



ECS Southeast, LLP

Geotechnical Subsurface Data Report

Emergency Bridge Package 2020-1

SCDOT Project ID: P039639

York County, South Carolina

ECS Project Number 08:14113

March 24, 2020



GEOTECHNICAL SUBSURFACE DATA REPORT

Emergency Bridge Package 2020-1
SCDOT Project ID: P039639
York County, South Carolina

Prepared For:



Mr. Trapp Harris, P.E.
955 Park Street
Columbia, SC 29201

Prepared By:

ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217

ECS Project No:

08:14113

Report Date:

March 24, 2020



March 24, 2020

Mr. Trapp Harris, P.E.
Geotechnical Engineer
South Carolina Department of Transportation
955 Park Street
Columbia, South Carolina 29201

ECS Project No. 08:14113

Reference: Geotechnical Subsurface Data Report
Emergency Bridge Package 2020-1
SCDOT Project ID: P039639
York County, South Carolina

Dear Mr. Harris:

ECS Southeast, LLP (ECS) has completed the subsurface exploration and laboratory testing for the above referenced project. Our services were performed in general accordance with the scope provided in the SCDOT NTP dated February 28, 2019. This report presents our understanding of the geotechnical aspects of the project, along with the results of the field exploration and laboratory testing conducted.

It has been our pleasure to be of service to the South Carolina Department of Transportation (SCDOT) during this phase of this project. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

Kelly N. de Montbrun
Kelly N. de Montbrun, P.E.
Geotechnical Project Engineer
KdeMontbrun@ecslimited.com
SC License No. 33477



Marc F. Plotkin, P.E., D.GE
Principal Engineer
MPlotkin@ecslimited.com



TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 PROJECT LOCATION	1
2.1 PROJECT LOCATION.....	1
2.2 PROJECT DESCRIPTION	1
3.0 SUBSURFACE EXPLORATION.....	1
3.1 SOIL TEST BORINGS	1
3.2 ROCK CORING	2
3.3 GROUNDWATER.....	2
3.4 LABORATORY TESTING	3
4.0 CLOSING.....	3

APPENDICES

Appendix A – Drawings & Reports

- Site Vicinity Map
- Boring Location Diagram

Appendix B – Field Operations

- Reference Notes for Boring Logs
- Boring Logs (Borings B-5, B-6, B-7, B-8)
- Rock Core Photo Logs (B-6 and B-7)
- Photo Log

Appendix C – Laboratory Testing

- Summary of Laboratory Results
- Laboratory Data Sheets
- Rock Coring Summary
- Uniaxial Compressive Strength Reports (3 sheets)

Appendix D – Supplemental Report Documents

- Hammer Calibration

1.0 INTRODUCTION

ECS is pleased to present this Geotechnical Subsurface Data Report for the S-46-816 Bridge over Mud Creek, as part of the Emergency Bridge Package 2020-1 project. The purpose of this report is to provide geotechnical information and laboratory testing results.

2.0 PROJECT LOCATION

2.1 PROJECT LOCATION

The project site is located along S-46-816 (Smith Ford Road) approximately 0.7 miles northwest of the intersection of Smith Ford Road and Huntington Road. The project site is approximately 3.2 miles west of the town of Hickory Grove in York County, South Carolina, as shown on the Site Vicinity Map in Appendix A.

2.2 PROJECT DESCRIPTION

The S-46-816 (Smith Ford Road) bridge over Mud Creek is a currently in-service 2 lane bridge in York County, South Carolina. We understand plans are to demolish the existing bridge and replace with a new bridge.

3.0 SUBSURFACE EXPLORATION

3.1 SOIL TEST BORINGS

ECS completed a total of four (4) soil test borings (B-5, B-6, B-7, and B-8) at the subject bridge consisting of two (2) bridge end bent borings and two (2) bridge approach borings. The soil test borings were performed utilizing a CME 75 drill rig on March 10 through 13, 2019. Photographic documentation of the drill rig setup at each boring location is included in Appendix B. The borings were located in the field by an ECS representative at the approximate locations provided by the SCDOT. After completion, the test locations were obtained by a licensed surveyor. A Boring Location Diagram is included in Appendix A.

