	4.0	19	27	Granular
SS - 3	6.5	6.5	16	19	Granular
SS - 4	9.0	9.0	13	14	Cohesive
SS - 5	11.5	11.5	18	20	Cohesive
SS - 6	14.0	14.0	28	28	Granular
SS - 7	14.5	14.5			Rock Socket
		Design Depth 10' Design N =		10	Granular
		7.5' Depth Shaft Design N =		10	Granular
		15.0' Depth Shaft Design N =		10	Granular
		Full Depth Shaft Design N =		NA	Granular

B-032-2-16
STA. 40+96 TO STA. 45+08

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.0			
SS - 1	4.0	4.0	12	17	Granular
SS - 2	6.5	6.5	16	19	Granular
SS - 3	7.5	7.5			Rock Socket
		7.5' Depth Shaft Design N =		18	Granular
		15.0' Depth Shaft Design N =		N/A	N/A
		Full Depth Shaft Design N =		N/A	N/A

B-001-5-16
STA. 51+04 TO STA. 52+16

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.5			
SS - 1	1.5	1.0	16	26	Cohesive
SS - 2	4.0	3.5	22	31	Cohesive
SS - 3	6.5	6.0	22	26	Cohesive
SS - 4	7.0	6.5			Rock Socket
		Design Depth 6' Design N =		26	Cohesive
		7.5' Depth Shaft Design N =		26	Cohesive
		Full Depth Shaft Design N =		N/A	N/A

B-003-4-16
STA. 52+16 TO STA. 54+20

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		2			
SS - 1	1.5	-	6	10	Granular
SS - 2	4.0	2.0	4	6	Cohesive
SS - 3	6.5	4.5	25	30	Cohesive
SS - 4	6.5	4.5			Rock Socket
		7.5' Depth Shaft Design N =		6	Cohesive
		15.0' Depth Shaft Design N =		N/A	N/A
		Full Depth Shaft Design N =		N/A	N/A

B-003-8-16
STA. 54+20 TO STA. 56+24

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	1.5	1.5	10	16	Cohesive
SS - 2	4.0	4.0	35	49	Cohesive
SS - 3	5.5	5.5			Rock Socket
		5.0' Depth Shaft Design N =		33	Cohesive
		15.0' Depth Shaft Design N =		N/A	N/A
		Full Depth Shaft Design N =		N/A	N/A

B-004-2-16
STA. 56+24 TO STA. 57+20

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		0.0			
SS - 1	2.5	2.5	4	6	Cohesive
SS - 2	5.0	5.0			Rock Socket
		7.5' Depth Shaft Design N =		6	Cohesive
		15.0' Depth Shaft Design N =		N/A	N/A
		Full Depth Shaft Design N =		N/A	N/A

B-004-2-16
STA. 57+20 TO STA. 57+92

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		4.0	20	20	Granular
SS - 1	2.5	5.5	4	6	Cohesive
SS - 2	5.0	8.0			Rock Socket
		7.5' Depth Shaft Design N =		20	Granular
		15' Depth Shaft Design N =		6	Granular
		Full Depth Shaft Design N =		N/A	N/A

B-004-6-16
STA. 57+92 TO STA. 58+64

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		20.0	20	20	Granular
SS - 1	4.0	24.0	91	146	Granular
SS - 2	4.0	24.0			Rock Socket
		Design Depth 8' Design N =		20	Cohesive
		4.0' Depth Shaft Design N =		20	Cohesive
		15.0' Depth Shaft Design N =		20	Cohesive
		Full Depth Shaft Design N =		N/A	N/A

B-004-6-16
STA. 58+64 TO STA. 59+12

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		29.0	20	20	Granular
SS - 1	4.0	33.0	91	146	Granular
SS - 2	4.0	33.0			Rock Socket
		Design Depth 8' Design N =		20	Cohesive
		4.0' Depth Shaft Design N =		20	Cohesive
		15.0' Depth Shaft Design N =		20	Cohesive
		Full Depth Shaft Design N =		N/A	N/A

B-005-2-16
STA. 59+12 TO STA. 59+36

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		29.0	20	20	Granular
SS - 1	1.5	30.5	13	21	Granular
SS - 2	4.0	33.0	19	27	Granular
SS - 3	6.5	35.5	25	30	Granular
SS - 4	9.0	38.0	25	28	Granular
SS - 5	11.5	40.5	32	35	Granular
SS - 6	12.5	41.5			Rock Socket
		Design Depth 9.5' Design N =		20	Cohesive
		7.5' Depth Shaft Design N =		26	Granular
		13.0' Depth Shaft Design N =		21	Granular
		Full Depth Shaft Design N =		N/A	N/A

B-001-3-16
STA. 70+00 TO STA. 70+72

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		1.0			
SS - 1	1.5	0.5	43	69	Granular
SS - 2	4.0	3.0	16	22	Cohesive
SS - 3	6.5	5.5	32	38	Granular
SS - 4	9.0	8.0	60	66	Cohesive
SS - 5	9.0	8.0			Rock Socket
	7.5' Depth Shaft Design N =			22	Cohesive
	15.0' Depth Shaft Design N =			N/A	N/A
	Full Depth Shaft Design N =			N/A	N/A

B-001-4-15
STA. 70+72 TO STA. 72+16

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.0			
SS - 1	2.5	2.5	5	8	Cohesive
SS - 2	5.0	5.0	25	35	Cohesive
SS - 3	6.5	6.5			Rock Socket
	7.5' Depth Shaft Design N =			22	Cohesive
	15.0' Depth Shaft Design N =			N/A	N/A
	Full Depth Shaft Design N =			N/A	N/A

B-003-1-15
STA. 72+16 TO STA. 73+84

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		8.0			
SS - 1	2.5	-	15	24	Cohesive
SS - 2	5.0	-	11	15	Granular
SS - 3	7.5	-	19	23	Granular
SS - 4	8.5	0.5			Rock Socket
	7.5' Depth Shaft Design N =			N/A	Rock Socket
	15.0' Depth Shaft Design N =			N/A	Rock Socket
	Full Depth Shaft Design N =			N/A	Rock Socket

B-003-5-15
STA. 73+84 TO STA. 74+80

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		7.0			
SS - 1	2.5	-	36	58	Cohesive
SS - 2	5.0	-	32	45	Granular
SS - 3	7.5	0.5	8	10	Granular
SS - 4	10.0	3.0			Rock Socket
	7.5' Depth Shaft Design N =			N/A	Rock Socket
	15.0' Depth Shaft Design N =			N/A	Rock Socket
	Full Depth Shaft Design N =			N/A	Rock Socket

B-003-6-15
STA. 74+80 TO STA. 75+88

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		1.0			
SS - 1	2.0	1.0			Rock Socket
	7.5' Depth Shaft Design N =			N/A	Rock Socket
	15.0' Depth Shaft Design N =			N/A	Rock Socket
	Full Depth Shaft Design N =			N/A	Rock Socket

B-004-1-16
STA. 75+88 TO STA. 77+44

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		3.0			
SS - 1	1.5	-	12	19	Granular
SS - 2	4.0	1.0	10	14	Granular
SS - 3	6.5	3.5	13	16	Granular
SS - 4	7.5	4.5			Rock Socket
	7.5' Depth Shaft Design N =			N/A	Rock Socket
	15.0' Depth Shaft Design N =			N/A	Rock Socket
	Full Depth Shaft Design N =			N/A	Rock Socket

B-004-1-16
STA. 75+88 TO STA. 77+44

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut					
SS - 1	1.5	1.5	12	19	Granular
SS - 2	4.0	4.0	10	14	Granular
SS - 3	6.5	6.5	13	16	Granular
SS - 4	7.5	7.5			Rock Socket
	7.5' Depth Shaft Design N =			N/A	Rock Socket
	15.0' Depth Shaft Design N =			N/A	Rock Socket
	Full Depth Shaft Design N =			N/A	Rock Socket

B-004-5-16
STA. 77+44 TO STA. 78+64

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.0			
SS - 1	4.0	4.0			Granular
SS - 2	6.5	6.5	26	31	Granular
SS - 3	9.0	9.0	31	34	Granular
SS - 4	11.5	11.5	16	18	Cohesive
SS - 5	14.0	14.0	48	48	Granular
SS - 6	15.5	15.5			Rock Socket
	7.5' Depth Shaft Design N =			33	Granular
	15.0' Depth Shaft Design N =			18	Granular
	Full Depth Shaft Design N =			18	Granular

B-005-1-16
STA. 78+64 TO STA. 79+60
1036.6

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Cut		0.0			
SS - 1	4.0	4.0	38	53	Granular
SS - 2	6.5	6.5	48	58	Granular
SS - 3	9.0	9.0	22	24	Cohesive
SS - 4	11.5	11.5	21	23	Cohesive
SS - 5	14.0	14.0	19	19	Cohesive
SS - 6	16.5	16.5	51	49	Cohesive
SS - 7	19.0	19.0	22	20	Granular
SS - 8	21.5	21.5	19	17	Cohesive
SS - 9	22.0	22.0			Rock Socket
		Design Depth 19' Design N =		19	Granular
		Design 11.5' Depth Shaft Design N =		23	Granular
		15.0' Depth Shaft Design N =		19	Cohesive
		Full Depth Shaft Design N =		17	Cohesive

B-005-1-16
STA. 78+64 TO STA. 79+60
1036.6

SAMPLE	DEPTH	Depth after Cut/Fill	Effeciency Corrected N_{60}	Depth Corrected $N1_{60}$	SOIL TYPE
Fill		8.5	20	20	Granular
SS - 1	4.0	12.5	38	53	Granular
SS - 2	6.5	15.0	48	58	Granular
SS - 3	9.0	17.5	22	24	Cohesive
SS - 4	11.5	20.0	21	23	Cohesive
SS - 5	14.0	22.5	19	19	Cohesive
SS - 6	16.5	25.0	51	49	Cohesive
SS - 7	19.0	27.5	22	20	Granular
SS - 8	21.5	30.0	19	17	Cohesive
SS - 9	22.0	30.5			Rock Socket
		Design Depth 19' Design N =		20	Granular
		Design 11.5' Depth Shaft Design N =		20	Granular
		15.0' Depth Shaft Design N =		20	Cohesive
		Full Depth Shaft Design N =		17	Cohesive

Objective:

The purpose of these calculations is to determine the drilled shafts depth for 1A, 1B, 2A, 2B, 3 and 4 where wall height is over 20 feet.

Source of Data:

1. Boring Logs are from the 2015 and 2016 exploration;
2. Unconfined compressive strength were taken from lab testing results.

Assumptions:

Subsurface profile:

1. Subsurface profiles were developed based on the closest project boring;
2. For all the SPT >= 50, an approximate N_{60} number has been assumed for calculation purpose;
3. The drain friction angle of granular material was obtained based on $N1_{60}$ according to AASHTO Table 10.4.6.2.4-1;
4. All the data highlighted in yellow is possible outlier and neglected from calculation; 4. All the data highlighted in yellow is possible outlier and neglected from calculation;
5. A granular material with φ' = 30 degrees, $N_{60}/N1_{60}$ = 20, unit weight = 120 pcf was assumed for the fill material for the LPILE ;
6. No rock core is availble, assume the unit weight = 150 pcf, Qu = 200 psi, Em = 900 psi, RQD = 10, and Krm = 0.0005 for the bedrock encountered for the noise barrier foundation.

Drilled Shaft Length Calculation:

7. p-y analyses are performed by LPILE ;
8. Service Wind (WS) Load = 25 psf (the maximum tributary area) and Service Dead (DC) Load = 90 psf (the minimum tributary area) are used for the analysis;
9. Service I Limit State (WS = 1; DC =1) and Strength III Limit State (WS = 1.4; DC =0.9) are checked for the analysis; The Service Limit deflection limit is 1.5% noise barrier height; and
10. Assume the drilled shaft wall has a 30-inch diameter, and reinforced with 10@#8 bars with 1.12%

References:

1. Geotechnical Bulletin 7: Drilled Shaft and Landslide Stabilization Design, Ohio Department of Transportation, Division of Geotechnical Engineering, November 2014.
2. GEOTECH CIRCULAR No. 5 Evaluation of Soil & Rock Properties: FHWA-IF-02-034, Ohio Department of Transportation, GeoSyntec Consultants, April 2002.
3. Drilled Shaft: Construction Procedures and LRFD Design Methods, FHWA-NHI-10-016 FHWA GEC 010, Department of Transportation Federal Highway Administration, May 2010.
4. AASHTO LRFD Bridge Design Specification, Eighth Edition, 2017.
5. 2016 LPIILE Technical Manual.

Definition of parameters:

Depth	Depth of top of the Spoon
Sample Interval	Length between the bottoms of last spoon and this spoon
γ	Moist weight of soil sample obtained based on blow count N_{60} according to Table 1 ref. 1
γ'	Effective unit weight of soil sample obtained based on γ and water table and strata depths
N_{60}	N_{60} is the SPT N-value corrected for field procedures and apparatus N_{60} = blow counts X energy ratio/ 60% = (ER/60%)N
σ'_v	Vertical effective stress at the location of the SPT N-value (KSF)
C_N	C_N = [0.77 log10 (40/σ'v)], CN < 2.0
$N1_{60}$	$N1_{60} = C_N X (N_{60})$
CLASF.	AASHTO Soil Classification (ODOT)
HP	Hand penetrometer readings
Φ'	Drained friction angle developed based on $N1_{60}$ according to *AASHTO Table 10.4.6.2.4-1per coarse granular content*

$N1_{60}$	A-4a A-4b	A-3	A-2-5 A-2-6 A-2-7 A-3a	A-2-4	A-1-b	A-1-a
<4	25	26	27	28	29	30
4	27	28	29	30	31	32
10	30	31	32	33	34	35
30	35	36	37	38	39	40
50	38	39	40	41	42	43

Linearly interpolate between values of N160 and drained friction angle.

S_u	Undrained shear strength from In-situ Tests (*Stroud,* 1974 & 1989, See Table 33 Ref. 2) $S_u = (f_{1(}N_{60})P_a)/100$ f_1 = 4.5 for PI = 50; f_1 = 5.5 for PI = 15 Pa = atmospheric pressure, 2116 psf
PI	Plastic Index
W_n	Moisture content
Φ'_{PI}	Drained friction angle based on PI (*Terzaghi, Peck, and Mesri, 1996, See Fig. 74 Ref. 2*)
RQD	Weighted RQD of each rock stratum, here assume =10;
Q_u	Unconfined compressive strength of rock in each stratum here assume =200 psi;
Subgrade Modulus k	For sand, k is based on its relative density (*Reese et al., 1974*) For clay, k is based on its undrained shear strength (*Reese et al., 1975*)
Principal Strain ε_{50}	ε_{50} is based on its undrained shear strength (*Reese et al., 1975; Reese & Welch, 1975*)
Intact Modulus E_i	E_i = Modulus X Q_u (Qu =90 according to *Horvath and Kenney, 1979, Figure 3-56*)
Modulus Ratio E_m/E_i	Modulus Ratio is estimated based on RQD (*after O'Neill and Reese, 1999*) here assume =0.0
Mass Modulus E_m	E_i = Modulus Ratio X Intact Modulus = E_m/E_i X E_i = 900 psi
Stiffness Constant K_{rm}	K_{rm} ranges from 0.0005 to 0.00005 for weak rock, and here assume =0.0005;

Table 10.4.6.2.4-1—Correlation of $SPT N1_{60}$ Values to Drained Friction Angle of Granular Soils (modified after Bowles, 1977)

N_{160}	ϕ_f
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

Soil Modulus Parameter k for Sands			
Relative Density	**Loose**	**Medium**	**Dense**
Submerged Sand	20 lb/in3	60 lb/in3	125 lb/in3
Submerged Sand	5,430 KPa/m	16,300 KPa/m	33,900 KPa/m
Sand Above WT	25 lb/in3	90 lb/in3	225 lb/in3
Sand Above WT	6,790 KPa/m	24,430 KPa/m	61,000 KPa/m

Soil Modulus Parameter k for Clays			
Average Undrained Shear Strength		**Static**	**Cyclic**
Soft Clay	c = 1.74 to 3.47 psi	30 pci	--
	250 to 500 psf		
	12 to 24 KPa	8,140 KPa/m	--
Medium Clay	c = 3.47 to 6.94 psi	100 pci	--
	500 to 1000 psf		
	24 to 48 KPa	27,150 KPa/m	--
Stiff Clay	c = 6.94 to 13.9 psi	500 pci	200 pci
	1000 to 2000 psf		
	48 to 96 KPa	136,000 KPa/m	54,300 KPa/m
Very Stiff Clay	c = 13.9 to 27.8 psi	1000 pci	400 pci
	2000 to 4000 psf		
	96 to 192 KPa	271,000 KPa/m	108,500 KPa/m
Hard Clay	c = 27.8 to 55.6 psi	2000 pci	800 pci
	4000 to 8000 psf		
	192 to 383 KPa	543,000 KPa/m	217,000 KPa/m

Soil Strain Parameter E50		
Soft Clay	c = 1.74 to 3.47 psi 250 to 500 psf 12 to 24 KPa	E50 = 0.02
Medium Clay	c = 3.47 to 6.94 psi 500 to 1000 psf 24 to 48 KPa	E50 = 0.01
Stiff Clay	c = 6.94 to 13.9 psi 1000 to 2000 psf 48 to 96 KPa	E50 = 0.007
Very Stiff Clay	c = 13.9 to 27.8 psi 2000 to 4000 psf 96 to 192 KPa	E50 = 0.005
Hard Clay	c = 27.8 to 55.6 psi 4000 to 8000 psf 192 to 383 KPa	E50 = 0.004
Limestone		E50 = 0.001

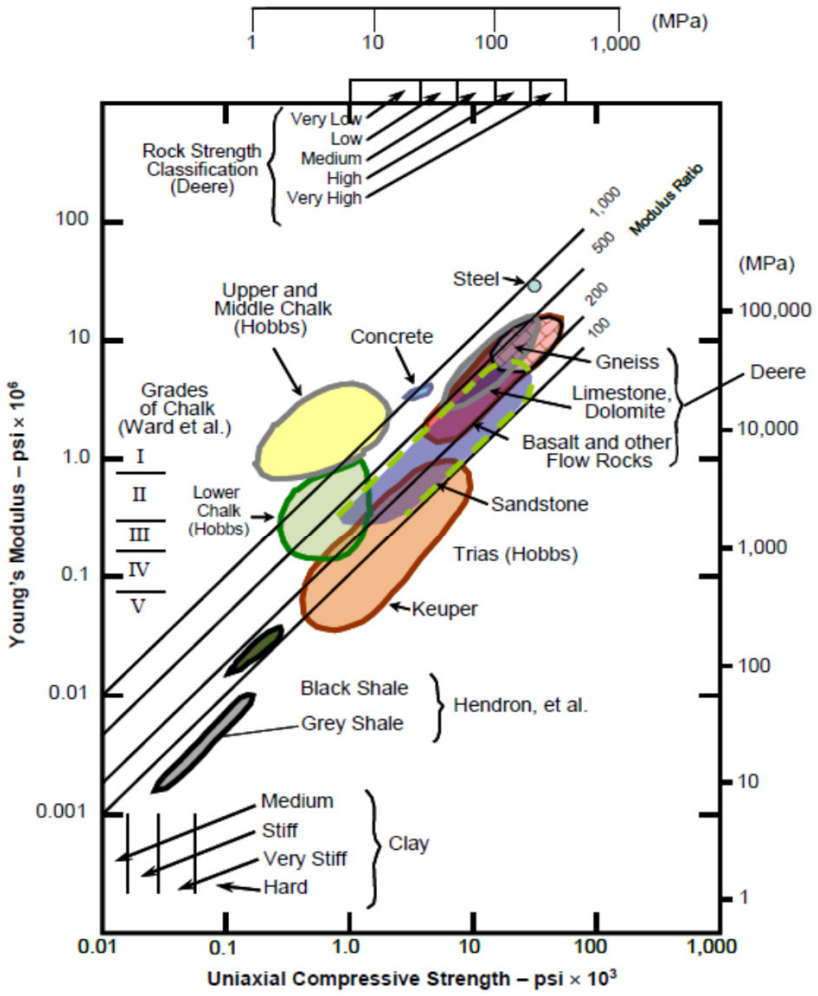


Figure 3-56 Engineering Properties for Intact Rocks
(after Deere, 1968; Peck, 1976; and Horvath and Kenney, 1979)

Table 10.4.6.5-1 Estimation of E_m based on *RQD* (after *O'Neill and Reese, 1999*).

RQD (percent)	E_m/E_i	
	Closed Joints	Open Joints
100	1.00	0.60
70	0.70	0.10
50	0.15	0.10
20	0.05	0.05

Limit State	Wind (WS) Load	Dead (DC) Load
Service I	25	90
Strength III	35	81

DRILLED SHAFT NO.	WORK POINT STATION	Post Spacing	Max Barrier Height	Max Tributary Area	Min Tributary Area	Service I Shear (lb.)	Service I Moment (lb-in.)	Service I Axial (lb.)	Strength III Shear (lb.)	Strength III Moment (lb-in.)	Strength III Axial (lb.)	Ground Slope	SHAFT LENGTH (feet)	Service Deflection (in.)	Service Deflection Check	Service Max Moment (lb-in.)	Strength Max Moment (lb-in.)	Applicable Boring	Notes:
Noise Barrier No. 1A																			
8	02+00.00	24	19.00	504.00	456.00	12,600	1,058,400	41,040	17,640	1,481,760	36,936	26.6	20.00	0.39880	OK	1,691,100	2,411,069	B-023-0-15	9' Fill
9	02+24.00	24	19.00										20.00						
10	02+48.00	24	20.00										20.00						
11	02+72.00	24	21.00										20.00						
12	02+96.00	24	21.00										20.00						
13	03+20.00	24	21.00	528.00	336.00	13,200	1,161,600	30,240	18,480	1,626,240	27,216	26.6	20.00	0.53380	OK	1,804,449	2,559,154	B-025-0-15	12' Fill
14	03+44.00	16	21.00										20.00						
15	03+60.00	16	21.00										20.00						
16	03+76.00	16	21.00										20.00						
17	03+92.00	24	22.00										20.00						
18	04+16.00	24	22.00										20.00						
19	04+40.00	24	22.00	528.00	528.00	13,200	1,161,600	47,520	18,480	1,626,240	42,768	26.6	20.00	0.51610	OK	1,811,340	2,588,895	B-025-3-16	13.5 Fill
20	04+64.00	24	22.00										20.00						
21	04+88.00	24	22.00										20.00						
22	05+12.00	24	22.00	528.00	504.00	13,200	1,161,600	45,360	18,480	1,626,240	40,824	26.6	20.00	0.53270	OK	1,807,428	2,587,616	B-026-0-15	10' Fill
23	05+36.00	24	21.00										20.00						
24	05+60.00	24	21.00										20.00						
25	05+84.00	24	22.00										20.00						
26	06+08.00	24	21.00										20.00						
27	06+32.00	24	21.00										20.00						
28	06+56.00	24	21.00	504.00	504.00	12,600	1,058,400	45,360	17,640	1,481,760	40,824	26.6	15.00	0.37300	OK	1,584,181	2,234,241	B-030-1-16	1' Fill
29	06+80.00	24	21.00										15.00						
30	07+04.00	24	21.00										15.00						
31	07+28.00	24	21.00										15.00						
32	07+52.00	24	21.00										15.00						
33	07+76.00	24	21.00										15.00						
34	08+00.00	24	21.00										15.00						
35	08+24.00	24	21.00	504.00	168.00	12,600	1,058,400	15,120	17,640	1,481,760	13,608	26.6	10.00	0.31820	OK	1,252,810	1,756,067	B-031-1-16	4' Cut
36	08+48.00	24	21.00										10.00						
37	08+72.00	8	21.00										10.00						

DRILLED SHAFT NO.	WORK POINT STATION	Post Spacing	Max Barrier Height	Max Tributary Area	Min Tributary Area	Service I Shear (lb.)	Service I Moment (lb-in.)	Service I Axial (lb.)	Strength III Shear (lb.)	Strength III Moment (lb-in.)	Strength III Axial (lb.)	Ground Slope	SHAFT LENGTH (feet)	Service Deflection (in.)	Service Deflection Check	Service Max Moment (lb-in.)	Strength Max Moment (lb-in.)	Applicable Boring	Notes:
Noise Barrier No. 1B																			
27	16+24.00	24	21.00	504.00	352.00	12,600	1,209,600	31,680	17,640	1,693,440	28,512	0	9.00	0.02449	OK	1,326,287	1,855,362	B-033-0-16	
28	16+48.00	16	22.00										9.00						
29	16+64.00	16	23.00										9.00						
30	16+80.00	16	24.00	528.00	384.00	13,200	1,161,600	34,560	18,480	1,626,240	31,104	0	9.00	0.05810	OK	1,324,574	1,854,113	B-034-0-16	
31	16+96.00	24	22.00										9.00						

B-023-0-15 **Surface Elevation=** 1012.4 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
1	1011.4	1.5	2.5	0.125	22	0.219	1.74183	38	A-1-b	40.2				9.0
3.5	1008.9	2.5	5.0	0.105	4	0.496	1.4679	6	A-6a		0.3	466	15.0	26.0
6	1006.4	2.5	7.5	0.11	3	0.768	1.32208	4	A-6b		0.25	349	18.0	28.0
8.5	1003.9	2.5	10.0	0.125	20	1.069	1.21135	24	A-6b		2.25	2328		25.0
11	1001.4	2.5	12.5	0.135	51	1.399	1.12137	57	A-1-b	42.0				11.0
13.5	998.9	2.5	15.0	0.135	50	1.736	1.04908	52	A-1-b	42.0				13.0
16	996.4	2.5	17.5	0.135	45	2.074	0.98968	45	A-1-b	41.3				10.0
18.5	993.9	2.5	20.0	0.13	22	2.403	0.94048	21	A-1-b	36.8				10.0
23.5	988.9	5.0	25.0	0.13	12	3.053	0.8604	10	A-6b		0.6	1397		27.0
28.5	983.9	5.0	30.0	0.14	36	3.745	0.79203	29	A-6b		1.8	4190		28.0
33.5	978.9	5.0	35.0	0.135	18	4.424	0.73633	13	A-6b		0.25	2095	16.0	25.0

Strata No.	**B-023-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. N_{60}.** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	C	0.0	9.5	1002.9	9.5	20	19	116.3	26.3		933	1047	17	31.0
Strata 2	G	9.5	23.7	988.7	14.2	42	44	133.8	11.0	40.5				
Strata 3	C	23.7	39.0	973.4	15.3	22	17	135.0	26.7		883	2560	16	31.0

Strata No.	**Design Parameters for NB1A P8 to P12 (STA 2+00 TO STA 2+96)**									
	Type	**Btm. Dep** (ft.)	**Submerged** (Y/N)	**Avg. N_{60}.** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)
Cut/Fill	G	9	N	20	20	120	30		42.5	
Strata 1	C	18.5	N	20	19	116.0		950		0.011
Strata 2	G	32.7	N	42	44	134.0	40.5		111	
Strata 3	C	48.0	N	22	17	135.0		1000		0.01

B-025-0-15 **Surface Elevation=** 1004.9 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
1	1003.9	1.5	2.5	0.12	11	0.21	1.75548	19	A-6a		0.25	1,280	13.0	25.0
3.5	1001.4	2.5	5.0	0.11	5	0.4925	1.47043	7	A-6a		1.5	582	19.0	28.0
6	998.9	2.5	7.5	0.12	7	0.785	1.31454	9	A-6b		0.5	815		29.0

Strata No.	**B-025-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. N_{60}.** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	C	0	9.5	995.4	9.5	8	12	117	27.3		750	892	16	31.0

Strata No.	**Design Parameters for NB1A P13 to P18 (STA 3+20 TO STA 4+16)**													
	Type	**Btm. Dep** (ft.)	**Submerged** (Y/N)	**Avg. N_{60}.** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)	**RQD** (%)	**Q_u** (psi)	**E_m** (psi)	**k_{rm}** (dim.)
Cut/Fill	G	12	N	20	20	120	30		42.5					
Strata 1	C	21.5	N	8	12	116.5		800		0.014				
Strata 2	R	31.5	N			150.0					10	200	900	0.0005

B-026-0-15 **Surface Elevation=** 1007.7 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**Wn** (%)
1	1006.7	1.5	2.5	0.12	9	0.21	1.75548	16	A-4a(NP)	31.5	0.5			17.0
3.5	1004.2	2.5	5.0	0.105	4	0.48375	1.47643	6	A-4a(NP)	28.0				15.0
6	1001.7	2.5	7.5	0.13	31	0.79	1.31241	41	A-4a(NP)	36.7				13.0
8.5	999.2	2.5	10.0	0.13	63	1.115	1.19718	75	A-1-b	42.0				13.0
11	996.7	2.5	12.5	0.13	20	1.44	1.11165	22	A-1-b	37.0				14.0

Strata No.	**B-026-0-15**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**Avg. $N_{60.}$** (dim.)	**Avg $N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S/SL	0	6.0	1001.7	6.0	7	11	113	16.0	29.8				
Strata 2	G/SL	6.0	13.5	994.2	7.5	38	46	130	13.3	38.6				

Strata No.	**Design Parameters for NB1A P22 to P27 (STA 5+12 TO STA 6+32)**									
	Type	**Btm. Dep** (ft.)	**Submerged** (Y/N)	**Avg. $N_{60.}$** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)
Cut/Fill	G	10	N	20	20	120	30		42.5	
Strata 1	S/SL	16.0	N	7	11	112.5	29.5		14	
Strata 2	G/SL	23.5	N	38	46	130.0	38.5		104	

B-025-3-16 **Surface Elevation=** 1012.5 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
0	1012.5	1.5	1.5	0.12	12	0.090	2.000	24	A-4a		2.25	1,397		14
2.5	1010.0	2.5	4.0	0.11	6	0.373	1.564	9	A-4a		0.3	698	5	15
5	1007.5	2.5	6.5	0.125	10	0.674	1.366	14	A-3a	33.0				13

Strata No.	**B-025-3-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**$N_{60.}$** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	C	0	4.5	1008.0	4.5	9	17	115	15		1275	1047	5	34
Strata 2	S	4.5	8.0	1004.5	3.5	10	14	125	13	33.0				

Strata No.	**Design Parameters for NB1A P19 to P21 (STA 4+40 TO STA 4+88)**													
	Type	**Btm. Dep.** (ft.)	**Submerged** (Y/N)	**Avg. $N_{60.}$** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)	**RQD** (%)	**Q_u** (psi)	**E_m** (psi)	**k_{rm}** (dim.)
Cut/Fill	G	13.5	N	20	20	120	30		42.5					
Strata 1	C	18.0	N	9	17	115.0		1150		0.0096				
Strata 2	S	21.5	N	10	14	125.0	33.0		25					
Strata 2	R	31.5	N			150.0					10	200	900	0.0005

B-030-1-16 **Surface Elevation=** 1023.1 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
2.5	1020.6	1.5	4.0	0.12	15	0.390	1.548	23	A-3a	35.3				8
5	1018.1	2.5	6.5	0.125	27	0.699	1.353	37	A-3a	38.1				7
7.5	1015.6	2.5	9.0	0.12	8	1.003	1.233	10	A-4a		0.6	931	10	16
10	1013.1	2.5	11.5	0.125	10	1.311	1.143	11	A-3a	32.3				11
12.5	1010.6	2.5	14.0	0.125	12	1.624	1.071	13	A-4a		2	1,397		17
15	1008.1	2.5	16.5	0.13	18	1.945	1.011	18	A-4a		1.8	2,095	9	18
17.5	1005.6	2.5	19.0	0.135	37	2.279	0.958	35	A-2-4	38.8				13
20	1003.1	2.5	21.5	0.14	33	2.625	0.911	30	A-3a	37.0				11

Strata No.	**B-030-1-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	S	0	7.0	1016.1	7.0	21	30	123	8	36.7				
Strata 2	C	7.0	17.0	1006.1	10.0	12	13	125	16		1467	1474	10	33
Strata 3	G/SL	17.0	23.0	1000.1	6.0	35	33	138	12	37.9				

Strata No.	**Design Parameters for NB1A P28 to P34 (STA 6+38 TO STA 8+06)**									
	Type	**Btm. Dep.** (ft.)	**Submerged** (Y/N)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)
Cut/Fill	G	1	N	20	20	120	30		42.5	
Strata 1	S	8.0	N	21	30	122.5	36.5		44	
Strata 2	C	18.0	N	12	13	125.0		1450		0.0087
Strata 3	G/SL	24.0	N	35	33	137.5	37.5		99	

B-031-1-16 **Surface Elevation=** 1023.1 **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	efct. Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	**ϕ'** (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
2.5	1020.6	1.5	4.0	0.12	11	0.390	1.548	17	A-4a		0.8	1,280	9	18
5	1018.1	5	9.0	0.125	15	0.855	1.286	19	A-4a		2.25	1,746		17
7.5	1015.6	5	14.0	0.125	25	1.324	1.140	28	A-2-6	36.5				14
10	1013.1	5	19.0	0.13	26	1.795	1.038	27	A-4a			3,026	4	15
12.5	1010.6	6	25.0	0.135	34	2.346	0.948	32	A-4a		2.5	3,957	5	13

Strata No.	**B-031-1-16**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	**ϕ'_{PI}** (deg.)
Strata 1	C	0	15.0	1008.1	15.0	22	25	127	15		1850	2502	6	34

Strata No.	**Design Parameters STA for NB1A P35 to P38 (8+06 TO STA 8+78)**													
	Type	**Btm. Dep.** (ft.)	**Submerged** (Y/N)	**Avg. N_{60}** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)	**RQD** (%)	**Q_u** (psi)	**E_m** (psi)	**k_{rm}** (dim.)
Cut/Fill	G	-4	N	20	20	120	30		42.5					
Strata 1	C	11.0	N	22	25	127.0		2150		0.0069				
Strata 2	R	21.0	N			150.0					10	200	900	0.0005

B-033-0-16 **Surface Elevation=** 1034.4 efct. **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	Smpl. Int. (ft.)	Dpt. (Btm. of Spn.) (ft.)	Unit Wght. γ' (kcf.)	N_{60} (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	CLASF.	ϕ' (deg.)	H.P. (tsf.)	S_u (psf.)	PI (%)	W_n (%)
0	1034.4	1.5	1.5	0.125	19	0.094	2.000	38	A-4a			2211		34
2.5	1031.9	2.5	4.0	0.125	37	0.406	1.535	57	A-4a		4.5	4306		16
5	1029.4	2.5	6.5	0.13	46	0.728	1.340	62	A-4b		4.5	5353		10
7.5	1026.9	2.5	9.0	0.13	60	1.053	1.216	73	A-4a		4.5	6983	10	10
10	1024.4	2.5	11.5	0.135	31	1.386	1.124	35	A-3a	37.8				7
12.5	1021.9	2.5	14.0	0.13	29	1.715	1.053	31	A-4a		3.5	3375	10	15

Strata No.	B-033-0-16													
	Type	Top Dep. (ft.)	Btm. Dep. (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	$N_{60.}$ (dim.)	$N1_{60}$ (dim.)	γ_{moist} (pcf.)	W_n (%)	ϕ' (deg.)	C=HP/2 (psf.)	$C=S_u$ (psf.)	Avg PI. (%)	ϕ'_{PI} (deg.)
Strata 1	C	0.0	15.0	1019.4	15.0	37	49	129	15		4250	4446	10	32.5

Strata No.	Design Parameters NB1B P25 to P30 (STA. 15+76 TO 16+60)													
	Type	Btm. Dep. (ft.)	Submerged (Y/N)	Avg. $N_{60.}$ (dim.)	Avg $N1_{60}$ (dim.)	γ' (pcf.)	ϕ' (deg.)	C' (psf.)	k (pci.)	ξ_{50} (dim.)	RQD (%)	Q_u (psi)	E_m (psi)	k_{rm} (dim.)
Cut/Fill	G	0	N	20	20	120	30		42.5					
Strata 1	C	15.0	N	37	49	129.0		4300		0.0049				
Strata 2	R	25.0	N			150.0					10	200	900	0.0005

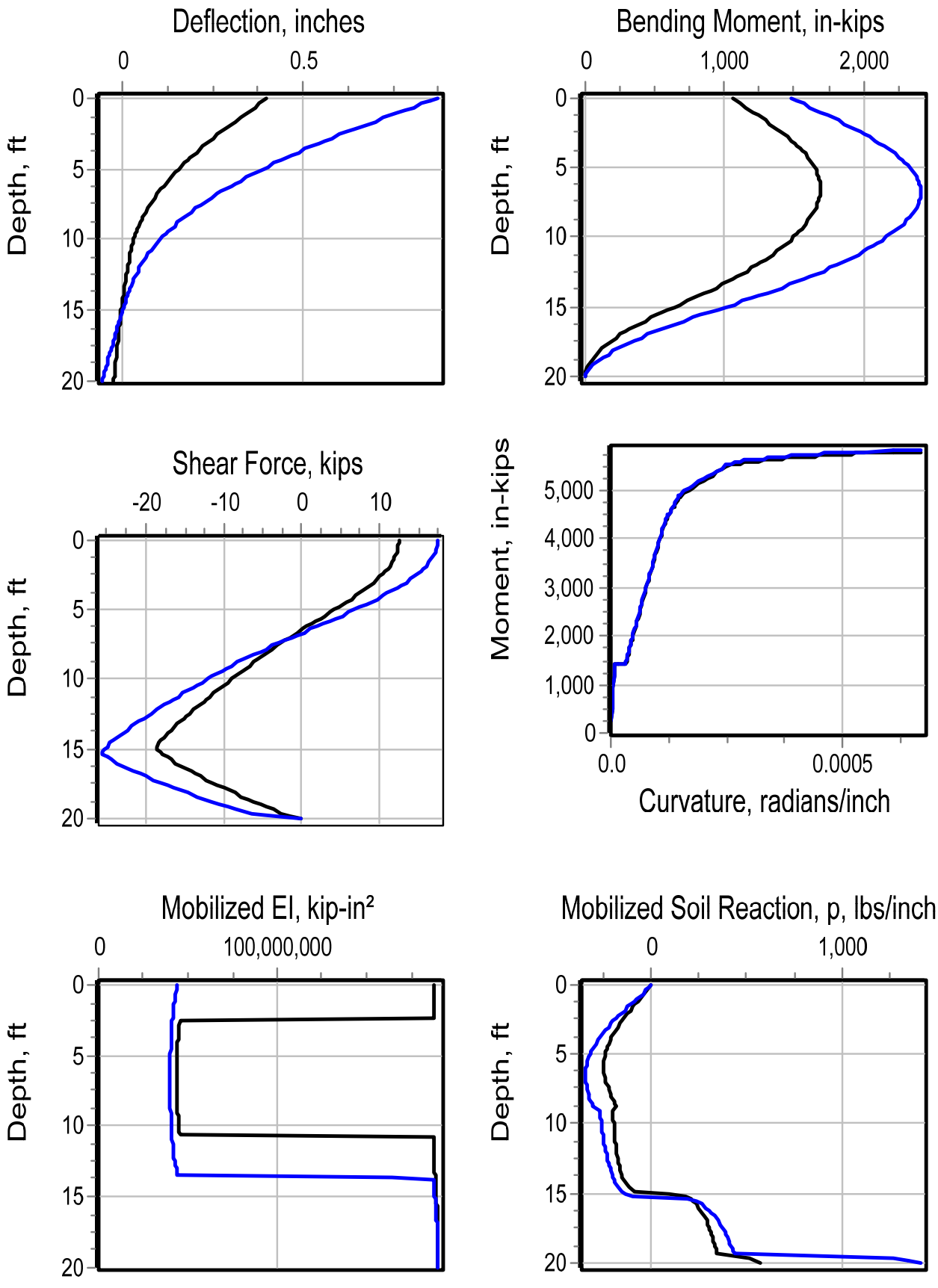
B-034-016 **Surface Elevation=** 1036.7 efct. **Water Dep. (ft.)=** Dry Water Elv. = Dry

Depth (ft.)	Elv. (Top of Spn.) (ft.)	**Smpl. Int.** (ft.)	Dpt. (Btm. of Spn.) (ft.)	Unit Wght. γ' (kcf.)	**N_{60}** (dim.)	Mid-spn. σ'_v (ksf.)	C_N (ksf.)	$N1_{60}$ (dim.)	**CLASF.**	ϕ' (deg.)	**H.P.** (tsf.)	S_u (psf.)	**PI** (%)	**W_n** (%)
0	1036.7	1.5	1.5	0.11	7	0.0825	2	14	A-6a		1	815		21
2.5	1034.2	2.5	4.0	0.125	40	0.38375	1.5539	62	A-6a		4.5	4655	11	9
5	1031.7	2.5	6.5	0.13	56	0.705	1.3505	76	A-6a		4.5	6517		10
7.5	1029.2	2.5	9.0	0.13	41	1.03	1.2237	50	A-4a		4.5	4772		8
10	1026.7	2.5	11.5	0.135	32	1.36375	1.1298	36	A-4a		4.5	3724	6	11
12.5	1024.2	2.5	14.0	0.13	29	1.6925	1.0576	31	A-4a		4.5	3375		9

Strata No.	**B-034-016**													
	Type	**Top Dep.** (ft.)	**Btm. Dep.** (ft.)	Btm. Elv. (ft.)	Str. Dep. (ft.)	**N_{60}** (dim.)	**$N1_{60}$** (dim.)	**γ_{moist}** (pcf.)	**W_n** (%)	**ϕ'** (deg.)	**C=HP/2** (psf.)	**$C=S_u$** (psf.)	**Avg PI.** (%)	ϕ'_{PI} (deg.)
Strata 1	C	0	15.0	1021.7	15.0	34	45	126.7	11		4150	3976	9	33

Strata No.	**Design Parameters NB1B P31 to P33 (STA. 16+72 TO 17+20)**													
	Type	**Btm. Dep.** (ft.)	**Submerged** (Y/N)	**Avg. $N_{60.}$** (dim.)	**Avg $N1_{60}$** (dim.)	**γ'** (pcf.)	**ϕ'** (deg.)	**C'** (psf.)	**k** (pci.)	**ξ_{50}** (dim.)	**RQD** (%)	**Q_u** (psi)	**E_m** (psi)	**k_{rm}** (dim.)
Cut/Fill	G	0	N	20	20	120	30		42.5					
Strata 1	C	15.0	N	34	45	126.5		4050		0.005				
Strata 2	R	25.0	N			150.0					10	200	900	0.0005

NB1A_P8-P12


Deflection, inches
0
0.5
Depth, ft
0
5
10
15
20
Bending Moment, in-kips
0
1,000
2,000
Depth, ft
0
5
10
15
20
Shear Force, kips
-20
-10
0
10
Depth, ft
0
5
10
15
20
Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch
Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
5
10
15
20
Mobilized Soil Reaction, p, lbs/inch
0
1,000
Depth, ft
0
5
10
15
20

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LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2019\Noise Wall\LPILE\

Name of input data file:
SUM-8_NB1A_P8-P12.lp10

Name of output report file:

SUM-8_NB1A_P8-P12.lp10

Name of plot output file:
SUM-8_NB1A_P8-P12.lp10

Name of runtime message file:
SUM-8_NB1A_P8-P12.lp10

Date and Time of Analysis

Date: August 30, 2019 Time: 13:55:43

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NAS1A_P8-P12

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 20.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	20.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 20.000000 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 26.600 degrees
= 0.464 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 9.000000 ft
Effective unit weight at top of layer = 120.000000 pcf
Effective unit weight at bottom of layer = 120.000000 pcf
Friction angle at top of layer = 30.000000 deg.
Friction angle at bottom of layer = 30.000000 deg.
Subgrade k at top of layer = 42.500000 pci
Subgrade k at bottom of layer = 42.500000 pci

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 9.000000 ft
Distance from top of pile to bottom of layer = 19.500000 ft
Effective unit weight at top of layer = 116.000000 pcf
Effective unit weight at bottom of layer = 116.000000 pcf
Undrained cohesion at top of layer = 950.000000 psf
Undrained cohesion at bottom of layer = 950.000000 psf
Epsilon-50 at top of layer = 0.011000
Epsilon-50 at bottom of layer = 0.011000

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 19.500000 ft
Distance from top of pile to bottom of layer = 33.700000 ft

Effective unit weight at top of layer = 134.000000 pcf
Effective unit weight at bottom of layer = 134.000000 pcf
Friction angle at top of layer = 40.500000 deg.
Friction angle at bottom of layer = 40.500000 deg.
Subgrade k at top of layer = 111.000000 pci
Subgrade k at bottom of layer = 111.000000 pci

(Depth of the lowest soil layer extends 13.700 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	E50 or krm	kpy pci
1	Sand	0.00	120.0000	--	30.0000	--	42.5000
	(Reese, et al.)	9.0000	120.0000	--	30.0000	--	42.5000
2	Stiff Clay	9.0000	116.0000	950.0000	--	0.01100	--
	w/o Free Water	19.5000	116.0000	950.0000	--	0.01100	--
3	Sand	19.5000	134.0000	--	40.5000	--	111.0000
	(Reese, et al.)	33.7000	134.0000	--	40.5000	--	111.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V =	12600. lbs	M =	1058400. in-lbs	41040.	No
2	1	V =	17640. lbs	M =	1481760. in-lbs	36936.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 20.000000 ft
Shaft Diameter = 30.000000 in
Concrete Cover Thickness = 3.000000 in

Number of Reinforcing Bars = 10 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 706.858347 sq. in.
Total Area of Reinforcing Steel = 7.900000 sq. in.
Area Ratio of Steel Reinforcement = 1.12 percent
Edge-to-Edge Bar Spacing = 6.107391 in
Maximum Concrete Aggregate Size = 0.750000 in
Ratio of Bar Spacing to Aggregate Size = 8.14
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 3147.516 kips
Tensile Load for Cracking of Concrete = -334.148 kips
Nominal Axial Tensile Capacity = -474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete = 4500. psi
Modulus of Elasticity of Concrete = 3823676. psi
Modulus of Rupture of Concrete = -503.115295 psi
Compression Strain at Peak Stress = 0.002001
Tensile Strain at Fracture of Concrete = -0.0001152
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	36.936
2	41.040

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.

Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 36.936 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
0.00000125	238.3589252	190687140.	23.7977311	0.00002975	-0.00000775	0.1319901	0.8572303	
0.00000250	475.8280707	190331228.	19.4139523	0.00004853	-0.00002647	0.2140370	1.3966365	
0.00000375	711.9218979	189845839.	17.9533709	0.00006733	-0.00004517	0.2953170	1.9361166	
0.00000500	946.6151118	189323022.	17.2232578	0.00008612	-0.00006388	0.3758227	2.4756224	
0.00000625	1180.	188784711.	16.7852774	0.0001049	-0.00008259	0.4555526	3.0151440	
0.00000750	1412.	188238546.	16.4933484	0.0001237	-0.0001013	0.5345061	3.5546783	
0.00000875	1412.	161347325.	11.3442887	0.00009926	-0.0001632	0.4298366	-4.6958242	C
0.00001000	1412.	141178910.	10.9364264	0.0001094	-0.0001906	0.4721412	-5.4849364	C
0.00001125	1412.	125492364.	10.6063297	0.0001193	-0.0002182	0.5136119	-6.2782474	C
0.00001250	1412.	112943128.	10.3348172	0.0001292	-0.0002458	0.5544764	-7.0742537	C
0.00001375	1412.	102675571.	10.1061168	0.0001390	-0.0002735	0.5947529	-7.8728734	C
0.00001500	1412.	94119273.	9.9113432	0.0001487	-0.0003013	0.6345606	-8.6733157	C

0.00001625	1412.	86879329.	9.7451423	0.0001584	-0.0003291	0.6740706
-9.4744141 C						
0.00001750	1412.	80673663.	9.5981468	0.0001680	-0.0003570	0.7130499
-10.2778154 C						
0.00001875	1412.	75295418.	9.4711133	0.0001776	-0.0003849	0.7518576
-11.0810196 C						
0.00002000	1412.	70589455.	9.3569980	0.0001871	-0.0004129	0.7902235
-11.8859411 C						
0.00002125	1412.	66437134.	9.2559446	0.0001967	-0.0004408	0.8283607
-12.6910866 C						
0.00002250	1412.	62746182.	9.1664237	0.0002062	-0.0004688	0.8663285
-13.4960335 C						
0.00002375	1412.	59443751.	9.0842070	0.0002157	-0.0004968	0.9038965
-14.3024399 C						
0.00002500	1412.	56471564.	9.0099281	0.0002252	-0.0005248	0.9412410
-15.1090521 C						
0.00002625	1412.	53782442.	8.9429879	0.0002348	-0.0005527	0.9784182
-15.9154629 C						
0.00002750	1412.	51337785.	8.8823867	0.0002443	-0.0005807	1.0154278
-16.7216715 C						
0.00002875	1412.	49105708.	8.8264092	0.0002538	-0.0006087	1.0521688
-17.5284188 C						
0.00003000	1412.	47059637.	8.7741720	0.0002632	-0.0006368	1.0886064
-18.3359702 C						
0.00003125	1412.	45177251.	8.7263418	0.0002727	-0.0006648	1.1248782
-19.1433151 C						
0.00003250	1445.	44453788.	8.6824108	0.0002822	-0.0006928	1.1609838
-19.9504527 C						
0.00003375	1489.	44121742.	8.6419467	0.0002917	-0.0007208	1.1969230
-20.7573821 C						
0.00003500	1533.	43812433.	8.6045787	0.0003012	-0.0007488	1.2326952
-21.5641026 C						
0.00003625	1578.	43523507.	8.5699872	0.0003107	-0.0007768	1.2683003
-22.3706133 C						
0.00003750	1622.	43252515.	8.5374299	0.0003202	-0.0008048	1.3036717
-23.1774198 C						
0.00003875	1666.	42997497.	8.5064467	0.0003296	-0.0008329	1.3387715
-23.9848179 C						

0.00004000	1710.	42757566.	8.4775862	0.0003391	-0.0008609	1.3737055 -24.7919999 C
0.00004125	1754.	42531348.	8.4506561	0.0003486	-0.0008889	1.4084733 -25.5989651 C
0.00004250	1798.	42317630.	8.4254868	0.0003581	-0.0009169	1.4430744 -26.4057124 C
0.00004375	1843.	42115338.	8.4019280	0.0003676	-0.0009449	1.4775087 -27.2122412 C
0.00004500	1887.	41923517.	8.3798463	0.0003771	-0.0009729	1.5117757 -28.0185504 C
0.00004625	1931.	41741316.	8.3591226	0.0003866	-0.0010009	1.5458750 -28.8246392 C
0.00004750	1974.	41567971.	8.3396502	0.0003961	-0.0010289	1.5798063 -29.6305068 C
0.00004875	2018.	41402800.	8.3213335	0.0004057	-0.0010568	1.6135692 -30.4361521 C
0.00005125	2106.	41094577.	8.2878317	0.0004248	-0.0011127	1.6805883 -32.0467725 C
0.00005375	2194.	40812399.	8.2580236	0.0004439	-0.0011686	1.7469294 -33.6564931 C
0.00005625	2281.	40552399.	8.2306855	0.0004630	-0.0012245	1.8124455 -35.2665066 C
0.00005875	2368.	40311968.	8.2059360	0.0004821	-0.0012804	1.8772256 -36.8760738 C
0.00006125	2455.	40088839.	8.1837408	0.0005013	-0.0013362	1.9413263 -38.4846927 C
0.00006375	2542.	39880960.	8.1638039	0.0005204	-0.0013921	2.0047444 -40.0923548 C
0.00006625	2629.	39686588.	8.1458741	0.0005397	-0.0014478	2.0674769 -41.6990517 C
0.00006875	2716.	39504232.	8.1297367	0.0005589	-0.0015036	2.1295203 -43.3047747 C
0.00007125	2802.	39332612.	8.1152074	0.0005782	-0.0015593	2.1908714 -44.9095150 C
0.00007375	2889.	39170621.	8.1021268	0.0005975	-0.0016150	2.2515270 -46.5132635 C
0.00007625	2975.	39017295.	8.0903566	0.0006169	-0.0016706	2.3114835 -48.1160113 C

0.00007875	3061.	38871795.	8.0797759	0.0006363	-0.0017262	2.3707375 -49.7177490 C
0.00008125	3147.	38733382.	8.0702790	0.0006557	-0.0017818	2.4292857 -51.3184673 C
0.00008375	3233.	38601409.	8.0617729	0.0006752	-0.0018373	2.4871244 -52.9181564 C
0.00008625	3318.	38475300.	8.0541751	0.0006947	-0.0018928	2.5442500 -54.5168067 C
0.00008875	3404.	38354540.	8.0474129	0.0007142	-0.0019483	2.6006589 -56.1144104 C
0.00009125	3489.	38238687.	8.0414214	0.0007338	-0.0020037	2.6563476 -57.7109527 C
0.00009375	3574.	38127327.	8.0361427	0.0007534	-0.0020591	2.7113124 -59.3064259 C
0.00009625	3659.	38020098.	8.0315249	0.0007730	-0.0021145	2.7655493 -60.0000000 CY
0.00009875	3744.	37916671.	8.0275217	0.0007927	-0.0021698	2.8190546 -60.0000000 CY
0.0001013	3829.	37816752.	8.0240913	0.0008124	-0.0022251	2.8718244 -60.0000000 CY
0.0001038	3913.	37720073.	8.0211957	0.0008322	-0.0022803	2.9238547 -60.0000000 CY
0.0001063	3998.	37626392.	8.0188011	0.0008520	-0.0023355	2.9751416 -60.0000000 CY
0.0001088	4082.	37535489.	8.0168764	0.0008718	-0.0023907	3.0256809 -60.0000000 CY
0.0001113	4166.	37447164.	8.0153936	0.0008917	-0.0024458	3.0754686 -60.0000000 CY
0.0001138	4248.	37345789.	8.0132567	0.0009115	-0.0025010	3.1241977 -60.0000000 CY
0.0001163	4315.	37115175.	8.0022636	0.0009303	-0.0025572	3.1695356 -60.0000000 CY
0.0001188	4365.	36753717.	7.9820095	0.0009479	-0.0026146	3.2113356 -60.0000000 CY
0.0001213	4409.	36362180.	7.9596058	0.0009651	-0.0026724	3.2516112 -60.0000000 CY
0.0001238	4453.	35984145.	7.9376696	0.0009823	-0.0027302	3.2911211 -60.0000000 CY

0.0001263	4497.	35620048.	7.9163746	0.0009994	-0.0027881	3.3299297
-60.0000000 CY						
0.0001288	4541.	35269410.	7.8961190	0.0010166	-0.0028459	3.3681670
-60.0000000 CY						
0.0001313	4585.	34931455.	7.8768451	0.0010338	-0.0029037	3.4058301
-60.0000000 CY						
0.0001338	4628.	34605469.	7.8584995	0.0010511	-0.0029614	3.4429166
-60.0000000 CY						
0.0001363	4672.	34290787.	7.8410327	0.0010683	-0.0030192	3.4794237
-60.0000000 CY						
0.0001388	4716.	33986794.	7.8243989	0.0010856	-0.0030769	3.5153486
-60.0000000 CY						
0.0001413	4759.	33692917.	7.8085555	0.0011030	-0.0031345	3.5506888
-60.0000000 CY						
0.0001438	4802.	33405628.	7.7931785	0.0011203	-0.0031922	3.5853584
-60.0000000 CY						
0.0001463	4841.	33099181.	7.7757732	0.0011372	-0.0032503	3.6186396
-60.0000000 CY						
0.0001488	4872.	32752096.	7.7541831	0.0011534	-0.0033091	3.6499174
-60.0000000 CY						
0.0001588	4944.	31141127.	7.6425710	0.0012133	-0.0035492	3.7601260
-60.0000000 CY						
0.0001688	5007.	29668377.	7.5360666	0.0012717	-0.0037908	3.8603642
-60.0000000 CY						
0.0001788	5069.	28356584.	7.4432222	0.0013305	-0.0040320	3.9537978
-60.0000000 CY						
0.0001888	5130.	27180072.	7.3619046	0.0013896	-0.0042729	4.0403166
-60.0000000 CY						
0.0001988	5190.	26115242.	7.2865741	0.0014482	-0.0045143	4.1188086
-60.0000000 CY						
0.0002088	5250.	25148550.	7.2193734	0.0015070	-0.0047555	4.1901829
-60.0000000 CY						
0.0002188	5308.	24266985.	7.1598816	0.0015662	-0.0049963	4.2545248
-60.0000000 CY						
0.0002288	5366.	23459303.	7.1071288	0.0016258	-0.0052367	4.3117099
-60.0000000 CY						
0.0002388	5423.	22716134.	7.0603099	0.0016856	-0.0054769	4.3616085
-60.0000000 CY						

0.0002488	5478.	22021059.	7.0149140	0.0017450	-0.0057175	4.4034570
-60.0000000 CY						
0.0002588	5520.	21331494.	6.9636743	0.0018019	-0.0059606	4.4365045
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0.0002688	5543.	20626912.	6.9024820	0.0018550	-0.0062075	4.4611220
-60.0000000 CY						
0.0002788	5558.	19937929.	6.8386118	0.0019063	-0.0064562	4.4791324
-60.0000000 CY						
0.0002888	5571.	19292490.	6.7794256	0.0019576	-0.0067049	4.4915988
-60.0000000 CY						
0.0002988	5583.	18687560.	6.7229935	0.0020085	-0.0069540	4.4984601
-60.0000000 CY						
0.0003088	5594.	18119000.	6.6688110	0.0020590	-0.0072035	4.4955018
-60.0000000 CY						
0.0003188	5605.	17584815.	6.6190483	0.0021098	-0.0074527	4.4986767
-60.0000000 CY						
0.0003288	5616.	17081976.	6.5732543	0.0021610	-0.0077015	4.4953754
60.0000000 CY						
0.0003388	5626.	16607529.	6.5311838	0.0022124	-0.0079501	4.4979869
60.0000000 CY						
0.0003488	5636.	16159395.	6.4923163	0.0022642	-0.0081983	4.4992721
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0.0003588	5645.	15734901.	6.4566749	0.0023163	-0.0084462	4.4958102
60.0000000 CY						
0.0003688	5654.	15331545.	6.4210004	0.0023677	-0.0086948	4.4995442
60.0000000 CY						
0.0003788	5662.	14948302.	6.3874479	0.0024192	-0.0089433	4.4921722
60.0000000 CY						
0.0003888	5670.	14583973.	6.3564077	0.0024711	-0.0091914	4.4966667
60.0000000 CY						
0.0003988	5677.	14237397.	6.3275035	0.0025231	-0.0094394	4.4997153
60.0000000 CY						
0.0004088	5684.	13906972.	6.3008204	0.0025755	-0.0096870	4.4913884
60.0000000 CY						
0.0004188	5692.	13591701.	6.2760762	0.0026281	-0.0099344	4.4954636
60.0000000 CY						
0.0004288	5698.	13290726.	6.2529770	0.0026810	-0.0101815	4.4991703
60.0000000 CY						

0.0004388	5705.	13002940.	6.2315249	0.0027341	-0.0104284	4.4964543	60.0000000 CY
0.0004488	5711.	12727294.	6.2117610	0.0027875	-0.0106750	4.4912490	60.0000000 CY
0.0004588	5718.	12463347.	6.1932686	0.0028412	-0.0109213	4.4967105	60.0000000 CY
0.0004688	5724.	12210345.	6.1759752	0.0028950	-0.0111675	4.4995608	60.0000000 CY
0.0004788	5729.	11967422.	6.1599782	0.0029491	-0.0114134	4.4944348	60.0000000 CY
0.0004888	5735.	11733829.	6.1446178	0.0030032	-0.0116593	4.4893790	60.0000000 CYT
0.0004988	5740.	11509135.	6.1290476	0.0030569	-0.0119056	4.4951003	60.0000000 CYT
0.0005088	5745.	11293057.	6.1144353	0.0031107	-0.0121518	4.4986494	60.0000000 CYT
0.0005188	5750.	11085092.	6.1007338	0.0031648	-0.0123977	4.4999890	60.0000000 CYT
0.0005288	5755.	10884494.	6.0882442	0.0032192	-0.0126433	4.4892036	60.0000000 CYT
0.0005388	5760.	10691150.	6.0765387	0.0032737	-0.0128888	4.4885841	60.0000000 CYT
0.0005488	5764.	10504693.	6.0655407	0.0033285	-0.0131340	4.4942464	60.0000000 CYT
0.0006088	5790.	9510709.	6.0137421	0.0036609	-0.0146016	4.4937159	60.0000000 CYT
0.0006688	5790.	8657412.	6.0106579	0.0040196	-0.0160429	4.4913676	60.0000000 CYT

Axial Thrust Force = 41.040 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
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   0.00000125   238.2423678    190593894.    24.7766624    0.00003097   -0.00000653
0.1374117     0.8927165
   0.00000250   475.6917796    190276712.    19.9047514    0.00004976   -0.00002524
0.2194220     1.4322195
   0.00000375   711.7808394    189808224.    18.2816803    0.00006856   -0.00004394
0.3006688     1.9718202
   0.00000500   946.4716621    189294332.    17.4703716    0.00008735   -0.00006265
0.3811420     2.5114539
   0.00000625        1180.    188761486.    16.9836931     0.0001061   -0.00008135     0.4608395
 3.0511069
   0.00000750        1412.    188219000.    16.6593092     0.0001249    -0.0001001     0.5397605
 3.5907748
   0.00000875        1412.    161330571.    11.7004305     0.0001024    -0.0001601     0.4431576
-4.6054532 C
   0.00001000        1412.    141164250.    11.2621588     0.0001126    -0.0001874     0.4859922
-5.3904740 C
   0.00001125        1412.    125479333.    10.9067189     0.0001227    -0.0002148     0.5279071
-6.1802455 C
   0.00001250        1412.    112931400.    10.6134929     0.0001327    -0.0002423     0.5691358
-6.9732338 C
   0.00001375        1412.    102664909.    10.3672012     0.0001425    -0.0002700     0.6097824
-7.7687660 C
   0.00001500        1412.     94109500.    10.1560814     0.0001523    -0.0002977     0.6498510
-8.5668546 C
   0.00001625        1412.     86870308.     9.9748508     0.0001621    -0.0003254     0.6895379
-9.3661640 C
   0.00001750        1412.     80665286.     9.8167456     0.0001718    -0.0003532     0.7288200
-10.1668766 C
   0.00001875        1412.     75287600.     9.6775837     0.0001815    -0.0003810     0.7677344
-10.9687513 C
   0.00002000        1412.     70582125.     9.5540709     0.0001911    -0.0004089     0.8063046
-11.7716388 C
   0.00002125        1412.     66430235.     9.4452427     0.0002007    -0.0004368     0.8446877
-12.5744316 C
   0.00002250        1412.     62739667.     9.3454043     0.0002103    -0.0004647     0.8825888
-13.3792486 C
   0.00002375        1412.     59437579.     9.2563653     0.0002198    -0.0004927     0.9203201
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-14.1838658 C						
0.00002500	1412.	56465700.	9.1765069	0.0002294	-0.0005206	0.9578811
-14.9882824 C						
0.00002625	1412.	53776857.	9.1027834	0.0002389	-0.0005486	0.9950908
-15.7938185 C						
0.00002750	1412.	51332455.	9.0350987	0.0002485	-0.0005765	1.0320320
-16.5998837 C						
0.00002875	1412.	49100609.	8.9735437	0.0002580	-0.0006045	1.0688051
-17.4057454 C						
0.00003000	1412.	47054750.	8.9173530	0.0002675	-0.0006325	1.1054096
-18.2114028 C						
0.00003125	1431.	45784566.	8.8658838	0.0002771	-0.0006604	1.1418453
-19.0168552 C						
0.00003250	1475.	45389602.	8.8173549	0.0002866	-0.0006884	1.1779564
-19.8232679 C						
0.00003375	1519.	45022195.	8.7720557	0.0002961	-0.0007164	1.2138250
-20.6300379 C						
0.00003500	1564.	44680049.	8.7301988	0.0003056	-0.0007444	1.2495265
-21.4365981 C						
0.00003625	1608.	44360548.	8.6914288	0.0003151	-0.0007724	1.2850607
-22.2429479 C						
0.00003750	1652.	44061424.	8.6554378	0.0003246	-0.0008004	1.3204271
-23.0490863 C						
0.00003875	1697.	43780702.	8.6219574	0.0003341	-0.0008284	1.3556253
-23.8550127 C						
0.00004000	1741.	43516654.	8.5907532	0.0003436	-0.0008564	1.3906552
-24.6607262 C						
0.00004125	1785.	43267761.	8.5616188	0.0003532	-0.0008843	1.4255162
-25.4662259 C						
0.00004250	1829.	43032173.	8.5337668	0.0003627	-0.0009123	1.4601129
-26.2722572 C						
0.00004375	1873.	42808897.	8.5072558	0.0003722	-0.0009403	1.4944735
-27.0786065 C						
0.00004500	1917.	42597256.	8.4823866	0.0003817	-0.0009683	1.5286666
-27.8847354 C						
0.00004625	1961.	42396304.	8.4590266	0.0003912	-0.0009963	1.5626919
-28.6906430 C						
0.00004750	2005.	42205193.	8.4370573	0.0004008	-0.0010242	1.5965489

-29.4963284 C						
0.00004875	2049.	42023165.	8.4163726	0.0004103	-0.0010522	1.6302372
-30.3017906 C						
0.00005125	2136.	41683688.	8.3784829	0.0004294	-0.0011081	1.6971066
-31.9120421 C						
0.00005375	2224.	41373156.	8.3446975	0.0004485	-0.0011640	1.7632970
-33.5213901 C						
0.00005625	2311.	41087692.	8.3144738	0.0004677	-0.0012198	1.8288053
-35.1298270 C						
0.00005875	2398.	40824078.	8.2873615	0.0004869	-0.0012756	1.8936286
-36.7373451 C						
0.00006125	2486.	40579621.	8.2629841	0.0005061	-0.0013314	1.9577637
-38.3439368 C						
0.00006375	2572.	40351881.	8.2406648	0.0005253	-0.0013872	2.0211309
-39.9502583 C						
0.00006625	2659.	40138907.	8.2200558	0.0005446	-0.0014429	2.0837039
-41.5565302 C						
0.00006875	2746.	39939296.	8.2014363	0.0005638	-0.0014987	2.1455869
-43.1618237 C						
0.00007125	2832.	39751625.	8.1846013	0.0005832	-0.0015543	2.2067765
-44.7661298 C						
0.00007375	2919.	39574663.	8.1693735	0.0006025	-0.0016100	2.2672693
-46.3694396 C						
0.00007625	3005.	39407342.	8.1555990	0.0006219	-0.0016656	2.3270620
-47.9717439 C						
0.00007875	3091.	39248728.	8.1431435	0.0006413	-0.0017212	2.3861510
-49.5730332 C						
0.00008125	3177.	39098002.	8.1318893	0.0006607	-0.0017768	2.4445329
-51.1732981 C						
0.00008375	3262.	38954444.	8.1217327	0.0006802	-0.0018323	2.5022041
-52.7725290 C						
0.00008625	3348.	38817415.	8.1125823	0.0006997	-0.0018878	2.5591611
-54.3707158 C						
0.00008875	3433.	38686350.	8.1043569	0.0007193	-0.0019432	2.6154001
-55.9678487 C						
0.00009125	3519.	38560743.	8.0969843	0.0007388	-0.0019987	2.6709176
-57.5639175 C						
0.00009375	3604.	38440140.	8.0904002	0.0007585	-0.0020540	2.7257095

-59.1589140 C

0.00009625	3689.	38324146.	8.0845469	0.0007781	-0.0021094	2.7797725

-60.0000000 CY

0.00009875	3773.	38212392.	8.0793726	0.0007978	-0.0021647	2.8331026

-60.0000000 CY

0.0001013	3858.	38104551.	8.0748307	0.0008176	-0.0022199	2.8856957

-60.0000000 CY

0.0001038	3943.	38000326.	8.0708794	0.0008374	-0.0022751	2.9375480

-60.0000000 CY

0.0001063	4027.	37899448.	8.0674805	0.0008572	-0.0023303	2.9886554

-60.0000000 CY

0.0001088	4111.	37801673.	8.0645996	0.0008770	-0.0023855	3.0390138

-60.0000000 CY

0.0001113	4195.	37706778.	8.0622055	0.0008969	-0.0024406	3.0886191

-60.0000000 CY

0.0001138	4278.	37610822.	8.0600126	0.0009168	-0.0024957	3.1373947

-60.0000000 CY

0.0001163	4346.	37388761.	8.0492027	0.0009357	-0.0025518	3.1828491

-60.0000000 CY

0.0001188	4398.	37033008.	8.0289410	0.0009534	-0.0026091	3.2247167

-60.0000000 CY

0.0001213	4442.	36636370.	8.0057589	0.0009707	-0.0026668	3.2648351

-60.0000000 CY

0.0001238	4486.	36252874.	7.9835692	0.0009880	-0.0027245	3.3043283

-60.0000000 CY

0.0001263	4530.	35883851.	7.9624707	0.0010053	-0.0027822	3.3432409

-60.0000000 CY

0.0001288	4574.	35528181.	7.9420330	0.0010225	-0.0028400	3.3814641

-60.0000000 CY

0.0001313	4618.	35184951.	7.9220053	0.0010398	-0.0028977	3.4189384

-60.0000000 CY

0.0001338	4662.	34853883.	7.9029352	0.0010570	-0.0029555	3.4558348

-60.0000000 CY

0.0001363	4705.	34534303.	7.8847718	0.0010743	-0.0030132	3.4921506

-60.0000000 CY

0.0001388	4749.	34225585.	7.8674676	0.0010916	-0.0030709	3.5278830

-60.0000000 CY

0.0001413	4792.	33927149.	7.8509788	0.0011090	-0.0031285	3.5630293

-60.0000000 CY						
0.0001438	4835.	33636222.	7.8350521	0.0011263	-0.0031862	3.5975252
-60.0000000 CY						
0.0001463	4875.	33334269.	7.8178903	0.0011434	-0.0032441	3.6308597
-60.0000000 CY						
0.0001488	4908.	32994026.	7.7967911	0.0011598	-0.0033027	3.6622641
-60.0000000 CY						
0.0001588	4981.	31375958.	7.6840665	0.0012198	-0.0035427	3.7720929
-60.0000000 CY						
0.0001688	5044.	29890577.	7.5773008	0.0012787	-0.0037838	3.8721107
-60.0000000 CY						
0.0001788	5106.	28565630.	7.4824461	0.0013375	-0.0040250	3.9647308
-60.0000000 CY						
0.0001888	5167.	27377340.	7.3993419	0.0013966	-0.0042659	4.0504201
-60.0000000 CY						
0.0001988	5228.	26303766.	7.3247202	0.0014558	-0.0045067	4.1286704
-60.0000000 CY						
0.0002088	5287.	25327373.	7.2560128	0.0015147	-0.0047478	4.1991449
-60.0000000 CY						
0.0002188	5346.	24436981.	7.1951642	0.0015739	-0.0049886	4.2625668
-60.0000000 CY						
0.0002288	5403.	23621224.	7.1411854	0.0016335	-0.0052290	4.3188102
-60.0000000 CY						
0.0002388	5460.	22870640.	7.0932555	0.0016935	-0.0054690	4.3677441
-60.0000000 CY						
0.0002488	5515.	22172097.	7.0495938	0.0017536	-0.0057089	4.4090574
-60.0000000 CY						
0.0002588	5558.	21481410.	6.9985391	0.0018109	-0.0059516	4.4412336
-60.0000000 CY						
0.0002688	5584.	20776082.	6.9375749	0.0018645	-0.0061980	4.4649654
-60.0000000 CY						
0.0002788	5598.	20083412.	6.8731909	0.0019159	-0.0064466	4.4819806
-60.0000000 CY						
0.0002888	5611.	19432527.	6.8130345	0.0019673	-0.0066952	4.4933792
-60.0000000 CY						
0.0002988	5624.	18823953.	6.7578780	0.0020189	-0.0069436	4.4992052
-60.0000000 CY						
0.0003088	5635.	18250958.	6.7035370	0.0020697	-0.0071928	4.4945050

-60.0000000 CY						
0.0003188	5646.	17712269.	6.6529419	0.0021206	-0.0074419	4.4993789
60.0000000 CY						
0.0003288	5656.	17205079.	6.6064415	0.0021719	-0.0076906	4.4936108
60.0000000 CY						
0.0003388	5666.	16726672.	6.5636363	0.0022234	-0.0079391	4.4988970
60.0000000 CY						
0.0003488	5676.	16274656.	6.5241725	0.0022753	-0.0081872	4.4951043
60.0000000 CY						
0.0003588	5685.	15846663.	6.4878729	0.0023275	-0.0084350	4.4972057
60.0000000 CY						
0.0003688	5694.	15441154.	6.4542315	0.0023800	-0.0086825	4.4999302
60.0000000 CY						
0.0003788	5702.	15054768.	6.4206014	0.0024318	-0.0089307	4.4927685
60.0000000 CY						
0.0003888	5710.	14687461.	6.3889620	0.0024837	-0.0091788	4.4980361
60.0000000 CY						
0.0003988	5717.	14338046.	6.3594975	0.0025358	-0.0094267	4.4999888
60.0000000 CY						
0.0004088	5724.	14004774.	6.3324074	0.0025884	-0.0096741	4.4915380
60.0000000 CY						
0.0004188	5731.	13686963.	6.3071434	0.0026411	-0.0099214	4.4971314
60.0000000 CY						
0.0004288	5738.	13383560.	6.2835565	0.0026941	-0.0101684	4.4997779
60.0000000 CY						
0.0004388	5745.	13093298.	6.2617840	0.0027474	-0.0104151	4.4914738
60.0000000 CY						
0.0004488	5751.	12815467.	6.2415604	0.0028009	-0.0106616	4.4937007
60.0000000 CY						
0.0004588	5757.	12549426.	6.2226351	0.0028546	-0.0109079	4.4981450
60.0000000 CY						
0.0004688	5763.	12294416.	6.2049340	0.0029086	-0.0111539	4.4999569
60.0000000 CY						
0.0004788	5769.	12049420.	6.1886942	0.0029628	-0.0113997	4.4892774
60.0000000 CY						
0.0004888	5774.	11814133.	6.1735333	0.0030173	-0.0116452	4.4922430
60.0000000 CYT						
0.0004988	5780.	11588038.	6.1593232	0.0030720	-0.0118905	4.4970854

60.0000000 CYT

0.0005088	5785.	11370491.	6.1455102	0.0031265	-0.0121360	4.4996005

60.0000000 CYT

0.0005188	5790.	11160752.	6.1316269	0.0031808	-0.0123817	4.4951600

60.0000000 CYT

0.0005288	5794.	10958572.	6.1188153	0.0032353	-0.0126272	4.4854712

60.0000000 CYT

0.0005388	5799.	10763736.	6.1067654	0.0032900	-0.0128725	4.4919756

60.0000000 CYT

0.0005488	5803.	10575839.	6.0954418	0.0033449	-0.0131176	4.4965830

60.0000000 CYT

0.0006088	5828.	9574096.	6.0421293	0.0036781	-0.0145844	4.4962852

60.0000000 CYT

0.0006688	5828.	8715112.	6.0381331	0.0040380	-0.0160245	4.4946082

60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	36.936	5734.585	0.00300000
2	41.040	5772.410	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5735.	24.008400	3727.	37937141.
2	0.65	5772.	26.676000	3752.	38240612.
1	0.70	5735.	25.855200	4014.	37608677.
2	0.70	5772.	28.728000	4041.	37883324.
1	0.75	5735.	27.702000	4301.	37162646.
2	0.75	5772.	30.780000	4329.	37444546.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	110761.
2	9.0000	10.0511	No	No	110761.	197132.
3	19.5000	10.1893	No	No	307893.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for

peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 12600.0 lbs
Applied moment at pile head = 1058400.0 in-lbs
Axial thrust load on pile head = 41040.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3988	1058400.	12600.	-0.00443	0.00	1.89E+11	0.00	0.00	0.00
0.2000	0.3882	1089075.	12587.	-0.00441	0.00	1.89E+11	-11.0740	68.4616	0.00
0.4000	0.3776	1119686.	12546.	-0.00440	0.00	1.89E+11	-22.6418	143.8969	0.00
0.6000	0.3671	1150164.	12478.	-0.00439	0.00	1.89E+11	-34.5864	226.1226	0.00
0.8000	0.3566	1180442.	12380.	-0.00437	0.00	1.89E+11	-46.7911	314.9308	0.00
1.0000	0.3461	1210449.	12253.	-0.00436	0.00	1.89E+11	-59.1397	410.0865	0.00
1.2000	0.3357	1240114.	12096.	-0.00434	0.00	1.89E+11	-71.5160	511.3228	0.00
1.4000	0.3253	1269365.	11909.	-0.00432	0.00	1.89E+11	-84.0081	619.8372	0.00

1.6000	0.3149	1298130.	11693.	-0.00431	0.00	1.88E+11	-96.4693	735.1914	0.00
1.8000	0.3046	1326339.	11447.	-0.00429	0.00	1.88E+11	-108.7483	856.8450	0.00
2.0000	0.2943	1353919.	11171.	-0.00427	0.00	1.88E+11	-120.7499	984.6316	0.00
2.2000	0.2841	1380802.	10867.	-0.00426	0.00	1.88E+11	-132.3803	1118.	0.00
2.4000	0.2739	1406921.	10536.	-0.00424	0.00	1.88E+11	-143.5477	1258.	0.00
2.6000	0.2637	1432212.	10179.	-0.00419	0.00	4.60E+10	-154.3555	1405.	0.00
2.8000	0.2538	1456605.	9796.	-0.00412	0.00	4.56E+10	-164.8062	1559.	0.00
3.0000	0.2440	1480042.	9388.	-0.00404	0.00	4.53E+10	-174.6550	1718.	0.00
3.2000	0.2344	1502466.	8958.	-0.00396	0.00	4.52E+10	-183.8330	1882.	0.00
3.4000	0.2250	1523822.	8507.	-0.00388	0.00	4.50E+10	-192.2746	2051.	0.00
3.6000	0.2158	1544063.	8036.	-0.00380	0.00	4.48E+10	-199.9174	2224.	0.00
3.8000	0.2067	1563145.	7548.	-0.00371	0.00	4.47E+10	-207.0275	2403.	0.00
4.0000	0.1979	1581025.	7042.	-0.00363	0.00	4.46E+10	-214.3086	2599.	0.00
4.2000	0.1893	1597663.	6520.	-0.00354	0.00	4.44E+10	-220.8000	2799.	0.00
4.4000	0.1809	1613021.	5984.	-0.00346	0.00	4.43E+10	-226.4548	3004.	0.00
4.6000	0.1727	1627065.	5434.	-0.00337	0.00	4.42E+10	-231.2293	3213.	0.00
4.8000	0.1647	1639769.	4875.	-0.00328	0.00	4.41E+10	-235.0830	3425.	0.00
5.0000	0.1570	1651110.	4307.	-0.00319	0.00	4.41E+10	-237.9792	3638.	0.00
5.2000	0.1494	1661072.	3732.	-0.00310	0.00	4.40E+10	-241.4742	3878.	0.00

5.4000	0.1421	1669633.	3149.	-0.00301	0.00	4.39E+10	-244.1285	4123.
0.00								
5.6000	0.1350	1676780.	2561.	-0.00292	0.00	4.39E+10	-245.9196	4373.
0.00								
5.8000	0.1281	1682501.	1970.	-0.00283	0.00	4.39E+10	-246.8284	4625.
0.00								
6.0000	0.1214	1686791.	1377.	-0.00273	0.00	4.38E+10	-246.8393	4879.
0.00								
6.2000	0.1150	1689650.	785.9117	-0.00264	0.00	4.38E+10	-245.9404	5134.
0.00								
6.4000	0.1087	1691084.	197.3145	-0.00255	0.00	4.38E+10	-244.5572	5398.
0.00								
6.6000	0.1027	1691100.	-386.9889	-0.00246	0.00	4.38E+10	-242.3623	5662.
0.00								
6.8000	0.09694	1689710.	-964.8669	-0.00236	0.00	4.38E+10	-239.2027	5922.
0.00								
7.0000	0.09138	1686934.	-1534.	-0.00227	0.00	4.38E+10	-235.0802	6174.
0.00								
7.2000	0.08603	1682794.	-2092.	-0.00218	0.00	4.39E+10	-230.0037	6416.
0.00								
7.4000	0.08091	1677321.	-2637.	-0.00209	0.00	4.39E+10	-223.9896	6644.
0.00								
7.6000	0.07601	1670549.	-3168.	-0.00200	0.00	4.39E+10	-218.5527	6900.
0.00								
7.8000	0.07133	1662508.	-3687.	-0.00191	0.00	4.40E+10	-213.8093	7194.
0.00								
8.0000	0.06687	1653227.	-4193.	-0.00181	0.00	4.41E+10	-208.3266	7477.
0.00								
8.2000	0.06262	1642738.	-4686.	-0.00173	0.00	4.41E+10	-202.1403	7747.
0.00								
8.4000	0.05859	1631075.	-5163.	-0.00164	0.00	4.42E+10	-195.2941	8000.
0.00								
8.6000	0.05477	1618278.	-5623.	-0.00155	0.00	4.43E+10	-187.8395	8231.
0.00								
8.8000	0.05116	1604391.	-6064.	-0.00146	0.00	4.44E+10	-179.8359	8437.
0.00								
9.0000	0.04776	1589460.	-6523.	-0.00137	0.00	4.45E+10	-203.1093	10208.
0.00								

9.2000	0.04456	1573350.	-7009.	-0.00129	0.00	4.46E+10	-201.6668	10862.	0.00
9.4000	0.04157	1556070.	-7491.	-0.00121	0.00	4.47E+10	-200.2012	11560.	0.00
9.6000	0.03877	1537629.	-7970.	-0.00112	0.00	4.49E+10	-198.7254	12301.	0.00
9.8000	0.03618	1518035.	-8445.	-0.00104	0.00	4.50E+10	-197.2543	13086.	0.00
10.0000	0.03378	1497297.	-8917.	-9.61E-04	0.00	4.52E+10	-195.8049	13913.	0.00
10.2000	0.03157	1475424.	-9385.	-8.82E-04	0.00	4.54E+10	-194.3962	14780.	0.00
10.4000	0.02954	1452423.	-9850.	-8.05E-04	0.00	4.56E+10	-193.0494	15683.	0.00
10.6000	0.02770	1428302.	-10312.	-7.29E-04	0.00	4.59E+10	-191.7876	16615.	0.00
10.8000	0.02604	1403069.	-10771.	-6.83E-04	0.00	1.88E+11	-190.6354	17568.	0.00
11.0000	0.02443	1376737.	-11227.	-6.65E-04	0.00	1.88E+11	-189.3638	18606.	0.00
11.2000	0.02285	1349312.	-11680.	-6.48E-04	0.00	1.88E+11	-187.9646	19742.	0.00
11.4000	0.02132	1320803.	-12129.	-6.31E-04	0.00	1.88E+11	-186.4281	20990.	0.00
11.6000	0.01982	1291218.	-12574.	-6.14E-04	0.00	1.88E+11	-184.7431	22368.	0.00
11.8000	0.01837	1260568.	-13015.	-5.98E-04	0.00	1.89E+11	-182.8962	23898.	0.00
12.0000	0.01695	1228862.	-13452.	-5.82E-04	0.00	1.89E+11	-180.8717	25608.	0.00
12.2000	0.01557	1196113.	-13883.	-5.67E-04	0.00	1.89E+11	-178.6504	27532.	0.00
12.4000	0.01423	1162334.	-14309.	-5.52E-04	0.00	1.89E+11	-176.2093	29716.	0.00
12.6000	0.01293	1127538.	-14729.	-5.37E-04	0.00	1.89E+11	-173.5200	32220.	0.00
12.8000	0.01165	1091741.	-15142.	-5.23E-04	0.00	1.89E+11	-170.5468	35125.	0.00

13.0000	0.01041	1054960.	-15547.	-5.09E-04	0.00	1.89E+11	-167.2446	38542.	0.00
13.2000	0.00921	1017215.	-15944.	-4.96E-04	0.00	1.89E+11	-163.5542	42630.	0.00
13.4000	0.00803	978527.	-16332.	-4.84E-04	0.00	1.89E+11	-159.3969	47627.	0.00
13.6000	0.00689	938919.	-16708.	-4.71E-04	0.00	1.89E+11	-154.6633	53902.	0.00
13.8000	0.00577	898419.	-17073.	-4.60E-04	0.00	1.89E+11	-149.1954	62066.	0.00
14.0000	0.00468	857059.	-17423.	-4.49E-04	0.00	1.89E+11	-142.7514	73217.	0.00
14.2000	0.00362	814875.	-17757.	-4.38E-04	0.00	1.90E+11	-134.9290	89569.	0.00
14.4000	0.00258	771913.	-18069.	-4.28E-04	0.00	1.90E+11	-124.9734	116420.	0.00
14.6000	0.00156	728231.	-18352.	-4.19E-04	0.00	1.90E+11	-111.1398	170909.	0.00
14.8000	5.67E-04	683907.	-18585.	-4.10E-04	0.00	1.90E+11	-83.3825	352846.	0.00
15.0000	-4.06E-04	639102.	-18567.	-4.01E-04	0.00	1.90E+11	98.8780	585031.	0.00
15.2000	-0.00136	594866.	-18233.	-3.93E-04	0.00	1.90E+11	179.4278	316863.	0.00
15.4000	-0.00229	551663.	-17772.	-3.86E-04	0.00	1.90E+11	204.5263	213940.	0.00
15.6000	-0.00321	509637.	-17260.	-3.80E-04	0.00	1.90E+11	222.4903	166190.	0.00
15.8000	-0.00412	468891.	-16709.	-3.73E-04	0.00	1.90E+11	236.7050	138011.	0.00
16.0000	-0.00501	429509.	-16126.	-3.68E-04	0.00	1.90E+11	248.5643	119185.	0.00
16.2000	-0.00588	391558.	-15517.	-3.63E-04	0.00	1.90E+11	258.7915	105606.	0.00
16.4000	-0.00675	355097.	-14885.	-3.58E-04	0.00	1.90E+11	267.8149	95287.	0.00
16.6000	-0.00760	320179.	-14233.	-3.54E-04	0.00	1.90E+11	275.9112	87142.	0.00

16.8000	-0.00844	286849.	-13562.	-3.50E-04	0.00	1.90E+11	283.2704	80525.	0.00
17.0000	-0.00928	255150.	-12874.	-3.46E-04	0.00	1.91E+11	290.0293	75026.	0.00
17.2000	-0.01011	225122.	-12170.	-3.43E-04	0.00	1.91E+11	296.2896	70370.	0.00
17.4000	-0.01093	196800.	-11452.	-3.41E-04	0.00	1.91E+11	302.1295	66368.	0.00
17.6000	-0.01174	170218.	-10721.	-3.38E-04	0.00	1.91E+11	307.6102	62883.	0.00
17.8000	-0.01255	145407.	-9976.	-3.36E-04	0.00	1.91E+11	312.7806	59816.	0.00
18.0000	-0.01335	122399.	-9220.	-3.35E-04	0.00	1.91E+11	317.6805	57091.	0.00
18.2000	-0.01416	101219.	-8452.	-3.33E-04	0.00	1.91E+11	322.3426	54649.	0.00
18.4000	-0.01495	81897.	-7673.	-3.32E-04	0.00	1.91E+11	326.7940	52446.	0.00
18.6000	-0.01575	64456.	-6883.	-3.31E-04	0.00	1.91E+11	331.0576	50446.	0.00
18.8000	-0.01654	48923.	-6084.	-3.30E-04	0.00	1.91E+11	335.1527	48619.	0.00
19.0000	-0.01734	35320.	-5275.	-3.30E-04	0.00	1.91E+11	339.0957	46943.	0.00
19.2000	-0.01813	23669.	-4456.	-3.30E-04	0.00	1.91E+11	342.9008	45397.	0.00
19.4000	-0.01892	13995.	-3629.	-3.29E-04	0.00	1.91E+11	346.5799	43967.	0.00
19.6000	-0.01971	6316.	-2596.	-3.29E-04	0.00	1.91E+11	514.5407	62657.	0.00
19.8000	-0.02050	1601.	-1329.	-3.29E-04	0.00	1.91E+11	540.6266	63297.	0.00
20.0000	-0.02129	0.00	0.00	-3.29E-04	0.00	1.91E+11	567.1321	31968.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual

stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.39882096 inches
Computed slope at pile head = -0.00442772 radians
Maximum bending moment = 1691100. inch-lbs
Maximum shear force = -18585. lbs
Depth of maximum bending moment = 6.60000000 feet below pile head
Depth of maximum shear force = 14.80000000 feet below pile head
Number of iterations = 102
Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 17640.0 lbs
Applied moment at pile head = 1481760.0 in-lbs
Axial thrust load on pile head = 36936.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.8685	1481760.	17640.	-0.00930	0.00	4.42E+10	0.00	0.00	0.00
0.2000	0.8463	1524917.	17623.	-0.00922	0.00	4.42E+10	-13.9757	39.6332	0.00