The soil test borings were drilled by a CME 75 drill rig using the rotary wash drilling method with a 6 inch bit. Standard Penetration Tests (SPTs) were generally conducted continuously within the top 10 feet and at 5-foot intervals thereafter until refusal was encountered. The SPT is used to provide an index for estimating soil strength and density. In conjunction with the penetration testing, split barrel soil samples were recovered for soil classification and laboratory testing at various intervals. The N-values presented in the boring logs are uncorrected, field N-values. Blow counts recorded at these intervals were produced from a standard penetration test hammer with an energy efficiency of 72.8%. The hammer calibration records are included in Appendix D.

An ECS Geotechnical Professional was on site and visually classified each sample during drilling. Samples from each split spoon were sealed in plastic bags and returned to the ECS office for laboratory testing. The boring logs are included in Appendix B. A summary of the borings is presented in Table 3.1.1.

Table 3.1.1 Summary of Subsurface Exploration Boring Locations

Boring ID	Boring Type	Northing (Int. ft)	Easting (Int. ft)	Ground Surface Elevation (ft.)	Water Table Depth (ft.)	Water Table Elevation (ft.)
B-5	SPT	1147460.25	1858716.40	445.0	17.3	427.7
B-6	SPT	1147559.13	1858703.52	445.1	19.8	425.3
B-7	SPT	1147714.04	1858684.04	444.9	16.8	428.1
B-8	SPT	1147769.63	1858676.98	443.9	19.6	424.3

3.2 ROCK CORING

Rock coring was performed within the soil test borings B-6 and B-7 located at the bridge end bents at the auger and spoon refusal depths. Boring B-6 was terminated in rock at a depth of approximately 80 feet below the existing ground surface. Boring B-7 encountered soil underlying rock cored in HQ-1, therefore, SPT sampling and drilling was resumed in Boring B-7 and the boring was terminated at drilling/spoon refusal at a depth of approximately 86 feet below the existing ground surface. A summary of the rock coring runs recovered from the Boring B-6 and B-7 is included in Table 3.2.1.

Rock coring was performed using a diamond-studded bit fastened to the end of a hollow double tube core barrel. A HQ core barrel was used to obtain rock cores 2½ inches in diameter. This device was rotated at high speed by the drill rig and the cuttings were brought to the surface by circulating water. Core samples of the materials penetrated were protected and retained in the swivel-mounted inner tube of the core barrel. Upon completion of each drill run, the core barrel was brought to the surface, removed and placed in core boxes, and returned to our laboratory for testing. An ECS Project Geologist was on site and visually classified each sample during coring. The rock coring results are presented on the boring logs and a Photo Log is included in Appendix B.

Table 3.2.1 Summary of Rock Core Runs

Boring ID	Run ID	Run Depth (ft)	Recovery (%)	Rock Quality Designation (%)	q _u (psi)
B-6	HQ-1	65.0 – 70.0	78	57	9389.7
	HQ-2	70.0 – 75.0	100	90	7921.4
	HQ-3	75.0 – 80.0	100	100	3327.9
B-7	HQ-1	78.0 – 83.0	12	0	-

3.3 GROUNDWATER

Groundwater was measured between approximately 17.3 and 19.8 feet below the existing ground surface at around the 24-hr time interval within Borings B-5, B-6, B-7, and B-8. After a 24 hour measurement was obtained, the boring was backfilled and capped with bentonite. Groundwater elevations should be expected to vary depending on seasonal fluctuations in precipitation, surface water absorption characteristics, and other factors not readily apparent at the time of our exploration, and may be higher or lower than inferred from the recent test boring data.

3.4 LABORATORY TESTING

The laboratory testing frequency was determined by the SCDOT and laboratory testing was performed in accordance with the respective ASTM and AASHTO standards. Individual laboratory test results and a Laboratory Testing Summary are presented in Appendix C. Table 3.3.1 provides a quantitative overview of the testing performed:

Table 3.4.1 Laboratory Test Quantities

Test Type	Quantity
Atterberg Limits	5
Sieve Analysis	8
Moisture Content	16
Hydrometer	8
Corrosion Testing	1
Unconfined Compressive Strength (Rock)	3

4.0 CLOSING

Due to the prevailing geology, changes in the subsurface conditions can occur over relatively short distances that have not been disclosed by the results of the borings evaluated. Consequently, there may be undisclosed subsurface conditions that require special treatment or additional preparation once these conditions are revealed during construction. The assessment of site environmental conditions for the presence of pollutants in the soil, rock, and groundwater of the site was beyond the scope of services for this project.

APPENDIX A – Drawings & Reports

Site Vicinity Map

Boring Location Diagram

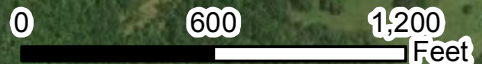


Mud
island

Smith
Ford Rd

Huntington Rd

Mud Creek



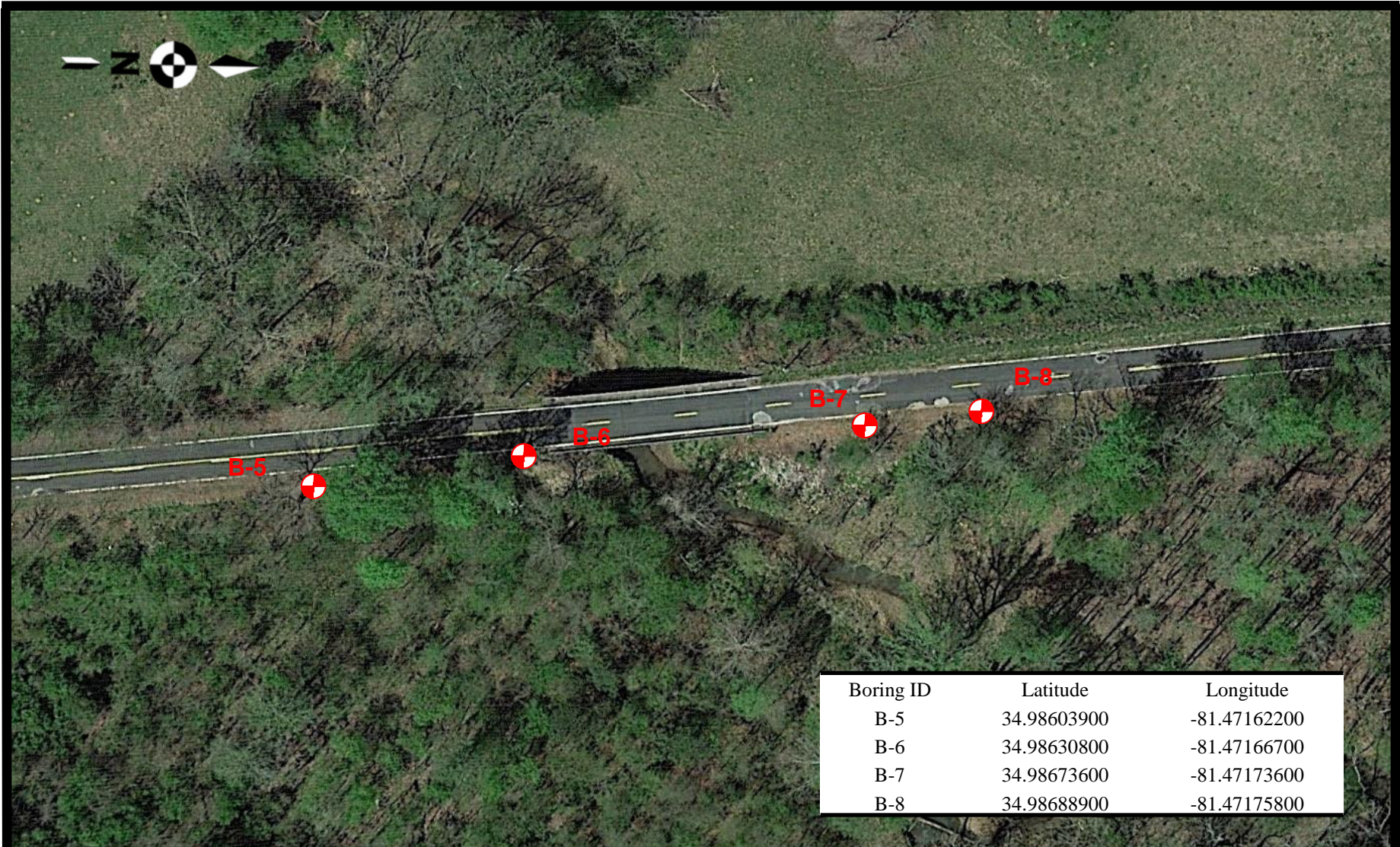
Site Vicinity Map

EMERGENCY BRIDGE PACKAGE 2020-1

S-816 BRIDGE OVER MUD CREEK, YORK COUNTY, SC

SCDOT

ENGINEER MFP
SCALE 1" = 600'
PROJECT NO. 08:14113
SHEET 1 OF 1
DATE 3/19/2020




Boring ID	Latitude	Longitude
B-5	34.98603900	-81.47162200
B-6	34.98630800	-81.47166700
B-7	34.98673600	-81.47173600
B-8	34.98688900	-81.47175800

Source: Google Earth (2020)
Scale: Not to Scale

Note: Borings B-1 through B-4 were performed as part of the Emergency Bridge Package 2020-1: S-174 (Timms Mills Road) Bridge over Six & Twenty Creek, Anderson County, SC.

LEGEND

-  Boring Location
- B-#** Boring Number



Boring Location Plan
Emergency Bridge Package 2020-1
S-816 (Smith Ford Road) Bridge over Mud Creek
York County, South Carolina
ECS Project No.: 08:14113

APPENDIX B – Field Operations

Reference Notes for Boring Logs

Boring Logs (Borings B-5, B-6, B-7, B-8)

Rock Core Photo Logs (Borings B-6 and B-7)

Photo Log



USCS SOIL DESIGNATION

USCS classification per ASTM D 2487 and D 2488

AASHTO SOIL DESIGNATION

AASHTO classification per AASHTO M 145 and ASTM D 3282

CONTAINS

Contains is used to describe non-ASTM components such as roots, construction debris, asphalt concrete, etc. "contains slight" is used for occasional particles, "contains" is used for about 10% to 30% particles, "contains significant" is used for > 30% particles



ECS REFERENCE NOTES FOR SCDOT BORING LOGS - ROCK DESCRIPTIONS

The descriptions noted on the boring logs generally conform to the SCDOT GDM format.

DESCRIPTION FORMAT