0.4000	0.8243	1567986.	17572.	-0.00913	0.00	4.36E+10	-28.5928	83.2520	0.00
0.6000	0.8025	1610882.	17485.	-0.00905	0.00	4.33E+10	-43.7179	130.7517	0.00
0.8000	0.7809	1653519.	17362.	-0.00895	0.00	4.31E+10	-59.2203	182.0159	0.00
1.0000	0.7595	1695807.	17201.	-0.00886	0.00	4.28E+10	-74.9716	236.9150	0.00
1.2000	0.7383	1737654.	17002.	-0.00876	0.00	4.26E+10	-90.8461	295.3040	0.00
1.4000	0.7174	1778969.	16765.	-0.00867	0.00	4.24E+10	-106.7594	357.1501	0.00
1.6000	0.6967	1819661.	16489.	-0.00856	0.00	4.22E+10	-122.6056	422.3333	0.00
1.8000	0.6763	1859637.	16176.	-0.00846	0.00	4.20E+10	-138.2732	490.6895	0.00
2.0000	0.6561	1898807.	15826.	-0.00835	0.00	4.19E+10	-153.6627	562.0677	0.00
2.2000	0.6362	1937083.	15439.	-0.00824	0.00	4.17E+10	-168.6783	636.3018	0.00
2.4000	0.6166	1974377.	15017.	-0.00813	0.00	4.16E+10	-183.2277	713.2075	0.00
2.6000	0.5972	2010606.	14560.	-0.00801	0.00	4.14E+10	-197.4187	793.3702	0.00
2.8000	0.5781	2045687.	14070.	-0.00790	0.00	4.13E+10	-211.2323	876.9162	0.00
3.0000	0.5593	2079541.	13547.	-0.00778	0.00	4.12E+10	-224.4170	962.9766	0.00
3.2000	0.5408	2112091.	12993.	-0.00765	0.00	4.11E+10	-236.8995	1051.	0.00
3.4000	0.5226	2143266.	12411.	-0.00753	0.00	4.10E+10	-248.6097	1142.	0.00
3.6000	0.5047	2172998.	11801.	-0.00740	0.00	4.09E+10	-259.4804	1234.	0.00
3.8000	0.4870	2201224.	11166.	-0.00727	0.00	4.08E+10	-269.8548	1330.	0.00
4.0000	0.4697	2227884.	10505.	-0.00714	0.00	4.07E+10	-280.6192	1434.	0.00

4.2000	0.4528	2252916.	9820.	-0.00701	0.00	4.06E+10	-290.5100	1540.
0.00								
4.4000	0.4361	2276263.	9112.	-0.00688	0.00	4.06E+10	-299.4642	1648.
0.00								
4.6000	0.4198	2297873.	8384.	-0.00674	0.00	4.05E+10	-307.4214	1758.
0.00								
4.8000	0.4037	2317701.	7638.	-0.00660	0.00	4.04E+10	-314.3242	1868.
0.00								
5.0000	0.3880	2335705.	6876.	-0.00647	0.00	4.04E+10	-320.1180	1980.
0.00								
5.2000	0.3727	2351854.	6101.	-0.00633	0.00	4.04E+10	-326.4369	2102.
0.00								
5.4000	0.3577	2366110.	5311.	-0.00619	0.00	4.03E+10	-331.7533	2226.
0.00								
5.6000	0.3430	2378442.	4509.	-0.00605	0.00	4.03E+10	-336.0290	2351.
0.00								
5.8000	0.3287	2388826.	3699.	-0.00590	0.00	4.03E+10	-339.2289	2477.
0.00								
6.0000	0.3147	2397244.	2882.	-0.00576	0.00	4.02E+10	-341.3208	2603.
0.00								
6.2000	0.3010	2403683.	2062.	-0.00562	0.00	4.02E+10	-342.2759	2729.
0.00								
6.4000	0.2877	2408138.	1239.	-0.00547	0.00	4.02E+10	-343.5387	2866.
0.00								
6.6000	0.2747	2410601.	413.8771	-0.00533	0.00	4.02E+10	-344.1343	3006.
0.00								
6.8000	0.2621	2411069.	-411.3378	-0.00519	0.00	4.02E+10	-343.5448	3146.
0.00								
7.0000	0.2498	2409546.	-1234.	-0.00504	0.00	4.02E+10	-341.7409	3283.
0.00								
7.2000	0.2379	2406042.	-2050.	-0.00490	0.00	4.02E+10	-338.6982	3417.
0.00								
7.4000	0.2263	2400574.	-2858.	-0.00476	0.00	4.02E+10	-334.3973	3546.
0.00								
7.6000	0.2151	2393167.	-3657.	-0.00461	0.00	4.02E+10	-331.0847	3694.
0.00								
7.8000	0.2042	2383840.	-4448.	-0.00447	0.00	4.03E+10	-328.9123	3866.
0.00								

8.0000	0.1936	2372606.	-5234.	-0.00433	0.00	4.03E+10	-325.6617	4036.
0.00								
8.2000	0.1834	2359484.	-6010.	-0.00419	0.00	4.03E+10	-321.3253	4205.
0.00								
8.4000	0.1735	2344499.	-6775.	-0.00405	0.00	4.04E+10	-315.9026	4369.
0.00								
8.6000	0.1640	2327682.	-7525.	-0.00391	0.00	4.04E+10	-309.4000	4528.
0.00								
8.8000	0.1548	2309070.	-8259.	-0.00377	0.00	4.05E+10	-301.8327	4680.
0.00								
9.0000	0.1459	2288708.	-8943.	-0.00363	0.00	4.05E+10	-268.5218	4417.
0.00								
9.2000	0.1373	2266787.	-9586.	-0.00350	0.00	4.06E+10	-267.2018	4670.
0.00								
9.4000	0.1291	2243314.	-10226.	-0.00337	0.00	4.07E+10	-265.7680	4941.
0.00								
9.6000	0.1212	2218300.	-10862.	-0.00324	0.00	4.07E+10	-264.2193	5234.
0.00								
9.8000	0.1136	2191752.	-11494.	-0.00311	0.00	4.08E+10	-262.5542	5549.
0.00								
10.0000	0.1063	2163680.	-12122.	-0.00298	0.00	4.09E+10	-260.7711	5890.
0.00								
10.2000	0.09927	2134095.	-12745.	-0.00285	0.00	4.10E+10	-258.8685	6259.
0.00								
10.4000	0.09257	2103008.	-13364.	-0.00273	0.00	4.11E+10	-256.8446	6659.
0.00								
10.6000	0.08617	2070430.	-13978.	-0.00261	0.00	4.12E+10	-254.6976	7094.
0.00								
10.8000	0.08006	2036375.	-14587.	-0.00249	0.00	4.13E+10	-252.4254	7567.
0.00								
11.0000	0.07424	2000855.	-15190.	-0.00237	0.00	4.15E+10	-250.0257	8083.
0.00								
11.2000	0.06869	1963885.	-15787.	-0.00226	0.00	4.16E+10	-247.4960	8648.
0.00								
11.4000	0.06341	1925479.	-16377.	-0.00214	0.00	4.18E+10	-244.8334	9266.
0.00								
11.6000	0.05840	1885653.	-16962.	-0.00203	0.00	4.19E+10	-242.0346	9946.
0.00								

11.8000	0.05365	1844423.	-17539.	-0.00193	0.00	4.21E+10	-239.0958	10696.
0.00								
12.0000	0.04915	1801807.	-18109.	-0.00182	0.00	4.23E+10	-236.0125	11524.
0.00								
12.2000	0.04490	1757823.	-18672.	-0.00172	0.00	4.25E+10	-232.7796	12444.
0.00								
12.4000	0.04088	1712489.	-19226.	-0.00163	0.00	4.27E+10	-229.3908	13467.
0.00								
12.6000	0.03709	1665825.	-19773.	-0.00153	0.00	4.30E+10	-225.8386	14612.
0.00								
12.8000	0.03353	1617851.	-20310.	-0.00144	0.00	4.33E+10	-222.1141	15897.
0.00								
13.0000	0.03019	1568591.	-20839.	-0.00135	0.00	4.36E+10	-218.2060	17349.
0.00								
13.2000	0.02705	1518066.	-21357.	-0.00127	0.00	4.39E+10	-214.1005	18999.
0.00								
13.4000	0.02411	1466301.	-21866.	-0.00119	0.00	4.43E+10	-209.7803	20886.
0.00								
13.6000	0.02136	1413320.	-22364.	-0.00114	0.00	1.65E+11	-205.2235	23063.
0.00								
13.8000	0.01866	1359155.	-22850.	-0.00112	0.00	1.88E+11	-200.0469	25735.
0.00								
14.0000	0.01600	1303836.	-23323.	-0.00110	0.00	1.88E+11	-194.0836	29117.
0.00								
14.2000	0.01338	1247398.	-23781.	-0.00108	0.00	1.89E+11	-187.1097	33566.
0.00								
14.4000	0.01080	1189881.	-24220.	-0.00107	0.00	1.89E+11	-178.7769	39737.
0.00								
14.6000	0.00825	1131333.	-24636.	-0.00105	0.00	1.89E+11	-168.4923	48997.
0.00								
14.8000	0.00574	1071813.	-25025.	-0.00104	0.00	1.89E+11	-155.0986	64813.
0.00								
15.0000	0.00327	1011399.	-25374.	-0.00103	0.00	1.89E+11	-135.7095	99726.
0.00								
15.2000	8.19E-04	950201.	-25652.	-0.00101	0.00	1.89E+11	-96.6019	282911.
0.00								
15.4000	-0.00160	888446.	-25544.	-0.00100	0.00	1.89E+11	187.1120	281004.
0.00								

15.6000	-0.00399	827768.	-25037.	-9.91E-04	0.00	1.90E+11	234.9836	141391.	0.00
15.8000	-0.00635	768442.	-24439.	-9.81E-04	0.00	1.90E+11	263.9378	99692.	0.00
16.0000	-0.00870	710636.	-23779.	-9.71E-04	0.00	1.90E+11	285.4490	78779.	0.00
16.2000	-0.01102	654474.	-23073.	-9.63E-04	0.00	1.90E+11	302.8206	65970.	0.00
16.4000	-0.01332	600054.	-22329.	-9.55E-04	0.00	1.90E+11	317.5131	57221.	0.00
16.6000	-0.01560	547463.	-21552.	-9.48E-04	0.00	1.90E+11	330.3135	50818.	0.00
16.8000	-0.01787	496774.	-20745.	-9.41E-04	0.00	1.90E+11	341.6989	45902.	0.00
17.0000	-0.02012	448053.	-19913.	-9.35E-04	0.00	1.90E+11	351.9822	41993.	0.00
17.2000	-0.02235	401358.	-19057.	-9.30E-04	0.00	1.90E+11	361.3811	38799.	0.00
17.4000	-0.02458	356745.	-18179.	-9.25E-04	0.00	1.90E+11	370.0534	36134.	0.00
17.6000	-0.02679	314263.	-17281.	-9.21E-04	0.00	1.91E+11	378.1176	33870.	0.00
17.8000	-0.02900	273958.	-16365.	-9.17E-04	0.00	1.91E+11	385.6649	31919.	0.00
18.0000	-0.03119	235874.	-15431.	-9.14E-04	0.00	1.91E+11	392.7674	30218.	0.00
18.2000	-0.03338	200053.	-14480.	-9.11E-04	0.00	1.91E+11	399.4829	28719.	0.00
18.4000	-0.03557	166532.	-13514.	-9.09E-04	0.00	1.91E+11	405.8586	27386.	0.00
18.6000	-0.03775	135349.	-12532.	-9.07E-04	0.00	1.91E+11	411.9336	26192.	0.00
18.8000	-0.03992	106539.	-11537.	-9.05E-04	0.00	1.91E+11	417.7404	25114.	0.00
19.0000	-0.04209	80134.	-10527.	-9.04E-04	0.00	1.91E+11	423.3065	24136.	0.00
19.2000	-0.04426	56168.	-9505.	-9.03E-04	0.00	1.91E+11	428.6556	23244.	0.00

19.4000	-0.04643	34670.	-8470.	-9.03E-04	0.00	1.91E+11	433.8076	22425.	0.00
19.6000	-0.04859	15672.	-6427.	-9.02E-04	0.00	1.91E+11	1269.	62657.	0.00
19.8000	-0.05076	3981.	-3298.	-9.02E-04	0.00	1.91E+11	1339.	63297.	0.00
20.0000	-0.05292	0.00	0.00	-9.02E-04	0.00	1.91E+11	1410.	31968.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.86852119 inches
Computed slope at pile head = -0.00929936 radians
Maximum bending moment = 2411069. inch-lbs
Maximum shear force = -25652. lbs
Depth of maximum bending moment = 6.80000000 feet below pile head
Depth of maximum shear force = 15.20000000 feet below pile head
Number of iterations = 45
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

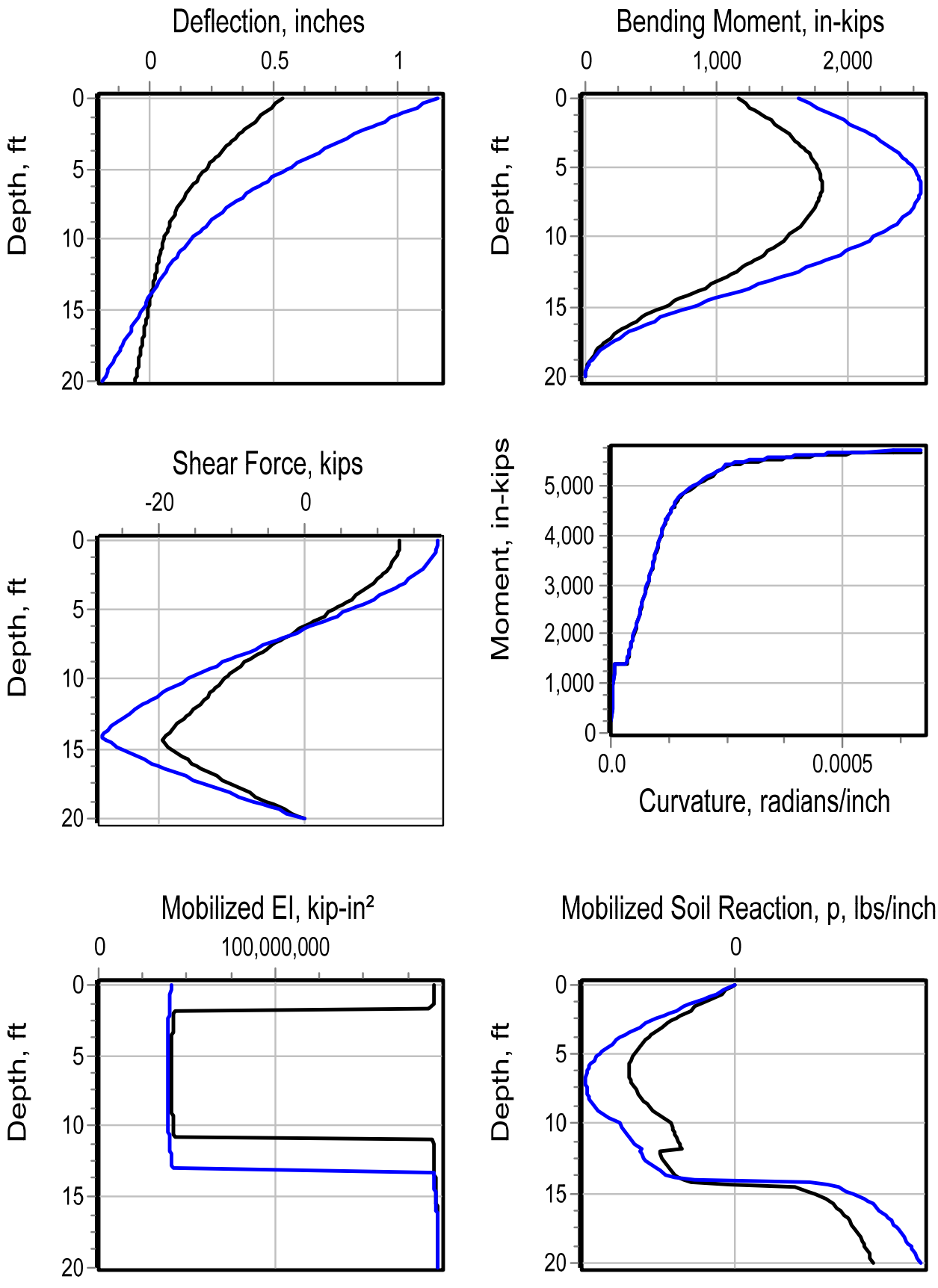
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.

Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Pile-head Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	12600.	M, in-lb	1058400.	41040.	0.3988	-0.00443	-18585.	1691100.
2	V, lb	17640.	M, in-lb	1481760.	36936.	0.8685	-0.00930	-25652.	2411069.

Maximum pile-head deflection = 0.8685211867 inches
Maximum pile-head rotation = -0.0092993607 radians = -0.532814 deg.

The analysis ended normally.


Deflection, inches
0
0.5
1
Depth, ft
0
5
10
15
20
Bending Moment, in-kips
0
1,000
2,000
Depth, ft
0
5
10
15
20
Shear Force, kips
-20
0
Depth, ft
0
5
10
15
20
Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch
Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
5
10
15
20
Mobilized Soil Reaction, p, lbs/inch
0
Depth, ft
0
5
10
15
20

==========

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==========

This copy of LPile is being used by:

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Files Used for Analysis

Path to file locations:
\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2019\Noise Wall\LPILE\

Name of input data file:
SUM-8_NB1A_P13-P19.lp10

Name of output report file:

SUM-8_NB1A_P13-P19.lp10

Name of plot output file:
SUM-8_NB1A_P13-P19.lp10

Name of runtime message file:
SUM-8_NB1A_P13-P19.lp10

Date and Time of Analysis

Date: August 30, 2019 Time: 13:30:22

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1A_P13-P19

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 20.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	20.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 20.000000 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 26.600 degrees
= 0.464 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 12.000000 ft
Effective unit weight at top of layer = 120.000000 pcf
Effective unit weight at bottom of layer = 120.000000 pcf
Friction angle at top of layer = 30.000000 deg.
Friction angle at bottom of layer = 30.000000 deg.
Subgrade k at top of layer = 42.500000 pci
Subgrade k at bottom of layer = 42.500000 pci

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 12.000000 ft
Distance from top of pile to bottom of layer = 21.500000 ft
Effective unit weight at top of layer = 116.500000 pcf
Effective unit weight at bottom of layer = 116.500000 pcf
Undrained cohesion at top of layer = 800.000000 psf
Undrained cohesion at bottom of layer = 800.000000 psf
Epsilon-50 at top of layer = 0.014000
Epsilon-50 at bottom of layer = 0.014000

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 21.500000 ft
Distance from top of pile to bottom of layer = 31.500000 ft

Effective unit weight at top of layer = 150.000000 pcf
Effective unit weight at bottom of layer = 150.000000 pcf
Uniaxial compressive strength at top of layer = 200.000000 psi
Uniaxial compressive strength at bottom of layer = 200.000000 psi
Initial modulus of rock at top of layer = 900.000000 psi
Initial modulus of rock at bottom of layer = 900.000000 psi
RQD of rock at top of layer = 10.000000 %
RQD of rock at bottom of layer = 10.000000 %
k rm of rock at top of layer = 0.0005000
k rm of rock at bottom of layer = 0.0005000

(Depth of the lowest soil layer extends 11.500 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass kpy pci	Modulus psi
1	Rock	0.0	150.0	0.0	0.0	200.0	10.0	0.0005	0.0	900.0
2	Rock	11.5	150.0	0.0	0.0	200.0	10.0	0.0005	0.0	900.0

1	Sand	0.00	120.0000	--	30.0000	--	--	--	42.5000	--
	(Reese, et al.)	12.0000	120.0000	--	30.0000	--	--	--	42.5000	--
2	Stiff Clay	12.0000	116.5000	800.0000	--	--	--	0.01400	--	--
	w/o Free Water	21.5000	116.5000	800.0000	--	--	--	0.01400	--	--
3	Weak	21.5000	150.0000	--	--	200.0000	10.0000	5.00E-04	--	900.0000
	Rock	31.5000	150.0000	--	--	200.0000	10.0000	5.00E-04	--	900.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 13200. lbs	M = 1161600. in-lbs	30240.	No
2	1	V = 18480. lbs	M = 1626240. in-lbs	27216.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 20.000000 ft
Shaft Diameter = 30.000000 in
Concrete Cover Thickness = 3.000000 in
Number of Reinforcing Bars = 10 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 706.858347 sq. in.
Total Area of Reinforcing Steel = 7.900000 sq. in.
Area Ratio of Steel Reinforcement = 1.12 percent
Edge-to-Edge Bar Spacing = 6.107391 in
Maximum Concrete Aggregate Size = 0.750000 in
Ratio of Bar Spacing to Aggregate Size = 8.14
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 3147.516 kips
Tensile Load for Cracking of Concrete = -334.148 kips
Nominal Axial Tensile Capacity = -474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete = 4500. psi
Modulus of Elasticity of Concrete = 3823676. psi
Modulus of Rupture of Concrete = -503.115295 psi
Compression Strain at Peak Stress = 0.002001
Tensile Strain at Fracture of Concrete = -0.0001152

Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	27.216
2	30.240

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 27.216 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg

```
  0.00000125  238.6007583  190880607.  21.4807087  0.00002685  -0.00001065
0.1191445  0.7732382
  0.00000250  476.0977941  190439118.  18.2519310  0.00004563  -0.00002937
0.2012738  1.3123900
  0.00000375  712.1987119  189919657.  17.1759762  0.00006441  -0.00004809
0.2826310  1.8515749
  0.00000500  946.8958010  189379160.  16.6380910  0.00008319  -0.00006681
0.3632130  2.3907732
  0.00000625       1180.  188830095.  16.3154120   0.0001020  -0.00008553   0.4430190
 2.9299809
  0.00000750       1412.  188276713.  16.1003300   0.0001208  -0.0001042   0.5220489
 3.4691968
  0.00000875       1412.  161380040.  10.4466466  0.00009141  -0.0001711   0.3961646
 -4.9236009 C
  0.00001000       1412.  141207535.  10.1181878   0.0001012  -0.0001988   0.4372424
-5.7222256 C
  0.00001125       1412.  125517809.   9.8542866  0.0001109  -0.0002266   0.4777101
-6.5236015 C
  0.00001250       1412.  112966028.   9.6379918  0.0001205  -0.0002545   0.5177016
-7.3268530 C
  0.00001375       1412.  102696389.   9.4584894  0.0001301  -0.0002824   0.5573466
-8.1311148 C
  0.00001500       1412.   94138357.   9.3042143  0.0001396  -0.0003104   0.5964985
-8.9374168 C
  0.00001625       1412.   86896945.   9.1738235  0.0001491  -0.0003384   0.6354652
-9.7436481 C
  0.00001750       1412.   80690020.   9.0591487  0.0001585  -0.0003665   0.6740251
-10.5513570 C
  0.00001875       1412.   75310685.   8.9593482  0.0001680  -0.0003945   0.7123595
-11.3592918 C
  0.00002000       1412.   70603767.   8.8723615  0.0001774  -0.0004226   0.7505287
-12.1670303 C
  0.00002125       1412.   66450605.   8.7938339  0.0001869  -0.0004506   0.7883506
-12.9758623 C
  0.00002250       1412.   62758904.   8.7235690  0.0001963  -0.0004787   0.8259384
-13.7849961 C
  0.00002375       1412.   59455804.   8.6609914  0.0002057  -0.0005068   0.8633629
-14.5939296 C
```

0.00002500	1412.	56483014.	8.6049489	0.0002151	-0.0005349	0.9006237
-15.4026620 C						
0.00002625	1412.	53793347.	8.5545089	0.0002246	-0.0005629	0.9377204
-16.2111925 C						
0.00002750	1412.	51348195.	8.5073509	0.0002340	-0.0005910	0.9744823
-17.0207626 C						
0.00002875	1412.	49115664.	8.4643856	0.0002434	-0.0006191	1.0110640
-17.8302559 C						
0.00003000	1412.	47069178.	8.4252392	0.0002528	-0.0006472	1.0474831
-18.6395418 C						
0.00003125	1412.	45186411.	8.3894544	0.0002622	-0.0006753	1.0837393
-19.4486194 C						
0.00003250	1412.	43448472.	8.3566440	0.0002716	-0.0007034	1.1198321
-20.2574879 C						
0.00003375	1417.	41979484.	8.3264785	0.0002810	-0.0007315	1.1557614
-21.0661466 C						
0.00003500	1461.	41747131.	8.2986752	0.0002905	-0.0007595	1.1915268
-21.8745946 C						
0.00003625	1505.	41529879.	8.2729906	0.0002999	-0.0007876	1.2271278
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0.00003750	1550.	41326195.	8.2491832	0.0003093	-0.0008157	1.2625599
-23.4908882 C						
0.00003875	1594.	41134278.	8.2262773	0.0003188	-0.0008437	1.2977058
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-25.1082090 C						
0.00004125	1682.	40782912.	8.1851810	0.0003376	-0.0008999	1.3675074
-25.9165397 C						
0.00004250	1726.	40621548.	8.1667145	0.0003471	-0.0009279	1.4021624
-26.7246492 C						
0.00004375	1771.	40468635.	8.1494783	0.0003565	-0.0009560	1.4366531
-27.5325368 C						
0.00004500	1815.	40323467.	8.1333704	0.0003660	-0.0009840	1.4709790
-28.3402015 C						
0.00004625	1859.	40185411.	8.1183001	0.0003755	-0.0010120	1.5051399
-29.1476424 C						
0.00004750	1903.	40053906.	8.1041861	0.0003849	-0.0010401	1.5391353
-29.9548585 C						

0.00004875	1947.	39928443.	8.0909556	0.0003944	-0.0010681	1.5729649
-30.7618489 C						
0.00005125	2034.	39693869.	8.0668889	0.0004134	-0.0011241	1.6401252
-32.3751487 C						
0.00005375	2122.	39478546.	8.0456476	0.0004325	-0.0011800	1.7066178
-33.9875342 C						
0.00005625	2209.	39279887.	8.0268598	0.0004515	-0.0012360	1.7724397
-35.5989974 C						
0.00005875	2297.	39095749.	8.0102169	0.0004706	-0.0012919	1.8375878
-37.2095304 C						
0.00006125	2384.	38924336.	7.9954608	0.0004897	-0.0013478	1.9020590
-38.8191251 C						
0.00006375	2471.	38764134.	7.9823741	0.0005089	-0.0014036	1.9658502
-40.4277733 C						
0.00006625	2558.	38613857.	7.9707720	0.0005281	-0.0014594	2.0289582
-42.0354666 C						
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-43.6421965 C						
0.00007125	2732.	38338839.	7.9514133	0.0005665	-0.0015710	2.1531118
-45.2479545 C						
0.00007375	2818.	38212283.	7.9431265	0.0005858	-0.0016267	2.2140852
-46.8533255 C						
0.00007625	2905.	38092080.	7.9357920	0.0006051	-0.0016824	2.2743545
-48.4577940 C						
0.00007875	2991.	37977630.	7.9293771	0.0006244	-0.0017381	2.3339304
-50.0612239 C						
0.00008125	3077.	37868382.	7.9238011	0.0006438	-0.0017937	2.3928091
-51.6636072 C						
0.00008375	3163.	37763856.	7.9189931	0.0006632	-0.0018493	2.4509872
-53.2649338 C						
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-54.8651934 C						
0.00008875	3334.	37567312.	7.9114376	0.0007021	-0.0019604	2.5652269
-56.4643754 C						
0.00009125	3420.	37474582.	7.9085852	0.0007217	-0.0020158	2.6212810
-58.0624690 C						
0.00009375	3505.	37385132.	7.9062893	0.0007412	-0.0020713	2.6766198
-59.6594635 C						

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0.0002788	5462.	19592995.	6.7575506	0.0018837	-0.0064788	4.4716366
-60.0000000 CY						
0.0002888	5474.	18957500.	6.6964262	0.0019336	-0.0067289	4.4862949
-60.0000000 CY						
0.0002988	5486.	18363021.	6.6397130	0.0019836	-0.0069789	4.4956937
-60.0000000 CY						
0.0003088	5498.	17805955.	6.5875782	0.0020339	-0.0072286	4.4998074
-60.0000000 CY						

0.0003188	5509.	17282529.	6.5397272	0.0020845	-0.0074780	4.4960077
-60.0000000 CY						
0.0003288	5520.	16789860.	6.4956751	0.0021355	-0.0077270	4.4998048
60.0000000 CY						
0.0003388	5530.	16324947.	6.4552490	0.0021867	-0.0079758	4.4947956
60.0000000 CY						
0.0003488	5540.	15884191.	6.4148814	0.0022372	-0.0082253	4.4992937
60.0000000 CY						
0.0003588	5549.	15466793.	6.3771764	0.0022878	-0.0084747	4.4932260
60.0000000 CY						
0.0003688	5557.	15071071.	6.3423911	0.0023388	-0.0087237	4.4972872
60.0000000 CY						
0.0003788	5566.	14695615.	6.3100915	0.0023899	-0.0089726	4.4999201
60.0000000 CY						
0.0003888	5574.	14338460.	6.2803829	0.0024415	-0.0092210	4.4920664
60.0000000 CY						
0.0003988	5582.	13998600.	6.2528037	0.0024933	-0.0094692	4.4976521
60.0000000 CY						
0.0004088	5590.	13674861.	6.2271321	0.0025453	-0.0097172	4.4999423
60.0000000 CY						
0.0004188	5597.	13365702.	6.2035402	0.0025977	-0.0099648	4.4900881
60.0000000 CY						
0.0004288	5604.	13070471.	6.1815954	0.0026504	-0.0102121	4.4962479
60.0000000 CY						
0.0004388	5611.	12788298.	6.1611238	0.0027032	-0.0104593	4.4994834
60.0000000 CY						
0.0004488	5617.	12517883.	6.1412887	0.0027559	-0.0107066	4.4944578
60.0000000 CY						
0.0004588	5624.	12258384.	6.1217640	0.0028084	-0.0109541	4.4915112
60.0000000 CY						
0.0004688	5630.	12009678.	6.1034720	0.0028610	-0.0112015	4.4967518
60.0000000 CY						
0.0004788	5635.	11771084.	6.0863450	0.0029138	-0.0114487	4.4995314
60.0000000 CY						
0.0004888	5641.	11541829.	6.0704791	0.0029669	-0.0116956	4.4950512
60.0000000 CY						
0.0004988	5647.	11321315.	6.0558425	0.0030204	-0.0119421	4.4881821
60.0000000 CYT						

0.0005088	5652.	11109260.	6.0421107	0.0030739	-0.0121886	4.4942598	60.0000000 CYT
0.0005188	5657.	10905172.	6.0292387	0.0031277	-0.0124348	4.4981821	60.0000000 CYT
0.0005288	5662.	10708593.	6.0171855	0.0031816	-0.0126809	4.4999131	60.0000000 CYT
0.0005388	5667.	10518876.	6.0061833	0.0032358	-0.0129267	4.4913899	60.0000000 CYT
0.0005488	5672.	10335828.	5.9959611	0.0032903	-0.0131722	4.4864658	60.0000000 CYT
0.0006088	5698.	9360251.	5.9477226	0.0036207	-0.0146418	4.4851441	60.0000000 CYT
0.0006688	5698.	8520453.	5.9468075	0.0039769	-0.0160856	4.4809048	60.0000000 CYT

Axial Thrust Force = 30.240 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
0.00000125	238.5313733	190825099.	22.2013552	0.00002775	-0.00000975	0.1231418	0.7993616	
0.00000250	476.0220779	190408831.	18.6133949	0.00004653	-0.00002847	0.2052460	1.3385961	
0.00000375	712.1213131	189899017.	17.4178080	0.00006532	-0.00004718	0.2865794	1.8778741	
0.00000500	946.8174266	189363485.	16.8201290	0.00008410	-0.00006590	0.3671378	2.4171687	
0.00000625	1180.	188817431.	16.4615833	0.0001029	-0.00008462	0.4469202	2.9564745	
0.00000750	1412.	188266067.	16.2225962	0.0001217	-0.0001033	0.5259264	3.4957897	
0.00000875	1412.	161370914.	10.7348652	0.00009393	-0.0001686	0.4069912		

-4.8504654 C						
0.00001000	1412.	141199550.	10.3805500	0.0001038	-0.0001962	0.4484489
-5.6461405 C						
0.00001125	1412.	125510711.	10.0951488	0.0001136	-0.0002239	0.4892261
-6.4450202 C						
0.00001250	1412.	112959640.	9.8602174	0.0001233	-0.0002517	0.5294481
-7.2462962 C						
0.00001375	1412.	102690582.	9.6642774	0.0001329	-0.0002796	0.5692520
-8.0490569 C						
0.00001500	1412.	94133033.	9.4981844	0.0001425	-0.0003075	0.6086792
-8.8530397 C						
0.00001625	1412.	86892031.	9.3546937	0.0001520	-0.0003355	0.6477080
-9.6584131 C						
0.00001750	1412.	80685457.	9.2305772	0.0001615	-0.0003635	0.6864587
-10.4643570 C						
0.00001875	1412.	75306427.	9.1223652	0.0001710	-0.0003915	0.7249637
-11.2706514 C						
0.00002000	1412.	70599775.	9.0253649	0.0001805	-0.0004195	0.7630835
-12.0782883 C						
0.00002125	1412.	66446847.	8.9400969	0.0001900	-0.0004475	0.8010377
-12.8857277 C						
0.00002250	1412.	62755356.	8.8646071	0.0001995	-0.0004755	0.8388258
-13.6929688 C						
0.00002375	1412.	59452442.	8.7953056	0.0002089	-0.0005036	0.8762515
-14.5014207 C						
0.00002500	1412.	56479820.	8.7327021	0.0002183	-0.0005317	0.9134615
-15.3100409 C						
0.00002625	1412.	53790305.	8.6763267	0.0002278	-0.0005597	0.9505075
-16.1184587 C						
0.00002750	1412.	51345291.	8.6253311	0.0002372	-0.0005878	0.9873889
-16.9266734 C						
0.00002875	1412.	49112887.	8.5790144	0.0002466	-0.0006159	1.0241055
-17.7346842 C						
0.00003000	1412.	47066517.	8.5362901	0.0002561	-0.0006439	1.0605977
-18.5429275 C						
0.00003125	1412.	45183856.	8.4962003	0.0002655	-0.0006720	1.0968015
-19.3518809 C						
0.00003250	1412.	43446015.	8.4594168	0.0002749	-0.0007001	1.1328419

-20.1606246 C						
0.00003375	1439.	42647289.	8.4255730	0.0002844	-0.0007281	1.1687185
-20.9691578 C						
0.00003500	1484.	42390582.	8.3943548	0.0002938	-0.0007562	1.2044310
-21.7774798 C						
0.00003625	1528.	42150654.	8.3654914	0.0003032	-0.0007843	1.2399791
-22.5855896 C						
0.00003750	1572.	41925823.	8.3387480	0.0003127	-0.0008123	1.2753624
-23.3934865 C						
0.00003875	1616.	41714626.	8.3139202	0.0003222	-0.0008403	1.3105805
-24.2011695 C						
0.00004000	1661.	41515781.	8.2908292	0.0003316	-0.0008684	1.3456331
-25.0086380 C						
0.00004125	1705.	41328163.	8.2693178	0.0003411	-0.0008964	1.3805199
-25.8158909 C						
0.00004250	1749.	41150761.	8.2492181	0.0003506	-0.0009244	1.4152358
-26.6229636 C						
0.00004375	1793.	40982303.	8.2297358	0.0003601	-0.0009524	1.4496714
-27.4307101 C						
0.00004500	1837.	40822451.	8.2115071	0.0003695	-0.0009805	1.4839422
-28.2382331 C						
0.00004625	1881.	40670505.	8.1944313	0.0003790	-0.0010085	1.5180476
-29.0455314 C						
0.00004750	1925.	40525837.	8.1784178	0.0003885	-0.0010365	1.5519875
-29.8526043 C						
0.00004875	1969.	40387886.	8.1633857	0.0003980	-0.0010645	1.5857613
-30.6594508 C						
0.00005125	2057.	40130158.	8.1359810	0.0004170	-0.0011205	1.6528096
-32.2724606 C						
0.00005375	2144.	39893828.	8.1117141	0.0004360	-0.0011765	1.7191895
-33.8845530 C						
0.00005625	2232.	39676025.	8.0901714	0.0004551	-0.0012324	1.7848978
-35.4957202 C						
0.00005875	2319.	39474366.	8.0710099	0.0004742	-0.0012883	1.8499317
-37.1059542 C						
0.00006125	2406.	39286856.	8.0539426	0.0004933	-0.0013442	1.9142879
-38.7152467 C						
0.00006375	2493.	39111814.	8.0387276	0.0005125	-0.0014000	1.9779633

-40.3235896 C						
0.00006625	2580.	38947813.	8.0251596	0.0005317	-0.0014558	2.0409547
-41.9309745 C						
0.00006875	2667.	38793631.	8.0130631	0.0005509	-0.0015116	2.1032589
-43.5373927 C						
0.00007125	2754.	38648219.	8.0022876	0.0005702	-0.0015673	2.1648727
-45.1428356 C						
0.00007375	2840.	38510670.	7.9927027	0.0005895	-0.0016230	2.2257927
-46.7472944 C						
0.00007625	2926.	38380195.	7.9841955	0.0006088	-0.0016787	2.2860155
-48.3507600 C						
0.00007875	3013.	38256100.	7.9766673	0.0006282	-0.0017343	2.3455376
-49.9532255 C						
0.00008125	3099.	38137793.	7.9700317	0.0006476	-0.0017899	2.4043560
-51.5546769 C						
0.00008375	3185.	38024735.	7.9642126	0.0006670	-0.0018455	2.4624669
-53.1551074 C						
0.00008625	3270.	37916455.	7.9591429	0.0006865	-0.0019010	2.5198667
-54.7545073 C						
0.00008875	3356.	37812535.	7.9547630	0.0007060	-0.0019565	2.5765520
-56.3528668 C						
0.00009125	3441.	37712603.	7.9510201	0.0007255	-0.0020120	2.6325191
-57.9501760 C						
0.00009375	3527.	37616319.	7.9477746	0.0007451	-0.0020674	2.6877396
-59.5466751 C						
0.00009625	3612.	37523391.	7.9450553	0.0007647	-0.0021228	2.7422280
-60.0000000 CY						
0.00009875	3697.	37433555.	7.9428669	0.0007844	-0.0021781	2.7959923
-60.0000000 CY						
0.0001013	3781.	37346569.	7.9411742	0.0008040	-0.0022335	2.8490285
-60.0000000 CY						
0.0001038	3866.	37262212.	7.9399450	0.0008238	-0.0022887	2.9013325
-60.0000000 CY						
0.0001063	3950.	37180286.	7.9391508	0.0008435	-0.0023440	2.9529002
-60.0000000 CY						
0.0001088	4035.	37100608.	7.9387653	0.0008633	-0.0023992	3.0037276
-60.0000000 CY						
0.0001113	4119.	37022856.	7.9387537	0.0008832	-0.0024543	3.0538071

-60.0000000 CY						
0.0001138	4199.	36912704.	7.9366258	0.0009028	-0.0025097	3.1024308
-60.0000000 CY						
0.0001163	4263.	36667730.	7.9248061	0.0009213	-0.0025662	3.1474195
-60.0000000 CY						
0.0001188	4310.	36295469.	7.9035460	0.0009385	-0.0026240	3.1888081
-60.0000000 CY						
0.0001213	4354.	35911962.	7.8814281	0.0009556	-0.0026819	3.2290509
-60.0000000 CY						
0.0001238	4398.	35543255.	7.8604194	0.0009727	-0.0027398	3.2687293
-60.0000000 CY						
0.0001263	4443.	35188464.	7.8404557	0.0009899	-0.0027976	3.3078406
-60.0000000 CY						
0.0001288	4487.	34846775.	7.8214777	0.0010070	-0.0028555	3.3463824
-60.0000000 CY						
0.0001313	4530.	34517432.	7.8034308	0.0010242	-0.0029133	3.3843521
-60.0000000 CY						
0.0001338	4574.	34199741.	7.7862643	0.0010414	-0.0029711	3.4217470
-60.0000000 CY						
0.0001363	4618.	33893054.	7.7699314	0.0010587	-0.0030288	3.4585646
-60.0000000 CY						
0.0001388	4662.	33596772.	7.7543887	0.0010759	-0.0030866	3.4948020
-60.0000000 CY						
0.0001413	4705.	33310337.	7.7395958	0.0010932	-0.0031443	3.5304567
-60.0000000 CY						
0.0001438	4748.	33028990.	7.7251146	0.0011105	-0.0032020	3.5654078
-60.0000000 CY						
0.0001463	4785.	32715254.	7.7073256	0.0011272	-0.0032603	3.5985979
-60.0000000 CY						
0.0001488	4813.	32357064.	7.6849535	0.0011431	-0.0033194	3.6296640
-60.0000000 CY						
0.0001588	4882.	30754165.	7.5719124	0.0012020	-0.0035605	3.7395239
-60.0000000 CY						
0.0001688	4945.	29305566.	7.4691081	0.0012604	-0.0038021	3.8410573
-60.0000000 CY						
0.0001788	5008.	28015245.	7.3795327	0.0013191	-0.0040434	3.9358099
-60.0000000 CY						
0.0001888	5069.	26855350.	7.2980215	0.0013775	-0.0042850	4.0228167

-60.0000000 CY 0.0001988	5129.	25807369.	7.2246652	0.0014359	-0.0045266	4.1025289
-60.0000000 CY 0.0002088	5189.	24856499.	7.1599152	0.0014946	-0.0047679	4.1753594
-60.0000000 CY 0.0002188	5248.	23989341.	7.1026310	0.0015537	-0.0050088	4.2411905
-60.0000000 CY 0.0002288	5306.	23194833.	7.0518732	0.0016131	-0.0052494	4.2998996
-60.0000000 CY 0.0002388	5363.	22462084.	7.0038459	0.0016722	-0.0054903	4.3507694
-60.0000000 CY 0.0002488	5416.	21774326.	6.9586955	0.0017310	-0.0057315	4.3940230
-60.0000000 CY 0.0002588	5456.	21086627.	6.9071896	0.0017872	-0.0059753	4.4284546
-60.0000000 CY 0.0002688	5478.	20382948.	6.8455772	0.0018397	-0.0062228	4.4544646
-60.0000000 CY 0.0002788	5491.	19700363.	6.7826456	0.0018907	-0.0064718	4.4740798
-60.0000000 CY 0.0002888	5504.	19062320.	6.7228926	0.0019412	-0.0067213	4.4881264
-60.0000000 CY 0.0002988	5516.	18464053.	6.6654776	0.0019913	-0.0069712	4.4966982
-60.0000000 CY 0.0003088	5528.	17903437.	6.6126937	0.0020417	-0.0072208	4.4999680
-60.0000000 CY 0.0003188	5539.	17376635.	6.5642639	0.0020924	-0.0074701	4.4969868
-60.0000000 CY 0.0003288	5550.	16880846.	6.5196467	0.0021433	-0.0077192	4.4999685
60.0000000 CY 0.0003388	5560.	16412920.	6.4787362	0.0021947	-0.0079678	4.4959416
60.0000000 CY 0.0003488	5570.	15970491.	6.4400877	0.0022460	-0.0082165	4.4997022
60.0000000 CY 0.0003588	5579.	15550362.	6.4019515	0.0022967	-0.0084658	4.4926822
60.0000000 CY 0.0003688	5587.	15152174.	6.3666840	0.0023477	-0.0087148	4.4981864
60.0000000 CY 0.0003788	5596.	14774369.	6.3339403	0.0023990	-0.0089635	4.4997749

60.0000000 CY						
0.0003888	5604.	14414902.	6.3038762	0.0024506	-0.0092119	4.4936977
60.0000000 CY						
0.0003988	5612.	14072953.	6.2758852	0.0025025	-0.0094600	4.4985026
60.0000000 CY						
0.0004088	5619.	13747196.	6.2498501	0.0025546	-0.0097079	4.4992042
60.0000000 CY						
0.0004188	5626.	13436069.	6.2259531	0.0026071	-0.0099554	4.4919705
60.0000000 CY						
0.0004288	5633.	13139052.	6.2036493	0.0026598	-0.0102027	4.4973757
60.0000000 CY						
0.0004388	5640.	12855170.	6.1828405	0.0027127	-0.0104498	4.4998406
60.0000000 CY						
0.0004488	5647.	12583245.	6.1636887	0.0027660	-0.0106965	4.4906869
60.0000000 CY						
0.0004588	5653.	12322594.	6.1454201	0.0028192	-0.0109433	4.4934991
60.0000000 CY						
0.0004688	5659.	12072395.	6.1268083	0.0028719	-0.0111906	4.4979393
60.0000000 CY						
0.0004788	5665.	11832367.	6.1093808	0.0029249	-0.0114376	4.4999009
60.0000000 CY						
0.0004888	5670.	11601620.	6.0933588	0.0029781	-0.0116844	4.4908561
60.0000000 CY						
0.0004988	5676.	11379806.	6.0784313	0.0030316	-0.0119309	4.4906366
60.0000000 CYT						
0.0005088	5681.	11166500.	6.0644249	0.0030853	-0.0121772	4.4959388
60.0000000 CYT						
0.0005188	5686.	10961206.	6.0512941	0.0031391	-0.0124234	4.4990694
60.0000000 CYT						
0.0005288	5691.	10763436.	6.0390321	0.0031931	-0.0126694	4.4989652
60.0000000 CYT						
0.0005388	5696.	10572525.	6.0278906	0.0032475	-0.0129150	4.4870027
60.0000000 CYT						
0.0005488	5701.	10388417.	6.0174264	0.0033021	-0.0131604	4.4892157
60.0000000 CYT						
0.0006088	5727.	9407109.	5.9680843	0.0036331	-0.0146294	4.4881752
60.0000000 CYT						
0.0006688	5727.	8563107.	5.9664932	0.0039901	-0.0160724	4.4845677

60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	27.216	5644.434	0.00300000
2	30.240	5672.494	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5644.	17.690400	3669.	37221031.
2	0.65	5672.	19.656000	3687.	37443542.
1	0.70	5644.	19.051200	3951.	36958962.

2	0.70	5672.	21.168000	3971.	37161057.
1	0.75	5644.	20.412000	4233.	36487880.
2	0.75	5672.	22.680000	4254.	36699418.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	200244.
2	12.0000	16.8371	No	No	200244.	143967.
3	21.5000	21.5000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 13200.0 lbs

Applied moment at pile head = 1161600.0 in-lbs
Axial thrust load on pile head = 30240.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5338	1161600.	13200.	-0.00576	0.00	1.89E+11	0.00	0.00	0.00
0.2000	0.5200	1193697.	13186.	-0.00574	0.00	1.89E+11	-11.9558	55.1794	0.00
0.4000	0.5062	1225725.	13142.	-0.00573	0.00	1.89E+11	-24.4742	116.0261	0.00
0.6000	0.4925	1257610.	13068.	-0.00571	0.00	1.89E+11	-37.4377	182.4286	0.00
0.8000	0.4788	1289278.	12962.	-0.00569	0.00	1.89E+11	-50.7239	254.2349	0.00
1.0000	0.4652	1320653.	12824.	-0.00568	0.00	1.88E+11	-64.2108	331.2747	0.00
1.2000	0.4516	1351657.	12654.	-0.00566	0.00	1.88E+11	-77.7772	413.3563	0.00
1.4000	0.4380	1382212.	12450.	-0.00564	0.00	1.88E+11	-91.4546	501.0991	0.00
1.6000	0.4245	1412239.	12215.	-0.00563	0.00	1.86E+11	-105.1044	594.2350	0.00
1.8000	0.4110	1441658.	11946.	-0.00558	0.00	4.26E+10	-118.5826	692.4241	0.00
2.0000	0.3977	1470389.	11646.	-0.00549	0.00	4.25E+10	-131.8015	795.3166	0.00
2.2000	0.3846	1498355.	11314.	-0.00541	0.00	4.23E+10	-144.6671	902.6464	0.00
2.4000	0.3718	1525482.	10952.	-0.00532	0.00	4.22E+10	-157.0882	1014.	0.00
2.6000	0.3591	1551697.	10560.	-0.00524	0.00	4.20E+10	-169.1719	1131.	0.00
2.8000	0.3466	1576931.	10140.	-0.00515	0.00	4.19E+10	-180.8980	1252.	0.00

3.0000	0.3344	1601117.	9693.	-0.00506	0.00	4.18E+10	-192.0143	1378.
0.00								
3.2000	0.3224	1624190.	9219.	-0.00496	0.00	4.17E+10	-202.4463	1507.
0.00								
3.4000	0.3106	1646090.	8722.	-0.00487	0.00	4.16E+10	-212.1227	1639.
0.00								
3.6000	0.2990	1666762.	8202.	-0.00477	0.00	4.15E+10	-220.9749	1774.
0.00								
3.8000	0.2877	1686154.	7662.	-0.00468	0.00	4.14E+10	-229.2992	1913.
0.00								
4.0000	0.2766	1704218.	7101.	-0.00458	0.00	4.13E+10	-237.8802	2064.
0.00								
4.2000	0.2657	1720904.	6521.	-0.00448	0.00	4.13E+10	-245.6516	2219.
0.00								
4.4000	0.2551	1736168.	5923.	-0.00438	0.00	4.12E+10	-252.5608	2376.
0.00								
4.6000	0.2447	1749971.	5310.	-0.00428	0.00	4.11E+10	-258.5584	2536.
0.00								
4.8000	0.2345	1762276.	4683.	-0.00417	0.00	4.11E+10	-263.5979	2697.
0.00								
5.0000	0.2247	1773056.	4046.	-0.00407	0.00	4.11E+10	-267.6358	2859.
0.00								
5.2000	0.2150	1782286.	3398.	-0.00397	0.00	4.10E+10	-272.2706	3039.
0.00								
5.4000	0.2056	1789941.	2740.	-0.00386	0.00	4.10E+10	-276.0191	3222.
0.00								
5.6000	0.1965	1795998.	2074.	-0.00376	0.00	4.10E+10	-278.8527	3406.
0.00								
5.8000	0.1876	1800442.	1403.	-0.00365	0.00	4.10E+10	-280.7461	3592.
0.00								
6.0000	0.1790	1803261.	727.6389	-0.00355	0.00	4.09E+10	-281.6772	3778.
0.00								
6.2000	0.1706	1804449.	51.6741	-0.00344	0.00	4.09E+10	-281.6269	3963.
0.00								
6.4000	0.1624	1804008.	-623.9216	-0.00333	0.00	4.09E+10	-281.3696	4157.
0.00								
6.6000	0.1546	1801938.	-1298.	-0.00323	0.00	4.09E+10	-280.3554	4353.
0.00								

6.8000	0.1469	1798246.	-1968.	-0.00312	0.00	4.10E+10	-278.3041	4545.
0.00								
7.0000	0.1396	1792943.	-2633.	-0.00302	0.00	4.10E+10	-275.2046	4732.
0.00								
7.2000	0.1325	1786048.	-3288.	-0.00291	0.00	4.10E+10	-271.0513	4911.
0.00								
7.4000	0.1256	1777583.	-3932.	-0.00281	0.00	4.10E+10	-265.8449	5080.
0.00								
7.6000	0.1190	1767580.	-4565.	-0.00270	0.00	4.11E+10	-261.3762	5272.
0.00								
7.8000	0.1126	1756063.	-5188.	-0.00260	0.00	4.11E+10	-257.7785	5494.
0.00								
8.0000	0.1065	1743055.	-5801.	-0.00250	0.00	4.12E+10	-253.3200	5709.
0.00								
8.2000	0.1006	1728580.	-6403.	-0.00240	0.00	4.12E+10	-248.0174	5916.
0.00								
8.4000	0.09498	1712669.	-6991.	-0.00230	0.00	4.13E+10	-241.8947	6112.
0.00								
8.6000	0.08958	1695357.	-7563.	-0.00220	0.00	4.14E+10	-234.9829	6295.
0.00								
8.8000	0.08442	1676685.	-8118.	-0.00210	0.00	4.14E+10	-227.3208	6462.
0.00								
9.0000	0.07950	1656697.	-8653.	-0.00201	0.00	4.15E+10	-218.9546	6610.
0.00								
9.2000	0.07480	1635440.	-9168.	-0.00191	0.00	4.16E+10	-209.9386	6736.
0.00								
9.4000	0.07032	1612967.	-9660.	-0.00182	0.00	4.17E+10	-200.3346	6837.
0.00								
9.6000	0.06608	1589334.	-10129.	-0.00173	0.00	4.18E+10	-190.2121	6909.
0.00								
9.8000	0.06204	1564598.	-10573.	-0.00163	0.00	4.20E+10	-179.6477	6949.
0.00								
10.0000	0.05823	1538822.	-10991.	-0.00155	0.00	4.21E+10	-168.7248	6954.
0.00								
10.2000	0.05462	1512066.	-11393.	-0.00146	0.00	4.22E+10	-166.3944	7311.
0.00								
10.4000	0.05122	1484347.	-11789.	-0.00137	0.00	4.24E+10	-163.8718	7678.
0.00								

10.6000	0.04803	1455677.	-12179.	-0.00129	0.00	4.26E+10	-161.1799	8055.
0.00								
10.8000	0.04503	1426073.	-12563.	-0.00121	0.00	4.31E+10	-158.3434	8440.
0.00								
11.0000	0.04222	1395551.	-12939.	-0.00116	0.00	1.88E+11	-155.3853	8834.
0.00								
11.2000	0.03945	1364132.	-13308.	-0.00114	0.00	1.88E+11	-152.0118	9248.
0.00								
11.4000	0.03672	1331837.	-13668.	-0.00113	0.00	1.88E+11	-148.2098	9686.
0.00								
11.6000	0.03404	1298687.	-14019.	-0.00111	0.00	1.89E+11	-143.9647	10150.
0.00								
11.8000	0.03139	1264707.	-14359.	-0.00109	0.00	1.89E+11	-139.2602	10646.
0.00								
12.0000	0.02879	1229923.	-14767.	-0.00108	0.00	1.89E+11	-200.9314	16751.
0.00								
12.2000	0.02622	1193981.	-15246.	-0.00106	0.00	1.89E+11	-197.8089	18107.
0.00								
12.4000	0.02369	1156898.	-15716.	-0.00105	0.00	1.89E+11	-194.3294	19690.
0.00								
12.6000	0.02119	1118695.	-16178.	-0.00103	0.00	1.89E+11	-190.4318	21569.
0.00								
12.8000	0.01873	1079394.	-16630.	-0.00102	0.00	1.89E+11	-186.0354	23842.
0.00								
13.0000	0.01630	1039020.	-17070.	-0.00101	0.00	1.89E+11	-181.0309	26661.
0.00								
13.2000	0.01390	997603.	-17498.	-9.93E-04	0.00	1.89E+11	-175.2638	30266.
0.00								
13.4000	0.01153	955175.	-17910.	-9.81E-04	0.00	1.89E+11	-168.5048	35075.
0.00								
13.6000	0.00919	911776.	-18305.	-9.69E-04	0.00	1.89E+11	-160.3889	41882.
0.00								
13.8000	0.00688	867452.	-18678.	-9.58E-04	0.00	1.90E+11	-150.2736	52424.
0.00								
14.0000	0.00459	822261.	-19022.	-9.47E-04	0.00	1.90E+11	-136.8335	71475.
0.00								
14.2000	0.00233	776282.	-19326.	-9.37E-04	0.00	1.90E+11	-116.3619	119619.
0.00								

14.4000	9.83E-05	729632.	-19482.	-9.27E-04	0.00	1.90E+11	-13.6648	333755.	0.00
14.6000	-0.00212	682902.	-19308.	-9.18E-04	0.00	1.90E+11	158.8891	180215.	0.00
14.8000	-0.00431	637087.	-18889.	-9.10E-04	0.00	1.90E+11	189.8191	105711.	0.00
15.0000	-0.00648	592365.	-18409.	-9.02E-04	0.00	1.90E+11	210.2299	77817.	0.00
15.2000	-0.00864	548853.	-17886.	-8.95E-04	0.00	1.90E+11	225.8756	62743.	0.00
15.4000	-0.01078	506642.	-17329.	-8.88E-04	0.00	1.90E+11	238.7226	53149.	0.00
15.6000	-0.01290	465805.	-16742.	-8.82E-04	0.00	1.90E+11	249.7033	46442.	0.00
15.8000	-0.01501	426406.	-16132.	-8.77E-04	0.00	1.90E+11	259.3400	41455.	0.00
16.0000	-0.01711	388501.	-15499.	-8.71E-04	0.00	1.91E+11	267.9580	37582.	0.00
16.2000	-0.01920	352139.	-14846.	-8.67E-04	0.00	1.91E+11	275.7744	34477.	0.00
16.4000	-0.02127	317364.	-14176.	-8.63E-04	0.00	1.91E+11	282.9421	31922.	0.00
16.6000	-0.02334	284220.	-13489.	-8.59E-04	0.00	1.91E+11	289.5733	29779.	0.00
16.8000	-0.02539	252743.	-12786.	-8.55E-04	0.00	1.91E+11	295.7530	27951.	0.00
17.0000	-0.02744	222969.	-12070.	-8.52E-04	0.00	1.91E+11	301.5469	26371.	0.00
17.2000	-0.02949	194932.	-11339.	-8.50E-04	0.00	1.91E+11	307.0073	24989.	0.00
17.4000	-0.03152	168663.	-10596.	-8.47E-04	0.00	1.91E+11	312.1765	23768.	0.00
17.6000	-0.03355	144192.	-9841.	-8.46E-04	0.00	1.91E+11	317.0889	22680.	0.00
17.8000	-0.03558	121547.	-9075.	-8.44E-04	0.00	1.91E+11	321.7732	21704.	0.00
18.0000	-0.03760	100756.	-8297.	-8.42E-04	0.00	1.91E+11	326.2535	20822.	0.00

18.2000	-0.03962	81844.	-7509.	-8.41E-04	0.00	1.91E+11	330.5500	20021.
0.00								
18.4000	-0.04164	64836.	-6711.	-8.40E-04	0.00	1.91E+11	334.6804	19289.
0.00								
18.6000	-0.04366	49755.	-5903.	-8.40E-04	0.00	1.91E+11	338.6594	18617.
0.00								
18.8000	-0.04567	36625.	-5085.	-8.39E-04	0.00	1.91E+11	342.5001	17997.
0.00								
19.0000	-0.04769	25468.	-4259.	-8.39E-04	0.00	1.91E+11	346.2138	17424.
0.00								
19.2000	-0.04970	16305.	-3424.	-8.38E-04	0.00	1.91E+11	349.8103	16893.
0.00								
19.4000	-0.05171	9157.	-2580.	-8.38E-04	0.00	1.91E+11	353.2984	16397.
0.00								
19.6000	-0.05372	4044.	-1728.	-8.38E-04	0.00	1.91E+11	356.6856	15934.
0.00								
19.8000	-0.05573	985.1373	-867.7955	-8.38E-04	0.00	1.91E+11	359.9789	15501.
0.00								
20.0000	-0.05775	0.00	0.00	-8.38E-04	0.00	1.91E+11	363.1840	7547.
0.00								

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.53380950 inches
Computed slope at pile head = -0.00575676 radians
Maximum bending moment = 1804449. inch-lbs
Maximum shear force = -19482. lbs
Depth of maximum bending moment = 6.20000000 feet below pile head
Depth of maximum shear force = 14.40000000 feet below pile head
Number of iterations = 97

Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 18480.0 lbs
Applied moment at pile head = 1626240.0 in-lbs
Axial thrust load on pile head = 27216.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. p	Soil Spr. Es*h	Distrib. Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	1.1629	1626240.	18480.	-0.01163	0.00	4.10E+10	0.00	0.00	0.00
0.2000	1.1351	1671348.	18461.	-0.01153	0.00	4.10E+10	-15.7009	33.1962	0.00
0.4000	1.1076	1716360.	18404.	-0.01143	0.00	4.07E+10	-32.2618	69.9071	0.00
0.6000	1.0803	1761179.	18306.	-0.01133	0.00	4.05E+10	-49.3466	109.6309	0.00
0.8000	1.0532	1805707.	18166.	-0.01122	0.00	4.04E+10	-66.8739	152.3873	0.00
1.0000	1.0264	1849842.	17984.	-0.01111	0.00	4.02E+10	-84.7023	198.0530	0.00
1.2000	0.9999	1893483.	17759.	-0.01100	0.00	4.01E+10	-102.6937	246.4933	0.00
1.4000	0.9736	1936525.	17491.	-0.01088	0.00	4.00E+10	-120.6475	297.3991	0.00
1.6000	0.9476	1978864.	17180.	-0.01077	0.00	3.98E+10	-138.4757	350.7057	0.00

1.8000	0.9219	2020397.	16827.	-0.01065	0.00	3.97E+10	-156.0833	406.3177
0.00								
2.0000	0.8965	2061024.	16432.	-0.01052	0.00	3.96E+10	-173.3593	464.0791
0.00								
2.2000	0.8714	2100644.	15995.	-0.01040	0.00	3.95E+10	-190.1972	523.8223
0.00								
2.4000	0.8466	2139160.	15519.	-0.01027	0.00	3.94E+10	-206.4947	585.3659
0.00								
2.6000	0.8221	2176479.	15005.	-0.01014	0.00	3.94E+10	-222.3506	649.0876
0.00								
2.8000	0.7980	2212508.	14453.	-0.01000	0.00	3.93E+10	-237.7380	715.0260
0.00								
3.0000	0.7741	2247158.	13865.	-0.00987	0.00	3.92E+10	-252.3975	782.4980
0.00								
3.2000	0.7506	2280346.	13242.	-0.00973	0.00	3.91E+10	-266.2495	851.3008
0.00								
3.4000	0.7274	2311991.	12588.	-0.00959	0.00	3.91E+10	-279.2180	921.2121
0.00								
3.6000	0.7046	2342019.	11903.	-0.00944	0.00	3.90E+10	-291.2305	991.9871
0.00								
3.8000	0.6821	2370359.	11190.	-0.00930	0.00	3.90E+10	-302.6998	1065.
0.00								
4.0000	0.6600	2396947.	10449.	-0.00915	0.00	3.89E+10	-314.6879	1144.
0.00								
4.2000	0.6382	2421712.	9681.	-0.00900	0.00	3.89E+10	-325.7901	1225.
0.00								
4.4000	0.6168	2444591.	8887.	-0.00885	0.00	3.88E+10	-335.9523	1307.
0.00								
4.6000	0.5957	2465525.	8069.	-0.00870	0.00	3.88E+10	-345.1228	1390.
0.00								
4.8000	0.5750	2484461.	7231.	-0.00855	0.00	3.87E+10	-353.2524	1474.
0.00								
5.0000	0.5547	2501353.	6375.	-0.00839	0.00	3.87E+10	-360.2936	1559.
0.00								
5.2000	0.5347	2516159.	5501.	-0.00824	0.00	3.87E+10	-367.8945	1651.
0.00								
5.4000	0.5151	2528835.	4610.	-0.00808	0.00	3.87E+10	-374.5307	1745.
0.00								

5.6000	0.4959	2539344.	3705.	-0.00792	0.00	3.86E+10	-380.1671	1840.	0.00
5.8000	0.4771	2547653.	2787.	-0.00777	0.00	3.86E+10	-384.6871	1935.	0.00
6.0000	0.4586	2553736.	1860.	-0.00761	0.00	3.86E+10	-388.0136	2030.	0.00
6.2000	0.4406	2557574.	925.9978	-0.00745	0.00	3.86E+10	-390.1091	2125.	0.00
6.4000	0.4229	2559154.	-13.7457	-0.00729	0.00	3.86E+10	-393.0105	2230.	0.00
6.6000	0.4056	2558460.	-959.8185	-0.00713	0.00	3.86E+10	-395.3835	2340.	0.00
6.8000	0.3887	2555478.	-1910.	-0.00697	0.00	3.86E+10	-396.5040	2448.	0.00
7.0000	0.3721	2550202.	-2861.	-0.00681	0.00	3.86E+10	-396.3289	2556.	0.00
7.2000	0.3560	2542633.	-3811.	-0.00665	0.00	3.86E+10	-394.8179	2662.	0.00
7.4000	0.3402	2532780.	-4755.	-0.00650	0.00	3.87E+10	-391.9345	2765.	0.00
7.6000	0.3248	2520658.	-5694.	-0.00634	0.00	3.87E+10	-390.3114	2884.	0.00
7.8000	0.3098	2506278.	-6630.	-0.00618	0.00	3.87E+10	-390.1239	3023.	0.00
8.0000	0.2951	2489641.	-7565.	-0.00603	0.00	3.87E+10	-388.7407	3161.	0.00
8.2000	0.2808	2470755.	-8495.	-0.00588	0.00	3.88E+10	-386.1300	3300.	0.00
8.4000	0.2669	2449634.	-9417.	-0.00572	0.00	3.88E+10	-382.2651	3437.	0.00
8.6000	0.2534	2426302.	-10328.	-0.00557	0.00	3.88E+10	-377.1246	3572.	0.00
8.8000	0.2402	2400788.	-11225.	-0.00542	0.00	3.89E+10	-370.6938	3704.	0.00
9.0000	0.2273	2373129.	-12106.	-0.00528	0.00	3.89E+10	-362.9649	3832.	0.00
9.2000	0.2148	2343369.	-12966.	-0.00513	0.00	3.90E+10	-353.9385	3954.	0.00

9.4000	0.2027	2311562.	-13803.	-0.00499	0.00	3.91E+10	-343.6245	4069.
0.00								
9.6000	0.1909	2277766.	-14614.	-0.00485	0.00	3.91E+10	-332.0429	4175.
0.00								
9.8000	0.1794	2242048.	-15395.	-0.00471	0.00	3.92E+10	-319.2255	4270.
0.00								
10.0000	0.1683	2204483.	-16145.	-0.00457	0.00	3.93E+10	-305.2168	4353.
0.00								
10.2000	0.1575	2165150.	-16873.	-0.00444	0.00	3.94E+10	-301.7810	4599.
0.00								
10.4000	0.1470	2124071.	-17592.	-0.00431	0.00	3.95E+10	-297.6043	4859.
0.00								
10.6000	0.1368	2081270.	-18301.	-0.00418	0.00	3.96E+10	-292.6677	5135.
0.00								
10.8000	0.1269	2036774.	-18996.	-0.00406	0.00	3.97E+10	-286.9516	5426.
0.00								
11.0000	0.1173	1990617.	-19677.	-0.00393	0.00	3.98E+10	-280.4344	5736.
0.00								
11.2000	0.1080	1942837.	-20341.	-0.00382	0.00	3.99E+10	-273.0923	6067.
0.00								
11.4000	0.09901	1893477.	-20987.	-0.00370	0.00	4.01E+10	-264.8986	6421.
0.00								
11.6000	0.09026	1842583.	-21612.	-0.00359	0.00	4.02E+10	-255.8226	6802.
0.00								
11.8000	0.08178	1790209.	-22214.	-0.00348	0.00	4.04E+10	-245.8281	7214.
0.00								
12.0000	0.07355	1736412.	-22814.	-0.00338	0.00	4.06E+10	-254.0443	8289.
0.00								
12.2000	0.06557	1681144.	-23417.	-0.00328	0.00	4.08E+10	-248.7620	9105.
0.00								
12.4000	0.05783	1624438.	-24007.	-0.00318	0.00	4.10E+10	-242.9178	10082.
0.00								
12.6000	0.05031	1566326.	-24582.	-0.00309	0.00	4.13E+10	-236.3952	11277.
0.00								
12.8000	0.04301	1506846.	-25141.	-0.00300	0.00	4.15E+10	-229.0322	12779.
0.00								
13.0000	0.03592	1446041.	-25680.	-0.00291	0.00	4.18E+10	-220.5938	14737.
0.00								

13.2000	0.02904	1383961.	-26198.	-0.00286	0.00	1.88E+11	-210.7183	17417.
0.00								
13.4000	0.02219	1320665.	-26689.	-0.00284	0.00	1.88E+11	-198.4744	21467.
0.00								
13.6000	0.01538	1256226.	-27146.	-0.00283	0.00	1.89E+11	-182.4341	28464.
0.00								
13.8000	0.00861	1190734.	-27556.	-0.00281	0.00	1.89E+11	-158.9694	44289.
0.00								
14.0000	0.00188	1124326.	-27878.	-0.00280	0.00	1.89E+11	-109.4850	139566.
0.00								
14.2000	-0.00481	1057286.	-27775.	-0.00278	0.00	1.89E+11	195.1648	97283.
0.00								
14.4000	-0.01148	991369.	-27250.	-0.00277	0.00	1.89E+11	242.5209	50701.
0.00								
14.6000	-0.01812	926849.	-26633.	-0.00276	0.00	1.89E+11	271.8161	36012.
0.00								
14.8000	-0.02472	863893.	-25954.	-0.00275	0.00	1.90E+11	293.7898	28521.
0.00								
15.0000	-0.03130	802629.	-25227.	-0.00274	0.00	1.90E+11	311.6459	23894.
0.00								
15.2000	-0.03786	743159.	-24461.	-0.00273	0.00	1.90E+11	326.8199	20718.
0.00								
15.4000	-0.04439	685572.	-23661.	-0.00272	0.00	1.90E+11	340.0904	18386.
0.00								
15.6000	-0.05091	629942.	-22830.	-0.00271	0.00	1.90E+11	351.9315	16592.
0.00								
15.8000	-0.05740	576339.	-21973.	-0.00270	0.00	1.90E+11	362.6551	15163.
0.00								
16.0000	-0.06388	524825.	-21091.	-0.00270	0.00	1.90E+11	372.4785	13995.
0.00								
16.2000	-0.07034	475455.	-20186.	-0.00269	0.00	1.90E+11	381.5593	13019.
0.00								
16.4000	-0.07678	428283.	-19260.	-0.00268	0.00	1.90E+11	390.0162	12191.
0.00								
16.6000	-0.08322	383358.	-18315.	-0.00268	0.00	1.91E+11	397.9408	11477.
0.00								
16.8000	-0.08964	340724.	-17351.	-0.00267	0.00	1.91E+11	405.4053	10855.
0.00								

17.0000	-0.09605	300424.	-16369.	-0.00267	0.00	1.91E+11	412.4678	10306.	0.00
17.2000	-0.1025	262501.	-15371.	-0.00267	0.00	1.91E+11	419.1758	9820.	0.00
17.4000	-0.1088	226991.	-14357.	-0.00266	0.00	1.91E+11	425.5686	9384.	0.00
17.6000	-0.1152	193933.	-13329.	-0.00266	0.00	1.91E+11	431.6793	8991.	0.00
17.8000	-0.1216	163361.	-12286.	-0.00266	0.00	1.91E+11	437.5356	8635.	0.00
18.0000	-0.1280	135309.	-11229.	-0.00266	0.00	1.91E+11	443.1616	8310.	0.00
18.2000	-0.1344	109810.	-10159.	-0.00265	0.00	1.91E+11	448.5777	8013.	0.00
18.4000	-0.1407	86894.	-9076.	-0.00265	0.00	1.91E+11	453.8018	7739.	0.00
18.6000	-0.1471	66592.	-7981.	-0.00265	0.00	1.91E+11	458.8494	7486.	0.00
18.8000	-0.1535	48934.	-6874.	-0.00265	0.00	1.91E+11	463.7342	7252.	0.00
19.0000	-0.1598	33946.	-5755.	-0.00265	0.00	1.91E+11	468.4683	7035.	0.00
19.2000	-0.1662	21656.	-4625.	-0.00265	0.00	1.91E+11	473.0623	6832.	0.00
19.4000	-0.1726	12091.	-3484.	-0.00265	0.00	1.91E+11	477.5258	6642.	0.00
19.6000	-0.1789	5277.	-2333.	-0.00265	0.00	1.91E+11	481.8672	6464.	0.00
19.8000	-0.1853	1239.	-1172.	-0.00265	0.00	1.91E+11	486.0943	6297.	0.00
20.0000	-0.1916	0.00	0.00	-0.00265	0.00	1.91E+11	490.2139	3070.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the

magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 1.16292599 inches
Computed slope at pile head = -0.01162538 radians
Maximum bending moment = 2559154. inch-lbs
Maximum shear force = -27878. lbs
Depth of maximum bending moment = 6.40000000 feet below pile head
Depth of maximum shear force = 14.00000000 feet below pile head
Number of iterations = 42
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

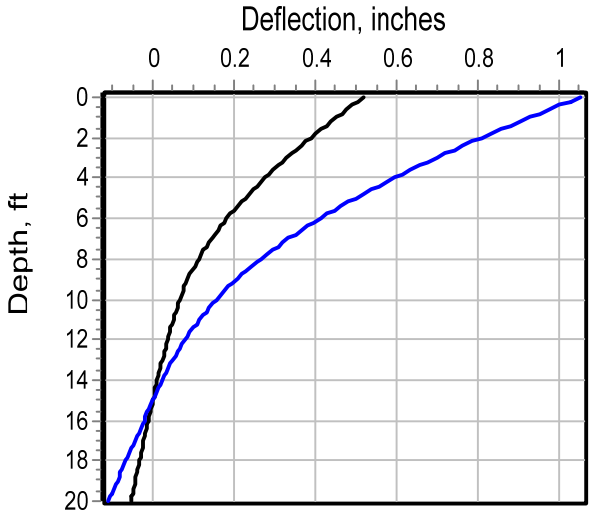
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

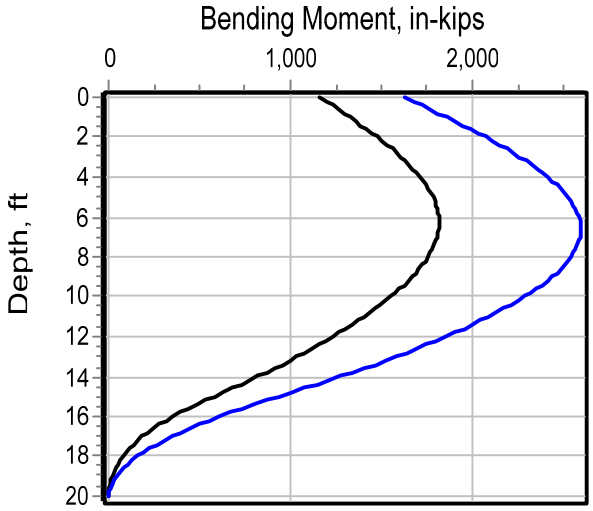
Load Case No.	Load Type 1	Load Pile-head 1	Load Type 2	Load Pile-head 2	Axial Pile-head Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	13200.	M, in-lb	1161600.	30240.	0.5338	-0.00576	-19482.	1804449.
2	V, lb	18480.	M, in-lb	1626240.	27216.	1.1629	-0.01163	-27878.	2559154.

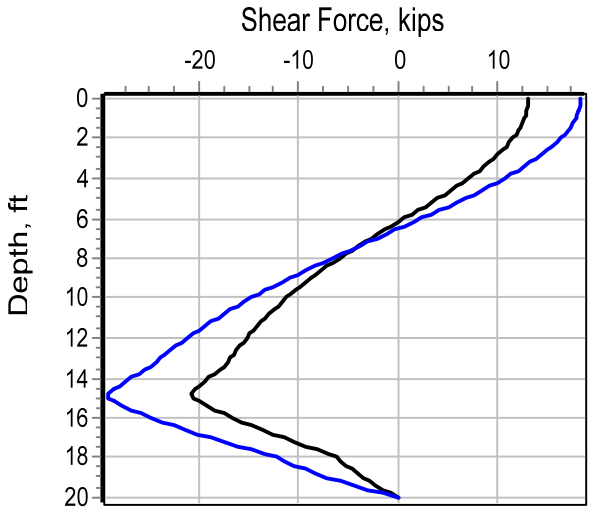
Maximum pile-head deflection = 1.1629259893 inches
Maximum pile-head rotation = -0.0116253826 radians = -0.666085 deg.

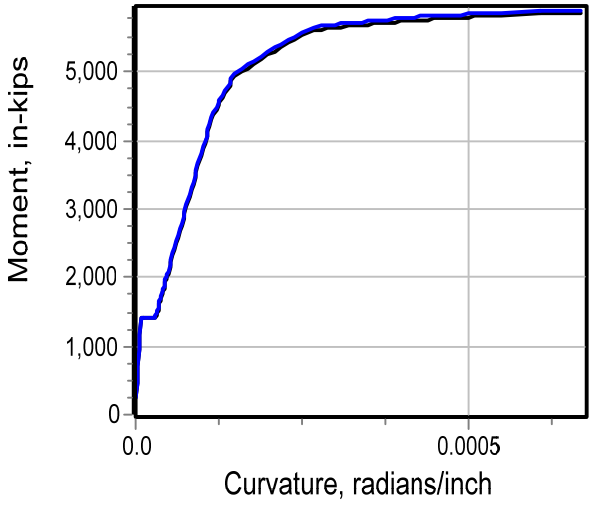
The analysis ended normally.