Rock origin, TYPE, color, texture, grain size and shape, weathering / alteration, strength, hardness, strike and dip, discontinuity type, discontinuity width, amount of infilling, type of infilling, surface shape of joint, discontinuity spacing, roughness of surface, other

Descriptions are typically provided for each run. When portions of an individual run are notably different, the run may be subdivided into sub-runs with appropriate descriptions provided.

ROCK ORIGIN AND TYPE

Sedimentary:	Breccia, sandstone, siltstone, mudstone, shale, coal, conglomerate, limestone, chert, dolomite, etc.
Metamorphic:	Schist, phyllite, gneiss, marble, metaquartzite, slate, amphibolite, hornfels, serpentine, metatuff, etc.
Igneous:	Granite, syenite, diorite, gabbro, periodite, diabase, basalt, pegmatite, etc.

COLOR

Basic colors (when moist) using the Munsell color chart

Mottled, indicates splotches of various colors

Variegated, indicates thin layers of various colors

TEXTURE

Very Thickly Bedded	> 1.0 m
Thickly Bedded	0.5 to 1.0 m
Thinly Bedded	50 to 500 mm
Very Thinly Bedded	10 to 50 mm
Laminated	2.5 to 10 mm
Thinly Laminated	< 2.5 mm

GRAIN SIZE AND SHAPE

Size

Very coarse grained	> 4.75	Grain sizes greater than popcorn kernels
Coarse grained	2.00 – 4.75	Individual grains easy to distinguish by eye
Medium grained	0.425 – 2.00	Individual grains distinguished by eye
Fine grained	0.075 – 0.425	Individual grains distinguished with difficulty
Very fine grained	<0.075	Individual grains cannot be distinguished by unaided eye

Shape

Angular	Shows little wear; edges and corners are sharp
Subangular	Shows definite effects of wear; edges and corners are slightly rounded off
Subrounded	Shows considerable wear; edges and corners are rounded to smooth curves
Rounded	Shows extreme wear; edges and corners are smoother to broad curves
Well-rounded	Completely worn; edges and corners are not present