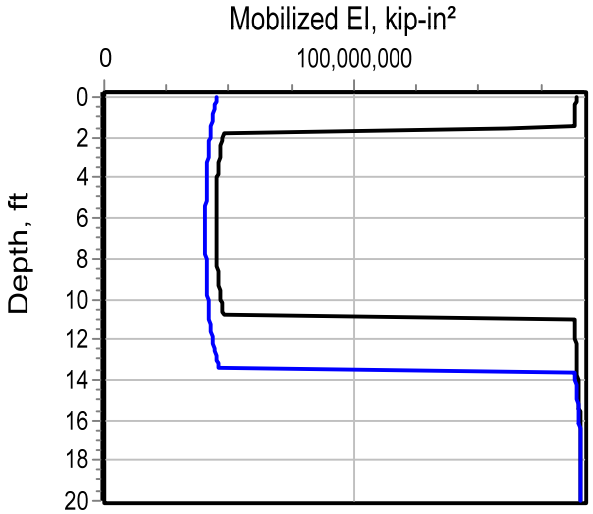
NB1A_P19-P21

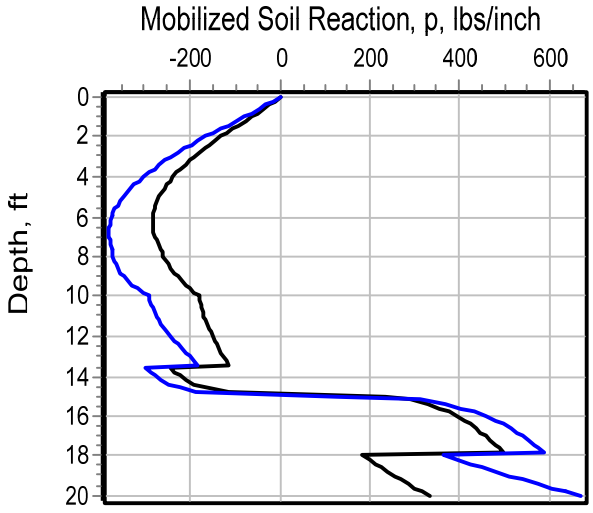

Deflection, inches
0
0.2
0.4
0.6
0.8
1
Depth, ft
0
2
4
6
8
10
12
14
16
18
20


Bending Moment, in-kips
0
1,000
2,000
Depth, ft
0
2
4
6
8
10
12
14
16
18
20


Shear Force, kips
-20
-10
0
10
Depth, ft
0
2
4
6
8
10
12
14
16
18
20


Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch


Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
2
4
6
8
10
12
14
16
18
20


Mobilized Soil Reaction, p, lbs/inch
-200
0
200
400
600
Depth, ft
0
2
4
6
8
10
12
14
16
18
20

==========

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==========

This copy of LPile is being used by:

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Files Used for Analysis

Path to file locations:
\\gfcmh01s\Projects\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Noise Wall\updated\LPILE\New\

Name of input data file:
SUM-8_NB1A_P20-P22.lp10

Name of output report file:
SUM-8_NB1A_P20-P22.lp10

Name of plot output file:
SUM-8_NB1A_P20-P22.lp10

Name of runtime message file:
SUM-8_NB1A_P20-P22.lp10

Date and Time of Analysis

Date: March 6, 2019 Time: 10:39:39

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1A_P19-P21

Program Options and Settings

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed = 500
 - Deflection tolerance for convergence = 1.0000E-05 in
 - Maximum allowable deflection = 100.0000 in
 - Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 20.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	20.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	20.000000 ft
Shaft Diameter	=	30.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	26.600 degrees
	=	0.464 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	13.500000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Friction angle at top of layer	=	30.000000 deg.
Friction angle at bottom of layer	=	30.000000 deg.
Subgrade k at top of layer	=	42.500000 pci
Subgrade k at bottom of layer	=	42.500000 pci

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	13.500000 ft
Distance from top of pile to bottom of layer	=	18.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf
Undrained cohesion at top of layer	=	1150. psf
Undrained cohesion at bottom of layer	=	1150. psf
Epsilon-50 at top of layer	=	0.009600
Epsilon-50 at bottom of layer	=	0.009600

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	18.000000 ft
Distance from top of pile to bottom of layer	=	21.500000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Friction angle at top of layer	=	33.000000 deg.
Friction angle at bottom of layer	=	33.000000 deg.
Subgrade k at top of layer	=	25.000000 pci
Subgrade k at bottom of layer	=	25.000000 pci

Layer 4 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	21.500000 ft
Distance from top of pile to bottom of layer	=	31.500000 ft
Effective unit weight at top of layer	=	150.000000 pcf
Effective unit weight at bottom of layer	=	150.000000 pcf
Uniaxial compressive strength at top of layer	=	200.000000 psi
Uniaxial compressive strength at bottom of layer	=	200.000000 psi
Initial modulus of rock at top of layer	=	900.000000 psi
Initial modulus of rock at bottom of layer	=	900.000000 psi
RQD of rock at top of layer	=	10.000000 %
RQD of rock at bottom of layer	=	10.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 11.500 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Rock Mass Modulus kpy pci	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	RQD %	E50 or krm
1	Sand		0.00	120.0000	--	30.0000	--	--	--
	42.5000	--							
	(Reese, et al.)		13.5000	120.0000	--	30.0000	--	--	--
	42.5000	--							
2	Stiff Clay		13.5000	115.0000	1150.	--	--	--	
0.00960	--	--							
	w/o Free Water		18.0000	115.0000	1150.	--	--	--	
0.00960	--	--							
3	Sand		18.0000	125.0000	--	33.0000	--	--	--
	25.0000	--							
	(Reese, et al.)		21.5000	125.0000	--	33.0000	--	--	--
	25.0000	--							
4	Weak		21.5000	150.0000	--	--	200.0000	10.0000	
5.00E-04	--	900.0000							
	Rock		31.5000	150.0000	--	--	200.0000	10.0000	
5.00E-04	--	900.0000							

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 13200. lbs	M =	1161600. in-lbs		47520.	No
2	1	V = 18480. lbs	M =	1626240. in-lbs		42768.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	20.000000 ft
Shaft Diameter	=	30.000000 in
Concrete Cover Thickness	=	3.000000 in
Number of Reinforcing Bars	=	10 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	706.858347 sq. in.
Total Area of Reinforcing Steel	=	7.900000 sq. in.
Area Ratio of Steel Reinforcement	=	1.12 percent
Edge-to-Edge Bar Spacing	=	6.107391 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.14
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3147.516 kips
Tensile Load for Cracking of Concrete	=	-334.148 kips
Nominal Axial Tensile Capacity	=	-474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530

3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete	=	4500. psi
Modulus of Elasticity of Concrete	=	3823676. psi
Modulus of Rupture of Concrete	=	-503.115295 psi
Compression Strain at Peak Stress	=	0.002001
Tensile Strain at Fracture of Concrete	=	-0.0001152
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	42.768
2	47.520

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 42.768 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.1912490	190552999.	25.1889710	0.00003149	-0.00000601	0.1396942	0.9076627	
0.00000250	475.6305666	190252227.	20.1114379	0.00005028	-0.00002472	0.2216887	1.4472042	
0.00000375	711.7172222	189791259.	18.4199314	0.00006907	-0.00004343	0.3029214	1.9868550	
0.00000500	946.4068692	189281374.	17.5744283	0.00008787	-0.00006213	0.3833808	2.5265421	
0.00000625	1180.	188750990.	17.0672423	0.0001067	-0.00008083	0.4630646	3.0662502	
0.00000750	1412.	188210163.	16.7291915	0.0001255	-0.00009953	0.5419720	3.6059742	

0.00000875	1412.	161322997.	11.8479740	0.0001037	-0.0001588	0.4486698	-4.5680141 C
0.00001000	1412.	141157622.	11.3952800	0.0001140	-0.0001860	0.4916460	-5.3518688 C
0.00001125	1412.	125473442.	11.0301760	0.0001241	-0.0002134	0.5337749	-6.1399676 C
0.00001250	1412.	112926098.	10.7281726	0.0001341	-0.0002409	0.5751604	-6.9316624 C
0.00001375	1412.	102660089.	10.4738885	0.0001440	-0.0002685	0.6159156	-7.7262245 C
0.00001500	1412.	94105081.	10.2572783	0.0001539	-0.0002961	0.6561646	-8.5228339 C
0.00001625	1412.	86866229.	10.0708785	0.0001637	-0.0003238	0.6959946	-9.3209109 C
0.00001750	1412.	80661498.	9.9066791	0.0001734	-0.0003516	0.7352984	-10.1212353 C
0.00001875	1412.	75284065.	9.7641105	0.0001831	-0.0003794	0.7743779	-10.9217024 C
0.00002000	1412.	70578811.	9.6357503	0.0001927	-0.0004073	0.8129593	-11.7242648 C
0.00002125	1412.	66427116.	9.5223685	0.0002024	-0.0004351	0.8513294	-12.5269028 C
0.00002250	1412.	62736721.	9.4208519	0.0002120	-0.0004630	0.8894323	-13.3300190 C
0.00002375	1412.	59434788.	9.3279221	0.0002215	-0.0004910	0.9271354	-14.1345811 C
0.00002500	1412.	56463049.	9.2445623	0.0002311	-0.0005189	0.9646682	-14.9389423 C
0.00002625	1412.	53774332.	9.1694062	0.0002407	-0.0005468	1.0020304	-15.7431020 C
0.00002750	1412.	51330044.	9.0994759	0.0002502	-0.0005748	1.0390198	-16.5485429 C
0.00002875	1412.	49098303.	9.0351950	0.0002598	-0.0006027	1.0757639	-17.3543436 C
0.00003000	1412.	47052541.	8.9765059	0.0002693	-0.0006307	1.1123395	-18.1599398 C
0.00003125	1443.	46191859.	8.9227384	0.0002788	-0.0006587	1.1487461	-18.9653307 C
0.00003250	1488.	45782383.	8.8733255	0.0002884	-0.0006866	1.1849835	-19.7705156 C
0.00003375	1532.	45401172.	8.8269073	0.0002979	-0.0007146	1.2209376	-20.5763519 C
0.00003500	1577.	45045205.	8.7831581	0.0003074	-0.0007426	1.2566093	-21.3828444 C
0.00003625	1621.	44712835.	8.7426266	0.0003169	-0.0007706	1.2921135	-22.1891261 C
0.00003750	1665.	44401699.	8.7049919	0.0003264	-0.0007986	1.3274499	-22.9951962 C
0.00003875	1709.	44109738.	8.6699742	0.0003360	-0.0008265	1.3626181	-23.8010539 C
0.00004000	1753.	43835154.	8.6373289	0.0003455	-0.0008545	1.3976177	-24.6066983 C
0.00004125	1798.	43576362.	8.6068411	0.0003550	-0.0008825	1.4324484	-25.4121287 C
0.00004250	1842.	43331966.	8.5783211	0.0003646	-0.0009104	1.4671099	-26.2173441 C
0.00004375	1886.	43100730.	8.5516008	0.0003741	-0.0009384	1.5016017	-27.0223439 C
0.00004500	1930.	42880799.	8.5256185	0.0003837	-0.0009663	1.5357737	-27.8283177 C
0.00004625	1974.	42671955.	8.5011472	0.0003932	-0.0009943	1.5697677	-28.6341487 C
0.00004750	2017.	42473367.	8.4781254	0.0004027	-0.0010223	1.6035933	-29.4397571 C
0.00004875	2061.	42284243.	8.4564424	0.0004123	-0.0010502	1.6372502	-30.2451419 C
0.00005125	2149.	41931612.	8.4167030	0.0004314	-0.0011061	1.7040564	-31.8552375 C
0.00005375	2236.	41609146.	8.3812410	0.0004505	-0.0011620	1.7701833	-33.4644279 C
0.00005625	2324.	41312806.	8.3494907	0.0004697	-0.0012178	1.8356277	-35.0727056 C
0.00005875	2411.	41039238.	8.3209827	0.0004889	-0.0012736	1.9003865	-36.6800630 C
0.00006125	2498.	40785636.	8.2953245	0.0005081	-0.0013294	1.9644568	-38.2864922 C
0.00006375	2585.	40549635.	8.2721850	0.0005274	-0.0013851	2.0278352	-39.8919853 C
0.00006625	2672.	40329225.	8.2512833	0.0005466	-0.0014409	2.0905187	-41.4965343 C
0.00006875	2758.	40122375.	8.2316691	0.0005659	-0.0014966	2.1523452	-43.1015471 C
0.00007125	2845.	39927947.	8.2138621	0.0005852	-0.0015523	2.2134666	-44.7056697 C
0.00007375	2931.	39744684.	8.1977292	0.0006046	-0.0016079	2.2738908	-46.3087940 C
0.00007625	3017.	39571473.	8.1831098	0.0006240	-0.0016635	2.3336143	-47.9109106 C
0.00007875	3103.	39407339.	8.1698640	0.0006434	-0.0017191	2.3926337	-49.5120104 C
0.00008125	3189.	39251431.	8.1578689	0.0006628	-0.0017747	2.4509454	-51.1120836 C
0.00008375	3275.	39102997.	8.1470167	0.0006823	-0.0018302	2.5085460	-52.7111205 C
0.00008625	3360.	38961372.	8.1372117	0.0007018	-0.0018857	2.5654317	-54.3091114 C
0.00008875	3446.	38825967.	8.1283696	0.0007214	-0.0019411	2.6215991	-55.9060461 C
0.00009125	3531.	38696256.	8.1204149	0.0007410	-0.0019965	2.6770442	-57.5019144 C
0.00009375	3616.	38571768.	8.1132805	0.0007606	-0.0020519	2.7317636	-59.0967059 C
0.00009625	3701.	38452080.	8.1069063	0.0007803	-0.0021072	2.7857529	-60.0000000 CY
0.00009875	3786.	38336821.	8.1012384	0.0008000	-0.0021625	2.8390090	-60.0000000 CY
0.0001013	3870.	38225646.	8.0962281	0.0008197	-0.0022178	2.8915276	-60.0000000 CY
0.0001038	3955.	38118244.	8.0918317	0.0008395	-0.0022730	2.9433048	-60.0000000 CY
0.0001063	4039.	38014337.	8.0880095	0.0008594	-0.0023281	2.9943364	-60.0000000 CY
0.0001088	4123.	37913669.	8.0847256	0.0008792	-0.0023833	3.0446185	-60.0000000 CY
0.0001113	4207.	37816009.	8.0819474	0.0008991	-0.0024384	3.0941468	-60.0000000 CY
0.0001138	4290.	37717934.	8.0794244	0.0009190	-0.0024935	3.1428551	-60.0000000 CY
0.0001163	4360.	37503890.	8.0690015	0.0009380	-0.0025495	3.1884447	-60.0000000 CY
0.0001188	4412.	37150547.	8.0487381	0.0009558	-0.0026067	3.2303403	-60.0000000 CY
0.0001213	4456.	36751762.	8.0252278	0.0009731	-0.0026644	3.2703922	-60.0000000 CY
0.0001238	4500.	36365785.	8.0026926	0.0009903	-0.0027222	3.3098094	-60.0000000 CY
0.0001263	4544.	35994379.	7.9812628	0.0010076	-0.0027799	3.3486457	-60.0000000 CY
0.0001288	4588.	35636689.	7.9608755	0.0010250	-0.0028375	3.3868983	-60.0000000 CY
0.0001313	4632.	35291626.	7.9410577	0.0010423	-0.0028952	3.4244449	-60.0000000 CY
0.0001338	4676.	34958419.	7.9216822	0.0010595	-0.0029530	3.4612611	-60.0000000 CY

0.0001363	4719.	34636777.	7.9032251	0.0010768	-0.0030107	3.4974961	-60.0000000 CY
0.0001388	4763.	34326071.	7.8856383	0.0010941	-0.0030684	3.5331472	-60.0000000 CY
0.0001413	4806.	34025715.	7.8688774	0.0011115	-0.0031260	3.5682117	-60.0000000 CY
0.0001438	4849.	33733257.	7.8527190	0.0011288	-0.0031837	3.6026341	-60.0000000 CY
0.0001463	4890.	33433202.	7.8356617	0.0011460	-0.0032415	3.6359904	-60.0000000 CY
0.0001488	4923.	33095848.	7.8147719	0.0011624	-0.0033001	3.6674473	-60.0000000 CY
0.0001588	4997.	31474610.	7.7014054	0.0012226	-0.0035399	3.7770644	-60.0000000 CY
0.0001688	5060.	29984099.	7.5947074	0.0012816	-0.0037809	3.8770369	-60.0000000 CY
0.0001788	5122.	28653612.	7.4990048	0.0013404	-0.0040221	3.9693131	-60.0000000 CY
0.0001888	5183.	27460363.	7.4151470	0.0013996	-0.0042629	4.0546518	-60.0000000 CY
0.0001988	5244.	26383103.	7.3408282	0.0014590	-0.0045035	4.1327959	-60.0000000 CY
0.0002088	5303.	25402627.	7.2714854	0.0015179	-0.0047446	4.2028901	-60.0000000 CY
0.0002188	5361.	24508518.	7.2100646	0.0015772	-0.0049853	4.2659229	-60.0000000 CY
0.0002288	5419.	23689362.	7.1555689	0.0016368	-0.0052257	4.3217680	-60.0000000 CY
0.0002388	5476.	22935656.	7.1071706	0.0016968	-0.0054657	4.3702938	-60.0000000 CY
0.0002488	5531.	22235103.	7.0632850	0.0017570	-0.0057055	4.4112223	-60.0000000 CY
0.0002588	5575.	21544492.	7.0132757	0.0018147	-0.0059478	4.4431774	-60.0000000 CY
0.0002688	5600.	20838860.	6.9524132	0.0018685	-0.0061940	4.4665304	-60.0000000 CY
0.0002788	5615.	20144639.	6.8878147	0.0019200	-0.0064425	4.4831223	-60.0000000 CY
0.0002888	5628.	19491461.	6.8272490	0.0019714	-0.0066911	4.4940685	-60.0000000 CY
0.0002988	5641.	18880744.	6.7717143	0.0020230	-0.0069395	4.4994331	-60.0000000 CY
0.0003088	5652.	18306484.	6.7182325	0.0020743	-0.0071882	4.4951951	-60.0000000 CY
0.0003188	5663.	17765901.	6.6672864	0.0021252	-0.0074373	4.4995970	60.0000000 CY
0.0003288	5673.	17256881.	6.6204870	0.0021765	-0.0076860	4.4943695	60.0000000 CY
0.0003388	5683.	16776807.	6.5773719	0.0022281	-0.0079344	4.4992003	60.0000000 CY
0.0003488	5693.	16323158.	6.5376555	0.0022800	-0.0081825	4.4933403	60.0000000 CY
0.0003588	5702.	15893692.	6.5010783	0.0023323	-0.0084302	4.4977115	60.0000000 CY
0.0003688	5711.	15486787.	6.4671780	0.0023848	-0.0086777	4.4999891	60.0000000 CY
0.0003788	5719.	15099568.	6.4346444	0.0024371	-0.0089254	4.4936959	60.0000000 CY
0.0003888	5727.	14731002.	6.4027525	0.0024891	-0.0091734	4.4985076	60.0000000 CY
0.0003988	5734.	14380362.	6.3730767	0.0025413	-0.0094212	4.4991524	60.0000000 CY
0.0004088	5741.	14045925.	6.3457881	0.0025938	-0.0096687	4.4925713	60.0000000 CY
0.0004188	5748.	13727043.	6.3203052	0.0026466	-0.0099159	4.4977232	60.0000000 CY
0.0004288	5755.	13422618.	6.2965130	0.0026996	-0.0101629	4.4999188	60.0000000 CY
0.0004388	5761.	13131316.	6.2746031	0.0027530	-0.0104095	4.4893638	60.0000000 CY
0.0004488	5768.	12852565.	6.2541859	0.0028066	-0.0106559	4.4946182	60.0000000 CY
0.0004588	5774.	12585643.	6.2350783	0.0028603	-0.0109022	4.4986297	60.0000000 CY
0.0004688	5780.	12329787.	6.2172057	0.0029143	-0.0111482	4.4999998	60.0000000 CY
0.0004788	5785.	12083921.	6.2008610	0.0029687	-0.0113938	4.4870923	60.0000000 CY
0.0004888	5791.	11847868.	6.1855352	0.0030232	-0.0116393	4.4932999	60.0000000 CYT
0.0004988	5796.	11621037.	6.1711693	0.0030779	-0.0118846	4.4977225	60.0000000 CYT
0.0005088	5801.	11402877.	6.1577140	0.0031327	-0.0121298	4.4998203	60.0000000 CYT
0.0005188	5806.	11192567.	6.1447480	0.0031876	-0.0123749	4.4926066	60.0000000 CYT
0.0005288	5811.	10989736.	6.1317833	0.0032422	-0.0126203	4.4871710	60.0000000 CYT
0.0005388	5815.	10794271.	6.1195887	0.0032969	-0.0128656	4.4932343	60.0000000 CYT
0.0005488	5820.	10605766.	6.1081285	0.0033518	-0.0131107	4.4973915	60.0000000 CYT
0.0006088	5844.	9600760.	6.0541766	0.0036855	-0.0145770	4.4971726	60.0000000 CYT
0.0006688	5844.	8739383.	6.0497973	0.0040458	-0.0160167	4.4957544	60.0000000 CYT

Axial Thrust Force = 47.520 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.0455653	190436452.	26.3232354	0.00003290	-0.00000460	0.1459702	0.9487798	
0.00000250	475.4509025	190180361.	20.6799388	0.00005170	-0.00002330	0.2279204	1.4884206	
0.00000375	711.5295241	189741206.	18.8001731	0.00007050	-0.00004200	0.3091138	2.0282063	
0.00000500	946.2153786	189243076.	17.8606138	0.00008930	-0.00006070	0.3895352	2.5680390	
0.00000625	1179.	188719942.	17.2970217	0.0001081	-0.00007939	0.4691812	3.1078977	
0.00000750	1411.	188184012.	16.9213813	0.0001269	-0.00009809	0.5480508	3.6477755	
0.00000875	1411.	161300582.	12.2399198	0.0001071	-0.0001554	0.4632948	-4.4685580 C	
0.00001000	1411.	141138009.	11.7555034	0.0001176	-0.0001824	0.5069250	-5.2474041 C	
0.00001125	1411.	125456008.	11.3628366	0.0001278	-0.0002097	0.5495643	-6.0314371 C	
0.00001250	1411.	112910407.	11.0378778	0.0001380	-0.0002370	0.5914074	-6.8193943 C	
0.00001375	1411.	102645825.	10.7638629	0.0001480	-0.0002645	0.6325611	-7.6105971 C	

0.00001500	1411.	94092006.	10.5298092	0.0001579	-0.0002921	0.6731417	-8.4042830 C
0.00001625	1411.	86854160.	10.3283133	0.0001678	-0.0003197	0.7132770	-9.1995948 C
0.00001750	1411.	80650291.	10.1507825	0.0001776	-0.0003474	0.7528544	-9.9973529 C
0.00001875	1411.	75273605.	9.9954544	0.0001874	-0.0003751	0.7921115	-10.7959091 C
0.00002000	1411.	70569005.	9.8568140	0.0001971	-0.0004029	0.8309403	-11.5960478 C
0.00002125	1411.	66417887.	9.7342646	0.0002069	-0.0004306	0.8695458	-12.3963219 C
0.00002250	1411.	62728004.	9.6222295	0.0002165	-0.0004585	0.9076666	-13.1986202 C
0.00002375	1411.	59426530.	9.5222798	0.0002262	-0.0004863	0.9456139	-14.0007172 C
0.00002500	1411.	56455204.	9.4319576	0.0002358	-0.0005142	0.9833232	-14.8030807 C
0.00002625	1411.	53766861.	9.3480797	0.0002454	-0.0005421	1.0206074	-15.6070867 C
0.00002750	1411.	51322912.	9.2720816	0.0002550	-0.0005700	1.0577204	-16.4108899 C
0.00002875	1411.	49091482.	9.2029361	0.0002646	-0.0005979	1.0946619	-17.2144894 C
0.00003000	1434.	47801408.	9.1393957	0.0002742	-0.0006258	1.1313857	-18.0182257 C
0.00003125	1478.	47311430.	9.0793000	0.0002837	-0.0006538	1.1677123	-18.8234468 C
0.00003250	1523.	46858059.	9.0240465	0.0002933	-0.0006817	1.2038693	-19.6284610 C
0.00003375	1567.	46437226.	8.9730980	0.0003028	-0.0007097	1.2398566	-20.4332677 C
0.00003500	1612.	46045439.	8.9259939	0.0003124	-0.0007376	1.2756736	-21.2378661 C
0.00003625	1656.	45679691.	8.8823373	0.0003220	-0.0007655	1.3113201	-22.0422553 C
0.00003750	1700.	45337004.	8.8414579	0.0003316	-0.0007934	1.3467497	-22.8467894 C
0.00003875	1744.	45014151.	8.8022070	0.0003411	-0.0008214	1.3818350	-23.6524573 C
0.00004000	1788.	44710602.	8.7655939	0.0003506	-0.0008494	1.4167514	-24.4579110 C
0.00004125	1833.	44424598.	8.7313794	0.0003602	-0.0008773	1.4514988	-25.2631497 C
0.00004250	1877.	44154589.	8.6993528	0.0003697	-0.0009053	1.4860766	-26.0681726 C
0.00004375	1921.	43899200.	8.6693269	0.0003793	-0.0009332	1.5204845	-26.8729788 C
0.00004500	1965.	43657212.	8.6411359	0.0003889	-0.0009611	1.5547222	-27.6775675 C
0.00004625	2009.	43427533.	8.6146315	0.0003984	-0.0009891	1.5887893	-28.4819379 C
0.00004750	2052.	43209191.	8.5896812	0.0004080	-0.0010170	1.6226854	-29.2860890 C
0.00004875	2096.	43001310.	8.5661661	0.0004176	-0.0010449	1.6564102	-30.0900200 C
0.00005125	2184.	42613026.	8.5219655	0.0004368	-0.0011007	1.7231525	-31.6987911 C
0.00005375	2271.	42257756.	8.4818868	0.0004559	-0.0011566	1.7891042	-33.3075464 C
0.00005625	2359.	41931518.	8.4459328	0.0004751	-0.0012124	1.8543723	-34.9153845 C
0.00005875	2446.	41630588.	8.4135816	0.0004943	-0.0012682	1.9189537	-36.5222977 C
0.00006125	2533.	41351850.	8.3843964	0.0005135	-0.0013240	1.9828454	-38.1282781 C
0.00006375	2620.	41092675.	8.3580092	0.0005328	-0.0013797	2.0460441	-39.7333178 C
0.00006625	2706.	40850832.	8.3341073	0.0005521	-0.0014354	2.1085466	-41.3374086 C
0.00006875	2793.	40624415.	8.3124239	0.0005715	-0.0014910	2.1703496	-42.9405422 C
0.00007125	2879.	40411782.	8.2927293	0.0005909	-0.0015466	2.2314500	-44.5427103 C
0.00007375	2966.	40211518.	8.2748255	0.0006103	-0.0016022	2.2918442	-46.1439042 C
0.00007625	3052.	40022390.	8.2585401	0.0006297	-0.0016578	2.3515290	-47.7441154 C
0.00007875	3138.	39843223.	8.2434662	0.0006492	-0.0017133	2.4104389	-49.3439213 C
0.00008125	3223.	39673069.	8.2294313	0.0006686	-0.0017689	2.4685572	-50.9434647 C
0.00008375	3309.	39511231.	8.2166634	0.0006881	-0.0018244	2.5259630	-52.5419660 C
0.00008625	3395.	39356972.	8.2050563	0.0007077	-0.0018798	2.5826525	-54.1394151 C
0.00008875	3480.	39209637.	8.1945159	0.0007273	-0.0019352	2.6386221	-55.7358020 C
0.00009125	3565.	39068642.	8.1849583	0.0007469	-0.0019906	2.6938680	-57.3311162 C
0.00009375	3650.	38933466.	8.1763089	0.0007665	-0.0020460	2.7483866	-58.9253473 C
0.00009625	3735.	38803641.	8.1685007	0.0007862	-0.0021013	2.8021738	-60.0000000 CY
0.00009875	3820.	38678747.	8.1614737	0.0008059	-0.0021566	2.8552259	-60.0000000 CY
0.0001013	3904.	38558399.	8.1551737	0.0008257	-0.0022118	2.9075387	-60.0000000 CY
0.0001038	3988.	38442266.	8.1495519	0.0008455	-0.0022670	2.9591087	-60.0000000 CY
0.0001063	4073.	38330031.	8.1445643	0.0008654	-0.0023221	3.0099315	-60.0000000 CY
0.0001088	4157.	38221411.	8.1401708	0.0008852	-0.0023773	3.0600030	-60.0000000 CY
0.0001113	4240.	38116150.	8.1363352	0.0009052	-0.0024323	3.1093190	-60.0000000 CY
0.0001138	4324.	38011410.	8.1328448	0.0009251	-0.0024874	3.1578251	-60.0000000 CY
0.0001163	4397.	37820294.	8.1235552	0.0009444	-0.0025431	3.2038011	-60.0000000 CY
0.0001188	4450.	37473600.	8.1032918	0.0009623	-0.0026002	3.2457727	-60.0000000 CY
0.0001213	4495.	37068915.	8.0788784	0.0009796	-0.0026579	3.2856413	-60.0000000 CY
0.0001238	4539.	36676119.	8.0553916	0.0009969	-0.0027156	3.3248489	-60.0000000 CY
0.0001263	4583.	36298161.	8.0330491	0.0010142	-0.0027733	3.3634743	-60.0000000 CY
0.0001288	4627.	35934170.	8.0117860	0.0010315	-0.0028310	3.4015149	-60.0000000 CY
0.0001313	4670.	35583343.	7.9915421	0.0010489	-0.0028886	3.4389679	-60.0000000 CY
0.0001338	4714.	35244939.	7.9722619	0.0010663	-0.0029462	3.4758307	-60.0000000 CY
0.0001363	4758.	34918267.	7.9538939	0.0010837	-0.0030038	3.5121006	-60.0000000 CY
0.0001388	4801.	34602227.	7.9357200	0.0011011	-0.0030614	3.5475822	-60.0000000 CY
0.0001413	4844.	34296594.	7.9182098	0.0011184	-0.0031191	3.5824209	-60.0000000 CY
0.0001438	4887.	33999929.	7.9014141	0.0011358	-0.0031767	3.6166406	-60.0000000 CY
0.0001463	4929.	33705111.	7.8846500	0.0011531	-0.0032344	3.6500549	-60.0000000 CY

0.0001488	4964.	33369666.	7.8637368	0.0011697	-0.0032928	3.6814807	-60.0000000 CY
0.0001588	5040.	31745796.	7.7492154	0.0012302	-0.0035323	3.7906844	-60.0000000 CY
0.0001688	5103.	30241167.	7.6427140	0.0012897	-0.0037728	3.8905223	-60.0000000 CY
0.0001788	5165.	28895448.	7.5446747	0.0013486	-0.0040139	3.9818492	-60.0000000 CY
0.0001888	5226.	27688564.	7.4587405	0.0014078	-0.0042547	4.0662201	-60.0000000 CY
0.0001988	5287.	26599465.	7.3831235	0.0014674	-0.0044951	4.1435185	-60.0000000 CY
0.0002088	5346.	25609450.	7.3141754	0.0015268	-0.0047357	4.2131014	-60.0000000 CY
0.0002188	5404.	24705121.	7.2511784	0.0015862	-0.0049763	4.2750592	-60.0000000 CY
0.0002288	5462.	23876618.	7.1952588	0.0016459	-0.0052166	4.3298035	-60.0000000 CY
0.0002388	5519.	23114326.	7.1455707	0.0017060	-0.0054565	4.3772011	-60.0000000 CY
0.0002488	5574.	22408209.	7.1009981	0.0017664	-0.0056961	4.4170507	-60.0000000 CY
0.0002588	5619.	21717670.	7.0536949	0.0018251	-0.0059374	4.4483412	-60.0000000 CY
0.0002688	5647.	21011399.	6.9934120	0.0018795	-0.0061830	4.4706685	-60.0000000 CY
0.0002788	5662.	20312925.	6.9282295	0.0019312	-0.0064313	4.4860833	-60.0000000 CY
0.0002888	5675.	19653442.	6.8665350	0.0019827	-0.0066798	4.4957765	-60.0000000 CY
0.0002988	5687.	19036831.	6.8099583	0.0020345	-0.0069280	4.4998632	-60.0000000 CY
0.0003088	5699.	18458634.	6.7581461	0.0020866	-0.0071759	4.4968358	-60.0000000 CY
0.0003188	5710.	17913290.	6.7069623	0.0021378	-0.0074247	4.4999556	60.0000000 CY
0.0003288	5720.	17399242.	6.6593361	0.0021893	-0.0076732	4.4962184	60.0000000 CY
0.0003388	5730.	16914581.	6.6153673	0.0022410	-0.0079215	4.4997859	60.0000000 CY
0.0003488	5739.	16456450.	6.5749508	0.0022930	-0.0081695	4.4938661	60.0000000 CY
0.0003588	5748.	16022932.	6.5376091	0.0023454	-0.0084171	4.4988479	60.0000000 CY
0.0003688	5757.	15612047.	6.5030883	0.0023980	-0.0086645	4.4961983	60.0000000 CY
0.0003788	5765.	15221773.	6.4713203	0.0024510	-0.0089115	4.4958178	60.0000000 CY
0.0003888	5773.	14850642.	6.4409369	0.0025039	-0.0091586	4.4994759	60.0000000 CY
0.0003988	5780.	14496521.	6.4107693	0.0025563	-0.0094062	4.4935140	60.0000000 CY
0.0004088	5787.	14158998.	6.3828383	0.0026090	-0.0096535	4.4950814	60.0000000 CY
0.0004188	5794.	13837172.	6.3567530	0.0026619	-0.0099006	4.4990057	60.0000000 CY
0.0004288	5801.	13529845.	6.3324753	0.0027150	-0.0101475	4.4974044	60.0000000 CY
0.0004388	5807.	13235784.	6.3101009	0.0027686	-0.0103939	4.4913537	60.0000000 CY
0.0004488	5813.	12954501.	6.2891511	0.0028223	-0.0106402	4.4967824	60.0000000 CY
0.0004588	5819.	12685153.	6.2695423	0.0028762	-0.0108863	4.4995898	60.0000000 CY
0.0004688	5825.	12426787.	6.2513761	0.0029303	-0.0111322	4.4941561	60.0000000 CY
0.0004788	5831.	12178723.	6.2345569	0.0029848	-0.0113777	4.4902587	60.0000000 CY
0.0004888	5836.	11940563.	6.2187778	0.0030394	-0.0116231	4.4958233	60.0000000 CYT
0.0004988	5841.	11711705.	6.2039837	0.0030942	-0.0118683	4.4990777	60.0000000 CYT
0.0005088	5846.	11491553.	6.1901711	0.0031492	-0.0121133	4.4985483	60.0000000 CYT
0.0005188	5851.	11279357.	6.1775476	0.0032046	-0.0123579	4.4862236	60.0000000 CYT
0.0005288	5856.	11075005.	6.1656868	0.0032601	-0.0126024	4.4911155	60.0000000 CYT
0.0005388	5861.	10878055.	6.1545519	0.0033158	-0.0128467	4.4961210	60.0000000 CYT
0.0005488	5865.	10687978.	6.1433208	0.0033711	-0.0130914	4.4990638	60.0000000 CYT
0.0006088	5889.	9674002.	6.0876050	0.0037058	-0.0145567	4.4990016	60.0000000 CYT
0.0006688	5889.	8806054.	6.0821751	0.0040675	-0.0159950	4.4982192	60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	42.768	5788.321	0.00300000
2	47.520	5832.063	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5788.	27.799200	3762.	38368581.
2	0.65	5832.	30.888000	3791.	38721057.
1	0.70	5788.	29.937600	4052.	37999012.
2	0.70	5832.	33.264000	4082.	38317259.
1	0.75	5788.	32.076000	4341.	37561205.
2	0.75	5832.	35.640000	4374.	37879515.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	262999.
2	13.5000	16.5683	No	No	262999.	112032.
3	18.0000	14.2651	No	No	375031.	146623.
4	21.5000	21.5000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 13200.0 lbs
Applied moment at pile head = 1161600.0 in-lbs
Axial thrust load on pile head = 47520.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5161	1161600.	13200.	-0.00541	0.00	1.89E+11	0.00	0.00	0.00
0.2000	0.5031	1193896.	13186.	-0.00540	0.00	1.89E+11	-11.8511	56.5345	0.00
0.4000	0.4902	1226123.	13142.	-0.00538	0.00	1.89E+11	-24.2649	118.8082	0.00
0.6000	0.4773	1258208.	13069.	-0.00537	0.00	1.89E+11	-37.1215	186.6693	0.00
0.8000	0.4644	1290077.	12964.	-0.00535	0.00	1.88E+11	-50.3007	259.9457	0.00
1.0000	0.4516	1321654.	12827.	-0.00533	0.00	1.88E+11	-63.6827	338.4440	0.00
1.2000	0.4388	1352863.	12658.	-0.00532	0.00	1.88E+11	-77.1481	421.9461	0.00
1.4000	0.4261	1383626.	12457.	-0.00530	0.00	1.88E+11	-90.7356	511.0951	0.00

1.6000	0.4134	1413864.	12223.	-0.00528	0.00	1.61E+11	-104.3064	605.5798	0.00
1.8000	0.4007	1443498.	11956.	-0.00523	0.00	4.77E+10	-117.7175	705.0062	0.00
2.0000	0.3883	1472447.	11658.	-0.00516	0.00	4.74E+10	-130.8809	809.0161	0.00
2.2000	0.3760	1500632.	11328.	-0.00508	0.00	4.71E+10	-143.7037	917.3166	0.00
2.4000	0.3639	1527982.	10969.	-0.00501	0.00	4.68E+10	-156.0956	1030.	0.00
2.6000	0.3519	1554423.	10579.	-0.00493	0.00	4.66E+10	-168.1645	1147.	0.00
2.8000	0.3402	1579887.	10162.	-0.00485	0.00	4.63E+10	-179.8911	1269.	0.00
3.0000	0.3287	1604305.	9717.	-0.00476	0.00	4.61E+10	-191.0238	1395.	0.00
3.2000	0.3174	1627614.	9246.	-0.00468	0.00	4.59E+10	-201.4889	1524.	0.00
3.4000	0.3062	1649752.	8750.	-0.00459	0.00	4.57E+10	-211.2152	1655.	0.00
3.6000	0.2953	1670663.	8233.	-0.00451	0.00	4.56E+10	-220.1348	1789.	0.00
3.8000	0.2846	1690297.	7694.	-0.00442	0.00	4.54E+10	-228.5429	1927.	0.00
4.0000	0.2741	1708604.	7135.	-0.00433	0.00	4.53E+10	-237.2223	2077.	0.00
4.2000	0.2638	1725534.	6557.	-0.00424	0.00	4.51E+10	-245.1110	2230.	0.00
4.4000	0.2538	1741042.	5960.	-0.00414	0.00	4.50E+10	-252.1569	2385.	0.00
4.6000	0.2440	1755087.	5347.	-0.00405	0.00	4.49E+10	-258.3105	2541.	0.00
4.8000	0.2343	1767633.	4721.	-0.00396	0.00	4.49E+10	-263.5252	2699.	0.00
5.0000	0.2250	1778651.	4084.	-0.00386	0.00	4.48E+10	-267.7575	2857.	0.00
5.2000	0.2158	1788115.	3435.	-0.00377	0.00	4.47E+10	-272.6057	3032.	0.00
5.4000	0.2069	1795999.	2776.	-0.00367	0.00	4.47E+10	-276.5864	3208.	0.00
5.6000	0.1982	1802278.	2109.	-0.00357	0.00	4.46E+10	-279.6704	3386.	0.00
5.8000	0.1897	1806935.	1435.	-0.00348	0.00	4.46E+10	-281.8318	3565.	0.00
6.0000	0.1815	1809958.	757.0290	-0.00338	0.00	4.46E+10	-283.0473	3742.	0.00
6.2000	0.1735	1811340.	77.4161	-0.00328	0.00	4.46E+10	-283.2968	3918.	0.00
6.4000	0.1658	1811078.	-602.5882	-0.00318	0.00	4.46E+10	-283.3735	4102.	0.00
6.6000	0.1583	1809173.	-1282.	-0.00309	0.00	4.46E+10	-282.7208	4288.	0.00
6.8000	0.1510	1805629.	-1958.	-0.00299	0.00	4.46E+10	-281.0514	4468.	0.00
7.0000	0.1439	1800454.	-2630.	-0.00289	0.00	4.46E+10	-278.3523	4642.	0.00
7.2000	0.1371	1793665.	-3293.	-0.00279	0.00	4.47E+10	-274.6158	4808.	0.00
7.4000	0.1305	1785284.	-3947.	-0.00270	0.00	4.47E+10	-269.8396	4962.	0.00
7.6000	0.1241	1775337.	-4589.	-0.00260	0.00	4.48E+10	-265.8416	5139.	0.00
7.8000	0.1180	1763848.	-5224.	-0.00251	0.00	4.49E+10	-262.7624	5344.	0.00
8.0000	0.1121	1750835.	-5850.	-0.00241	0.00	4.50E+10	-258.8402	5542.	0.00
8.2000	0.1064	1736320.	-6465.	-0.00232	0.00	4.51E+10	-254.0876	5730.	0.00
8.4000	0.1010	1720332.	-7068.	-0.00223	0.00	4.52E+10	-248.5235	5908.	0.00
8.6000	0.09572	1702901.	-7657.	-0.00214	0.00	4.53E+10	-242.1734	6072.	0.00
8.8000	0.09069	1684065.	-8230.	-0.00205	0.00	4.55E+10	-235.0694	6220.	0.00
9.0000	0.08588	1663865.	-8785.	-0.00196	0.00	4.56E+10	-227.2505	6350.	0.00
9.2000	0.08128	1642346.	-9320.	-0.00187	0.00	4.58E+10	-218.7623	6459.	0.00
9.4000	0.07689	1619557.	-9834.	-0.00179	0.00	4.60E+10	-209.6578	6544.	0.00
9.6000	0.07270	1595551.	-10326.	-0.00170	0.00	4.62E+10	-199.9966	6603.	0.00
9.8000	0.06871	1570383.	-10793.	-0.00162	0.00	4.64E+10	-189.8448	6632.	0.00
10.0000	0.06491	1544113.	-11236.	-0.00154	0.00	4.67E+10	-179.2750	6629.	0.00
10.2000	0.06130	1516801.	-11664.	-0.00146	0.00	4.69E+10	-177.5432	6951.	0.00
10.4000	0.05788	1488457.	-12088.	-0.00139	0.00	4.72E+10	-175.6059	7282.	0.00
10.6000	0.05464	1459094.	-12507.	-0.00131	0.00	4.75E+10	-173.4798	7620.	0.00
10.8000	0.05158	1428722.	-12921.	-0.00124	0.00	4.82E+10	-171.1822	7965.	0.00
11.0000	0.04869	1397357.	-13329.	-0.00120	0.00	1.88E+11	-168.7295	8317.	0.00
11.2000	0.04584	1365018.	-13730.	-0.00118	0.00	1.88E+11	-165.8813	8685.	0.00
11.4000	0.04303	1331721.	-14124.	-0.00116	0.00	1.88E+11	-162.6268	9070.	0.00
11.6000	0.04027	1297485.	-14510.	-0.00114	0.00	1.88E+11	-158.9548	9474.	0.00
11.8000	0.03754	1262332.	-14887.	-0.00113	0.00	1.89E+11	-154.8526	9900.	0.00
12.0000	0.03485	1226286.	-15253.	-0.00111	0.00	1.89E+11	-150.3066	10350.	0.00
12.2000	0.03220	1189371.	-15608.	-0.00110	0.00	1.89E+11	-145.3013	10829.	0.00
12.4000	0.02959	1151618.	-15950.	-0.00108	0.00	1.89E+11	-139.8190	11341.	0.00
12.6000	0.02701	1113059.	-16280.	-0.00107	0.00	1.89E+11	-134.9873	11995.	0.00
12.8000	0.02446	1073719.	-16599.	-0.00105	0.00	1.89E+11	-130.7383	12826.	0.00
13.0000	0.02195	1033626.	-16906.	-0.00104	0.00	1.89E+11	-125.8524	13759.	0.00
13.2000	0.01947	992806.	-17202.	-0.00103	0.00	1.89E+11	-120.2539	14822.	0.00
13.4000	0.01702	951291.	-17483.	-0.00101	0.00	1.89E+11	-113.8473	16053.	0.00
13.6000	0.01460	909120.	-17911.	-0.00100	0.00	1.89E+11	-243.1432	39970.	0.00
13.8000	0.01221	865547.	-18484.	-9.92E-04	0.00	1.89E+11	-234.2193	46054.	0.00
14.0000	0.00984	820623.	-19033.	-9.81E-04	0.00	1.89E+11	-223.5587	54536.	0.00
14.2000	0.00750	774411.	-19554.	-9.71E-04	0.00	1.90E+11	-210.3883	67363.	0.00
14.4000	0.00518	726986.	-20038.	-9.62E-04	0.00	1.90E+11	-193.1801	89561.	0.00
14.6000	0.00288	678446.	-20472.	-9.53E-04	0.00	1.90E+11	-168.0300	140036.	0.00
14.8000	6.03E-04	628938.	-20811.	-9.45E-04	0.00	1.90E+11	-114.4602	455246.	0.00

15.0000	-0.00165	578770.	-20665.	-9.37E-04	0.00	1.90E+11	236.0608	342561.	0.00
15.2000	-0.00389	529961.	-20031.	-9.30E-04	0.00	1.90E+11	292.3812	180224.	0.00
15.4000	-0.00612	482835.	-19287.	-9.23E-04	0.00	1.90E+11	327.3340	128424.	0.00
15.6000	-0.00833	437594.	-18470.	-9.18E-04	0.00	1.90E+11	353.5577	101911.	0.00
15.8000	-0.01052	394389.	-17596.	-9.12E-04	0.00	1.90E+11	374.8608	85503.	0.00
16.0000	-0.01271	353342.	-16674.	-9.08E-04	0.00	1.90E+11	392.9565	74225.	0.00
16.2000	-0.01488	314558.	-15712.	-9.03E-04	0.00	1.90E+11	408.7763	65936.	0.00
16.4000	-0.01704	278128.	-14714.	-9.00E-04	0.00	1.90E+11	422.8880	59552.	0.00
16.6000	-0.01920	244134.	-13684.	-8.96E-04	0.00	1.90E+11	435.6659	54464.	0.00
16.8000	-0.02135	212649.	-12624.	-8.94E-04	0.00	1.90E+11	447.3705	50300.	0.00
17.0000	-0.02349	183740.	-11538.	-8.91E-04	0.00	1.90E+11	458.1910	46820.	0.00
17.2000	-0.02562	157471.	-10426.	-8.89E-04	0.00	1.90E+11	468.2697	43861.	0.00
17.4000	-0.02775	133898.	-9291.	-8.87E-04	0.00	1.90E+11	477.7162	41310.	0.00
17.6000	-0.02988	113077.	-8134.	-8.86E-04	0.00	1.90E+11	486.6168	39084.	0.00
17.8000	-0.03200	95058.	-6956.	-8.84E-04	0.00	1.90E+11	495.0410	37123.	0.00
18.0000	-0.03413	79891.	-6141.	-8.83E-04	0.00	1.90E+11	184.2769	12960.	0.00
18.2000	-0.03624	65785.	-5682.	-8.82E-04	0.00	1.90E+11	197.8904	13104.	0.00
18.4000	-0.03836	52819.	-5190.	-8.81E-04	0.00	1.90E+11	211.7472	13248.	0.00
18.6000	-0.04047	41073.	-4665.	-8.81E-04	0.00	1.90E+11	225.8489	13392.	0.00
18.8000	-0.04259	30627.	-4106.	-8.80E-04	0.00	1.90E+11	240.1974	13536.	0.00
19.0000	-0.04470	21565.	-3512.	-8.80E-04	0.00	1.90E+11	254.7943	13680.	0.00
19.2000	-0.04681	13970.	-2883.	-8.80E-04	0.00	1.90E+11	269.6409	13824.	0.00
19.4000	-0.04892	7929.	-2217.	-8.80E-04	0.00	1.90E+11	284.7385	13968.	0.00
19.6000	-0.05104	3527.	-1516.	-8.80E-04	0.00	1.90E+11	300.0880	14112.	0.00
19.8000	-0.05315	854.5318	-776.6832	-8.80E-04	0.00	1.90E+11	315.6903	14256.	0.00
20.0000	-0.05526	0.00	0.00	-8.80E-04	0.00	1.90E+11	331.5457	7200.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.51607143 inches
Computed slope at pile head      =    -0.00541188 radians
Maximum bending moment           =       1811340. inch-lbs
Maximum shear force              =        -20811. lbs
Depth of maximum bending moment  =     6.20000000 feet below pile head
Depth of maximum shear force     =    14.80000000 feet below pile head
Number of iterations             =             97
Number of zero deflection points =              1
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

```
Shear force at pile head                          =      18480.0 lbs
Applied moment at pile head                       =    1626240.0 in-lbs
Axial thrust load on pile head                    =      42768.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0525	1626240.	18480.	-0.01063	0.00	4.47E+10	0.00	0.00	0.00
0.2000	1.0271	1671679.	18462.	-0.01054	0.00	4.47E+10	-15.0948	35.2723	0.00
0.4000	1.0019	1717021.	18407.	-0.01045	0.00	4.41E+10	-30.8929	74.0035	0.00
0.6000	0.9769	1762176.	18313.	-0.01036	0.00	4.38E+10	-47.2525	116.0859	0.00

0.8000	0.9522	1807049.	18179.	-0.01026	0.00	4.35E+10	-64.0346	161.4017	0.00
1.0000	0.9277	1851543.	18005.	-0.01016	0.00	4.33E+10	-81.1030	209.8220	0.00
1.2000	0.9034	1895559.	17790.	-0.01005	0.00	4.31E+10	-98.3246	261.2048	0.00
1.4000	0.8794	1938998.	17533.	-0.00995	0.00	4.28E+10	-115.5418	315.3196	0.00
1.6000	0.8557	1981761.	17235.	-0.00984	0.00	4.26E+10	-132.6599	372.0794	0.00
1.8000	0.8322	2023747.	16897.	-0.00972	0.00	4.24E+10	-149.5781	431.3627	0.00
2.0000	0.8090	2064861.	16518.	-0.00961	0.00	4.23E+10	-166.1895	493.0091	0.00
2.2000	0.7861	2105005.	16100.	-0.00949	0.00	4.21E+10	-182.3915	556.8452	0.00
2.4000	0.7635	2144086.	15643.	-0.00937	0.00	4.20E+10	-198.0856	622.6821	0.00
2.6000	0.7411	2182014.	15149.	-0.00924	0.00	4.18E+10	-213.3737	690.9509	0.00
2.8000	0.7191	2218700.	14619.	-0.00912	0.00	4.17E+10	-228.2316	761.7069	0.00
3.0000	0.6974	2254058.	14055.	-0.00899	0.00	4.15E+10	-242.4028	834.2042	0.00
3.2000	0.6760	2288006.	13457.	-0.00886	0.00	4.14E+10	-255.8099	908.2290	0.00
3.4000	0.6549	2320468.	12828.	-0.00872	0.00	4.13E+10	-268.3786	983.5452	0.00
3.6000	0.6341	2351369.	12170.	-0.00859	0.00	4.12E+10	-280.0382	1060.	0.00
3.8000	0.6137	2380644.	11484.	-0.00845	0.00	4.11E+10	-291.1839	1139.	0.00
4.0000	0.5936	2408227.	10771.	-0.00831	0.00	4.10E+10	-302.8361	1224.	0.00
4.2000	0.5738	2434051.	10031.	-0.00817	0.00	4.10E+10	-313.6452	1312.	0.00
4.4000	0.5544	2458055.	9267.	-0.00802	0.00	4.09E+10	-323.5579	1401.	0.00
4.6000	0.5353	2480179.	8480.	-0.00788	0.00	4.08E+10	-332.5234	1491.	0.00
4.8000	0.5165	2500374.	7672.	-0.00773	0.00	4.08E+10	-340.4926	1582.	0.00
5.0000	0.4982	2518592.	6846.	-0.00758	0.00	4.07E+10	-347.4182	1674.	0.00
5.2000	0.4801	2534793.	6004.	-0.00744	0.00	4.07E+10	-354.8855	1774.	0.00
5.4000	0.4625	2548935.	5144.	-0.00728	0.00	4.06E+10	-361.3193	1875.	0.00
5.6000	0.4452	2560981.	4271.	-0.00713	0.00	4.06E+10	-366.6764	1977.	0.00
5.8000	0.4282	2570899.	3385.	-0.00698	0.00	4.06E+10	-370.9166	2079.	0.00
6.0000	0.4117	2578665.	2492.	-0.00683	0.00	4.06E+10	-374.0024	2180.	0.00
6.2000	0.3955	2584260.	1592.	-0.00668	0.00	4.06E+10	-375.8993	2281.	0.00
6.4000	0.3796	2587675.	686.4648	-0.00652	0.00	4.05E+10	-378.4652	2393.	0.00
6.6000	0.3641	2588895.	-224.2682	-0.00637	0.00	4.05E+10	-380.4790	2508.	0.00
6.8000	0.3490	2587907.	-1138.	-0.00622	0.00	4.05E+10	-381.2805	2622.	0.00
7.0000	0.3343	2584707.	-2053.	-0.00606	0.00	4.06E+10	-380.8315	2734.	0.00
7.2000	0.3199	2579298.	-2965.	-0.00591	0.00	4.06E+10	-379.0975	2844.	0.00
7.4000	0.3059	2571690.	-3871.	-0.00576	0.00	4.06E+10	-376.0478	2950.	0.00
7.6000	0.2923	2561899.	-4771.	-0.00561	0.00	4.06E+10	-374.2110	3073.	0.00
7.8000	0.2790	2549938.	-5669.	-0.00546	0.00	4.06E+10	-373.7633	3215.	0.00
8.0000	0.2661	2535809.	-6564.	-0.00531	0.00	4.07E+10	-372.1897	3357.	0.00
8.2000	0.2535	2519520.	-7454.	-0.00516	0.00	4.07E+10	-369.4677	3498.	0.00
8.4000	0.2413	2501089.	-8336.	-0.00501	0.00	4.08E+10	-365.5795	3636.	0.00
8.6000	0.2295	2480536.	-9207.	-0.00486	0.00	4.08E+10	-360.5136	3770.	0.00
8.8000	0.2180	2457892.	-10065.	-0.00472	0.00	4.09E+10	-354.2650	3901.	0.00
9.0000	0.2068	2433192.	-10906.	-0.00458	0.00	4.10E+10	-346.8359	4025.	0.00
9.2000	0.1960	2406480.	-11729.	-0.00443	0.00	4.11E+10	-338.2366	4141.	0.00
9.4000	0.1855	2377805.	-12529.	-0.00429	0.00	4.11E+10	-328.4863	4249.	0.00
9.6000	0.1754	2347224.	-13304.	-0.00416	0.00	4.12E+10	-317.6139	4346.	0.00
9.8000	0.1656	2314799.	-14052.	-0.00402	0.00	4.13E+10	-305.6586	4430.	0.00
10.0000	0.1561	2280601.	-14770.	-0.00389	0.00	4.15E+10	-292.6713	4500.	0.00
10.2000	0.1469	2244702.	-15469.	-0.00376	0.00	4.16E+10	-290.2497	4741.	0.00
10.4000	0.1381	2207119.	-16162.	-0.00363	0.00	4.17E+10	-287.2575	4993.	0.00
10.6000	0.1295	2167868.	-16847.	-0.00350	0.00	4.19E+10	-283.6917	5257.	0.00
10.8000	0.1213	2126970.	-17523.	-0.00338	0.00	4.20E+10	-279.5499	5533.	0.00
11.0000	0.1133	2084449.	-18189.	-0.00326	0.00	4.22E+10	-274.8301	5822.	0.00
11.2000	0.1056	2040334.	-18842.	-0.00314	0.00	4.24E+10	-269.5305	6125.	0.00
11.4000	0.09821	1994654.	-19482.	-0.00303	0.00	4.26E+10	-263.6496	6443.	0.00
11.6000	0.09108	1947443.	-20107.	-0.00292	0.00	4.28E+10	-257.1854	6777.	0.00
11.8000	0.08421	1898740.	-20715.	-0.00281	0.00	4.30E+10	-250.1355	7129.	0.00
12.0000	0.07759	1848586.	-21307.	-0.00271	0.00	4.33E+10	-242.4965	7501.	0.00
12.2000	0.07122	1797024.	-21879.	-0.00261	0.00	4.36E+10	-234.2637	7894.	0.00
12.4000	0.06509	1744103.	-22430.	-0.00251	0.00	4.39E+10	-225.4303	8313.	0.00
12.6000	0.05918	1689873.	-22962.	-0.00241	0.00	4.42E+10	-217.4809	8820.	0.00
12.8000	0.05350	1634382.	-23475.	-0.00232	0.00	4.46E+10	-210.3749	9438.	0.00
13.0000	0.04802	1577669.	-23971.	-0.00224	0.00	4.50E+10	-202.5620	10124.	0.00
13.2000	0.04275	1519781.	-24447.	-0.00216	0.00	4.55E+10	-193.9768	10890.	0.00
13.4000	0.03767	1460768.	-24901.	-0.00208	0.00	4.60E+10	-184.5369	11758.	0.00
13.6000	0.03277	1400684.	-25479.	-0.00203	0.00	1.88E+11	-297.6210	21796.	0.00
13.8000	0.02792	1338883.	-26182.	-0.00201	0.00	1.88E+11	-288.0469	24763.	0.00
14.0000	0.02310	1275422.	-26860.	-0.00200	0.00	1.89E+11	-276.7570	28750.	0.00

14.2000	0.01833	1210365.	-27508.	-0.00198	0.00	1.89E+11	-263.1022	34450.	0.00
14.4000	0.01359	1143791.	-28119.	-0.00197	0.00	1.89E+11	-245.9206	43425.	0.00
14.6000	0.00889	1075799.	-28681.	-0.00195	0.00	1.89E+11	-222.7446	60140.	0.00
14.8000	0.00422	1006523.	-29172.	-0.00194	0.00	1.89E+11	-186.2085	105921.	0.00
15.0000	-4.20E-04	936173.	-29241.	-0.00193	0.00	1.89E+11	128.2157	732713.	0.00
15.2000	-0.00503	866560.	-28714.	-0.00192	0.00	1.89E+11	311.6997	148705.	0.00
15.4000	-0.00961	798741.	-27900.	-0.00191	0.00	1.90E+11	366.4980	91482.	0.00
15.6000	-0.01417	733032.	-26975.	-0.00190	0.00	1.90E+11	403.8472	68376.	0.00
15.8000	-0.01871	669649.	-25971.	-0.00189	0.00	1.90E+11	432.8842	55519.	0.00
16.0000	-0.02323	608758.	-24903.	-0.00188	0.00	1.90E+11	456.9315	47207.	0.00
16.2000	-0.02773	550498.	-23782.	-0.00187	0.00	1.90E+11	477.6090	41338.	0.00
16.4000	-0.03221	494988.	-22614.	-0.00186	0.00	1.90E+11	495.8396	36944.	0.00
16.6000	-0.03668	442334.	-21404.	-0.00186	0.00	1.90E+11	512.2034	33515.	0.00
16.8000	-0.04113	392630.	-20157.	-0.00185	0.00	1.90E+11	527.0912	30754.	0.00
17.0000	-0.04557	345961.	-18876.	-0.00185	0.00	1.90E+11	540.7793	28478.	0.00
17.2000	-0.05001	302407.	-17562.	-0.00184	0.00	1.90E+11	553.4716	26563.	0.00
17.4000	-0.05443	262040.	-16220.	-0.00184	0.00	1.90E+11	565.3225	24927.	0.00
17.6000	-0.05884	224929.	-14850.	-0.00184	0.00	1.91E+11	576.4524	23511.	0.00
17.8000	-0.06325	191138.	-13454.	-0.00184	0.00	1.91E+11	586.9568	22271.	0.00
18.0000	-0.06765	160728.	-12311.	-0.00183	0.00	1.91E+11	365.3271	12960.	0.00
18.2000	-0.07205	132422.	-11401.	-0.00183	0.00	1.91E+11	393.3944	13104.	0.00
18.4000	-0.07644	106381.	-10422.	-0.00183	0.00	1.91E+11	421.9673	13248.	0.00
18.6000	-0.08083	82771.	-9374.	-0.00183	0.00	1.91E+11	451.0494	13392.	0.00
18.8000	-0.08522	61759.	-8256.	-0.00183	0.00	1.91E+11	480.6441	13536.	0.00
19.0000	-0.08961	43516.	-7067.	-0.00183	0.00	1.91E+11	510.7547	13680.	0.00
19.2000	-0.09399	28214.	-5804.	-0.00183	0.00	1.91E+11	541.3840	13824.	0.00
19.4000	-0.09837	16031.	-4467.	-0.00183	0.00	1.91E+11	572.5344	13968.	0.00
19.6000	-0.1028	7145.	-3055.	-0.00183	0.00	1.91E+11	604.2080	14112.	0.00
19.8000	-0.1071	1740.	-1567.	-0.00183	0.00	1.91E+11	636.4062	14256.	0.00
20.0000	-0.1115	0.00	0.00	-0.00183	0.00	1.91E+11	669.1301	7200.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     1.05249005 inches
Computed slope at pile head      =    -0.01063123 radians
Maximum bending moment           =       2588895. inch-lbs
Maximum shear force              =        -29241. lbs
Depth of maximum bending moment  =     6.60000000 feet below pile head
Depth of maximum shear force     =    15.00000000 feet below pile head
Number of iterations             =             47
Number of zero deflection points =              1
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

```
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians
```

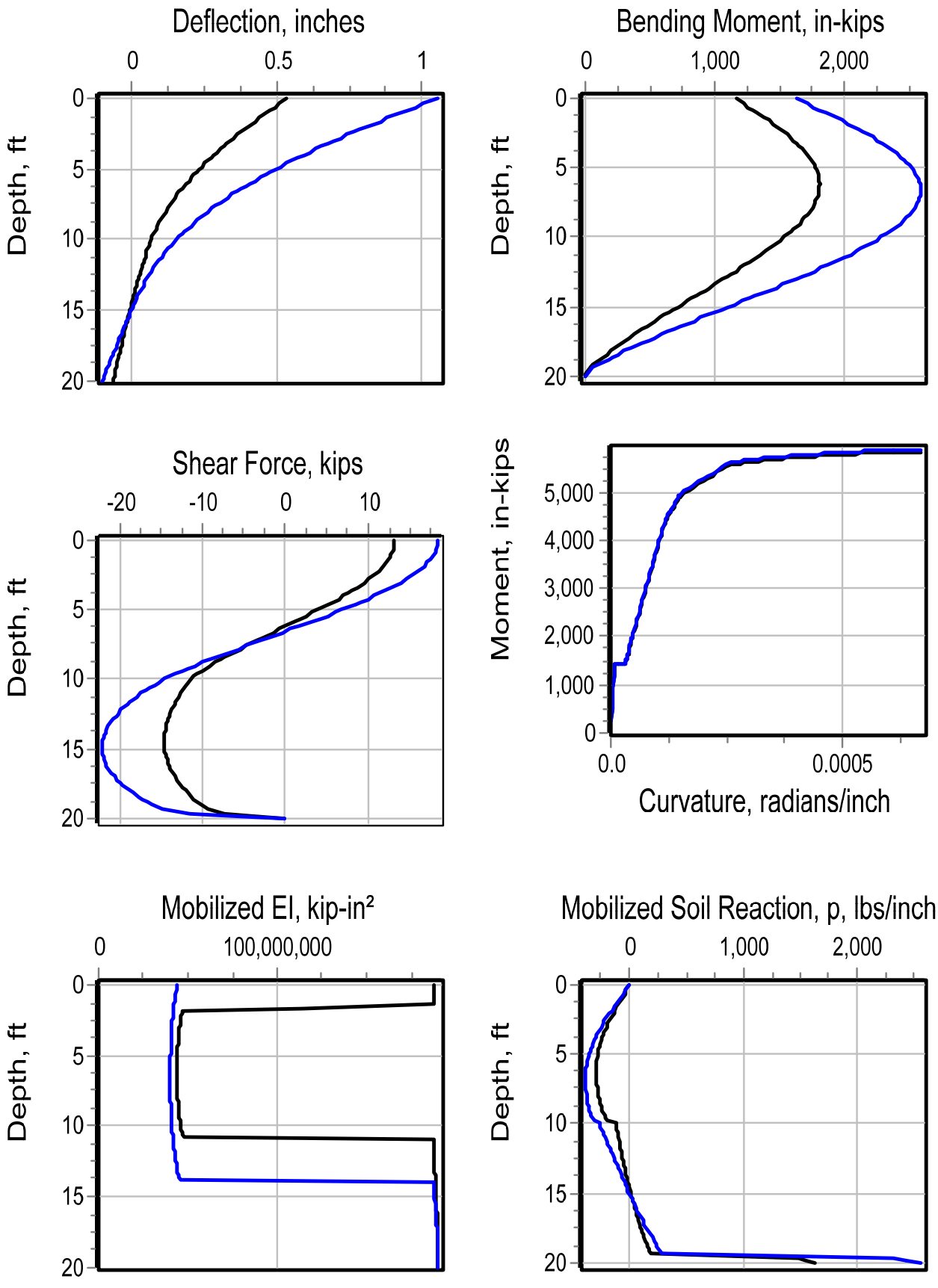
Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs

1	V, lb	13200.	M, in-lb	1161600.	47520.	0.5161	-0.00541	-20811.	1811340.
2	V, lb	18480.	M, in-lb	1626240.	42768.	1.0525	-0.01063	-29241.	2588895.

Maximum pile-head deflection = 1.0524900507 inches
Maximum pile-head rotation = -0.0106312260 radians = -0.609124 deg.

The analysis ended normally.

NB1A_P22-P27


Deflection, inches
0
0.5
1
Depth, ft
0
5
10
15
20
Bending Moment, in-kips
0
1,000
2,000
Depth, ft
Shear Force, kips
-20
-10
0
10
Depth, ft
Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch
Mobilized EI, kip-in²
0
100,000,000
Depth, ft
Mobilized Soil Reaction, p, lbs/inch
0
1,000
2,000
Depth, ft

==========

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2019\Noise Wall\LPILE\

Name of input data file:
SUM-8_NB1A_P22-P27.lp10

Name of output report file:

SUM-8_NB1A_P22-P27.lp10

Name of plot output file:
SUM-8_NB1A_P22-P27.lp10

Name of runtime message file:
SUM-8_NB1A_P22-P27.lp10

Date and Time of Analysis

Date: August 30, 2019 Time: 14:20:35

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1A_P23-P27

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 20.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	20.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 20.000000 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 26.600 degrees
= 0.464 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 10.000000 ft
Effective unit weight at top of layer = 120.000000 pcf
Effective unit weight at bottom of layer = 120.000000 pcf
Friction angle at top of layer = 30.000000 deg.
Friction angle at bottom of layer = 30.000000 deg.
Subgrade k at top of layer = 42.500000 pci
Subgrade k at bottom of layer = 42.500000 pci

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 10.000000 ft
Distance from top of pile to bottom of layer = 19.500000 ft
Effective unit weight at top of layer = 112.500000 pcf
Effective unit weight at bottom of layer = 112.500000 pcf
Friction angle at top of layer = 29.500000 deg.
Friction angle at bottom of layer = 29.500000 deg.
Subgrade k at top of layer = 14.000000 pci
Subgrade k at bottom of layer = 14.000000 pci

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 19.500000 ft
Distance from top of pile to bottom of layer = 27.000000 ft

Effective unit weight at top of layer = 130.000000 pcf
Effective unit weight at bottom of layer = 130.000000 pcf
Friction angle at top of layer = 38.500000 deg.
Friction angle at bottom of layer = 38.500000 deg.
Subgrade k at top of layer = 104.000000 pci
Subgrade k at bottom of layer = 104.000000 pci

(Depth of the lowest soil layer extends 7.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand	0.00	120.0000	30.0000	42.5000
	(Reese, et al.)	10.0000	120.0000	30.0000	42.5000
2	Sand	10.0000	112.5000	29.5000	14.0000
	(Reese, et al.)	19.5000	112.5000	29.5000	14.0000
3	Sand	19.5000	130.0000	38.5000	104.0000
	(Reese, et al.)	27.0000	130.0000	38.5000	104.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V =	13200. lbs	M =	1161600. in-lbs	45360.	No
2	1	V =	18480. lbs	M =	1626240. in-lbs	40824.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 20.000000 ft
Shaft Diameter = 30.000000 in
Concrete Cover Thickness = 3.000000 in

Number of Reinforcing Bars = 10 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 706.858347 sq. in.
Total Area of Reinforcing Steel = 7.900000 sq. in.
Area Ratio of Steel Reinforcement = 1.12 percent
Edge-to-Edge Bar Spacing = 6.107391 in
Maximum Concrete Aggregate Size = 0.750000 in
Ratio of Bar Spacing to Aggregate Size = 8.14
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 3147.516 kips
Tensile Load for Cracking of Concrete = -334.148 kips
Nominal Axial Tensile Capacity = -474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete = 4500. psi
Modulus of Elasticity of Concrete = 3823676. psi
Modulus of Rupture of Concrete = -503.115295 psi
Compression Strain at Peak Stress = 0.002001
Tensile Strain at Fracture of Concrete = -0.0001152
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	40.824
2	45.360

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.

Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 40.824 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
0.00000125	238.2486787	190598943.	24.7251292	0.00003091	-0.00000659	0.1371264	0.8908484	
0.00000250	475.6992735	190279709.	19.8789171	0.00004970	-0.00002530	0.2191386	1.4303465	
0.00000375	711.7886161	189810298.	18.2643996	0.00006849	-0.00004401	0.3003872	1.9699410	
0.00000500	946.4795782	189295916.	17.4573649	0.00008729	-0.00006271	0.3808621	2.5095679	
0.00000625	1180.	188762769.	16.9732497	0.0001061	-0.00008142	0.4605613	3.0492140	
0.00000750	1412.	188220079.	16.6505741	0.0001249	-0.0001001	0.5394841	3.5888749	
0.00000875	1412.	161331497.	11.6819932	0.0001022	-0.0001603	0.4424685	-4.6101317	C
0.00001000	1412.	141165059.	11.2453845	0.0001125	-0.0001875	0.4852795	-5.3953385	C
0.00001125	1412.	125480053.	10.8909714	0.0001225	-0.0002150	0.5271584	-6.1853830	C
0.00001250	1412.	112932048.	10.5988418	0.0001325	-0.0002425	0.5683657	-6.9785448	C
0.00001375	1412.	102665498.	10.3538698	0.0001424	-0.0002701	0.6090157	-7.7740819	C
0.00001500	1412.	94110040.	10.1434363	0.0001522	-0.0002978	0.6490617	-8.5723552	C

0.00001625	1412.	86870806.	9.9627610	0.0001619	-0.0003256	0.6887246
-9.3718614 C						
0.00001750	1412.	80665748.	9.8055080	0.0001716	-0.0003534	0.7280101
-10.1725797 C						
0.00001875	1412.	75288032.	9.6667087	0.0001813	-0.0003812	0.7668989
-10.9746646 C						
0.00002000	1412.	70582530.	9.5438648	0.0001909	-0.0004091	0.8054726
-11.7775583 C						
0.00002125	1412.	66430616.	9.4352720	0.0002005	-0.0004370	0.8438286
-12.5805761 C						
0.00002250	1412.	62740026.	9.3359770	0.0002101	-0.0004649	0.8817333
-13.3854000 C						
0.00002375	1412.	59437920.	9.2474242	0.0002196	-0.0004929	0.9194681
-14.1900240 C						
0.00002500	1412.	56466024.	9.1680033	0.0002292	-0.0005208	0.9570326
-14.9944475 C						
0.00002625	1412.	53777166.	9.0943664	0.0002387	-0.0005488	0.9942136
-15.8002260 C						
0.00002750	1412.	51332749.	9.0270548	0.0002482	-0.0005768	1.0311584
-16.6062987 C						
0.00002875	1412.	49100890.	8.9658404	0.0002578	-0.0006047	1.0679351
-17.4121680 C						
0.00003000	1412.	47055020.	8.9099619	0.0002673	-0.0006327	1.1045432
-18.2178330 C						
0.00003125	1429.	45733647.	8.8587799	0.0002768	-0.0006607	1.1409826
-19.0232931 C						
0.00003250	1474.	45340362.	8.8102466	0.0002863	-0.0006887	1.1770635
-19.8299675 C						
0.00003375	1518.	44974816.	8.7652021	0.0002958	-0.0007167	1.2129358
-20.6367458 C						
0.00003500	1562.	44634398.	8.7235817	0.0003053	-0.0007447	1.2486410
-21.4433145 C						
0.00003625	1606.	44316506.	8.6850318	0.0003148	-0.0007727	1.2841789
-22.2496727 C						
0.00003750	1651.	44018883.	8.6492461	0.0003243	-0.0008007	1.3195490
-23.0558197 C						
0.00003875	1695.	43739566.	8.6159579	0.0003339	-0.0008286	1.3547511
-23.8617547 C						

0.00004000	1739.	43476836.	8.5849337	0.0003434	-0.0008566	1.3897847
-24.6674768 C						
0.00004125	1783.	43229180.	8.5559684	0.0003529	-0.0008846	1.4246495
-25.4729852 C						
0.00004250	1827.	42994577.	8.5280629	0.0003624	-0.0009126	1.4592165
-26.2792874 C						
0.00004375	1871.	42772406.	8.5017074	0.0003719	-0.0009406	1.4935810
-27.0856461 C						
0.00004500	1915.	42561807.	8.4769849	0.0003815	-0.0009685	1.5277780
-27.8917845 C						
0.00004625	1959.	42361842.	8.4537638	0.0003910	-0.0009965	1.5618072
-28.6977017 C						
0.00004750	2003.	42171666.	8.4319261	0.0004005	-0.0010245	1.5956681
-29.5033966 C						
0.00004875	2047.	41990525.	8.4113661	0.0004101	-0.0010524	1.6293604
-30.3088686 C						
0.00005125	2135.	41652692.	8.3737075	0.0004292	-0.0011083	1.6962376
-31.9191395 C						
0.00005375	2222.	41343653.	8.3401316	0.0004483	-0.0011642	1.7624360
-33.5285072 C						
0.00005625	2310.	41059549.	8.3100987	0.0004674	-0.0012201	1.8279523
-35.1369639 C						
0.00005875	2397.	40797179.	8.2831608	0.0004866	-0.0012759	1.8927836
-36.7445021 C						
0.00006125	2484.	40553865.	8.2589434	0.0005059	-0.0013316	1.9569268
-38.3511140 C						
0.00006375	2571.	40327105.	8.2366157	0.0005251	-0.0013874	2.0202689
-39.9577441 C						
0.00006625	2658.	40115110.	8.2161477	0.0005443	-0.0014432	2.0828504
-41.5640385 C						
0.00006875	2744.	39916407.	8.1976590	0.0005636	-0.0014989	2.1447419
-43.1693546 C						
0.00007125	2831.	39729580.	8.1809455	0.0005829	-0.0015546	2.2059400
-44.7736837 C						
0.00007375	2917.	39553406.	8.1658308	0.0006022	-0.0016103	2.2664414
-46.3770167 C						
0.00007625	3003.	39386821.	8.1521619	0.0006216	-0.0016659	2.3262426
-47.9793443 C						

0.00007875	3089.	39228897.	8.1398051	0.0006410	-0.0017215	2.3853404 -49.5806573 C
0.00008125	3175.	39078820.	8.1286434	0.0006605	-0.0017770	2.4437310 -51.1809462 C
0.00008375	3261.	38935871.	8.1185738	0.0006799	-0.0018326	2.5014110 -52.7802012 C
0.00008625	3346.	38799417.	8.1095051	0.0006994	-0.0018881	2.5583769 -54.3784125 C
0.00008875	3432.	38668894.	8.1013568	0.0007190	-0.0019435	2.6146249 -55.9755702 C
0.00009125	3517.	38543800.	8.0940570	0.0007386	-0.0019989	2.6701514 -57.5716639 C
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0.0003688	5692.	15435449.	6.4526161	0.0023794	-0.0086831	4.4999192
60.0000000 CY						
0.0003788	5700.	15049167.	6.4188495	0.0024311	-0.0089314	4.4926484
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0.0003888	5708.	14682016.	6.3872417	0.0024830	-0.0091795	4.4979728
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0.0003988	5715.	14332752.	6.3578067	0.0025352	-0.0094273	4.4999835
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0.0004088	5722.	13999629.	6.3307382	0.0025877	-0.0096748	4.4914044
60.0000000 CY						
0.0004188	5729.	13681951.	6.3055016	0.0026404	-0.0099221	4.4970528
60.0000000 CY						
0.0004288	5736.	13378676.	6.2819404	0.0026934	-0.0101691	4.4997555
60.0000000 CY						

0.0004388	5743.	13088544.	6.2601849	0.0027467	-0.0104158	4.4917370	60.0000000 CY
0.0004488	5749.	12810828.	6.2399856	0.0028002	-0.0106623	4.4935812	60.0000000 CY
0.0004588	5755.	12544898.	6.2210829	0.0028539	-0.0109086	4.4980794	60.0000000 CY
0.0004688	5761.	12289993.	6.2034033	0.0029078	-0.0111547	4.4999463	60.0000000 CY
0.0004788	5767.	12045107.	6.1871766	0.0029621	-0.0114004	4.4895500	60.0000000 CY
0.0004888	5772.	11809915.	6.1720363	0.0030166	-0.0116459	4.4921058	60.0000000 CYT
0.0004988	5777.	11583912.	6.1578456	0.0030712	-0.0118913	4.4970004	60.0000000 CYT
0.0005088	5783.	11366418.	6.1438665	0.0031257	-0.0121368	4.4995642	60.0000000 CYT
0.0005188	5788.	11156774.	6.1299908	0.0031799	-0.0123826	4.4954784	60.0000000 CYT
0.0005288	5792.	10954676.	6.1171984	0.0032345	-0.0126280	4.4852518	60.0000000 CYT
0.0005388	5797.	10759918.	6.1051665	0.0032892	-0.0128733	4.4918112	60.0000000 CYT
0.0005488	5801.	10572096.	6.0938601	0.0033440	-0.0131185	4.4964746	60.0000000 CYT
0.0006088	5826.	9570762.	6.0406274	0.0036772	-0.0145853	4.4961660	60.0000000 CYT
0.0006688	5826.	8712077.	6.0366791	0.0040370	-0.0160255	4.4944557	60.0000000 CYT

Axial Thrust Force = 45.360 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
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  0.00000125  238.1126319   190490106.   25.8075831   0.00003226  -0.00000524
0.1431176    0.9300874
  0.00000250  475.5346003   190213840.   20.4215080   0.00005105  -0.00002395
0.2250882    1.4696843
  0.00000375  711.6171469   189764572.   18.6273263   0.00006985  -0.00004265
0.3062995    2.0094092
  0.00000500  946.3048362   189260967.   17.7305240   0.00008865  -0.00006135
0.3867382    2.5491760
  0.00000625       1180.   188734451.   17.1925730    0.0001075  -0.00008005   0.4664014
 3.0889664
  0.00000750       1411.   188196235.   16.8340198    0.0001263  -0.00009874   0.5452882
 3.6287743
  0.00000875       1411.   161311059.   12.0631340    0.0001056   -0.0001569   0.4567016
-4.5134172 C
  0.00001000       1411.   141147176.   11.5937720    0.0001159   -0.0001841   0.5000687
-5.2943061 C
  0.00001125       1411.   125464157.   11.2134821    0.0001262   -0.0002113   0.5424793
-6.0801640 C
  0.00001250       1411.   112917741.   10.8985764    0.0001362   -0.0002388   0.5841039
-6.8698910 C
  0.00001375       1411.   102652492.   10.6340414    0.0001462   -0.0002663   0.6251133
-7.6623635 C
  0.00001500       1411.    94098117.   10.4072547    0.0001561   -0.0002939   0.6655119
-8.4575942 C
  0.00001625       1411.    86859801.   10.2112423    0.0001659   -0.0003216   0.7054225
-9.2547645 C
  0.00001750       1411.    80655529.   10.0416884    0.0001757   -0.0003493   0.7450134
-10.0527181 C
  0.00001875       1411.    75278494.    9.8902470   0.0001854   -0.0003771   0.7840521
-10.8531157 C
  0.00002000       1411.    70573588.    9.7580814   0.0001952   -0.0004048   0.8229150
-11.6533127 C
  0.00002125       1411.    66422201.    9.6378998   0.0002048   -0.0004327   0.8612671
-12.4557067 C
  0.00002250       1411.    62732078.    9.5311208   0.0002145   -0.0004605   0.8994226
-13.2580686 C
  0.00002375       1411.    59430390.    9.4353500   0.0002241   -0.0004884   0.9373550
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-14.0605901 C						
0.00002500	1411.	56458870.	9.3467336	0.0002337	-0.0005163	0.9748454
-14.8648680 C						
0.00002625	1411.	53770353.	9.2668222	0.0002433	-0.0005442	1.0121650
-15.6689441 C						
0.00002750	1411.	51326246.	9.1944294	0.0002528	-0.0005722	1.0493136
-16.4728175 C						
0.00002875	1411.	49094670.	9.1277548	0.0002624	-0.0006001	1.0861983
-17.2771718 C						
0.00003000	1418.	47270991.	9.0653149	0.0002720	-0.0006280	1.1227303
-18.0826760 C						
0.00003125	1463.	46802623.	9.0080971	0.0002815	-0.0006560	1.1590933
-18.8879744 C						
0.00003250	1507.	46369201.	8.9554998	0.0002911	-0.0006839	1.1952869
-19.6930663 C						
0.00003375	1551.	45966840.	8.9070103	0.0003006	-0.0007119	1.2313108
-20.4979511 C						
0.00003500	1596.	45592208.	8.8621892	0.0003102	-0.0007398	1.2671645
-21.3026279 C						
0.00003625	1640.	45241097.	8.8194954	0.0003197	-0.0007678	1.3026881
-22.1083179 C						
0.00003750	1684.	44911947.	8.7793929	0.0003292	-0.0007958	1.3379794
-22.9142851 C						
0.00003875	1728.	44603134.	8.7420672	0.0003388	-0.0008237	1.3731024
-23.7200394 C						
0.00004000	1773.	44312748.	8.7072586	0.0003483	-0.0008517	1.4080567
-24.5255800 C						
0.00004125	1817.	44039112.	8.6747389	0.0003578	-0.0008797	1.4428419
-25.3309059 C						
0.00004250	1861.	43780743.	8.6443070	0.0003674	-0.0009076	1.4774578
-26.1360165 C						
0.00004375	1905.	43536332.	8.6157844	0.0003769	-0.0009356	1.5119039
-26.9409109 C						
0.00004500	1949.	43304711.	8.5890128	0.0003865	-0.0009635	1.5461799
-27.7455881 C						
0.00004625	1993.	43084841.	8.5638508	0.0003961	-0.0009914	1.5802854
-28.5500475 C						
0.00004750	2037.	42875481.	8.5397884	0.0004056	-0.0010194	1.6141544

-29.3548163 C						
0.00004875	2080.	42675719.	8.5166066	0.0004152	-0.0010473	1.6477641
-30.1600847 C						
0.00005125	2168.	42303361.	8.4740903	0.0004343	-0.0011032	1.7144754
-31.7699457 C						
0.00005375	2256.	41963000.	8.4361112	0.0004534	-0.0011591	1.7805067
-33.3788991 C						
0.00005625	2343.	41650349.	8.4020689	0.0004726	-0.0012149	1.8458550
-34.9869374 C						
0.00005875	2430.	41361854.	8.3714656	0.0004918	-0.0012707	1.9105172
-36.5940528 C						
0.00006125	2517.	41094540.	8.3438844	0.0005111	-0.0013264	1.9744901
-38.2002376 C						
0.00006375	2604.	40845897.	8.3189742	0.0005303	-0.0013822	2.0377706
-39.8054838 C						
0.00006625	2691.	40613794.	8.2964367	0.0005496	-0.0014379	2.1003554
-41.4097832 C						
0.00006875	2777.	40396413.	8.2760173	0.0005690	-0.0014935	2.1622413
-43.0131277 C						
0.00007125	2864.	40192185.	8.2574971	0.0005883	-0.0015492	2.2234251
-44.6155089 C						
0.00007375	2950.	39999604.	8.2403087	0.0006077	-0.0016048	2.2838153
-46.2177270 C						
0.00007625	3036.	39817558.	8.2244210	0.0006271	-0.0016604	2.3434349
-47.8195614 C						
0.00007875	3122.	39645148.	8.2099886	0.0006465	-0.0017160	2.4023496
-49.4203758 C						
0.00008125	3208.	39481469.	8.1968814	0.0006660	-0.0017715	2.4605560
-51.0201604 C						
0.00008375	3294.	39325723.	8.1849847	0.0006855	-0.0018270	2.5180504
-52.6189057 C						
0.00008625	3379.	39177206.	8.1741972	0.0007050	-0.0018825	2.5748292
-54.2166016 C						
0.00008875	3464.	39035292.	8.1644291	0.0007246	-0.0019379	2.6308887
-55.8132379 C						
0.00009125	3550.	38899425.	8.1556004	0.0007442	-0.0019933	2.6862253
-57.4088046 C						
0.00009375	3635.	38769107.	8.1476400	0.0007638	-0.0020487	2.7408352

-59.0032909 C						
0.00009625	3719.	38643891.	8.1404840	0.0007835	-0.0021040	2.7947145
-60.0000000 CY						
0.00009875	3804.	38523370.	8.1340750	0.0008032	-0.0021593	2.8478592
-60.0000000 CY						
0.0001013	3889.	38407194.	8.1283615	0.0008230	-0.0022145	2.9002658
-60.0000000 CY						
0.0001038	3973.	38295030.	8.1232970	0.0008428	-0.0022697	2.9519300
-60.0000000 CY						
0.0001063	4057.	38186579.	8.1188394	0.0008626	-0.0023249	3.0028479
-60.0000000 CY						
0.0001088	4141.	38081574.	8.1149505	0.0008825	-0.0023800	3.0530152
-60.0000000 CY						
0.0001113	4225.	37979767.	8.1115957	0.0009024	-0.0024351	3.1024278
-60.0000000 CY						
0.0001138	4309.	37878056.	8.1085452	0.0009223	-0.0024902	3.1510259
-60.0000000 CY						
0.0001163	4380.	37676511.	8.0987385	0.0009415	-0.0025460	3.1968266
-60.0000000 CY						
0.0001188	4433.	37326790.	8.0784743	0.0009593	-0.0026032	3.2387639
-60.0000000 CY						
0.0001213	4477.	36924786.	8.0544716	0.0009766	-0.0026609	3.2787159
-60.0000000 CY						
0.0001238	4521.	36535090.	8.0314175	0.0009939	-0.0027186	3.3180189
-60.0000000 CY						
0.0001263	4565.	36160109.	8.0094901	0.0010112	-0.0027763	3.3567403
-60.0000000 CY						
0.0001288	4609.	35798982.	7.9886254	0.0010285	-0.0028340	3.3948774
-60.0000000 CY						
0.0001313	4653.	35450912.	7.9687641	0.0010459	-0.0028916	3.4324275
-60.0000000 CY						
0.0001338	4697.	35115157.	7.9498443	0.0010633	-0.0029492	3.4693860
-60.0000000 CY						
0.0001363	4740.	34790423.	7.9309462	0.0010806	-0.0030069	3.5054995
-60.0000000 CY						
0.0001388	4784.	34476734.	7.9129351	0.0010979	-0.0030646	3.5410284
-60.0000000 CY						
0.0001413	4827.	34173500.	7.8957657	0.0011153	-0.0031222	3.5759698

-60.0000000 CY						
0.0001438	4870.	33878746.	7.8792597	0.0011326	-0.0031799	3.6102819
-60.0000000 CY						
0.0001463	4911.	33581544.	7.8623613	0.0011499	-0.0032376	3.6436702
-60.0000000 CY						
0.0001488	4946.	33248326.	7.8417678	0.0011665	-0.0032960	3.6751991
-60.0000000 CY						
0.0001588	5020.	31622549.	7.7274602	0.0012267	-0.0035358	3.7845029
-60.0000000 CY						
0.0001688	5083.	30124340.	7.6208675	0.0012860	-0.0037765	3.8844038
-60.0000000 CY						
0.0001788	5145.	28785544.	7.5238913	0.0013449	-0.0040176	3.9761628
-60.0000000 CY						
0.0001888	5207.	27584857.	7.4389016	0.0014041	-0.0042584	4.0609744
-60.0000000 CY						
0.0001988	5267.	26501340.	7.3641283	0.0014636	-0.0044989	4.1387226
-60.0000000 CY						
0.0002088	5326.	25515460.	7.2947452	0.0015228	-0.0047397	4.2084758
-60.0000000 CY						
0.0002188	5385.	24615779.	7.2324652	0.0015821	-0.0049804	4.2709233
-60.0000000 CY						
0.0002288	5442.	23791524.	7.1771932	0.0016418	-0.0052207	4.3261689
-60.0000000 CY						
0.0002388	5499.	23033135.	7.1280917	0.0017018	-0.0054607	4.3740804
-60.0000000 CY						
0.0002488	5554.	22329546.	7.0838307	0.0017621	-0.0057004	4.4144221
-60.0000000 CY						
0.0002588	5599.	21639078.	7.0354442	0.0018204	-0.0059421	4.4460400
-60.0000000 CY						
0.0002688	5626.	20932990.	6.9747407	0.0018745	-0.0061880	4.4688178
-60.0000000 CY						
0.0002788	5641.	20236448.	6.9098226	0.0019261	-0.0064364	4.4847701
-60.0000000 CY						
0.0002888	5654.	19579830.	6.8486418	0.0019775	-0.0066850	4.4950345
-60.0000000 CY						
0.0002988	5666.	18965899.	6.7925391	0.0020293	-0.0069332	4.4997037
-60.0000000 CY						
0.0003088	5678.	18389744.	6.7403594	0.0020811	-0.0071814	4.4961469

-60.0000000 CY						
0.0003188	5689.	17846313.	6.6888859	0.0021321	-0.0074304	4.4998368
60.0000000 CY						
0.0003288	5699.	17334550.	6.6416364	0.0021834	-0.0076791	4.4954215
60.0000000 CY						
0.0003388	5709.	16851974.	6.5980559	0.0022351	-0.0079274	4.4995653
60.0000000 CY						
0.0003488	5718.	16395879.	6.5579586	0.0022871	-0.0081754	4.4928424
60.0000000 CY						
0.0003588	5727.	15964203.	6.5209646	0.0023394	-0.0084231	4.4983780
60.0000000 CY						
0.0003688	5736.	15555146.	6.4867135	0.0023920	-0.0086705	4.4984635
60.0000000 CY						
0.0003788	5744.	15166508.	6.4552612	0.0024449	-0.0089176	4.4949421
60.0000000 CY						
0.0003888	5752.	14796276.	6.4235325	0.0024971	-0.0091654	4.4990960
60.0000000 CY						
0.0003988	5759.	14443738.	6.3935898	0.0025494	-0.0094131	4.4960838
60.0000000 CY						
0.0004088	5766.	14107618.	6.3659509	0.0026021	-0.0096604	4.4940012
60.0000000 CY						
0.0004188	5773.	13787130.	6.3401394	0.0026549	-0.0099076	4.4984861
60.0000000 CY						
0.0004288	5780.	13481172.	6.3160392	0.0027080	-0.0101545	4.5000000
60.0000000 CY						
0.0004388	5786.	13188314.	6.2939206	0.0027615	-0.0104010	4.4898972
60.0000000 CY						
0.0004488	5793.	12908182.	6.2732129	0.0028151	-0.0106474	4.4958646
60.0000000 CY						
0.0004588	5799.	12639937.	6.2538318	0.0028689	-0.0108936	4.4992218
60.0000000 CY						
0.0004688	5804.	12382712.	6.2357982	0.0029230	-0.0111395	4.4968955
60.0000000 CY						
0.0004788	5810.	12135646.	6.2191971	0.0029774	-0.0113851	4.4886588
60.0000000 CY						
0.0004888	5815.	11898443.	6.2036240	0.0030320	-0.0116305	4.4947466
60.0000000 CYT						
0.0004988	5821.	11670507.	6.1890244	0.0030868	-0.0118757	4.4985346

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60.0000000 CYT
   0.0005088      5826.    11451284.    6.1753487    0.0031417   -0.0121208    4.4999848
60.0000000 CYT
   0.0005188      5831.    11239968.    6.1628696    0.0031970   -0.0123655    4.4890800
60.0000000 CYT
   0.0005288      5836.    11036422.    6.1511887    0.0032524   -0.0126101    4.4895171
60.0000000 CYT
   0.0005388      5840.    10840040.    6.1389330    0.0033074   -0.0128551    4.4949300
60.0000000 CYT
   0.0005488      5845.    10650625.    6.1272684    0.0033623   -0.0131002    4.4984050
60.0000000 CYT
   0.0006088      5869.     9640725.    6.0723554    0.0036965   -0.0145660    4.4982827
60.0000000 CYT
   0.0006688      5869.     8775763.    6.0674024    0.0040576   -0.0160049    4.4972254
60.0000000 CYT
```

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	40.824	5770.421	0.00300000
2	45.360	5812.182	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5770.	26.535600	3751.	38224623.
2	0.65	5812.	29.484000	3778.	38560739.
1	0.70	5770.	28.576800	4039.	37868865.
2	0.70	5812.	31.752000	4069.	38172582.
1	0.75	5770.	30.618000	4328.	37429744.
2	0.75	5812.	34.020000	4359.	37735215.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	136007.
2	10.0000	10.1876	Yes	No	136007.	510529.
3	19.5000	15.0355	Yes	No	646536.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for

peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 13200.0 lbs
Applied moment at pile head = 1161600.0 in-lbs
Axial thrust load on pile head = 45360.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5327	1161600.	13200.	-0.00556	0.00	1.89E+11	0.00	0.00	0.00
0.2000	0.5193	1193885.	13186.	-0.00555	0.00	1.89E+11	-11.9517	55.2312	0.00
0.4000	0.5061	1226099.	13142.	-0.00553	0.00	1.89E+11	-24.4716	116.0595	0.00
0.6000	0.4928	1258170.	13068.	-0.00552	0.00	1.89E+11	-37.4432	182.3555	0.00
0.8000	0.4796	1290024.	12962.	-0.00550	0.00	1.88E+11	-50.7453	253.9502	0.00
1.0000	0.4664	1321584.	12824.	-0.00548	0.00	1.88E+11	-64.2572	330.6550	0.00
1.2000	0.4533	1352772.	12653.	-0.00547	0.00	1.88E+11	-77.8588	412.2588	0.00
1.4000	0.4402	1383510.	12450.	-0.00545	0.00	1.88E+11	-91.5822	499.3516	0.00

1.6000	0.4271	1413718.	12214.	-0.00542	0.00	1.14E+11	-105.2898	591.6381
0.00								
1.8000	0.4141	1443317.	11945.	-0.00537	0.00	4.70E+10	-118.8412	688.7196
0.00								
2.0000	0.4013	1472223.	11644.	-0.00530	0.00	4.67E+10	-132.1463	790.2630
0.00								
2.2000	0.3887	1500359.	11311.	-0.00522	0.00	4.64E+10	-145.1115	895.9822
0.00								
2.4000	0.3763	1527652.	10948.	-0.00514	0.00	4.62E+10	-157.6458	1006.
0.00								
2.6000	0.3640	1554027.	10555.	-0.00506	0.00	4.59E+10	-169.8566	1120.
0.00								
2.8000	0.3520	1579416.	10133.	-0.00498	0.00	4.57E+10	-181.7237	1239.
0.00								
3.0000	0.3401	1603749.	9683.	-0.00490	0.00	4.55E+10	-192.9948	1362.
0.00								
3.2000	0.3285	1626960.	9207.	-0.00481	0.00	4.53E+10	-203.5952	1488.
0.00								
3.4000	0.3170	1648990.	8707.	-0.00472	0.00	4.52E+10	-213.4532	1616.
0.00								
3.6000	0.3058	1669781.	8183.	-0.00464	0.00	4.50E+10	-222.4999	1746.
0.00								
3.8000	0.2948	1689280.	7639.	-0.00455	0.00	4.49E+10	-231.0337	1881.
0.00								
4.0000	0.2840	1707439.	7074.	-0.00446	0.00	4.47E+10	-239.8464	2027.
0.00								
4.2000	0.2734	1724206.	6489.	-0.00436	0.00	4.46E+10	-247.8639	2176.
0.00								
4.4000	0.2630	1739536.	5885.	-0.00427	0.00	4.45E+10	-255.0331	2327.
0.00								
4.6000	0.2529	1753386.	5266.	-0.00418	0.00	4.44E+10	-261.3039	2480.
0.00								
4.8000	0.2430	1765721.	4632.	-0.00408	0.00	4.44E+10	-266.6286	2634.
0.00								
5.0000	0.2333	1776510.	3987.	-0.00398	0.00	4.43E+10	-270.9630	2788.
0.00								
5.2000	0.2238	1785728.	3331.	-0.00389	0.00	4.42E+10	-275.9086	2958.
0.00								

5.4000	0.2146	1793345.	2664.	-0.00379	0.00	4.42E+10	-279.9778	3131.
0.00								
5.6000	0.2056	1799340.	1988.	-0.00369	0.00	4.41E+10	-283.1407	3304.
0.00								
5.8000	0.1969	1803693.	1306.	-0.00360	0.00	4.41E+10	-285.3704	3478.
0.00								
6.0000	0.1884	1806391.	619.5377	-0.00350	0.00	4.41E+10	-286.6427	3652.
0.00								
6.2000	0.1801	1807428.	-68.7573	-0.00340	0.00	4.41E+10	-286.9365	3824.
0.00								
6.4000	0.1721	1806801.	-757.5801	-0.00330	0.00	4.41E+10	-287.0825	4004.
0.00								
6.6000	0.1643	1804510.	-1446.	-0.00320	0.00	4.41E+10	-286.4990	4186.
0.00								
6.8000	0.1567	1800558.	-2132.	-0.00310	0.00	4.41E+10	-284.8846	4363.
0.00								
7.0000	0.1494	1794955.	-2812.	-0.00301	0.00	4.42E+10	-282.2250	4535.
0.00								
7.2000	0.1423	1787715.	-3485.	-0.00291	0.00	4.42E+10	-278.5107	4699.
0.00								
7.4000	0.1354	1778860.	-4148.	-0.00281	0.00	4.43E+10	-273.7378	4852.
0.00								
7.6000	0.1288	1768419.	-4800.	-0.00272	0.00	4.43E+10	-269.7491	5028.
0.00								
7.8000	0.1224	1756413.	-5444.	-0.00262	0.00	4.44E+10	-266.6848	5231.
0.00								
8.0000	0.1162	1742860.	-6079.	-0.00253	0.00	4.45E+10	-262.7544	5428.
0.00								
8.2000	0.1102	1727784.	-6704.	-0.00243	0.00	4.46E+10	-257.9687	5617.
0.00								
8.4000	0.1045	1711212.	-7316.	-0.00234	0.00	4.47E+10	-252.3443	5796.
0.00								
8.6000	0.09899	1693177.	-7914.	-0.00225	0.00	4.48E+10	-245.9048	5962.
0.00								
8.8000	0.09370	1673715.	-8496.	-0.00216	0.00	4.50E+10	-238.6805	6113.
0.00								
9.0000	0.08862	1652868.	-9059.	-0.00207	0.00	4.51E+10	-230.7088	6248.
0.00								

9.2000	0.08376	1630683.	-9602.	-0.00198	0.00	4.53E+10	-222.0342	6362.
0.00								
9.4000	0.07910	1607210.	-10124.	-0.00190	0.00	4.55E+10	-212.7088	6454.
0.00								
9.6000	0.07465	1582503.	-10622.	-0.00181	0.00	4.57E+10	-202.7919	6520.
0.00								
9.8000	0.07039	1556618.	-11097.	-0.00173	0.00	4.59E+10	-192.3502	6558.
0.00								
10.0000	0.06633	1529616.	-11461.	-0.00165	0.00	4.62E+10	-111.4342	4032.
0.00								
10.2000	0.06246	1501964.	-11723.	-0.00157	0.00	4.64E+10	-107.0327	4113.
0.00								
10.4000	0.05878	1473687.	-11975.	-0.00150	0.00	4.67E+10	-102.6968	4193.
0.00								
10.6000	0.05528	1444811.	-12216.	-0.00142	0.00	4.70E+10	-98.4372	4274.
0.00								
10.8000	0.05195	1415359.	-12448.	-0.00135	0.00	4.86E+10	-94.2637	4355.
0.00								
11.0000	0.04880	1385356.	-12669.	-0.00131	0.00	1.88E+11	-90.1767	4435.
0.00								
11.2000	0.04568	1354833.	-12880.	-0.00129	0.00	1.88E+11	-85.9574	4516.
0.00								
11.4000	0.04261	1323812.	-13081.	-0.00127	0.00	1.88E+11	-81.6082	4596.
0.00								
11.6000	0.03958	1292319.	-13272.	-0.00126	0.00	1.88E+11	-77.1314	4677.
0.00								
11.8000	0.03659	1260381.	-13451.	-0.00124	0.00	1.89E+11	-72.5291	4758.
0.00								
12.0000	0.03363	1228022.	-13620.	-0.00122	0.00	1.89E+11	-67.8034	4838.
0.00								
12.2000	0.03072	1195272.	-13777.	-0.00121	0.00	1.89E+11	-62.9561	4919.
0.00								
12.4000	0.02784	1162157.	-13922.	-0.00119	0.00	1.89E+11	-57.9888	5000.
0.00								
12.6000	0.02499	1128707.	-14055.	-0.00118	0.00	1.89E+11	-52.9031	5080.
0.00								
12.8000	0.02218	1094950.	-14176.	-0.00116	0.00	1.89E+11	-47.7002	5161.
0.00								