WEATHERING / ALTERATION

Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broken by hand
Completely Weather / Altered	Original minerals of rock have been almost entirely decomposed to secondary minerals, although the original fabric may be intact; material can be granulated by hand
Highly Weathered / Altered	More than half of the rock is decomposed; rock is weakened so that a minimum 1-7/8 inch diameter sample can be easily broken readily by hand across rock fabric
Moderately Weathered / Altered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum 1-7/8 inch diameter sample cannot be broken readily by hand across rock fabric



Slightly Weathered / Altered
Fresh

Rock is slightly discolored, but not noticeably lower in strength than fresh rock
Rock shows no discoloration, loss of strength, or other effect of weathering / alteration

STRENGTH

Extremely Weak Rock	Can be indented by thumbnail
Very Weak Rock	Can be peeled by pocket knife
Weak Rock	Can be peeled with difficulty by pocket knife
Medium Strong Rock	Can be indented 3/16 inch with sharp end of pick
Strong Rock	Requires one hammer blow to fracture
Very Strong Rock	Requires many hammer blows to fracture
Extremely Strong Rock	Can only be chipped with hammer blows

HARDNESS

Very Soft	Can be deformed by hand
Soft	Can be scratched with a fingernail
Moderately Hard	Can be scratched easily by a knife
Hard	Can be scratched with difficulty by a knife
Very Hard	Can not be scratched with a knife

STRIKE AND DIP

Dip of fracture surface measured relative to horizontal with bearing and direction.

DISCONTINUITY TYPE

F - Fault
J - Joint
Sh - Shear
Fo - Foliation
V - Vein
B - Bedding

DISCONTINUITY WIDTH (MM)

W - Wide (12.5 – 50)
MW - Moderately Wide (2.5 – 12.5)
N - Narrow (1.25 – 2.5)
VN - Very Narrow (<1.25)
T - Tight (0)

AMOUNT OF INFILLING

Su - Surface Stain
Sp - Spotty
Pa - Partially Filled
Fi - Filled
No - None

TYPE OF INFILLING

Cl - Clay
Ca - Calcite
Ch - Chloride
Fe - Iron Oxide
Gy - Gypsum/Tale
H - Healed
No - None
Py - Pyrite
Qz - Quartz
Sd - Sand



SURFACE SHAPE OF JOINT

- Wa - Wavy
- Pl - Planar
- St - Stepped
- Ir - Irregular

DISCONTINUITY SPACING (FT)

- Ew - Extremely Wide (>65)
- W - Wide (22 – 65)
- M - Moderate (7.5 – 22)
- C - Close (2 – 7.5)
- VC - Very Close (<2)

ROUGHNESS OF SURFACE

- Slk - Slicksided (surface has smooth, glassy finish with visual evidence of striations)
- S - Smooth (surface appears smooth and feels so to the touch)
- SR - Slightly Rough (asperities on the discontinuity surfaces are distinguishable and can be felt)
- R - Rough (some ridges and side-angle steps are evident; asperities are clearly visible, and discontinuity surface feels very abrasive)
- VR - Very Rough (near-vertical steps and ridges occur on the discontinuity surface)

REC and RQD

Rock Recovery, expressed as REC, is the percentage of the total length or rock recovered divided by the length of the core run. The Rock Quality Designation, expressed as RQD is the percentage of the total length of the rock pieces 4 inches in length or greater divided the length of the rock core run. Mechanical breaks are neglected in determining the RQD.