13.0000	0.01941	1060917.	-14284.	-0.00115	0.00	1.89E+11	-42.3815	5242.
0.00								
13.2000	0.01666	1026639.	-14379.	-0.00114	0.00	1.89E+11	-36.9478	5322.
0.00								
13.4000	0.01395	992146.	-14461.	-0.00112	0.00	1.89E+11	-31.4002	5403.
0.00								
13.6000	0.01127	957471.	-14529.	-0.00111	0.00	1.89E+11	-25.7392	5484.
0.00								
13.8000	0.00861	922647.	-14584.	-0.00110	0.00	1.89E+11	-19.9656	5564.
0.00								
14.0000	0.00599	887706.	-14625.	-0.00109	0.00	1.89E+11	-14.0797	5645.
0.00								
14.2000	0.00339	852683.	-14652.	-0.00108	0.00	1.89E+11	-8.0817	5725.
0.00								
14.4000	8.15E-04	817612.	-14664.	-0.00107	0.00	1.90E+11	-1.9719	5806.
0.00								
14.6000	-0.00173	782528.	-14661.	-0.00106	0.00	1.90E+11	4.2499	5887.
0.00								
14.8000	-0.00426	747468.	-14643.	-0.00105	0.00	1.90E+11	10.5837	5967.
0.00								
15.0000	-0.00676	712468.	-14610.	-0.00104	0.00	1.90E+11	17.0300	6048.
0.00								
15.2000	-0.00924	677565.	-14561.	-0.00103	0.00	1.90E+11	23.5892	6129.
0.00								
15.4000	-0.01170	642798.	-14497.	-0.00102	0.00	1.90E+11	30.2617	6209.
0.00								
15.6000	-0.01414	608203.	-14416.	-0.00101	0.00	1.90E+11	37.0484	6290.
0.00								
15.8000	-0.01656	573821.	-14319.	-0.00101	0.00	1.90E+11	43.9501	6371.
0.00								
16.0000	-0.01896	539691.	-14205.	-9.98E-04	0.00	1.90E+11	50.9678	6451.
0.00								
16.2000	-0.02135	505855.	-14074.	-9.92E-04	0.00	1.90E+11	58.1024	6532.
0.00								
16.4000	-0.02372	472352.	-13926.	-9.85E-04	0.00	1.90E+11	65.3553	6612.
0.00								
16.6000	-0.02608	439225.	-13760.	-9.80E-04	0.00	1.90E+11	72.7276	6693.
0.00								

16.8000	-0.02842	406516.	-13577.	-9.74E-04	0.00	1.90E+11	80.2209	6774.	0.00
17.0000	-0.03076	374269.	-13375.	-9.69E-04	0.00	1.90E+11	87.8366	6854.	0.00
17.2000	-0.03308	342527.	-13155.	-9.65E-04	0.00	1.90E+11	95.5762	6935.	0.00
17.4000	-0.03539	311335.	-12916.	-9.61E-04	0.00	1.90E+11	103.4416	7016.	0.00
17.6000	-0.03769	280739.	-12658.	-9.57E-04	0.00	1.90E+11	111.4343	7096.	0.00
17.8000	-0.03998	250784.	-12381.	-9.54E-04	0.00	1.90E+11	119.5563	7177.	0.00
18.0000	-0.04226	221518.	-12084.	-9.51E-04	0.00	1.90E+11	127.8093	7258.	0.00
18.2000	-0.04454	192987.	-11767.	-9.48E-04	0.00	1.90E+11	136.1955	7338.	0.00
18.4000	-0.04682	165241.	-11430.	-9.46E-04	0.00	1.90E+11	144.7167	7419.	0.00
18.6000	-0.04908	138327.	-11073.	-9.44E-04	0.00	1.90E+11	153.3750	7500.	0.00
18.8000	-0.05135	112298.	-10694.	-9.42E-04	0.00	1.90E+11	162.1725	7580.	0.00
19.0000	-0.05361	87202.	-10294.	-9.41E-04	0.00	1.90E+11	171.1112	7661.	0.00
19.2000	-0.05586	63091.	-9872.	-9.40E-04	0.00	1.90E+11	180.1933	7741.	0.00
19.4000	-0.05812	40019.	-9429.	-9.39E-04	0.00	1.90E+11	189.4209	7822.	0.00
19.6000	-0.06037	18037.	-7429.	-9.39E-04	0.00	1.90E+11	1477.	58706.	0.00
19.8000	-0.06263	4562.	-3800.	-9.39E-04	0.00	1.90E+11	1548.	59305.	0.00
20.0000	-0.06488	0.00	0.00	-9.39E-04	0.00	1.90E+11	1619.	29952.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual

stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.53267298 inches
Computed slope at pile head = -0.00556141 radians
Maximum bending moment = 1807428. inch-lbs
Maximum shear force = -14664. lbs
Depth of maximum bending moment = 6.20000000 feet below pile head
Depth of maximum shear force = 14.40000000 feet below pile head
Number of iterations = 325
Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 18480.0 lbs
Applied moment at pile head = 1626240.0 in-lbs
Axial thrust load on pile head = 40824.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0554	1626240.	18480.	-0.01070	0.00	4.42E+10	0.00	0.00	0.00
0.2000	1.0298	1671636.	18462.	-0.01061	0.00	4.42E+10	-15.1118	35.2180	0.00

0.4000	1.0045	1716937.	18407.	-0.01052	0.00	4.36E+10	-30.9263	73.8936	0.00
0.6000	0.9793	1762049.	18313.	-0.01042	0.00	4.33E+10	-47.3014	115.9200	0.00
0.8000	0.9544	1806880.	18179.	-0.01032	0.00	4.31E+10	-64.0978	161.1805	0.00
1.0000	0.9298	1851332.	18005.	-0.01022	0.00	4.29E+10	-81.1792	209.5474	0.00
1.2000	0.9054	1895306.	17789.	-0.01012	0.00	4.27E+10	-98.4122	260.8797	0.00
1.4000	0.8812	1938703.	17532.	-0.01001	0.00	4.25E+10	-115.6382	314.9464	0.00
1.6000	0.8573	1981423.	17234.	-0.00990	0.00	4.23E+10	-132.7628	371.6624	0.00
1.8000	0.8337	2023367.	16895.	-0.00978	0.00	4.21E+10	-149.6852	430.9080	0.00
2.0000	0.8103	2064438.	16516.	-0.00967	0.00	4.19E+10	-166.2984	492.5245	0.00
2.2000	0.7873	2104539.	16098.	-0.00955	0.00	4.18E+10	-182.4998	556.3399	0.00
2.4000	0.7645	2143577.	15641.	-0.00943	0.00	4.16E+10	-198.1907	622.1672	0.00
2.6000	0.7420	2181462.	15147.	-0.00930	0.00	4.15E+10	-213.4732	690.4383	0.00
2.8000	0.7199	2218104.	14617.	-0.00917	0.00	4.14E+10	-228.3232	761.2106	0.00
3.0000	0.6980	2253419.	14052.	-0.00904	0.00	4.12E+10	-242.4840	833.7410	0.00
3.2000	0.6765	2287325.	13454.	-0.00891	0.00	4.11E+10	-255.8782	907.8180	0.00
3.4000	0.6552	2319743.	12824.	-0.00878	0.00	4.10E+10	-268.4319	983.2079	0.00
3.6000	0.6343	2350602.	12166.	-0.00864	0.00	4.09E+10	-280.0742	1060.	0.00
3.8000	0.6138	2379834.	11481.	-0.00850	0.00	4.08E+10	-291.2005	1139.	0.00
4.0000	0.5935	2407375.	10768.	-0.00836	0.00	4.08E+10	-302.8314	1225.	0.00

4.2000	0.5736	2433158.	10028.	-0.00822	0.00	4.07E+10	-313.6170	1312.
0.00								
4.4000	0.5541	2457120.	9264.	-0.00807	0.00	4.06E+10	-323.5042	1401.
0.00								
4.6000	0.5349	2479205.	8476.	-0.00793	0.00	4.06E+10	-332.4421	1492.
0.00								
4.8000	0.5160	2499361.	7669.	-0.00778	0.00	4.05E+10	-340.3821	1583.
0.00								
5.0000	0.4975	2517541.	6844.	-0.00763	0.00	4.05E+10	-347.2763	1675.
0.00								
5.2000	0.4794	2533707.	6001.	-0.00748	0.00	4.04E+10	-354.7067	1776.
0.00								
5.4000	0.4616	2547814.	5143.	-0.00733	0.00	4.04E+10	-361.1003	1877.
0.00								
5.6000	0.4442	2559827.	4270.	-0.00718	0.00	4.04E+10	-366.4139	1980.
0.00								
5.8000	0.4272	2569715.	3385.	-0.00703	0.00	4.03E+10	-370.6074	2082.
0.00								
6.0000	0.4105	2577452.	2492.	-0.00687	0.00	4.03E+10	-373.6432	2185.
0.00								
6.2000	0.3942	2583023.	1593.	-0.00672	0.00	4.03E+10	-375.4869	2286.
0.00								
6.4000	0.3782	2586416.	688.8589	-0.00657	0.00	4.03E+10	-377.9905	2398.
0.00								
6.6000	0.3627	2587616.	-220.6516	-0.00641	0.00	4.03E+10	-379.9350	2514.
0.00								
6.8000	0.3475	2586613.	-1133.	-0.00626	0.00	4.03E+10	-380.6617	2629.
0.00								
7.0000	0.3326	2583402.	-2046.	-0.00610	0.00	4.03E+10	-380.1325	2743.
0.00								
7.2000	0.3182	2577986.	-2956.	-0.00595	0.00	4.03E+10	-378.3126	2854.
0.00								
7.4000	0.3041	2570377.	-3861.	-0.00580	0.00	4.03E+10	-375.1715	2961.
0.00								
7.6000	0.2904	2560591.	-4759.	-0.00564	0.00	4.04E+10	-373.2310	3085.
0.00								
7.8000	0.2770	2548641.	-5654.	-0.00549	0.00	4.04E+10	-372.6650	3229.
0.00								

8.0000	0.2640	2534529.	-6546.	-0.00534	0.00	4.04E+10	-370.9646	3372.
0.00								
8.2000	0.2514	2518266.	-7433.	-0.00519	0.00	4.05E+10	-368.1068	3515.
0.00								
8.4000	0.2391	2499867.	-8312.	-0.00504	0.00	4.05E+10	-364.0741	3655.
0.00								
8.6000	0.2272	2479358.	-9179.	-0.00489	0.00	4.06E+10	-358.8550	3791.
0.00								
8.8000	0.2156	2456767.	-10033.	-0.00475	0.00	4.06E+10	-352.4448	3923.
0.00								
9.0000	0.2044	2432131.	-10869.	-0.00460	0.00	4.07E+10	-344.8462	4050.
0.00								
9.2000	0.1935	2405495.	-11687.	-0.00446	0.00	4.08E+10	-336.0700	4169.
0.00								
9.4000	0.1830	2376910.	-12481.	-0.00432	0.00	4.09E+10	-326.1364	4278.
0.00								
9.6000	0.1727	2346432.	-13251.	-0.00418	0.00	4.09E+10	-315.0753	4377.
0.00								
9.8000	0.1629	2314126.	-13992.	-0.00405	0.00	4.10E+10	-302.9275	4464.
0.00								
10.0000	0.1533	2280062.	-14665.	-0.00391	0.00	4.12E+10	-257.5874	4032.
0.00								
10.2000	0.1441	2244501.	-15270.	-0.00378	0.00	4.13E+10	-246.9237	4113.
0.00								
10.4000	0.1352	2207505.	-15850.	-0.00365	0.00	4.14E+10	-236.1872	4193.
0.00								
10.6000	0.1266	2169137.	-16404.	-0.00352	0.00	4.15E+10	-225.3985	4274.
0.00								
10.8000	0.1183	2129457.	-16932.	-0.00340	0.00	4.17E+10	-214.5771	4355.
0.00								
11.0000	0.1102	2088530.	-17434.	-0.00328	0.00	4.18E+10	-203.7414	4435.
0.00								
11.2000	0.1025	2046417.	-17910.	-0.00316	0.00	4.20E+10	-192.9084	4516.
0.00								
11.4000	0.09508	2003182.	-18360.	-0.00305	0.00	4.22E+10	-182.0937	4596.
0.00								
11.6000	0.08791	1958886.	-18784.	-0.00293	0.00	4.24E+10	-171.3120	4677.
0.00								

11.8000	0.08100	1913593.	-19182.	-0.00282	0.00	4.26E+10	-160.5763	4758.
0.00								
12.0000	0.07435	1867365.	-19555.	-0.00272	0.00	4.28E+10	-149.8985	4838.
0.00								
12.2000	0.06796	1820263.	-19902.	-0.00261	0.00	4.30E+10	-139.2892	4919.
0.00								
12.4000	0.06181	1772348.	-20223.	-0.00251	0.00	4.33E+10	-128.7578	5000.
0.00								
12.6000	0.05589	1723682.	-20520.	-0.00242	0.00	4.36E+10	-118.3122	5080.
0.00								
12.8000	0.05020	1674326.	-20791.	-0.00232	0.00	4.39E+10	-107.9592	5161.
0.00								
13.0000	0.04474	1624339.	-21038.	-0.00223	0.00	4.42E+10	-97.7040	5242.
0.00								
13.2000	0.03948	1573780.	-21261.	-0.00215	0.00	4.45E+10	-87.5509	5322.
0.00								
13.4000	0.03443	1522709.	-21459.	-0.00206	0.00	4.49E+10	-77.5027	5403.
0.00								
13.6000	0.02957	1471183.	-21633.	-0.00199	0.00	4.54E+10	-67.5609	5484.
0.00								
13.8000	0.02490	1419261.	-21783.	-0.00191	0.00	4.66E+10	-57.7257	5564.
0.00								
14.0000	0.02040	1366998.	-21910.	-0.00186	0.00	1.88E+11	-47.9893	5645.
0.00								
14.2000	0.01595	1314458.	-22013.	-0.00185	0.00	1.88E+11	-38.0506	5725.
0.00								
14.4000	0.01154	1261697.	-22092.	-0.00183	0.00	1.89E+11	-27.9098	5806.
0.00								
14.6000	0.00716	1208774.	-22147.	-0.00182	0.00	1.89E+11	-17.5669	5887.
0.00								
14.8000	0.00282	1155748.	-22176.	-0.00180	0.00	1.89E+11	-7.0219	5967.
0.00								
15.0000	-0.00148	1102680.	-22180.	-0.00179	0.00	1.89E+11	3.7259	6048.
0.00								
15.2000	-0.00575	1049632.	-22158.	-0.00177	0.00	1.89E+11	14.6769	6129.
0.00								
15.4000	-0.00998	996667.	-22110.	-0.00176	0.00	1.89E+11	25.8320	6209.
0.00								

15.6000	-0.01419	943850.	-22034.	-0.00175	0.00	1.89E+11	37.1924	6290.
0.00								
15.8000	-0.01837	891246.	-21931.	-0.00174	0.00	1.89E+11	48.7592	6371.
0.00								
16.0000	-0.02252	838922.	-21800.	-0.00172	0.00	1.89E+11	60.5338	6451.
0.00								
16.2000	-0.02665	786945.	-21640.	-0.00171	0.00	1.90E+11	72.5181	6532.
0.00								
16.4000	-0.03075	735385.	-21451.	-0.00170	0.00	1.90E+11	84.7136	6612.
0.00								
16.6000	-0.03483	684312.	-21233.	-0.00170	0.00	1.90E+11	97.1226	6693.
0.00								
16.8000	-0.03888	633798.	-20985.	-0.00169	0.00	1.90E+11	109.7470	6774.
0.00								
17.0000	-0.04292	583915.	-20706.	-0.00168	0.00	1.90E+11	122.5893	6854.
0.00								
17.2000	-0.04694	534737.	-20396.	-0.00167	0.00	1.90E+11	135.6519	6935.
0.00								
17.4000	-0.05095	486340.	-20055.	-0.00167	0.00	1.90E+11	148.9373	7016.
0.00								
17.6000	-0.05494	438801.	-19681.	-0.00166	0.00	1.90E+11	162.4484	7096.
0.00								
17.8000	-0.05892	392196.	-19275.	-0.00165	0.00	1.90E+11	176.1879	7177.
0.00								
18.0000	-0.06288	346606.	-18835.	-0.00165	0.00	1.90E+11	190.1588	7258.
0.00								
18.2000	-0.06684	302111.	-18362.	-0.00165	0.00	1.90E+11	204.3641	7338.
0.00								
18.4000	-0.07078	258793.	-17854.	-0.00164	0.00	1.91E+11	218.8069	7419.
0.00								
18.6000	-0.07472	216734.	-17311.	-0.00164	0.00	1.91E+11	233.4905	7500.
0.00								
18.8000	-0.07865	176020.	-16733.	-0.00164	0.00	1.91E+11	248.4179	7580.
0.00								
19.0000	-0.08258	136737.	-16118.	-0.00163	0.00	1.91E+11	263.5926	7661.
0.00								
19.2000	-0.08650	98972.	-15467.	-0.00163	0.00	1.91E+11	279.0178	7741.
0.00								

19.4000	-0.09042	62814.	-14779.	-0.00163	0.00	1.91E+11	294.6968	7822.	0.00
19.6000	-0.09434	28354.	-11656.	-0.00163	0.00	1.91E+11	2308.	58706.	0.00
19.8000	-0.09825	7185.	-5974.	-0.00163	0.00	1.91E+11	2428.	59305.	0.00
20.0000	-0.1022	0.00	0.00	-0.00163	0.00	1.91E+11	2550.	29952.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 1.05539902 inches
Computed slope at pile head = -0.01070202 radians
Maximum bending moment = 2587616. inch-lbs
Maximum shear force = -22180. lbs
Depth of maximum bending moment = 6.60000000 feet below pile head
Depth of maximum shear force = 15.00000000 feet below pile head
Number of iterations = 202
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

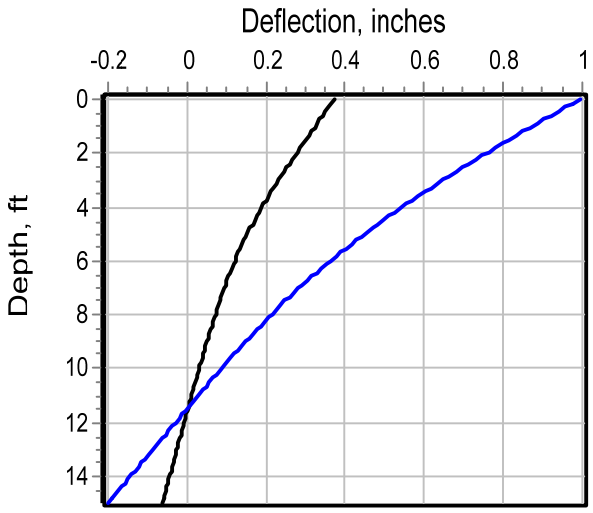
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	13200.	M, in-lb	1161600.	45360.	0.5327	-0.00556	-14664.	1807428.
2	V, lb	18480.	M, in-lb	1626240.	40824.	1.0554	-0.01070	-22180.	2587616.

Maximum pile-head deflection = 1.0553990192 inches
Maximum pile-head rotation = -0.0107020224 radians = -0.613181 deg.

The analysis ended normally.

NB1A_P28-P34


Deflection, inches
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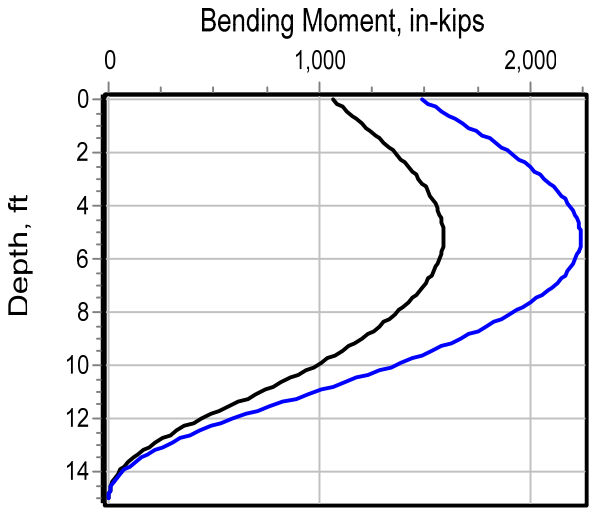
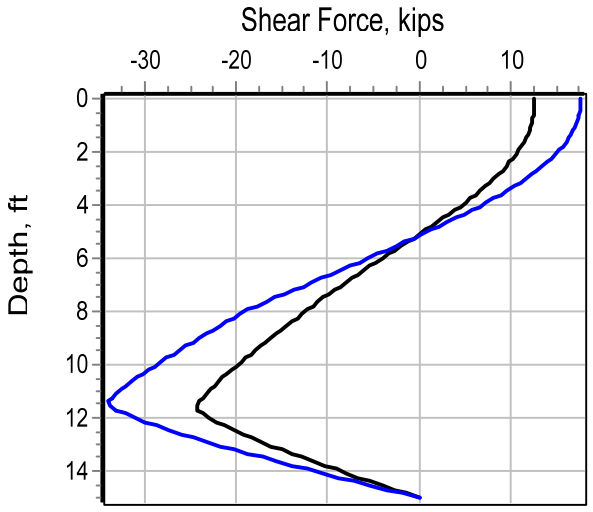
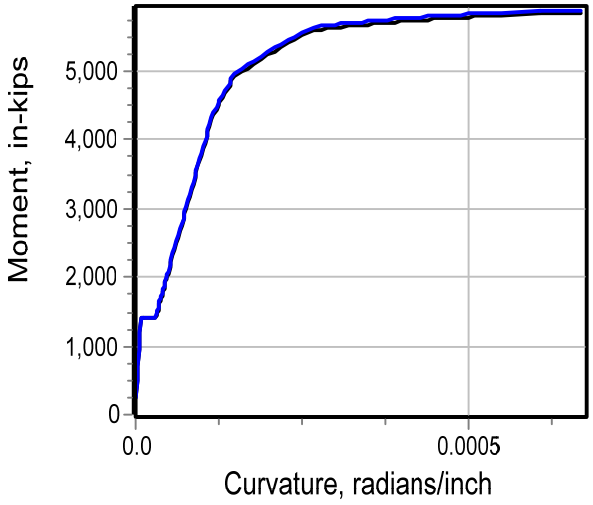
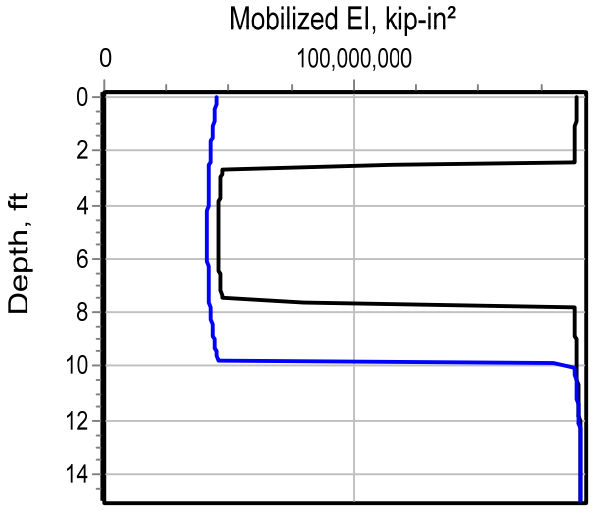
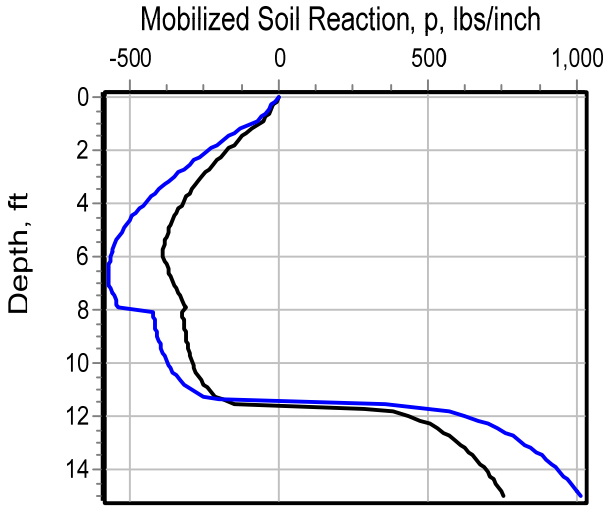
0
0.2
0.4
0.6
0.8
1
Depth, ft
0
2
4
6
8
10
12
14


Bending Moment, in-kips
0
1,000
2,000
Depth, ft
0
2
4
6
8
10
12
14


Shear Force, kips
-30
-20
-10
0
10
Depth, ft
0
2
4
6
8
10
12
14


Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch


Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
2
4
6
8
10
12
14


Mobilized Soil Reaction, p, lbs/inch
-500
0
500
1,000
Depth, ft
0
2
4
6
8
10
12
14

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is being used by:

Yuru ZImmerman
GF CLM

Serial Number of Security Device: 139693993

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Files Used for Analysis

Path to file locations:
\\gfcmh01s\Projects\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2018\Noise Wall\updated\LPILE\New\

Name of input data file:
SUM-8_NB1A_P28-P34.lp10

Name of output report file:
SUM-8_NB1A_P28-P34.lp10

Name of plot output file:
SUM-8_NB1A_P28-P34.lp10

Name of runtime message file:
SUM-8_NB1A_P28-P34.lp10

Date and Time of Analysis

Date: March 6, 2019 Time: 11:11:54

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1A_P28-P34

Program Options and Settings

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed = 500
 - Deflection tolerance for convergence = 1.0000E-05 in
 - Maximum allowable deflection = 100.0000 in
 - Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 15.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	15.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	15.000000 ft
Shaft Diameter	=	30.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	26.600 degrees
	=	0.464 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	1.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Friction angle at top of layer	=	30.000000 deg.
Friction angle at bottom of layer	=	30.000000 deg.
Subgrade k at top of layer	=	42.500000 pci
Subgrade k at bottom of layer	=	42.500000 pci

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	1.000000 ft
Distance from top of pile to bottom of layer	=	8.000000 ft
Effective unit weight at top of layer	=	122.500000 pcf
Effective unit weight at bottom of layer	=	122.500000 pcf
Friction angle at top of layer	=	36.500000 deg.
Friction angle at bottom of layer	=	36.500000 deg.
Subgrade k at top of layer	=	44.000000 pci
Subgrade k at bottom of layer	=	44.000000 pci

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer	=	8.000000 ft
Distance from top of pile to bottom of layer	=	18.000000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf
Undrained cohesion at top of layer	=	1450. psf
Undrained cohesion at bottom of layer	=	1450. psf
Epsilon-50 at top of layer	=	0.008700
Epsilon-50 at bottom of layer	=	0.008700

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	18.000000 ft
Distance from top of pile to bottom of layer	=	24.000000 ft
Effective unit weight at top of layer	=	137.500000 pcf
Effective unit weight at bottom of layer	=	137.500000 pcf
Friction angle at top of layer	=	37.500000 deg.
Friction angle at bottom of layer	=	37.500000 deg.
Subgrade k at top of layer	=	99.000000 pci
Subgrade k at bottom of layer	=	99.000000 pci

(Depth of the lowest soil layer extends 9.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Angle of Friction deg.	E50 or krm	kpy pci
1	Sand	0.00	120.0000	--	30.0000	--	42.5000
	(Reese, et al.)	1.0000	120.0000	--	30.0000	--	42.5000
2	Sand	1.0000	122.5000	--	36.5000	--	44.0000
	(Reese, et al.)	8.0000	122.5000	--	36.5000	--	44.0000
3	Stiff Clay	8.0000	125.0000	1450.	--	0.00870	--
	w/o Free Water	18.0000	125.0000	1450.	--	0.00870	--
4	Sand	18.0000	137.5000	--	37.5000	--	99.0000
	(Reese, et al.)	24.0000	137.5000	--	37.5000	--	99.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 12600. lbs	M = 1058400. in-lbs	45360.	No
2	1	V = 17640. lbs	M = 1481760. in-lbs	40824.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	15.000000 ft
Shaft Diameter	=	30.000000 in
Concrete Cover Thickness	=	3.000000 in
Number of Reinforcing Bars	=	10 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	706.858347 sq. in.
Total Area of Reinforcing Steel	=	7.900000 sq. in.
Area Ratio of Steel Reinforcement	=	1.12 percent
Edge-to-Edge Bar Spacing	=	6.107391 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.14
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3147.516 kips
Tensile Load for Cracking of Concrete	=	-334.148 kips
Nominal Axial Tensile Capacity	=	-474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete	=	4500. psi
Modulus of Elasticity of Concrete	=	3823676. psi
Modulus of Rupture of Concrete	=	-503.115295 psi
Compression Strain at Peak Stress	=	0.002001
Tensile Strain at Fracture of Concrete	=	-0.0001152

Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	40.824
2	45.360

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 40.824 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.2486787	190598943.	24.7251292	0.00003091	-0.00000659	0.1371264	0.8908484	
0.00000250	475.6992735	190279709.	19.8789171	0.00004970	-0.00002530	0.2191386	1.4303465	
0.00000375	711.7886161	189810298.	18.2643996	0.00006849	-0.00004401	0.3003872	1.9699410	
0.00000500	946.4795782	189295916.	17.4573649	0.00008729	-0.00006271	0.3808621	2.5095679	
0.00000625	1180.	188762769.	16.9732497	0.0001061	-0.00008142	0.4605613	3.0492140	
0.00000750	1412.	188220079.	16.6505741	0.0001249	-0.0001001	0.5394841	3.5888749	
0.00000875	1412.	161331497.	11.6819932	0.0001022	-0.0001603	0.4424685	-4.6101317	C
0.00001000	1412.	141165059.	11.2453845	0.0001125	-0.0001875	0.4852795	-5.3953385	C
0.00001125	1412.	125480053.	10.8909714	0.0001225	-0.0002150	0.5271584	-6.1853830	C
0.00001250	1412.	112932048.	10.5988418	0.0001325	-0.0002425	0.5683657	-6.9785448	C
0.00001375	1412.	102665498.	10.3538698	0.0001424	-0.0002701	0.6090157	-7.7740819	C
0.00001500	1412.	94110040.	10.1434363	0.0001522	-0.0002978	0.6490617	-8.5723552	C
0.00001625	1412.	86870806.	9.9627610	0.0001619	-0.0003256	0.6887246	-9.3718614	C
0.00001750	1412.	80665748.	9.8055080	0.0001716	-0.0003534	0.7280101	-10.1725797	C
0.00001875	1412.	75288032.	9.6667087	0.0001813	-0.0003812	0.7668989	-10.9746646	C
0.00002000	1412.	70582530.	9.5438648	0.0001909	-0.0004091	0.8054726	-11.7775583	C
0.00002125	1412.	66430616.	9.4352720	0.0002005	-0.0004370	0.8438286	-12.5805761	C
0.00002250	1412.	62740026.	9.3359770	0.0002101	-0.0004649	0.8817333	-13.3854000	C
0.00002375	1412.	59437920.	9.2474242	0.0002196	-0.0004929	0.9194681	-14.1900240	C
0.00002500	1412.	56466024.	9.1680033	0.0002292	-0.0005208	0.9570326	-14.9944475	C
0.00002625	1412.	53777166.	9.0943664	0.0002387	-0.0005488	0.9942136	-15.8002260	C
0.00002750	1412.	51332749.	9.0270548	0.0002482	-0.0005768	1.0311584	-16.6062987	C
0.00002875	1412.	49100890.	8.9658404	0.0002578	-0.0006047	1.0679351	-17.4121680	C
0.00003000	1412.	47055020.	8.9099619	0.0002673	-0.0006327	1.1045432	-18.2178330	C
0.00003125	1429.	45733647.	8.8587799	0.0002768	-0.0006607	1.1409826	-19.0232931	C
0.00003250	1474.	45340362.	8.8102466	0.0002863	-0.0006887	1.1770635	-19.8299675	C
0.00003375	1518.	44974816.	8.7652021	0.0002958	-0.0007167	1.2129358	-20.6367458	C
0.00003500	1562.	44634398.	8.7235817	0.0003053	-0.0007447	1.2486410	-21.4433145	C
0.00003625	1606.	44316506.	8.6850318	0.0003148	-0.0007727	1.2841789	-22.2496727	C
0.00003750	1651.	44018883.	8.6492461	0.0003243	-0.0008007	1.3195490	-23.0558197	C
0.00003875	1695.	43739566.	8.6159579	0.0003339	-0.0008286	1.3547511	-23.8617547	C
0.00004000	1739.	43476836.	8.5849337	0.0003434	-0.0008566	1.3897847	-24.6674768	C

0.00004125	1783.	43229180.	8.5559684	0.0003529	-0.0008846	1.4246495	-25.4729852 C
0.00004250	1827.	42994577.	8.5280629	0.0003624	-0.0009126	1.4592165	-26.2792874 C
0.00004375	1871.	42772406.	8.5017074	0.0003719	-0.0009406	1.4935810	-27.0856461 C
0.00004500	1915.	42561807.	8.4769849	0.0003815	-0.0009685	1.5277780	-27.8917845 C
0.00004625	1959.	42361842.	8.4537638	0.0003910	-0.0009965	1.5618072	-28.6977017 C
0.00004750	2003.	42171666.	8.4319261	0.0004005	-0.0010245	1.5956681	-29.5033966 C
0.00004875	2047.	41990525.	8.4113661	0.0004101	-0.0010524	1.6293604	-30.3088686 C
0.00005125	2135.	41652692.	8.3737075	0.0004292	-0.0011083	1.6962376	-31.9191395 C
0.00005375	2222.	41343653.	8.3401316	0.0004483	-0.0011642	1.7624360	-33.5285072 C
0.00005625	2310.	41059549.	8.3100987	0.0004674	-0.0012201	1.8279523	-35.1369639 C
0.00005875	2397.	40797179.	8.2831608	0.0004866	-0.0012759	1.8927836	-36.7445021 C
0.00006125	2484.	40553865.	8.2589434	0.0005059	-0.0013316	1.9569268	-38.3511140 C
0.00006375	2571.	40327105.	8.2366157	0.0005251	-0.0013874	2.0202689	-39.9577441 C
0.00006625	2658.	40115110.	8.2161477	0.0005443	-0.0014432	2.0828504	-41.5640385 C
0.00006875	2744.	39916407.	8.1976590	0.0005636	-0.0014989	2.1447419	-43.1693546 C
0.00007125	2831.	39729580.	8.1809455	0.0005829	-0.0015546	2.2059400	-44.7736837 C
0.00007375	2917.	39553406.	8.1658308	0.0006022	-0.0016103	2.2664414	-46.3770167 C
0.00007625	3003.	39386821.	8.1521619	0.0006216	-0.0016659	2.3262426	-47.9793443 C
0.00007875	3089.	39228897.	8.1398051	0.0006410	-0.0017215	2.3853404	-49.5806573 C
0.00008125	3175.	39078820.	8.1286434	0.0006605	-0.0017770	2.4437310	-51.1809462 C
0.00008375	3261.	38935871.	8.1185738	0.0006799	-0.0018326	2.5014110	-52.7802012 C
0.00008625	3346.	38799417.	8.1095051	0.0006994	-0.0018881	2.5583769	-54.3784125 C
0.00008875	3432.	38668894.	8.1013568	0.0007190	-0.0019435	2.6146249	-55.9755702 C
0.00009125	3517.	38543800.	8.0940570	0.0007386	-0.0019989	2.6701514	-57.5716639 C
0.00009375	3602.	38423683.	8.0875416	0.0007582	-0.0020543	2.7249524	-59.1666857 C
0.00009625	3687.	38308150.	8.0817534	0.0007779	-0.0021096	2.7790246	-60.0000000 CY
0.00009875	3772.	38196835.	8.0766408	0.0007976	-0.0021649	2.8323639	-60.0000000 CY
0.0001013	3857.	38089411.	8.0721575	0.0008173	-0.0022202	2.8849664	-60.0000000 CY
0.0001038	3941.	37985582.	8.0682617	0.0008371	-0.0022754	2.9368280	-60.0000000 CY
0.0001063	4025.	37885083.	8.0649157	0.0008569	-0.0023306	2.9879449	-60.0000000 CY
0.0001088	4109.	37787670.	8.0620852	0.0008768	-0.0023857	3.0383129	-60.0000000 CY
0.0001113	4193.	37693121.	8.0597391	0.0008966	-0.0024409	3.0879278	-60.0000000 CY
0.0001138	4277.	37596879.	8.0575490	0.0009165	-0.0024960	3.1367009	-60.0000000 CY
0.0001163	4345.	37374367.	8.0467294	0.0009354	-0.0025521	3.1821493	-60.0000000 CY
0.0001188	4396.	37018313.	8.0264679	0.0009531	-0.0026094	3.2240134	-60.0000000 CY
0.0001213	4440.	36621943.	8.0033268	0.0009704	-0.0026671	3.2641400	-60.0000000 CY
0.0001238	4485.	36238758.	7.9811803	0.0009877	-0.0027248	3.3036427	-60.0000000 CY
0.0001263	4529.	35870033.	7.9601232	0.0010050	-0.0027825	3.3425649	-60.0000000 CY
0.0001288	4573.	35514567.	7.9396133	0.0010222	-0.0028403	3.3807653	-60.0000000 CY
0.0001313	4616.	35171614.	7.9196253	0.0010395	-0.0028980	3.4182496	-60.0000000 CY
0.0001338	4660.	34840813.	7.9005934	0.0010567	-0.0029558	3.4551560	-60.0000000 CY
0.0001363	4704.	34521491.	7.8824666	0.0010740	-0.0030135	3.4914819	-60.0000000 CY
0.0001388	4747.	34213022.	7.8651978	0.0010913	-0.0030712	3.5272244	-60.0000000 CY
0.0001413	4790.	33914826.	7.8487430	0.0011086	-0.0031289	3.5623810	-60.0000000 CY
0.0001438	4833.	33624090.	7.8328452	0.0011260	-0.0031865	3.5968860	-60.0000000 CY
0.0001463	4873.	33321900.	7.8156705	0.0011430	-0.0032445	3.6302177	-60.0000000 CY
0.0001488	4906.	32981296.	7.7945452	0.0011594	-0.0033031	3.6616155	-60.0000000 CY
0.0001588	4979.	31363625.	7.6819009	0.0012195	-0.0035430	3.7714707	-60.0000000 CY
0.0001688	5042.	29878885.	7.5751268	0.0012783	-0.0037842	3.8714941	-60.0000000 CY
0.0001788	5104.	28554630.	7.4803781	0.0013371	-0.0040254	3.9641571	-60.0000000 CY
0.0001888	5166.	27366960.	7.3973680	0.0013963	-0.0042662	4.0498902	-60.0000000 CY
0.0001988	5226.	26293847.	7.3227087	0.0014554	-0.0045071	4.1281536	-60.0000000 CY
0.0002088	5285.	25317965.	7.2540807	0.0015143	-0.0047482	4.1986756	-60.0000000 CY
0.0002188	5344.	24428037.	7.1933035	0.0015735	-0.0049890	4.2621460	-60.0000000 CY
0.0002288	5401.	23612706.	7.1393893	0.0016331	-0.0052294	4.3184392	-60.0000000 CY
0.0002388	5458.	22862512.	7.0915180	0.0016931	-0.0054694	4.3674240	-60.0000000 CY
0.0002488	5513.	22164152.	7.0477642	0.0017531	-0.0057094	4.4087661	-60.0000000 CY
0.0002588	5556.	21473522.	6.9966994	0.0018104	-0.0059521	4.4409886	-60.0000000 CY
0.0002688	5581.	20768234.	6.9357227	0.0018640	-0.0061985	4.4647676	-60.0000000 CY
0.0002788	5596.	20075757.	6.8713656	0.0019154	-0.0064471	4.4818355	-60.0000000 CY
0.0002888	5609.	19425159.	6.8112604	0.0019668	-0.0066957	4.4932905	-60.0000000 CY
0.0002988	5622.	18816852.	6.7561511	0.0020184	-0.0069441	4.4991741	-60.0000000 CY
0.0003088	5633.	18244015.	6.7017031	0.0020692	-0.0071933	4.4944157	-60.0000000 CY
0.0003188	5644.	17705563.	6.6511520	0.0021201	-0.0074424	4.4993484	60.0000000 CY
0.0003288	5654.	17198602.	6.6046889	0.0021713	-0.0076912	4.4935127	60.0000000 CY
0.0003388	5664.	16720404.	6.5619223	0.0022229	-0.0079396	4.4988557	60.0000000 CY
0.0003488	5674.	16268592.	6.5224901	0.0022747	-0.0081878	4.4953244	60.0000000 CY

0.0003588	5683.	15840784.	6.4862252	0.0023269	-0.0084356	4.4971390	60.0000000 CY
0.0003688	5692.	15435449.	6.4526161	0.0023794	-0.0086831	4.4999192	60.0000000 CY
0.0003788	5700.	15049167.	6.4188495	0.0024311	-0.0089314	4.4926484	60.0000000 CY
0.0003888	5708.	14682016.	6.3872417	0.0024830	-0.0091795	4.4979728	60.0000000 CY
0.0003988	5715.	14332752.	6.3578067	0.0025352	-0.0094273	4.4999835	60.0000000 CY
0.0004088	5722.	13999629.	6.3307382	0.0025877	-0.0096748	4.4914044	60.0000000 CY
0.0004188	5729.	13681951.	6.3055016	0.0026404	-0.0099221	4.4970528	60.0000000 CY
0.0004288	5736.	13378676.	6.2819404	0.0026934	-0.0101691	4.4997555	60.0000000 CY
0.0004388	5743.	13088544.	6.2601849	0.0027467	-0.0104158	4.4917370	60.0000000 CY
0.0004488	5749.	12810828.	6.2399856	0.0028002	-0.0106623	4.4935812	60.0000000 CY
0.0004588	5755.	12544898.	6.2210829	0.0028539	-0.0109086	4.4980794	60.0000000 CY
0.0004688	5761.	12289993.	6.2034033	0.0029078	-0.0111547	4.4999463	60.0000000 CY
0.0004788	5767.	12045107.	6.1871766	0.0029621	-0.0114004	4.4895500	60.0000000 CY
0.0004888	5772.	11809915.	6.1720363	0.0030166	-0.0116459	4.4921058	60.0000000 CYT
0.0004988	5777.	11583912.	6.1578456	0.0030712	-0.0118913	4.4970004	60.0000000 CYT
0.0005088	5783.	11366418.	6.1438665	0.0031257	-0.0121368	4.4995642	60.0000000 CYT
0.0005188	5788.	11156774.	6.1299908	0.0031799	-0.0123826	4.4954784	60.0000000 CYT
0.0005288	5792.	10954676.	6.1171984	0.0032345	-0.0126280	4.4852518	60.0000000 CYT
0.0005388	5797.	10759918.	6.1051665	0.0032892	-0.0128733	4.4918112	60.0000000 CYT
0.0005488	5801.	10572096.	6.0938601	0.0033440	-0.0131185	4.4964746	60.0000000 CYT
0.0006088	5826.	9570762.	6.0406274	0.0036772	-0.0145853	4.4961660	60.0000000 CYT
0.0006688	5826.	8712077.	6.0366791	0.0040370	-0.0160255	4.4944557	60.0000000 CYT

Axial Thrust Force = 45.360 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.1126319	190490106.	25.8075831	0.00003226	-0.00000524	0.1431176	0.9300874	
0.00000250	475.5346003	190213840.	20.4215080	0.00005105	-0.00002395	0.2250882	1.4696843	
0.00000375	711.6171469	189764572.	18.6273263	0.00006985	-0.00004265	0.3062995	2.0094092	
0.00000500	946.3048362	189260967.	17.7305240	0.00008865	-0.00006135	0.3867382	2.5491760	
0.00000625	1180.	188734451.	17.1925730	0.0001075	-0.00008005	0.4664014	3.0889664	
0.00000750	1411.	188196235.	16.8340198	0.0001263	-0.00009874	0.5452882	3.6287743	
0.00000875	1411.	161311059.	12.0631340	0.0001056	-0.0001569	0.4567016	-4.5134172	C
0.00001000	1411.	141147176.	11.5937720	0.0001159	-0.0001841	0.5000687	-5.2943061	C
0.00001125	1411.	125464157.	11.2134821	0.0001262	-0.0002113	0.5424793	-6.0801640	C
0.00001250	1411.	112917741.	10.8985764	0.0001362	-0.0002388	0.5841039	-6.8698910	C
0.00001375	1411.	102652492.	10.6340414	0.0001462	-0.0002663	0.6251133	-7.6623635	C
0.00001500	1411.	94098117.	10.4072547	0.0001561	-0.0002939	0.6655119	-8.4575942	C
0.00001625	1411.	86859801.	10.2112423	0.0001659	-0.0003216	0.7054225	-9.2547645	C
0.00001750	1411.	80655529.	10.0416884	0.0001757	-0.0003493	0.7450134	-10.0527181	C
0.00001875	1411.	75278494.	9.8902470	0.0001854	-0.0003771	0.7840521	-10.8531157	C
0.00002000	1411.	70573588.	9.7580814	0.0001952	-0.0004048	0.8229150	-11.6533127	C
0.00002125	1411.	66422201.	9.6378998	0.0002048	-0.0004327	0.8612671	-12.4557067	C
0.00002250	1411.	62732078.	9.5311208	0.0002145	-0.0004605	0.8994226	-13.2580686	C
0.00002375	1411.	59430390.	9.4353500	0.0002241	-0.0004884	0.9373550	-14.0605901	C
0.00002500	1411.	56458870.	9.3467336	0.0002337	-0.0005163	0.9748454	-14.8648680	C
0.00002625	1411.	53770353.	9.2668222	0.0002433	-0.0005442	1.0121650	-15.6689441	C
0.00002750	1411.	51326246.	9.1944294	0.0002528	-0.0005722	1.0493136	-16.4728175	C
0.00002875	1411.	49094670.	9.1277548	0.0002624	-0.0006001	1.0861983	-17.2771718	C
0.00003000	1418.	47270991.	9.0653149	0.0002720	-0.0006280	1.1227303	-18.0826760	C
0.00003125	1463.	46802623.	9.0080971	0.0002815	-0.0006560	1.1590933	-18.8879744	C
0.00003250	1507.	46369201.	8.9554998	0.0002911	-0.0006839	1.1952869	-19.6930663	C
0.00003375	1551.	45966840.	8.9070103	0.0003006	-0.0007119	1.2313108	-20.4979511	C
0.00003500	1596.	45592208.	8.8621892	0.0003102	-0.0007398	1.2671645	-21.3026279	C
0.00003625	1640.	45241097.	8.8194954	0.0003197	-0.0007678	1.3026881	-22.1083179	C
0.00003750	1684.	44911947.	8.7793929	0.0003292	-0.0007958	1.3379794	-22.9142851	C
0.00003875	1728.	44603134.	8.7420672	0.0003388	-0.0008237	1.3731024	-23.7200394	C
0.00004000	1773.	44312748.	8.7072586	0.0003483	-0.0008517	1.4080567	-24.5255800	C
0.00004125	1817.	44039112.	8.6747389	0.0003578	-0.0008797	1.4428419	-25.3309059	C
0.00004250	1861.	43780743.	8.6443070	0.0003674	-0.0009076	1.4774578	-26.1360165	C
0.00004375	1905.	43536332.	8.6157844	0.0003769	-0.0009356	1.5119039	-26.9409109	C
0.00004500	1949.	43304711.	8.5890128	0.0003865	-0.0009635	1.5461799	-27.7455881	C
0.00004625	1993.	43084841.	8.5638508	0.0003961	-0.0009914	1.5802854	-28.5500475	C

0.00004750	2037.	42875481.	8.5397884	0.0004056	-0.0010194	1.6141544	-29.3548163 C
0.00004875	2080.	42675719.	8.5166066	0.0004152	-0.0010473	1.6477641	-30.1600847 C
0.00005125	2168.	42303361.	8.4740903	0.0004343	-0.0011032	1.7144754	-31.7699457 C
0.00005375	2256.	41963000.	8.4361112	0.0004534	-0.0011591	1.7805067	-33.3788991 C
0.00005625	2343.	41650349.	8.4020689	0.0004726	-0.0012149	1.8458550	-34.9869374 C
0.00005875	2430.	41361854.	8.3714656	0.0004918	-0.0012707	1.9105172	-36.5940528 C
0.00006125	2517.	41094540.	8.3438844	0.0005111	-0.0013264	1.9744901	-38.2002376 C
0.00006375	2604.	40845897.	8.3189742	0.0005303	-0.0013822	2.0377706	-39.8054838 C
0.00006625	2691.	40613794.	8.2964367	0.0005496	-0.0014379	2.1003554	-41.4097832 C
0.00006875	2777.	40396413.	8.2760173	0.0005690	-0.0014935	2.1622413	-43.0131277 C
0.00007125	2864.	40192185.	8.2574971	0.0005883	-0.0015492	2.2234251	-44.6155089 C
0.00007375	2950.	39999604.	8.2403087	0.0006077	-0.0016048	2.2838153	-46.2177270 C
0.00007625	3036.	39817558.	8.2244210	0.0006271	-0.0016604	2.3434349	-47.8195614 C
0.00007875	3122.	39645148.	8.2099886	0.0006465	-0.0017160	2.4023496	-49.4203758 C
0.00008125	3208.	39481469.	8.1968814	0.0006660	-0.0017715	2.4605560	-51.0201604 C
0.00008375	3294.	39325723.	8.1849847	0.0006855	-0.0018270	2.5180504	-52.6189057 C
0.00008625	3379.	39177206.	8.1741972	0.0007050	-0.0018825	2.5748292	-54.2166016 C
0.00008875	3464.	39035292.	8.1644291	0.0007246	-0.0019379	2.6308887	-55.8132379 C
0.00009125	3550.	38899425.	8.1556004	0.0007442	-0.0019933	2.6862253	-57.4088046 C
0.00009375	3635.	38769107.	8.1476400	0.0007638	-0.0020487	2.7408352	-59.0032909 C
0.00009625	3719.	38643891.	8.1404840	0.0007835	-0.0021040	2.7947145	-60.0000000 CY
0.00009875	3804.	38523370.	8.1340750	0.0008032	-0.0021593	2.8478592	-60.0000000 CY
0.0001013	3889.	38407194.	8.1283615	0.0008230	-0.0022145	2.9002658	-60.0000000 CY
0.0001038	3973.	38295030.	8.1232970	0.0008428	-0.0022697	2.9519300	-60.0000000 CY
0.0001063	4057.	38186579.	8.1188394	0.0008626	-0.0023249	3.0028479	-60.0000000 CY
0.0001088	4141.	38081574.	8.1149505	0.0008825	-0.0023800	3.0530152	-60.0000000 CY
0.0001113	4225.	37979767.	8.1115957	0.0009024	-0.0024351	3.1024278	-60.0000000 CY
0.0001138	4309.	37878056.	8.1085452	0.0009223	-0.0024902	3.1510259	-60.0000000 CY
0.0001163	4380.	37676511.	8.0987385	0.0009415	-0.0025460	3.1968266	-60.0000000 CY
0.0001188	4433.	37326790.	8.0784743	0.0009593	-0.0026032	3.2387639	-60.0000000 CY
0.0001213	4477.	36924786.	8.0544716	0.0009766	-0.0026609	3.2787159	-60.0000000 CY
0.0001238	4521.	36535090.	8.0314175	0.0009939	-0.0027186	3.3180189	-60.0000000 CY
0.0001263	4565.	36160109.	8.0094901	0.0010112	-0.0027763	3.3567403	-60.0000000 CY
0.0001288	4609.	35798982.	7.9886254	0.0010285	-0.0028340	3.3948774	-60.0000000 CY
0.0001313	4653.	35450912.	7.9687641	0.0010459	-0.0028916	3.4324275	-60.0000000 CY
0.0001338	4697.	35115157.	7.9498443	0.0010633	-0.0029492	3.4693860	-60.0000000 CY
0.0001363	4740.	34790423.	7.9309462	0.0010806	-0.0030069	3.5054995	-60.0000000 CY
0.0001388	4784.	34476734.	7.9129351	0.0010979	-0.0030646	3.5410284	-60.0000000 CY
0.0001413	4827.	34173500.	7.8957657	0.0011153	-0.0031222	3.5759698	-60.0000000 CY
0.0001438	4870.	33878746.	7.8792597	0.0011326	-0.0031799	3.6102819	-60.0000000 CY
0.0001463	4911.	33581544.	7.8623613	0.0011499	-0.0032376	3.6436702	-60.0000000 CY
0.0001488	4946.	33248326.	7.8417678	0.0011665	-0.0032960	3.6751991	-60.0000000 CY
0.0001588	5020.	31622549.	7.7274602	0.0012267	-0.0035358	3.7845029	-60.0000000 CY
0.0001688	5083.	30124340.	7.6208675	0.0012860	-0.0037765	3.8844038	-60.0000000 CY
0.0001788	5145.	28785544.	7.5238913	0.0013449	-0.0040176	3.9761628	-60.0000000 CY
0.0001888	5207.	27584857.	7.4389016	0.0014041	-0.0042584	4.0609744	-60.0000000 CY
0.0001988	5267.	26501340.	7.3641283	0.0014636	-0.0044989	4.1387226	-60.0000000 CY
0.0002088	5326.	25515460.	7.2947452	0.0015228	-0.0047397	4.2084758	-60.0000000 CY
0.0002188	5385.	24615779.	7.2324652	0.0015821	-0.0049804	4.2709233	-60.0000000 CY
0.0002288	5442.	23791524.	7.1771932	0.0016418	-0.0052207	4.3261689	-60.0000000 CY
0.0002388	5499.	23033135.	7.1280917	0.0017018	-0.0054607	4.3740804	-60.0000000 CY
0.0002488	5554.	22329546.	7.0838307	0.0017621	-0.0057004	4.4144221	-60.0000000 CY
0.0002588	5599.	21639078.	7.0354442	0.0018204	-0.0059421	4.4460400	-60.0000000 CY
0.0002688	5626.	20932990.	6.9747407	0.0018745	-0.0061880	4.4688178	-60.0000000 CY
0.0002788	5641.	20236448.	6.9098226	0.0019261	-0.0064364	4.4847701	-60.0000000 CY
0.0002888	5654.	19579830.	6.8486418	0.0019775	-0.0066850	4.4950345	-60.0000000 CY
0.0002988	5666.	18965899.	6.7925391	0.0020293	-0.0069332	4.4997037	-60.0000000 CY
0.0003088	5678.	18389744.	6.7403594	0.0020811	-0.0071814	4.4961469	-60.0000000 CY
0.0003188	5689.	17846313.	6.6888859	0.0021321	-0.0074304	4.4998368	60.0000000 CY
0.0003288	5699.	17334550.	6.6416364	0.0021834	-0.0076791	4.4954215	60.0000000 CY
0.0003388	5709.	16851974.	6.5980559	0.0022351	-0.0079274	4.4995653	60.0000000 CY
0.0003488	5718.	16395879.	6.5579586	0.0022871	-0.0081754	4.4928424	60.0000000 CY
0.0003588	5727.	15964203.	6.5209646	0.0023394	-0.0084231	4.4983780	60.0000000 CY
0.0003688	5736.	15555146.	6.4867135	0.0023920	-0.0086705	4.4984635	60.0000000 CY
0.0003788	5744.	15166508.	6.4552612	0.0024449	-0.0089176	4.4949421	60.0000000 CY
0.0003888	5752.	14796276.	6.4235325	0.0024971	-0.0091654	4.4990960	60.0000000 CY
0.0003988	5759.	14443738.	6.3935898	0.0025494	-0.0094131	4.4960838	60.0000000 CY

0.0004088	5766.	14107618.	6.3659509	0.0026021	-0.0096604	4.4940012	60.0000000 CY
0.0004188	5773.	13787130.	6.3401394	0.0026549	-0.0099076	4.4984861	60.0000000 CY
0.0004288	5780.	13481172.	6.3160392	0.0027080	-0.0101545	4.5000000	60.0000000 CY
0.0004388	5786.	13188314.	6.2939206	0.0027615	-0.0104010	4.4898972	60.0000000 CY
0.0004488	5793.	12908182.	6.2732129	0.0028151	-0.0106474	4.4958646	60.0000000 CY
0.0004588	5799.	12639937.	6.2538318	0.0028689	-0.0108936	4.4992218	60.0000000 CY
0.0004688	5804.	12382712.	6.2357982	0.0029230	-0.0111395	4.4968955	60.0000000 CY
0.0004788	5810.	12135646.	6.2191971	0.0029774	-0.0113851	4.4886588	60.0000000 CY
0.0004888	5815.	11898443.	6.2036240	0.0030320	-0.0116305	4.4947466	60.0000000 CYT
0.0004988	5821.	11670507.	6.1890244	0.0030868	-0.0118757	4.4985346	60.0000000 CYT
0.0005088	5826.	11451284.	6.1753487	0.0031417	-0.0121208	4.4999848	60.0000000 CYT
0.0005188	5831.	11239968.	6.1628696	0.0031970	-0.0123655	4.4890800	60.0000000 CYT
0.0005288	5836.	11036422.	6.1511887	0.0032524	-0.0126101	4.4895171	60.0000000 CYT
0.0005388	5840.	10840040.	6.1389330	0.0033074	-0.0128551	4.4949300	60.0000000 CYT
0.0005488	5845.	10650625.	6.1272684	0.0033623	-0.0131002	4.4984050	60.0000000 CYT
0.0006088	5869.	9640725.	6.0723554	0.0036965	-0.0145660	4.4982827	60.0000000 CYT
0.0006688	5869.	8775763.	6.0674024	0.0040576	-0.0160049	4.4972254	60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	40.824	5770.421	0.00300000
2	45.360	5812.182	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5770.	26.535600	3751.	38224623.
2	0.65	5812.	29.484000	3778.	38560739.
1	0.70	5770.	28.576800	4039.	37868865.
2	0.70	5812.	31.752000	4069.	38172582.
1	0.75	5770.	30.618000	4328.	37429744.
2	0.75	5812.	34.020000	4359.	37735215.

Layering Correction Equivalent Depths of Soil & Rock Layers

Top of Layer	Equivalent Top Depth	Same Layer	Layer is	F0	F1

Layer No.	Below Pile Head ft	Below Grnd Surf ft	Type As Layer Above	Rock or is Below Rock Layer	Integral for Layer lbs	Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	1257.
2	1.0000	0.8404	Yes	No	1257.	137773.
3	8.0000	8.9712	No	No	139030.	166269.
4	18.0000	18.0000	No	No	305299.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 12600.0 lbs
Applied moment at pile head = 1058400.0 in-lbs
Axial thrust load on pile head = 45360.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3730	1058400.	12600.	-0.00403	0.00	1.89E+11	0.00	0.00	0.00
0.1500	0.3657	1081409.	12593.	-0.00402	0.00	1.89E+11	-8.1129	39.9285	0.00
0.3000	0.3585	1104390.	12571.	-0.00401	0.00	1.89E+11	-16.5144	82.9155	0.00
0.4500	0.3513	1127317.	12533.	-0.00400	0.00	1.89E+11	-25.1560	128.8941	0.00
0.6000	0.3441	1150162.	12480.	-0.00399	0.00	1.89E+11	-33.9893	177.7914	0.00
0.7500	0.3369	1172895.	12411.	-0.00398	0.00	1.89E+11	-42.9662	229.5279	0.00
0.9000	0.3298	1195489.	12325.	-0.00396	0.00	1.89E+11	-52.0384	284.0164	0.00
1.0500	0.3227	1217913.	12207.	-0.00395	0.00	1.89E+11	-78.5794	438.3440	0.00
1.2000	0.3156	1240081.	12053.	-0.00394	0.00	1.89E+11	-92.8310	529.5040	0.00
1.3500	0.3085	1261948.	11873.	-0.00393	0.00	1.89E+11	-107.1170	625.0214	0.00
1.5000	0.3014	1283467.	11667.	-0.00392	0.00	1.88E+11	-121.5477	725.8411	0.00
1.6500	0.2944	1304591.	11436.	-0.00391	0.00	1.88E+11	-136.0647	831.9632	0.00
1.8000	0.2874	1325273.	11178.	-0.00389	0.00	1.88E+11	-150.4960	942.6757	0.00
1.9500	0.2804	1345466.	10894.	-0.00388	0.00	1.88E+11	-164.7766	1058.	0.00
2.1000	0.2734	1365125.	10585.	-0.00387	0.00	1.88E+11	-178.8426	1177.	0.00
2.2500	0.2665	1384202.	10250.	-0.00385	0.00	1.88E+11	-192.6307	1301.	0.00
2.4000	0.2595	1402655.	9892.	-0.00384	0.00	1.88E+11	-206.0788	1429.	0.00
2.5500	0.2526	1420439.	9509.	-0.00382	0.00	1.16E+11	-219.1258	1561.	0.00
2.7000	0.2458	1437511.	9103.	-0.00378	0.00	4.71E+10	-231.8344	1698.	0.00
2.8500	0.2390	1453828.	8674.	-0.00373	0.00	4.69E+10	-244.4149	1841.	0.00
3.0000	0.2323	1469348.	8224.	-0.00367	0.00	4.67E+10	-256.5239	1987.	0.00
3.1500	0.2258	1484032.	7751.	-0.00362	0.00	4.66E+10	-268.1145	2137.	0.00
3.3000	0.2193	1497843.	7259.	-0.00356	0.00	4.65E+10	-279.1413	2291.	0.00
3.4500	0.2130	1510745.	6747.	-0.00350	0.00	4.63E+10	-289.5604	2447.	0.00
3.6000	0.2067	1522704.	6217.	-0.00344	0.00	4.62E+10	-299.3295	2606.	0.00
3.7500	0.2006	1533688.	5670.	-0.00338	0.00	4.61E+10	-308.4082	2768.	0.00
3.9000	0.1946	1543668.	5107.	-0.00332	0.00	4.60E+10	-316.7573	2931.	0.00
4.0500	0.1886	1552616.	4529.	-0.00326	0.00	4.60E+10	-325.7951	3109.	0.00
4.2000	0.1828	1560505.	3935.	-0.00320	0.00	4.59E+10	-334.2810	3291.	0.00
4.3500	0.1771	1567305.	3326.	-0.00314	0.00	4.58E+10	-342.0882	3477.	0.00
4.5000	0.1715	1572992.	2704.	-0.00308	0.00	4.58E+10	-349.1862	3664.	0.00
4.6500	0.1660	1577542.	2070.	-0.00301	0.00	4.57E+10	-355.5459	3854.	0.00
4.8000	0.1607	1580935.	1425.	-0.00295	0.00	4.57E+10	-361.1397	4046.	0.00
4.9500	0.1554	1583154.	770.4743	-0.00289	0.00	4.57E+10	-365.9419	4238.	0.00