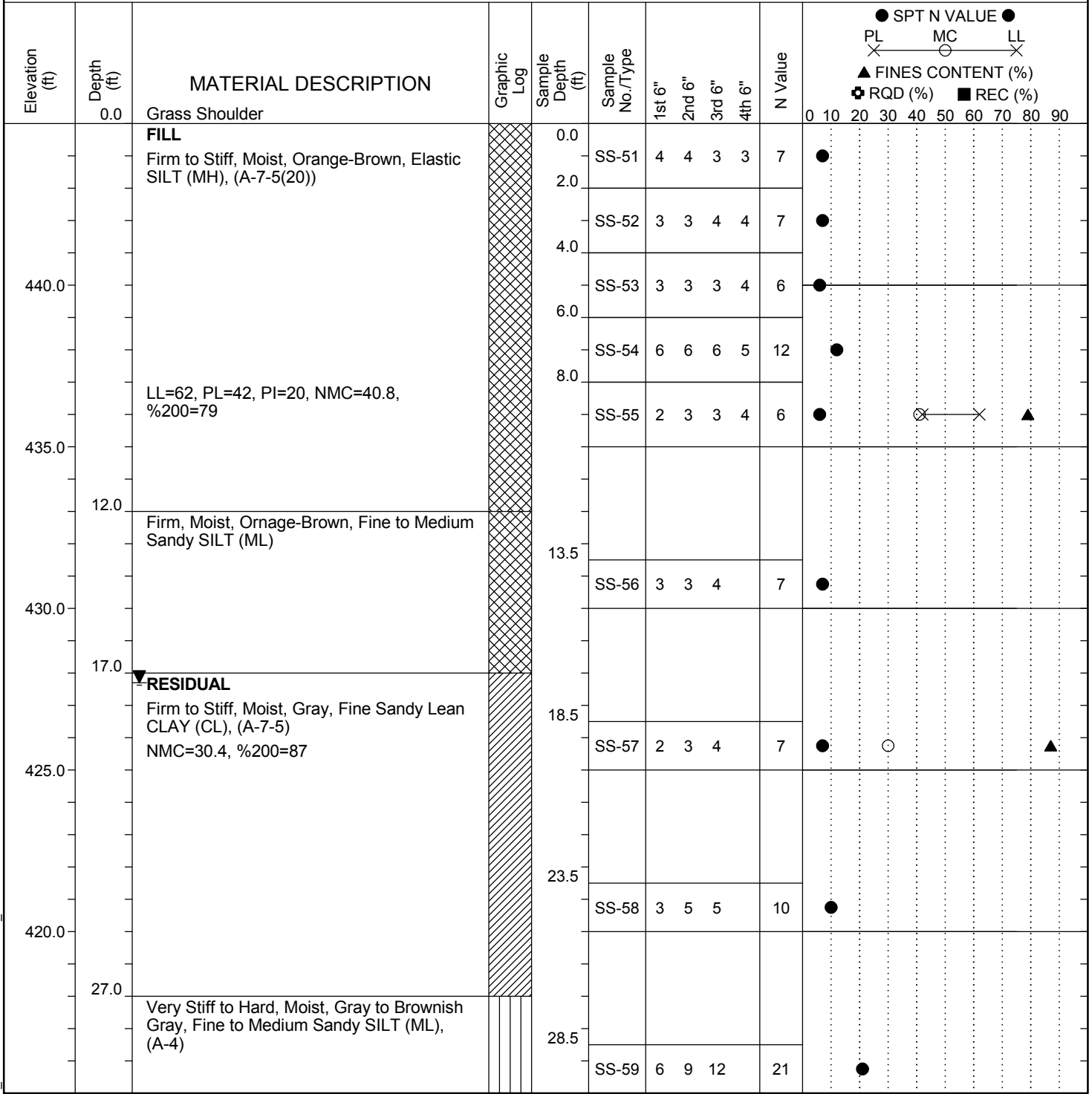
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p>COARSE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<p>SAND AND SANDY SOILS</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SM	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES	
	<p>FINE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
<p>HIGHLY ORGANIC SOILS</p>				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-5
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 445.0 ft	Latitude: 34.986039	Longitude: -81.471622
Total Depth: 49.8 ft	Soil Depth: 49.8 ft	Core Depth: N/A ft
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic
Core Size: N/A	Driller: Betts	Groundwater: TOB N/A
		Energy Ratio: 73%
		24HR: 17.3 ft