5.1000	0.1503	1584181.	108.1914	-0.00283	0.00	4.57E+10	-369.9280	4431.	0.00
5.2500	0.1452	1584005.	-561.5031	-0.00276	0.00	4.57E+10	-374.1770	4637.	0.00
5.4000	0.1403	1582611.	-1239.	-0.00270	0.00	4.57E+10	-378.4212	4854.	0.00
5.5500	0.1355	1579986.	-1923.	-0.00264	0.00	4.57E+10	-381.9489	5073.	0.00
5.7000	0.1308	1576119.	-2613.	-0.00258	0.00	4.58E+10	-384.7448	5294.	0.00
5.8500	0.1262	1571000.	-3308.	-0.00252	0.00	4.58E+10	-386.7952	5516.	0.00
6.0000	0.1218	1564622.	-4003.	-0.00245	0.00	4.59E+10	-385.7231	5702.	0.00
6.1500	0.1174	1556990.	-4693.	-0.00239	0.00	4.59E+10	-381.1987	5845.	0.00
6.3000	0.1131	1548118.	-5375.	-0.00233	0.00	4.60E+10	-376.3486	5988.	0.00
6.4500	0.1090	1538022.	-6048.	-0.00227	0.00	4.61E+10	-371.1963	6130.	0.00
6.6000	0.1050	1526717.	-6711.	-0.00221	0.00	4.62E+10	-365.7643	6273.	0.00
6.7500	0.1010	1514223.	-7364.	-0.00215	0.00	4.63E+10	-360.0747	6415.	0.00
6.9000	0.09721	1500558.	-8007.	-0.00209	0.00	4.64E+10	-354.1488	6558.	0.00
7.0500	0.09349	1485740.	-8639.	-0.00204	0.00	4.66E+10	-348.0072	6700.	0.00
7.2000	0.08988	1469791.	-9260.	-0.00198	0.00	4.67E+10	-341.6695	6843.	0.00
7.3500	0.08636	1452729.	-9869.	-0.00192	0.00	4.69E+10	-335.1548	6985.	0.00
7.5000	0.08295	1434577.	-10466.	-0.00187	0.00	4.71E+10	-328.4810	7128.	0.00
7.6500	0.07964	1415356.	-11051.	-0.00182	0.00	7.94E+10	-321.6653	7271.	0.00
7.8000	0.07638	1395091.	-11624.	-0.00180	0.00	1.88E+11	-314.5624	7413.	0.00
7.9500	0.07315	1373805.	-12183.	-0.00179	0.00	1.88E+11	-307.0446	7556.	0.00
8.1000	0.06994	1351523.	-12749.	-0.00178	0.00	1.88E+11	-321.2641	8268.	0.00
8.2500	0.06675	1328200.	-13326.	-0.00176	0.00	1.88E+11	-319.9876	8628.	0.00
8.4000	0.06359	1303838.	-13901.	-0.00175	0.00	1.88E+11	-318.5446	9017.	0.00
8.5500	0.06045	1278444.	-14472.	-0.00174	0.00	1.88E+11	-316.9229	9437.	0.00
8.7000	0.05733	1252021.	-15041.	-0.00173	0.00	1.89E+11	-315.1088	9893.	0.00
8.8500	0.05424	1224577.	-15607.	-0.00171	0.00	1.89E+11	-313.0868	10391.	0.00
9.0000	0.05116	1196117.	-16168.	-0.00170	0.00	1.89E+11	-310.8388	10936.	0.00
9.1500	0.04811	1166650.	-16725.	-0.00169	0.00	1.89E+11	-308.3439	11537.	0.00
9.3000	0.04507	1136182.	-17278.	-0.00168	0.00	1.89E+11	-305.5777	12204.	0.00
9.4500	0.04206	1104723.	-17825.	-0.00167	0.00	1.89E+11	-302.5117	12947.	0.00
9.6000	0.03906	1072284.	-18367.	-0.00166	0.00	1.89E+11	-299.1116	13784.	0.00
9.7500	0.03608	1038874.	-18902.	-0.00165	0.00	1.89E+11	-295.3361	14733.	0.00
9.9000	0.03312	1004507.	-19430.	-0.00164	0.00	1.89E+11	-291.1348	15822.	0.00
10.0500	0.03018	969196.	-19949.	-0.00163	0.00	1.89E+11	-286.4450	17085.	0.00
10.2000	0.02725	932956.	-20460.	-0.00162	0.00	1.89E+11	-281.1874	18572.	0.00
10.3500	0.02434	895804.	-20961.	-0.00161	0.00	1.89E+11	-275.2589	20354.	0.00
10.5000	0.02145	857759.	-21450.	-0.00160	0.00	1.89E+11	-268.5223	22536.	0.00
10.6500	0.01857	818844.	-21927.	-0.00160	0.00	1.89E+11	-260.7883	25283.	0.00
10.8000	0.01570	779083.	-22388.	-0.00159	0.00	1.90E+11	-251.7835	28867.	0.00
10.9500	0.01285	738506.	-22832.	-0.00158	0.00	1.90E+11	-241.0895	33779.	0.00
11.1000	0.01001	697148.	-23254.	-0.00157	0.00	1.90E+11	-228.0105	41015.	0.00
11.2500	0.00718	655049.	-23649.	-0.00157	0.00	1.90E+11	-211.2371	52972.	0.00
11.4000	0.00436	612266.	-24008.	-0.00156	0.00	1.90E+11	-187.7243	77492.	0.00
11.5500	0.00155	568875.	-24309.	-0.00156	0.00	1.90E+11	-145.9834	169145.	0.00
11.7000	-0.00124	525010.	-24184.	-0.00155	0.00	1.90E+11	284.0518	411086.	0.00
11.8500	-0.00403	482064.	-23586.	-0.00155	0.00	1.90E+11	381.1361	170146.	0.00
12.0000	-0.00681	440354.	-22852.	-0.00154	0.00	1.90E+11	434.5269	114816.	0.00
12.1500	-0.00958	400051.	-22035.	-0.00154	0.00	1.90E+11	473.2488	88874.	0.00
12.3000	-0.01235	361280.	-21155.	-0.00153	0.00	1.90E+11	504.2142	73485.	0.00
12.4500	-0.01511	324144.	-20224.	-0.00153	0.00	1.90E+11	530.2865	63170.	0.00
12.6000	-0.01786	288725.	-19249.	-0.00153	0.00	1.90E+11	552.9544	55715.	0.00
12.7500	-0.02061	255097.	-18235.	-0.00153	0.00	1.90E+11	573.1003	50043.	0.00
12.9000	-0.02336	223326.	-17188.	-0.00152	0.00	1.90E+11	591.2935	45565.	0.00
13.0500	-0.02610	193471.	-16108.	-0.00152	0.00	1.90E+11	607.9252	41926.	0.00
13.2000	-0.02884	165585.	-15000.	-0.00152	0.00	1.90E+11	623.2762	38904.	0.00
13.3500	-0.03157	139719.	-13865.	-0.00152	0.00	1.90E+11	637.5559	36348.	0.00
13.5000	-0.03431	115918.	-12706.	-0.00152	0.00	1.90E+11	650.9246	34154.	0.00
13.6500	-0.03704	94226.	-11523.	-0.00152	0.00	1.90E+11	663.5080	32248.	0.00
13.8000	-0.03976	74683.	-10318.	-0.00152	0.00	1.90E+11	675.4069	30573.	0.00
13.9500	-0.04249	57329.	-9092.	-0.00152	0.00	1.90E+11	686.7031	29089.	0.00
14.1000	-0.04522	42200.	-7846.	-0.00151	0.00	1.90E+11	697.4640	27763.	0.00
14.2500	-0.04795	29331.	-6581.	-0.00151	0.00	1.90E+11	707.7461	26571.	0.00
14.4000	-0.05067	18754.	-5299.	-0.00151	0.00	1.90E+11	717.5969	25491.	0.00
14.5500	-0.05340	10503.	-3998.	-0.00151	0.00	1.90E+11	727.0568	24509.	0.00
14.7000	-0.05612	4607.	-2682.	-0.00151	0.00	1.90E+11	736.1607	23611.	0.00
14.8500	-0.05885	1097.	-1349.	-0.00151	0.00	1.90E+11	744.9385	22786.	0.00
15.0000	-0.06157	0.00	0.00	-0.00151	0.00	1.90E+11	753.4166	11013.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.37297678 inches
Computed slope at pile head      =    -0.00402920 radians
Maximum bending moment           =       1584181. inch-lbs
Maximum shear force              =        -24309. lbs
Depth of maximum bending moment  =     5.10000000 feet below pile head
Depth of maximum shear force     =    11.55000000 feet below pile head
Number of iterations             =             81
Number of zero deflection points =              1
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

```
Shear force at pile head                          =      17640.0 lbs
Applied moment at pile head                       =    1481760.0 in-lbs
Axial thrust load on pile head                    =      40824.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.9954	1481760.	17640.	-0.01033	0.00	4.53E+10	0.00	0.00	0.00
0.1500	0.9768	1514269.	17630.	-0.01027	0.00	4.53E+10	-10.9899	20.2507	0.00
0.3000	0.9584	1546738.	17600.	-0.01021	0.00	4.48E+10	-22.3822	42.0361	0.00
0.4500	0.9401	1579130.	17549.	-0.01015	0.00	4.45E+10	-34.1176	65.3250	0.00
0.6000	0.9219	1611406.	17477.	-0.01008	0.00	4.43E+10	-46.1372	90.0835	0.00
0.7500	0.9038	1643528.	17383.	-0.01001	0.00	4.41E+10	-58.3834	116.2755	0.00
0.9000	0.8858	1675456.	17267.	-0.00995	0.00	4.39E+10	-70.7991	143.8624	0.00
1.0500	0.8680	1707150.	17107.	-0.00988	0.00	4.37E+10	-106.6578	221.1815	0.00
1.2000	0.8503	1738493.	16897.	-0.00981	0.00	4.35E+10	-126.1979	267.1555	0.00
1.3500	0.8327	1769422.	16653.	-0.00973	0.00	4.33E+10	-145.8803	315.3446	0.00
1.5000	0.8152	1799873.	16372.	-0.00966	0.00	4.31E+10	-165.6131	365.6648	0.00
1.6500	0.7979	1829781.	16056.	-0.00958	0.00	4.30E+10	-185.3265	418.0723	0.00
1.8000	0.7807	1859084.	15705.	-0.00951	0.00	4.28E+10	-204.9473	472.5084	0.00
1.9500	0.7637	1887717.	15319.	-0.00943	0.00	4.27E+10	-224.4007	528.9022	0.00
2.1000	0.7468	1915616.	14897.	-0.00935	0.00	4.26E+10	-243.6143	587.1791	0.00
2.2500	0.7300	1942721.	14442.	-0.00926	0.00	4.24E+10	-262.5177	647.2600	0.00
2.4000	0.7134	1968969.	13953.	-0.00918	0.00	4.23E+10	-281.0428	709.0606	0.00
2.5500	0.6970	1994300.	13431.	-0.00910	0.00	4.22E+10	-299.1235	772.4911	0.00
2.7000	0.6807	2018656.	12876.	-0.00901	0.00	4.21E+10	-316.8165	837.7745	0.00
2.8500	0.6646	2041979.	12290.	-0.00892	0.00	4.20E+10	-334.3161	905.5254	0.00
3.0000	0.6486	2064212.	11673.	-0.00884	0.00	4.19E+10	-351.2660	974.8871	0.00
3.1500	0.6327	2085301.	11026.	-0.00875	0.00	4.18E+10	-367.6119	1046.	0.00
3.3000	0.6171	2105192.	10350.	-0.00866	0.00	4.18E+10	-383.3012	1118.	0.00
3.4500	0.6016	2123835.	9647.	-0.00857	0.00	4.17E+10	-398.2832	1192.	0.00
3.6000	0.5862	2141180.	8917.	-0.00847	0.00	4.16E+10	-412.5087	1267.	0.00
3.7500	0.5711	2157182.	8163.	-0.00838	0.00	4.16E+10	-425.9302	1343.	0.00
3.9000	0.5561	2171798.	7385.	-0.00829	0.00	4.15E+10	-438.5015	1419.	0.00
4.0500	0.5412	2184985.	6583.	-0.00819	0.00	4.15E+10	-452.2192	1504.	0.00
4.2000	0.5266	2196700.	5757.	-0.00810	0.00	4.14E+10	-465.3539	1591.	0.00
4.3500	0.5121	2206901.	4908.	-0.00800	0.00	4.14E+10	-477.7354	1679.	0.00

4.5000	0.4978	2215547.	4038.	-0.00791	0.00	4.14E+10	-489.3261	1769.	0.00
4.6500	0.4836	2222600.	3148.	-0.00781	0.00	4.13E+10	-500.0336	1861.	0.00
4.8000	0.4696	2228026.	2239.	-0.00771	0.00	4.13E+10	-509.7839	1954.	0.00
4.9500	0.4559	2231793.	1313.	-0.00762	0.00	4.13E+10	-518.5338	2047.	0.00
5.1000	0.4422	2233873.	373.0079	-0.00752	0.00	4.13E+10	-526.2415	2142.	0.00
5.2500	0.4288	2234241.	-581.2460	-0.00742	0.00	4.13E+10	-534.0406	2242.	0.00
5.4000	0.4155	2232871.	-1549.	-0.00732	0.00	4.13E+10	-541.6408	2346.	0.00
5.5500	0.4024	2229739.	-2530.	-0.00723	0.00	4.13E+10	-548.2710	2452.	0.00
5.7000	0.3895	2224824.	-3522.	-0.00713	0.00	4.13E+10	-553.8999	2560.	0.00
5.8500	0.3768	2218107.	-4523.	-0.00703	0.00	4.14E+10	-558.4975	2668.	0.00
6.0000	0.3642	2209573.	-5532.	-0.00694	0.00	4.14E+10	-562.0353	2778.	0.00
6.1500	0.3518	2199212.	-6546.	-0.00684	0.00	4.14E+10	-564.4857	2888.	0.00
6.3000	0.3396	2187014.	-7563.	-0.00674	0.00	4.15E+10	-565.8230	2999.	0.00
6.4500	0.3275	2172976.	-8582.	-0.00665	0.00	4.15E+10	-566.7145	3115.	0.00
6.6000	0.3156	2157095.	-9604.	-0.00656	0.00	4.16E+10	-568.3422	3241.	0.00
6.7500	0.3039	2139366.	-10627.	-0.00646	0.00	4.16E+10	-568.8078	3369.	0.00
6.9000	0.2924	2119787.	-11650.	-0.00637	0.00	4.17E+10	-568.0771	3498.	0.00
7.0500	0.2810	2098360.	-12671.	-0.00628	0.00	4.18E+10	-566.1172	3627.	0.00
7.2000	0.2697	2075093.	-13687.	-0.00619	0.00	4.19E+10	-562.8966	3756.	0.00
7.3500	0.2587	2049996.	-14697.	-0.00610	0.00	4.20E+10	-558.3857	3885.	0.00
7.5000	0.2478	2023083.	-15696.	-0.00602	0.00	4.21E+10	-552.5568	4014.	0.00
7.6500	0.2370	1994373.	-16685.	-0.00593	0.00	4.22E+10	-545.3843	4142.	0.00
7.8000	0.2264	1963890.	-17663.	-0.00584	0.00	4.23E+10	-542.0703	4309.	0.00
7.9500	0.2160	1931644.	-18635.	-0.00576	0.00	4.25E+10	-537.8831	4483.	0.00
8.1000	0.2057	1897650.	-19498.	-0.00568	0.00	4.26E+10	-420.7183	3682.	0.00
8.2500	0.1955	1862287.	-20253.	-0.00560	0.00	4.28E+10	-418.6267	3854.	0.00
8.4000	0.1855	1825561.	-21005.	-0.00552	0.00	4.30E+10	-416.3191	4039.	0.00
8.5500	0.1756	1787481.	-21752.	-0.00545	0.00	4.32E+10	-413.7795	4240.	0.00
8.7000	0.1659	1748055.	-22494.	-0.00538	0.00	4.34E+10	-410.9898	4459.	0.00
8.8500	0.1563	1707292.	-23231.	-0.00530	0.00	4.37E+10	-407.9289	4698.	0.00
9.0000	0.1468	1665203.	-23962.	-0.00524	0.00	4.39E+10	-404.5725	4960.	0.00
9.1500	0.1374	1621797.	-24687.	-0.00517	0.00	4.42E+10	-400.8923	5250.	0.00
9.3000	0.1282	1577088.	-25405.	-0.00510	0.00	4.45E+10	-396.8549	5572.	0.00
9.4500	0.1191	1531088.	-26116.	-0.00504	0.00	4.49E+10	-392.4207	5932.	0.00
9.6000	0.1101	1483812.	-26818.	-0.00498	0.00	4.53E+10	-387.5421	6338.	0.00
9.7500	0.1011	1435276.	-27510.	-0.00492	0.00	4.57E+10	-382.1611	6801.	0.00
9.9000	0.09234	1385498.	-28193.	-0.00489	0.00	1.80E+11	-376.2064	7334.	0.00
10.0500	0.08355	1334500.	-28864.	-0.00487	0.00	1.88E+11	-369.5067	7960.	0.00
10.2000	0.07479	1282304.	-29522.	-0.00486	0.00	1.88E+11	-361.9292	8711.	0.00
10.3500	0.06605	1228934.	-30166.	-0.00485	0.00	1.89E+11	-353.2970	9628.	0.00
10.5000	0.05733	1174419.	-30793.	-0.00484	0.00	1.89E+11	-343.3664	10780.	0.00
10.6500	0.04863	1118790.	-31401.	-0.00483	0.00	1.89E+11	-331.7875	12280.	0.00
10.8000	0.03995	1062085.	-31986.	-0.00482	0.00	1.89E+11	-318.0276	14328.	0.00
10.9500	0.03129	1004350.	-32543.	-0.00481	0.00	1.89E+11	-301.2071	17326.	0.00
11.1000	0.02265	945638.	-33066.	-0.00480	0.00	1.89E+11	-279.6901	22228.	0.00
11.2500	0.01402	886019.	-33542.	-0.00479	0.00	1.89E+11	-249.7519	32062.	0.00
11.4000	0.00541	825590.	-33945.	-0.00478	0.00	1.90E+11	-198.1496	65944.	0.00
11.5500	-0.00319	764518.	-33800.	-0.00477	0.00	1.90E+11	359.3634	202794.	0.00
11.7000	-0.01178	704611.	-33028.	-0.00477	0.00	1.90E+11	498.2135	76160.	0.00
11.8500	-0.02035	646317.	-32066.	-0.00476	0.00	1.90E+11	571.2412	50531.	0.00
12.0000	-0.02891	589873.	-30990.	-0.00475	0.00	1.90E+11	623.6726	38830.	0.00
12.1500	-0.03746	535450.	-29830.	-0.00475	0.00	1.90E+11	665.4190	31972.	0.00
12.3000	-0.04601	483182.	-28601.	-0.00474	0.00	1.90E+11	700.4872	27407.	0.00
12.4500	-0.05454	433184.	-27313.	-0.00474	0.00	1.90E+11	730.9342	24123.	0.00
12.6000	-0.06307	385553.	-25973.	-0.00474	0.00	1.90E+11	757.9691	21633.	0.00
12.7500	-0.07159	340379.	-24586.	-0.00473	0.00	1.90E+11	782.3684	19671.	0.00
12.9000	-0.08010	297738.	-23158.	-0.00473	0.00	1.90E+11	804.6629	18081.	0.00
13.0500	-0.08861	257705.	-21691.	-0.00473	0.00	1.91E+11	825.2327	16763.	0.00
13.2000	-0.09712	220345.	-20188.	-0.00472	0.00	1.91E+11	844.3606	15649.	0.00
13.3500	-0.1056	185721.	-18652.	-0.00472	0.00	1.91E+11	862.2628	14695.	0.00
13.5000	-0.1141	153890.	-17085.	-0.00472	0.00	1.91E+11	879.1085	13866.	0.00
13.6500	-0.1226	124908.	-15489.	-0.00472	0.00	1.91E+11	895.0331	13139.	0.00
13.8000	-0.1311	98825.	-13864.	-0.00472	0.00	1.91E+11	910.1468	12495.	0.00
13.9500	-0.1396	75691.	-12213.	-0.00472	0.00	1.91E+11	924.5402	11921.	0.00
14.1000	-0.1481	55553.	-10536.	-0.00472	0.00	1.91E+11	938.2891	11404.	0.00
14.2500	-0.1566	38454.	-8835.	-0.00472	0.00	1.91E+11	951.4574	10937.	0.00
14.4000	-0.1651	24439.	-7111.	-0.00472	0.00	1.91E+11	964.0996	10513.	0.00

14.5500	-0.1736	13547.	-5365.	-0.00472	0.00	1.91E+11	976.2627	10125.	0.00
14.7000	-0.1821	5818.	-3597.	-0.00472	0.00	1.91E+11	987.9870	9768.	0.00
14.8500	-0.1905	1290.	-1809.	-0.00472	0.00	1.91E+11	999.3082	9440.	0.00
15.0000	-0.1990	0.00	0.00	-0.00472	0.00	1.91E+11	1010.	4568.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.99538645 inches
Computed slope at pile head = -0.01032964 radians
Maximum bending moment = 2234241. inch-lbs
Maximum shear force = -33945. lbs
Depth of maximum bending moment = 5.25000000 feet below pile head
Depth of maximum shear force = 11.40000000 feet below pile head
Number of iterations = 53
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

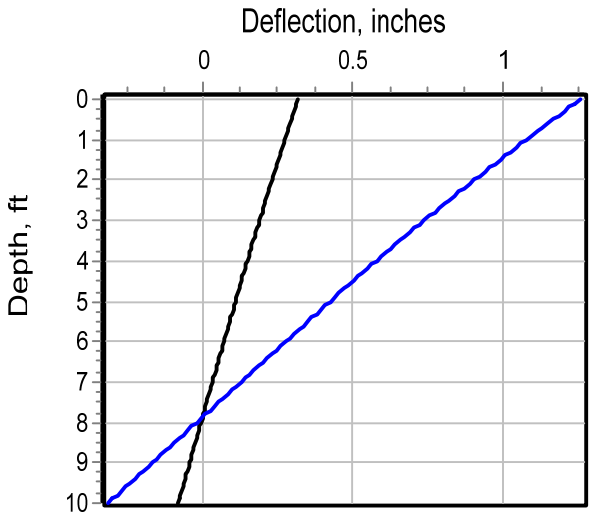
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	12600.	M, in-lb	1058400.	45360.	0.3730	-0.00403	-24309.	1584181.
2	V, lb	17640.	M, in-lb	1481760.	40824.	0.9954	-0.01033	-33945.	2234241.

Maximum pile-head deflection = 0.9953864534 inches
Maximum pile-head rotation = -0.0103296435 radians = -0.591845 deg.

The analysis ended normally.

NB1A_P35-P38


Deflection, inches
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1
Depth, ft
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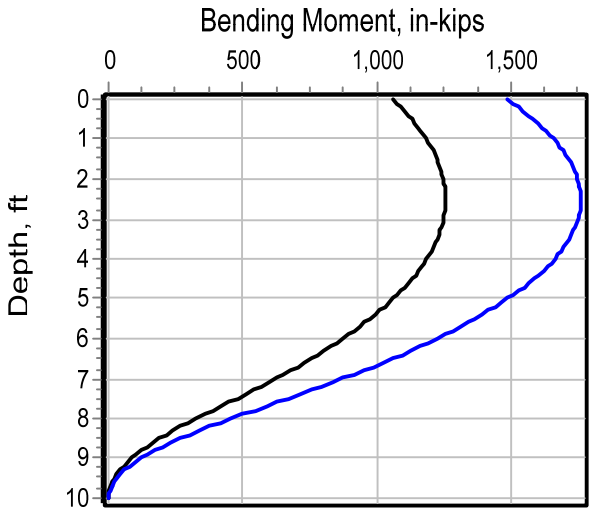
1
2
3
4
5
6
7
8
9
10


Bending Moment, in-kips
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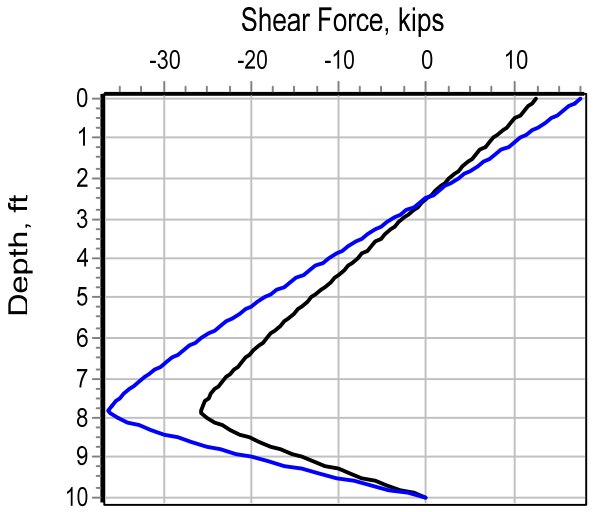
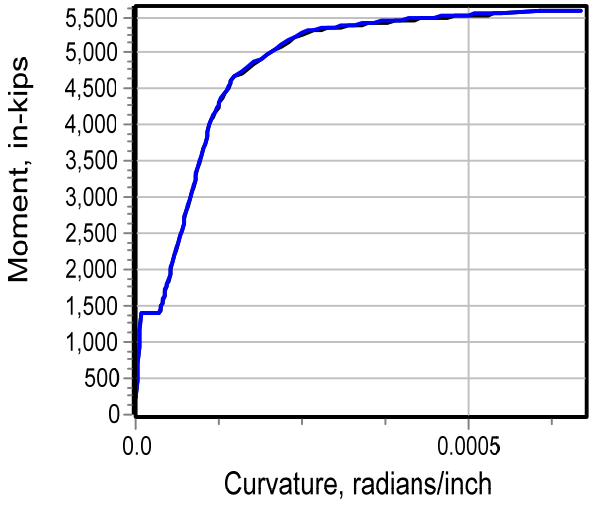
500
1,000
1,500
Depth, ft
0
1
2
3
4
5
6
7
8
9
10


Shear Force, kips
-30
-20
-10
0
10
Depth, ft
0
1
2
3
4
5
6
7
8
9
10


Moment, in-kips
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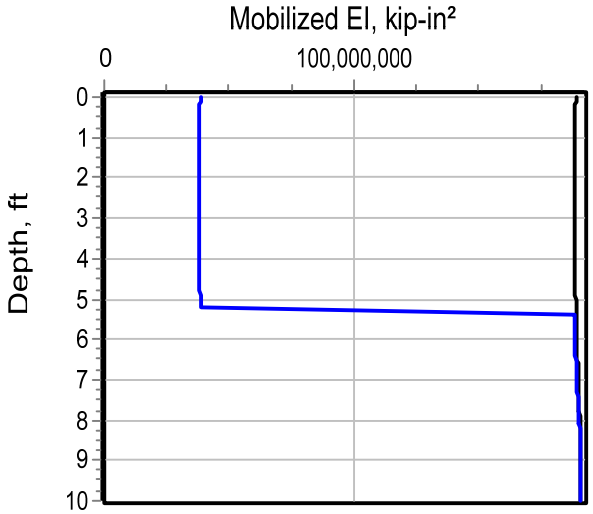
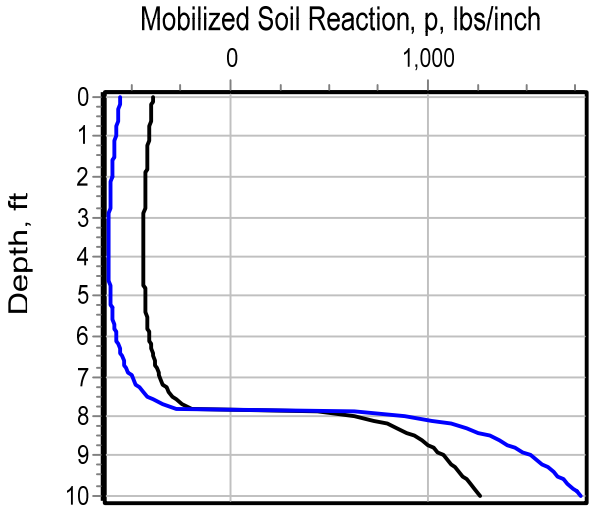
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0.0
0.0005
Curvature, radians/inch


Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
1
2
3
4
5
6
7
8
9
10


Mobilized Soil Reaction, p, lbs/inch
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1,000
Depth, ft
0
1
2
3
4
5
6
7
8
9
10

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Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Name of input data file:
SUM-8_NB1A_P35-P38.lp10

Name of output report file:
SUM-8_NB1A_P35-P38.lp10

Name of plot output file:
SUM-8_NB1A_P35-P38.lp10

Name of runtime message file:
SUM-8_NB1A_P35-P38.lp10

Date and Time of Analysis

Date: March 6, 2019 Time: 11:22:04

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1A_P35-P38

Program Options and Settings

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed = 500
 - Deflection tolerance for convergence = 1.0000E-05 in
 - Maximum allowable deflection = 100.0000 in
 - Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 10.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	10.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	10.000000 ft
Shaft Diameter	=	30.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	26.600 degrees
	=	0.464 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	11.000000 ft
Effective unit weight at top of layer	=	127.000000 pcf
Effective unit weight at bottom of layer	=	127.000000 pcf
Undrained cohesion at top of layer	=	2150. psf
Undrained cohesion at bottom of layer	=	2150. psf
Epsilon-50 at top of layer	=	0.006900
Epsilon-50 at bottom of layer	=	0.006900

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	11.000000 ft
Distance from top of pile to bottom of layer	=	21.000000 ft
Effective unit weight at top of layer	=	150.000000 pcf
Effective unit weight at bottom of layer	=	150.000000 pcf
Uniaxial compressive strength at top of layer	=	200.000000 psi
Uniaxial compressive strength at bottom of layer	=	200.000000 psi
Initial modulus of rock at top of layer	=	900.000000 psi
Initial modulus of rock at bottom of layer	=	900.000000 psi
RQD of rock at top of layer	=	10.000000 %
RQD of rock at bottom of layer	=	10.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 11.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay w/o Free Water	0.00 11.0000	127.0000 127.0000	2150. 2150.	-- --	-- --	0.00690 0.00690	-- --
2	Weak Rock	11.0000 21.0000	150.0000 150.0000	-- --	200.0000 200.0000	10.0000 10.0000	5.00E-04 5.00E-04	900.0000 900.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 12600. lbs	M = 1058400. in-lbs	15120.	No
2	1	V = 17640. lbs	M = 1481760. in-lbs	13608.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	10.000000 ft
Shaft Diameter	=	30.000000 in
Concrete Cover Thickness	=	3.000000 in
Number of Reinforcing Bars	=	10 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	706.858347 sq. in.
Total Area of Reinforcing Steel	=	7.900000 sq. in.
Area Ratio of Steel Reinforcement	=	1.12 percent
Edge-to-Edge Bar Spacing	=	6.107391 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.14
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	3147.516 kips
Tensile Load for Cracking of Concrete	=	-334.148 kips
Nominal Axial Tensile Capacity	=	-474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150
9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete	=	4500. psi
Modulus of Elasticity of Concrete	=	3823676. psi
Modulus of Rupture of Concrete	=	-503.115295 psi
Compression Strain at Peak Stress	=	0.002001
Tensile Strain at Fracture of Concrete	=	-0.0001152
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force

	kips
1	13.608
2	15.120

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 13.608 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.8336764	191066941.	18.2395617	0.00002280	-0.00001470	0.1011438	0.6557466	
0.00000250	476.3430252	190537210.	16.6257974	0.00004156	-0.00003344	0.1833812	1.1944953	
0.00000375	712.4477805	189986075.	16.0879373	0.00006033	-0.00005217	0.2648438	1.7332507	
0.00000500	947.1474510	189429490.	15.8190361	0.00007910	-0.00007090	0.3455309	2.2720103	
0.00000625	1180.	188870716.	15.6577161	0.00009786	-0.00008964	0.4254425	2.8107736	
0.00000750	1412.	188310845.	15.5501857	0.0001166	-0.0001084	0.5045786	3.3495404	
0.00000875	1412.	161409296.	9.0248553	0.00007897	-0.0001835	0.3425471	-5.2843804	C
0.00001000	1412.	141233134.	8.8352959	0.00008835	-0.0002116	0.3822226	-6.0942642	C
0.00001125	1412.	125540563.	8.6832732	0.00009769	-0.0002398	0.4214868	-6.9056446	C
0.00001250	1412.	112986507.	8.5621845	0.0001070	-0.0002680	0.4605911	-7.7168331	C
0.00001375	1412.	102715006.	8.4603826	0.0001163	-0.0002962	0.4993479	-8.5291099	C
0.00001500	1412.	94155423.	8.3756212	0.0001256	-0.0003244	0.5379225	-9.3413547	C
0.00001625	1412.	86912698.	8.3043173	0.0001349	-0.0003526	0.5763387	-10.1534029	C
0.00001750	1412.	80704648.	8.2433478	0.0001443	-0.0003807	0.6145786	-10.9653759	C
0.00001875	1412.	75324338.	8.1891141	0.0001535	-0.0004090	0.6525226	-11.7781067	C
0.00002000	1412.	70616567.	8.1420095	0.0001628	-0.0004372	0.6903093	-12.5906344	C
0.00002125	1412.	66462651.	8.1007774	0.0001721	-0.0004654	0.7279386	-13.4029584	C
0.00002250	1412.	62770282.	8.0644401	0.0001814	-0.0004936	0.7654099	-14.2150778	C
0.00002375	1412.	59466583.	8.0322260	0.0001908	-0.0005217	0.8027231	-15.0269917	C
0.00002500	1412.	56493254.	8.0035177	0.0002001	-0.0005499	0.8398778	-15.8386996	C
0.00002625	1412.	53803099.	7.9778155	0.0002094	-0.0005781	0.8768737	-16.6502004	C
0.00002750	1412.	51357503.	7.9547103	0.0002188	-0.0006062	0.9137105	-17.4614935	C
0.00002875	1412.	49124568.	7.9332245	0.0002281	-0.0006344	0.9503142	-18.2731115	C
0.00003000	1412.	47077711.	7.9136061	0.0002374	-0.0006626	0.9867393	-19.0846626	C
0.00003125	1412.	45194603.	7.8957962	0.0002467	-0.0006908	1.0230062	-19.8959971	C
0.00003250	1412.	43456349.	7.8795869	0.0002561	-0.0007189	1.0591143	-20.7071143	C
0.00003375	1412.	41846854.	7.8648014	0.0002654	-0.0007471	1.0950635	-21.5180130	C
0.00003500	1412.	40352324.	7.8512881	0.0002748	-0.0007752	1.1308533	-22.3286925	C
0.00003625	1412.	38960865.	7.8389162	0.0002842	-0.0008033	1.1664834	-23.1391518	C
0.00003750	1448.	38612827.	7.8275723	0.0002935	-0.0008315	1.2019533	-23.9493910	C
0.00003875	1492.	38510361.	7.8171579	0.0003029	-0.0008596	1.2372630	-24.7594071	C
0.00004000	1537.	38413483.	7.8075867	0.0003123	-0.0008877	1.2724120	-25.5692002	C
0.00004125	1581.	38321683.	7.7987826	0.0003217	-0.0009158	1.3073998	-26.3787694	C
0.00004250	1625.	38234508.	7.7906790	0.0003311	-0.0009439	1.3422262	-27.1881137	C
0.00004375	1669.	38151561.	7.7832163	0.0003405	-0.0009720	1.3768908	-27.9972322	C
0.00004500	1713.	38072486.	7.7763421	0.0003499	-0.0010001	1.4113932	-28.8061240	C
0.00004625	1757.	37996966.	7.7700093	0.0003594	-0.0010281	1.4457331	-29.6147879	C
0.00004750	1801.	37924718.	7.7641758	0.0003688	-0.0010562	1.4799101	-30.4232231	C

0.00004875	1845.	37855489.	7.7588040	0.0003782	-0.0010843	1.5139238	-31.2314286 C
0.00005125	1933.	37725185.	7.7493129	0.0003972	-0.0011403	1.5814598	-32.8471474 C
0.00005375	2021.	37604487.	7.7413020	0.0004161	-0.0011964	1.6483384	-34.4619339 C
0.00005625	2109.	37492090.	7.7345790	0.0004351	-0.0012524	1.7145565	-36.0757811 C
0.00005875	2196.	37386918.	7.7289844	0.0004541	-0.0013084	1.7801110	-37.6886808 C
0.00006125	2284.	37288067.	7.7243847	0.0004731	-0.0013644	1.8449988	-39.3006244 C
0.00006375	2371.	37194777.	7.7206676	0.0004922	-0.0014203	1.9092167	-40.9116034 C
0.00006625	2458.	37106402.	7.7177378	0.0005113	-0.0014762	1.9727617	-42.5216089 C
0.00006875	2545.	37022391.	7.7155137	0.0005304	-0.0015321	2.0356304	-44.1306320 C
0.00007125	2632.	36942267.	7.7139256	0.0005496	-0.0015879	2.0978196	-45.7386637 C
0.00007375	2719.	36865621.	7.7129129	0.0005688	-0.0016437	2.1593260	-47.3456947 C
0.00007625	2805.	36792094.	7.7124235	0.0005881	-0.0016994	2.2201463	-48.9517158 C
0.00007875	2892.	36721375.	7.7124116	0.0006074	-0.0017551	2.2802770	-50.5567173 C
0.00008125	2978.	36653189.	7.7128372	0.0006267	-0.0018108	2.3397148	-52.1606895 C
0.00008375	3064.	36587296.	7.7136653	0.0006460	-0.0018665	2.3984561	-53.7636227 C
0.00008625	3150.	36523482.	7.7148648	0.0006654	-0.0019221	2.4564973	-55.3655067 C
0.00008875	3236.	36461556.	7.7164083	0.0006848	-0.0019777	2.5138350	-56.9663314 C
0.00009125	3322.	36401350.	7.7182716	0.0007043	-0.0020332	2.5704655	-58.5660863 C
0.00009375	3407.	36342712.	7.7204328	0.0007238	-0.0020887	2.6263850	-60.0000000 CY
0.00009625	3492.	36285506.	7.7228726	0.0007433	-0.0021442	2.6815899	-60.0000000 CY
0.00009875	3578.	36229611.	7.7255737	0.0007629	-0.0021996	2.7360763	-60.0000000 CY
0.0001013	3663.	36174914.	7.7285206	0.0007825	-0.0022550	2.7898403	-60.0000000 CY
0.0001038	3748.	36121317.	7.7316992	0.0008022	-0.0023103	2.8428782	-60.0000000 CY
0.0001063	3832.	36068728.	7.7350970	0.0008219	-0.0023656	2.8951858	-60.0000000 CY
0.0001088	3917.	36017065.	7.7387026	0.0008416	-0.0024209	2.9467593	-60.0000000 CY
0.0001113	4001.	35963847.	7.7423371	0.0008613	-0.0024762	2.9975456	-60.0000000 CY
0.0001138	4075.	35825593.	7.7400108	0.0008804	-0.0025321	3.0458010	-60.0000000 CY
0.0001163	4129.	35518165.	7.7253900	0.0008981	-0.0025894	3.0896424	-60.0000000 CY
0.0001188	4174.	35148889.	7.7061204	0.0009151	-0.0026474	3.1312622	-60.0000000 CY
0.0001213	4218.	34790464.	7.6875813	0.0009321	-0.0027054	3.1722397	-60.0000000 CY
0.0001238	4263.	34445837.	7.6700020	0.0009492	-0.0027633	3.2126572	-60.0000000 CY
0.0001263	4307.	34114184.	7.6533272	0.0009662	-0.0028213	3.2525122	-60.0000000 CY
0.0001288	4351.	33794371.	7.6368513	0.0009832	-0.0028793	3.2916060	-60.0000000 CY
0.0001313	4395.	33486004.	7.6210448	0.0010003	-0.0029372	3.3300899	-60.0000000 CY
0.0001338	4439.	33188531.	7.6060357	0.0010173	-0.0029952	3.3680134	-60.0000000 CY
0.0001363	4483.	32901349.	7.5917819	0.0010344	-0.0030531	3.4053739	-60.0000000 CY
0.0001388	4527.	32623895.	7.5782442	0.0010515	-0.0031110	3.4421688	-60.0000000 CY
0.0001413	4570.	32353127.	7.5651400	0.0010686	-0.0031689	3.4783208	-60.0000000 CY
0.0001438	4610.	32066336.	7.5502146	0.0010853	-0.0032272	3.5131548	-60.0000000 CY
0.0001463	4641.	31736337.	7.5306924	0.0011014	-0.0032861	3.5458381	-60.0000000 CY
0.0001488	4665.	31359929.	7.5061300	0.0011165	-0.0033460	3.5762449	-60.0000000 CY
0.0001588	4729.	29791565.	7.3981403	0.0011745	-0.0035880	3.6876542	-60.0000000 CY
0.0001688	4793.	28400416.	7.3016620	0.0012322	-0.0038303	3.7915190	-60.0000000 CY
0.0001788	4855.	27158985.	7.2150496	0.0012897	-0.0040728	3.8880069	-60.0000000 CY
0.0001888	4916.	26045699.	7.1392307	0.0013475	-0.0043150	3.9779022	-60.0000000 CY
0.0001988	4977.	25041137.	7.0726128	0.0014057	-0.0045568	4.0610996	-60.0000000 CY
0.0002088	5037.	24128019.	7.0115037	0.0014637	-0.0047988	4.1368475	-60.0000000 CY
0.0002188	5096.	23294492.	6.9561393	0.0015217	-0.0050408	4.2054654	-60.0000000 CY
0.0002288	5154.	22530914.	6.9071010	0.0015800	-0.0052825	4.2672524	-60.0000000 CY
0.0002388	5212.	21828420.	6.8636347	0.0016387	-0.0055238	4.3220869	-60.0000000 CY
0.0002488	5263.	21158038.	6.8205470	0.0016966	-0.0057659	4.3689723	-60.0000000 CY
0.0002588	5295.	20463573.	6.7659002	0.0017507	-0.0060118	4.4062155	-60.0000000 CY
0.0002688	5312.	19765334.	6.7009495	0.0018009	-0.0062616	4.4351774	-60.0000000 CY
0.0002788	5325.	19102829.	6.6372738	0.0018501	-0.0065124	4.4583991	-60.0000000 CY
0.0002888	5338.	18485123.	6.5789061	0.0018997	-0.0067628	4.4765761	-60.0000000 CY
0.0002988	5350.	17907693.	6.5253308	0.0019494	-0.0070131	4.4896257	-60.0000000 CY
0.0003088	5362.	17366598.	6.4760999	0.0019995	-0.0072630	4.4974625	-60.0000000 CY
0.0003188	5373.	16857404.	6.4290685	0.0020493	-0.0075132	4.4997147	-60.0000000 CY
0.0003288	5384.	16376706.	6.3836725	0.0020986	-0.0077639	4.4971897	-60.0000000 CY
0.0003388	5394.	15923524.	6.3417463	0.0021483	-0.0080142	4.4999734	60.0000000 CY
0.0003488	5404.	15495089.	6.3032456	0.0021983	-0.0082642	4.4953955	60.0000000 CY
0.0003588	5413.	15089749.	6.2676301	0.0022485	-0.0085140	4.4994927	60.0000000 CY
0.0003688	5423.	14705406.	6.2348180	0.0022991	-0.0087634	4.4918090	60.0000000 CY
0.0003788	5431.	14340477.	6.2045376	0.0023500	-0.0090125	4.4973652	60.0000000 CY
0.0003888	5440.	13993714.	6.1764330	0.0024011	-0.0092614	4.4999318	60.0000000 CY
0.0003988	5448.	13663352.	6.1506284	0.0024526	-0.0095099	4.4915996	60.0000000 CY
0.0004088	5456.	13347744.	6.1241704	0.0025033	-0.0097592	4.4972731	60.0000000 CY

0.0004188	5463.	13046751.	6.0994454	0.0025541	-0.0100084	4.4998418	60.0000000 CY
0.0004288	5470.	12759060.	6.0766688	0.0026054	-0.0102571	4.4902962	60.0000000 CY
0.0004388	5477.	12483989.	6.0555125	0.0026569	-0.0105056	4.4948361	60.0000000 CY
0.0004488	5484.	12220832.	6.0357507	0.0027085	-0.0107540	4.4988062	60.0000000 CY
0.0004588	5491.	11968766.	6.0173352	0.0027605	-0.0110020	4.4989411	60.0000000 CY
0.0004688	5497.	11726773.	6.0004857	0.0028127	-0.0112498	4.4882974	60.0000000 CY
0.0004788	5503.	11494622.	5.9847165	0.0028652	-0.0114973	4.4946364	60.0000000 CY
0.0004888	5509.	11271705.	5.9699699	0.0029178	-0.0117447	4.4985485	60.0000000 CY
0.0004988	5515.	11057460.	5.9561930	0.0029707	-0.0119918	4.4999924	60.0000000 CY
0.0005088	5520.	10851060.	5.9436700	0.0030238	-0.0122387	4.4883378	60.0000000 CYT
0.0005188	5526.	10652388.	5.9319697	0.0030772	-0.0124853	4.4907576	60.0000000 CYT
0.0005288	5531.	10461032.	5.9210224	0.0031307	-0.0127318	4.4960013	60.0000000 CYT
0.0005388	5537.	10276578.	5.9107929	0.0031844	-0.0129781	4.4990907	60.0000000 CYT
0.0005488	5542.	10098615.	5.9012845	0.0032383	-0.0132242	4.4988933	60.0000000 CYT
0.0006088	5569.	9148878.	5.8579678	0.0035660	-0.0146965	4.4951107	60.0000000 CYT
0.0006688	5569.	8328044.	5.8601017	0.0039189	-0.0161436	4.4953810	60.0000000 CYT

Axial Thrust Force = 15.120 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.8148244	191051860.	18.5995761	0.00002325	-0.00001425	0.1031450	0.6687971	
0.00000250	476.3236572	190529463.	16.8064501	0.00004202	-0.00003298	0.1853708	1.2075926	
0.00000375	712.4281977	189980853.	16.2088176	0.00006078	-0.00005172	0.2668218	1.7463964	
0.00000500	947.1276963	189425539.	15.9100349	0.00007955	-0.00007045	0.3474973	2.2852051	
0.00000625	1180.	188867530.	15.7307886	0.00009832	-0.00008918	0.4273972	2.8240180	
0.00000750	1412.	188308169.	15.6113096	0.0001171	-0.0001079	0.5065216	3.3628349	
0.00000875	1412.	161407002.	9.1952927	0.00008046	-0.0001820	0.3489929	-5.2411320	C
0.00001000	1412.	141231127.	8.9866060	0.00008987	-0.0002101	0.3887311	-6.0503842	C
0.00001125	1412.	125538779.	8.8225594	0.00009925	-0.0002382	0.4281947	-6.8602025	C
0.00001250	1412.	112984901.	8.6876872	0.0001086	-0.0002664	0.4672745	-7.6713384	C
0.00001375	1412.	102713547.	8.5778208	0.0001179	-0.0002946	0.5061940	-8.4822814	C
0.00001500	1412.	94154084.	8.4843531	0.0001273	-0.0003227	0.5448039	-9.2940564	C
0.00001625	1412.	86911462.	8.4048076	0.0001366	-0.0003509	0.5831950	-10.1060469	C
0.00001750	1412.	80703501.	8.3370152	0.0001459	-0.0003791	0.6214273	-10.9178398	C
0.00001875	1412.	75323267.	8.2786265	0.0001552	-0.0004073	0.6595006	-11.7294343	C
0.00002000	1412.	70615563.	8.2270462	0.0001645	-0.0004355	0.6973455	-12.5413132	C
0.00002125	1412.	66461707.	8.1809148	0.0001738	-0.0004637	0.7349489	-13.3535737	C
0.00002250	1412.	62769390.	8.1402232	0.0001832	-0.0004918	0.7723943	-14.1656293	C
0.00002375	1412.	59465737.	8.1041135	0.0001925	-0.0005200	0.8096815	-14.9774792	C
0.00002500	1412.	56492451.	8.0718996	0.0002018	-0.0005482	0.8468102	-15.7891227	C
0.00002625	1412.	53802334.	8.0430260	0.0002111	-0.0005764	0.8837799	-16.6005589	C
0.00002750	1412.	51356773.	8.0170381	0.0002205	-0.0006045	0.9205904	-17.4117870	C
0.00002875	1412.	49123870.	7.9935607	0.0002298	-0.0006327	0.9572413	-18.2228062	C
0.00003000	1412.	47077042.	7.9722808	0.0002392	-0.0006608	0.9937324	-19.0336156	C
0.00003125	1412.	45193960.	7.9529356	0.0002485	-0.0006890	1.0300632	-19.8442145	C
0.00003250	1412.	43455731.	7.9347171	0.0002579	-0.0007171	1.0661587	-20.6551540	C
0.00003375	1412.	41846260.	7.9179634	0.0002672	-0.0007453	1.1020807	-21.4659807	C
0.00003500	1412.	40351750.	7.9026228	0.0002766	-0.0007734	1.1378432	-22.2765878	C
0.00003625	1415.	39034440.	7.8885499	0.0002860	-0.0008015	1.1734459	-23.0869743	C
0.00003750	1459.	38915125.	7.8756189	0.0002953	-0.0008297	1.2088885	-23.8971394	C
0.00003875	1504.	38802667.	7.8637200	0.0003047	-0.0008578	1.2441707	-24.7070820	C
0.00004000	1548.	38696416.	7.8527573	0.0003141	-0.0008859	1.2792918	-25.5168024	C
0.00004125	1592.	38595814.	7.8426466	0.0003235	-0.0009140	1.3142519	-26.3262974	C
0.00004250	1636.	38500356.	7.8333133	0.0003329	-0.0009421	1.3490505	-27.1355671	C
0.00004375	1680.	38409597.	7.8246916	0.0003423	-0.0009702	1.3836872	-27.9446107	C
0.00004500	1725.	38323144.	7.8167230	0.0003518	-0.0009982	1.4181616	-28.7534270	C
0.00004625	1769.	38240643.	7.8093553	0.0003612	-0.0010263	1.4524734	-29.5620153	C
0.00004750	1813.	38161782.	7.8025416	0.0003706	-0.0010544	1.4866222	-30.3703744	C
0.00004875	1857.	38086276.	7.7962402	0.0003801	-0.0010824	1.5206076	-31.1785033	C
0.00005125	1945.	37944344.	7.7850267	0.0003990	-0.0011385	1.5880870	-32.7940665	C
0.00005375	2032.	37813082.	7.7754546	0.0004179	-0.0011946	1.6549082	-34.4086991	C
0.00005625	2120.	37691064.	7.7673101	0.0004369	-0.0012506	1.7210687	-36.0223889	C
0.00005875	2208.	37577087.	7.7604159	0.0004559	-0.0013066	1.7865652	-37.6351296	C

0.00006125	2295.	37470146.	7.7546238	0.0004750	-0.0013625	1.8513946	-39.2469126 C
0.00006375	2382.	37369399.	7.7498086	0.0004941	-0.0014184	1.9155538	-40.8577292 C
0.00006625	2469.	37274127.	7.7458644	0.0005132	-0.0014743	1.9790395	-42.4675707 C
0.00006875	2556.	37183717.	7.7427007	0.0005323	-0.0015302	2.0418486	-44.0764280 C
0.00007125	2643.	37097641.	7.7402397	0.0005515	-0.0015860	2.1039778	-45.6842922 C
0.00007375	2730.	37015443.	7.7384142	0.0005707	-0.0016418	2.1654237	-47.2911539 C
0.00007625	2816.	36936727.	7.7371661	0.0005900	-0.0016975	2.2261831	-48.8970038 C
0.00007875	2903.	36861145.	7.7364444	0.0006092	-0.0017533	2.2862524	-50.5018323 C
0.00008125	2989.	36788393.	7.7362048	0.0006286	-0.0018089	2.3456284	-52.1056297 C
0.00008375	3075.	36718204.	7.7364081	0.0006479	-0.0018646	2.4043074	-53.7083860 C
0.00008625	3161.	36650340.	7.7370199	0.0006673	-0.0019202	2.4622859	-55.3100912 C
0.00008875	3247.	36584590.	7.7380096	0.0006867	-0.0019758	2.5195603	-56.9107351 C
0.00009125	3333.	36520767.	7.7393501	0.0007062	-0.0020313	2.5761270	-58.5103072 C
0.00009375	3418.	36458703.	7.7410172	0.0007257	-0.0020868	2.6319824	-60.0000000 CY
0.00009625	3503.	36398247.	7.7429893	0.0007453	-0.0021422	2.6871225	-60.0000000 CY
0.00009875	3589.	36339263.	7.7452472	0.0007648	-0.0021977	2.7415436	-60.0000000 CY
0.0001013	3674.	36281628.	7.7477735	0.0007845	-0.0022530	2.7952420	-60.0000000 CY
0.0001038	3758.	36225232.	7.7505525	0.0008041	-0.0023084	2.8482135	-60.0000000 CY
0.0001063	3843.	36169974.	7.7535703	0.0008238	-0.0023637	2.9004543	-60.0000000 CY
0.0001088	3928.	36115762.	7.7568140	0.0008436	-0.0024189	2.9519604	-60.0000000 CY
0.0001113	4012.	36060311.	7.7601178	0.0008633	-0.0024742	3.0026829	-60.0000000 CY
0.0001138	4087.	35929717.	7.7581787	0.0008825	-0.0025300	3.0510809	-60.0000000 CY
0.0001163	4141.	35624512.	7.7435585	0.0009002	-0.0025873	3.0949564	-60.0000000 CY
0.0001188	4186.	35253261.	7.7239810	0.0009172	-0.0026453	3.1365191	-60.0000000 CY
0.0001213	4231.	34892554.	7.7051177	0.0009342	-0.0027033	3.1774302	-60.0000000 CY
0.0001238	4275.	34545736.	7.6872278	0.0009513	-0.0027612	3.2177810	-60.0000000 CY
0.0001263	4319.	34211978.	7.6702550	0.0009684	-0.0028191	3.2575689	-60.0000000 CY
0.0001288	4363.	33890514.	7.6541475	0.0009855	-0.0028770	3.2967915	-60.0000000 CY
0.0001313	4407.	33580310.	7.6382716	0.0010025	-0.0029350	3.3352702	-60.0000000 CY
0.0001338	4451.	33280949.	7.6229871	0.0010196	-0.0029929	3.3731230	-60.0000000 CY
0.0001363	4495.	32991946.	7.6084684	0.0010367	-0.0030508	3.4104123	-60.0000000 CY
0.0001388	4539.	32712737.	7.5946759	0.0010538	-0.0031087	3.4471355	-60.0000000 CY
0.0001413	4582.	32440573.	7.5813552	0.0010709	-0.0031666	3.4832242	-60.0000000 CY
0.0001438	4622.	32155555.	7.5665309	0.0010877	-0.0032248	3.5180895	-60.0000000 CY
0.0001463	4655.	31828252.	7.5472092	0.0011038	-0.0032837	3.5508352	-60.0000000 CY
0.0001488	4679.	31453549.	7.5227504	0.0011190	-0.0033435	3.5812769	-60.0000000 CY
0.0001588	4743.	29879158.	7.4138375	0.0011769	-0.0035856	3.6924100	-60.0000000 CY
0.0001688	4807.	28483391.	7.3174458	0.0012348	-0.0038277	3.7962653	-60.0000000 CY
0.0001788	4869.	27237062.	7.2300656	0.0012924	-0.0040701	3.8924515	-60.0000000 CY
0.0001888	4930.	26119392.	7.1535642	0.0013502	-0.0043123	3.9820394	-60.0000000 CY
0.0001988	4991.	25110881.	7.0863364	0.0014084	-0.0045541	4.0649231	-60.0000000 CY
0.0002088	5051.	24194765.	7.0255573	0.0014666	-0.0047959	4.1405869	-60.0000000 CY
0.0002188	5110.	23357954.	6.9696740	0.0015246	-0.0050379	4.2088630	-60.0000000 CY
0.0002288	5168.	22591373.	6.9201668	0.0015830	-0.0052795	4.2703001	-60.0000000 CY
0.0002388	5225.	21886122.	6.8762756	0.0016417	-0.0055208	4.3247762	-60.0000000 CY
0.0002488	5277.	21215826.	6.8333616	0.0016998	-0.0057627	4.3714077	-60.0000000 CY
0.0002588	5310.	20521042.	6.7787906	0.0017540	-0.0060085	4.4083690	-60.0000000 CY
0.0002688	5327.	19822078.	6.7146649	0.0018046	-0.0062579	4.4371523	-60.0000000 CY
0.0002788	5340.	19157396.	6.6505824	0.0018538	-0.0065087	4.4599882	-60.0000000 CY
0.0002888	5353.	18537664.	6.5918393	0.0019034	-0.0067591	4.4777724	-60.0000000 CY
0.0002988	5365.	17958339.	6.5379170	0.0019532	-0.0070093	4.4904220	-60.0000000 CY
0.0003088	5377.	17415470.	6.4883649	0.0020033	-0.0072592	4.4978509	-60.0000000 CY
0.0003188	5389.	16905195.	6.4421471	0.0020534	-0.0075091	4.4981507	-60.0000000 CY
0.0003288	5399.	16422921.	6.3964512	0.0021028	-0.0077597	4.4976421	-60.0000000 CY
0.0003388	5409.	15968254.	6.3542465	0.0021525	-0.0080100	4.4999996	60.0000000 CY
0.0003488	5419.	15538381.	6.3155088	0.0022025	-0.0082600	4.4959903	60.0000000 CY
0.0003588	5429.	15131726.	6.2796455	0.0022528	-0.0085097	4.4996777	60.0000000 CY
0.0003688	5438.	14746090.	6.2466336	0.0023034	-0.0087591	4.4919854	60.0000000 CY
0.0003788	5446.	14379992.	6.2161294	0.0023544	-0.0090081	4.4978214	60.0000000 CY
0.0003888	5455.	14032118.	6.1878155	0.0024055	-0.0092570	4.4999873	60.0000000 CY
0.0003988	5463.	13700653.	6.1618486	0.0024570	-0.0095055	4.4924467	60.0000000 CY
0.0004088	5471.	13384442.	6.1363874	0.0025082	-0.0097543	4.4977980	60.0000000 CY
0.0004188	5478.	13082489.	6.1114704	0.0025592	-0.0100033	4.4999476	60.0000000 CY
0.0004288	5485.	12793830.	6.0885616	0.0026105	-0.0102520	4.4892780	60.0000000 CY
0.0004388	5492.	12517898.	6.0672257	0.0026620	-0.0105005	4.4955896	60.0000000 CY
0.0004488	5499.	12253915.	6.0472951	0.0027137	-0.0107488	4.4991556	60.0000000 CY
0.0004588	5505.	12000998.	6.0287805	0.0027657	-0.0109968	4.4969714	60.0000000 CY

0.0004688	5512.	11758259.	6.0117705	0.0028180	-0.0112445	4.4894794	60.0000000 CY
0.0004788	5518.	11525394.	5.9958501	0.0028705	-0.0114920	4.4954323	60.0000000 CY
0.0004888	5524.	11301789.	5.9809610	0.0029232	-0.0117393	4.4989501	60.0000000 CY
0.0004988	5530.	11086852.	5.9670837	0.0029761	-0.0119864	4.4989390	60.0000000 CY
0.0005088	5535.	10879797.	5.9544541	0.0030293	-0.0122332	4.4862796	60.0000000 CYT
0.0005188	5541.	10680524.	5.9426231	0.0030827	-0.0124798	4.4918499	60.0000000 CYT
0.0005288	5546.	10488588.	5.9315523	0.0031363	-0.0127262	4.4967131	60.0000000 CYT
0.0005388	5551.	10303575.	5.9212063	0.0031900	-0.0129725	4.4994140	60.0000000 CYT
0.0005488	5556.	10125016.	5.9116547	0.0032440	-0.0132185	4.4967585	60.0000000 CYT
0.0006088	5584.	9172404.	5.8677948	0.0035720	-0.0146905	4.4928666	60.0000000 CYT
0.0006688	5584.	8349459.	5.8695895	0.0039253	-0.0161372	4.4930007	60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	13.608	5517.981	0.00300000
2	15.120	5532.051	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5518.	8.845200	3587.	36223813.
2	0.65	5532.	9.828000	3596.	36334293.
1	0.70	5518.	9.525600	3863.	36050224.
2	0.70	5532.	10.584000	3872.	36151134.
1	0.75	5518.	10.206000	4138.	35440119.
2	0.75	5532.	11.340000	4149.	35561045.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	230875.
2	11.0000	11.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 12600.0 lbs
Applied moment at pile head = 1058400.0 in-lbs
Axial thrust load on pile head = 15120.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3182	1058400.	12600.	-0.00366	0.00	1.89E+11	-396.4503	747.5072	0.00
0.10000	0.3138	1073301.	12123.	-0.00365	0.00	1.89E+11	-398.4895	1524.	0.00
0.2000	0.3095	1087628.	11644.	-0.00364	0.00	1.89E+11	-400.4929	1553.	0.00
0.3000	0.3051	1101378.	11162.	-0.00364	0.00	1.89E+11	-402.4600	1583.	0.00
0.4000	0.3007	1114548.	10678.	-0.00363	0.00	1.89E+11	-404.3901	1614.	0.00
0.5000	0.2964	1127136.	10191.	-0.00362	0.00	1.89E+11	-406.2828	1645.	0.00
0.6000	0.2920	1139139.	9703.	-0.00361	0.00	1.89E+11	-408.1374	1677.	0.00
0.7000	0.2877	1150554.	9212.	-0.00361	0.00	1.89E+11	-409.9533	1710.	0.00
0.8000	0.2834	1161378.	8719.	-0.00360	0.00	1.89E+11	-411.7297	1744.	0.00
0.9000	0.2791	1171610.	8224.	-0.00359	0.00	1.89E+11	-413.4661	1778.	0.00
1.0000	0.2748	1181246.	7727.	-0.00359	0.00	1.89E+11	-415.1617	1813.	0.00
1.1000	0.2705	1190284.	7227.	-0.00358	0.00	1.89E+11	-416.8157	1849.	0.00
1.2000	0.2662	1198721.	6726.	-0.00357	0.00	1.89E+11	-418.4275	1886.	0.00
1.3000	0.2619	1206556.	6223.	-0.00356	0.00	1.89E+11	-419.9962	1924.	0.00
1.4000	0.2576	1213786.	5718.	-0.00355	0.00	1.89E+11	-421.5209	1963.	0.00
1.5000	0.2534	1220409.	5212.	-0.00355	0.00	1.89E+11	-423.0009	2003.	0.00
1.6000	0.2491	1226422.	4703.	-0.00354	0.00	1.89E+11	-424.4352	2045.	0.00
1.7000	0.2449	1231825.	4193.	-0.00353	0.00	1.89E+11	-425.8229	2087.	0.00
1.8000	0.2406	1236614.	3681.	-0.00352	0.00	1.89E+11	-427.1631	2130.	0.00
1.9000	0.2364	1240787.	3168.	-0.00352	0.00	1.89E+11	-428.4546	2175.	0.00
2.0000	0.2322	1244344.	2653.	-0.00351	0.00	1.89E+11	-429.6965	2221.	0.00
2.1000	0.2280	1247281.	2137.	-0.00350	0.00	1.89E+11	-430.8876	2268.	0.00
2.2000	0.2238	1249598.	1619.	-0.00349	0.00	1.89E+11	-432.0267	2317.	0.00
2.3000	0.2196	1251293.	1100.	-0.00348	0.00	1.89E+11	-433.1127	2367.	0.00
2.4000	0.2154	1252364.	579.3344	-0.00348	0.00	1.89E+11	-434.1443	2418.	0.00
2.5000	0.2113	1252810.	57.7758	-0.00347	0.00	1.89E+11	-435.1201	2472.	0.00
2.6000	0.2071	1252629.	-464.9194	-0.00346	0.00	1.89E+11	-436.0387	2526.	0.00
2.7000	0.2030	1251819.	-988.6818	-0.00345	0.00	1.89E+11	-436.8986	2583.	0.00
2.8000	0.1988	1250381.	-1513.	-0.00344	0.00	1.89E+11	-437.6983	2642.	0.00
2.9000	0.1947	1248312.	-2039.	-0.00344	0.00	1.89E+11	-438.4362	2702.	0.00
3.0000	0.1906	1245612.	-2566.	-0.00343	0.00	1.89E+11	-439.1105	2765.	0.00
3.1000	0.1865	1242279.	-3093.	-0.00342	0.00	1.89E+11	-439.7193	2830.	0.00
3.2000	0.1824	1238313.	-3621.	-0.00341	0.00	1.89E+11	-440.2608	2897.	0.00
3.3000	0.1783	1233713.	-4150.	-0.00340	0.00	1.89E+11	-440.7330	2967.	0.00
3.4000	0.1742	1228478.	-4679.	-0.00340	0.00	1.89E+11	-441.1336	3039.	0.00
3.5000	0.1701	1222607.	-5208.	-0.00339	0.00	1.89E+11	-441.4604	3114.	0.00
3.6000	0.1661	1216101.	-5738.	-0.00338	0.00	1.89E+11	-441.7109	3192.	0.00
3.7000	0.1620	1208958.	-6268.	-0.00337	0.00	1.89E+11	-441.8825	3273.	0.00
3.8000	0.1580	1201179.	-6799.	-0.00337	0.00	1.89E+11	-441.9726	3358.	0.00
3.9000	0.1539	1192764.	-7329.	-0.00336	0.00	1.89E+11	-441.9781	3446.	0.00
4.0000	0.1499	1183712.	-7859.	-0.00335	0.00	1.89E+11	-441.8960	3537.	0.00
4.1000	0.1459	1174023.	-8389.	-0.00334	0.00	1.89E+11	-441.7228	3633.	0.00

4.2000	0.1419	1163699.	-8919.	-0.00334	0.00	1.89E+11	-441.4550	3734.	0.00
4.3000	0.1379	1152738.	-9449.	-0.00333	0.00	1.89E+11	-441.0887	3839.	0.00
4.4000	0.1339	1141142.	-9978.	-0.00332	0.00	1.89E+11	-440.6198	3949.	0.00
4.5000	0.1299	1128911.	-10506.	-0.00331	0.00	1.89E+11	-440.0438	4065.	0.00
4.6000	0.1259	1116047.	-11034.	-0.00331	0.00	1.89E+11	-439.3558	4186.	0.00
4.7000	0.1220	1102550.	-11561.	-0.00330	0.00	1.89E+11	-438.5506	4315.	0.00
4.8000	0.1180	1088421.	-12086.	-0.00329	0.00	1.89E+11	-437.6225	4450.	0.00
4.9000	0.1141	1073662.	-12611.	-0.00329	0.00	1.89E+11	-436.5653	4593.	0.00
5.0000	0.1101	1058274.	-13134.	-0.00328	0.00	1.89E+11	-435.3722	4744.	0.00
5.1000	0.1062	1042259.	-13656.	-0.00327	0.00	1.89E+11	-434.0360	4904.	0.00
5.2000	0.1023	1025619.	-14176.	-0.00327	0.00	1.89E+11	-432.5483	5075.	0.00
5.3000	0.09836	1008356.	-14694.	-0.00326	0.00	1.89E+11	-430.9003	5257.	0.00
5.4000	0.09445	990473.	-15210.	-0.00325	0.00	1.89E+11	-429.0821	5451.	0.00
5.5000	0.09055	971971.	-15723.	-0.00325	0.00	1.89E+11	-427.0827	5660.	0.00
5.6000	0.08666	952854.	-16235.	-0.00324	0.00	1.89E+11	-424.8898	5884.	0.00
5.7000	0.08277	933126.	-16743.	-0.00324	0.00	1.89E+11	-422.4897	6125.	0.00
5.8000	0.07889	912788.	-17248.	-0.00323	0.00	1.89E+11	-419.8668	6386.	0.00
5.9000	0.07502	891847.	-17751.	-0.00322	0.00	1.90E+11	-417.0038	6670.	0.00
6.0000	0.07116	870304.	-18249.	-0.00322	0.00	1.90E+11	-413.8805	6980.	0.00
6.1000	0.06730	848166.	-18744.	-0.00321	0.00	1.90E+11	-410.4741	7319.	0.00
6.2000	0.06345	825436.	-19234.	-0.00321	0.00	1.90E+11	-406.7582	7693.	0.00
6.3000	0.05960	802120.	-19720.	-0.00320	0.00	1.90E+11	-402.7019	8108.	0.00
6.4000	0.05576	778225.	-20200.	-0.00320	0.00	1.90E+11	-398.2689	8571.	0.00
6.5000	0.05193	753755.	-20675.	-0.00319	0.00	1.90E+11	-393.4160	9091.	0.00
6.6000	0.04810	728720.	-21144.	-0.00319	0.00	1.90E+11	-388.0913	9682.	0.00
6.7000	0.04428	703125.	-21606.	-0.00318	0.00	1.90E+11	-382.2316	10359.	0.00
6.8000	0.04046	676980.	-22061.	-0.00318	0.00	1.90E+11	-375.7582	11144.	0.00
6.9000	0.03665	650293.	-22508.	-0.00317	0.00	1.90E+11	-368.5718	12068.	0.00
7.0000	0.03284	623076.	-22945.	-0.00317	0.00	1.90E+11	-360.5441	13173.	0.00
7.1000	0.02904	595340.	-23373.	-0.00317	0.00	1.90E+11	-351.5048	14525.	0.00
7.2000	0.02524	567097.	-23788.	-0.00316	0.00	1.90E+11	-341.2195	16221.	0.00
7.3000	0.02145	538363.	-24190.	-0.00316	0.00	1.90E+11	-329.3520	18425.	0.00
7.4000	0.01766	509155.	-24577.	-0.00316	0.00	1.90E+11	-315.3913	21430.	0.00
7.5000	0.01388	479492.	-24946.	-0.00315	0.00	1.91E+11	-298.4971	25816.	0.00
7.6000	0.01009	449400.	-25291.	-0.00315	0.00	1.91E+11	-277.1149	32946.	0.00
7.7000	0.00631	418908.	-25606.	-0.00315	0.00	1.91E+11	-247.7434	47078.	0.00
7.8000	0.00254	388059.	-25874.	-0.00314	0.00	1.91E+11	-198.3139	93706.	0.00
7.9000	-0.00123	356925.	-25725.	-0.00314	0.00	1.91E+11	445.2925	433474.	0.00
8.0000	-0.00500	326433.	-25079.	-0.00314	0.00	1.91E+11	632.0221	151614.	0.00
8.1000	-0.00877	296850.	-24263.	-0.00314	0.00	1.91E+11	727.2505	99515.	0.00
8.2000	-0.01253	268314.	-23350.	-0.00314	0.00	1.91E+11	795.1826	76128.	0.00
8.3000	-0.01630	240924.	-22363.	-0.00314	0.00	1.91E+11	849.1221	62522.	0.00
8.4000	-0.02006	214756.	-21317.	-0.00313	0.00	1.91E+11	894.3661	53505.	0.00
8.5000	-0.02382	189876.	-20221.	-0.00313	0.00	1.91E+11	933.6134	47037.	0.00
8.6000	-0.02758	166340.	-19079.	-0.00313	0.00	1.91E+11	968.4426	42143.	0.00
8.7000	-0.03133	144199.	-17898.	-0.00313	0.00	1.91E+11	999.8640	38293.	0.00
8.8000	-0.03509	123498.	-16681.	-0.00313	0.00	1.91E+11	1029.	35176.	0.00
8.9000	-0.03884	104278.	-15431.	-0.00313	0.00	1.91E+11	1055.	32594.	0.00
9.0000	-0.04260	86577.	-14150.	-0.00313	0.00	1.91E+11	1080.	30415.	0.00
9.1000	-0.04635	70431.	-12841.	-0.00313	0.00	1.91E+11	1103.	28548.	0.00
9.2000	-0.05010	55872.	-11505.	-0.00313	0.00	1.91E+11	1124.	26929.	0.00
9.3000	-0.05386	42933.	-10143.	-0.00313	0.00	1.91E+11	1145.	25509.	0.00
9.4000	-0.05761	31642.	-8758.	-0.00313	0.00	1.91E+11	1164.	24253.	0.00
9.5000	-0.06136	22028.	-7349.	-0.00313	0.00	1.91E+11	1183.	23132.	0.00
9.6000	-0.06511	14117.	-5919.	-0.00313	0.00	1.91E+11	1200.	22125.	0.00
9.7000	-0.06886	7935.	-4469.	-0.00313	0.00	1.91E+11	1217.	21215.	0.00
9.8000	-0.07261	3506.	-2998.	-0.00313	0.00	1.91E+11	1234.	20387.	0.00
9.9000	-0.07637	853.6218	-1508.	-0.00313	0.00	1.91E+11	1249.	19631.	0.00
10.0000	-0.08012	0.00	0.00	-0.00313	0.00	1.91E+11	1264.	9469.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.31821794 inches
Computed slope at pile head      =    -0.00365679 radians
Maximum bending moment           =       1252810. inch-lbs
Maximum shear force              =        -25874. lbs
Depth of maximum bending moment  =     2.50000000 feet below pile head
Depth of maximum shear force     =     7.80000000 feet below pile head
Number of iterations             =             40
Number of zero deflection points =              1
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

```
Shear force at pile head                          =      17640.0 lbs
Applied moment at pile head                       =    1481760.0 in-lbs
Axial thrust load on pile head                    =      13608.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.2593	1481760.	17640.	-0.01520	0.00	3.85E+10	-559.1540	266.4141	0.00
0.10000	1.2411	1502773.	16967.	-0.01515	0.00	3.85E+10	-561.9327	543.3326	0.00
0.2000	1.2229	1522976.	16291.	-0.01510	0.00	3.84E+10	-564.6600	554.0738	0.00
0.3000	1.2048	1542366.	15612.	-0.01506	0.00	3.84E+10	-567.3350	565.0600	0.00
0.4000	1.1868	1560937.	14930.	-0.01501	0.00	3.84E+10	-569.9571	576.2995	0.00
0.5000	1.1688	1578688.	14244.	-0.01496	0.00	3.83E+10	-572.5256	587.8015	0.00
0.6000	1.1509	1595612.	13556.	-0.01491	0.00	3.83E+10	-575.0396	599.5751	0.00
0.7000	1.1330	1611708.	12864.	-0.01486	0.00	3.83E+10	-577.4983	611.6303	0.00
0.8000	1.1152	1626972.	12170.	-0.01481	0.00	3.82E+10	-579.9010	623.9773	0.00
0.9000	1.0975	1641399.	11473.	-0.01476	0.00	3.82E+10	-582.2467	636.6270	0.00
1.0000	1.0798	1654988.	10772.	-0.01470	0.00	3.82E+10	-584.5345	649.5908	0.00
1.1000	1.0622	1667734.	10070.	-0.01465	0.00	3.82E+10	-586.7636	662.8808	0.00
1.2000	1.0447	1679634.	9364.	-0.01460	0.00	3.81E+10	-588.9329	676.5095	0.00
1.3000	1.0272	1690685.	8656.	-0.01455	0.00	3.81E+10	-591.0415	690.4903	0.00
1.4000	1.0097	1700884.	7946.	-0.01449	0.00	3.81E+10	-593.0882	704.8373	0.00
1.5000	0.9924	1710228.	7233.	-0.01444	0.00	3.81E+10	-595.0720	719.5655	0.00
1.6000	0.9751	1718714.	6518.	-0.01439	0.00	3.81E+10	-596.9918	734.6906	0.00
1.7000	0.9579	1726340.	5800.	-0.01433	0.00	3.80E+10	-598.8464	750.2293	0.00
1.8000	0.9407	1733103.	5080.	-0.01428	0.00	3.80E+10	-600.6345	766.1991	0.00
1.9000	0.9236	1739000.	4359.	-0.01422	0.00	3.80E+10	-602.3548	782.6190	0.00
2.0000	0.9066	1744028.	3635.	-0.01417	0.00	3.80E+10	-604.0060	799.5087	0.00
2.1000	0.8896	1748186.	2909.	-0.01411	0.00	3.80E+10	-605.5867	816.8894	0.00
2.2000	0.8727	1751471.	2182.	-0.01406	0.00	3.80E+10	-607.0954	834.7836	0.00
2.3000	0.8559	1753881.	1452.	-0.01400	0.00	3.80E+10	-608.5305	853.2152	0.00
2.4000	0.8391	1755413.	721.0835	-0.01395	0.00	3.80E+10	-609.8904	872.2098	0.00
2.5000	0.8224	1756067.	-11.5548	-0.01389	0.00	3.80E+10	-611.1735	891.7947	0.00
2.6000	0.8058	1755839.	-745.6855	-0.01383	0.00	3.80E+10	-612.3778	911.9990	0.00
2.7000	0.7892	1754729.	-1481.	-0.01378	0.00	3.80E+10	-613.5015	932.8538	0.00
2.8000	0.7727	1752734.	-2218.	-0.01372	0.00	3.80E+10	-614.5426	954.3927	0.00
2.9000	0.7563	1749854.	-2956.	-0.01367	0.00	3.80E+10	-615.4990	976.6514	0.00
3.0000	0.7399	1746086.	-3695.	-0.01361	0.00	3.80E+10	-616.3685	999.6685	0.00
3.1000	0.7236	1741430.	-4435.	-0.01356	0.00	3.80E+10	-617.1488	1023.	0.00
3.2000	0.7073	1735884.	-5176.	-0.01350	0.00	3.80E+10	-617.8374	1048.	0.00
3.3000	0.6912	1729448.	-5918.	-0.01345	0.00	3.80E+10	-618.4316	1074.	0.00
3.4000	0.6751	1722120.	-6660.	-0.01339	0.00	3.81E+10	-618.9287	1100.	0.00
3.5000	0.6590	1713900.	-7403.	-0.01334	0.00	3.81E+10	-619.3258	1128.	0.00
3.6000	0.6431	1704788.	-8147.	-0.01329	0.00	3.81E+10	-619.6197	1156.	0.00
3.7000	0.6271	1694782.	-8890.	-0.01323	0.00	3.81E+10	-619.8070	1186.	0.00

3.8000	0.6113	1683883.	-9634.	-0.01318	0.00	3.81E+10	-619.8843	1217.	0.00
3.9000	0.5955	1672090.	-10378.	-0.01313	0.00	3.81E+10	-619.8478	1249.	0.00
4.0000	0.5798	1659404.	-11122.	-0.01307	0.00	3.82E+10	-619.6934	1283.	0.00
4.1000	0.5641	1645825.	-11865.	-0.01302	0.00	3.82E+10	-619.4168	1318.	0.00
4.2000	0.5485	1631353.	-12608.	-0.01297	0.00	3.82E+10	-619.0134	1354.	0.00
4.3000	0.5330	1615988.	-13351.	-0.01292	0.00	3.83E+10	-618.4781	1392.	0.00
4.4000	0.5175	1599733.	-14093.	-0.01287	0.00	3.83E+10	-617.8058	1433.	0.00
4.5000	0.5021	1582586.	-14833.	-0.01282	0.00	3.83E+10	-616.9905	1475.	0.00
4.6000	0.4868	1564551.	-15573.	-0.01277	0.00	3.84E+10	-616.0260	1519.	0.00
4.7000	0.4715	1545627.	-16312.	-0.01272	0.00	3.84E+10	-614.9057	1565.	0.00
4.8000	0.4562	1525818.	-17049.	-0.01267	0.00	3.84E+10	-613.6222	1614.	0.00
4.9000	0.4411	1505124.	-17784.	-0.01263	0.00	3.85E+10	-612.1676	1666.	0.00
5.0000	0.4259	1483548.	-18518.	-0.01258	0.00	3.85E+10	-610.5331	1720.	0.00
5.1000	0.4109	1461091.	-19250.	-0.01253	0.00	3.86E+10	-608.7094	1778.	0.00
5.2000	0.3958	1437758.	-19979.	-0.01249	0.00	3.88E+10	-606.6861	1839.	0.00
5.3000	0.3809	1413550.	-20706.	-0.01246	0.00	1.37E+11	-604.4518	1904.	0.00
5.4000	0.3659	1388472.	-21429.	-0.01245	0.00	1.88E+11	-601.9783	1974.	0.00
5.5000	0.3510	1362526.	-22150.	-0.01244	0.00	1.88E+11	-599.2485	2049.	0.00
5.6000	0.3361	1335718.	-22867.	-0.01243	0.00	1.88E+11	-596.2451	2129.	0.00
5.7000	0.3212	1308050.	-23581.	-0.01242	0.00	1.89E+11	-592.9488	2215.	0.00
5.8000	0.3063	1279529.	-24290.	-0.01242	0.00	1.89E+11	-589.3375	2309.	0.00
5.9000	0.2914	1250159.	-24995.	-0.01241	0.00	1.89E+11	-585.3867	2411.	0.00
6.0000	0.2765	1219946.	-25695.	-0.01240	0.00	1.89E+11	-581.0681	2522.	0.00
6.1000	0.2616	1188896.	-26389.	-0.01239	0.00	1.89E+11	-576.3495	2644.	0.00
6.2000	0.2467	1157016.	-27078.	-0.01239	0.00	1.89E+11	-571.1935	2778.	0.00
6.3000	0.2319	1124313.	-27760.	-0.01238	0.00	1.89E+11	-565.5567	2927.	0.00
6.4000	0.2170	1090796.	-28435.	-0.01237	0.00	1.89E+11	-559.3879	3093.	0.00
6.5000	0.2022	1056473.	-29102.	-0.01236	0.00	1.89E+11	-552.6264	3280.	0.00
6.6000	0.1874	1021355.	-29761.	-0.01236	0.00	1.89E+11	-545.1990	3492.	0.00
6.7000	0.1725	985451.	-30410.	-0.01235	0.00	1.89E+11	-537.0165	3735.	0.00
6.8000	0.1577	948773.	-31049.	-0.01234	0.00	1.89E+11	-527.9682	4017.	0.00
6.9000	0.1429	911336.	-31677.	-0.01234	0.00	1.89E+11	-517.9145	4349.	0.00
7.0000	0.1281	873152.	-32292.	-0.01233	0.00	1.90E+11	-506.6746	4746.	0.00
7.1000	0.1133	834239.	-32892.	-0.01233	0.00	1.90E+11	-494.0084	5232.	0.00
7.2000	0.09852	794614.	-33476.	-0.01232	0.00	1.90E+11	-479.5863	5841.	0.00
7.3000	0.08374	754299.	-34042.	-0.01232	0.00	1.90E+11	-462.9346	6634.	0.00
7.4000	0.06896	713317.	-34585.	-0.01231	0.00	1.90E+11	-443.3338	7715.	0.00
7.5000	0.05418	671696.	-35103.	-0.01231	0.00	1.90E+11	-419.6002	9293.	0.00
7.6000	0.03942	629471.	-35589.	-0.01230	0.00	1.90E+11	-389.5432	11859.	0.00
7.7000	0.02465	586685.	-36031.	-0.01230	0.00	1.90E+11	-348.2257	16950.	0.00
7.8000	0.00989	543398.	-36407.	-0.01230	0.00	1.90E+11	-278.5980	33791.	0.00
7.9000	-0.00486	499709.	-36198.	-0.01229	0.00	1.90E+11	627.5185	154909.	0.00
8.0000	-0.01961	456924.	-35288.	-0.01229	0.00	1.91E+11	889.3339	54416.	0.00
8.1000	-0.03436	415420.	-34140.	-0.01229	0.00	1.91E+11	1023.	35734.	0.00
8.2000	-0.04910	375388.	-32855.	-0.01229	0.00	1.91E+11	1119.	27339.	0.00
8.3000	-0.06385	336968.	-31467.	-0.01228	0.00	1.91E+11	1195.	22452.	0.00
8.4000	-0.07858	300268.	-29996.	-0.01228	0.00	1.91E+11	1258.	19214.	0.00
8.5000	-0.09332	265380.	-28453.	-0.01228	0.00	1.91E+11	1313.	16890.	0.00
8.6000	-0.1081	232383.	-26847.	-0.01228	0.00	1.91E+11	1363.	15131.	0.00
8.7000	-0.1228	201348.	-25185.	-0.01228	0.00	1.91E+11	1407.	13748.	0.00
8.8000	-0.1375	172339.	-23473.	-0.01228	0.00	1.91E+11	1447.	12628.	0.00
8.9000	-0.1523	145414.	-21714.	-0.01227	0.00	1.91E+11	1484.	11700.	0.00
9.0000	-0.1670	120626.	-19912.	-0.01227	0.00	1.91E+11	1519.	10917.	0.00
9.1000	-0.1817	98026.	-18069.	-0.01227	0.00	1.91E+11	1552.	10247.	0.00
9.2000	-0.1964	77660.	-16189.	-0.01227	0.00	1.91E+11	1582.	9665.	0.00
9.3000	-0.2112	59573.	-14273.	-0.01227	0.00	1.91E+11	1611.	9155.	0.00
9.4000	-0.2259	43805.	-12324.	-0.01227	0.00	1.91E+11	1638.	8703.	0.00
9.5000	-0.2406	30396.	-10342.	-0.01227	0.00	1.91E+11	1664.	8301.	0.00
9.6000	-0.2553	19384.	-8330.	-0.01227	0.00	1.91E+11	1689.	7939.	0.00
9.7000	-0.2701	10805.	-6288.	-0.01227	0.00	1.91E+11	1713.	7612.	0.00
9.8000	-0.2848	4693.	-4219.	-0.01227	0.00	1.91E+11	1736.	7315.	0.00
9.9000	-0.2995	1081.	-2122.	-0.01227	0.00	1.91E+11	1758.	7044.	0.00
10.0000	-0.3142	0.00	0.00	-0.01227	0.00	1.91E+11	1779.	3397.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual

stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     1.25928905 inches
Computed slope at pile head      =    -0.01519723 radians
Maximum bending moment           =       1756067. inch-lbs
Maximum shear force              =        -36407. lbs
Depth of maximum bending moment  =     2.50000000 feet below pile head
Depth of maximum shear force     =     7.80000000 feet below pile head
Number of iterations             =             79
Number of zero deflection points =              1
```

Summary of Pile-head Responses for Conventional Analyses

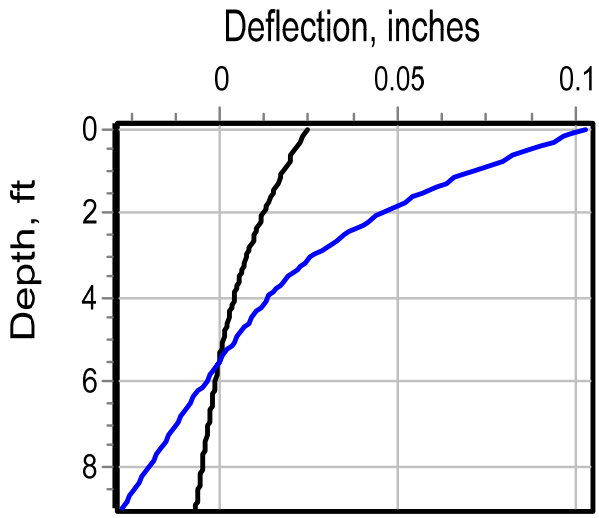
Definitions of Pile-head Loading Conditions:

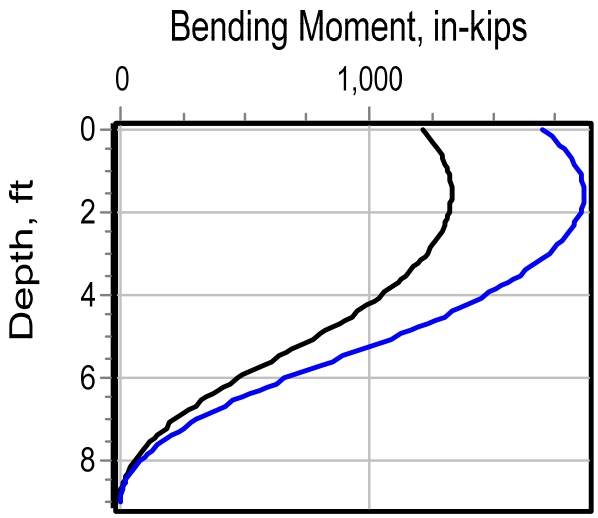
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

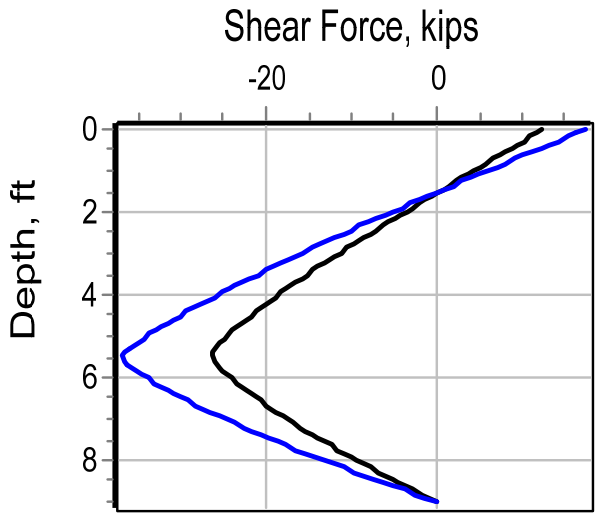
Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	12600.	M, in-lb	1058400.	15120.	0.3182	-0.00366	-25874.	1252810.
2	V, lb	17640.	M, in-lb	1481760.	13608.	1.2593	-0.01520	-36407.	1756067.

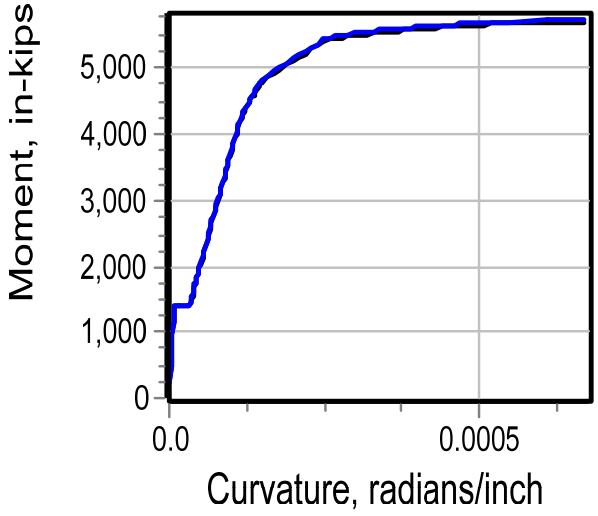
Maximum pile-head deflection = 1.2592890493 inches
Maximum pile-head rotation = -0.0151972292 radians = -0.870737 deg.

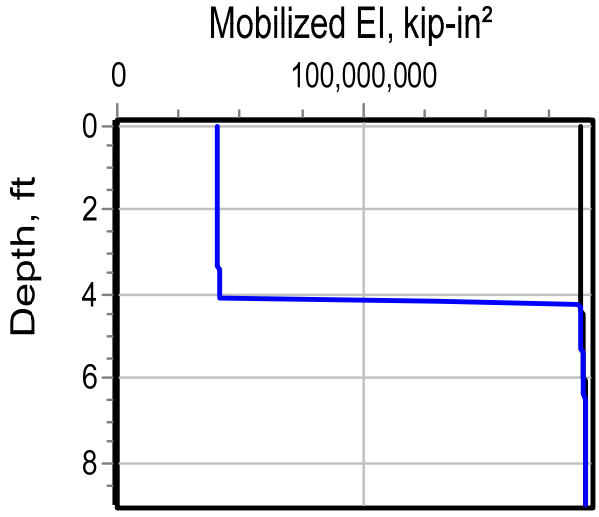
The analysis ended normally.

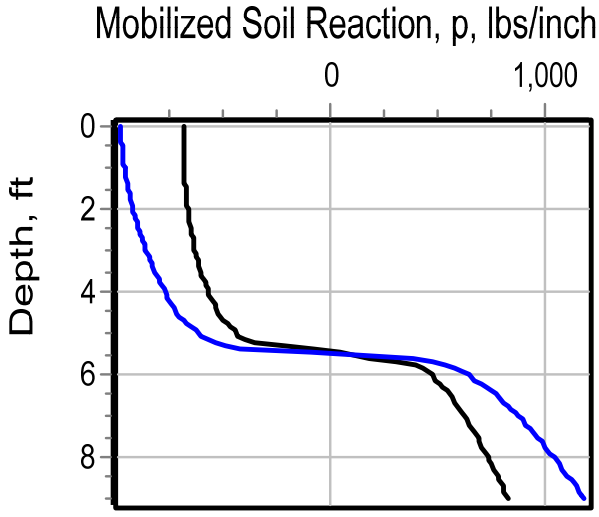

Deflection, inches
0
0.05
0.1
Depth, ft
0
2
4
6
8


Bending Moment, in-kips
0
1,000
Depth, ft
0
2
4
6
8


Shear Force, kips
-20
0
Depth, ft
0
2
4
6
8


Moment, in-kips
5,000
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch


Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
2
4
6
8


Mobilized Soil Reaction, p, lbs/inch
0
1,000
Depth, ft
0
2
4
6
8

==========

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2019\Noise Wall\LPILE\

Name of input data file:
SUM-8_NB1B_P27-P29.lp10

Name of output report file:

SUM-8_NB1B_P27-P29.lp10

Name of plot output file:
SUM-8_NB1B_P27-P29.lp10

Name of runtime message file:
SUM-8_NB1B_P27-P29.lp10

Date and Time of Analysis

Date: August 30, 2019 Time: 14:37:24

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1B_P25-P30

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	9.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 15.000000 ft
Effective unit weight at top of layer = 129.000000 pcf
Effective unit weight at bottom of layer = 129.000000 pcf
Undrained cohesion at top of layer = 4300. psf
Undrained cohesion at bottom of layer = 4300. psf
Epsilon-50 at top of layer = 0.004900
Epsilon-50 at bottom of layer = 0.004900

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 15.000000 ft
Distance from top of pile to bottom of layer = 25.000000 ft
Effective unit weight at top of layer = 150.000000 pcf
Effective unit weight at bottom of layer = 150.000000 pcf
Uniaxial compressive strength at top of layer = 200.000000 psi
Uniaxial compressive strength at bottom of layer = 200.000000 psi
Initial modulus of rock at top of layer = 900.000000 psi
Initial modulus of rock at bottom of layer = 900.000000 psi
RQD of rock at top of layer = 10.000000 %
RQD of rock at bottom of layer = 10.000000 %
k rm of rock at top of layer = 0.0005000
k rm of rock at bottom of layer = 0.0005000

(Depth of the lowest soil layer extends 16.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay w/o Free Water	0.00 15.0000	129.0000 129.0000	4300. 4300.	-- --	-- --	0.00490 0.00490	-- --
2	Weak Rock	15.0000 25.0000	150.0000 150.0000	-- --	200.0000 200.0000	10.0000 10.0000	5.00E-04 5.00E-04	900.0000 900.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 12600. lbs	M =	1209600. in-lbs		31680.	No
2	1	V = 17640. lbs	M =	1693440. in-lbs		28512.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 9.000000 ft
Shaft Diameter = 30.000000 in
Concrete Cover Thickness = 3.000000 in
Number of Reinforcing Bars = 10 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 706.858347 sq. in.
Total Area of Reinforcing Steel = 7.900000 sq. in.
Area Ratio of Steel Reinforcement = 1.12 percent
Edge-to-Edge Bar Spacing = 6.107391 in
Maximum Concrete Aggregate Size = 0.750000 in
Ratio of Bar Spacing to Aggregate Size = 8.14
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 3147.516 kips
Tensile Load for Cracking of Concrete = -334.148 kips
Nominal Axial Tensile Capacity = -474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150

9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete = 4500. psi
Modulus of Elasticity of Concrete = 3823676. psi
Modulus of Rupture of Concrete = -503.115295 psi
Compression Strain at Peak Stress = 0.002001
Tensile Strain at Fracture of Concrete = -0.0001152
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	28.512
2	31.680

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in

reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.

Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 28.512 kips

Bending Curvature	Bending Moment	Bending Stiffness	Depth to N Axis	Max Comp Strain	Max Tens Strain	Max Conc Stress	Max Steel Stress	Run Msg
rad/in.	in-kip	kip-in2	in	in/in	in/in	ksi	ksi	
0.00000125	238.5717239	190857379.	21.7895364	0.00002724	-0.00001026	0.1208577	0.7844332	
0.00000250	476.0662673	190426507.	18.4068387	0.00004602	-0.00002898	0.2029764	1.3236208	
0.00000375	712.1665112	189911070.	17.2796159	0.00006480	-0.00004770	0.2843234	1.8628457	
0.00000500	946.8632043	189372641.	16.7161058	0.00008358	-0.00006642	0.3648952	2.4020854	
0.00000625	1180.	188824829.	16.3780559	0.0001024	-0.00008514	0.4446911	2.9413351	
0.00000750	1412.	188272286.	16.1527292	0.0001211	-0.0001039	0.5237109	3.4805936	
0.00000875	1412.	161376245.	10.5713184	0.00009250	-0.0001700	0.4008495	-4.8919654	C
0.00001000	1412.	141204215.	10.2310331	0.0001023	-0.0001977	0.4420643	-5.6895004	C
0.00001125	1412.	125514858.	9.9581476	0.0001120	-0.0002255	0.4826779	-6.4897168	C

0.00001250	1412.	112963372.	9.7348746	0.0001217	-0.0002533	0.5228248
-7.2917329 C						
0.00001375	1412.	102693974.	9.5466555	0.0001313	-0.0002812	0.5624495
-8.0959586 C						
0.00001500	1412.	94136143.	9.3880705	0.0001408	-0.0003092	0.6017667
-8.9009393 C						
0.00001625	1412.	86894901.	9.2513132	0.0001503	-0.0003372	0.6407127
-9.7071311 C						
0.00001750	1412.	80688123.	9.1338922	0.0001598	-0.0003652	0.6794487
-10.5134247 C						
0.00001875	1412.	75308915.	9.0291884	0.0001693	-0.0003932	0.7177620
-11.3213163 C						
0.00002000	1412.	70602107.	8.9379115	0.0001788	-0.0004212	0.7559100
-12.1290113 C						
0.00002125	1412.	66449042.	8.8576933	0.0001882	-0.0004493	0.7938925
-12.9365090 C						
0.00002250	1412.	62757429.	8.7842350	0.0001976	-0.0004774	0.8314846
-13.7454116 C						
0.00002375	1412.	59454406.	8.7185338	0.0002071	-0.0005054	0.8688874
-14.5542973 C						
0.00002500	1412.	56481686.	8.6596805	0.0002165	-0.0005335	0.9061264
-15.3629816 C						
0.00002625	1412.	53792082.	8.6066976	0.0002259	-0.0005616	0.9432014
-16.1714639 C						
0.00002750	1412.	51346987.	8.5587857	0.0002354	-0.0005896	0.9801120
-16.9797433 C						
0.00002875	1412.	49114509.	8.5139659	0.0002448	-0.0006177	1.0167078
-17.7889183 C						
0.00003000	1412.	47068072.	8.4728146	0.0002542	-0.0006458	1.0531046
-18.5981512 C						
0.00003125	1412.	45185349.	8.4351854	0.0002636	-0.0006739	1.0893383
-19.4071757 C						
0.00003250	1412.	43447451.	8.4006728	0.0002730	-0.0007020	1.1254087
-20.2159908 C						
0.00003375	1426.	42265724.	8.3689315	0.0002825	-0.0007300	1.1613154
-21.0245957 C						
0.00003500	1471.	42022932.	8.3396652	0.0002919	-0.0007581	1.1970582
-21.8329897 C						

0.00003625	1515.	41795961.	8.3126187	0.0003013	-0.0007862	1.2326365 -22.6411720 C
0.00003750	1559.	41583224.	8.2875708	0.0003108	-0.0008142	1.2680501 -23.4491417 C
0.00003875	1604.	41383342.	8.2643288	0.0003202	-0.0008423	1.3032987 -24.2568979 C
0.00004000	1648.	41194935.	8.2424425	0.0003297	-0.0008703	1.3383394 -25.0647666 C
0.00004125	1692.	41016818.	8.2215464	0.0003391	-0.0008984	1.3731350 -25.8730375 C
0.00004250	1736.	40848388.	8.2020592	0.0003486	-0.0009264	1.4077665 -26.6810870 C
0.00004375	1780.	40688812.	8.1838606	0.0003580	-0.0009545	1.4422336 -27.4889142 C
0.00004500	1824.	40537349.	8.1668442	0.0003675	-0.0009825	1.4765358 -28.2965182 C
0.00004625	1868.	40393340.	8.1509147	0.0003770	-0.0010105	1.5106730 -29.1038981 C
0.00004750	1912.	40256193.	8.1359869	0.0003865	-0.0010385	1.5446446 -29.9110529 C
0.00004875	1956.	40125378.	8.1219846	0.0003959	-0.0010666	1.5784503 -30.7179817 C
0.00005125	2044.	39880879.	8.0964878	0.0004149	-0.0011226	1.6455626 -32.3311573 C
0.00005375	2132.	39656552.	8.0739503	0.0004340	-0.0011785	1.7120069 -33.9434173 C
0.00005625	2219.	39449688.	8.0539822	0.0004530	-0.0012345	1.7777802 -35.5547538 C
0.00005875	2306.	39258039.	8.0362603	0.0004721	-0.0012904	1.8428794 -37.1651588 C
0.00006125	2394.	39079727.	8.0205141	0.0004913	-0.0013462	1.9073013 -38.7746242 C
0.00006375	2481.	38913164.	8.0065155	0.0005104	-0.0014021	1.9710429 -40.3831417 C
0.00006625	2568.	38757005.	7.9940712	0.0005296	-0.0014579	2.0341010 -41.9907030 C
0.00006875	2654.	38610098.	7.9830158	0.0005488	-0.0015137	2.0964723 -43.5972995 C

0.00007125	2741.	38471453.	7.9732073	0.0005681	-0.0015694	2.1581537 -45.2029226 C
0.00007375	2828.	38340215.	7.9645231	0.0005874	-0.0016251	2.2191417 -46.8075635 C
0.00007625	2914.	38215635.	7.9568565	0.0006067	-0.0016808	2.2794328 -48.4112153 C
0.00007875	3000.	38097075.	7.9501148	0.0006261	-0.0017364	2.3390242 -50.0138644 C
0.00008125	3086.	37983925.	7.9439703	0.0006454	-0.0017921	2.3978508 -51.6160822 C
0.00008375	3172.	37875719.	7.9386240	0.0006649	-0.0018476	2.4559748 -53.2172555 C
0.00008625	3258.	37772023.	7.9340149	0.0006843	-0.0019032	2.5133942 -54.8173585 C
0.00008875	3343.	37672439.	7.9300848	0.0007038	-0.0019587	2.5701053 -56.4163822 C
0.00009125	3429.	37576614.	7.9267821	0.0007233	-0.0020142	2.6261043 -58.0143158 C
0.00009375	3514.	37484232.	7.9240604	0.0007429	-0.0020696	2.6813873 -59.6111483 C
0.00009625	3599.	37395013.	7.9218787	0.0007625	-0.0021250	2.7359507 -60.0000000 CY
0.00009875	3684.	37308700.	7.9201998	0.0007821	-0.0021804	2.7897905 -60.0000000 CY
0.0001013	3769.	37225066.	7.9189904	0.0008018	-0.0022357	2.8429028 -60.0000000 CY
0.0001038	3854.	37143902.	7.9182204	0.0008215	-0.0022910	2.8952835 -60.0000000 CY
0.0001063	3938.	37065021.	7.9178629	0.0008413	-0.0023462	2.9469286 -60.0000000 CY
0.0001088	4022.	36988251.	7.9178931	0.0008611	-0.0024014	2.9978339 -60.0000000 CY
0.0001113	4107.	36913045.	7.9182612	0.0008809	-0.0024566	3.0479875 -60.0000000 CY
0.0001138	4186.	36800655.	7.9161600	0.0009005	-0.0025120	3.0965885 -60.0000000 CY
0.0001163	4249.	36551826.	7.9042420	0.0009189	-0.0025686	3.1415173 -60.0000000 CY

0.0001188	4296.	36176500.	7.8829352	0.0009361	-0.0026264	3.1828582
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0.0001213	4340.	35795596.	7.8611904	0.0009532	-0.0026843	3.2231779
-60.0000000 CY						
0.0001238	4384.	35429390.	7.8405393	0.0009703	-0.0027422	3.2629335
-60.0000000 CY						
0.0001263	4428.	35077001.	7.8209184	0.0009874	-0.0028001	3.3021227
-60.0000000 CY						
0.0001288	4472.	34737622.	7.8022695	0.0010045	-0.0028580	3.3407428
-60.0000000 CY						
0.0001313	4516.	34410503.	7.7845386	0.0010217	-0.0029158	3.3787912
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0.0001338	4560.	34094953.	7.7676758	0.0010389	-0.0029736	3.4162655
-60.0000000 CY						
0.0001363	4604.	33790329.	7.7516350	0.0010562	-0.0030313	3.4531628
-60.0000000 CY						
0.0001388	4648.	33496038.	7.7363733	0.0010734	-0.0030891	3.4894806
-60.0000000 CY						
0.0001413	4691.	33211525.	7.7218510	0.0010907	-0.0031468	3.5252161
-60.0000000 CY						
0.0001438	4734.	32931712.	7.7076009	0.0011080	-0.0032045	3.5602395
-60.0000000 CY						
0.0001463	4770.	32616103.	7.6897154	0.0011246	-0.0032629	3.5934051
-60.0000000 CY						
0.0001488	4798.	32255059.	7.6671454	0.0011405	-0.0033220	3.6244156
-60.0000000 CY						
0.0001588	4866.	30654248.	7.5537439	0.0011992	-0.0035633	3.7341807
-60.0000000 CY						
0.0001688	4930.	29211884.	7.4518918	0.0012575	-0.0038050	3.8360467
-60.0000000 CY						
0.0001788	4992.	27927104.	7.3631579	0.0013162	-0.0040463	3.9311381
-60.0000000 CY						
0.0001888	5053.	26771330.	7.2814074	0.0013744	-0.0042881	4.0182118
-60.0000000 CY						
0.0001988	5113.	25727860.	7.2087542	0.0014327	-0.0045298	4.0982898
-60.0000000 CY						
0.0002088	5173.	24781074.	7.1446352	0.0014914	-0.0047711	4.1714940
-60.0000000 CY						

0.0002188	5232.	23917634.	7.0879194	0.0015505	-0.0050120	4.2377070
-60.0000000 CY						
0.0002288	5290.	23126031.	7.0368255	0.0016097	-0.0052528	4.2966210
-60.0000000 CY						
0.0002388	5347.	22396361.	6.9891577	0.0016687	-0.0054938	4.3478829
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0.0002488	5401.	21710592.	6.9442597	0.0017274	-0.0057351	4.3915295
-60.0000000 CY						
0.0002588	5440.	21023383.	6.8926921	0.0017835	-0.0059790	4.4263111
-60.0000000 CY						
0.0002688	5461.	20319142.	6.8307843	0.0018358	-0.0062267	4.4526478
-60.0000000 CY						
0.0002788	5474.	19639016.	6.7682920	0.0018867	-0.0064758	4.4726958
-60.0000000 CY						
0.0002888	5487.	19002427.	6.7077530	0.0019369	-0.0067256	4.4870947
-60.0000000 CY						
0.0002988	5499.	18406328.	6.6507392	0.0019869	-0.0069756	4.4961399
-60.0000000 CY						
0.0003088	5510.	17847740.	6.5983264	0.0020372	-0.0072253	4.4998927
-60.0000000 CY						
0.0003188	5522.	17322867.	6.5502275	0.0020879	-0.0074746	4.4964435
-60.0000000 CY						
0.0003288	5532.	16828861.	6.5059334	0.0021388	-0.0077237	4.4998919
60.0000000 CY						
0.0003388	5543.	16362656.	6.4653000	0.0021901	-0.0079724	4.4953034
60.0000000 CY						
0.0003488	5553.	15921183.	6.4256658	0.0022410	-0.0082215	4.4994898
60.0000000 CY						
0.0003588	5562.	15502615.	6.3877765	0.0022916	-0.0084709	4.4917994
60.0000000 CY						
0.0003688	5570.	15105836.	6.3527846	0.0023426	-0.0087199	4.4976940
60.0000000 CY						
0.0003788	5579.	14729377.	6.3202922	0.0023938	-0.0089687	4.4999765
60.0000000 CY						
0.0003888	5587.	14371227.	6.2904342	0.0024454	-0.0092171	4.4927872
60.0000000 CY						
0.0003988	5595.	14030472.	6.2626785	0.0024972	-0.0094653	4.4980393
60.0000000 CY						

0.0004088	5602.	13705880.	6.2368417	0.0025493	-0.0097132	4.4999885
60.0000000 CY						
0.0004188	5610.	13395865.	6.2131290	0.0026017	-0.0099608	4.4909176
60.0000000 CY						
0.0004288	5617.	13099869.	6.1910303	0.0026544	-0.0102081	4.4967550
60.0000000 CY						
0.0004388	5623.	12816963.	6.1704142	0.0027073	-0.0104552	4.4996612
60.0000000 CY						
0.0004488	5630.	12546034.	6.1513904	0.0027604	-0.0107021	4.4927573
60.0000000 CY						
0.0004588	5636.	12285908.	6.1318816	0.0028130	-0.0109495	4.4923938
60.0000000 CY						
0.0004688	5642.	12036564.	6.1134525	0.0028657	-0.0111968	4.4972926
60.0000000 CY						
0.0004788	5648.	11797355.	6.0961966	0.0029186	-0.0114439	4.4997229
60.0000000 CY						
0.0004888	5654.	11567460.	6.0802646	0.0029717	-0.0116908	4.4932570
60.0000000 CY						
0.0004988	5659.	11346389.	6.0655033	0.0030252	-0.0119373	4.4892668
60.0000000 CYT						
0.0005088	5664.	11133798.	6.0516537	0.0030788	-0.0121837	4.4950133
60.0000000 CYT						
0.0005188	5670.	10929193.	6.0386707	0.0031326	-0.0124299	4.4985976
60.0000000 CYT						
0.0005288	5675.	10732116.	6.0265128	0.0031865	-0.0126760	4.4999832
60.0000000 CYT						
0.0005388	5679.	10541875.	6.0154668	0.0032408	-0.0129217	4.4895136
60.0000000 CYT						
0.0005488	5684.	10358372.	6.0051408	0.0032953	-0.0131672	4.4876800
60.0000000 CYT						
0.0006088	5710.	9380338.	5.9564298	0.0036260	-0.0146365	4.4864826
60.0000000 CYT						
0.0006688	5710.	8538738.	5.9552249	0.0039826	-0.0160799	4.4825187
60.0000000 CYT						

Axial Thrust Force = 31.680 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.4963735	190797099.	22.5445820	0.00002818	-0.00000932	0.1250450	0.8118036	
0.00000250	475.9833906	190393356.	18.7855367	0.00004696	-0.00002804	0.2071371	1.3510764	
0.00000375	712.0816753	189888447.	17.5329733	0.00006575	-0.00004675	0.2884591	1.8903984	
0.00000500	946.7772570	189355451.	16.9068180	0.00008453	-0.00006547	0.3690061	2.4297386	
0.00000625	1180.	188810938.	16.5311914	0.0001033	-0.00008418	0.4487773	2.9690910	
0.00000750	1412.	188260607.	16.2808200	0.0001221	-0.0001029	0.5277722	3.5084534	
0.00000875	1412.	161366234.	10.8691544	0.00009511	-0.0001674	0.4120308	-4.8163896	C
0.00001000	1412.	141195455.	10.5019977	0.0001050	-0.0001950	0.4536311	-5.6109207	C
0.00001125	1412.	125507071.	10.2068289	0.0001148	-0.0002227	0.4945602	-6.4085846	C
0.00001250	1412.	112956364.	9.9642987	0.0001246	-0.0002504	0.5349436	-7.2085667	C
0.00001375	1412.	102687604.	9.7619306	0.0001342	-0.0002783	0.5748952	-8.0101176	C
0.00001500	1412.	94130303.	9.5881815	0.0001438	-0.0003062	0.6143242	-8.8138910	C
0.00001625	1412.	86889511.	9.4408974	0.0001534	-0.0003341	0.6535362	-9.6177896	C
0.00001750	1412.	80683117.	9.3107108	0.0001629	-0.0003621	0.6922637	-10.4236892	C
0.00001875	1412.	75304243.	9.1982426	0.0001725	-0.0003900	0.7308232	-11.2293930	C
0.00002000	1412.	70597728.	9.0982893	0.0001820	-0.0004180	0.7690599		

-12.0359922 C						
0.00002125	1412.	66444920.	9.0088107	0.0001914	-0.0004461	0.8069905
-12.8433828 C						
0.00002250	1412.	62753536.	8.9295784	0.0002009	-0.0004741	0.8447550
-13.6505751 C						
0.00002375	1412.	59450718.	8.8589754	0.0002104	-0.0005021	0.8823532
-14.4575681 C						
0.00002500	1412.	56478182.	8.7935939	0.0002198	-0.0005302	0.9195725
-15.2658943 C						
0.00002625	1412.	53788745.	8.7343897	0.0002293	-0.0005582	0.9565941
-16.0742583 C						
0.00002750	1412.	51343802.	8.6808226	0.0002387	-0.0005863	0.9934513
-16.8824189 C						
0.00002875	1412.	49111463.	8.6321584	0.0002482	-0.0006143	1.0301435
-17.6903754 C						
0.00003000	1412.	47065152.	8.5877850	0.0002576	-0.0006424	1.0666705
-18.4981270 C						
0.00003125	1412.	45182546.	8.5470812	0.0002671	-0.0006704	1.1030188
-19.3057701 C						
0.00003250	1412.	43444755.	8.5084040	0.0002765	-0.0006985	1.1390342
-20.1144542 C						
0.00003375	1450.	42965183.	8.4728071	0.0002860	-0.0007265	1.1748857
-20.9229275 C						
0.00003500	1494.	42696882.	8.4399613	0.0002954	-0.0007546	1.2105731
-21.7311892 C						
0.00003625	1539.	42446158.	8.4095827	0.0003048	-0.0007827	1.2460959
-22.5392386 C						
0.00003750	1583.	42211251.	8.3814255	0.0003143	-0.0008107	1.2814538
-23.3470746 C						
0.00003875	1627.	41990627.	8.3552754	0.0003238	-0.0008387	1.3166466
-24.1546966 C						
0.00004000	1671.	41782944.	8.3309450	0.0003332	-0.0008668	1.3516737
-24.9621037 C						
0.00004125	1715.	41587022.	8.3082695	0.0003427	-0.0008948	1.3865349
-25.7692950 C						
0.00004250	1760.	41401821.	8.2871037	0.0003522	-0.0009228	1.4212298
-26.5762696 C						
0.00004375	1804.	41226419.	8.2673187	0.0003617	-0.0009508	1.4557581

-27.3830267 C						
0.00004500	1848.	41059970.	8.2487535	0.0003712	-0.0009788	1.4901117
-28.1896265 C						
0.00004625	1892.	40901411.	8.2307217	0.0003807	-0.0010068	1.5241907
-28.9968568 C						
0.00004750	1936.	40750478.	8.2138029	0.0003902	-0.0010348	1.5581041
-29.8038613 C						
0.00004875	1980.	40606582.	8.1979122	0.0003996	-0.0010629	1.5918513
-30.6106390 C						
0.00005125	2067.	40337831.	8.1689164	0.0004187	-0.0011188	1.6588462
-32.2235103 C						
0.00005375	2155.	40091501.	8.1432074	0.0004377	-0.0011748	1.7251723
-33.8354628 C						
0.00005625	2242.	39864584.	8.1203517	0.0004568	-0.0012307	1.7908265
-35.4464886 C						
0.00005875	2330.	39654584.	8.0999898	0.0004759	-0.0012866	1.8558059
-37.0565797 C						
0.00006125	2417.	39459412.	8.0818209	0.0004950	-0.0013425	1.9201072
-38.6657279 C						
0.00006375	2504.	39277306.	8.0655915	0.0005142	-0.0013983	1.9837274
-40.2739250 C						
0.00006625	2591.	39106770.	8.0510865	0.0005334	-0.0014541	2.0466632
-41.8811624 C						
0.00006875	2678.	38946527.	8.0381219	0.0005526	-0.0015099	2.1089115
-43.4874317 C						
0.00007125	2764.	38795478.	8.0265400	0.0005719	-0.0015656	2.1704689
-45.0927241 C						
0.00007375	2851.	38652670.	8.0162041	0.0005912	-0.0016213	2.2313321
-46.6970307 C						
0.00007625	2937.	38517279.	8.0069959	0.0006105	-0.0016770	2.2914977
-48.3003426 C						
0.00007875	3023.	38388584.	7.9988119	0.0006299	-0.0017326	2.3509625
-49.9026505 C						
0.00008125	3109.	38265946.	7.9915616	0.0006493	-0.0017882	2.4097226
-51.5039472 C						
0.00008375	3195.	38148819.	7.9851653	0.0006688	-0.0018437	2.4677751
-53.1042188 C						
0.00008625	3281.	38036704.	7.9795525	0.0006882	-0.0018993	2.5251161

-54.7034581 C						
0.00008875	3366.	37929162.	7.9746608	0.0007078	-0.0019547	2.5817421
-56.3016551 C						
0.00009125	3452.	37825805.	7.9704348	0.0007273	-0.0020102	2.6376494
-57.8988001 C						
0.00009375	3537.	37726284.	7.9668249	0.0007469	-0.0020656	2.6928344
-59.4948827 C						
0.00009625	3622.	37630286.	7.9637869	0.0007665	-0.0021210	2.7472932
-60.0000000 CY						
0.00009875	3707.	37537529.	7.9612809	0.0007862	-0.0021763	2.8010222
-60.0000000 CY						
0.0001013	3792.	37447761.	7.9592712	0.0008059	-0.0022316	2.8540173
-60.0000000 CY						
0.0001038	3876.	37360752.	7.9577256	0.0008256	-0.0022869	2.9062748
-60.0000000 CY						
0.0001063	3961.	37276293.	7.9566149	0.0008454	-0.0023421	2.9577907
-60.0000000 CY						
0.0001088	4045.	37194196.	7.9559128	0.0008652	-0.0023973	3.0085608
-60.0000000 CY						
0.0001113	4129.	37114289.	7.9555951	0.0008851	-0.0024524	3.0585812
-60.0000000 CY						
0.0001138	4209.	37006005.	7.9535363	0.0009047	-0.0025078	3.1072489
-60.0000000 CY						
0.0001163	4274.	36764285.	7.9419598	0.0009233	-0.0025642	3.1523330
-60.0000000 CY						
0.0001188	4322.	36394583.	7.9207394	0.0009406	-0.0026219	3.1937612
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0.0001213	4366.	36008906.	7.8983104	0.0009577	-0.0026798	3.2339399
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0.0001238	4410.	35638115.	7.8770035	0.0009748	-0.0027377	3.2735537
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0.0001263	4454.	35281323.	7.8567538	0.0009919	-0.0027956	3.3126001
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0.0001288	4498.	34937708.	7.8375014	0.0010091	-0.0028534	3.3510765
-60.0000000 CY						
0.0001313	4542.	34606514.	7.8191909	0.0010263	-0.0029112	3.3889805
-60.0000000 CY						
0.0001338	4586.	34287038.	7.8017712	0.0010435	-0.0029690	3.4263092

-60.0000000 CY						
0.0001363	4630.	33978631.	7.7851947	0.0010607	-0.0030268	3.4630602
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0.0001388	4673.	33680690.	7.7694176	0.0010780	-0.0030845	3.4992306
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0.0001413	4717.	33392655.	7.7543991	0.0010953	-0.0031422	3.5348178
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0.0001438	4760.	33110029.	7.7397254	0.0011126	-0.0031999	3.5697086
-60.0000000 CY						
0.0001463	4797.	32797856.	7.7220174	0.0011293	-0.0032582	3.6029187
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0.0001488	4826.	32442048.	7.6998116	0.0011453	-0.0033172	3.6340309
-60.0000000 CY						
0.0001588	4895.	30837412.	7.5870735	0.0012044	-0.0035581	3.7439683
-60.0000000 CY						
0.0001688	4958.	29383618.	7.4834747	0.0012628	-0.0037997	3.8452240
-60.0000000 CY						
0.0001788	5021.	28088678.	7.3931974	0.0013215	-0.0040410	3.9396938
-60.0000000 CY						
0.0001888	5082.	26925349.	7.3118876	0.0013801	-0.0042824	4.0266429
-60.0000000 CY						
0.0001988	5142.	25873609.	7.2379447	0.0014385	-0.0045240	4.1060496
-60.0000000 CY						
0.0002088	5202.	24919335.	7.1726685	0.0014973	-0.0047652	4.1785681
-60.0000000 CY						
0.0002188	5261.	24049079.	7.1149102	0.0015564	-0.0050061	4.2440802
-60.0000000 CY						
0.0002288	5319.	23251737.	7.0637240	0.0016158	-0.0052467	4.3024628
-60.0000000 CY						
0.0002388	5376.	22516837.	7.0161078	0.0016751	-0.0054874	4.3531580
-60.0000000 CY						
0.0002488	5430.	21827419.	6.9707478	0.0017340	-0.0057285	4.3960825
-60.0000000 CY						
0.0002588	5470.	21139314.	6.9192955	0.0017904	-0.0059721	4.4302203
-60.0000000 CY						
0.0002688	5492.	20435719.	6.8578382	0.0018430	-0.0062195	4.4559434
-60.0000000 CY						
0.0002788	5506.	19751473.	6.7946347	0.0018940	-0.0064685	4.4752082

-60.0000000 CY						
0.0002888	5519.	19112216.	6.7355419	0.0019449	-0.0067176	4.4889554
-60.0000000 CY						
0.0002988	5531.	18512143.	6.6777921	0.0019950	-0.0069675	4.4971313
-60.0000000 CY						
0.0003088	5542.	17949837.	6.6246986	0.0020454	-0.0072171	4.4999970
-60.0000000 CY						
0.0003188	5553.	17421429.	6.5759924	0.0020961	-0.0074664	4.4974063
-60.0000000 CY						
0.0003288	5564.	16924153.	6.5311058	0.0021471	-0.0077154	4.4999974
60.0000000 CY						
0.0003388	5574.	16454794.	6.4899636	0.0021985	-0.0079640	4.4964391
60.0000000 CY						
0.0003488	5584.	16011474.	6.4519534	0.0022501	-0.0082124	4.4998344
60.0000000 CY						
0.0003588	5593.	15590137.	6.4138007	0.0023010	-0.0084615	4.4934330
60.0000000 CY						
0.0003688	5602.	15190774.	6.3783033	0.0023520	-0.0087105	4.4985527
60.0000000 CY						
0.0003788	5610.	14811797.	6.3453872	0.0024033	-0.0089592	4.4981485
60.0000000 CY						
0.0003888	5618.	14451285.	6.3151134	0.0024550	-0.0092075	4.4944116
60.0000000 CY						
0.0003988	5626.	14108341.	6.2869261	0.0025069	-0.0094556	4.4988421
60.0000000 CY						
0.0004088	5633.	13781577.	6.2607533	0.0025591	-0.0097034	4.4975323
60.0000000 CY						
0.0004188	5640.	13469560.	6.2366742	0.0026116	-0.0099509	4.4928009
60.0000000 CY						
0.0004288	5647.	13171691.	6.2141994	0.0026643	-0.0101982	4.4978440
60.0000000 CY						
0.0004388	5654.	12886995.	6.1932300	0.0027173	-0.0104452	4.4999393
60.0000000 CY						
0.0004488	5661.	12614243.	6.1739706	0.0027706	-0.0106919	4.4889560
60.0000000 CY						
0.0004588	5667.	12352976.	6.1560327	0.0028241	-0.0109384	4.4943049
60.0000000 CY						
0.0004688	5673.	12102240.	6.1379810	0.0028772	-0.0111853	4.4984126

60.0000000 CY						
0.0004788	5679.	11861529.	6.1204106	0.0029301	-0.0114324	4.4999810
60.0000000 CY						
0.0004888	5684.	11630074.	6.1043121	0.0029835	-0.0116790	4.4888478
60.0000000 CY						
0.0004988	5690.	11407641.	6.0892462	0.0030370	-0.0119255	4.4917107
60.0000000 CYT						
0.0005088	5695.	11193739.	6.0751093	0.0030907	-0.0121718	4.4966402
60.0000000 CYT						
0.0005188	5700.	10987871.	6.0618553	0.0031446	-0.0124179	4.4993901
60.0000000 CYT						
0.0005288	5705.	10789490.	6.0495471	0.0031987	-0.0126638	4.4968795
60.0000000 CYT						
0.0005388	5710.	10598056.	6.0382842	0.0032531	-0.0129094	4.4849020
60.0000000 CYT						
0.0005488	5714.	10413443.	6.0277049	0.0033077	-0.0131548	4.4904221
60.0000000 CYT						
0.0006088	5740.	9429407.	5.9778360	0.0036390	-0.0146235	4.4895044
60.0000000 CYT						
0.0006688	5740.	8583404.	5.9759234	0.0039964	-0.0160661	4.4861842
60.0000000 CYT						

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	28.512	5656.461	0.00300000
2	31.680	5685.853	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5656.	18.532800	3677.	37316354.
2	0.65	5686.	20.592000	3696.	37549574.
1	0.70	5656.	19.958400	3960.	37045568.
2	0.70	5686.	22.176000	3980.	37257303.
1	0.75	5656.	21.384000	4242.	36578668.
2	0.75	5686.	23.760000	4264.	36799778.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	390386.

2	15.0000	15.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 12600.0 lbs
Applied moment at pile head = 1209600.0 in-lbs
Axial thrust load on pile head = 31680.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.02449	1209600.	12600.	-5.90E-04	0.00	1.89E+11	-682.9130	15057.	0.00
0.09000	0.02386	1222830.	11862.	-5.83E-04	0.00	1.89E+11	-683.1359	30923.	0.00
0.1800	0.02323	1235263.	11124.	-5.76E-04	0.00	1.89E+11	-683.2619	31762.	0.00
0.2700	0.02261	1246898.	10387.	-5.69E-04	0.00	1.89E+11	-683.2899	32632.	0.00
0.3600	0.02200	1257736.	9649.	-5.62E-04	0.00	1.89E+11	-683.2188	33534.	0.00

0.4500	0.02140	1267778.	8911.	-5.55E-04	0.00	1.89E+11	-683.0475	34470.	0.00
0.5400	0.02081	1277022.	8173.	-5.47E-04	0.00	1.89E+11	-682.7746	35442.	0.00
0.6300	0.02022	1285469.	7436.	-5.40E-04	0.00	1.89E+11	-682.3990	36451.	0.00
0.7200	0.01964	1293121.	6699.	-5.33E-04	0.00	1.89E+11	-681.9194	37499.	0.00
0.8100	0.01907	1299976.	5963.	-5.25E-04	0.00	1.89E+11	-681.3342	38590.	0.00
0.9000	0.01851	1306037.	5228.	-5.18E-04	0.00	1.88E+11	-680.6420	39724.	0.00
0.9900	0.01795	1311304.	4493.	-5.10E-04	0.00	1.88E+11	-679.8413	40904.	0.00
1.0800	0.01740	1315777.	3759.	-5.03E-04	0.00	1.88E+11	-678.9304	42133.	0.00
1.1700	0.01686	1319458.	3027.	-4.95E-04	0.00	1.88E+11	-677.9076	43414.	0.00
1.2600	0.01633	1322349.	2295.	-4.88E-04	0.00	1.88E+11	-676.7711	44749.	0.00
1.3500	0.01581	1324449.	1565.	-4.80E-04	0.00	1.88E+11	-675.5188	46142.	0.00
1.4400	0.01530	1325762.	836.0750	-4.72E-04	0.00	1.88E+11	-674.1487	47596.	0.00
1.5300	0.01479	1326287.	108.7991	-4.65E-04	0.00	1.88E+11	-672.6586	49116.	0.00
1.6200	0.01429	1326028.	-616.8015	-4.57E-04	0.00	1.88E+11	-671.0461	50705.	0.00
1.7100	0.01380	1324986.	-1341.	-4.50E-04	0.00	1.88E+11	-669.3087	52368.	0.00
1.8000	0.01332	1323164.	-2062.	-4.42E-04	0.00	1.88E+11	-667.4436	54109.	0.00
1.8900	0.01285	1320562.	-2782.	-4.34E-04	0.00	1.88E+11	-665.4479	55934.	0.00
1.9800	0.01238	1317184.	-3500.	-4.27E-04	0.00	1.88E+11	-663.3185	57849.	0.00
2.0700	0.01193	1313032.	-4215.	-4.19E-04	0.00	1.88E+11	-661.0519	59860.	0.00

2.1600	0.01148	1308108.	-4928.	-4.12E-04	0.00	1.88E+11	-658.6445	61975.
0.00								
2.2500	0.01104	1302416.	-5637.	-4.04E-04	0.00	1.88E+11	-656.0922	64200.
0.00								
2.3400	0.01060	1295959.	-6345.	-3.97E-04	0.00	1.89E+11	-653.3907	66544.
0.00								
2.4300	0.01018	1288739.	-7049.	-3.89E-04	0.00	1.89E+11	-650.5354	69016.
0.00								
2.5200	0.00976	1280760.	-7750.	-3.82E-04	0.00	1.89E+11	-647.5209	71628.
0.00								
2.6100	0.00935	1272026.	-8447.	-3.75E-04	0.00	1.89E+11	-644.3418	74391.
0.00								
2.7000	0.00895	1262540.	-9141.	-3.68E-04	0.00	1.89E+11	-640.9917	77318.
0.00								
2.7900	0.00856	1252306.	-9832.	-3.60E-04	0.00	1.89E+11	-637.4639	80423.
0.00								
2.8800	0.00818	1241328.	-10518.	-3.53E-04	0.00	1.89E+11	-633.7507	83723.
0.00								
2.9700	0.00780	1229611.	-11201.	-3.46E-04	0.00	1.89E+11	-629.8440	87236.
0.00								
3.0600	0.00743	1217159.	-11879.	-3.39E-04	0.00	1.89E+11	-625.7344	90985.
0.00								
3.1500	0.00707	1203976.	-12552.	-3.32E-04	0.00	1.89E+11	-621.4116	94992.
0.00								
3.2400	0.00671	1190069.	-13221.	-3.25E-04	0.00	1.89E+11	-616.8642	99287.
0.00								
3.3300	0.00636	1175442.	-13884.	-3.19E-04	0.00	1.89E+11	-612.0792	103901.
0.00								
3.4200	0.00602	1160101.	-14543.	-3.12E-04	0.00	1.89E+11	-607.0419	108872.
0.00								
3.5100	0.00569	1144051.	-15195.	-3.05E-04	0.00	1.89E+11	-601.7361	114244.
0.00								
3.6000	0.00536	1127300.	-15842.	-2.99E-04	0.00	1.89E+11	-596.1429	120068.
0.00								
3.6900	0.00504	1109852.	-16483.	-2.92E-04	0.00	1.89E+11	-590.2410	126405.
0.00								
3.7800	0.00473	1091717.	-17117.	-2.86E-04	0.00	1.89E+11	-584.0057	133330.
0.00								

3.8700	0.00442	1072899.	-17744.	-2.80E-04	0.00	1.89E+11	-577.4086	140931.
0.00								
3.9600	0.00413	1053408.	-18364.	-2.74E-04	0.00	1.89E+11	-570.4165	149316.
0.00								
4.0500	0.00383	1033252.	-18976.	-2.68E-04	0.00	1.89E+11	-562.9904	158620.
0.00								
4.1400	0.00355	1012439.	-19580.	-2.62E-04	0.00	1.89E+11	-555.0841	169010.
0.00								
4.2300	0.00327	990978.	-20175.	-2.56E-04	0.00	1.89E+11	-546.6423	180702.
0.00								
4.3200	0.00299	968879.	-20760.	-2.51E-04	0.00	1.89E+11	-537.5978	193970.
0.00								
4.4100	0.00273	946153.	-21336.	-2.45E-04	0.00	1.89E+11	-527.8684	209179.
0.00								
4.5000	0.00246	922811.	-21900.	-2.40E-04	0.00	1.89E+11	-517.3513	226819.
0.00								
4.5900	0.00221	898865.	-22453.	-2.35E-04	0.00	1.89E+11	-505.9158	247570.
0.00								
4.6800	0.00196	874330.	-22992.	-2.30E-04	0.00	1.89E+11	-493.3922	272399.
0.00								
4.7700	0.00171	849218.	-23518.	-2.25E-04	0.00	1.90E+11	-479.5538	302744.
0.00								
4.8600	0.00147	823547.	-24027.	-2.20E-04	0.00	1.90E+11	-464.0870	340839.
0.00								
4.9500	0.00124	797335.	-24519.	-2.15E-04	0.00	1.90E+11	-446.5396	390376.
0.00								
5.0400	0.00101	770601.	-24990.	-2.11E-04	0.00	1.90E+11	-426.2196	457966.
0.00								
5.1300	7.80E-04	743370.	-25437.	-2.07E-04	0.00	1.90E+11	-401.9807	556856.
0.00								
5.2200	5.59E-04	715671.	-25845.	-2.03E-04	0.00	1.90E+11	-352.1662	680776.
0.00								
5.3100	3.42E-04	687560.	-26152.	-1.99E-04	0.00	1.90E+11	-216.7309	684131.
0.00								
5.4000	1.30E-04	659196.	-26313.	-1.95E-04	0.00	1.90E+11	-82.6382	687486.
0.00								
5.4900	-7.85E-05	630736.	-26331.	-1.91E-04	0.00	1.90E+11	50.1846	690841.
0.00								

5.5800	-2.83E-04	602335.	-26206.	-1.88E-04	0.00	1.90E+11	181.8126	694196.
0.00								
5.6700	-4.84E-04	574145.	-25939.	-1.84E-04	0.00	1.90E+11	312.3232	697550.
0.00								
5.7600	-6.81E-04	546319.	-25553.	-1.81E-04	0.00	1.90E+11	402.0786	637896.
0.00								
5.8500	-8.75E-04	518963.	-25104.	-1.78E-04	0.00	1.90E+11	430.1183	531144.
0.00								
5.9400	-0.00107	492107.	-24626.	-1.75E-04	0.00	1.90E+11	454.0079	460302.
0.00								
6.0300	-0.00125	465782.	-24125.	-1.72E-04	0.00	1.90E+11	475.0439	409498.
0.00								
6.1200	-0.00144	440010.	-23601.	-1.70E-04	0.00	1.90E+11	493.9879	371096.
0.00								
6.2100	-0.00162	414815.	-23058.	-1.67E-04	0.00	1.90E+11	511.3287	340941.
0.00								
6.3000	-0.00180	390215.	-22498.	-1.65E-04	0.00	1.90E+11	527.4006	316566.
0.00								
6.3900	-0.00198	366231.	-21920.	-1.63E-04	0.00	1.91E+11	542.4429	296410.
0.00								
6.4800	-0.00215	342880.	-21326.	-1.61E-04	0.00	1.91E+11	556.6332	279434.
0.00								
6.5700	-0.00232	320177.	-20718.	-1.59E-04	0.00	1.91E+11	570.1077	264918.
0.00								
6.6600	-0.00250	298140.	-20095.	-1.57E-04	0.00	1.91E+11	582.9728	252345.
0.00								
6.7500	-0.00266	276783.	-19459.	-1.56E-04	0.00	1.91E+11	595.3139	241337.
0.00								
6.8400	-0.00283	256119.	-18810.	-1.54E-04	0.00	1.91E+11	607.2001	231608.
0.00								
6.9300	-0.00300	236164.	-18148.	-1.53E-04	0.00	1.91E+11	618.6886	222937.
0.00								
7.0200	-0.00316	216931.	-17473.	-1.52E-04	0.00	1.91E+11	629.8270	215154.
0.00								
7.1100	-0.00332	198432.	-16787.	-1.50E-04	0.00	1.91E+11	640.6557	208123.
0.00								
7.2000	-0.00349	180681.	-16090.	-1.49E-04	0.00	1.91E+11	651.2089	201734.
0.00								

7.2900	-0.00365	163689.	-15381.	-1.48E-04	0.00	1.91E+11	661.5160	195898.	0.00
7.3800	-0.00381	147468.	-14661.	-1.47E-04	0.00	1.91E+11	671.6025	190542.	0.00
7.4700	-0.00397	132031.	-13930.	-1.47E-04	0.00	1.91E+11	681.4906	185605.	0.00
7.5600	-0.00412	117389.	-13189.	-1.46E-04	0.00	1.91E+11	691.1998	181037.	0.00
7.6500	-0.00428	103553.	-12437.	-1.45E-04	0.00	1.91E+11	700.7471	176795.	0.00
7.7400	-0.00444	90534.	-11676.	-1.45E-04	0.00	1.91E+11	710.1477	172843.	0.00
7.8300	-0.00459	78344.	-10904.	-1.44E-04	0.00	1.91E+11	719.4148	169149.	0.00
7.9200	-0.00475	66992.	-10122.	-1.44E-04	0.00	1.91E+11	728.5605	165687.	0.00
8.0100	-0.00490	56491.	-9330.	-1.44E-04	0.00	1.91E+11	737.5953	162433.	0.00
8.1000	-0.00506	46849.	-8528.	-1.43E-04	0.00	1.91E+11	746.5288	159369.	0.00
8.1900	-0.00521	38079.	-7717.	-1.43E-04	0.00	1.91E+11	755.3692	156476.	0.00
8.2800	-0.00537	30190.	-6897.	-1.43E-04	0.00	1.91E+11	764.1244	153739.	0.00
8.3700	-0.00552	23191.	-6067.	-1.43E-04	0.00	1.91E+11	772.8009	151145.	0.00
8.4600	-0.00568	17095.	-5228.	-1.43E-04	0.00	1.91E+11	781.4050	148681.	0.00
8.5500	-0.00583	11909.	-4379.	-1.42E-04	0.00	1.91E+11	789.9419	146338.	0.00
8.6400	-0.00598	7645.	-3521.	-1.42E-04	0.00	1.91E+11	798.4167	144106.	0.00
8.7300	-0.00614	4313.	-2655.	-1.42E-04	0.00	1.91E+11	806.8335	141977.	0.00
8.8200	-0.00629	1921.	-1779.	-1.42E-04	0.00	1.91E+11	815.1963	139943.	0.00
8.9100	-0.00644	480.2197	-893.8517	-1.42E-04	0.00	1.91E+11	823.5083	137997.	0.00

9.0000 -0.00660 0.00 0.00 -1.42E-04 0.00 1.91E+11 831.7727 68068.
0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.02449256 inches
Computed slope at pile head = -0.00059011 radians
Maximum bending moment = 1326287. inch-lbs
Maximum shear force = -26331. lbs
Depth of maximum bending moment = 1.53000000 feet below pile head
Depth of maximum shear force = 5.49000000 feet below pile head
Number of iterations = 26
Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 17640.0 lbs
Applied moment at pile head = 1693440.0 in-lbs
Axial thrust load on pile head = 28512.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil Res.	Soil Spr.	Distrib.
X	y	Moment	Force	S	Stress	Stiffness	p	Es*h	Lat. Load

feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch
0.00	0.1026	1693440.	17640.	-0.00291	0.00	4.10E+10	-976.8131	5141.	0.00
0.09000	0.09948	1712011.	16585.	-0.00287	0.00	4.10E+10	-975.9873	10596.	0.00
0.1800	0.09641	1729441.	15532.	-0.00282	0.00	4.09E+10	-974.9996	10922.	0.00
0.2700	0.09339	1745733.	14480.	-0.00278	0.00	4.08E+10	-973.8490	11263.	0.00
0.3600	0.09041	1760888.	13429.	-0.00273	0.00	4.08E+10	-972.5348	11617.	0.00
0.4500	0.08749	1774907.	12379.	-0.00268	0.00	4.07E+10	-971.0557	11987.	0.00
0.5400	0.08462	1787792.	11331.	-0.00264	0.00	4.07E+10	-969.4108	12373.	0.00
0.6300	0.08180	1799545.	10285.	-0.00259	0.00	4.06E+10	-967.5992	12775.	0.00
0.7200	0.07903	1810167.	9241.	-0.00254	0.00	4.06E+10	-965.6199	13196.	0.00
0.8100	0.07631	1819662.	8200.	-0.00249	0.00	4.06E+10	-963.4718	13635.	0.00
0.9000	0.07365	1828032.	7160.	-0.00244	0.00	4.05E+10	-961.1540	14095.	0.00
0.9900	0.07104	1835278.	6124.	-0.00239	0.00	4.05E+10	-958.6656	14575.	0.00
1.0800	0.06848	1841406.	5090.	-0.00234	0.00	4.05E+10	-956.0054	15078.	0.00
1.1700	0.06597	1846416.	4059.	-0.00230	0.00	4.05E+10	-953.1727	15604.	0.00
1.2600	0.06352	1850314.	3031.	-0.00225	0.00	4.05E+10	-950.1664	16155.	0.00
1.3500	0.06112	1853101.	2006.	-0.00220	0.00	4.04E+10	-946.9856	16733.	0.00
1.4400	0.05878	1854783.	985.4289	-0.00215	0.00	4.04E+10	-943.6294	17339.	0.00
1.5300	0.05648	1855362.	-31.7832	-0.00210	0.00	4.04E+10	-940.0967	17975.	

0.00

1.6200	0.05424	1854843.	-1045.	-0.00205	0.00	4.04E+10	-936.3867	18643.
0.00								
1.7100	0.05206	1853231.	-2054.	-0.00200	0.00	4.04E+10	-932.4984	19345.
0.00								
1.8000	0.04993	1850529.	-3059.	-0.00195	0.00	4.05E+10	-928.4309	20083.
0.00								
1.8900	0.04785	1846743.	-4060.	-0.00190	0.00	4.05E+10	-924.1833	20860.
0.00								
1.9800	0.04582	1841877.	-5055.	-0.00185	0.00	4.05E+10	-919.7547	21677.
0.00								
2.0700	0.04385	1835937.	-6046.	-0.00180	0.00	4.05E+10	-915.1441	22538.
0.00								
2.1600	0.04193	1828929.	-7032.	-0.00175	0.00	4.05E+10	-910.3506	23447.
0.00								
2.2500	0.04007	1820856.	-8012.	-0.00170	0.00	4.05E+10	-905.3733	24405.
0.00								
2.3400	0.03825	1811727.	-8987.	-0.00166	0.00	4.06E+10	-900.2113	25416.
0.00								
2.4300	0.03649	1801545.	-9957.	-0.00161	0.00	4.06E+10	-894.8637	26485.
0.00								
2.5200	0.03478	1790319.	-10920.	-0.00156	0.00	4.07E+10	-889.3295	27616.
0.00								
2.6100	0.03312	1778054.	-11878.	-0.00151	0.00	4.07E+10	-883.6077	28813.
0.00								
2.7000	0.03151	1764757.	-12829.	-0.00147	0.00	4.07E+10	-877.6974	30080.
0.00								
2.7900	0.02996	1750434.	-13773.	-0.00142	0.00	4.08E+10	-871.5976	31424.
0.00								
2.8800	0.02845	1735093.	-14711.	-0.00137	0.00	4.09E+10	-865.3073	32851.
0.00								
2.9700	0.02699	1718742.	-15642.	-0.00133	0.00	4.09E+10	-858.8253	34366.
0.00								
3.0600	0.02558	1701388.	-16566.	-0.00128	0.00	4.10E+10	-852.1506	35977.
0.00								
3.1500	0.02422	1683038.	-17483.	-0.00124	0.00	4.11E+10	-845.2819	37691.
0.00								
3.2400	0.02291	1663701.	-18392.	-0.00119	0.00	4.11E+10	-838.2180	39518.

0.00								
3.3300	0.02164	1643385.	-19293.	-0.00115	0.00	4.12E+10	-830.9573	41467.
0.00								
3.4200	0.02042	1622098.	-20187.	-0.00111	0.00	4.13E+10	-823.4985	43547.
0.00								
3.5100	0.01925	1599850.	-21072.	-0.00107	0.00	4.14E+10	-815.8397	45771.
0.00								
3.6000	0.01812	1576649.	-21949.	-0.00102	0.00	4.15E+10	-807.9792	48152.
0.00								
3.6900	0.01704	1552504.	-22817.	-9.83E-04	0.00	4.16E+10	-799.9146	50704.
0.00								
3.7800	0.01600	1527424.	-23677.	-9.43E-04	0.00	4.17E+10	-791.6435	53442.
0.00								
3.8700	0.01500	1501420.	-24527.	-9.04E-04	0.00	4.19E+10	-783.1630	56386.
0.00								
3.9600	0.01404	1474502.	-25368.	-8.66E-04	0.00	4.20E+10	-774.4700	59555.
0.00								
4.0500	0.01313	1446679.	-26200.	-8.29E-04	0.00	4.22E+10	-765.5603	62971.
0.00								
4.1400	0.01226	1417962.	-27022.	-8.04E-04	0.00	1.31E+11	-756.4360	66662.
0.00								
4.2300	0.01139	1388362.	-27833.	-7.94E-04	0.00	1.88E+11	-746.6555	70779.
0.00								
4.3200	0.01054	1357891.	-28634.	-7.86E-04	0.00	1.88E+11	-736.0741	75427.
0.00								
4.4100	0.00969	1326561.	-29423.	-7.79E-04	0.00	1.88E+11	-724.5876	80723.
0.00								
4.5000	0.00886	1294386.	-30198.	-7.71E-04	0.00	1.89E+11	-712.0671	86824.
0.00								
4.5900	0.00803	1261380.	-30960.	-7.64E-04	0.00	1.89E+11	-698.3515	93943.
0.00								
4.6800	0.00721	1227559.	-31706.	-7.57E-04	0.00	1.89E+11	-683.2344	102381.
0.00								
4.7700	0.00639	1192941.	-32435.	-7.50E-04	0.00	1.89E+11	-666.4451	112572.
0.00								
4.8600	0.00559	1157546.	-33145.	-7.43E-04	0.00	1.89E+11	-647.6180	125174.
0.00								
4.9500	0.00479	1121395.	-33832.	-7.37E-04	0.00	1.89E+11	-626.2393	141239.

0.00									
5.0400	0.00400	1084513.	-34495.	-7.30E-04	0.00	1.89E+11	-601.5514	162561.	
0.00									
5.1300	0.00321	1046930.	-35129.	-7.24E-04	0.00	1.89E+11	-572.3595	192503.	
0.00									
5.2200	0.00243	1008679.	-35728.	-7.18E-04	0.00	1.89E+11	-536.5910	238272.	
0.00									
5.3100	0.00166	969801.	-36283.	-7.13E-04	0.00	1.89E+11	-490.0720	318950.	
0.00									
5.4000	8.93E-04	930352.	-36775.	-7.07E-04	0.00	1.89E+11	-421.7365	510228.	
0.00									
5.4900	1.32E-04	890411.	-37048.	-7.02E-04	0.00	1.89E+11	-84.2246	690841.	
0.00									
5.5800	-6.24E-04	850371.	-36883.	-6.97E-04	0.00	1.90E+11	389.4962	674268.	
0.00									
5.6700	-0.00137	810786.	-36416.	-6.92E-04	0.00	1.90E+11	476.7459	374686.	
0.00									
5.7600	-0.00212	771756.	-35870.	-6.88E-04	0.00	1.90E+11	533.8316	272016.	
0.00									
5.8500	-0.00286	733349.	-35269.	-6.84E-04	0.00	1.90E+11	578.1059	218300.	
0.00									
5.9400	-0.00360	695617.	-34625.	-6.80E-04	0.00	1.90E+11	615.0809	184722.	
0.00									
6.0300	-0.00433	658601.	-33943.	-6.76E-04	0.00	1.90E+11	647.2838	161524.	
0.00									
6.1200	-0.00506	622341.	-33229.	-6.72E-04	0.00	1.90E+11	676.1019	144429.	
0.00									
6.2100	-0.00578	586868.	-32484.	-6.69E-04	0.00	1.90E+11	702.3852	131250.	
0.00									
6.3000	-0.00650	552215.	-31713.	-6.65E-04	0.00	1.90E+11	726.6953	120744.	
0.00									
6.3900	-0.00722	518410.	-30916.	-6.62E-04	0.00	1.90E+11	749.4238	112150.	
0.00									
6.4800	-0.00793	485479.	-30095.	-6.60E-04	0.00	1.90E+11	770.8558	104975.	
0.00									
6.5700	-0.00864	453446.	-29251.	-6.57E-04	0.00	1.90E+11	791.2054	98884.	
0.00									
6.6600	-0.00935	422337.	-28386.	-6.54E-04	0.00	1.90E+11	810.6381	93640.	

0.00

6.7500	-0.01005	392173.	-27501.	-6.52E-04	0.00	1.91E+11	829.2842	89073.	0.00
6.8400	-0.01076	362976.	-26595.	-6.50E-04	0.00	1.91E+11	847.2487	85056.	0.00
6.9300	-0.01146	334767.	-25671.	-6.48E-04	0.00	1.91E+11	864.6172	81491.	0.00
7.0200	-0.01216	307567.	-24728.	-6.46E-04	0.00	1.91E+11	881.4605	78303.	0.00
7.1100	-0.01285	281394.	-23767.	-6.44E-04	0.00	1.91E+11	897.8381	75434.	0.00
7.2000	-0.01355	256269.	-22789.	-6.43E-04	0.00	1.91E+11	913.8000	72836.	0.00
7.2900	-0.01424	232210.	-21793.	-6.42E-04	0.00	1.91E+11	929.3893	70472.	0.00
7.3800	-0.01494	209235.	-20782.	-6.40E-04	0.00	1.91E+11	944.6427	68309.	0.00
7.4700	-0.01563	187362.	-19753.	-6.39E-04	0.00	1.91E+11	959.5922	66322.	0.00
7.5600	-0.01632	166607.	-18709.	-6.38E-04	0.00	1.91E+11	974.2658	64489.	0.00
7.6500	-0.01700	146990.	-17649.	-6.37E-04	0.00	1.91E+11	988.6879	62793.	0.00
7.7400	-0.01769	128525.	-16574.	-6.37E-04	0.00	1.91E+11	1003.	61218.	0.00
7.8300	-0.01838	111230.	-15483.	-6.36E-04	0.00	1.91E+11	1017.	59751.	0.00
7.9200	-0.01907	95121.	-14377.	-6.35E-04	0.00	1.91E+11	1031.	58381.	0.00
8.0100	-0.01975	80214.	-13257.	-6.35E-04	0.00	1.91E+11	1044.	57099.	0.00
8.1000	-0.02044	66526.	-12122.	-6.34E-04	0.00	1.91E+11	1058.	55894.	0.00
8.1900	-0.02112	54071.	-10972.	-6.34E-04	0.00	1.91E+11	1071.	54762.	0.00
8.2800	-0.02181	42865.	-9808.	-6.34E-04	0.00	1.91E+11	1084.	53694.	0.00
8.3700	-0.02249	32923.	-8631.	-6.34E-04	0.00	1.91E+11	1097.	52685.	

0.00									
8.4600	-0.02317	24262.	-7439.	-6.33E-04	0.00	1.91E+11	1110.	51731.	
0.00									
8.5500	-0.02386	16895.	-6233.	-6.33E-04	0.00	1.91E+11	1123.	50826.	
0.00									
8.6400	-0.02454	10838.	-5013.	-6.33E-04	0.00	1.91E+11	1136.	49968.	
0.00									
8.7300	-0.02523	6105.	-3780.	-6.33E-04	0.00	1.91E+11	1148.	49152.	
0.00									
8.8200	-0.02591	2712.	-2534.	-6.33E-04	0.00	1.91E+11	1161.	48375.	
0.00									
8.9100	-0.02659	671.7487	-1273.	-6.33E-04	0.00	1.91E+11	1173.	47634.	
0.00									
9.0000	-0.02728	0.00	0.00	-6.33E-04	0.00	1.91E+11	1185.	23464.	0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.10260093 inches
Computed slope at pile head = -0.00291189 radians
Maximum bending moment = 1855362. inch-lbs
Maximum shear force = -37048. lbs
Depth of maximum bending moment = 1.53000000 feet below pile head
Depth of maximum shear force = 5.49000000 feet below pile head
Number of iterations = 62
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

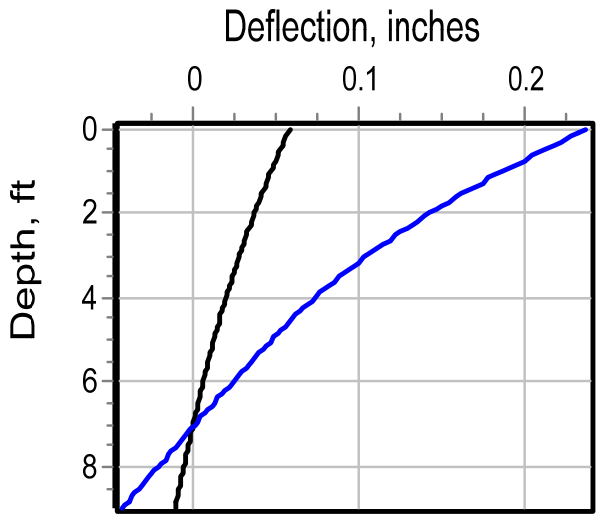
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

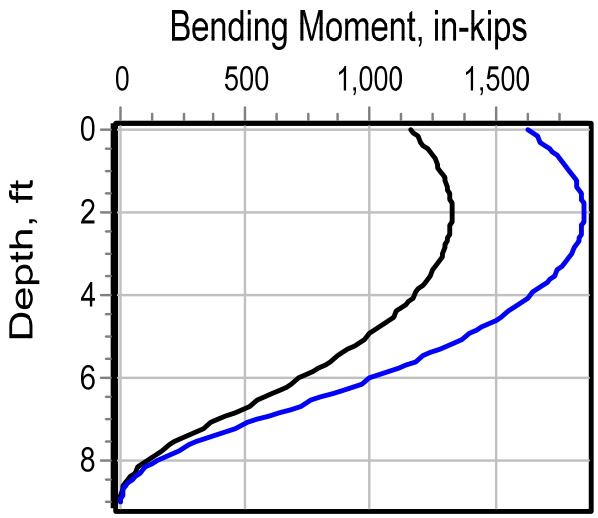
Load Case No.	Load Type 1	Load Pile-head 1	Load Type 2	Load Pile-head 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	12600.	M, in-lb	1209600.	31680.	0.02449	-5.90E-04	-26331.	1326287.
2	V, lb	17640.	M, in-lb	1693440.	28512.	0.1026	-0.00291	-37048.	1855362.

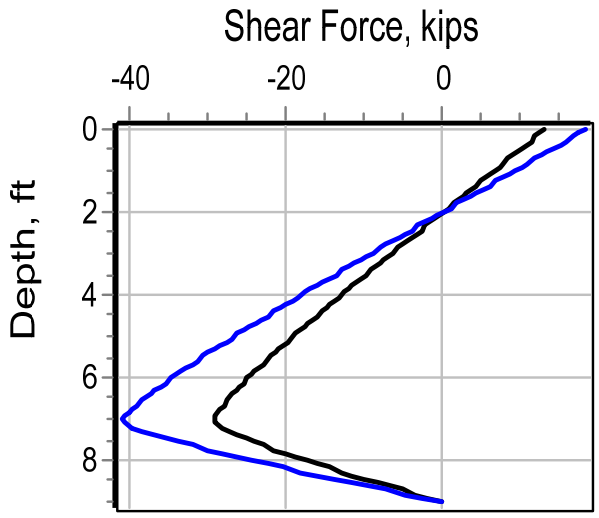
Maximum pile-head deflection = 0.1026009260 inches
Maximum pile-head rotation = -0.0029118928 radians = -0.166839 deg.

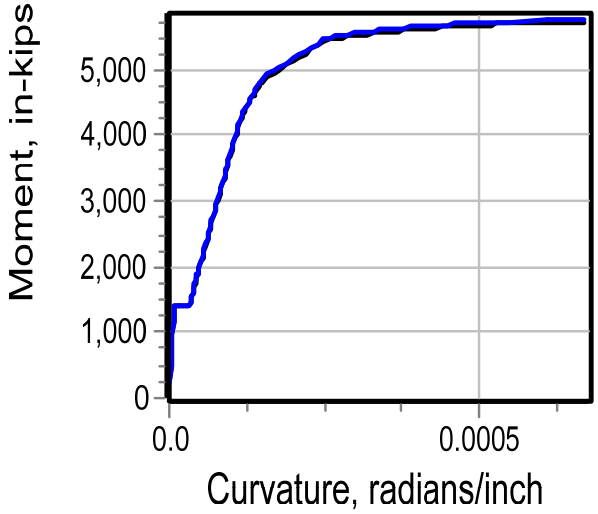
The analysis ended normally.

NB1B_P30-P31


Deflection, inches
0
0.1
0.2
Depth, ft
0
2
4
6
8


Bending Moment, in-kips
0
500
1,000
1,500
Depth, ft
0
2
4
6
8


Shear Force, kips
-40
-20
0
Depth, ft
0
2
4
6
8


Moment, in-kips
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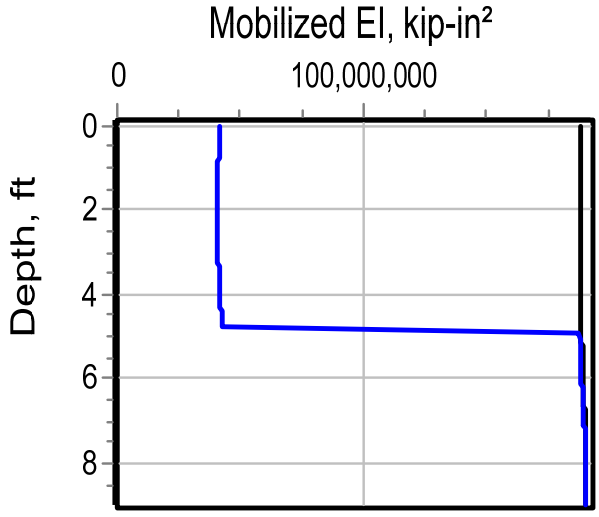
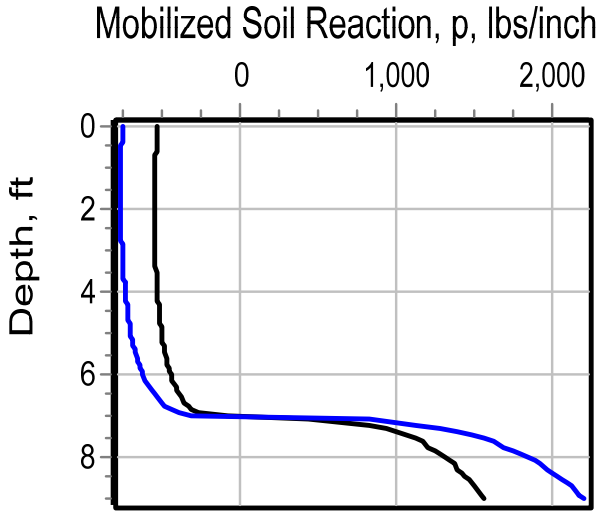
4,000
3,000
2,000
1,000
0
0.0
0.0005
Curvature, radians/inch


Mobilized EI, kip-in²
0
100,000,000
Depth, ft
0
2
4
6
8


Mobilized Soil Reaction, p, lbs/inch
0
1,000
2,000
Depth, ft
0
2
4
6
8

==========

LPile for Windows, Version 2018-10.003

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\062368- ms-SUM-8-1.75\E. Prj Wrk\E_Eng\GEO\50 Calculations\2019\Noise Wall\LPILE\

Name of input data file:
SUM-8_NB1B_P30-P31.lp10

Name of output report file:

SUM-8_NB1B_P30-P31.lp10

Name of plot output file:
SUM-8_NB1B_P30-P31.lp10

Name of runtime message file:
SUM-8_NB1B_P30-P31.lp10

Date and Time of Analysis

Date: August 30, 2019 Time: 14:51:42

Problem Title

Project Name: SUM-8-1.75

Job Number: 062368

Client:ODOT/MS

Engineer: YLZ (CHKD TLM)

Description: NB1B_P31-P33

Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 9.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	30.0000
2	9.000	30.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 9.000000 ft
Shaft Diameter = 30.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 26.600 degrees
= 0.464 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 0.0000 ft
Distance from top of pile to bottom of layer = 15.000000 ft
Effective unit weight at top of layer = 126.500000 pcf
Effective unit weight at bottom of layer = 126.500000 pcf
Undrained cohesion at top of layer = 4050. psf
Undrained cohesion at bottom of layer = 4050. psf
Epsilon-50 at top of layer = 0.005000
Epsilon-50 at bottom of layer = 0.005000

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 15.000000 ft
Distance from top of pile to bottom of layer = 25.000000 ft
Effective unit weight at top of layer = 150.000000 pcf
Effective unit weight at bottom of layer = 150.000000 pcf
Uniaxial compressive strength at top of layer = 200.000000 psi
Uniaxial compressive strength at bottom of layer = 200.000000 psi
Initial modulus of rock at top of layer = 900.000000 psi
Initial modulus of rock at bottom of layer = 900.000000 psi
RQD of rock at top of layer = 10.000000 %
RQD of rock at bottom of layer = 10.000000 %
k rm of rock at top of layer = 0.0005000
k rm of rock at bottom of layer = 0.0005000

(Depth of the lowest soil layer extends 16.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of
50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 150.00 pcf

This data may be erroneous. Please check your data.

Summary of Input Soil Properties

Layer Num.	Soil Type (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	Uniaxial qu psi	RQD %	E50 or krm	Rock Mass Modulus psi
1	Stiff Clay w/o Free Water	0.00 15.0000	126.5000 126.5000	4050. 4050.	-- --	-- --	0.00500 0.00500	-- --
2	Weak Rock	15.0000 25.0000	150.0000 150.0000	-- --	200.0000 200.0000	10.0000 10.0000	5.00E-04 5.00E-04	900.0000 900.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	1	V = 13200. lbs	M =	1161600. in-lbs		34560.	No
2	1	V = 18480. lbs	M =	1626240. in-lbs		31104.	No

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section = 9.000000 ft
Shaft Diameter = 30.000000 in
Concrete Cover Thickness = 3.000000 in
Number of Reinforcing Bars = 10 bars
Yield Stress of Reinforcing Bars = 60000. psi
Modulus of Elasticity of Reinforcing Bars = 29000000. psi
Gross Area of Shaft = 706.858347 sq. in.
Total Area of Reinforcing Steel = 7.900000 sq. in.
Area Ratio of Steel Reinforcement = 1.12 percent
Edge-to-Edge Bar Spacing = 6.107391 in
Maximum Concrete Aggregate Size = 0.750000 in
Ratio of Bar Spacing to Aggregate Size = 8.14
Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As = 3147.516 kips
Tensile Load for Cracking of Concrete = -334.148 kips
Nominal Axial Tensile Capacity = -474.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	11.500000	0.00000
2	1.000000	0.790000	9.303695	6.759530
3	1.000000	0.790000	3.553695	10.937150
4	1.000000	0.790000	-3.553695	10.937150
5	1.000000	0.790000	-9.303695	6.759530
6	1.000000	0.790000	-11.500000	0.00000
7	1.000000	0.790000	-9.303695	-6.759530
8	1.000000	0.790000	-3.553695	-10.937150

9	1.000000	0.790000	3.553695	-10.937150
10	1.000000	0.790000	9.303695	-6.759530

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.107 inches
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 8.14

Concrete Properties:

Compressive Strength of Concrete = 4500. psi
Modulus of Elasticity of Concrete = 3823676. psi
Modulus of Rupture of Concrete = -503.115295 psi
Compression Strain at Peak Stress = 0.002001
Tensile Strain at Fracture of Concrete = -0.0001152
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	31.104
2	34.560

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in

reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.

Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 31.104 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.5105192	190808415.	22.4072863	0.00002801	-0.00000949	0.1242837	0.8068266	
0.00000250	475.9990684	190399627.	18.7166787	0.00004679	-0.00002821	0.2063807	1.3460842	
0.00000375	712.0977456	189892732.	17.4869066	0.00006558	-0.00004692	0.2877073	1.8853886	
0.00000500	946.7935454	189358709.	16.8721420	0.00008436	-0.00006564	0.3682588	2.4247106	
0.00000625	1180.	188813571.	16.5033479	0.0001031	-0.00008435	0.4480345	2.9640443	
0.00000750	1412.	188262821.	16.2575303	0.0001219	-0.0001031	0.5270339	3.5033879	
0.00000875	1412.	161368132.	10.8154308	0.00009464	-0.0001679	0.4100151	-4.8300219	C
0.00001000	1412.	141197116.	10.4534113	0.0001045	-0.0001955	0.4515583	-5.6250107	C
0.00001125	1412.	125508547.	10.1621500	0.0001143	-0.0002232	0.4924267	-6.4231611	C

0.00001250	1412.	112957693.	9.9226596	0.0001240	-0.0002510	0.5327455
-7.2236609 C						
0.00001375	1412.	102688811.	9.7231172	0.0001337	-0.0002788	0.5726528
-8.0255945 C						
0.00001500	1412.	94131411.	9.5521768	0.0001433	-0.0003067	0.6120663
-8.8295531 C						
0.00001625	1412.	86890533.	9.4064101	0.0001529	-0.0003346	0.6512050
-9.6340417 C						
0.00001750	1412.	80684066.	9.2786519	0.0001624	-0.0003626	0.6899418
-10.4399591 C						
0.00001875	1412.	75305128.	9.1682882	0.0001719	-0.0003906	0.7285105
-11.2456807 C						
0.00002000	1412.	70598558.	9.0691144	0.0001814	-0.0004186	0.7666695
-12.0529136 C						
0.00002125	1412.	66445702.	8.9813204	0.0001909	-0.0004466	0.8046095
-12.8603238 C						
0.00002250	1412.	62754274.	8.9035853	0.0002003	-0.0004747	0.8423835
-13.6675355 C						
0.00002375	1412.	59451417.	8.8337123	0.0002098	-0.0005027	0.8799327
-14.4749681 C						
0.00002500	1412.	56478846.	8.7692328	0.0002192	-0.0005308	0.9171283
-15.2835562 C						
0.00002625	1412.	53789377.	8.7111603	0.0002287	-0.0005588	0.9541596
-16.0919417 C						
0.00002750	1412.	51344406.	8.6586219	0.0002381	-0.0005869	0.9910265
-16.9001239 C						
0.00002875	1412.	49112040.	8.6108969	0.0002476	-0.0006149	1.0277285
-17.7081021 C						
0.00003000	1412.	47065705.	8.5673843	0.0002570	-0.0006430	1.0642653
-18.5158756 C						
0.00003125	1412.	45183077.	8.5267250	0.0002665	-0.0006710	1.1005321
-19.3242179 C						
0.00003250	1412.	43445266.	8.4888054	0.0002759	-0.0006991	1.1365575
-20.1329258 C						
0.00003375	1446.	42838034.	8.4539098	0.0002853	-0.0007272	1.1724191
-20.9414231 C						
0.00003500	1490.	42574370.	8.4217152	0.0002948	-0.0007552	1.2081165
-21.7497090 C						

0.00003625	1534.	42327965.	8.3919428	0.0003042	-0.0007833	1.2436494 -22.5577825 C
0.00003750	1579.	42097088.	8.3643512	0.0003137	-0.0008113	1.2790175 -23.3656429 C
0.00003875	1623.	41880234.	8.3387302	0.0003231	-0.0008394	1.3142204 -24.1732894 C
0.00004000	1667.	41676086.	8.3148956	0.0003326	-0.0008674	1.3492577 -24.9807210 C
0.00004125	1711.	41483485.	8.2926858	0.0003421	-0.0008954	1.3841291 -25.7879370 C
0.00004250	1755.	41301411.	8.2719582	0.0003516	-0.0009234	1.4188343 -26.5949364 C
0.00004375	1799.	41128957.	8.2525863	0.0003611	-0.0009514	1.4533729 -27.4017185 C
0.00004500	1843.	40964969.	8.2338520	0.0003705	-0.0009795	1.4876441 -28.2090730 C
0.00004625	1887.	40809055.	8.2162026	0.0003800	-0.0010075	1.5217337 -29.0163306 C
0.00004750	1931.	40660628.	8.1996460	0.0003895	-0.0010355	1.5556577 -29.8233625 C
0.00004875	1975.	40519110.	8.1840988	0.0003990	-0.0010635	1.5894156 -30.6301677 C
0.00005125	2063.	40254768.	8.1557396	0.0004180	-0.0011195	1.6564318 -32.2430944 C
0.00005375	2151.	40012438.	8.1306075	0.0004370	-0.0011755	1.7227794 -33.8551029 C
0.00005625	2238.	39789167.	8.1082771	0.0004561	-0.0012314	1.7884553 -35.4661853 C
0.00005875	2325.	39582502.	8.0883955	0.0004752	-0.0012873	1.8534565 -37.0763335 C
0.00006125	2413.	39390395.	8.0706673	0.0004943	-0.0013432	1.9177798 -38.6855395 C
0.00006375	2500.	39211115.	8.0548437	0.0005135	-0.0013990	1.9814220 -40.2937950 C
0.00006625	2587.	39043193.	8.0407135	0.0005327	-0.0014548	2.0443801 -41.9010914 C
0.00006875	2673.	38885374.	8.0280963	0.0005519	-0.0015106	2.1066508 -43.5074203 C

0.00007125	2760.	38736579.	8.0168370	0.0005712	-0.0015663	2.1682307
-45.1127729 C						
0.00007375	2846.	38595875.	8.0068016	0.0005905	-0.0016220	2.2291166
-46.7171405 C						
0.00007625	2933.	38462451.	7.9978738	0.0006098	-0.0016777	2.2893052
-48.3205139 C						
0.00007875	3019.	38335597.	7.9899522	0.0006292	-0.0017333	2.3487930
-49.9228840 C						
0.00008125	3105.	38214689.	7.9829478	0.0006486	-0.0017889	2.4075763
-51.5242435 C						
0.00008375	3191.	38099190.	7.9767824	0.0006681	-0.0018444	2.4656521
-53.1245787 C						
0.00008625	3277.	37988609.	7.9713868	0.0006875	-0.0019000	2.5230167
-54.7238822 C						
0.00008875	3362.	37882516.	7.9666999	0.0007070	-0.0019555	2.5796665
-56.3221443 C						
0.00009125	3447.	37780529.	7.9626672	0.0007266	-0.0020109	2.6355977
-57.9193550 C						
0.00009375	3533.	37682305.	7.9592400	0.0007462	-0.0020663	2.6908067
-59.5155041 C						
0.00009625	3618.	37587538.	7.9563749	0.0007658	-0.0021217	2.7452898
-60.0000000 CY						
0.00009875	3703.	37495951.	7.9540328	0.0007855	-0.0021770	2.7990432
-60.0000000 CY						
0.0001013	3787.	37407296.	7.9521787	0.0008052	-0.0022323	2.8520630
-60.0000000 CY						
0.0001038	3872.	37321347.	7.9507808	0.0008249	-0.0022876	2.9043453
-60.0000000 CY						
0.0001063	3957.	37237899.	7.9498024	0.0008447	-0.0023428	2.9558839
-60.0000000 CY						
0.0001088	4041.	37156767.	7.9492089	0.0008645	-0.0023980	3.0066722
-60.0000000 CY						
0.0001113	4125.	37077743.	7.9490074	0.0008843	-0.0024532	3.0567147
-60.0000000 CY						
0.0001138	4205.	36968711.	7.9468666	0.0009040	-0.0025085	3.1053495
-60.0000000 CY						
0.0001163	4269.	36725667.	7.9350965	0.0009225	-0.0025650	3.1503682
-60.0000000 CY						

0.0001188	4317.	36354941.	7.9138601	0.0009398	-0.0026227	3.1917805
-60.0000000 CY						
0.0001213	4361.	35970131.	7.8915555	0.0009569	-0.0026806	3.2319849
-60.0000000 CY						
0.0001238	4406.	35600174.	7.8703680	0.0009740	-0.0027385	3.2716245
-60.0000000 CY						
0.0001263	4450.	35244183.	7.8502327	0.0009911	-0.0027964	3.3106969
-60.0000000 CY						
0.0001288	4494.	34901338.	7.8310901	0.0010083	-0.0028542	3.3491995
-60.0000000 CY						
0.0001313	4537.	34570884.	7.8128850	0.0010254	-0.0029121	3.3871297
-60.0000000 CY						
0.0001338	4581.	34252122.	7.7955666	0.0010427	-0.0029698	3.4244850
-60.0000000 CY						
0.0001363	4625.	33944403.	7.7790876	0.0010599	-0.0030276	3.4612626
-60.0000000 CY						
0.0001388	4669.	33647126.	7.7634043	0.0010772	-0.0030853	3.4974598
-60.0000000 CY						
0.0001413	4712.	33359731.	7.7484760	0.0010945	-0.0031430	3.5330740
-60.0000000 CY						
0.0001438	4755.	33077616.	7.7338794	0.0011117	-0.0032008	3.5679890
-60.0000000 CY						
0.0001463	4792.	32764818.	7.7161389	0.0011285	-0.0032590	3.6011911
-60.0000000 CY						
0.0001488	4821.	32408057.	7.6938664	0.0011445	-0.0033180	3.6322848
-60.0000000 CY						
0.0001588	4890.	30804115.	7.5810068	0.0012035	-0.0035590	3.7421915
-60.0000000 CY						
0.0001688	4953.	29352399.	7.4777259	0.0012619	-0.0038006	3.8435583
-60.0000000 CY						
0.0001788	5016.	28059307.	7.3877294	0.0013206	-0.0040419	3.9381413
-60.0000000 CY						
0.0001888	5077.	26897352.	7.3063389	0.0013791	-0.0042834	4.0251137
-60.0000000 CY						
0.0001988	5137.	25847115.	7.2326307	0.0014375	-0.0045250	4.1046426
-60.0000000 CY						
0.0002088	5197.	24894203.	7.1675650	0.0014962	-0.0047663	4.1772860
-60.0000000 CY						

0.0002188	5256.	24025185.	7.1099964	0.0015553	-0.0050072	4.2429257
-60.0000000 CY						
0.0002288	5314.	23228977.	7.0589816	0.0016147	-0.0052478	4.3014390
-60.0000000 CY						
0.0002388	5371.	22494938.	7.0112006	0.0016739	-0.0054886	4.3522044
-60.0000000 CY						
0.0002488	5424.	21806184.	6.9659244	0.0017328	-0.0057297	4.3952607
-60.0000000 CY						
0.0002588	5464.	21118241.	6.9144505	0.0017891	-0.0059734	4.4295163
-60.0000000 CY						
0.0002688	5486.	20414757.	6.8529659	0.0018417	-0.0062208	4.4553587
-60.0000000 CY						
0.0002788	5500.	19731030.	6.7898360	0.0018927	-0.0064698	4.4747596
-60.0000000 CY						
0.0002888	5513.	19092259.	6.7304786	0.0019434	-0.0067191	4.4886272
-60.0000000 CY						
0.0002988	5525.	18492909.	6.6728628	0.0019935	-0.0069690	4.4969616
-60.0000000 CY						
0.0003088	5536.	17931278.	6.6198931	0.0020439	-0.0072186	4.4999891
-60.0000000 CY						
0.0003188	5547.	17403513.	6.5712975	0.0020946	-0.0074679	4.4972422
-60.0000000 CY						
0.0003288	5558.	16906832.	6.5265187	0.0021456	-0.0077169	4.4999896
60.0000000 CY						
0.0003388	5568.	16438046.	6.4854693	0.0021970	-0.0079655	4.4962439
60.0000000 CY						
0.0003488	5578.	15995137.	6.4473170	0.0022485	-0.0082140	4.4997874
60.0000000 CY						
0.0003588	5587.	15574228.	6.4090570	0.0022992	-0.0084633	4.4931373
60.0000000 CY						
0.0003688	5596.	15175335.	6.3736516	0.0023503	-0.0087122	4.4984110
60.0000000 CY						
0.0003788	5604.	14796827.	6.3408045	0.0024016	-0.0089609	4.4987996
60.0000000 CY						
0.0003888	5612.	14436733.	6.3106146	0.0024533	-0.0092092	4.4941309
60.0000000 CY						
0.0003988	5620.	14094187.	6.2825058	0.0025051	-0.0094574	4.4987114
60.0000000 CY						

0.0004088	5628.	13767826.	6.2563883	0.0025573	-0.0097052	4.4982016
60.0000000 CY						
0.0004188	5635.	13456165.	6.2323820	0.0026098	-0.0099527	4.4924739
60.0000000 CY						
0.0004288	5642.	13158637.	6.2099756	0.0026625	-0.0102000	4.4976620
60.0000000 CY						
0.0004388	5649.	12874266.	6.1890704	0.0027155	-0.0104470	4.4999054
60.0000000 CY						
0.0004488	5655.	12601845.	6.1698542	0.0027687	-0.0106938	4.4896489
60.0000000 CY						
0.0004588	5661.	12340872.	6.1519770	0.0028222	-0.0109403	4.4940032
60.0000000 CY						
0.0004688	5667.	12090302.	6.1335072	0.0028751	-0.0111874	4.4982305
60.0000000 CY						
0.0004788	5673.	11849866.	6.1159940	0.0029280	-0.0114345	4.4999565
60.0000000 CY						
0.0004888	5679.	11618694.	6.0999262	0.0029813	-0.0116812	4.4896520
60.0000000 CY						
0.0004988	5684.	11396508.	6.0849157	0.0030349	-0.0119276	4.4912885
60.0000000 CYT						
0.0005088	5689.	11182845.	6.0708309	0.0030885	-0.0121740	4.4963673
60.0000000 CYT						
0.0005188	5694.	10977207.	6.0576262	0.0031424	-0.0124201	4.4992698
60.0000000 CYT						
0.0005288	5699.	10779070.	6.0453367	0.0031965	-0.0126660	4.4977146
60.0000000 CYT						
0.0005388	5704.	10587845.	6.0341223	0.0032509	-0.0129116	4.4857432
60.0000000 CYT						
0.0005488	5709.	10403434.	6.0235891	0.0033054	-0.0131571	4.4899476
60.0000000 CYT						
0.0006088	5735.	9420489.	5.9739310	0.0036366	-0.0146259	4.4889816
60.0000000 CYT						
0.0006688	5735.	8575286.	5.9721469	0.0039939	-0.0160686	4.4855476
60.0000000 CYT						

Axial Thrust Force = 34.560 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Conc Stress ksi	Max Steel Stress ksi	Run Msg
0.00000125	238.4228512	190738281.	23.2311639	0.00002904	-0.00000846	0.1288508	0.8366922	
0.00000250	475.9010014	190360401.	19.1298541	0.00004782	-0.00002718	0.2109183	1.3760394	
0.00000375	711.9970507	189865880.	17.7633192	0.00006661	-0.00004589	0.2922174	1.9154485	
0.00000500	946.6914204	189338284.	17.0802045	0.00008540	-0.00006460	0.3727418	2.4548797	
0.00000625	1180.	188797057.	16.6704132	0.0001042	-0.00008331	0.4524904	2.9943249	
0.00000750	1412.	188248932.	16.3972715	0.0001230	-0.0001020	0.5314626	3.5337816	
0.00000875	1412.	161356228.	11.1321312	0.00009741	-0.0001651	0.4218907	-4.7496592	C
0.00001000	1412.	141186699.	10.7420642	0.0001074	-0.0001926	0.4638651	-5.5413014	C
0.00001125	1412.	125499288.	10.4277480	0.0001173	-0.0002202	0.5051011	-6.3365097	C
0.00001250	1412.	112949359.	10.1685304	0.0001271	-0.0002479	0.5457162	-7.1345327	C
0.00001375	1412.	102681236.	9.9515075	0.0001368	-0.0002757	0.5858390	-7.9345239	C
0.00001500	1412.	94124466.	9.7676935	0.0001465	-0.0003035	0.6255718	-8.7358033	C
0.00001625	1412.	86884123.	9.6076769	0.0001561	-0.0003314	0.6647994	-9.5391948	C
0.00001750	1412.	80678114.	9.4703665	0.0001657	-0.0003593	0.7038164	-10.3426639	C
0.00001875	1412.	75299573.	9.3481159	0.0001753	-0.0003872	0.7423835	-11.1478994	C
0.00002000	1412.	70593350.	9.2408326	0.0001848	-0.0004152	0.7807281		

-11.9533170 C						
0.00002125	1412.	66440800.	9.1463586	0.0001944	-0.0004431	0.8188922
-12.7586189 C						
0.00002250	1412.	62749644.	9.0596351	0.0002038	-0.0004712	0.8566093
-13.5657131 C						
0.00002375	1412.	59447031.	8.9823301	0.0002133	-0.0004992	0.8941600
-14.3726075 C						
0.00002500	1412.	56474680.	8.9130320	0.0002228	-0.0005272	0.9315438
-15.1793017 C						
0.00002625	1412.	53785409.	8.8505978	0.0002323	-0.0005552	0.9687605
-15.9857948 C						
0.00002750	1412.	51340618.	8.7919068	0.0002418	-0.0005832	1.0055713
-16.7938292 C						
0.00002875	1412.	49108417.	8.7385436	0.0002512	-0.0006113	1.0422147
-17.6016767 C						
0.00003000	1412.	47062233.	8.6898633	0.0002607	-0.0006393	1.0786928
-18.4093188 C						
0.00003125	1412.	45179744.	8.6453049	0.0002702	-0.0006673	1.1150051
-19.2167548 C						
0.00003250	1427.	43911749.	8.6043937	0.0002796	-0.0006954	1.1511514
-20.0239838 C						
0.00003375	1472.	43600182.	8.5667251	0.0002891	-0.0007234	1.1871314
-20.8310052 C						
0.00003500	1516.	43309275.	8.5312610	0.0002986	-0.0007514	1.2228516
-21.6385200 C						
0.00003625	1560.	43036968.	8.4978496	0.0003080	-0.0007795	1.2583239
-22.4464480 C						
0.00003750	1604.	42781914.	8.4668623	0.0003175	-0.0008075	1.2936311
-23.2541621 C						
0.00003875	1649.	42542440.	8.4380652	0.0003270	-0.0008355	1.3287730
-24.0616616 C						
0.00004000	1693.	42317084.	8.4112537	0.0003365	-0.0008635	1.3637491
-24.8689456 C						
0.00004125	1737.	42104559.	8.3862481	0.0003459	-0.0008916	1.3985591
-25.6760131 C						
0.00004250	1781.	41903730.	8.3628896	0.0003554	-0.0009196	1.4332027
-26.4828634 C						
0.00004375	1825.	41713592.	8.3410378	0.0003649	-0.0009476	1.4676795

-27.2894956 C						
0.00004500	1869.	41533251.	8.3205679	0.0003744	-0.0009756	1.5019892
-28.0959088 C						
0.00004625	1913.	41361909.	8.3013683	0.0003839	-0.0010036	1.5361313
-28.9021021 C						
0.00004750	1957.	41198855.	8.2833396	0.0003935	-0.0010315	1.5701055
-29.7080746 C						
0.00004875	2001.	41043448.	8.2663922	0.0004030	-0.0010595	1.6039115
-30.5138255 C						
0.00005125	2089.	40753015.	8.2348542	0.0004220	-0.0011155	1.6709124
-32.1255103 C						
0.00005375	2176.	40486691.	8.2062585	0.0004411	-0.0011714	1.7371307
-33.7371820 C						
0.00005625	2264.	40241552.	8.1807744	0.0004602	-0.0012273	1.8026766
-35.3479241 C						
0.00005875	2351.	40014875.	8.1580095	0.0004793	-0.0012832	1.8675468
-36.9577286 C						
0.00006125	2438.	39804382.	8.1376355	0.0004984	-0.0013391	1.9317383
-38.5665873 C						
0.00006375	2525.	39608151.	8.1193756	0.0005176	-0.0013949	1.9952479
-40.1744917 C						
0.00006625	2612.	39424552.	8.1029948	0.0005368	-0.0014507	2.0580723
-41.7814335 C						
0.00006875	2699.	39252191.	8.0882926	0.0005561	-0.0015064	2.1202084
-43.3874040 C						
0.00007125	2785.	39089868.	8.0750964	0.0005754	-0.0015621	2.1816529
-44.9923944 C						
0.00007375	2872.	38936547.	8.0632573	0.0005947	-0.0016178	2.2424024
-46.5963958 C						
0.00007625	2958.	38791327.	8.0526459	0.0006140	-0.0016735	2.3024536
-48.1993991 C						
0.00007875	3044.	38653422.	8.0431493	0.0006334	-0.0017291	2.3618030
-49.8013951 C						
0.00008125	3130.	38522142.	8.0346685	0.0006528	-0.0017847	2.4204471
-51.4023745 C						
0.00008375	3216.	38396872.	8.0271167	0.0006723	-0.0018402	2.4783823
-53.0023301 C						
0.00008625	3301.	38277089.	8.0204167	0.0006918	-0.0018957	2.5356055

-54.6012470 C						
0.00008875	3387.	38162307.	8.0145006	0.0007113	-0.0019512	2.5921127
-56.1991181 C						
0.00009125	3472.	38052101.	8.0093076	0.0007308	-0.0020067	2.6479004
-57.7959334 C						
0.00009375	3557.	37946093.	8.0047837	0.0007504	-0.0020621	2.7029648
-59.3916827 C						
0.00009625	3642.	37843939.	8.0008804	0.0007701	-0.0021174	2.7573022
-60.0000000 CY						
0.00009875	3727.	37745335.	7.9975544	0.0007898	-0.0021727	2.8109087
-60.0000000 CY						
0.0001013	3812.	37650004.	7.9947666	0.0008095	-0.0022280	2.8637805
-60.0000000 CY						
0.0001038	3897.	37557696.	7.9924816	0.0008292	-0.0022833	2.9159136
-60.0000000 CY						
0.0001063	3981.	37468183.	7.9906677	0.0008490	-0.0023385	2.9673041
-60.0000000 CY						
0.0001088	4065.	37381261.	7.9892959	0.0008688	-0.0023937	3.0179479
-60.0000000 CY						
0.0001113	4149.	37296740.	7.9883401	0.0008887	-0.0024488	3.0678409
-60.0000000 CY						
0.0001138	4231.	37192237.	7.9862376	0.0009084	-0.0025041	3.1165424
-60.0000000 CY						
0.0001163	4296.	36956685.	7.9751413	0.0009271	-0.0025604	3.1618122
-60.0000000 CY						
0.0001188	4345.	36591935.	7.9548939	0.0009446	-0.0026179	3.2035726
-60.0000000 CY						
0.0001213	4390.	36202718.	7.9321228	0.0009618	-0.0026757	3.2437033
-60.0000000 CY						
0.0001238	4434.	35827762.	7.9102190	0.0009789	-0.0027336	3.2831878
-60.0000000 CY						
0.0001263	4478.	35466967.	7.8893969	0.0009960	-0.0027915	3.3221040
-60.0000000 CY						
0.0001288	4522.	35119503.	7.8695951	0.0010132	-0.0028493	3.3604496
-60.0000000 CY						
0.0001313	4565.	34784604.	7.8507570	0.0010304	-0.0029071	3.3982217
-60.0000000 CY						
0.0001338	4609.	34461560.	7.8328302	0.0010476	-0.0029649	3.4354179

-60.0000000 CY						
0.0001363	4653.	34149715.	7.8157662	0.0010649	-0.0030226	3.4720353
-60.0000000 CY						
0.0001388	4696.	33848457.	7.7995199	0.0010822	-0.0030803	3.5080714
-60.0000000 CY						
0.0001413	4740.	33557221.	7.7840496	0.0010995	-0.0031380	3.5435234
-60.0000000 CY						
0.0001438	4783.	33272039.	7.7689906	0.0011168	-0.0031957	3.5782932
-60.0000000 CY						
0.0001463	4821.	32963000.	7.7514472	0.0011336	-0.0032539	3.6115427
-60.0000000 CY						
0.0001488	4851.	32611966.	7.7295770	0.0011498	-0.0033127	3.6427461
-60.0000000 CY						
0.0001588	4922.	31003858.	7.6174519	0.0012093	-0.0035532	3.7528344
-60.0000000 CY						
0.0001688	4985.	29539676.	7.5122622	0.0012677	-0.0037948	3.8535333
-60.0000000 CY						
0.0001788	5047.	28235501.	7.4205793	0.0013264	-0.0040361	3.9474361
-60.0000000 CY						
0.0001888	5109.	27065296.	7.3396773	0.0013854	-0.0042771	4.0342649
-60.0000000 CY						
0.0001988	5169.	26006039.	7.2645599	0.0014438	-0.0045187	4.1130588
-60.0000000 CY						
0.0002088	5228.	25044959.	7.1982299	0.0015026	-0.0047599	4.1849513
-60.0000000 CY						
0.0002188	5287.	24168506.	7.1395223	0.0015618	-0.0050007	4.2498233
-60.0000000 CY						
0.0002288	5345.	23365498.	7.0874782	0.0016213	-0.0052412	4.3075509
-60.0000000 CY						
0.0002388	5402.	22626288.	7.0406916	0.0016810	-0.0054815	4.3578888
-60.0000000 CY						
0.0002488	5456.	21933553.	6.9949142	0.0017400	-0.0057225	4.4001513
-60.0000000 CY						
0.0002588	5497.	21244643.	6.9435750	0.0017967	-0.0059658	4.4336951
-60.0000000 CY						
0.0002688	5520.	20540503.	6.8822593	0.0018496	-0.0062129	4.4588163
-60.0000000 CY						
0.0002788	5534.	19853660.	6.8186893	0.0019007	-0.0064618	4.4773965

-60.0000000 CY						
0.0002888	5547.	19211372.	6.7600632	0.0019520	-0.0067105	4.4904770
-60.0000000 CY						
0.0002988	5559.	18608284.	6.7025103	0.0020024	-0.0069601	4.4979087
-60.0000000 CY						
0.0003088	5571.	18042556.	6.6488182	0.0020528	-0.0072097	4.4978175
-60.0000000 CY						
0.0003188	5582.	17510976.	6.5995363	0.0021036	-0.0074589	4.4981535
-60.0000000 CY						
0.0003288	5592.	17010660.	6.5541490	0.0021547	-0.0077078	4.4977317
60.0000000 CY						
0.0003388	5602.	16538505.	6.5125030	0.0022061	-0.0079564	4.4973398
60.0000000 CY						
0.0003488	5612.	16092561.	6.4740148	0.0022578	-0.0082047	4.4999778
60.0000000 CY						
0.0003588	5621.	15669645.	6.4376002	0.0023095	-0.0084530	4.4948183
60.0000000 CY						
0.0003688	5630.	15267933.	6.4016428	0.0023606	-0.0087019	4.4991637
60.0000000 CY						
0.0003788	5638.	14886615.	6.3683793	0.0024120	-0.0089505	4.4948816
60.0000000 CY						
0.0003888	5646.	14524012.	6.3376858	0.0024638	-0.0091987	4.4957161
60.0000000 CY						
0.0003988	5654.	14179078.	6.3091057	0.0025158	-0.0094467	4.4993923
60.0000000 CY						
0.0004088	5661.	13850306.	6.2826548	0.0025680	-0.0096945	4.4941739
60.0000000 CY						
0.0004188	5668.	13536506.	6.2582114	0.0026206	-0.0099419	4.4943322
60.0000000 CY						
0.0004288	5675.	13236935.	6.2353945	0.0026734	-0.0101891	4.4986460
60.0000000 CY						
0.0004388	5682.	12950588.	6.2141242	0.0027264	-0.0104361	4.4993183
60.0000000 CY						
0.0004488	5688.	12676206.	6.1946264	0.0027798	-0.0106827	4.4896572
60.0000000 CY						
0.0004588	5695.	12413471.	6.1763847	0.0028334	-0.0109291	4.4957010
60.0000000 CY						
0.0004688	5701.	12161631.	6.1593273	0.0028872	-0.0111753	4.4991455

60.0000000 CY
0.0004788 5707. 11919739. 6.1426715 0.0029408 -0.0114217 4.4975432
60.0000000 CY
0.0004888 5712. 11686946. 6.1263333 0.0029942 -0.0116683 4.4873362
60.0000000 CY
0.0004988 5717. 11463274. 6.1109909 0.0030479 -0.0119146 4.4936724
60.0000000 CYT
0.0005088 5723. 11248180. 6.0965933 0.0031016 -0.0121609 4.4978493
60.0000000 CYT
0.0005188 5728. 11041163. 6.0830938 0.0031556 -0.0124069 4.4998306
60.0000000 CYT
0.0005288 5732. 10841565. 6.0706887 0.0032099 -0.0126526 4.4926859
60.0000000 CYT
0.0005388 5737. 10649085. 6.0591830 0.0032644 -0.0128981 4.4863672
60.0000000 CYT
0.0005488 5742. 10463461. 6.0483741 0.0033190 -0.0131435 4.4926313
60.0000000 CYT
0.0006088 5767. 9473973. 5.9974492 0.0036509 -0.0146116 4.4919380
60.0000000 CYT
0.0006688 5767. 8623972. 5.9948941 0.0040091 -0.0160534 4.4891656
60.0000000 CYT

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	31.104	5680.510	0.00300000
2	34.560	5712.565	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	5681.	20.217600	3692.	37507161.
2	0.65	5713.	22.464000	3713.	37761815.
1	0.70	5681.	21.772800	3976.	37218808.
2	0.70	5713.	24.192000	3999.	37449810.
1	0.75	5681.	23.328000	4260.	36759666.
2	0.75	5713.	25.920000	4284.	36999023.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	368196.

2	15.0000	15.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 13200.0 lbs
Applied moment at pile head = 1161600.0 in-lbs
Axial thrust load on pile head = 34560.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.05810	1161600.	13200.	-9.59E-04	0.00	1.89E+11	-529.1480	4918.	0.00
0.09000	0.05707	1175583.	12628.	-9.52E-04	0.00	1.89E+11	-530.4370	10038.	0.00
0.1800	0.05604	1188947.	12054.	-9.45E-04	0.00	1.89E+11	-531.6776	10246.	0.00
0.2700	0.05503	1201691.	11479.	-9.39E-04	0.00	1.89E+11	-532.8693	10458.	0.00
0.3600	0.05402	1213813.	10903.	-9.32E-04	0.00	1.89E+11	-534.0118	10677.	0.00

0.4500	0.05301	1225312.	10326.	-9.25E-04	0.00	1.89E+11	-535.1046	10901. 0.00
0.5400	0.05202	1236186.	9748.	-9.18E-04	0.00	1.89E+11	-536.1470	11131. 0.00
0.6300	0.05103	1246435.	9168.	-9.11E-04	0.00	1.89E+11	-537.1386	11368. 0.00
0.7200	0.05005	1256057.	8587.	-9.03E-04	0.00	1.89E+11	-538.0789	11610. 0.00
0.8100	0.04908	1265051.	8006.	-8.96E-04	0.00	1.89E+11	-538.9673	11860. 0.00
0.9000	0.04812	1273416.	7423.	-8.89E-04	0.00	1.89E+11	-539.8031	12116. 0.00
0.9900	0.04716	1281151.	6840.	-8.82E-04	0.00	1.89E+11	-540.5858	12380. 0.00
1.0800	0.04621	1288256.	6256.	-8.74E-04	0.00	1.89E+11	-541.3147	12651. 0.00
1.1700	0.04527	1294728.	5671.	-8.67E-04	0.00	1.89E+11	-541.9892	12930. 0.00
1.2600	0.04434	1300569.	5085.	-8.59E-04	0.00	1.88E+11	-542.6085	13216. 0.00
1.3500	0.04342	1305776.	4499.	-8.52E-04	0.00	1.88E+11	-543.1720	13512. 0.00
1.4400	0.04250	1310349.	3912.	-8.44E-04	0.00	1.88E+11	-543.6788	13816. 0.00
1.5300	0.04159	1314288.	3324.	-8.37E-04	0.00	1.88E+11	-544.1282	14129. 0.00
1.6200	0.04069	1317592.	2736.	-8.29E-04	0.00	1.88E+11	-544.5193	14452. 0.00
1.7100	0.03980	1320261.	2148.	-8.22E-04	0.00	1.88E+11	-544.8513	14785. 0.00
1.8000	0.03892	1322293.	1560.	-8.14E-04	0.00	1.88E+11	-545.1232	15128. 0.00
1.8900	0.03804	1323690.	970.6772	-8.07E-04	0.00	1.88E+11	-545.3340	15482. 0.00
1.9800	0.03717	1324450.	381.6362	-7.99E-04	0.00	1.88E+11	-545.4827	15848. 0.00
2.0700	0.03632	1324574.	-207.5314	-7.92E-04	0.00	1.88E+11	-545.5683	16225. 0.00

2.1600	0.03546	1324061.	-796.7566	-7.84E-04	0.00	1.88E+11	-545.5896	16615. 0.00
2.2500	0.03462	1322912.	-1386.	-7.76E-04	0.00	1.88E+11	-545.5454	17018. 0.00
2.3400	0.03379	1321125.	-1975.	-7.69E-04	0.00	1.88E+11	-545.4344	17434. 0.00
2.4300	0.03296	1318703.	-2564.	-7.61E-04	0.00	1.88E+11	-545.2552	17866. 0.00
2.5200	0.03214	1315644.	-3153.	-7.54E-04	0.00	1.88E+11	-545.0065	18312. 0.00
2.6100	0.03133	1311949.	-3741.	-7.46E-04	0.00	1.88E+11	-544.6867	18774. 0.00
2.7000	0.03053	1307618.	-4329.	-7.39E-04	0.00	1.88E+11	-544.2941	19253. 0.00
2.7900	0.02974	1302653.	-4917.	-7.31E-04	0.00	1.88E+11	-543.8271	19750. 0.00
2.8800	0.02895	1297052.	-5504.	-7.24E-04	0.00	1.88E+11	-543.2839	20266. 0.00
2.9700	0.02817	1290818.	-6090.	-7.16E-04	0.00	1.89E+11	-542.6624	20801. 0.00
3.0600	0.02741	1283951.	-6676.	-7.09E-04	0.00	1.89E+11	-541.9607	21358. 0.00
3.1500	0.02664	1276451.	-7261.	-7.02E-04	0.00	1.89E+11	-541.1764	21937. 0.00
3.2400	0.02589	1268320.	-7845.	-6.94E-04	0.00	1.89E+11	-540.3071	22539. 0.00
3.3300	0.02514	1259558.	-8428.	-6.87E-04	0.00	1.89E+11	-539.3504	23166. 0.00
3.4200	0.02441	1250167.	-9010.	-6.80E-04	0.00	1.89E+11	-538.3035	23821. 0.00
3.5100	0.02368	1240147.	-9591.	-6.73E-04	0.00	1.89E+11	-537.1633	24504. 0.00
3.6000	0.02295	1229501.	-10170.	-6.66E-04	0.00	1.89E+11	-535.9268	25217. 0.00
3.6900	0.02224	1218229.	-10748.	-6.59E-04	0.00	1.89E+11	-534.5905	25963. 0.00
3.7800	0.02153	1206334.	-11325.	-6.52E-04	0.00	1.89E+11	-533.1507	26744. 0.00

3.8700	0.02083	1193817.	-11900.	-6.45E-04	0.00	1.89E+11	-531.6033	27563.
0.00								
3.9600	0.02014	1180679.	-12473.	-6.38E-04	0.00	1.89E+11	-529.9441	28422.
0.00								
4.0500	0.01945	1166923.	-13044.	-6.31E-04	0.00	1.89E+11	-528.1683	29325.
0.00								
4.1400	0.01877	1152550.	-13614.	-6.25E-04	0.00	1.89E+11	-526.2708	30275.
0.00								
4.2300	0.01810	1137564.	-14181.	-6.18E-04	0.00	1.89E+11	-524.2460	31277.
0.00								
4.3200	0.01744	1121965.	-14746.	-6.12E-04	0.00	1.89E+11	-522.0877	32334.
0.00								
4.4100	0.01678	1105758.	-15309.	-6.05E-04	0.00	1.89E+11	-519.7892	33453.
0.00								
4.5000	0.01613	1088944.	-15869.	-5.99E-04	0.00	1.89E+11	-517.3432	34638.
0.00								
4.5900	0.01549	1071526.	-16426.	-5.93E-04	0.00	1.89E+11	-514.7416	35896.
0.00								
4.6800	0.01485	1053508.	-16980.	-5.87E-04	0.00	1.89E+11	-511.9753	37234.
0.00								
4.7700	0.01422	1034892.	-17532.	-5.81E-04	0.00	1.89E+11	-509.0344	38662.
0.00								
4.8600	0.01360	1015683.	-18080.	-5.75E-04	0.00	1.89E+11	-505.9078	40188.
0.00								
4.9500	0.01298	995883.	-18624.	-5.69E-04	0.00	1.89E+11	-502.5832	41825.
0.00								
5.0400	0.01237	975496.	-19165.	-5.64E-04	0.00	1.89E+11	-499.0466	43585.
0.00								
5.1300	0.01176	954528.	-19702.	-5.58E-04	0.00	1.89E+11	-495.2824	45484.
0.00								
5.2200	0.01116	932981.	-20235.	-5.53E-04	0.00	1.89E+11	-491.2729	47541.
0.00								
5.3100	0.01057	910861.	-20763.	-5.47E-04	0.00	1.89E+11	-486.9978	49777.
0.00								
5.4000	0.00998	888173.	-21287.	-5.42E-04	0.00	1.89E+11	-482.4341	52219.
0.00								
5.4900	0.00939	864922.	-21805.	-5.37E-04	0.00	1.89E+11	-477.5551	54899.
0.00								

5.5800	0.00882	841114.	-22318.	-5.33E-04	0.00	1.90E+11	-472.3297	57856.
0.00								
5.6700	0.00824	816755.	-22825.	-5.28E-04	0.00	1.90E+11	-466.7216	61138.
0.00								
5.7600	0.00768	791851.	-23326.	-5.23E-04	0.00	1.90E+11	-460.6878	64809.
0.00								
5.8500	0.00711	766410.	-23820.	-5.19E-04	0.00	1.90E+11	-454.1769	68946.
0.00								
5.9400	0.00656	740439.	-24307.	-5.14E-04	0.00	1.90E+11	-447.1264	73651.
0.00								
6.0300	0.00600	713946.	-24785.	-5.10E-04	0.00	1.90E+11	-439.4598	79061.
0.00								
6.1200	0.00545	686940.	-25256.	-5.06E-04	0.00	1.90E+11	-431.0812	85359.
0.00								
6.2100	0.00491	659432.	-25716.	-5.03E-04	0.00	1.90E+11	-421.8687	92804.
0.00								
6.3000	0.00437	631431.	-26166.	-4.99E-04	0.00	1.90E+11	-411.6629	101767.
0.00								
6.3900	0.00383	602950.	-26605.	-4.95E-04	0.00	1.90E+11	-400.2494	112807.
0.00								
6.4800	0.00330	574002.	-27030.	-4.92E-04	0.00	1.90E+11	-387.3291	126808.
0.00								
6.5700	0.00277	544602.	-27440.	-4.89E-04	0.00	1.90E+11	-372.4649	145262.
0.00								
6.6600	0.00224	514767.	-27833.	-4.86E-04	0.00	1.90E+11	-354.9751	170923.
0.00								
6.7500	0.00172	484518.	-28205.	-4.83E-04	0.00	1.90E+11	-333.6980	209549.
0.00								
6.8400	0.00120	453880.	-28551.	-4.80E-04	0.00	1.90E+11	-306.3593	275789.
0.00								
6.9300	6.82E-04	422885.	-28860.	-4.78E-04	0.00	1.90E+11	-267.2648	423010.
0.00								
7.0200	1.68E-04	391578.	-29044.	-4.76E-04	0.00	1.90E+11	-72.6049	467868.
0.00								
7.1100	-3.45E-04	360186.	-28847.	-4.73E-04	0.00	1.90E+11	436.3485	1366875.
0.00								
7.2000	-8.55E-04	329302.	-28164.	-4.71E-04	0.00	1.91E+11	829.7583	1048202.
0.00								

7.2900	-0.00136	299387.	-27212.	-4.70E-04	0.00	1.91E+11	932.4053	738769.	0.00
7.3800	-0.00187	270559.	-26164.	-4.68E-04	0.00	1.91E+11	1009.	582944.	0.00
7.4700	-0.00237	242908.	-25041.	-4.67E-04	0.00	1.91E+11	1071.	487289.	0.00
7.5600	-0.00288	216506.	-23855.	-4.65E-04	0.00	1.91E+11	1124.	421866.	0.00
7.6500	-0.00338	191416.	-22617.	-4.64E-04	0.00	1.91E+11	1170.	373945.	0.00
7.7400	-0.00388	167689.	-21331.	-4.63E-04	0.00	1.91E+11	1211.	337135.	0.00
7.8300	-0.00438	145376.	-20003.	-4.62E-04	0.00	1.91E+11	1248.	307854.	0.00
7.9200	-0.00488	124518.	-18636.	-4.61E-04	0.00	1.91E+11	1282.	283932.	0.00
8.0100	-0.00538	105156.	-17234.	-4.61E-04	0.00	1.91E+11	1314.	263969.	0.00
8.1000	-0.00587	87327.	-15799.	-4.60E-04	0.00	1.91E+11	1343.	247021.	0.00
8.1900	-0.00637	71065.	-14333.	-4.60E-04	0.00	1.91E+11	1371.	232426.	0.00
8.2800	-0.00687	56402.	-12838.	-4.59E-04	0.00	1.91E+11	1397.	219708.	0.00
8.3700	-0.00736	43368.	-11317.	-4.59E-04	0.00	1.91E+11	1421.	208510.	0.00
8.4600	-0.00786	31993.	-9769.	-4.59E-04	0.00	1.91E+11	1445.	198564.	0.00
8.5500	-0.00835	22302.	-8196.	-4.59E-04	0.00	1.91E+11	1467.	189663.	0.00
8.6400	-0.00885	14323.	-6600.	-4.59E-04	0.00	1.91E+11	1488.	181642.	0.00
8.7300	-0.00934	8080.	-4982.	-4.59E-04	0.00	1.91E+11	1509.	174372.	0.00
8.8200	-0.00984	3596.	-3342.	-4.59E-04	0.00	1.91E+11	1528.	167746.	0.00
8.9100	-0.01034	895.8760	-1681.	-4.59E-04	0.00	1.91E+11	1547.	161681.	0.00

9.0000	-0.01083	0.00	0.00	-4.59E-04	0.00	1.91E+11	1565.	78052.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.05810127 inches
Computed slope at pile head = -0.00095893 radians
Maximum bending moment = 1324574. inch-lbs
Maximum shear force = -29044. lbs
Depth of maximum bending moment = 2.07000000 feet below pile head
Depth of maximum shear force = 7.02000000 feet below pile head
Number of iterations = 32
Number of zero deflection points = 1

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 18480.0 lbs
Applied moment at pile head = 1626240.0 in-lbs
Axial thrust load on pile head = 31104.0 lbs

Depth	Deflect.	Bending	Shear	Slope	Total	Bending	Soil Res.	Soil Spr.	Distrib.
X	y	Moment	Force	S	Stress	Stiffness	p	Es*h	Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	in-lb^2	lb/inch	lb/inch	lb/inch

0.00	0.2367	1626240.	18480.	-0.00444	0.00	4.19E+10	-751.7045	1715.	0.00
0.09000	0.2319	1645908.	17667.	-0.00440	0.00	4.19E+10	-753.0744	3507.	0.00
0.1800	0.2272	1664697.	16853.	-0.00436	0.00	4.17E+10	-754.3691	3586.	0.00
0.2700	0.2225	1682604.	16038.	-0.00431	0.00	4.16E+10	-755.5884	3667.	0.00
0.3600	0.2179	1699629.	15221.	-0.00427	0.00	4.15E+10	-756.7320	3751.	0.00
0.4500	0.2133	1715769.	14404.	-0.00422	0.00	4.15E+10	-757.7996	3837.	0.00
0.5400	0.2088	1731024.	13585.	-0.00418	0.00	4.14E+10	-758.7906	3925.	0.00
0.6300	0.2043	1745393.	12765.	-0.00413	0.00	4.13E+10	-759.7049	4016.	0.00
0.7200	0.1998	1758873.	11944.	-0.00409	0.00	4.13E+10	-760.5421	4110.	0.00
0.8100	0.1955	1771466.	11122.	-0.00404	0.00	4.12E+10	-761.3017	4207.	0.00
0.9000	0.1911	1783168.	10299.	-0.00399	0.00	4.12E+10	-761.9834	4306.	0.00
0.9900	0.1868	1793980.	9476.	-0.00395	0.00	4.11E+10	-762.5869	4408.	0.00
1.0800	0.1826	1803902.	8652.	-0.00390	0.00	4.11E+10	-763.1117	4514.	0.00
1.1700	0.1784	1812931.	7828.	-0.00385	0.00	4.11E+10	-763.5574	4622.	0.00
1.2600	0.1743	1821068.	7003.	-0.00381	0.00	4.10E+10	-763.9236	4734.	0.00
1.3500	0.1702	1828313.	6178.	-0.00376	0.00	4.10E+10	-764.2100	4850.	0.00
1.4400	0.1662	1834665.	5352.	-0.00371	0.00	4.10E+10	-764.4159	4969.	0.00
1.5300	0.1622	1840123.	4527.	-0.00366	0.00	4.10E+10	-764.5411	5091.	0.00

1.6200	0.1582	1844688.	3701.	-0.00361	0.00	4.10E+10	-764.5850	5218.
0.00								
1.7100	0.1544	1848359.	2875.	-0.00356	0.00	4.09E+10	-764.5471	5349.
0.00								
1.8000	0.1506	1851138.	2049.	-0.00351	0.00	4.09E+10	-764.4268	5484.
0.00								
1.8900	0.1468	1853022.	1224.	-0.00347	0.00	4.09E+10	-764.2237	5623.
0.00								
1.9800	0.1431	1854014.	398.8170	-0.00342	0.00	4.09E+10	-763.9372	5767.
0.00								
2.0700	0.1394	1854113.	-426.0350	-0.00337	0.00	4.09E+10	-763.5666	5916.
0.00								
2.1600	0.1358	1853320.	-1250.	-0.00332	0.00	4.09E+10	-763.1112	6069.
0.00								
2.2500	0.1322	1851636.	-2074.	-0.00327	0.00	4.09E+10	-762.5705	6228.
0.00								
2.3400	0.1287	1849060.	-2898.	-0.00322	0.00	4.09E+10	-761.9436	6393.
0.00								
2.4300	0.1253	1845593.	-3720.	-0.00317	0.00	4.10E+10	-761.2298	6563.
0.00								
2.5200	0.1219	1841237.	-4542.	-0.00312	0.00	4.10E+10	-760.4283	6739.
0.00								
2.6100	0.1185	1835993.	-5363.	-0.00308	0.00	4.10E+10	-759.5380	6921.
0.00								
2.7000	0.1152	1829861.	-6182.	-0.00303	0.00	4.10E+10	-758.5582	7109.
0.00								
2.7900	0.1120	1822842.	-7001.	-0.00298	0.00	4.10E+10	-757.4877	7305.
0.00								
2.8800	0.1088	1814939.	-7818.	-0.00293	0.00	4.11E+10	-756.3255	7508.
0.00								
2.9700	0.1057	1806152.	-8635.	-0.00288	0.00	4.11E+10	-755.0702	7718.
0.00								
3.0600	0.1026	1796482.	-9449.	-0.00284	0.00	4.11E+10	-753.7207	7936.
0.00								
3.1500	0.09953	1785932.	-10263.	-0.00279	0.00	4.12E+10	-752.2756	8163.
0.00								
3.2400	0.09654	1774502.	-11074.	-0.00274	0.00	4.12E+10	-750.7332	8398.
0.00								

3.3300	0.09361	1762196.	-11884.	-0.00270	0.00	4.13E+10	-749.0919	8643.
0.00								
3.4200	0.09072	1749014.	-12692.	-0.00265	0.00	4.13E+10	-747.3500	8897.
0.00								
3.5100	0.08788	1734959.	-13498.	-0.00260	0.00	4.14E+10	-745.5055	9162.
0.00								
3.6000	0.08509	1720032.	-14302.	-0.00256	0.00	4.14E+10	-743.5563	9437.
0.00								
3.6900	0.08235	1704237.	-15104.	-0.00252	0.00	4.15E+10	-741.5000	9724.
0.00								
3.7800	0.07966	1687576.	-15904.	-0.00247	0.00	4.16E+10	-739.3341	10023.
0.00								
3.8700	0.07702	1670051.	-16701.	-0.00243	0.00	4.17E+10	-737.0558	10336.
0.00								
3.9600	0.07442	1651664.	-17496.	-0.00238	0.00	4.17E+10	-734.6622	10662.
0.00								
4.0500	0.07187	1632420.	-18288.	-0.00234	0.00	4.18E+10	-732.1498	11003.
0.00								
4.1400	0.06936	1612319.	-19077.	-0.00230	0.00	4.19E+10	-729.5151	11359.
0.00								
4.2300	0.06690	1591367.	-19864.	-0.00226	0.00	4.20E+10	-726.7540	11733.
0.00								
4.3200	0.06448	1569566.	-20647.	-0.00222	0.00	4.21E+10	-723.8622	12124.
0.00								
4.4100	0.06210	1546918.	-21427.	-0.00218	0.00	4.23E+10	-720.8348	12535.
0.00								
4.5000	0.05977	1523429.	-22204.	-0.00214	0.00	4.24E+10	-717.6665	12967.
0.00								
4.5900	0.05748	1499102.	-22977.	-0.00210	0.00	4.25E+10	-714.3513	13421.
0.00								
4.6800	0.05524	1473939.	-23747.	-0.00206	0.00	4.27E+10	-710.8828	13900.
0.00								
4.7700	0.05303	1447947.	-24513.	-0.00203	0.00	4.29E+10	-707.2537	14405.
0.00								
4.8600	0.05086	1421128.	-25274.	-0.00200	0.00	1.14E+11	-703.4571	14938.
0.00								
4.9500	0.04870	1393488.	-26032.	-0.00199	0.00	1.88E+11	-699.3976	15509.
0.00								

5.0400	0.04656	1365033.	-26785.	-0.00198	0.00	1.88E+11	-695.0359	16123.
0.00								
5.1300	0.04442	1335766.	-27533.	-0.00198	0.00	1.88E+11	-690.3498	16785.
0.00								
5.2200	0.04229	1305694.	-28276.	-0.00197	0.00	1.88E+11	-685.3147	17501.
0.00								
5.3100	0.04017	1274822.	-29013.	-0.00196	0.00	1.89E+11	-679.9025	18279.
0.00								
5.4000	0.03806	1243157.	-29744.	-0.00195	0.00	1.89E+11	-674.0809	19129.
0.00								
5.4900	0.03595	1210705.	-30469.	-0.00195	0.00	1.89E+11	-667.8132	20061.
0.00								
5.5800	0.03385	1177475.	-31187.	-0.00194	0.00	1.89E+11	-661.0566	21089.
0.00								
5.6700	0.03176	1143473.	-31897.	-0.00193	0.00	1.89E+11	-653.7612	22229.
0.00								
5.7600	0.02968	1108708.	-32598.	-0.00193	0.00	1.89E+11	-645.8683	23502.
0.00								
5.8500	0.02760	1073190.	-33291.	-0.00192	0.00	1.89E+11	-637.3079	24935.
0.00								
5.9400	0.02553	1036928.	-33975.	-0.00191	0.00	1.89E+11	-627.9955	26563.
0.00								
6.0300	0.02347	999933.	-34647.	-0.00191	0.00	1.89E+11	-617.8277	28431.
0.00								
6.1200	0.02141	962218.	-35309.	-0.00190	0.00	1.89E+11	-606.6762	30600.
0.00								
6.2100	0.01936	923794.	-35957.	-0.00190	0.00	1.89E+11	-594.3782	33157.
0.00								
6.3000	0.01731	884678.	-36592.	-0.00189	0.00	1.89E+11	-580.7224	36223.
0.00								
6.3900	0.01527	844884.	-37211.	-0.00189	0.00	1.90E+11	-565.4273	39981.
0.00								
6.4800	0.01324	804430.	-37812.	-0.00188	0.00	1.90E+11	-548.1038	44715.
0.00								
6.5700	0.01121	763336.	-38393.	-0.00188	0.00	1.90E+11	-528.1898	50896.
0.00								
6.6600	0.00918	721627.	-38951.	-0.00187	0.00	1.90E+11	-504.8246	59375.
0.00								

6.7500	0.00716	679328.	-39481.	-0.00187	0.00	1.90E+11	-476.5754	71873.	0.00
6.8400	0.00514	636474.	-39976.	-0.00187	0.00	1.90E+11	-440.7445	92531.	0.00
6.9300	0.00313	593105.	-40425.	-0.00186	0.00	1.90E+11	-391.0558	134885.	0.00
7.0200	0.00112	549280.	-40801.	-0.00186	0.00	1.90E+11	-303.8689	292592.	0.00
7.1100	-8.84E-04	505100.	-40513.	-0.00186	0.00	1.90E+11	836.9065	1021890.	0.00
7.2000	-0.00289	461897.	-39454.	-0.00185	0.00	1.90E+11	1125.	420693.	0.00
7.2900	-0.00489	420005.	-38153.	-0.00185	0.00	1.90E+11	1283.	283477.	0.00
7.3800	-0.00689	379610.	-36706.	-0.00185	0.00	1.91E+11	1398.	219229.	0.00
7.4700	-0.00888	340845.	-35147.	-0.00185	0.00	1.91E+11	1489.	181136.	0.00
7.5600	-0.01087	303817.	-33496.	-0.00184	0.00	1.91E+11	1567.	155614.	0.00
7.6500	-0.01287	268617.	-31768.	-0.00184	0.00	1.91E+11	1634.	137175.	0.00
7.7400	-0.01485	235322.	-29971.	-0.00184	0.00	1.91E+11	1694.	123149.	0.00
7.8300	-0.01684	204003.	-28112.	-0.00184	0.00	1.91E+11	1748.	112077.	0.00
7.9200	-0.01883	174723.	-26198.	-0.00184	0.00	1.91E+11	1797.	103084.	0.00
8.0100	-0.02082	147539.	-24232.	-0.00184	0.00	1.91E+11	1843.	95616.	0.00
8.1000	-0.02280	122505.	-22219.	-0.00184	0.00	1.91E+11	1885.	89303.	0.00
8.1900	-0.02479	99670.	-20161.	-0.00184	0.00	1.91E+11	1925.	83885.	0.00
8.2800	-0.02677	79080.	-18062.	-0.00184	0.00	1.91E+11	1963.	79178.	0.00
8.3700	-0.02875	60780.	-15923.	-0.00184	0.00	1.91E+11	1998.	75046.	0.00

8.4600	-0.03074	44810.	-13747.	-0.00184	0.00	1.91E+11	2032.	71385.	0.00
8.5500	-0.03272	31209.	-11536.	-0.00184	0.00	1.91E+11	2064.	68115.	0.00
8.6400	-0.03470	20015.	-9291.	-0.00184	0.00	1.91E+11	2094.	65175.	0.00
8.7300	-0.03668	11264.	-7014.	-0.00184	0.00	1.91E+11	2123.	62515.	0.00
8.8200	-0.03866	4989.	-4705.	-0.00184	0.00	1.91E+11	2151.	60096.	0.00
8.9100	-0.04065	1224.	-2367.	-0.00184	0.00	1.91E+11	2179.	57884.	0.00
9.0000	-0.04263	0.00	0.00	-0.00184	0.00	1.91E+11	2205.	27927.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.23671054 inches
Computed slope at pile head = -0.00444026 radians
Maximum bending moment = 1854113. inch-lbs
Maximum shear force = -40801. lbs
Depth of maximum bending moment = 2.07000000 feet below pile head
Depth of maximum shear force = 7.02000000 feet below pile head
Number of iterations = 59
Number of zero deflection points = 1

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Load 1	Load Type 2	Load 2	Axial Pile-head Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	13200.	M, in-lb	1161600.	34560.	0.05810	-9.59E-04	-29044.	1324574.
2	V, lb	18480.	M, in-lb	1626240.	31104.	0.2367	-0.00444	-40801.	1854113.

Maximum pile-head deflection = 0.2367105378 inches
Maximum pile-head rotation = -0.0044402625 radians = -0.254408 deg.

The analysis ended normally.

Appendix F.8

Spread Footing Design

PURPOSE:

To determine the bearing resistance at the strength limit state, AASHTO's LRFD-2006, C10.4.6.4 on rock mass quality, Hoek and Brown constants were used with equation 10.8.3.5.4c-2

CODES/STANDARDS:

AASHTO *LRFD Bridge Design Specifications*, 8th edition, September 2017 (LRFD);

AASHTO *LRFD Bridge Design Specifications* 2006 (LRFD-2006).

FORMULAS

The source of coefficients and formulas should be referenced and cited.

SOURCE OF INPUT DATA

For boring information see appendix

Table 10.4.6.4-4 Approximate relationship between rock-mass quality and material constants used in defining nonlinear strength (Hoek and Brown, 1988)

Rock Quality	Constants	Rock Type: A = Carbonate rocks with well developed crystal cleavage—*dolomite, limestone and marble*; B = Lithified argillaceous rocks—*mudstone, siltstone, shale and slate (normal to cleavage)*; C = Arenaceous rocks with strong crystals and poorly developed crystal cleavage—*sandstone and quartzite*; D = Fine grained polyminerallic igneous crystalline rocks—*andesite, dolerite, diabase and rhyolite*; E = Coarse grained polyminerallic igneous & metamorphic crystalline rocks—*amphibolite, gabbro gneiss, granite, norite, quartz-diorite*				
		A	B	C	D	E
INTACT ROCK SAMPLES Laboratory size specimens free from discontinuities CSIR rating: *RMR* = 100	*m* *s*	7.00 1.00	10.00 1.00	15.00 1.00	17.00 1.00	25.00 1.00
VERY GOOD QUALITY ROCK MASS Tightly interlocking undisturbed rock with unweathered joints at 3–10 ft. CSIR rating: *RMR* = 85	*m* *s*	2.40 0.082	3.43 0.082	5.14 0.082	5.82 0.082	8.567 0.082
GOOD QUALITY ROCK MASS Fresh to slightly weathered rock, slightly disturbed with joints at 3–10 ft. CSIR rating: *RMR* = 65	*m* *s*	0.575 0.00293	0.821 0.00293	1.231 0.00293	1.395 0.00293	2.052 0.00293
FAIR QUALITY ROCK MASS Several sets of moderately weathered joints spaced at 1–3 ft. CSIR rating: *RMR* = 44	*m* *s*	0.128 0.00009	0.183 0.00009	0.275 0.00009	0.311 0.00009	0.458 0.00009
POOR QUALITY ROCK MASS Numerous weathered joints at 2 to 12 in.; some gouge. Clean compacted waste rock. CSIR rating: *RMR* = 23	*m* *s*	0.029 3×10^{-4}	0.041 3×10^{-4}	0.061 3×10^{-4}	0.069 3×10^{-4}	0.102 3×10^{-4}
VERY POOR QUALITY ROCK MASS Numerous heavily weathered joints spaced < 2 in. with gouge. Waste rock with fines. CSIR rating: *RMR* = 3	*m* *s*	0.007 1×10^{-7}	0.010 1×10^{-7}	0.015 1×10^{-7}	0.017 1×10^{-7}	0.025 1×10^{-7}

SB Rear Abutment

Applicable Boring B-005-2-16, Moderately Strong Sandstone,

RQD = 31%, Qu = 4111 psi, RMR = 59 (See attachment)

Fair Class C rock (by linear interpolation): m_{59} = 0.958, s_{59} = 0.00212,

NB Rear Abutment

Applicable Boring B-006-0-15, Slightly Strong Sandstone,

RQD = 80% (Avg. 92% and 67%), Qu = 5560 psi, RMR = 68, use 65 (See attachment)

Good Class B rock: m = 1.231, s = 0.00293

ASSUMPTIONS/PROJECT BACKGROUND:

The rear abutments will be supported to bear on spread footings with a width of 15'-8". Based on table C10.6.2.6.1.1 in AASHTO's LRFD, the spread footing for the rear abutment of the NB bridge will bear on hard sound sandstone with a presumptive bearing resistance at the service limit state of 40 kips per square foot (ksf). The rear abutment of the SB bridge will bear on weathered medium hard bedrock and has a presumptive bearing resistance at the service limit state of 16 ksf. These presumptive values assume one inch or less of settlement.

COMPUTER PROGRAMS USED:

None

CALCULATIONS:

$$q_R = \varphi_b q_n = \varphi_b \left[\sqrt{s} + \sqrt{(m\sqrt{s} + s}\right] q_u$$

SB Rear Abutment

$$q_R = 0.45\left[\sqrt{0.00212} + \sqrt{0.958 \times \sqrt{0.00212} + 0.00212}\right] 4111\ psi = 482.9\ psi = 69.5\ ksf$$

NB Rear Abutment

Good Class B rock: m = 1.231, s = 0.00293, q_u=5060 psi

$$q_R = 0.45\left[\sqrt{0.00293} + \sqrt{(1.231 \times \sqrt{0.00293} + 0.00293}\right] 5060\ psi = 723.6\ psi = 104.2\ ksf$$

Table 10.4.6.4-1 Geomechanics Classification of Rock Masses.

Parameter			Ranges of Values						
1	Strength of intact rock material	Point load strength index	>175 ksf	85–175 ksf	45–85 ksf	20–45 ksf	For this low range, uniaxial compressive test is preferred		
		Uniaxial compressive strength	>4320 ksf	2160–4320 ksf	1080–2160 ksf	520–1080 ksf	215–520 ksf	70–215 ksf	20–70 ksf
	Relative Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% to 100%	75% to 90%		50% to 75%	25% to 50%		<25%
	Relative Rating		20	17		13	8		3
3	Spacing of joints		>10 ft.	3–10 ft.		1–3 ft.	2 in.–1 ft.		<2 in.
	Relative Rating		30	25		20	10		5
4	Condition of joints		• Very rough surfaces • Not continuous • No separation • Hard joint wall rock	• Slightly rough surfaces • Separation <0.05 in. • Hard joint wall rock		• Slightly rough surfaces • Separation <0.05 in. • Soft joint wall rock	• Slicken-sided surfaces or • Gouge <0.2 in. thick or • Joints open 0.05–0.2 in. • Continuous joints		• Soft gouge >0.2 in. thick or • Joints open >0.2 in. • Continuous joints
	Relative Rating		25	20		12	6		0
5	Groundwater conditions (use one of the three evaluation criteria as appropriate to the method of exploration)	Inflow per 30 ft. tunnel length	None	<400 gal./hr.		400–2000 gal./hr.			>2000 gal./hr.
		Ratio = joint water pressure/ major principal stress	0	0.0–0.2		0.2–0.5			>0.5
		General Conditions	Completely Dry	Moist only (interstitial water)		Water under moderate pressure			Severe water problems
	Relative Rating		10	7		4			0

RMR = 4+8+20+20+7 = 59

Table 10.4.6.4-1 Geomechanics Classification of Rock Masses.

Parameter			Ranges of Values						
1	Strength of intact rock material	Point load strength index	>175 ksf	85–175 ksf	45–85 ksf	20–45 ksf	For this low range, uniaxial compressive test is preferred		
		Uniaxial compressive strength	>4320 ksf	2160–4320 ksf	1080–2160 ksf	520–1080 ksf	215–520 ksf	70–215 ksf	20–70 ksf
	Relative Rating		15	12	7	4	2	1	0
2	Drill core quality RQD		90% to 100%	75% to 90%		50% to 75%	25% to 50%		<25%
	Relative Rating		20	17		13	8		3
3	Spacing of joints		>10 ft.	3–10 ft.		1–3 ft.	2 in.–1 ft.		<2 in.
	Relative Rating		30	25		20	10		5
4	Condition of joints		• Very rough surfaces • Not continuous • No separation • Hard joint wall rock	• Slightly rough surfaces • Separation <0.05 in. • Hard joint wall rock		• Slightly rough surfaces • Separation <0.05 in. • Soft joint wall rock	• Slicken-sided surfaces or • Gouge <0.2 in. thick or • Joints open 0.05–0.2 in. • Continuous joints		• Soft gouge >0.2 in. thick or • Joints open >0.2 in. • Continuous joints
	Relative Rating		25	20		12	6		0
5	Groundwater conditions (use one of the three evaluation criteria as appropriate to the method of exploration)	Inflow per 30 ft. tunnel length	None	<400 gal./hr.		400–2000 gal./hr.	>2000 gal./hr.		
		Ratio = joint water pressure/ major principal stress	0	0.0–0.2		0.2–0.5	>0.5		
		General Conditions	Completely Dry	Moist only (interstitial water)		Water under moderate pressure	Severe water problems		
	Relative Rating		10	7		4	0		

RMR = 4+17+20+20+7 = 68

Gannett Fleming
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APPENDIX G

Subgrade Exploration Report

DRAFT REPORT
SUBGRADE EXPLORATION REPORT
SUM-8-1.75
SUMMIT COUNTY, OHIO
PID#: 91710

Prepared For:

ms consultants, inc.
2221 Schrock Road
Columbus, Ohio 43229-1547

Prepared by:

NATIONAL ENGINEERING AND ARCHITECTURAL SERVICES INC.
2800 Corporate Exchange Drive, Suite 240
Columbus, Ohio 43231

NEAS PROJECT 16-0187

MAY 30, 2017

NEAS Inc.
National Engineering & Architectural Services Inc.

EXECUTIVE SUMMARY

The Ohio Department of Transportation (ODOT) has proposed a bridge replacement project (SUM-8-1.75, PID 91710) which will include the replacement of the SUM-8-0199 major bridge structure (also known as the North Expressway Viaduct) with two (2) new major bridge structures carrying State Route 8 (SR-8) over the Little Cuyahoga River Valley in the City of Akron, Summit County, Ohio. The project limits extend about 0.8 miles along SR-8 from Perkins Street (St) on the south side of the valley to E. Glenwood Avenue (Ave) on the north side of the valley. The overall objective of the bridge replacement project is to maintain a safe route of travel with a structure able to accommodate additional traffic lanes in the future. To accomplish the objective of the project the following is planned as part of the proposed work: 1) the replacement of Bridge SUM-8-0199 over the Little Cuyahoga River Valley; 2) the addition of one auxiliary lane to SR-8 in each direction between Perkins St and E. Glenwood Ave; 3) the realignment/reconstruction of the SR-8 mainline freeway segments within the project limits; 4) the reconstruction of the entrance/exit ramps on the northern side of Perkins St (Ramps I and J); 5) the construction of a retaining wall (approximately 350 lineal feet); and, 6) the construction of four separate noise wall segments (estimated total of 4,850 lineal feet).

National Engineering and Architectural Services Inc. (NEAS) has been contracted to provide geotechnical engineering services for the project. The purpose of the geotechnical engineering services was to perform geotechnical explorations within the project limits to obtain information concerning the subsurface soil and groundwater conditions relevant to the design and construction of the project. Between December 27, 2016 and April 13, 2017, NEAS performed the site reconnaissance and exploration program for the project. The subsequent document presents the results of a subgrade exploration for the mainline SR-8, Ramp I, and Ramp J. As part of the referenced project, two phases of geotechnical exploration were performed with the intent to characterize the subsurface soils and groundwater conditions within the project limits. The first phase (Phase I) exploration, performed by Gannett Fleming, Inc. (GF), included a total of 47 borings while NEAS performed the second phase (Phase II) exploration which included a total of 46 borings. A total of 19 and 12 borings were utilized for subgrade characterization purposes from the Phase I and Phase II explorations, respectively, and are referenced within this report.

The existing pavement sections encountered varied throughout the project limits, and generally consisted of asphalt pavement overlying granular base material with the exception of boring B-030-1-16 which included a layer of concrete underlying the asphalt. Project asphalt thickness ranged from 3 to 12 inches while the granular base ranged from 6 to 18 inches in thickness. The concrete thickness along the shoulder of SR-8 Southbound (SB) was measured to be 10 inches in the indicated boring. In general, the overall thickness of the pavement section (pavement and granular base) ranged from 6 to 24 inches. Below the existing pavement section, the subgrade conditions in the project area are relatively consistent and are predominantly comprised of either fill soils (i.e., embankment fill, historical/urban fill, etc.) and/or natural soils consisting of coarse- and fine-grained soils. The coarse-grained, non-cohesive subgrade soils encountered within the project limits are generally classified as A-1-b, A-3, and A-3a, while the fine-grained, cohesive subgrade soils encountered within the project limits are generally classified as A-4a, A-6a, A-6b or A-7-6. Bedrock was encountered in 19 of the 31 borings utilized for subgrade classification purposes, though bedrock was only present within the pavement subgrade depths in 10 of the 31 borings. With respect to high sulfate content within the subgrade soil, based on the project laboratory testing program, each subgrade soil sample tested for sulfate was determined to have a sulfate content of less than 3,000 parts per million (i.e., lower than the level which ODOT considers high and may prevent the use of chemical stabilization).

Based on our evaluation of the subsurface conditions and our geotechnical engineering analyses of the proposed widening and improvement project, it is our opinion that the subgrade conditions encountered are generally satisfactory and pavement can be designed without the need for extreme levels of remediation. In general, the subgrade soils throughout the project can be stabilized where needed by

typical excavate and replace practices and/or compaction and proof rolling methods in accordance with Item 204 Subgrade Compaction and Proof Rolling of the ODOT Construction and Material Specifications (CMS) (ODOT [3], 2016). However, it is anticipated that shallow bedrock will be encountered within the proposed pavement subgrade depths in certain areas, and therefore, will require excavation and replacement in accordance with Item 204.05 of the ODOT CMS. It is NEAS's opinion that the subgrade soils will provide adequate pavement support assuming it is designed and constructed in accordance with the recommendations provided within this report, as well as all applicable ODOT standards and specifications.

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1. INTRODUCTION

1.1. General

NEAS presents our Subgrade Exploration Report for the SUM-8-1.75 project (PID 91710) along State Route 8 (SR-8) in the City of Akron, Summit County, Ohio. It is our understanding that the overall project objective is to replace the existing approximately 1,500 feet (ft) long bridge carrying SR-8 over the Little Cuyahoga River Valley, and in doing so to maintain a safe route of travel with a structure able to accommodate additional traffic lanes in the future. With respect to the proposed roadway/subgrade improvements, the referenced project includes the reconstruction of the SR-8 mainline freeway segments within the project limits, the entrance / exit ramps on the northern side of Perkins St (Ramps I and J), as well as the construction of an additional auxiliary lane along SR-8 in both directions between Perkins St and E. Glenwood Ave. This report presents a summary of the project encountered surficial and subsurface conditions and our recommendations for subgrade stabilization and pavement design parameters for SR-8 and Ramps I and J in accordance with ODOT's *Geotechnical Bulletin 1* (GB1) (ODOT [1], 2016) and *Pavement Design Manual* (PDM) (ODOT, 2015).

The exploration was conducted in general accordance with Barr Engineering, Inc.'s, DBA National Engineering and Architectural Services Inc. (NEAS) proposal to ms consultants, inc (ms consultants), dated November 15, 2016 and with the provisions of ODOT's *Specifications for Geotechnical Explorations* (SGE) (ODOT [2], 2016).

The scope of work by NEAS as part of the referenced project included: 1) a review of published geotechnical information including previous phase exploration results; 2) performing a total of 46 soil test borings (12 utilized within this report as a part of the subgrade exploration); 3) laboratory testing of soil samples in accordance with the SGE; 4) geotechnical engineering analysis to assess subgrade stabilization requirements and pavement design parameters; and, 5) development of this summary report.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Geology and Physiography

The project site is located within the Akron-Canton Interlobate Plateau. This area is characterized as a hummocky area of moderate relief between two converging glacial lobes dominated by kames, kame terraces, eskers, kettles, kettle lakes, and bogs/fens; the drainage of this area can be described as deranged where natural lakes are common (ODGS, 1998). The geology consists of sandy, Wisconsinan-aged and older drift over Devonian- to Pennsylvanian-aged sandstones, conglomerates and shale.

Outside the Little Cuyahoga River Valley in the northern and southern portions of the project site the overburden can be described as moraine. Within the valley, the overburden can be described as glacial outwash or kames consisting of glacial ice contact deposits (northern valley wall). The ground moraine in the southern part of the project area is characterized as occurring as hummocky, non-continuous patches, plugs, or benches mostly in valleys, while mixed with bedrock colluvium on slopes. The ground moraine mapped within the northern part of the project is described as flat and relatively continuous. The glacial outwash mapped within the valley can occur as valley terraces or low plains and is typically comprised of well-sorted, stratified sands and gravels (ODGS, 2002).

Based on the Bedrock Geologic Units Map of Ohio (USGS & ODGS, 2005), bedrock within most of the project area (with the exception of the northern valley wall and immediately adjacent to the north valley wall) consists of the Allegheny and Pottsville Groups which consist of undivided Pennsylvanian-aged shale, siltstone, and underclay which are calcareous in part and locally contain marine fossils. The primary and secondary rock types are shale and siltstone, respectively, with other rock types including claystone, sandstone, limestone, and coal. The remainder of the site (the northern valley wall and just north) lies within the Undivided Maxville Limestone; Rushville, Logan, and Cuyahoga Formations. This group is very close to the Allegheny and Pottsville Groups with respect to primary, secondary and other rock types, composition, and lithological description, though the Maxville Limestone group is identified as Mississippian-aged. According to the ODNR bedrock topography map of Ohio, bedrock elevations at the project site can be expected to range from 1050 ft above mean sea level (amsl) in areas north and south of the valley to 850 ft amsl within the valley. Therefore, bedrock is anticipated to range from a depth of 40 ft below ground surface (bgs) to above the ground surface (outcropping).

The soils at the project site have been mapped (Web Soil Survey) by the Natural Resources Conservation Service as being Canfield-Urban land complex (about 36.5%), Chili-Urban land complex (about 35%), Oshtemo-Glenford complex (about 14%), and Udorthents or Urban land (about 14.5%). The Canfield series consists of well-drained loamy soils formed in Wisconsinan-age till plains often thinly mantled with loess. A moderately shallow bedrock depth is also typical of this series. The Chili series consists of very deep, well drained soils on outwash plains, terraces, kames and beach ridges formed in Wisconsinan-age outwash deposits mainly of non-calcareous sandstone and shale with a large amount of quartz gravel. The Oshtemo and Glendford series consists of very deep, moderately to well drained soils formed in stratified loamy and sandy deposits on outwash plains, valley trains, moraines and beach ridges, as well as in Wisconsin-age glaciolacustrine or stream sediments on terraces in valleys, till plains, lake plains and outwash plains. With respect to the AASHTO Method of Soil Classification, the Canfield-Urban land complex soils are classified as both coarse-grained A-1-b, A-2-4 and A-2-6 soils and fine-grained A-4, A-6, and A-7-5 soils; the Chili-Urban land complex soils are classified as mainly coarse-grained A-1 and A-2 soils but include fine-grained A-4 soils; while the Oshtemo-Glenford complex soils are classified as mainly coarse-grained A-1, A-2 and A-3 soils, but also includes fine-grained A-4, A-6, A-7-5, A-7-6, and A-8 soils. Urban land and Udorthents are soils that have been disturbed by cutting or filling, and are not rated for local roads (USDA, 2015).

2.2. Hydrology/Hydrogeology

The Little Cuyahoga River is the most dominant hydraulic influence within the project area, therefore, groundwater within the river valley is typically expected at an elevation consistent with that of the river. Extending outside the river valley and as the ground surface elevation increases to the north and south, groundwater is likely encountered below the overburden soil, typically occurring in the upper few feet of bedrock where the strata has been somewhat weathered or broken.

The project site is not located within a special flood hazard area based on available mapping by the Federal Emergency Management Agency's (FEMA) National Flood Hazard mapping program, though the Little Cuyahoga River is designated as a Regulatory Floodway (FEMA, 2016).

2.3. Mining and Oil/Gas Production

ODNR's Oil & Gas Well Locator indicates two active oil or gas wells near the project area, one well is located southeast of Furnace St and one is located northwest of Furnace St, each immediately south of

East North St. However, no active oil or gas wells were shown within the project limits (ODNR [2], 2016).

ODNR's Ohio Mine Locator indicates one active mine in the area which is used for surface mining of sands and gravels. The referenced mine is located between SR-8 and Dan St just north of East North St. No other mines are shown to be within the immediate vicinity of the project's boundaries (ODNR [1], 2016).

2.4. Historical Records and Previous Phases of Project Exploration

A historic record search was performed through ODOT's Geotechnical Data Management System (GeoMS); Historical exploration records of rod soundings performed in 1948 within the limits of the SUM-8-1.75 (PID 91710) project were available for the existing Bridge SUM-8-0199 over the Little Cuyahoga River Valley. However, the historical rod soundings reviewed did not provide relevant information with respect to the existing pavement subgrade and therefore, were not utilized in our analysis and are not referenced within this report.

The subsurface exploration for the project was conducted in two phases, with the initial phase (Phase I) conducted by Gannett Fleming, Inc. (GF) between June 8, 2015 and July 13, 2015. The initial phase included 47 borings drilled to depths between 3.7 and 100 ft bgs and was conducted to obtain subsurface information necessary for preliminary design of the project structures and roadway improvements. A summary and results of the Phase I exploration can be found in Gannett Fleming's *SUM-8-1.75 - PID 91710 - Structure Foundation Exploration Report* dated January 2016. Of the 47 borings performed as part of the initial exploration, a portion (21) were performed with the intent of characterizing the existing subgrade soils within the project limits and aide in the analysis/design of the subgrade for the proposed roadway improvements. Of the 21 subgrade borings, 19 are utilized within this report. These borings include pertinent information within the project limits of the SUM-8-1.75 project and therefore, are included in the GB1 analysis and presented within this report. It should be noted that Borings B-005-0-15 and B-020-0-15 were omitted from our analysis as the borings were drilled at elevations outside of the proposed subgrade limits. A summary of the boring information (i.e., location, elevation, depth, etc.) for Phase I borings utilized for subgrade analysis is provided in Table 1 below. The locations of Phase I exploration borings are depicted on the Boring Location Plan provided in Appendix A while the individual logs are provided within Appendix B.

Table 1: Phase I Geotechnical Exploration Boring Summary

Boring Number	Location (Sta/offset)	Latitude[1] (ft)	Longitude[1] (ft)	Elevation[2] (ft)	Depth (ft)
B-001-0-15	515+84, 45' RT	41.084216	-81.502806	1034.1	6.2
B-002-0-15	517+48, 50' RT	41.084659	-81.502705	1035.6	3.7
B-003-0-15	218+05, 38' LT	41.084853	-81.503074	1037.5	6.3
B-004-0-15	222+05, 3' LT	41.085927	-81.502742	1038.9	3.7
B-021-0-15	545+06, 66' RT	41.091758	-81.499346	1028.1	7.0
B-022-0-15	248+06, 7' LT	41.092640	-81.499595	1024.7	10.0
B-024-0-15	549+04, 55' RT	41.092873	-81.499172	1026.3	7.0
B-027-0-15	551+79, 52' RT	41.093643	-81.499186	1025.1	38.6
B-029-0-15	252+07, 38' LT	41.093732	-81.499624	1022.7	10.0
B-030-0-15	553+19, 74' RT	41.094034	-81.499240	1024.9	7.0
B-031-0-15	254+57, 55' LT	41.094398	-81.499763	1023.1	10.0
B-032-0-15	557+48, 53' RT	41.095203	-81.499438	1021.9	5.3
B-001-2-15	415+52, 2' RT	41.084055	-81.502522	1050.5	11.4
B-003-2-15	418+52, 9' RT	41.084876	-81.502435	1053.4	8.6
B-004-4-15	423+06, 14' RT	41.086090	-81.502174	1037.3	10.0
B-001-1-15	314+55, 40' LT	41.084067	-81.503913	1052.7	11.2
B-003-3-15	318+54, 2' LT	41.085057	-81.503278	1037.5	8.8
B-003-7-15	320+34, 14' RT	41.085525	-81.503058	1045.5	8.6
B-004-3-15	323+04, 8' LT	41.086251	-81.502863	1039.7	6.2

Notes:
1. *Boring coordinates provided follow the projected NAD83 Ohio State Plan, North Zone coordinate system.*
2. *Elevations are based on NAVD88 datum and are in reference to mean sea level.*

2.5. Field Reconnaissance

Field reconnaissance visits for the overall project area were conducted on March 20, 2017 and March 21, 2017 along SR-8 and the surrounding areas, from the start of the project at the Perkins St overpass (SLM 1.75) to just north of the E. Glenwood Ave overpass (SLM 2.58). NEAS observed, photographed and recorded the existing pavement and roadway embankment conditions, location of bedrock outcropping, the existing bridge foundation (as observed from the surface) conditions, as well as other significant surface features during the visit. A summary of the site observations including photographs of noted features is provided below.

The general topography of the project area (Little Cuyahoga River Valley) gradually slopes from east to west. The northern and southern portions of the project area are relatively flat near the start and end of the project, however, each side slopes downward as the roadway extends towards the river valley. The surrounding land use on either side of SR-8 is predominantly residential while the land use within the valley is a mix of commercial, industrial and heavily wooded/undeveloped land. Bedrock outcroppings were observed and noted at various locations throughout the site though the majority of the outcroppings were located along the valley wall on the southeast side of the existing bridge. The bedrock outcroppings observed during our site visit consisted predominantly of sandstone with minor amounts of siltstone.

The existing Bridge SUM-8-0199 (North Expressway Viaduct) carries north and southbound traffic over the valley connecting the City of Akron to the northern suburbs. During our reconnaissance visit, no signs of structural distress related to geotechnical concerns were observed. No significant erosion was observed at any of the substructure locations, though signs of erosion were observed at multiple storm sewer outlet locations under the south half of the bridge (Photographs 1 and 2). All other structural elements within the project area (i.e., retaining walls, nearby bridges, high mast light towers, etc.) were observed to be performing well with no apparent signs of distress due to geotechnical conditions. In general, embankments slopes throughout the project site appeared to be stable with inclinations between 2 Horizontal to 1 Vertical (2H:1V) and vertical or nearly vertical (where bedrock is present or near the

surface. The relatively steep slopes observed were typically heavily vegetated with weeds, bushes, shrubs, and mature trees while the more gradual slopes were typically grassy with occasional bushes and/or shrubs. The river valley slopes within the footprint of the existing bridge generally consist of rip-rap covered slopes with the exception of a few areas on the south valley slope which were either benched for railroad construction or vegetated as indicated above. Minor scarps were observed along embankment slopes, however the slopes were observed to be about 2H:1V to 3H:1V and appeared relatively stable at the time of our reconnaissance. The referenced scarps where specifically noted at the E. Glenwood Ave and SR-8 NB exit and SB entrance ramps (Photographs 3 and 4).

In general, the pavement throughout the project area was observed to be in good to fair condition. With respect to the project ramps, the surface pavement consisted of both asphalt and concrete that was generally observed to be in good condition with occasional low severity distress. The exception being one medium severe longitudinal crack observed along the length of the SR-8 NB entrance ramp from Perkins St. The surface pavement of SR-8 within the project limits consisted of asphalt except for the concrete bridge deck portion of the roadway. The pavement along SR-8 was observed to be in good to fair condition with frequent low to medium severity distress; occasional medium to high severity longitudinal cracking and pothole patching (Photographs 5 and 6); transverse and block cracking (Photograph 7); and thermal cracking (Photograph 8). The site appeared to be well drained with the majority of the site draining either directly to the Little Cuyahoga River or to storm sewers which outlet to the Little Cuyahoga River. No significant signs of ponding water or poor drainage were observed along project roadways, ramps or structures during out site reconnaissance visit.

Photograph 1: Sign of erosion at storm sewer outlet under south side of existing bridge (1 of 2)

Photograph 2: Sign of erosion at storm sewer outlet under south side of existing bridge (2 of 2)

Photograph 3: Minor scarps on embankment slope at SR-8 NB exit ramp to E. Glenwood Ave

Photograph 4: Minor scarps on embankment slope at SR-8 SB entrance ramp from E. Glenwood Ave

Photograph 5: High severity longitudinal cracking and pothole patching along SR-8 NB

Photograph 6: Medium to high severity longitudinal cracking along SR-8 NB

Photograph 7: Medium to high severity transverse and block cracking along SR-8 SB

Photograph 8: Medium severity thermal cracking along SR-8 SB

3. GEOTECHNICAL EXPLORATION

3.1. Subgrade Exploration Program

The subsurface exploration for the project was conducted in two phases, with the initial phase (Phase I) conducted by GF between June 8, 2015 and July 13, 2015 and the second conducted by NEAS between December 27, 2016 and April 13, 2017. The initial phase included 47 borings drilled to depths between 3.7 and 100 ft bgs while the second phase included 46 borings (12 utilized within this report as a part of the subgrade exploration) drilled to depths between 13.5 and 85.0 ft bgs. The Phase II boring locations were selected by NEAS in general accordance with the guidelines contained in the SGE with the intent to evaluate subsurface soil and groundwater conditions. Borings were typically located within the planned roadway/subgrade improvement areas that were not restricted by underground utilities or dictated by terrain (i.e., steep embankment slopes). Target boring locations and as-drilled boring locations were located and surveyed in the field by the project surveyor, 2LMN, Inc. (2LMN), prior to and after the completion of drilling, respectively. A summary and results of the Phase I exploration can be found in Gannett Fleming's *SUM-8-1.75 - PID 91710 - Structure Foundation Exploration Report* dated January 2016. Each individual project boring log (included within Appendix B) includes the recorded boring latitude and longitude location (based on the surveyed Ohio State Plane North, NAD83, location) and the corresponding ground surface elevation. The boring locations are depicted on the Boring Location Plan provided in Appendix A. It should be noted that a number of borings were drilled for project structures, but can serve as both structure and roadway borings and therefore, are included within this report.

Phase II borings were drilled using either a CME 55 or CME 55X, truck- or track-mounted drilling rig, respectively, utilizing 3.25-inch (inner diameter) hollow stem augers. Soil samples for the borings were

typically recovered at 2.5-ft intervals using an 18-inch split spoon sampler (AASHTO T-206 "Standard Method for Penetration Test and Split Barrel Sampling of Soils."). The soil samples obtained from the exploration program were visually observed in the field by the NEAS field representative and preserved for review by a Geologist for possible laboratory testing. Standard penetration tests (SPT) were conducted using a CME auto hammer that has been calibrated to be between 81.8% and 88.1% efficient (depending on the specific hammer used) as indicated on the boring logs.

Field boring logs were prepared by drilling personnel and included pavement description (where present), lithological description, SPT results recorded as blows per 6-inch increment of penetration, and estimated unconfined shear strength values on specimens exhibiting cohesion that had not been significantly disturbed (using a hand-penetrometer). Groundwater level observations were recorded both during and after the completion of drilling. These groundwater level observations are included on the individual boring logs (Appendix B). After completing the borings, the boreholes were backfilled with either auger cuttings, bentonite chips, or a combination of these materials and patched with asphalt cold patch and/or cement where necessary and appropriate.

3.2. Laboratory Testing Program

The laboratory testing program on the Phase II exploration borings utilized for subgrade characterization consisted of classification testing, moisture content determinations, and unconfined compressive strength of rock cores. Data from the laboratory testing program were incorporated onto the borings logs (Appendix B). Soil samples are retained at the laboratory for 60 days following report submittal, after which time they will be discarded.

3.2.1. Classification Testing

Representative soil samples were selected for index property (Atterberg Limits) and gradation testing for classification purposes on approximately 36% of the soil samples obtained in the Phase II exploration borings utilized for subgrade characterization. At each subgrade boring location, a sample representing each distinctive strata obtained below the proposed top of subgrade elevation was generally tested while additional samples were selected for testing with the intent of properly classifying the subsurface soil and groundwater conditions within the planned project limits. Soils not selected for testing were compared to laboratory tested samples/strata and classified visually. Moisture content testing was conducted on all samples. The laboratory testing was performed in general accordance with applicable AASHTO specifications and ODOT Supplements.

Final classification of soil strata in accordance with AASHTO M-145 "Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes," as modified by ODOT "Classification of Soils" was made once laboratory test results became available. The results of the soil classification are presented on the boring logs in Appendix B.

3.2.2. Standard Penetration Test Results

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils were performed at 2.5-ft intervals in the referenced project borings performed. To account for the high efficiency (automatic) hammers used during SPT sampling, field SPT N-values were converted based on the calibrated efficiency (energy ratio) of the specific drill rig's hammer. Field N-values were converted to an equivalent rod energy of 60% (N_{60}) for use in analysis or for correlation purposes. The resulting N_{60} values, as well as the specific rig calibration information are shown on the boring logs provided in Appendix B.

3.2.3. Unconfined Compressive Strength of Rock Cores

Unconfined Compressive Strength of a Rock Core Tests were conducted in accordance with ASTM D 7012 "Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures", Method C on three rock core samples obtained within borings utilized for subgrade characterization . The samples tested were obtained from borings B-005-1-16, B-030-1-16, and B-031-3-16. The three rock core samples tested were classified as Sandstone. The Unconfined Compressive Strength of a Rock Core Test results are shown in Table 2.

Table 2: Unconfined Compressive Strength of Rock Core Tests Summary

Boring Number	Depth of Sample (ft)	Color, Classification	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psi)	Strain (%)
B-005-1-16	37.5 - 37.9	Brown, Sandstone	4.4	129.7	4680	0.6%
B-030-1-16	29.3 - 29.7	Light Brown, Sandstone	4.6	128.4	5184	0.8%
B-031-3-16	16.7 - 17.1	Brown, Sandstone	4.4	129.1	3826	0.6%

3.2.4. Sulfate Content Testing

Sulfate content testing of subgrade soils was conducted as a part of the Phase I exploration lab testing program. Sulfate testing was performed on one sample from 14 of the 19 Phase I subgrade borings referenced within this report. Sulfate content test results including boring ID, depth of sample tested, and sulfate content of soil in parts per million (PPM) are summarized in Table 3 below.

Table 3: Summary of Sulfate Content Testing

Boring ID	Depth (ft)	Sulfate Content (PPM)
B-001-0-15	1.0 - 2.5	400.0
B-003-0-15	6.0 - 6.3	300.0
B-021-0-15	1.0 - 2.5	800.0
B-022-0-15	1.0 - 2.5	700.0
B-024-0-15	1.0 - 2.5	300.0
B-029-0-15	1.0 - 2.5	400.0
B-030-0-15	1.0 - 2.5	600.0
B-031-0-15	1.0 - 2.5	800.0
B-032-0-15	2.5 - 4.0	300.0
B-001-2-15	1.0 - 2.5	400.0
B-004-4-15	3.5 - 5.0	1000.0
B-001-1-15	1.0 - 2.5	400.0
B-003-3-15	3.5 - 5.0	500.0
B-004-3-15	1.0 - 2.5	300.0

4. FINDINGS

The subsurface conditions encountered during the project explorations are described in the following subsections and/or on each boring log presented in Appendix B. The Phase II boring logs represent NEAS's interpretation of the subsurface conditions encountered at each boring location based on our site observations, field logs, visual review of the soil samples by NEAS's geologist, and laboratory test results. The lines designating the interfaces between various soil strata on the boring logs represent the

approximate interface location; the actual transition between strata may be gradual and indistinct. The subsurface soil and groundwater characterizations included herein, including summary test data, are based on the subsurface findings from the geotechnical explorations performed by GF and NEAS as part of the referenced project. At the time of the composition of this draft report, pavement grade information has been assumed to be consistent with the proposed profiles presented in the SUM-8-1.75 Roadway Plans prepared by ms consultants, dated February 1, 2017. It should be noted that for the purposes of this report and our analysis, the term 'subgrade' has been assumed to represent soils and/or soil conditions from 1.5 ft below proposed final pavement grades to a depth of 7.5 ft below the proposed pavement grades.

4.1. Existing Pavement

The pavement section thicknesses in terms of asphalt, concrete and granular base were measured at representative subgrade borings. Pavement section thicknesses were measured during both phases of subsurface exploration and are recorded on the test boring logs provided in Appendix B. A summary of the pavement measurements for the project is provided in Table 4 below.

Table 4: Measured Pavement Thicknesses

Pavement Thickness Summary			
Boring ID	Asphalt Thickness (in)	Concrete Thickness (in)	Base Thickness (in)
B-001-0-15	12.0	-	-
B-002-0-15	-	-	-
B-003-0-15	10.0	-	-
B-004-0-15	6.0	-	-
B-021-0-15	6.0	-	12.0
B-022-0-15	8.0	-	16.0
B-024-0-15	8.0	-	10.0
B-027-0-15	6.0	-	10.0
B-029-0-15	7.0	-	11.0
B-030-0-15	6.0	-	-
B-031-0-15	6.0	-	18.0
B-032-0-15	6.0	-	-
B-001-2-15	12.0	-	-
B-003-2-15	-	-	-
B-004-4-15	-	-	-
B-001-1-15	-	-	-
B-003-3-15	-	-	-
B-003-7-15	-	-	-
B-004-3-15	-	-	-
B-005-1-16	8.0	-	8.5
B-017-1-16	8.0	-	7.5
B-020-1-16	8.0	-	6.5
B-021-1-16	9.0	-	6.0
B-021-3-16	8.0	-	9.0
B-025-1-16	7.0	-	13.0
B-029-1-16	8.0	-	11.0
B-030-1-16	3.0	10.0	-
B-031-1-16	6.0	-	18.0
B-031-3-16	6.0	-	-
B-032-1-16	7.0	-	10.0
B-004-5-16	8.0	-	4.0

4.2. Subgrade Conditions

The subgrade conditions within the project area are relatively consistent and generally comprised of either fill soils (i.e., embankment fill, historical/urban fill, etc.) and/or natural glacially deposited soils, all over sandstone bedrock. The cohesive subgrade soils encountered within the project limits are generally classified as either A-4a, A-6a, A-6b, and A-7-6 soil, while the non-cohesive soils are classified as either A-1-b, A-3, or A-3a soil. Bedrock was encountered in 19 of the 31 borings utilized for subgrade characterization purposes at depths ranging from 1.4 to 33.5 ft bgs. With respect to sulfate content within the subgrade soil, based on the Phase I exploration laboratory testing program, each subgrade soil sample tested was determined to have a sulfate content of less than 3,000 parts per million (i.e., lower than the level which ODOT considers high and may prevent the use of chemical stabilization).

The following section presents a brief summary of the subsurface conditions encountered throughout the project site with problem areas highlighted if present.

4.2.1. Subgrade Soils

The subgrade soils encountered within the project limits were relatively consistent throughout and generally consisted of both coarse- and fine-grained material. Sixty-one percent (61%) of the samples obtained along the proposed roadways were classified as coarse-grained, non-cohesive soils and were comprised of: 1) Gravel and/or Stone Fragments with Sand (A-1-b, 18% of samples); 2) Fine Sand (A-3, 28% of samples); and, 3) Coarse and Fine Sand (A-3a, 14% of samples). With respect to the relative density of the coarse-grained soils, the descriptions varied from loose to very dense correlating to correlating to converted SPT-N values (N_{60}) between 5 to SPT-N refusal (requiring more than 50 blows per 6-inches of penetration) (29 bpf average). Natural moisture contents ranged from 1 to 20 percent (8 percent average).

The remaining thirty-nine percent (39%) of the samples obtained along the proposed roadways were classified as fine-grained, cohesive and non- cohesive soils and were comprised of: 1) Sandy Silt (A-4a, 13% of samples); 2) Silt and Clay (A-6a, 8% of samples); 3) Silty Clay (A-6b, 14% of samples); and, 4) Clay (A-7-6, 4% of samples). The relative consistency of the fine-grained, cohesive soil ranged from medium stiff to very stiff with a corresponding N_{60} values ranging from 5 to 29 bpf (15 bpf average). Natural moisture contents of the fine-grained soil ranged from 13 to 25 percent (17 percent average). Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the project roadways, the liquid and plastic limits ranged from 22 to 42 percent (34 percent average) and from 14 to 24 percent (19 percent average), respectively.

4.2.2. Groundwater

Groundwater measurements were taken during the boring drilling procedures and/or immediately following the completion of each borehole. Groundwater was observed during drilling in 1 of the 31 project subgrade borings. Within project boring B-027-0-15, groundwater was encountered at a depth of 17.3 ft bgs (approximate elevation 1007.8 ft amsl) which is at a depth well below bottom of subgrade elevation. Groundwater was not encountered in the borings performed solely for subgrade classification purposes.

It should be noted that groundwater is affected by many hydrologic characteristics in the area and may vary from those measured at the time of the exploration. The specific groundwater reading is included on the individual test boring log located within Appendix B.

5. ANALYSES AND RECOMMENDATIONS

We understand that the widening and/or reconstruction of portions of SR-8 and the entrance/exit ramps on the northern side of Perkins St (Ramps I and J) are planned as part of the SUM-8-1.75 project (PID 91710) along SR-8 in the City of Akron, Summit County, Ohio. For this purpose, a subgrade exploration and subsequent subgrade analysis was completed for the referenced project. The subgrade analysis was performed in accordance with ODOT's GB1 criteria utilizing the ODOT provided *GB1: Subgrade Analysis Spreadsheet* (GB1_SubgradeAnalysis.xls, Version 13.0 dated January 15, 2016). Input information for the spreadsheet was based on the soil characteristics gathered during both phases of the project subgrade exploration (i.e., SPT results, laboratory test results, etc.), and our geotechnical experience. For analysis purposes, final roadway elevations were determined based on the proposed profiles shown in the SUM-8-1.75 Roadway Plans prepared by ms consultants, dated February 1, 2017.

Based on our evaluation of the subsurface conditions and our geotechnical engineering analyses of the proposed widening and improvement project, it is our opinion that the subgrade conditions encountered are generally satisfactory and pavement can be designed without the need for extreme levels of remediation. In general, the subgrade soils throughout the project can be stabilized where needed by typical excavate and replace practices and/or typical compaction and proof rolling methods. The following sections provide further detail about the analysis performed and the recommended remediation.

5.1. Geotechnical Engineering Analysis

A GB1 analysis was performed to identify the method, location, and dimensions (including depth) of recommended subgrade stabilization in the referenced project plans. Appropriate stabilization of the subgrade will ensure a constructible pavement buildup, enhance pavement performance over its life, and help reduce costly extra work change orders (ODOT [1], 2016). In addition to identifying stabilization recommendations, pavement design parameters are also determined to aid in pavement section design. The subsections below present the results of our GB1 analysis including pavement design parameters and unsuitable subgrade conditions identified within the project limits. A GB1 analysis spreadsheet for the project subgrade soils is provided in Appendix C.

5.1.1. Pavement Design Recommendations

It is our understanding that pavement analyses and design is to be performed to determine the proposed pavement sections of: 1) Mainline SR-8 Northbound (NB) and Southbound (SB); 2) The SR-8 SB exit ramp to Perkins St (Ramp I); and, 3) The SR-8 NB entrance ramp from Perkins St (Ramp J). GB1 analyses were performed using the subgrade soil data obtained along each of the individual proposed roadway alignments to evaluate the soil characteristics for use in pavement design. The subgrade analysis parameters recommended for use in pavement design for the project are presented in Table 5 below. Provided in the table are average Plasticity Index (PI) values, maximum, minimum and average N_{60L} values, as well as the design CBR value recommended for use in pavement design. As indicated in the table, a design CBR of 9 is recommended for use in pavement design for the project.

Table 5: Pavement Design Values

Maximum N_{60L}	Minimum N_{60L}	Average N_{60L}	Average PI Value	Design CBR
30	5	17.8	14.9	9

5.1.2. Unsuitable Subgrade

Per ODOT's GB1, the presence of select subgrade conditions are prohibited within the subgrade zone for new pavement construction. These prohibited subgrade conditions generally include the presence of rock, specific soil types, weak soil conditions, and overly moist soil conditions. With respect to the planned roadways, these subgrade conditions are further discussed in the following subsections.

5.1.2.1. Rock

Rock was encountered within the proposed pavement subgrade depths in 10 of the 31 referenced subgrade borings performed within the project limits. However, rock was only encountered at depths at which may require excavation and replacement per GB1 (2 ft below bottom of proposed asphalt or concrete pavement) in only 4 subgrade borings (borings B-002-0-15, B-032-1-16, B-003-2-15, and B-003-7-15). It should be noted that for our analysis an asphalt thickness of 8 inches (0.67 ft) was assumed to estimate bottom of asphalt pavement elevation. A summary of the subgrade borings in which bedrock was encountered at or close to subgrade elevation including depth to bedrock is presented in Table 6 below.

Table 6: Subgrade Bedrock Summary

Boring ID	Depth of Rock in Boring (ft)	Depth of Rock Below Proposed Grade (ft)	Estimated Depth Below Bottom of Asphalt (ft)[2]
B-001-0-15	4.5	4.5	3.8
B-002-0-15	2.0	2.1	**1.4**
B-003-0-15	3.7	4.0	3.3
B-004-0-15	2.2	3.5	2.8
B-031-3-16	5.0	5.0	4.3
B-032-0-15	5.0	5.0	4.3
B-032-1-16	1.4	1.4	**0.7**
B-001-2-15	6.0	6.2	5.5
B-003-2-15	4.0	-6.0	**-6.7**[1]
B-001-1-15	8.5	8.8	8.1
B-003-7-15	6.0	-2.7	**-3.4**[1]
B-004-3-15	4.5	7.0	6.3

Notes:
1. *Negative value indicates rock present above proposed grade elevation.*
2. *Assumes an asphalt pavement thickness of 8 inches (0.67 ft).*

5.1.2.2. Prohibited Soils

Prohibited soil types per the GB1 include A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b, and soils with liquid limits greater than 65. These prohibited soil types were not encountered within the subgrade of the referenced project roadways based on the referenced subgrade borings.

5.1.2.3. Weak Soils

Soils for which the lowest N_{60} value (N_{60L}) at the referenced boring location is less than 12 bpf and in some cases less than 15 bpf (i.e., where moisture content is greater than optimum plus 3 percent) subgrade stabilization depths are recommended per *Figure B - Subgrade Stabilization* within the GB1. It should be noted that for the purposes of this report, the term "weak soils" has been assumed to represent subgrade soils of these conditions. A summary of the boring locations where weak soils were encountered and the associated GB1 recommended remediation depths are shown in Table 7 below.

Table 7: Summary of Weak Soils Encountered

Boring ID	N_{60}	Depth Below Proposed Grade (ft)	Remediation Depth (inches)		
			Excavate and Replace (Item 204)	Excavate and Replace (Item 204 w/ Geotextile)	Chemical Stabilization (Item 206)
B-020-1-16	9	5.5 -7.0	12	12	14
B-020-1-16	8	8.0 - 9.5	12	12	14
B-021-0-15	12	1.3 - 2.8	12	12	12
B-021-0-15	11	2.8 - 4.3	12	12	12
B-021-1-16	9	5.2 - 6.7	--	--	--
B-021-3-16	12	5.2 - 6.7	12	12	12
B-022-0-15	9	7.9 - 9.4	12	12	14
B-031-0-15	7	1.1 - 2.6	--	--	--
B-031-0-15	5	3.6 - 5.1	21	15	16
B-031-0-15	9	6.1 - 7.6	12	12	14
B-031-1-16	11	2.5 - 4.0	12	12	12
B-001-2-15	12	1.2 - 2.7	--	--	--
B-004-4-15	5	2.1 - 3.6	--	--	--
B-004-4-15	11	7.1 - 8.6	12	12	12
B-001-1-15	5	3.8 - 5.3	--	--	--
B-003-3-15	5	7.5 - 9.0	--	--	--
B-003-7-15	7	-7.7 - -6.2	15	12	14
B-004-3-15	11	3.5 - 5.0	--	--	--

Notes:
1. Remediation Depths marked as "--" are granular soils that may be rew orked.

It should be noted that *Figure B - Subgrade Stabilization* does not apply to soil types A-1-a, A-1-b, A-3, or A-3a, nor to soils with N_{60L} values of 15 bpf or more. Per GB1 guidance *these soils should be reworked to stabilize the subgrade.*

5.1.2.4. High Moisture Content Soils

High moisture content soils are defined by the GB1 as soils that exceed the estimated optimum moisture content (per *Figure A - Optimum Moisture Content* within the GB1) for a given classification by 3 percent or more. Per the GB1, soils determined to be above the identified moisture content levels are a likely indication of the presence of an unstable subgrade and may require some form of subgrade stabilization. Summaries of the boring locations where high moisture content conditions were encountered within the project subgrade soils are shown in Table 8 below.

Table 8: Summary of High Moisture Content Soils Encountered

Boring ID	Moisture Content (%)	Optimum Moisture Content (%)	Depth Below Subgrade (ft)
B-020-1-16	17	10	3.0 - 4.5
B-021-0-15	25	16	1.3 - 2.8
B-021-3-16	17	10	5.2 - 6.7
B-031-1-16	17	10	5.0 - 6.5
B-001-2-15	18	8	1.2 - 2.7
B-001-2-15	25	19	3.7 - 5.2
B-003-7-15	24	17	-5.2 - -3.7

5.2. Stabilization Recommendations

Unsuitable subgrade conditions that are prohibited within the subgrade per GB1 guidelines were encountered within the subgrade of portions of the proposed roadway improvement areas. These unsuitable subgrade conditions encountered along areas planned to be improved within the project limits include areas of identified weak soils and shallow rock, as previously indicated in Section 5.1.2. of this report. Although

weak soils, as defined in Section 5.1.2.3. of this report, were encountered within subgrade depths at various locations throughout the project area, it is our opinion that due to 1) the depth at which the weak soils were encountered; 2) the classification of the soils considered to be weak; 3) the relative consistency/density of the overlying soils; and/or, 4) the frequency at which soils considered to be weak were encountered, that no additional stabilization measures are necessary beyond the typical Item 204 Subgrade Compaction and Proof Rolling procedures as specified in ODOT's Construction and Materials Specifications (CMS) (ODOT [3], 2016).

Furthermore, as indicated above, rock was encountered within two feet of the estimated bottom of the proposed asphalt or concrete pavement in four (4) of the referenced subgrade borings (i.e., depth of rock identified by ODOT's GB1 as an unsuitable subgrade condition). At locations where bedrock is encountered within two feet of the bottom of the proposed asphalt or concrete pavement, it is recommended that the rock encountered be excavated in accordance with Item 204.05 *"Rock, Shale, or Coal Subgrade"* of ODOT's CMS.

Based on: 1) the results of our GB1 analysis; 2) the review of the unsuitable subgrade conditions as described in Section 5.1.2. of this report; and, 3) the subsequent conclusions regarding recommended stabilization, Table 9 below presents our recommendations for subgrade stabilization for the separate roadway segments within the project limits that have planned improvements.

Table 9: Summary of Subgrade Stabilization

Start Station	End Station	Excavate and Replace (inches)	Unsuitable Subgrade Conditions	Borings Considered
Mainline SR 8 - South of Bridge SUM-8-0199 (Over Little Cuyahoga River Valley)				
Begin Work	End Work	N/A	N/A	B-001-0-15, B-005-1-16, B-002-0-15, B-003-0-15, B-004-0-15, B-004-5-16
Mainline SR 8 Northbound - North of Bridge SUM-8-0199 (Over Little Cuyahoga River Valley)				
Begin Work	End Work	N/A	N/A	B-017-1-16, B-020-1-16, B-021-0-15, B-021-1-16, B-021-3-16,B-024-0-15, B-025-1-16, B-027-0-15, B-029-1-16, B-030-0-15, B-032-0-15
Mainline SR 8 Southbound - North of Bridge SUM-8-0199 (Over Little Cuyahoga River Valley)				
Begin Work	257+50	N/A	N/A	B-020-0-15, B-022-0-15, B-029-0-15, B-030-1-16, B-031-0-15, B-031-1-16, B-031-3-16
257+50	End Work	24	Shallow rock within subgrade	B-032-1-16
Ramp I				
Begin Work	319+50	N/A	N/A	B-001-1-15
319+50	322+00	24	Shallow rock within subgrade	B-003-7-15
322+50	End Work	N/A	N/A	B-004-3-15
Ramp J				
Begin Work	416+50	N/A	N/A	B-001-2-15
416+50	420+00	24	Shallow rock within subgrade	B-003-2-15
420+00	End Work	N/A	N/A	B-004-4-15, B-004-5-16

Excavations are estimated to extend to the depths indicated above with the excavated material being replaced with material in accordance with Section F "Excavate and Replace (Item 204)" of the ODOT GB1. Excavation of rock shall extend 12-inches beyond the edge of the proposed paved roadway, shoulder, or median while all other stabilization procedures (e.g., replacement, compaction, etc.) should extend 18-inches beyond the edge of the proposed paved roadway, shoulder or median.

6. QUALIFICATIONS

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subgrade conditions along the referenced portions of roadways. This report has been prepared for ms consultants, ODOT and their design consultants to be used solely in evaluating the roadway subgrade soils within the project limits and presenting geotechnical engineering recommendations specific to this project. The assessment of general site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this geotechnical exploration. Our recommendations are based on the results of our field explorations, laboratory tests results from representative soil samples, and geotechnical engineering analyses. The results of the field explorations and laboratory tests, which form the basis of our recommendations, are presented in the appendices as noted. This report does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. In the event that any changes occur in the nature, design or location of the proposed pavement work, the conclusions and recommendations contained in this report should not be considered valid until they are reviewed, and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to ms consultants in performing this geotechnical exploration for the SUM-8-1.75 project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

Brendan P. Andrews, P.E.
Geotechnical Engineer

Kevin C. Arens, E.I.
Staff Geotechnical Engineer

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APPENDIX A

SOIL BORING LOCATION PLAN

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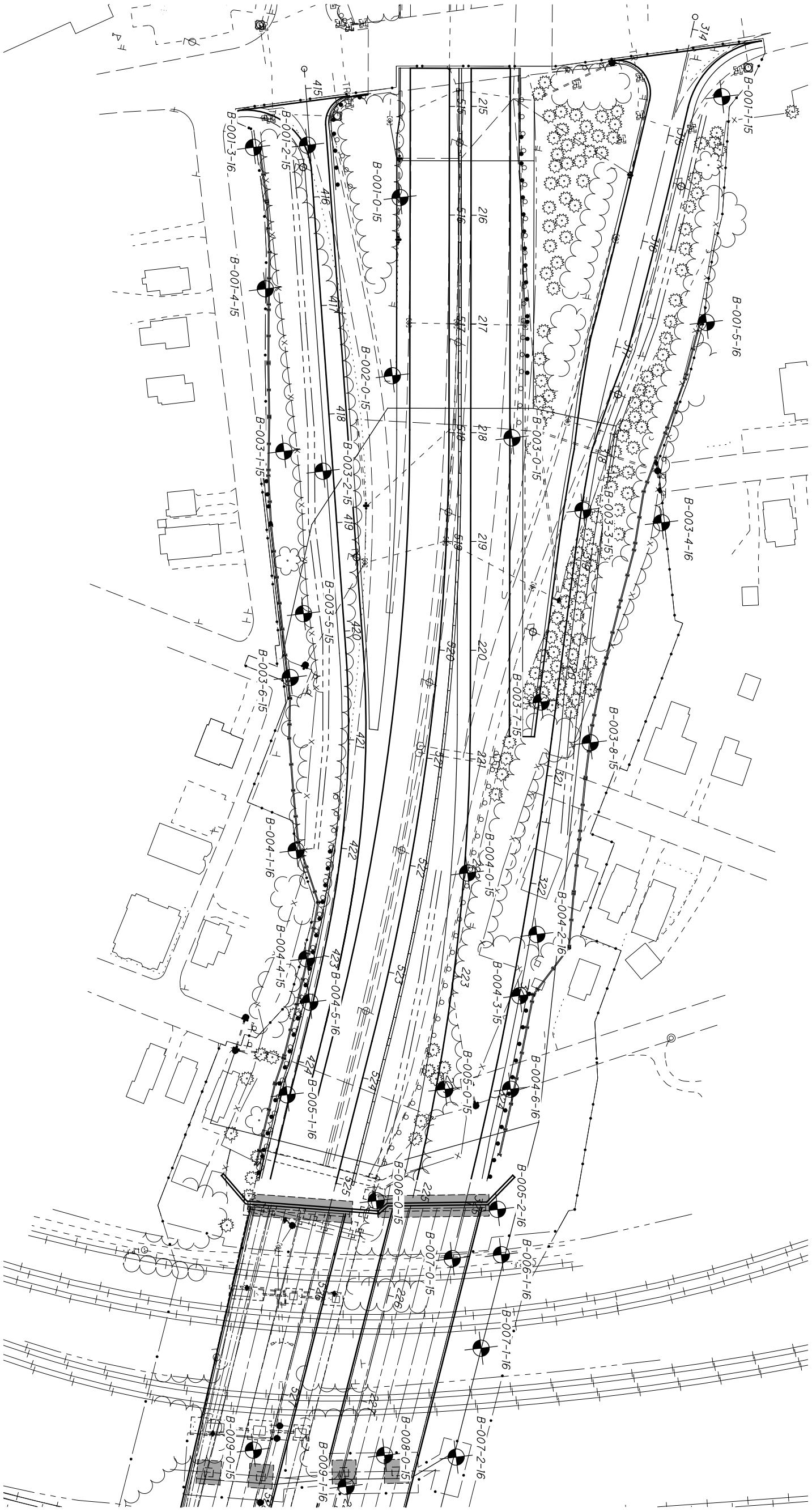

1/4	SUM-8-1.75	BORING LOCATION PLAN	DRAWN KCA / CHECKED BPA	0 50 / 25 100 HORIZONTAL SCALE IN FEET

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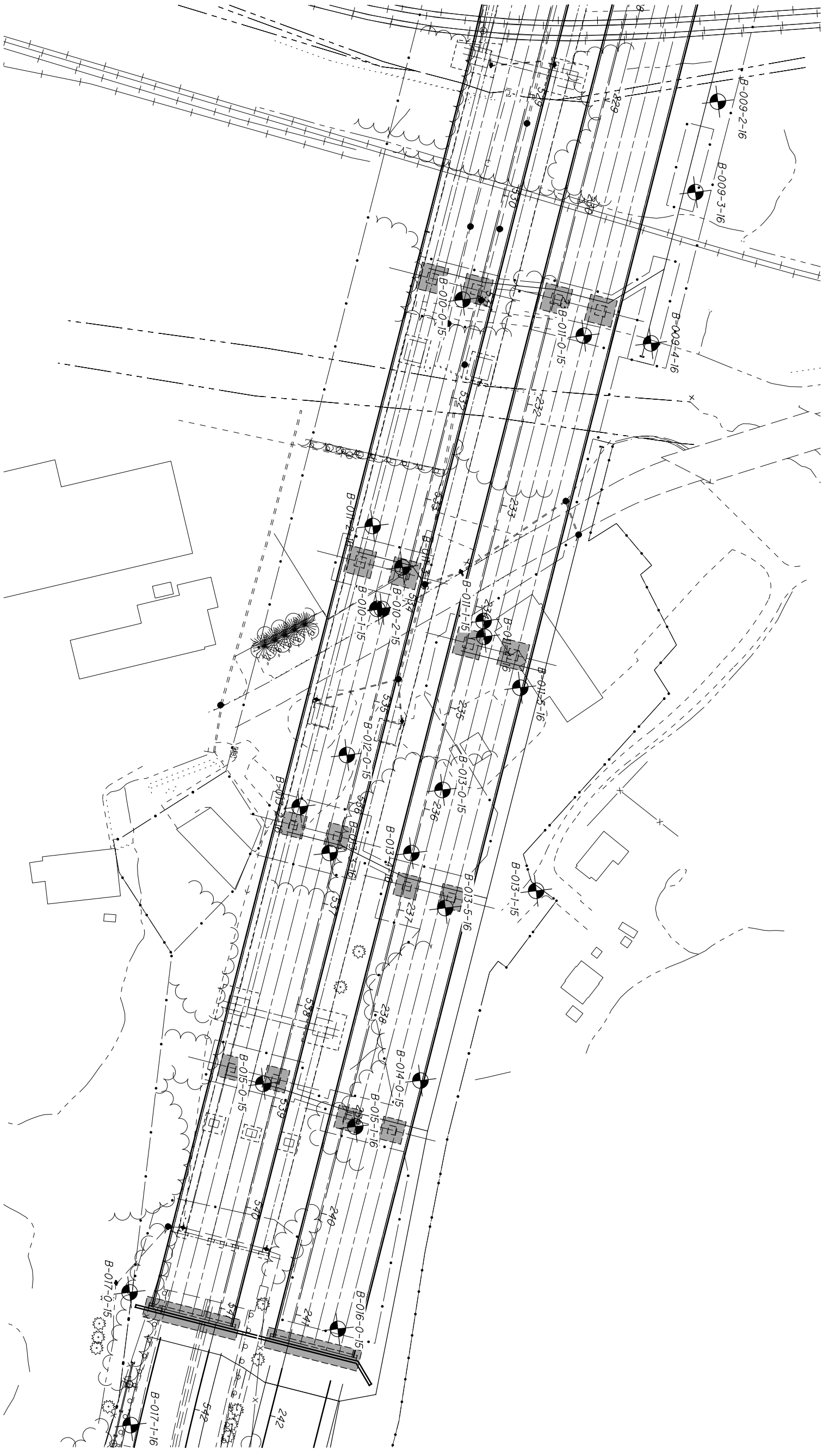

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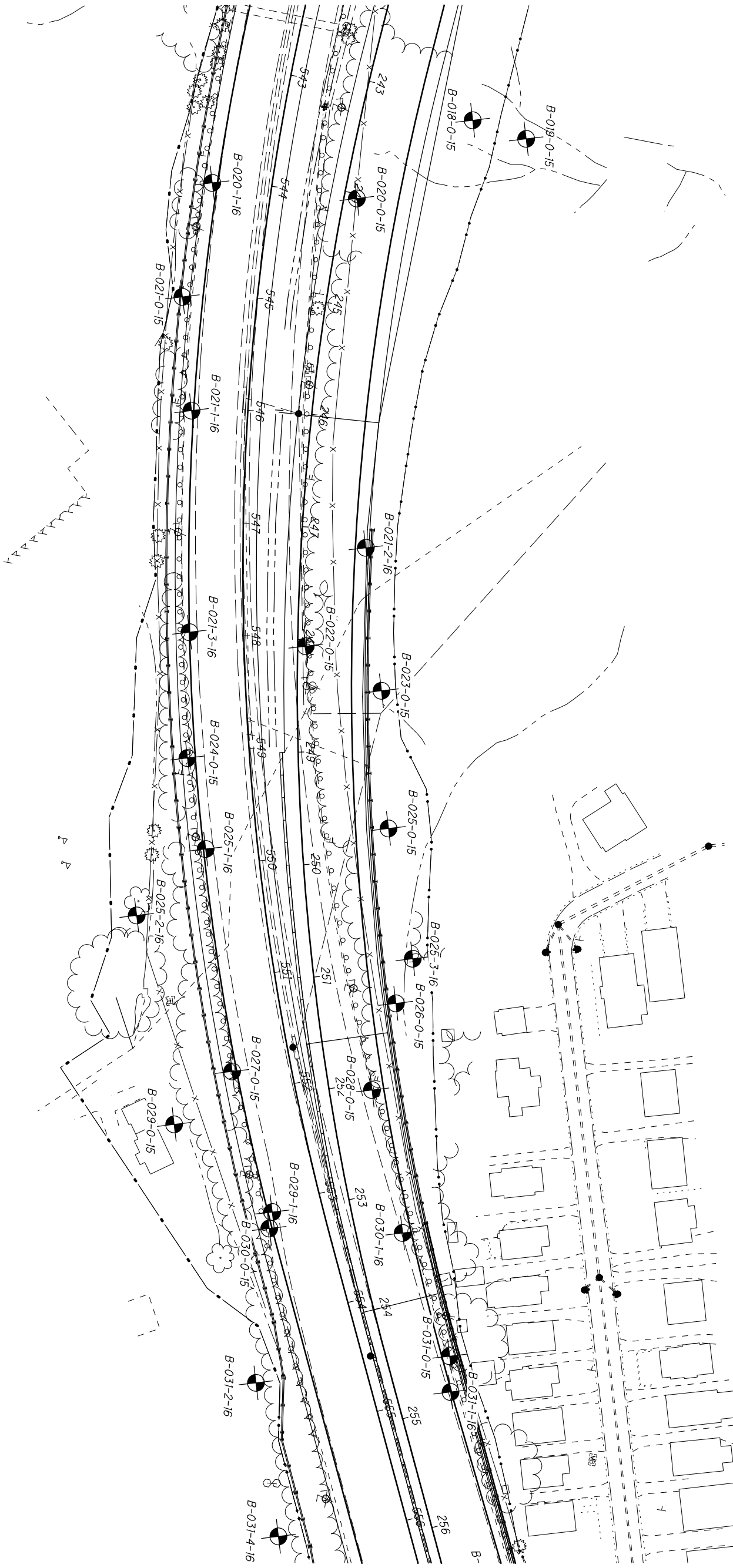

3/4	SUM-8-1.75	BORING LOCATION PLAN	CALCULATED KCA / CHECKED BPA	0 50 25 100 HORIZONTAL SCALE IN FEET

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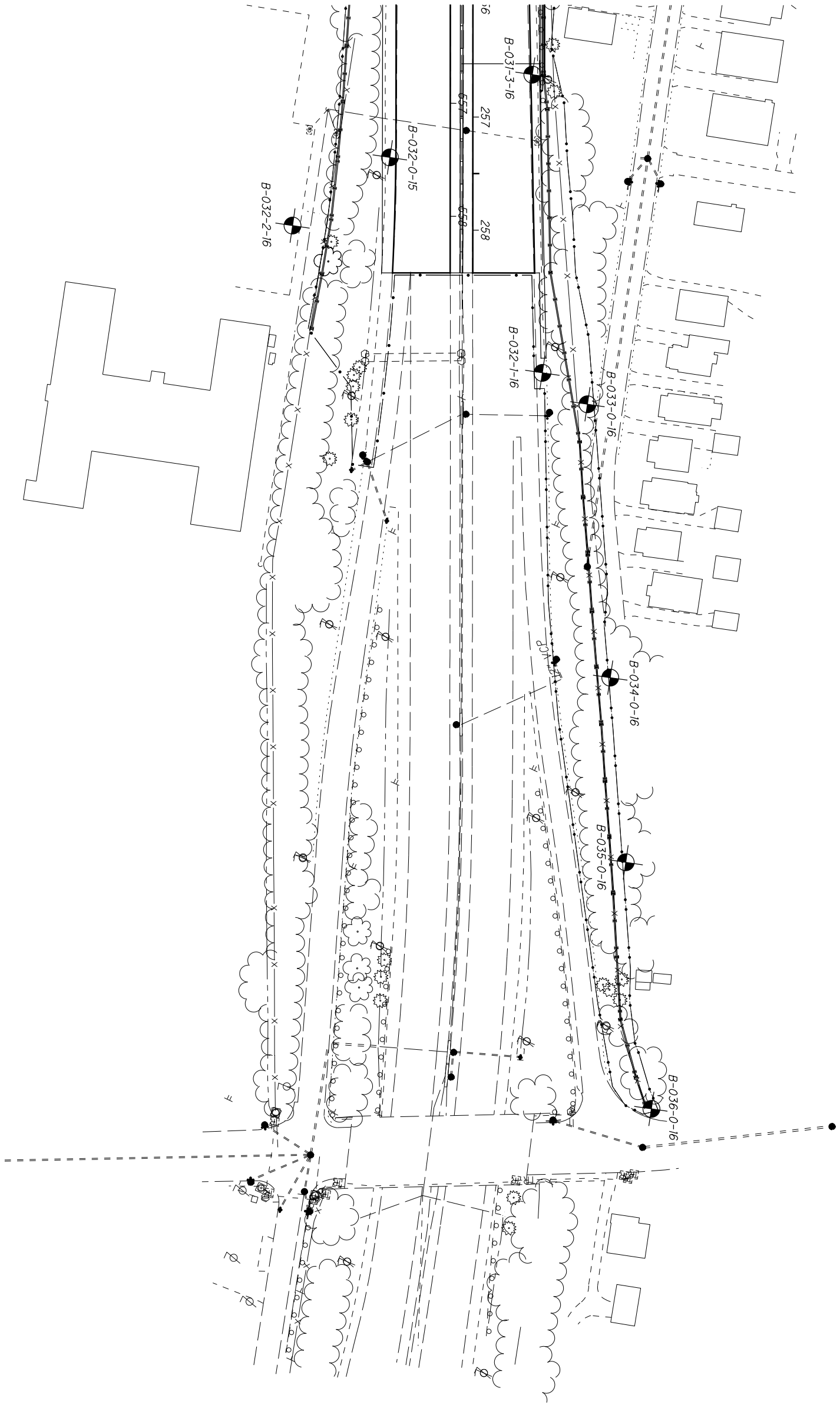

4 / 4	SUM-8-1.75	BORING LOCATION PLAN	CALCULATED KCA / CHECKED BPA	0 50 25 100 HORIZONTAL SCALE IN FEET

APPENDIX B

BORING LOGS

BARR ENGINEERING, INC.

LEGEND

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Gravel and/or Stone Fragments	A-1-a
	Gravel and/or Stone Fragments with Sand	A-1-b
F.S.	Fine Sand	A-3
	Coarse and Fine Sand	A-3a
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4 A-2-5
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6 A-2-7
	Sandy Silt	A-4a
	Silt	A-4b
	Elastic Silt and Clay	A-5
	Silt and Clay	A-6a
	Silty Clay	A-6b
	Elastic Clay	A-7-5
	Clay	A-7-6
	Organic Silt	A-8a
	Organic Clay	A-8b

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Shale	Visual
	Weathered Shale	Visual
	Sandstone	Visual

GRADATION (%)

GR Gravel
CS Coarse Sand
MS Medium Sand
FS Fine Sand
SI Silt
CL Clay (<5 micron)

SAMPLER SYMBOLS

Shelby Tube

Rock Core

Split Spoon Sample (SS)

* Indicates a Sample Taken Within 3 ft of Proposed Grade

ABBREVIATIONS

LL	LIQUID LIMIT (%)	HP	HAND PENETROMETER
PI	PLASTIC INDEX (%0	PID	PHOTOIONIZATION DETECTOR
WC	MOISTURE CONTENT (%)	UC	UNCONFINED COMPRESSION
SPT	STANDARD PENETRATION TEST	ppm	PARTS PER MILLION
NP	NON PLASTIC	$\mathcal{W}$	WATER FIRST ENCOUNTERED
-200	PERCENT PASSING NO. 200 SIEVE	▼	WATER LEVEL UPON COMPLETION
N_{60}	ADJUSTED SPT RESULT		
EOB	END OF BORING		

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil
Pavement or Base
Concrete

Uncontrolled Fill (Describe)

Bouldery Zone

Peat, S-Sedimentary
W-Woody F-Fibrous
L-Loamy & etc

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 515+84, 45' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1034.1 (MSL) EOB: 6.2 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084216, -81.502806

EXPLORATION ID B-001-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1034.1	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
12" ASPHALT (DRILLER'S DESCRIPTION)	1033.1																	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, (WEATHERED SANDSTONE), DRY		1 2 3	9 11 15	35	67	SS-1	-	12	21	61	- 6 -		NP	NP	NP	6	A-3 (0)	
	1029.6	TR																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		4 5	19 26 50/3"	-	80	SS-2	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
	1027.9	EOB	6 50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 314+55, 40' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1052.7 (MSL) EOB: 11.2 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084067, -81.503913

EXPLORATION ID B-001-1-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1052.7	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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1051.7																	
LOOSE TO MEDIUM DENSE, BROWN TO GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, (FILL), DRY		1	6 7 10	23	56	SS-1	-	43	22	30	-	5 -	NP	NP	NP	5	A-1-b (0)	
		2	2 2 2	5	28	SS-2	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		3																
		4																
		5																
		6	4 7 10	23	22	SS-3	-	49	6	39	-	6 -	NP	NP	NP	7	A-1-b (0)	
	1044.2	7																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 8	50/4"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1041.5	9																
		10																
		EOB 11	50/2"	-	0	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: *BORING MOVED UP HILL FROM SURVEYED LOCATION

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 415+52, 2' RT.	EXPLORATION ID B-001-2-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1050.5 (MSL) EOB: 11.4 ft.	PAGE 1 OF 1
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.084055, -81.502522	

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
12" ASPHALT (DRILLER'S DESCRIPTION)	1050.5																	
	1049.5																	
MEDIUM DENSE, REDDISH BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, TRACE SILT AND CLAY, DAMP		1	7 5 4	12	44	SS-1	-	21	29	22	27	1	NP	NP	NP	18	A-3a (0)	
	1048.0	2																
SOFT, DARK BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, MOIST		3																
		4	1 1 14	20	44	SS-2	0.25	15	18	12	27	28	35	24	11	25	A-6a (4)	
	1044.5	5																
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 6	50/2"	-	80	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		7																
		8																
		9	50/3"	-	62	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		10																
	1039.1	EOB 11	50/5"	-	89	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: CAVE @ 8.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 12 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 517+48, 50' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1035.6 (MSL) EOB: 3.7 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084659, -81.502705

EXPLORATION ID B-002-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1035.6	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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1034.6																	
VERY DENSE, BROWN TO RED, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVE, TRACE SILT AND CLAY, DRY	1033.6	TR	5 7 50/2"	-	86	SS-1	-	11	20	62	- 7 -		NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1031.9	EOB	50/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 218+05, 38' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.5 (MSL) EOB: 6.3 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.084853, -81.503074

EXPLORATION ID B-003-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1037.5	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
10" ASPHALT (DRILLER'S DESCRIPTION)	1036.7																	
DENSE, BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY	1033.8	1 2 3	16 16 15	41	72	SS-1	-	20	19	53	- 8 -		NP	NP	NP	6	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1031.2	TR 4 5	50/3"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		EOB 6	50/4"	-	75	SS-3	-	-	-	-	—	—	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 10 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 15:47 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\SUM-8-1.75 2015.GPJ

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 418+52, 9' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1053.4 (MSL) EOB: 8.6 ft.
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.084876, -81.502435

EXPLORATION ID B-003-2-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1053.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
18" TOPSOIL (BROWN, COARSE AND FINE SAND, DRY)	1051.9	1	4															
MEDIUM DENSE TO VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	1049.4	2 3 4	9 9	24	53	SS-1	-	12	53	27	-	8 -	NP	NP	NP	7	A-1-b (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		TR 4	50/3"	-	117	SS-2	-	-	-	-	-	-	-	-	-	3	Rock (V)	
		5 6	50/2"	-	67	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
	1044.8	7 8 EOB	50/1"	-	-	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 318+54, 2' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.5 (MSL) EOB: 8.8 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085057, -81.503278

EXPLORATION ID B-003-3-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1037.5	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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1036.5																	
MEDIUM DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY	1034.0	1	7 8 5	17	83	SS-1	-	10	22	63	- 5 -		NP	NP	NP	5	A-3 (0)	
LOOSE, BROWN, **FINE SAND**, SOME GRAVEL, TRACE COARSE SAND, SILT AND CLAY, DRY	1030.5	2 3 4 5 6	2 2 2	5	72	SS-2	-	22	7	69	- 2 -		NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1028.7	TR 7 8 EOB	9 20 50/3"	-	93	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			50/3"	-	67	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 320+34, 14' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1045.5 (MSL) EOB: 8.6 ft.
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.085525, -81.503058

EXPLORATION ID B-003-7-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
14" TOPSOIL (DRILLER'S DESCRIPTION)	1045.5																	
	1044.3																	
MEDIUM STIFF TO VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND AND GRAVEL, DRY TO DAMP		1	2 2 3	7	67	SS-1	1.60	-	-	-	-	-	-	-	-	19	A-6a (V)	
		2																
		3																
	1040.6	4	4 6 11	23	94	SS-2	2.75	14	5	6	29	46	37	22	15	24	A-6a (10)	
VERY DENSE, BROWN, **FINE SAND**, LITTLE GRAVEL AND COARSE SAND, TRACE SILT AND CLAY, DRY	1039.5	5																
		TR 6	50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		7																
	1036.9	8 EOB	50/1"	-	100	SS-4	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 222+05, 3' LT.	EXPLORATION ID B-004-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1038.9 (MSL) EOB: 3.7 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.085927, -81.502742	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1038.9	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
6" ASPHALT (DRILLER'S DESCRIPTION)	1038.4																	
VERY DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	1036.7	1	28	-	59	SS-1	-	44	24	26	- 6 -		NP	NP	NP	7	A-1-b (0)	
		2	14															
		TR	50/5"															
SANDSTONE, REDDISH BROWN, SEVERELY TO HIGHLY WEATHERED.	1035.2	3																
		EOB	60/2"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRACK (RW)	STATION / OFFSET: 323+04, 8' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / Y.Z.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: RAMP I
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1039.7 (MSL) EOB: 6.15 ft.
START: 7/13/15 END: 7/13/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.58	LAT / LONG: 41.086251, -81.502863

EXPLORATION ID B-004-3-15

PAGE 1 OF 1

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
24" TOPSOIL (DRILLER'S DESCRIPTION)	1039.7																	
VERY DENSE, BROWN, **FINE SAND**, TRACE COARSE SAND, GRAVEL, SILT AND CLAY, DRY	1037.7	1	2 4 4	11	67	SS-1	-	-	-	-	-	-	-	-	-	20	A-3 (V)	
		2																
		3																
		4	14 18 50/3"	-	67	SS-2	-	7	5	82	-	6 -	NP	NP	NP	4	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1035.2	TR																
	1033.5	5																
		EOB 6	50/2"	-	86	SS-3	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: CME 550 ATV (RW)	STATION / OFFSET: 423+06, 14' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1037.3 (MSL) EOB: 10.0 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81	LAT / LONG: 41.086090, -81.502174

EXPLORATION ID B-004-4-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1037.3	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
12" TOPSOIL (DRILLER'S DESCRIPTION)	1036.3																	
LOOSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY, DRY	1033.8	1	3 2 2	5	67	SS-1	-	22	17	55	- 6 -		NP	NP	NP	7	A-3 (0)	
VERY STIFF, BROWN TO GRAY, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY	1028.3	2 3 4 5	10 6 6	16	94	SS-2	3.00	-	-	-	-	-	-	-	-	16	A-6b (V)	
		6 7 8	6 6 2	11	100	SS-3	3.00	16	5	7	42	30	39	22	17	17	A-6b (10)	
DENSE, REDDISH BROWN, **FINE SAND**, LITTLE COARSE SAND AND GRAVEL, TRACE SILT AND CLAY, DRY	1027.3	9 EOB 10	4 15 16	42	89	SS-4	-	12	18	61	- 9 -		NP	NP	NP	9	A-3 (0)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 545+06, 66' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1028.1 (MSL) EOB: 7.0 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.091758, -81.499346

EXPLORATION ID B-021-0-15

MATERIAL DESCRIPTION AND NOTES	ELEV. 1028.1	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
6" ASPHALT, 12" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1026.6	1	7 4 5	12	72	SS-1	2.50	-	-	-	-	-	-	-	-	25	A-6b (V)	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, MOIST	1022.8	2 3 4 5	5 5 3	11	89	SS-2	3.00	16	5	6	51	22	39	21	18	25	A-6b (11)	
			3 3 7	13	89	SS-3	3.00	-	-	-	-	-	-	-	-	19	A-6b (V)	
MEDIUM DENSE, REDDISH BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT AND CLAY, DRY	1021.1	6 EOB 7	6 7 5	16	94	SS-4	-	33	18	40	- 9 -		NP	NP	NP	6	A-1-b (0)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 248+06, 7' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1024.7 (MSL) EOB: 10.0 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.092640, -81.499595

EXPLORATION ID B-022-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1024.7	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
8" ASPHALT, 16" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1022.7	1	8 11 14	33	78	SS-1	-	10	17	65	- 8 -		NP	NP	NP	7	A-3 (0)	
DENSE, REDDISH BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY	1021.2	2 3																
VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE GRAVEL, TRACE SAND (FILL), DRY	1018.7	4 5	4 5 6	15	100	SS-2	3.50	14	4	7	49	26	41	20	21	14	A-7-6 (12)	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND AND GRAVEL, DRY	1014.7	6 7 8	4 3 4	9	100	SS-3	3.50	16	7	5	45	27	39	21	18	13	A-6b (11)	
	EOB	9 10	3 3 3	8	6	SS-4	4.00	-	-	-	-	-	-	-	-	15	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 549+04, 55' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1026.3 (MSL) EOB: 7.0 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.092873, -81.499172

EXPLORATION ID B-024-0-15

PAGE 1 OF 1

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
8" ASPHALT, 10" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1026.3																	
	1024.8	1																
VERY STIFF, BROWN TO GRAY, **CLAY**, "AND" SILT, LITTLE SAND AND GRAVEL, (FILL), DRY		2	6 6 7	17	83	SS-1	3.50	11	4	9	55	21	42	19	23	15	A-7-6 (14)	
	1022.3	3	4 5 7	16	78	SS-2	4.00	-	-	-	-	-	-	-	-	16	A-7-6 (V)	
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DRY		4	5 4 6	13	89	SS-3	4.00	9	7	14	37	33	39	21	18	13	A-6b (10)	
	1019.3	5	5 6 8	19	100	SS-4	4.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
		EOB 6 7																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 8 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 551+79, 52' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1025.1 (MSL) EOB: 38.6 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.093643, -81.499186

EXPLORATION ID B-027-0-15

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1025.1	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
6" ASPHALT, 10" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1023.6		8 11 14	33	78	SS-1	-	19	23	55	- 3 -		NP	NP	NP	12	A-3 (0)	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, SILT AND CLAY, TRACE SILT AND CLAY (FILL), DRY																		
@ 4.5'; SANDSTONE FRAGMENT IN FILL.			3 8 15	31	67	SS-2	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
@ 6.5' TO 6.9'; LEAN CLAY SEAM.	1016.6		6 18 21	52	78	SS-3	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, MOIST			12 21 17	51	78	SS-4	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
@ 11.6' TO 11.9'; LEAN CLAY SEAM.	1008.8		12 10 22	43	89	SS-5	-	9	13	67	- 11 -		NP	NP	NP	7	A-3a (0)	
			12 15 19	45	100	SS-6	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
HARD, BROWN TO GRAY, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, (RESIDUAL), DRY		W	6 5 5	13	100	SS-7	4.50	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
			4 7 10	23	100	SS-8	4.50	9	3	16	39	33	41	21	20	17	A-7-6 (12)	
	996.6		8 10 12	29	100	SS-9	4.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
			8 9 21	40	89	SS-10	-	8	21	65	- 6 -		NP	NP	NP	8	A-3 (0)	

PID: 91710	SFN: 7700369	PROJECT: SUM-8-1.75	STATION / OFFSET: 551+79, 52' RT.	START: 6/10/15	END: 6/10/15	PG 2 OF 2	B-027-0-15

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
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND, LITTLE GRAVEL, TRACE SILT AND CLAY, DRY *(continued)*	995.1	31 32 33																
	991.6	TR	50/2"	-	100	SS-11	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.		34 35 36 37 38																
	986.5	EOB	50/1"	-	100	SS-12	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 252+07, 38' LT.	EXPLORATION ID B-029-0-15
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1022.7 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.093732, -81.499624	

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
7" ASPHALT, 11" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)	1022.7																	
	1021.2																	
DENSE TO VERY DENSE, REDDISH BROWN, **FINE SAND**, SOME COARSE SAND AND GRAVEL, TRACE SILT AND CLAY (WEATHERED SANDSTONE), DRY		1	7 8 7	20	83	SS-1	-	23	30	44	- 3 -		NP	NP	NP	11	A-1-b (0)	
		2																
		3																
		4	7 14 10	32	89	SS-2	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		5																
		6	20 23 24	63	78	SS-3	-	20	23	53	- 4 -		NP	NP	NP	9	A-3 (0)	
		7																
		8																
		9	20 30 31	82	89	SS-4	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
	1012.7	EOB 10																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 7 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 553+19, 74' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1024.9 (MSL) EOB: 7.0 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.094034, -81.499240

EXPLORATION ID B-030-0-15

PAGE 1 OF 1

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
6" ASPHALT (DRILLER'S DESCRIPTION)	1024.4																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND AND GRAVEL, DRY	1022.9	1	5 7 8	20	89	SS-1	4.00	24	9	9	39	19	37	22	15	15	A-6a (7)	
DENSE, REDDISH BROWN, **FINE SAND**, SOME GRAVEL, LITTLE COARSE SAND, TRACE SILT AND CLAY (FILL), DRY		2 3	7 15 13	37	72	SS-2	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
		4 5	7 11 17	37	89	SS-3	-	22	10	63	- 5 -		NP	NP	NP	7	A-3 (0)	
@ 6.0' TO 6.5'; LEAN CLAY SEAM	1017.9	6	7 11 19	40	78	SS-4	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
		EOB 7																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 254+57, 55' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 SB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1023.1 (MSL) EOB: 10.0 ft.
START: 6/11/15 END: 6/11/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.094398, -81.499763

EXPLORATION ID B-031-0-15

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1023.1	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
6" ASPHALT, 18" SAND AND GRAVEL BASE (DRILLER'S DESCRIPTION)																		
	1021.1		6 3 2	7	56	SS-1	-	32	33	29	- 6 -		NP	NP	NP	10	A-1-b (0)	
STIFF TO VERY STIFF, BROWN, **CLAY**, SOME SAND, LITTLE GRAVEL, (FILL), DRY		1 2 3 4 5 6 7 8	1 2 2	5	100	SS-2	1.00	-	-	-	-	-	-	-	-	15	A-6b (V)	
			2 3 4	9	100	SS-3	2.50	13	4	16	35	32	39	19	20	18	A-6b (10)	
	1013.1	EOB 9 10	11 10 9	25	89	SS-4	2.50	-	-	-	-	-	-	-	-	12	A-6b (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: SUM-8-1.75	DRILLING FIRM / OPERATOR: RIDGEWAY / P.S.	DRILL RIG: D-50 TRUCK (RW)	STATION / OFFSET: 557+48, 53' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: GF / S. MW.	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 8 NB
PID: 91710 SFN: 7700369	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/4/15	ELEVATION: 1021.9 (MSL) EOB: 5.33 ft.
START: 6/10/15 END: 6/10/15	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.25	LAT / LONG: 41.095203, -81.499438

EXPLORATION ID B-032-0-15

PAGE 1 OF 1

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
6" ASPHALT (DRILLER'S DESCRIPTION)	1021.9 1021.4																	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT AND CLAY, LITTLE GRAVEL, DRY	1019.7	1	5 7 10	23	83	SS-1	-	17	6	56	14	7	NP	NP	NP	7	A-3a (0)	
VERY DENSE, REDDISH BROWN, **FINE SAND**, LITTLE GRAVEL, TRACE SILT AND CLAY, (WEATHERED SANDSTONE), DRY	1016.9	2 3 4	7 15 50	87	89	SS-2	-	18	4	70	- 8 -		NP	NP	NP	8	A-3 (0)	
SANDSTONE, BROWN, SEVERELY TO HIGHLY WEATHERED.	1016.6	TR EOB 5	50/4"	-	100	SS-3	-	-	-	-			-	-	-	-	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 6 IN. ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:31 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 423+45, 3' RT.	EXPLORATION ID B-004-5-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: RAMP J	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.8 (MSL) EOB: 25.6 ft.	PAGE 1 OF 1
START: 1/21/17 END: 1/21/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086194, -81.502201	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1036.8	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
ASPHALT (8.0") & GRANULAR BASE (4.0")	1035.8																	
VERY DENSE, LIGHT GRAYISH BROWN, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS ASPHALT FRAGMENTS (3/8" TO 1.0" EXCLUDED FROM GRADATION), DRY **(FILL)**	1032.3		50/6"	-	67	SS-1	-	26	34	17	18	5	NP	NP	NP	1	A-1-b (0)	
MEDIUM DENSE TO DENSE, BROWN BECOMING BROWN AND BLACK, **COARSE AND FINE SAND**, SOME TO LITTLE SILT, TRACE TO LITTLE GRAVEL, TRACE TO LITTLE CLAY, CONTAINS PLASTIC FRAGMENTS AND CINDERS, DAMP **(FILL)**	1028.3		19 10 8	26	39	SS-2	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
VERY STIFF TO HARD, BROWN TO BLACK WITH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS CINDERS, @8.5' TO 9.0'; SLIGHTLY ORGANIC, DAMP TO MOIST **(FILL)**	1024.8		9 7 14	31	78	SS-3A	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
						SS-3B	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
			10 7 4	16	100	SS-4	3.25 - 4.5+	9	11	32	30	18	23	14	9	14	A-4a (3)	
DENSE TO VERY DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, TRACE GRAVEL, DAMP **(FILL)**			21 17 16	48	100	SS-5	-	7	19	55	11	8	NP	NP	NP	10	A-3a (0)	
@15.0' TO 15.8'; CHANGES TO BROWN WITH LIGHT BROWN, CONTAINS FEW CINDERS	1021.2	TR	19 50/4"	-	50	SS-6	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
SANDSTONE, BROWN AND GRAY BECOMING ORANGISH BROWN, SLIGHTLY TO MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE FRACTURES, SLIGHTLY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY TO VERY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 37%, REC 77%.			17		53	NQ2-1											CORE	
			57		100	NQ2-2											CORE	
	1011.2	EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:31 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 524+32, 64' RT.	EXPLORATION ID B-005-1-16
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1036.6 (MSL) EOB: 50.3 ft.	PAGE 1 OF 2
START: 1/21/17 END: 1/21/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 88.1	LAT / LONG: 41.086418, -81.502086	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1036.6	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
ASPHALT (8.0") & GRANULAR BASE (8.5")	1035.2	1																
DENSE, BROWN AND LIGHT GRAY BECOMING BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, DAMP		2																
		3	38 15 11	38	100	SS-1	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
		4																
		5																
		6	22 18 15	48	100	SS-2	-	19	8	53	12	8	NP	NP	NP	10	A-3a (0)	
	1029.6	7																
STIFF TO HARD, BROWN AND BLACK BECOMING BROWNISH GRAY AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN TRACE ANTHRACITE COAL FRAGMENTS, DAMP		8	23 8 7	22	100	SS-3	2.5 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		9																
		10																
		11	11 8 6	21	100	SS-4	1.25 - 1.75	9	10	29	33	19	26	16	10	16	A-4a (3)	
		12																
		13	11 6 7	19	78	SS-5	3.75 - 4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	
		14																
		15																
@15.0' TO 17.0'; BECOMES BLACK AND DARK BROWN, CONTAINS IRON STAINING AND FUEL ODOR		16	12 20 15	51	100	SS-6	2.0 - 4.5+	7	14	39	28	12	22	16	6	13	A-4a (1)	
	1019.6	17																
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP		18	9 10 5	22	100	SS-7	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	1017.1	19																
MEDIUM DENSE, BROWN, **SANDY SILT**, LITTLE STONE FRAGMENTS, LITTLE CLAY, CONTAINS IRON STAINING, DAMP		20																
@20.0'; NO HP, SAMPLE IS NON COHESIVE		21	9 7 6	19	100	SS-8	-	-	-	-	-	-	-	-	-	16	A-4a (V)	
	1014.6	22	TR															
SANDSTONE, ORANGISH BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		23	32 50/4"	-	100	SS-9	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	1011.3	24																
		25	50/3"	-	67	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		26																
		27																
		28	0		47	NQ2-1											CORE	
		29																

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 524+32, 64' RT.	START: 1/21/17	END: 1/21/17	PG 2 OF 2	B-005-1-16

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
SANDSTONE, BROWN AND ORANGISH BROWN, BECOMES DARK BROWN AND GRAY FROM 38.6' - 39.5', SLIGHTLY TO HIGHLY WEATHERED, SLIGHTLY TO MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, FERRIFEROUS, CROSS BEDDED, TRACE QUARTZITE PEBBLES THROUGHOUT, CONTAINS FEW VUGS FROM 36.5' - 36.8', SLIGHTLY MICACEOUS, BEDDING DISCONTINUITIES: LOW ANGLE, HIGHLY FRACTURED TO SLIGHTLY FRACTURED, OPEN TO TIGHT, BLOCKY/DISTURBED/SEAMY TO INTACT, DISINTEGRATED FROM 25.3' - 26.1', GOOD TO FAIR SURFACE CONDITION; RQD 68%, REC 88%. *(continued)* @37.5'; Qu = 4680 PSI	1006.6	31	85		98	NQ2-2											CORE	
		40	85		98	NQ2-3											CORE	
	986.3	EOB 50																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 40 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:32 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 542+28, 56' RT.	EXPLORATION ID B-017-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.091013, -81.499713	

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
ASPHALT (8.0") & GRANULAR BASE (7.5")	1029.2																	
	1027.9																	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP		1																
		2																
		3	8 16 15	46	50	SS-1	-	12	52	29	4	3	NP	NP	NP	9	A-1b (0)	
		4																
		5																
	1023.5		9			SS-2A	-	-	-	-	-	-	-	-	-	10	A-1b (V)	
VERY STIFF, BROWN AND DARK BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS 1/8" GRAY CLAY LENSE, MOIST	1022.2	6	7 7	21	72	SS-2B	2.0 - 2.5	5	12	32	31	20	22	14	8	15	A-4a (3)	
		7																
LOOSE TO MEDIUM DENSE, BROWN AND DARK BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, DAMP TO MOIST		8	7 4 5	13	100	SS-3	-	-	-	-	-	-	-	-	-	7	A-1b (V)	
		9																
		10	7 3 5	12	100	SS-4	-	-	-	-	-	-	-	-	-	7	A-1b (V)	
		11																
		12																
		13	2 3 4	10	100	SS-5	-	30	40	25	3	2	NP	NP	NP	6	A-1b (0)	
		14																
@15.0' TO 19.0'; BECOMES DARK BROWN		15	1 2 4	9	78	SS-6	-	-	-	-	-	-	-	-	-	12	A-1b (V)	
		16																
		17																
		18	1 2 3	7	100	SS-7	-	-	-	-	-	-	-	-	-	8	A-1b (V)	
		19																
@20.0' TO 21.5'; BECOME GRAYISH BROWN AND ORANGISH BROWN		20	2 5 6	16	100	SS-8	-	-	-	-	-	-	-	-	-	6	A-1b (V)	
	1007.2	21																
MEDIUM DENSE, BROWNISH GRAY AND ORANGISH BROWN, **COARSE AND FINE SAND**, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP		22																
		23	2 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
		24																
		25																
	1002.7	26	2 5 6	16	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 8.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 544+04, 52' RT.	EXPLORATION ID B-020-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1029.2 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.091487, -81.499523	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	1029.2																	
ASPHALT (8.0") & GRANULAR BASE (6.5")	1028.0																	
STIFF TO VERY STIFF, BROWN AND GRAY BECOMING BROWN AND ORANGISH BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST			13 7 6	19	56	SS-1	1.0 - 2.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
			5 3 4	10	89	SS-2	1.0 - 2.25	-	-	-	-	-	-	-	-	15	A-4a (V)	
@7.5' TO 13.3'; CONTAINS IRON STAINING			5 3 3	9	100	SS-3	1.0 - 2.25	7	9	26	34	24	27	17	10	16	A-4a (5)	
			3 2 3	7	100	SS-4	1.0 - 1.75	-	-	-	-	-	-	-	-	17	A-4a (V)	
	1015.9		3 3 5	12	100	SS-5A	1.25 - 2.25	-	-	-	-	-	-	-	-	16	A-4a (V)	
LOOSE TO MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, GRAVEL IS MOSTLY QUARTZITE PEBBLES, 13.3' TO 16.5'; CONTAINS IRON STAINING, DAMP						SS-5B	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			2 3 4	10	100	SS-6	-	19	34	39	3	5	NP	NP	NP	7	A-1-b (0)	
@17.5' TO 19.0'; BECOMES BROWN AND DARK BROWN			6 3 2	7	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	
	1009.7																	
LOOSE TO MEDIUM DENSE, BROWN AND LIGHT BROWN, **FINE SAND**, TRACE SILT, TRACE COARSE SAND, TRACE GRAVEL, DAMP			4 4 5	13	100	SS-8	-	-	-	-	-	-	-	-	-	10	A-3 (V)	
@22.5' TO 26.5'; BECOME TRACE SILT, DRY			2 1 3	6	100	SS-9	-	1	9	88	1	1	NP	NP	NP	4	A-3 (0)	
			1 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	
		EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 6.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 546+03, 50' RT.	EXPLORATION ID B-021-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1028.8 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.092030, -81.499363	

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
ASPHALT (9.0") & GRANULAR BASE (6.0")	1028.8																	
	1027.5																	
LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			9 6 6	18	83	SS-1	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
			5 3 4	10	100	SS-2	-	21	37	36	4	2	NP	NP	NP	8	A-1-b (0)	
	1021.8																	
LOOSE TO MEDIUM DENSE, LIGHT BROWN AND BROWN, **FINE SAND**, LITTLE COARSE SAND, TRACE GRAVEL, TRACE SILT, TRACE CLAY, DAMP TO MOIST			2 3 3	9	100	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			3 2 3	7	100	SS-4	-	2	13	82	2	1	NP	NP	NP	5	A-3 (0)	
			4 3 3	9	100	SS-5	-	-	-	-	-	-	-	-	-	13	A-3 (V)	
			3 3 5	12	100	SS-6	-	-	-	-	-	-	-	-	-	9	A-3 (V)	
			1 2 2	6	100	SS-7	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
@20.0' TO 21.5'; BECOMES VERY LOOSE			2 2 1	4	100	SS-8	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
			1 2 2	6	100	SS-9	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
	1002.3	EOB	2 2 4	9	100	SS-10	-	-	-	-	-	-	-	-	-	4	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 12.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 547+95, 48' RT.	EXPLORATION ID B-021-3-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1027.7 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/13/17 END: 2/13/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.092565, -81.499265	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1027.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (8.0") & GRANULAR BASE (9.0")	1026.3																	
MEDIUM STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @5.0' TO 6.5'; CONTAINS A 1.25" GRAVEL PIECE, DAMP TO MOIST **(FILL)** @2.5' TO 4.0'; NO RECOVERY		1 2 3 4 5 6 7 8 9	12 9 11	29	0	SS-1	-	-	-	-	-	-	-	-	-	-		
			8 5 4	13	78	SS-2	0.5 - 1.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
@7.5' TO 9.0'; CHANGES TO BROWN, GRAY AND DARK GRAY, CONTAINS FEW PORCELAIN AND ASPHALT FRAGMENTS, AND IRON STAINING	1018.2		5 6 6	18	100	SS-3	1.75 - 3.0	6	11	30	32	21	25	16	9	16	A-4a (4)	
VERY STIFF TO HARD, BROWN WITH BROWNISH GRAY AND DARK GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, DAMP	1015.7	10 11	7 7 7	21	100	SS-4	3.25 - 4.5+	5	10	28	35	22	25	15	10	15	A-4a (4)	
VERY LOOSE, BROWN WITH ORANGISH BROWN AND DARK GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, SS-5 NO HP, SAMPLE IS NON COHESIVE	1013.2	12 13 14	3 1 1	3	39	SS-5	-	-	-	-	-	-	-	-	-	12	A-4a (V)	
VERY LOOSE, ORANGISH BROWN, **FINE SAND**, SOME COARSE SAND, TRACE TO LITTLE GRAVEL, TRACE SILT, TRACE CLAY, DAMP @15.0' TO 16.5'; CONTAINS DECAYED WOOD FRAGMENTS AND IRON STAINING		15 16 17	1 WOH 1	1	50	SS-6	-	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@17.5' TO 26.5'; BECOMES LOOSE TO MEDIUM DENSE, BROWN		18 19	2 3 2	7	100	SS-7	-	6	32	58	2	2	NP	NP	NP	4	A-3 (0)	
		20 21 22	2 3 3	9	100	SS-8	-	-	-	-	-	-	-	-	-	5	A-3 (V)	
		23 24	3 4 5	13	100	SS-9	-	-	-	-	-	-	-	-	-	7	A-3 (V)	
		EOB 25 26	3 4 4	12	100	SS-10	-	-	-	-	-	-	-	-	-	7	A-3 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 549+84, 46' RT.	EXPLORATION ID B-025-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 NB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1026.7 (MSL) EOB: 26.5 ft.	PAGE 1 OF 1
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093093, -81.499228	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (7.0") & GRANULAR BASE (13.0")	1026.7																	
	1025.0																	
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, @1.7' TO 6.5'; CONTAIN FEW ROOT HAIRS, DAMP		1 2 3 4	5 6 8	21	100	SS-1	4.0 - 4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	
@5.0' TO 6.5'; CONTAINS FEW BLACK ORGANICS @5.0' TO 8.0'; BECOME BROWN WITH BROWNISH GRAY AND DARK GRAY		5 6 7 8	10 6 8	21	100	SS-2	2.5 - 4.0	8	9	27	34	22	27	15	12	15	A-6a (5)	
	1018.7	8	4	28	100	SS-3A	2.0 - 3.25	-	-	-	-	-	-	-	-	15	A-6a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL (FRIABLE SANDSTONE), TRACE TO LITTLE SILT, TRACE TO LITTLE CLAY, CONTAINS IRON STAINING, DAMP		9	7 12			SS-3B	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
	1014.7	10 11	3 4 7	16	100	SS-4	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
MEDIUM DENSE, BROWN AND ORANGISH BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL (FRIABLE SANDSTONE), CONTAINS IRON STAINING, NO HP, SAMPLE IS NON COHESIVE, DAMP	1012.2	12 13 14	2 4 7	16	100	SS-5	-	8	15	39	24	14	17	12	5	11	A-4a (1)	
MEDIUM DENSE, ORANGISH BROWN AND BROWNISH GRAY, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1009.7	15 16 17	2 4 15	28	100	SS-6	-	12	19	40	18	11	NP	NP	NP	9	A-3a (0)	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAINS IRON STAINING, DAMP		18 19	3 5 9	21	100	SS-7	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
@20.0' TO 21.5'; BECOMES BROWN WITH ORANGISH BROWN AND MAROONISH BROWN, GRAVEL IS FRIABLE SANDSTONE	1004.7	20 21 22	3 7 11	26	100	SS-8	2.5 - 4.0	6	10	36	31	17	19	12	7	11	A-4a (3)	
DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND**, (FRIABLE SANDSTONE), TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP	1002.2	23 24	6 14 15	43	100	SS-9	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
MEDIUM DENSE, LIGHT BROWN AND ORANGISH BROWN, **STONE FRAGMENTS WITH SAND AND SILT**, (FRIABLE SANDSTONE), LITTLE CLAY, CONTAINS IRON STAINING, DAMP	1000.2	25 26 EOB	6 9 8	25	78	SS-10	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 249+72, 77' LT.	EXPLORATION ID B-029-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1025.2 (MSL) EOB: 25.3 ft.	PAGE 1 OF 1
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.093990, -81.499291	

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
ASPHALT (8.0") & GRANULAR BASE (11.0")	1025.2																	
	1023.6																	
MEDIUM DENSE TO DENSE, BROWN AND ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY, CONTAINS IRON STAINING, DAMP		1																
		2																
		3	15 9 14	34	100	SS-1	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
		4																
		5																
		6	7 9 10	28	100	SS-2	-	11	37	41	6	5	NP	NP	NP	7	A-3a (0)	
		7																
		8	7 10 10	29	100	SS-3	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
	1015.7	9																
VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP TO MOIST		10																
		11	4 6 8	21	100	SS-4	3.25 - 4.5+	5	9	33	32	21	22	13	9	12	A-4a (4)	
		12																
@12.5' TO 14.0'; BECOMES BROWN WITH BROWNISH GRAY AND BLACK, CONTAINS FEW BLACK ORGANICS, ROOT HAIRS, AND IRON STAINS		13	4 9 11	29	100	SS-5	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
	1010.7	14																
DENSE, ORANGISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS IRON STAINING, MOIST		15																
		16	4 12 13	37	100	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	1007.7	17																
SANDSTONE, LIGHT BROWN, HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		TR 18	4 12 18	44	100	SS-7	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		19																
@20.0' TO 23.0'; BECOMES MAROONISH BROWN		20																
		21	27 24 31	81	100	SS-8	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		22																
		23	50/5"	-	80	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		24																
	999.9	EOB 25	50/4"	-	75	SS-10	-	-	-	-	-	-	-	-	-	-	Rock (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 11.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 25 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 251+32, 70' LT.	EXPLORATION ID B-030-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1023.1 (MSL) EOB: 33.0 ft.	PAGE 1 OF 2
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094081, -81.499698	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1023.1	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
ASPHALT (3.0") OVER CONCRETE (10.0")	1022.0	1																
MEDIUM DENSE, ORANGISH BROWN AND BROWN BECOMING ORANGISH BROWN AND REDDISH BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, DAMP		2																
		3	5 5 6	15	56	SS-1	-	21	17	40	14	8	NP	NP	NP	8	A-3a (0)	
		4																
		5																
		6	5 8 12	27	33	SS-2	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	1016.1	7																
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, TRACE BLACK ORGANICS, MOIST		8	6 3 3	8	100	SS-3	0.5 - 0.75	6	11	29	34	20	25	15	10	16	A-4a (4)	
	1013.6	9																
LOOSE TO MEDIUM DENSE, ORANGISH BROWN, **COARSE AND FINE SAND**, LITTLE SILT, LITTLE GRAVEL, TRACE CLAY, CONTAIN IRON STAINING, DAMP TO MOIST		10																
		11	3 3 4	10	100	SS-4	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
	1010.1	12																
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, @15.0' TO 16.5'; CONTAINS IRON STAINING AND TRACE BLACK ORGANICS, DAMP TO MOIST		13	5	12	100	SS-5A	-	-	-	-	-	-	-	-	-	15	A-3a (V)	
		14	5 4			SS-5B	1.75 - 2.5	-	-	-	-	-	-	-	-	17	A-4a (V)	
		15																
		16	3 5 8	18	100	SS-6	1.75 - 2.0	4	5	18	49	24	26	17	9	18	A-4a (8)	
	1006.1	17																
DENSE, BROWN WITH ORANGISH BROWN AND DARK, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, CONTAINS IRON STAINING, MOIST		18	6 10 17	37	100	SS-7	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
	1003.6	19																
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, LITTLE CLAY, MOIST		20																
		21	5 10 14	33	100	SS-8	-	15	8	44	21	12	NP	NP	NP	11	A-3a (0)	
	1000.1	22																
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.		TR 23	18 50/3"	-	78	SS-9	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
		24																
		25																
		26	18 24 28	71	67	SS-10	-	-	-	-	-	-	-	-	-	6	Rock (V)	
	995.1	27																
@29.3'; Qu = 5184 PSI		28																
		29																

PID: 91710	SFN:	PROJECT: SUM-8-01.75	STATION / OFFSET: 251+32, 70' LT.	START: 1/7/17	END: 1/7/17	PG 2 OF 2	B-030-1-16

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
SANDSTONE, LIGHT GRAY AND ORANGISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG, FINE TO COARSE GRAINED, LAMINATED TO VERY THIN BEDDED, FRIABLE, MICACEOUS, FERRIFEROUS, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, MODERATELY TO HIGHLY FRACTURED, OPEN TO NARROW, SLIGHTLY ROUGH, BLOCKY, FAIR TO GOOD SURFACE CONDITION; RQD 66%, REC 88%. *(continued)*	993.1	31	66		88	NQ2-1												CORE	
	990.1	EOB 32 33																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 254+88, 47' LT.	EXPLORATION ID B-031-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1023.1 (MSL) EOB: 20.5 ft.	PAGE 1 OF 1
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094480, -81.499786	

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
ASPHALT (6.0") & GRANULAR BASE (18.0")	1023.1																	
	1021.1																	
MEDIUM STIFF TO VERY STIFF, BROWNISH GRAY WITH BLACK AND BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, MOIST			5 4 4	11	100	SS-1	0.75 - 1.0	4	10	28	38	20	25	16	9	18	A-4a (5)	
@5.0' TO 6.5'; BECOMES BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, CONTAINS IRON STAINING			4 4 7	15	100	SS-2	1.75 - 3.0	-	-	-	-	-	-	-	-	17	A-4a (V)	
	1016.1																	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, MOIST			7 8 10	25	100	SS-3	-	-	-	-	-	-	-	-	-	14	A-2-6 (V)	
	1013.6																	
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, CONTAIN IRON STAINING, SS-4 NO HP DUE TO SAMPLE DISTURBANCE DURING RECOVERY, DAMP			6 8 11	26	100	SS-4	-	7	8	28	42	15	20	16	4	15	A-4a (4)	
			7 11 14	34	100	SS-5	1.75 - 3.25	8	12	30	34	16	19	14	5	13	A-4a (3)	
	1008.1																	
SANDSTONE, LIGHT BROWN, MODERATELY WEATHERED, FRIABLE, EASILY AUGERED.	1007.6	TR	50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SANDSTONE, BROWN AND LIGHT BROWN, MODERATELY WEATHERED, STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, MEDIUM TO COARSE GRAINED FROM 19.8' - 20.5', FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, SLIGHTLY FRACTURED TO HIGHLY FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH, BLOCKY, GOOD SURFACE CONDITION; RQD 75%, REC 100%.	1002.6	EOB	75		100	NQ2-1											CORE	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55	STATION / OFFSET: 256+63, 53' LT.	EXPLORATION ID B-031-3-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / ASHBAUGH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 12/3/15	ELEVATION: 1022.2 (MSL) EOB: 20.5 ft.	PAGE 1 OF 1
START: 1/7/17 END: 1/7/17	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 81.8	LAT / LONG: 41.094952, -81.499890	

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
1022.2																		
ASPHALT (6.0")	1021.7																	
DENSE TO VERY DENSE, LIGHT BROWN BECOMING BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, TRACE SILT, TRACE CLAY, (GRAVEL IS QUARTZITE PEBBLES AND FRIABLE SANDSTONE), DAMP		1																
		2																
		3	14 18 16	46	100	SS-1	-	34	1	52	8	5	NP	NP	NP	8	A-3a (0)	
		4																
	1017.2	5 TR																
SANDSTONE, BROWN, MODERATELY TO HIGHLY WEATHERED, FRIABLE, EASILY AUGERED.		6	19 21 34	75	100	SS-2	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		7																
@7.5' TO 8.4'; BECOME LIGHT BROWN AND ORANGISH BROWN		8	29 50/5"	-	36	SS-3	-	-	-	-	-	-	-	-	-	5	Rock (V)	
		9																
@10.0' TO 13.2'; CONTAINS FUEL ODOR		10																
		11	17 30 38	93	67	SS-4	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		12																
		13	26 50/2"	-	50	SS-5	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		14																
	1006.7	15	50/2"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
SANDSTONE, BROWN AND MAROONISH BROWN, MODERATELY WEATHERED, MODERATELY STRONG TO STRONG, FINE TO COARSE GRAINED, LAMINATED TO THIN BEDDED, FRIABLE, CONTAINS TRACE QUARTZITE PEBBLES THROUGHOUT, BEDDING DISCONTINUITIES: LOW ANGLE, HIGH ANGLE JOINT DISCONTINUITY FROM 15.8' - 16.0', SLIGHTLY FRACTURED TO HIGHLY FRACTURED, OPEN TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, INTACT TO BLOCKY, GOOD SURFACE CONDITION; RQD 64%, REC 91%. @16.7'; Qu = 3826 PSI		16																	
		17																
		18	64		91	NQ2-1											CORE	
		19																
	1001.7	20 EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 50 GAL. BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/25/17 16:33 - W:\062368- MS-SUM-8-1.75\E_PRJ WRK\E_ENG\GEO\30 SUBSURFACE INVEST\RENUMBERED SUM-8-1.75_051917.G

PROJECT: SUM-8-01.75	DRILLING FIRM / OPERATOR: NEAS / ASHBAUGH	DRILL RIG: CME 55X	STATION / OFFSET: 259+26, 62' LT.	EXPLORATION ID B-032-1-16
TYPE: NOISE WALL	SAMPLING FIRM / LOGGER: NEAS / K.BAME	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 8 SB	
PID: 91710 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/3/15	ELEVATION: 1020.9 (MSL) EOB: 22.0 ft.	PAGE 1 OF 1
START: 2/14/17 END: 2/14/17	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.1	LAT / LONG: 41.095666, -81.500051	

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
ASPHALT (7.0") & GRANULAR BASE (10.0")	1020.9																	
	1019.5	TR																
SANDSTONE, LIGHT PINKISH BROWN, SEVERLY WEATHERED, FRIABLE, EASILY AUGERED.		1																
		2																
		3	14 19 23	62	89	SS-1	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		4																
		5	16 50/4"	-	50	SS-2	-	-	-	-	-	-	-	-	-	6	Rock (V)	
		6																
		7																
		8	50/5"	-	100	SS-3	-	-	-	-	-	-	-	-	-	7	Rock (V)	
		9																
		10	50	-	50	SS-4	-	-	-	-	-	-	-	-	-	4	Rock (V)	
		11																
		12																
@12.5' TO 15.4'; BECOMES BROWN		13	48 50/5"	-	64	SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		14																
		15	50/5"	-	100	SS-6	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		16																
		17																
@17.5' TO 20.2'; BECOMES BROWN AND LIGHT BROWN		18	50/4"	-	75	SS-7	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		19																
		20	50/2"	-	50	SS-8	-	-	-	-	-	-	-	-	-	-	Rock (V)	
		21																
	998.9	EOB																
		22																

@22.0'; AUGER REFUSAL.

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 9.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; PUMPED 24 GAL. BENTONITE GROUT

APPENDIX C

GEOTECHNICAL BULLETIN 1 ANALYSIS SPREADSHEETS

Subgrade Analysis

V. 13.00 01/15/16

Design CBR 9

Global Options		
320	R&R	Option
206	CS	?
	LS	?
206	Depth	NA

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
10	0	13	20	10	0	0	0	0	9	0	0	6	10	0	3	0	0
12%		16%	25%	12%					11%			7%	12%		4%		
12%	53%								35%								

Surface Class		
2-5	0	
4b	0	
5	0	
7-5	0	
7-6	1	3%
8a	0	
8b	0	
R	1	3%

% Borings	
N_{60L}<= 5	13%
<=10	26%
>=20	48%
M+	35%
R	32%

% Surface	
13%	
3%	10%

UC @ Surface
Undercut
15.8
0
0

Rig	ER
A	80.3
B	80.6
C	88.1
D	81.8
E	
F	
G	
H	

Total Borings	31
PID	91710
Location	SUM-8-1.75

	N_{60}	N_{60L}	PI	Clay	M	M_{OPT}	GI
Average	29.0	17.8	14.9	11.4	11.3	10.2	3.17
Maximum	102	30	55	46	76	25	19	14
Minimum	5	5	1	1	2	1	6	0

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Sulfate		Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI			w/ Class	w/ MN	UC Class	UC MN	
1	B-001-0-15	SR 8 NB	1.0	2.5	0.0	1.0	2.5	11	15	26	A	35		NP		NP	3	3	6	6	8	3	0	400						
		515+80, 61' RT	3.5	4.8		3.5	4.8	26	50	76		102		NP		NP				5	8	3	0							
																						R				BR		24		
													30																	
2	B-002-0-15	SR 8 NB	1.0	2.2	0.1	1.1	2.3	7	50	57	A	76		NP		NP	4	3	7	4	8	3	0							
		517+43, 52' RT																				R				BR		24		
													30																	
3	B-003-0-15	SR 8 SB	1.0	2.5	0.3	1.3	2.8	16	15	31	A	41		NP		NP	4	4	8	6	8	3	0							
		218+00, 38' LT																				R		300		BR		24		Sulfate test Performed on weathered rock
													30																	
4	B-004-0-15	SR 8 SB	1.0	2.4	1.3	2.3	3.7	14	50	64	A	86		NP		NP	3	3	6	7	6	1b	0							
		222+00, BL																				R				BR		24		
													30																	
5	B-005-1-16	SR 8 NB	2.5	4.0	2.8	5.3	6.8	15	11	26	C	38								10	8	3a								
		524+26, 50' RT	5.0	6.5		7.8	9.3	18	15	33		48		NP		NP	12	8	20	10	8	3a								
													30																	
6	B-017-1-16	SR 8 NB	2.5	4.0	0.7	3.2	4.7	16	15	31	C	46		NP		NP	4	3	7	9	6	1b	0							
		542+28, 56' RT	5.0	6.0		5.7	6.7	9	7	16		23								10	6	1b								
			6.0	6.5		6.7	7.2	7	7	14		21		22	14	8	31	20	51	15	10	4a								
													21																	
7	B-020-1-16	SR 8 NB	2.5	4.0	0.5	3.0	4.5	7	6	13	C	19								17	10	4a	5				M			
		544+05, 53' RT	5.0	6.5		5.5	7.0	3	4	7		10								15	10	4a					N		12	
			7.5	9.0		8.0	9.5	3	3	6		9		27	17	10	34	24	58	16	12	4a					N		12	
													9																	
8	B-021-0-15	SR 8 NB	1.0	2.5	0.3	1.3	2.8	4	5	9	A	12								25	16	6b	10	800			MN		12	
		545+00, 57' RT	2.5	4.0		2.8	4.3	5	3	8		11		39	21	18	51	22	73	25	16	6b	11				N		12	
			4.0	5.5		4.3	5.8	3	7	10		13								19	16	6b	10							
			5.5	7.0		5.8	7.3	7	5	12		16	11	NP		NP	4	5	9	6	6	1b								
9	B-021-1-16	SR 8 NB	2.5	4.0	0.2	2.7	4.2	6	6	12	C	18								8	6	1b	0							
		546+03, 48' RT	5.0	6.5		5.2	6.7	3	4	7		10		NP		NP	4	2	6	8	6	1b					N		---	
													10																	
10	B-021-3-16	SR 8 NB	2.5	4.0	0.2	2.7	4.2	9	11	20	C	29									10	4a	5							
		547+96, 48' RT	5.0	6.5		5.2	6.7	5	4	9		13								17	10	4a					MN		12	
			7.5	9.0		7.7	9.2	6	6	12		18		25	16	9	32	21	53	16	11	4a								
													13																	
11	B-022-0-15	SR 8 SB	1.0	2.5	1.9	2.9	4.4	11	14	25	A	33		NP		NP	4	4	8	7	8	3	0	700						
		248+00, BL	3.5	5.0		5.4	6.9	5	6	11		15		41	20	21	49	26	75	14	18	7-6								
			6.0	7.5		7.9	9.4	3	4	7		9		39	21	18	45	27	72	13	16	6b					N		12	
													9																	

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class			Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI	Sulfate	w/ Class	w/ MN	UC Class	UC MN	
12	B-024-0-15	SR 8 NB	1.0	2.5	0.1	1.1	2.6	6	7	13	A	17		42	19	23	55	21	76	15	18	7-6	14	300					
		549+00, 50' RT	2.5	4.0		2.6	4.1	5	7	12		16								16	18	7-6	14						
			4.0	5.5		4.1	5.6	4	6	10		13		39	21	18	37	33	70	13	16	6b	10						
			5.5	7.0		5.6	7.1	6	8	14		19	13							13	16	6b							
13	B-025-1-16	SR 8 NB	2.5	4.0	0.1	2.6	4.1	6	8	14	C	21								15	14	6a	8						
		549+85, 46' RT	5.0	6.5		5.1	6.6	6	8	14		21		27	15	12	34	22	56	15	14	6a							
													21																
14	B-027-0-15	SR 8 NB	1.0	2.5	0.0	1.0	2.5	11	14	25	A	33		NP		NP	1	2	3	12	8	3	0						
		551+75, 50' RT	3.5	5.0		3.5	5.0	8	15	23		31								10	8	3	0						
			6.0	7.5		6.0	7.5	18	21	39		52								9	8	3							
													30																
15	B-029-0-15	SR 8 SB	1.0	2.5	0.5	1.5	3.0	8	7	15	A	20		NP		NP	1	2	3	11	6	1b	0	400					
		252+30, 35' LT	3.5	5.0		4.0	5.5	14	10	24		32								10	8	3	0						
			6.0	7.5		6.5	8.0	23	24	47		63		NP		NP	2	2	4	9	8	3							
													20																
16	B-029-1-16	SR 8 NB	2.5	4.0	0.0	2.5	4.0	9	14	23	C	34								7	8	3a	0						
		553+06, 44' RT	5.0	6.5		5.0	6.5	9	10	19		28		NP		NP	6	5	11	7	8	3a	0						
													28																
17	B-030-0-15	SR 8 NB	1.0	2.5	0.0	1.0	2.5	7	8	15	A	20		37	22	15	39	19	58	15	17	6a	7	600					
		553+15, 50' RT	2.5	4.0		2.5	4.0	15	13	28		37								8	8	3	0						
			4.0	5.5		4.0	5.5	11	17	28		37		NP		NP	2	3	5	7	8	3	0						
			5.5	7.0		5.5	7.0	11	19	30		40	20							10	8	3							
18	B-030-1-16	SR 8 SB	2.5	4.0	0.1	2.6	4.1	5	6	11	D	15		NP		NP	14	8	22	8	8	3a	0						
		253+39, 40' LT	5.0	6.5		5.1	6.6	8	12	20		27								7	8	3a							
													15																
19	B-031-0-15	SR 8 SB	1.0	2.5	0.1	1.1	2.6	3	2	5	A	7		NP		NP	3	3	6	10	6	1b	0	800		N		---	
		254+50, 55' LT	3.5	5.0		3.6	5.1	2	2	4		5								15	16	6b	10			N		21	
			6.0	7.5		6.1	7.6	3	4	7		9		39	19	20	35	32	67	18	16	6b				N		12	
													5																
20	B-031-1-16	SR 8 SB	2.5	4.0	0.0	2.5	4.0	4	4	8	D	11		25	16	9	38	20	58	18	11	4a	5			N		12	
		254+88, 47' LT	5.0	6.5		5.0	6.5	4	7	11		15								17	10	4a	5			M			
													11																
21	B-031-3-16	SR 8 SB	2.5	4.0	0.0	2.5	4.0	18	16	34	D	46		NP		NP	8	5	13	8	8	3a	0						
		256+62, 52' LT	5.0	6.5		5.0	6.5	21	34	55		75								5		R			BR		24		
													30																
22	B-032-0-15	SR 8 NB	1.0	2.5	0.0	1.0	2.5	7	10	17	A	23		NP		NP	14	7	21	7	8	3a	0						
		557+44, 63' RT	2.5	4.0		2.5	4.0	15	50	65		87		NP		NP	4	4	8	8	8	3	0	300					
																						R			BR		24		
													23																
23	B-032-1-16	SR 8 SB	1.4		0.0	1.4					C											R			BR		24		
		259+26, 62' LT																											
24	B-001-2-15	SR 8, Ramp J	1.0	2.5	0.2	1.2	2.7	5	4	9	B	12		NP		NP	27	1	28	18	8	3a	0	400		MN		---	
		415+50, BL	3.5	5.0		3.7	5.2	1	14	15		20		35	24	11	27	28	55	25	19	6a	4			M			
																						R			BR		24		
													12																
25	B-003-2-15	SR 8, Ramp J	1.0	2.5	-10.0	-9.0	-7.5	9	9	18	B	24		NP		NP	4	4	8	7	6	1b	0						
		418+50, BL																		3		R			BR		24		
													24																
26	B-004-4-15	SR 8, Ramp J	1.0	2.5	1.1	2.1	3.6	2	2	4	B	5		NP		NP	3	3	6	7	8	3	0			N		---	
		423+00, BL	3.5	5.0		4.6	6.1	6	6	12		16								16	16	6b	10	1000					
			6.0	7.5		7.1	8.6	6	2	8		11		39	22	17	42	30	72	17	17	6b				N		12	
													5																
27	B-004-5-16	SR 8, Ramp J	2.5	3.0	1.8	4.3	4.8	0	50	50	C	73		NP		NP	18	5	23	1	6	1b	0						
		423+45, 3' RT	5.0	6.5		6.8	8.3	10	8	18		26								10	8	3a							

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class			Problem		Undercuts		Analysis / Comments
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI	Sulfate		w/ Class	w/ MN	UC Class	UC MN	
													26																	
28	B-001-1-15	SR 8, Ramp I	1.0	2.5	0.3	1.3	2.8	7	10	17	A	23		NP		NP	2	3	5	5	6	1b	0	400						
		314+50,42' LT	3.5	5.0		3.8	5.3	2	2	4		5								5	6	1b	0				N		---	
			6.0	7.5		6.3	7.8	7	10	17		23		NP		NP	3	3	6	7	6	1b								
													5																	
29	B-003-3-15	SR 8, Ramp I	1.0	2.5	4.0	5.0	6.5	8	5	13	A	17		NP		NP	2	3	5	5	8	3	0							
		318+50, BL	3.5	5.0		7.5	9.0	2	2	4		5		NP		NP	1	1	2	4	8	3		500			N		---	
			6.0	7.3		10.0	11.3	20	50	70		94								6	8	3								
													5																	
30	B-003-7-15	SR 8, Ramp I	1.0	2.5	-8.7	-7.7	-6.2	2	3	5	A	7								19	14	6a	8			N		15		
		320+30, 15' RT	3.5	5.0		-5.2	-3.7	6	11	17		23		37	22	15	29	46	75	24	17	6a	10			M				
																						R			BR		24			
													7																	
31	B-004-3-15	SR 8, Ramp I	1.0	2.5	2.5	3.5	5.0	4	4	8	B	11								20	8	3	0	300			N		---	
		323+00, BL	3.5	4.8		6.0	7.3	18	50	68		91		NP		NP	3	3	6	4	8	3								
													11																	

Gannett Fleming
Engineers and Architects, P.C.
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APPENDIX H

Geotechnical Checklist

Ohio Department of Transportation
Geotechnical Engineering
Design Checklists

Version 4.0
August 07, 2013

Preface

Geotechnical design features that arise in the development of roadway projects vary both in type and complexity. Cuts, embankments, wetlands, mine issues, and rock slopes are just some geotechnical issues encountered on transportation projects. Consistent and comprehensive reconnaissance, analysis, and plan preparation are necessary to ensure that all possible geotechnical issues that may occur on a project will be adequately identified and accounted for on the final plans.

A set of topical review checklists, a reference list, and a technical publications list have been developed to aid the project development personnel in their production of geotechnically sound project plans. All projects that contain geotechnical related issues will benefit from the use of this document. Although it is expected that the District Geotechnical Engineer will be one of the main users of these checklists, any personnel responsible for a geotechnical aspect of the project plan development will use this document. Possible users of this checklist include, but are not limited to, design and geotechnical Consultants and District and Central Office Planning and Production staff.

The design checklists are provided to assist the project development personnel in:

- Developing a comprehensive geotechnical scope of services
- Developing and reviewing geotechnical reports and assimilating information
- Analyzing, designing, and reviewing geotechnical related aspects of a transportation project, including needs assessment, plans, and specifications
- Recognizing cost-saving opportunities
- Identifying deficiencies due to inadequate geotechnical investigation, analysis, or design
- Recognizing when to request additional technical assistance from a geotechnical specialist
- Defining areas of needed training

At first glance, the design checklist will seem to be inordinately lengthy. One, however, should not avoid using the checklist because of this. Only on major and complex projects will it be necessary to complete most of the checklist. Just those checklists that pertain to a specific geotechnical feature encountered on the project should be completed. Therefore, for most projects, only a small portion of the checklist will need to be completed.

Since several entities may be involved in the geotechnical development of a transportation project, it is possible that there may be more than one set of checklists completed for a specific project, or different entities may fill out different sections of the checklist. It is anticipated that all completed checklists will be included with the project file in District or Central Office.

Additional topics and questions may be added as the development of these checklists continues and input is received from the users. All additional updates, bulletins, and design guidance will be issued from the Office of Geotechnical Engineering and available on the internet at the Design Reference Resource Center. The Geotechnical Program Coordinator in the Office of Geotechnical Engineering will be the point of contact regarding the checklist, and any questions, recommendations, and training requests should be directed to the Geotechnical Program Coordinator.

Table of Contents

Symbols and Abbreviations

Y	Yes
N	No
X	Not Applicable (Reason should be explained in the “Notes” area of the checklist)
AML	Abandoned Mine Land Reclamation Program, DMRM, ODNR
AUMIRA	Manual for Abandoned Underground Mine Inventory and Risk Assessment, ODOT
BDM	Bridge Design Manual
CBR	California Bearing Ratio
CMS	Construction and Material Specifications, ODOT
DGE	District Geotechnical Engineer, ODOT District
DGS	Division of Geological Survey, ODNR
DMRM	Division of Mineral Resources Management, ODNR
DSWC	Division of Soil and Water Conservation, ODNR
EPA	Ohio Environmental Protection Agency
FHWA	Federal Highway Administration
F.S.	Factor of Safety
GB	Geotechnical Bulletin, OGE (Always followed by the applicable number (e.g., GB4))
GPC	Geotechnical Program Coordinator, OGE
k	Effective Modulus of Subgrade Reaction
L&D1	Location & Design Manual, Volume 1, ODOT
L&D3	Location & Design Manual, Volume 3, ODOT
M_R	Resilient Modulus
N	Standard Penetration Value
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OGE	Office of Geotechnical Engineering, ODOT
OSM	Office of Surface Mining, U.S. Department of the Interior
PI	Plasticity Index
ROW	Right of Way
SGE	Specifications for Geotechnical Explorations, ODOT
SPT	Standard Penetration Test
USGS	U.S. Geological Survey
WEAP	Wave Equation Analysis of Pile Driving (Software)

II. Reconnaissance and Planning Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

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

Planning - General		
Y N X 5	In planning the geotechnical exploration program for the project, have the specific geologic conditions, the proposed work, and existing subsurface exploration work been considered?	
Y N X 6	Have the borings been located to develop the maximum subsurface information while using a minimum number of borings?	
Y N X 7	Has the topography, geologic origin of materials, surface manifestation of soil conditions, and any other special design considerations been utilized in determining the spacing and depth of borings?	
Y N X 8	Have the borings been located so as to provide adequate overhead clearance for the equipment, clearance of underground utilities, minimize damage to private property, and minimize disruption of traffic, without compromising the quality of the exploration?	

II. Reconnaissance and Planning Checklist

Y	N	X	9	Have any previous geotechnical explorations been utilized to the fullest extent possible?	
Y	N	X	10	Have the scaled boring plans, showing all project and historic borings, and a schedule of borings in tabular format, been submitted to the District Geotechnical Engineer?	
				The schedule of borings should present the following information for each boring:	
Y	N	X		□ exploration identification number	
Y	N	X		□ location by station and offset	
Y	N	X		□ estimated amount of rock and soil, including the total for each for the entire program.	
Planning – Exploration Number					
Y	N	X	11	Have the coordinates, stations and offsets of all explorations (borings, probes, test pits, etc.) been identified?	
Y	N	X	12	Has each exploration been assigned a unique identification number, in the following format X-ZZZ-W-YY, as per Section 303.2 of the SGE?	
Y	N	X	13	When referring to historic explorations that did not use the identification scheme in 12 above, have the historic explorations been assigned identification numbers according to Section 303.2 of the SGE?	

Notes:

II. Reconnaissance and Planning Checklist

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

Notes:

III.A. Centerline Cuts Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

If you do not have a centerline cut on the project, you do not have to fill out this checklist.

Soil Cuts		
Y N X 1	Does drilling provide continuous stratigraphic sections for the range of elevations that represent proposed cut slope areas?	
Y N X 2	Do the cut slopes have a minimum stability F.S. of 1.30 and are not steeper than 2:1?	
	Check stability calculation method used:	
	X GSTABL7 or equivalent software	
	□ hand calculations	
Y N X 3	If there is a "red bed" or other historically unstable soil or rock layer through the cut slopes, was this layer considered as a possible failure zone?	
Y N X 4	Have erosion protection measures been addressed for backslopes, side slopes, and ditches (including riprap recommendations or special slope treatments)?	
Y N X 5	Have issues related to any special usage of excavated soils been addressed?	
6	If the cut is not completely above the water table,	
Y N X	a Did the design consider the construction or long-term ramifications of cutting below the water table?	All cuts are above water table
Y N X	b Did the design consider additional drainage in the cut slope (springs / seeps) and roadway base?	

III.B. Embankments Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

Settlement

Y N X	1	If soil conditions and project requirements warrant, have settlement issues been addressed? If not applicable (X), go to Question **14**	
Y N X	2	Have consolidation properties of the foundation soils been determined? Check methods used: □ laboratory consolidation tests □ empirical correlations with moisture content and Atterberg values □ other	
Y N X	3	Have calculations been performed to estimate the total expected embankment settlement and the time of consolidation? Check method used: □ EMBANK or equivalent software □ hand calculations	
Y N X	4	If differing foundation soil and/or loading conditions occur throughout the embankment area, have sufficient analyses been completed to evaluate consolidation at locations representative of the most critical conditions?	
Y N X	5	Have the total settlement and the time of consolidation analyses indicated acceptable values at all locations for the scope of the embankment work?	
Y N X	6	If total settlement or time of consolidation is unacceptable, have the stations and lateral extent of the problem areas been defined?	
Y N X	7	Has a method been chosen as a solution to the settlement issues? Check methods used: □ waiting periods with monitoring □ drainage blanket and wick drains □ surcharge (preloading) □ removal and replacement of weak soil □ lowering proposed grade / change alignment □ lightweight fill	

III.B. Embankments Checklist

				□ other List Other items:	
Y	N	X	8	Based on accepted design practices, and where applicable, adhering to published guidelines and design recommendations from FHWA, have calculations been performed to evaluate the effectiveness of the chosen solution(s)?	
Y	N	X	9	Has an economic analysis been performed to evaluate the cost benefits of the recommended solution compared to others?	
Y	N	X	10	Have all necessary notes, specifications, and details for the chosen solution been determined?	
Y	N	X	11	Have the need, locations, type, plan notes, and reading schedule for settlement platforms been determined?	
Y	N	X	12	Have the effects of the predicted settlement and the chosen solution been determined and accounted for on the construction schedule?	
Y	N	X	13	Has the effect of any foundation soil consolidation (including differential settlement) been evaluated with regard to adjacent structures (e.g., bridges, buildings, culverts, utilities) which will also undergo settlement and be subject to stresses induced by the consolidation of the surrounding soil?	

Notes :

Stage 1:

III.B. Embankments Checklist

Stability		
Y N X 14	If soil conditions and project requirements warrant, have stability issues been addressed? If not applicable (X), go to Question **29**	
Y N X 15	Has the total (short term) and effective (long term) shear strength of the foundation soils been determined? Check method used: □ laboratory shear tests X estimation from SPT or field tests	
Y N X 16	Have the values of shear strength for proposed embankment fill material, as determined from Geotechnical Bulletin 6 Shear Strength of Proposed Embankments (GB 6), been used in the stability analyses?	
Y N X 17	Have calculations been performed to determine the F.S. for stability? Check method used: X GSTABL7, or equivalent software □ hand calculations	
18	Have the following F.S. been met or exceeded, as determined by the calculations, for the given stability conditions:	
Y N X	a 1.30 for short term condition	
Y N X	b 1.30 for long term condition	
Y N X	c 1.10 for rapid drawdown, flood condition	
Y N X	d 1.50 for embankment supporting bridge abutments (not on deep foundations)	
Y N X 19	When differing soil or loading conditions occur throughout the embankment area, have sufficient analyses been completed to evaluate the stability at locations representative of the most critical conditions?	
Y N X 20	If the F.S. was not met or exceeded, have the stations and lateral extent of the problem areas been defined?	
Y N X 21	Has a method been chosen as a solution to the stability issues? Check the method(s) used: X flattening slopes	

III.B. Embankments Checklist

				□ counterberm	
				□ lightweight embankment □ reinforced soil slope □ soil nailing □ drainage blanket and wick drains □ removal of soft soil, adding shear key □ reduced grade / change alignment □ stage construction □ controlled rate of fill placement X drilled shaft slope stabilization □ other List Other items:	
Y	N	X	22	Based on accepted design practices, and where applicable, adhering to published guidelines and design recommendations from FHWA, have calculations been performed to evaluate the effectiveness of the chosen solution(s)?	Design loads were determined in SLIDE for access roads. The design and location of access roads may change per the requirements of the contractor therefore no further work is justified.
Y	N	X	23	Has an economic analysis been performed to evaluate the cost benefits of the recommended solution compared to others?	
Y	N	X	24	Have all necessary notes, specifications, and details for the chosen solution been determined?	
Y	N	X	25	Have the need, location, type, plan notes, and reading schedule for piezometers and inclinometers been determined?	
Y	N	X	26	If piezometers will be used, has the critical pressure value been determined and the appropriate information included in the plans?	
Y	N	X	27	Have the effects of the stability solution been determined and accounted for on the construction schedule?	
Y	N	X	28	Has the effect of the stability solution been evaluated with regard to structures (e.g., bridges, buildings, culverts, utilities) which may be subject to unusual stresses or require special construction considerations?	

Notes:

Stage 1:

III.B. Embankments Checklist

Sidehill Fills					
Y	N	X	29	If soil conditions and project requirements warrant, have sidehill fill issues been addressed? If not applicable (X), go to Question **34**	
Y	N	X	30	In accordance with Geotechnical Bulletin 2: Special Benching and Sidehill Embankment Fills (GB 2), have sidehill fills been evaluated to determine if special benching or shear keys are needed?	
			31	In accordance with GB 2, if special benching or shear keys are required, has	
Y	N	X		a Plan Note G110 from L&D3 been included in the General Notes?	
Y	N	X		b quantities for both excavation and embankment been calculated for the benched areas and added to the plan General Quantities?	
Y	N	X		c the special benching or shear keys been indicated on the appropriate cross sections?	
Y	N	X	32	Have water bearing zones been identified and their impact addressed?	None identified
Y	N	X	33	Have subsurface drainage controls been adequately addressed?	

Notes:

Stage 1:

III.B. Embankments Checklist

Special					
Y	N	X	34	Have all of the environmental factors, including wetlands, stream mitigation, and landfills, been considered and incorporated prior to design and analysis of embankment settlement and stability, including EPA or other government agencies' involvement, mitigation, or special design or construction considerations?	There is a landfill that is interfering with pier 5 of the bridge. Additional design work may be required after this submission. At this time it is GF's and MS's opinion cost as determined by the contractor will be the deciding factor.
			35	If an embankment is to be placed through standing water or over weak, wet soils (with or without a fabric separator), the fill should be placed by the method of end dumping to a given height above the standing water or until compaction is achievable over the soft soil. If end dumping is to be specified,	
Y	N	X		a has the material type for the fill to be end dumped been specified?	Fills should be performed per 203
Y	N	X		b has the need for a fabric separator or filter layer been determined?	
Y	N	X		c has the height of fill to be end dumped been determined?	
Y	N	X		d have all notes and specifications for end dumping been developed?	

Notes:

Stage 1:

III.C. Subgrade Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

If you do not have any subgrade work on the project, you do not have to fill out this checklist.

Y N X 1	Has the subsurface investigation adequately characterized the soil or rock according to Geotechnical Bulletin 1: Plan Subgrades (GB1)?	This section is skipped as it was performed by NEAS
Y N X 2	If soils classified as A-2-5, A-4b, A-5, A-7-5, A-8a, or A-8b, or having a LL>65, are present at the proposed subgrade (soil profile), do the plans specify that these materials need to be removed and replaced or chemically stabilized?	
Y N X	a If these materials are to be removed and replaced, have the station limits, depth, and lateral limits for the planned removal been provided?	
Y N X 3	If there is any rock, shale, or coal present at the proposed subgrade (CMS 204.05), do the plans specify the removal of the material?	
Y N X	a If removal of any rock, shale, or coal is required, have the station limits, depth, and lateral limits for the planned removal of the material at proposed subgrade been provided?	
Y N X 4	In accordance with GB1, do the SPT values and existing moisture contents for the proposed subgrade soils indicate the need for subgrade stabilization?	
Y N X	a If removal and replacement is applicable, has the detail of subgrade removal been shown on the plans, including depth of removal, station limits, lateral extent, replacement material, and plan notes (Item 204 – Subgrade Compaction and Proof Rolling)?	
Y N X	b If chemical stabilization is applicable, has the detail of this treatment been shown on the plans, including depth, percentage of chemical, station limits, lateral extent, and plan notes? Indicate type of subgrade treatment specified: □ cement treatment □ lime treatment □ lime kiln dust □ other	
Y N X 5	If drainage or groundwater is an issue with the proposed subgrade, has an appropriate drainage system (e.g., pipe, underdrains) been provided?	

III.C. Subgrade Checklist

Y	N	X	6	Has an appropriate quantity of Proof Rolling been included in the plans (CMS 204.06)?	
Y	N	X	7	Has a design CBR value been provided?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

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

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

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Spread Footings						
Y	N		4		Are there spread footings on the project? If no, go to Question **11**	
Y	N	X	5		Has the recommended bottom of footing elevation and reason for this recommendation been provided?	
Y	N	X		a	Has the recommended bottom of footing elevation taken scour from streams or other water flow into account?	
			6		Were representative sections analyzed for the entire length of the structure for the following:	
Y	N	X		a	bearing capacity?	
Y	N	X		b	sliding?	Parameter were provided for sliding and overturning
Y	N	X		c	overturning?	
Y	N	X		d	settlement?	
Y	N	X	7		Has the need for a shear key been evaluated?	
Y	N	X		a	If needed, have the details been included in the plans?	
Y	N	X	8		If special conditions exist (e.g. geometry, sloping rock, varying soil conditions), was the bottom of footing “stepped” to accommodate them?	
Y	N	X	9		Has the recommended allowable soil or rock bearing pressure been provided?	
Y	N	X	10		If weak soil is present at the proposed foundation level, has the removal / treatment of this soil been developed and included in the plans?	
Y	N	X		a	Have the procedure and quantities related to this removal / treatment been included in the plans?	Not included in geotechnical report.

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

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

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Drilled Shafts					
Y	N		17	Are there drilled shafts on the project? If no, go to the next checklist.	
Y	N	X	18	Have the drilled shaft diameter and embedment length been specified?	
Y	N	X	19	Have the recommended drilled shaft diameter and embedment been developed based on side friction and end bearing for vertical loading situations?	
			20	For shafts undergoing lateral loading, have the following been determined:	
Y	N	X		a. maximum lateral shear	
Y	N	X		b. maximum bending moment	
Y	N	X		c. maximum deflection	
Y	N	X		d. reinforcement design	
Y	N	X	21	Generally, bedrock sockets are 6" smaller in diameter than the soil embedment section of the drilled shaft. Has this factor been accounted for in the drilled shaft design?	
Y	N	X	22	If a bedrock socket is required below soil embedment, have separate quantities been estimated based on shaft diameters and materials to be excavated?	Quanties
Y	N	X	23	Has the site been assessed for groundwater influence?	
Y	N	X		a If yes, if artesian flow is a potential concern, does the design address control of groundwater flow during construction?	No artesian conditions
Y	N	X	24	If special construction features (e.g., slurry, casing, load tests) are required, have all the proper items been included in the plans?	None required

Notes:

Stage 1

VI.A. Soil Profile Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

General Presentation		
Y N X 1	Has a paper copy and electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	
Y N X 2	Has the geotechnical specification (title and date) under which the work was performed been clearly identified on every submission (reports, plans, etc.)?	
Y N X 3	Has the first complete version of all documents being submitted been labeled as 'Draft'?	
Y N X 4	Subsequent to ODOT's review and approval, has the complete version of the revised documents being submitted been labeled as 'Final'?	There may be revision after review
Y N X 5	Have the electronic copies of the final geotechnical plan sheets been submitted as TIFF images?	
Y N X 6	If the project includes structures, have all structure explorations been presented in the Soil Profile? (Do not create separate Structure Foundation Exploration Sheets)	
Y N X 7	Have the plan sheets been prepared using the size, lettering, format, file management, and CADD standards as prescribed in the applicable sections of the ODOT CADD Engineering Standards Manual?	
Y N X 8	Has a scale of 1"=1' been used for cover sheets and laboratory test data sheets?	
Y N X 9	Based on the project length, has the correct horizontal scale been used to plot the project data? Check scale used: X 1" = 20', 30', 40', or 50' for projects 1500' or less (use largest scale appropriate to present entire plan on one sheet) □ 1" = 50' projects greater than 1500'	
Y N X 10	Has a scale of 1" = 10' been utilized for the vertical scale of the project data?	
Y N X 11	Have the cross-sections been plotted at a scale of 1" = 10' (preferred) or 1" = 20' (for higher or wider slopes)?	

VI.A. Soil Profile Checklist

Cover Sheet			
	12	Has the following general information been provided on the cover sheet	
Y N X		a. Brief description of the project, including the bridge number of each bridge involved in the plan set, if any?	
Y N X		b. Brief presentation of geological and topographical information? Include comments on structure and pavement conditions.	
Y N X		c. Brief presentation of boring and sampling methods? Include date of last calibration and drill rod energy ratio as a percent for the hammer systems used.	
Y N X		d. Summary of general soil, bedrock, and groundwater conditions, including a generalized interpretation of findings?	
Y N X		e. Statement of where original drawings and data may be inspected?	
Y N X		f. Statement of where soil or rock samples may be inspected, if applicable?	Not Applicable
Y N X		g. Initials of personnel and dates they performed field reconnaissance, subsurface exploration and preparation of the soil profile?	
Y N X	13	Has a Legend been provided?	
	14	Have the following items been included in the Legend:	
Y N X		a. Symbols and usual descriptions for only the soil and bedrock types presented in the Soil Profile, as per the Soil and Rock Symbology Chart in Appendix D of the SGE?	
Y N X		b. All miscellaneous symbols and acronyms, used on any of the sheets, defined?	
Y N X		c. The number of soil samples for each classification that were mechanically classified and visually described in the current exploration?	
Y N X	15	Has a Location Map, showing the beginning and end stations for the project, been shown on the cover sheet, sized per the L&D Manual?	
Y N X	16	Have the station limits for each plan and profile sheet for projects with multiple alignments, or greater than 1500', been identified in a table?	

VI.A. Soil Profile Checklist

Y	N	X	17	Have the station limits for any cross-section sheets been identified in the same table?	
Y	N	X	18	Has a summary table of test data for all roadway and subgrade boring samples been shown?	
Y	N	X	19	If sampling and testing for a scour analysis was performed, has this data been shown in tabular form?	Not applicable
Y	N	X	20	If borings from previous subsurface explorations are being used, has that data been shown in a separate table?	
Y	N	X	21	In the summary table, has the data been displayed by roadway and subgrade boring in ascending stationing order for each roadway?	
Y	N	X	22	Have the centerline or baseline station, offset, and exploration identification number been provided for each boring presented in the table?	
			23	For each sample, has the following information been provided in the summary table:	
Y	N	X		a. Sample depth interval?	
Y	N	X		b. Sample number and type (other than split spoon)?	
Y	N	X		c. Percent recovery?	
Y	N	X		d. Percentage of aggregate, coarse sand, fine sand, silt, and clay size particles?	
Y	N	X		e. Liquid limit, plastic limit, plasticity index, and water content, all rounded to the nearest percent or whole number?	
Y	N	X		f. ODOT classification, and Group Index?	
Y	N	X		g. Visual description of samples not mechanically classified, including water content, and estimated ODOT classification with 'Visual' in parentheses?	
Y	N	X	24	Have all undisturbed test results been displayed in graphical format on the sheet prior to the plan and profile sheets?	

VI.A. Soil Profile Checklist

Surface Data					
			25	Has the following information been shown in a roadway plan drawing:	
Y	N	X	a	Existing surface features described in Section 702.5.1?	
Y	N	X	b	Proposed construction items, as described in Section 702.5.2?	
Y	N	X	c	Project and historic boring locations, with appropriate exploration targets and exploration identification numbers?	
Y	N	X	d	Notes regarding observations not readily shown by drawings?	
Y	N	X	26	Have the existing ground surface contours been presented?	
Y	N	X	27	If cross sections are to be developed for stationing covered on a plan sheet, has an index for the appropriate cross section sheets been included on the plan sheet?	
Subsurface Data					
Y	N	X	28	Has all the subsurface data been presented in the form of a profile along the centerline or baseline, and on cross sections where applicable?	
			29	Have the graphical boring logs been correctly shown, as follows:	
Y	N	X	a.	Location and depth of boring indicated by a heavy dashed vertical line?	
Y	N	X	b.	Exploration identification number above the boring?	
Y	N	X	c.	Logs indicate soil and bedrock layers with symbols 0.4” wide and centered on the heavy dashed vertical line where possible?	
Y	N	X	d.	Bedrock exposures with 0.4” wide symbols, but without a heavy dashed vertical line?	
Y	N	X	e.	Soil and bedrock symbols as per ODOT Soil and Rock Symbology chart (SGE - Appendix D)?	
Y	N	X	f.	Historical borings shown in same manner with the exploration identification number above the boring?	
Y	N	X	30	Have the proposed groundline and existing groundline been shown on the profile view, according to ODOT CADD standards?	

VI.A. Soil Profile Checklist

Y	N	X	31	Have the offsets from centerline or baseline been indicated above the borings in the profile view?	
Y	N	X	32	Have borings located immediately adjacent to the centerline or baseline and considered representative of centerline or baseline subsurface conditions been referenced directly to the centerline or baseline?	
Y	N	X	33	Have offset borings in or near the same elevation interval of a centerline or baseline boring been plotted either on a cross section or immediately above or below the centerline boring in a box containing an elevation scale?	
Y	N	X	34	Have cross-sections been developed to show subsurface conditions disclosed by a series of borings drilled transverse to centerline or baseline?	
Y	N	X	35	Have the existing and proposed groundlines been displayed on cross section sheets according to ODOT CADD standards?	
Y	N	X	36	Have bedrock exposures shown on the cross sections been plotted along the contour of the cross section?	
			37	Has the following information been provided adjacent to the graphical logs or bedrock exposure:	
Y	N	X		a. Thickness, to the nearest 0.1', of sod/topsoil or other shallow surface material written above the boring (with corresponding symbology at top of log)?	
Y	N	X		b. Moisture content, to nearest whole percent, with the bottom of the text aligned with the bottom of the sample? Label this column as 'WC' at bottom of the boring.	
Y	N	X		c. $N_{60,}$ aligned with the bottom of sample? Label column as 'N_{60}' at bottom of boring.	
Y	N	X		d. Free water indicated by a horizontal line with a 'w' attached, and static water indicated by a shaded equilateral triangle, point down?	
Y	N	X		e. Complete geologic description of each bedrock unit, including unit core loss, unit RQD, SDI, and compressive strength test results? (Do not present geologic descriptions for structure borings for which this information is presented on the boring logs as described in 703.3)	
Y	N	X		f. Visual description of any uncontrolled fill or interval not adequately defined by a graphical symbol?	

VI.A. Soil Profile Checklist

Y	N	X		g. Organic content with modifiers, per 603.5?	
Y	N	X		h. Designate a plastic soil with moisture content equal to or greater than the liquid limit minus three with a 1/8” solid black circle adjacent to the moisture content?	
Y	N	X		i. Designate a non-plastic soil with moisture content exceeding 25% or exceeding 19% but appearing wet initially, with a 1/8” open circle with a horizontal line through it adjacent to the moisture content?	
Y	N	X		j. The reason for discontinuing a boring prior to reaching the planned depth indicated immediately below the boring?	
Y	N	X	38	Have the boring logs of all structure borings and any roadway borings drilled in the vicinity of the structures been shown on the boring log sheets following the plan and profile sheets? (Create the logs in accordance with 703.3)	

Notes:

VI.C. Structure Foundation Exploration Checklist

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

General Presentation					
Y	N	X	1	Has the geotechnical information for explorations involving structures only (no roadway) been presented as plan drawings in the form of a Structure Foundation Exploration?	
Y	N	X	2	Have structures explored as part of the same construction project been presented together under the same cover sheet?	
Y	N	X	3	Has a paper copy and electronic copy of all geotechnical submissions been provided to the District Geotechnical Engineer (DGE)?	
Y	N	X	4	Has the geotechnical specification (title and date) under which the work was performed been clearly identified on every submission (reports, plans, etc.)?	
Y	N	X	5	Has the first complete version of all documents being submitted been labeled as 'Draft'?	
Y	N	X	6	Subsequent to ODOT's review and approval, has the complete version of the revised documents being submitted been labeled as 'Final'?	Final review not yet performed
Y	N	X	7	Have the electronic copies of the final geotechnical plan sheets been submitted as TIFF images?	
Y	N	X	8	Have the plan sheets been prepared using the size, lettering, format, file management, and CADD standards as prescribed in the applicable sections of the ODOT CADD Engineering Standards Manual?	
Y	N	X	9	Has a scale of 1"=1' been used for cover sheets and laboratory test data sheets?	

Cover Sheet

VI.C. Structure Foundation Exploration Checklist

	10	Has the following general information been provided on the cover sheet	See soil profile above
Y N X		h. Brief description of the project?	
Y N X		i. Brief presentation of geological and topographical information? Include comments on structure and pavement conditions.	
Y N X		j. Brief presentation of boring and sampling methods? Include date of last calibration and drill rod energy ratio as a percent for the hammer systems used.	
Y N X		k. Summary of general soil, bedrock, and groundwater conditions, including a generalized interpretation of findings?	
Y N X		l. Statement of where original drawings and data may be inspected?	
Y N X		m. Statement of where soil or rock samples may be inspected, if applicable?	
Y N X		n. Initials of personnel and dates they performed field reconnaissance, subsurface exploration and preparation of the soil profile?	
Y N X	11	Has a Legend been provided on the cover sheet?	
	12	Have the following items been included in the Legend:	
Y N X		d. Symbols and usual descriptions for only the soil and bedrock types encountered, as per the Soil and Rock Symbology Chart in Appendix D of the SGE?	
Y N X		e. All miscellaneous symbols and acronyms, used on any of the sheets, defined?	
Y N X		f. The number of soil samples for each classification that were mechanically classified and visually described?	
Y N X	13	Has a Location Map, showing the beginning and end stations for the project, been shown on the cover sheet, sized per the L&D Manual?	
Y N X	14	If sampling and testing for a scour analysis was performed, has this data been shown in tabular form?	

VI.C. Structure Foundation Exploration Checklist

Plan and Profile					
Y	N	X	15	Has the plan and profile view been shown at the same scale as the Site Plan for the proposed structure (when possible)?	
Y	N	X	16	Has the plan and profile been presented along the flowline for culverts?	
			17	Has the following information been shown in a roadway plan drawing:	
Y	N	X		a Existing surface features described in Section 702.5.1?	
Y	N	X		b Proposed construction items, as described in Section 702.5.2?	
Y	N	X		c Project and historic boring locations, with appropriate exploration targets and exploration identification numbers?	
Y	N	X		d Notes regarding observations not readily shown by drawings?	
Y	N	X	18	Have the existing ground surface contours been presented?	
Y	N	X	19	Has all the subsurface data been presented in the form of a profile along the centerline or baseline?	
			20	Have the graphical boring logs been correctly shown, as follows:	
Y	N	X		g. Location and depth of boring indicated by a heavy dashed vertical line?	
Y	N	X		h. Exploration identification number above the boring	
Y	N	X		i. Logs indicate soil and bedrock layers with symbols 0.4” wide and centered on the heavy dashed vertical line where possible?	
Y	N	X		j. Bedrock exposures with 0.4” wide symbols, but without a heavy dashed vertical line.	
Y	N	X		k. Soil and bedrock symbols as per ODOT Soil and Rock Symbology chart (SGE - Appendix D)?	
Y	N	X		l. Historical borings shown in same manner with the exploration identification number above the boring?	
Y	N	X	21	Have the proposed profile and existing groundline been shown on the profile view, according to ODOT CADD standards?	

VI.C. Structure Foundation Exploration Checklist

Y	N	X	22	Have the locations of the proposed structure foundation elements been shown on the profile view?	
Y	N	X	23	Have the offsets from centerline or baseline been indicated above the borings in the profile view?	
			24	Has the following information been provided adjacent to the graphical logs or bedrock exposure:	
Y	N	X		k. Thickness, to the nearest 0.1', of sod/topsoil or other shallow surface material written above the boring (with corresponding symbology at top of log)?	
Y	N	X		l. Moisture content, to nearest whole percent, with the text aligned with the bottom of the sample? Label this column as 'WC' at bottom of boring.	
Y	N	X		m. $N_{60,}$ aligned with bottom of sample? Label this column as 'N_{60}' at bottom of boring.	
Y	N	X		n. Free water indicated by a horizontal line with a 'w' attached, and static water indicated by a shaded equilateral triangle, point down?	
Y	N	X		o. Visual description of any uncontrolled fill or interval not adequately defined by a graphical symbol?	
Y	N	X		p. Organic content with modifiers, per 603.5?	
Y	N	X		q. Designate a plastic soil with moisture content equal to or greater than the liquid limit minus three with a 1/8" solid black circle adjacent to the moisture content?	
Y	N	X		r. Designate a non-plastic soil with moisture content exceeding 25% or exceeding 19% but appearing wet initially, with a 1/8" open circle with a horizontal line through it adjacent to the moisture content?	
Y	N	X		s. The reason for discontinuing a boring prior to reaching the planned depth indicated immediately below the boring?	

VI.C. Structure Foundation Exploration Checklist

Boring Logs					
Y	N	X	25	Have the boring logs of all structure borings been shown on the sheet(s) following the plan and profile views?	
Y	N	X	26	Has a scale of 1”=1’ been used for the boring log sheets?	
Y	N	X	27	Have the boring logs been developed by integrating the driller’s field logs, laboratory test data, and visual descriptions?	
			28	Has the following boring information been included in the heading of each boring log:	
Y	N	X		a. Exploration identification number?	
Y	N	X		b. Project designation (C-R-S) and PID?	
Y	N	X		c. Bridge identification (if applicable)?	
Y	N	X		d. Centerline or baseline name, station, offset, and surface elevation?	
Y	N	X		e. Coordinates?	
Y	N	X		f. Method of drilling?	
Y	N	X		g. Static and free water-level observations?	
Y	N	X		h. Date started and date completed?	
Y	N	X		i. Method and material (including quantity) used for backfilling or sealing, including type of instrumentation, if any?	
Y	N	X		j. Date of last calibration and drill rod energy ratio (ER) in percent for the hammer system(s) used?	
			29	Has the following boring information been included in each boring log:	
Y	N	X		a. A depth and elevation scale?	
Y	N	X		b. Indication of stratum change?	
Y	N	X		c. Description of material in each stratum?	
Y	N	X		d. Depth of bottom of boring?	
Y	N	X		e. Depth of boulders or cobbles, if encountered?	
Y	N	X		f. Caving depth?	
Y	N	X		g. Artesian water level and height of rise?	
Y	N	X		h. Running sand?	
Y	N	X		i. Cavities or other unusual conditions?	
Y	N	X		j. Depth interval represented by sample?	
Y	N	X		k. Sample number and type?	

VI.C. Structure Foundation Exploration Checklist

Y	N	X		l. Percent recovery for each sample?	
Y	N	X		m. Measured blow counts for each 6 inches of drive for split spoon samples?	
Y	N	X		n. N_{60} to the nearest whole number?	
Y	N	X		o. Particle-size analysis?	
Y	N	X		p. Liquid limit, plastic limit, plasticity index?	
Y	N	X		q. Water content?	
Y	N	X		r. ODOT soil classifications, with 'Visual' in parentheses for those samples visually classified?	
Y	N	X		s. Bedrock descriptions?	
Y	N	X		t. Run rock core percent recovery?	
Y	N	X		u. Run RQD?	
Y	N	X		v. Unit rock core percent recovery?	
Y	N	X		w. Unit RQD?	
Y	N	X		x. SDI, if applicable?	
Y	N	X		y. Rock compressive strength test results, if applicable?	
Y	N	X	30	Have all undisturbed test results been displayed in graphical format on the sheet(s) following the boring log sheet(s)?	

Notes:

Stage 1:

VI.D. Geotechnical Reports

C-R-S: SUM-8-1.75	PID: 91710	Reviewer: TLM	Date: 10-30-18

General					
Y	N	X	1	Has the first complete version of a geotechnical report being submitted been labeled as 'Draft'?	
Y	N	X	2	Subsequent to ODOT's review and approval, has the complete version of the revised geotechnical report being submitted been labeled 'Final'?	
Y	N	X	3	Have all geotechnical reports being submitted been titled correctly as prescribed in Section 705.1 of the SGE?	

Report Body					
Y	N	X	4	Do all geotechnical reports being submitted contain an Executive Summary as described in Section 705.2 of the SGE?	
Y	N	X	5	Do all geotechnical reports being submitted contain an Introduction as described in Section 705.3 of the SGE?	
Y	N	X	6	Do all geotechnical reports being submitted contain a section titled "Geology and Observations of the Project," as described in Section 705.4 of the SGE?	
Y	N	X	7	Do all geotechnical reports being submitted contain a section titled "Exploration," as described in Section 705.5 of the SGE?	
Y	N	X	8	Do all geotechnical reports being submitted contain a section titled "Findings," as described in Section 705.6 of the SGE?	
Y	N	X	9	Do all geotechnical reports being submitted contain a section titled "Analyses and Recommendations," as described in Section 705.7 of the SGE?	

VI.D. Geotechnical Reports

Appendices		
Y N X 10	Do all geotechnical reports being submitted contain all applicable Appendices as described in Section 705.8 of the SGE?	
Y N X 11	Do the Appendices present a site Boring Plan showing all boring locations as described in Section 705.8.1 of the SGE?	
Y N X 12	Do the Appendices include boring logs as described in Section 705.8.2 of the SGE?	
Y N X 13	Do the Appendices present reports of undisturbed test data as described in Section 705.8.3 of the SGE?	
Y N X 14	Do the Appendices present calculations in a logical format to support recommendations as described in Section 705.8.4 of the SGE?	

Notes:

VI.D. Geotechnical Reports

VII. References

Publications - FHWA

Advanced Course on Slope Stability, Volume 1 and 2, Abramson, Lee, Boyce, Glenn, et al., Report No. FHWA-HI-94-005 and 006

Corrosion/Degradation of Soil Reinforcement for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, Elias, Report No. FHWA/SA-96/072

Design and Construction of Driven Pile Foundations, Volume I and II, Hannigan, Goble, Thendean, Likins, and Raushe, Report No. FHWA-HI-97-013 and 014

Design Manual for Permanent Ground Anchor Walls, Weatherby, Report No. FHWA-RD-97-130

Drilled Shafts: Construction Procedures and Design Methods, O'Neill, Report No. FHWA-HI-88-042

Earth Retaining Structures, Participants Manual (Draft) and Workshop Handouts, Munfakh, et al., NHI Course No. 13236 - Module 6

Geotechnical Engineering Circular No. 2 - Earth Retaining Systems, Sabitini, Elias, et al., Report No. FHWA-SA-96-038

Geotechnical Engineering Circular No. 3 - Design Guidance: Geotechnical Earthquake Engineering for Highways, Volume I: Design Principal, Volume II: Design Examples, Kavazanjian, Matasovic, Hamou, and Sabitini, Report Nos. FHWA-SA-97-076 and 077

Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchor Systems, Sabitini, Pass and Bachus, Report No. FHWA-SA-99-015

Geotechnical Instrumentation Reference Manual, Dunnicliff, NHI Course No. 13241 - Module 11

Ground Improvement Technical Summaries, Volume I and II, Elias, Welsh, Warren and Lukas, Report No. FHWA-SA-98-086R

Mechanically Stabilized Earth Walls and Reinforced Soil Slopes: Design and Construction Guidelines, Elias and Christopher, Report No. FHWA-SA-96-071

Prefabricated Vertical Drains: Volume 1: Engineering Guidelines, Rixner, Kraemer, and Smith, Report No. FHWA/RD-86/168

Reinforced Soil Structures, Volume 1: Design and Construction Guidelines, Volume 2: Summary of Research Systems Information, Christopher, Gill, Juran, and Mitchell, Report Nos. FHWA/RD-89/043 and 044

Shallow Foundations Workshop, Draft Reference Manual and Draft Student Exercises, Munfakh, et al., NHI Course No. 132037 - Module 7

Soil Nailing for Stabilization of Highway Slopes and Excavations, Elias and Juran, Report No. FHWA/RD-89/198

Soils and Foundations Workshop, Reference Manual and Participant Workbook, Cheney and Chassie, Report No. NHI-00-045

Subdrainage Design, Moulton, Report No. FHWA-TS-80-224

Tiebacks, Weatherby, Report No. FHWA/RD-82/047

VI.D. Geotechnical Reports

VII. References

Publications - ODOT (www.dot.state.oh.us/drrc/)

CADD Engineering Standards Manual, Office of Production

Construction and Material Specifications, Office of Construction Administration

Location and Design Manual: Volume 1 - Roadway Design, Office of Roadway Engineering Services

Location and Design Manual: Volume 3 - Highway Plans, Office of Production

Manual for Abandoned Underground Mine Inventory and Risk Assessment, Ruegsegger, et al., Office of Geotechnical Engineering

Pavement Design & Rehabilitation Manual, Morse, Miller, et al., Office of Pavement Engineering

Specifications for Geotechnical Explorations, Office of Geotechnical Engineering

Geotechnical Bulletins - ODOT

GB1	Plan Subgrades
GB2	Special Benching and Sidehill Embankment Fills
GB3	Rock Cut Slope and Catchment Design
GB4	Guidelines for the Use of Geotechnical Instrumentation
GB5	Geotechnical Submission Guidelines
GB6	Shear Strength of Proposed Embankments
GB9	Geotechnical Software

Publications - ODNR (www.dnr.state.oh.us/)

Bedrock Geology Map, DGS

Bedrock Structure Map, DGS

Bedrock Topography Map, DGS

Geologic Map of Ohio, DGS

Known and Probable Karst in Ohio, DGS

Ohio Wetland Inventory Map (DSWC)

National Wetland Inventory Map (DSWC

Quaternary Geology of Ohio, DGS

Soil Survey, DSWC

USGS Open File Map Series #78-1057 Landslides and Related Features, DGS

Other publications or information available from ODNR:

Bulletins	Boring logs	Measured geologic section(s)
Information Circulars	Water well logs	Report of Investigations

VII. References

VI.D. Geotechnical Reports

Publications - AASHTO

Standard Specifications for Highway Bridges, Highway Subcommittee on Bridges and Structures, Latest Edition

Software

Category	Software	Source
Foundations	DRIVEN	FHWA
	LPILE	Ensoft, Inc.
Reinforced Soil Slopes	ReSSA	ADAMA Engineering
Mechanically Stabilized Walls	MSEW	ADAMA Engineering
	SNAILZ	California DOT
Rockfall	CRSP	Colorado Geological Survey, Colorado Department of Natural Resources
Settlement	FoSSA	ADAMA Engineering
Sheet Pile Walls	SPW911	Pile Buck, Inc.
Stability	GSTABL7 w/Stedwin	Gregory Geotechnical
	Akron Drilled Shaft	ODOT Office of Geotechnical Engineering