LEGEND

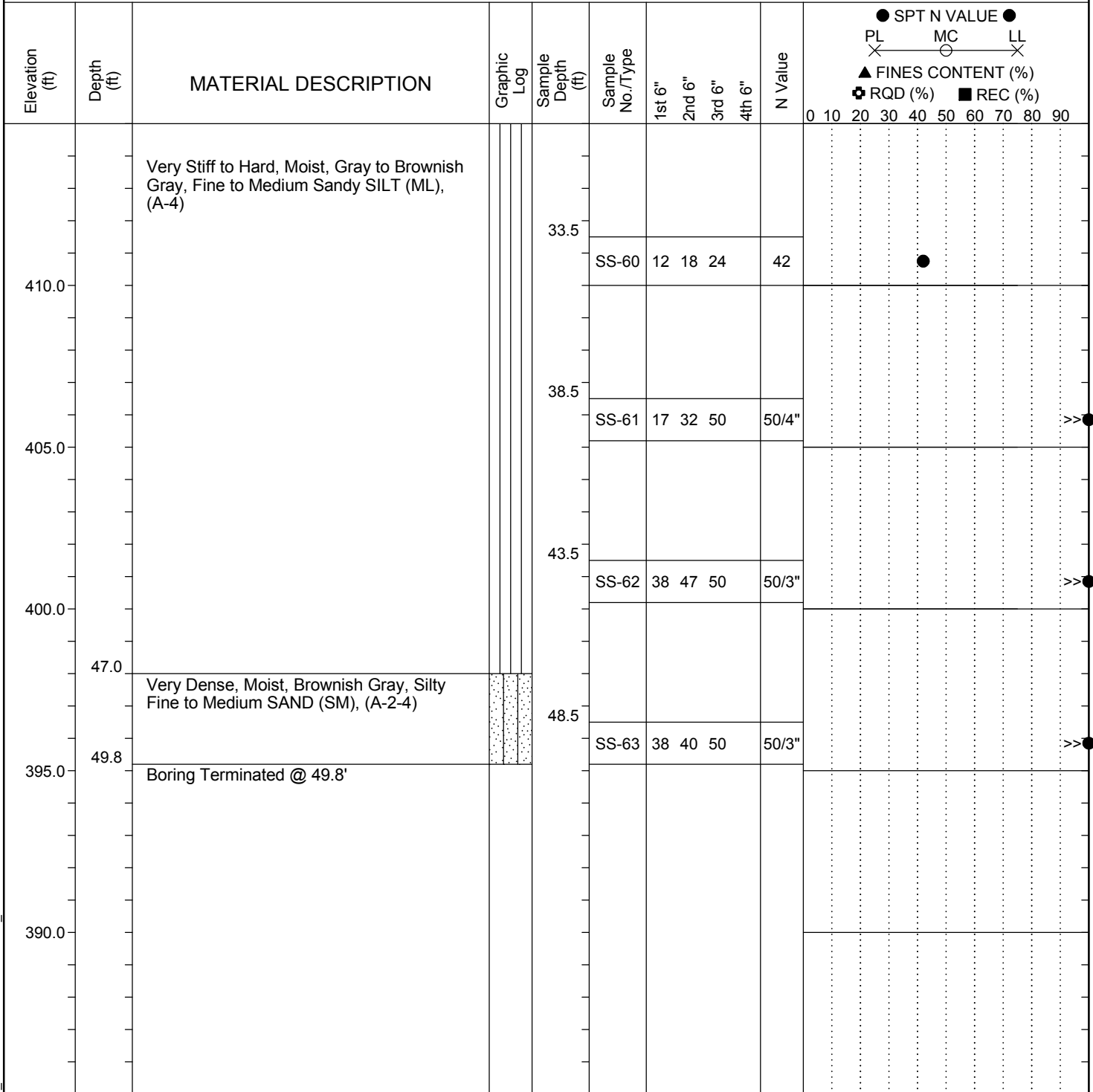
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID:	P039639		County:	York		Boring No.:	B-5	
Site Description:	Emergency Bridge Package 2020-1					Route:	S-46-816	
Eng./Geo.:	J. Garrick		Boring Location:			Offset:		
Elev.:	445.0 ft		Latitude:	34.986039		Longitude:	-81.471622	
Total Depth:	49.8 ft		Soil Depth:	49.8 ft		Core Depth:	N/A ft	
Date Started:	3/11/2020		Date Completed:	3/11/2020				
Bore Hole Diameter (in):	6		Sampler Configuration			Liner Required:	Y (N)	
Liner Used:	Y (N)							
Drill Machine:	CME 75		Drill Method:	Wash Rotary		Hammer Type:	Automatic	
Energy Ratio:	73%							
Core Size:	N/A		Driller:	Betts		Groundwater:	TOB N/A	
24HR	17.3 ft							



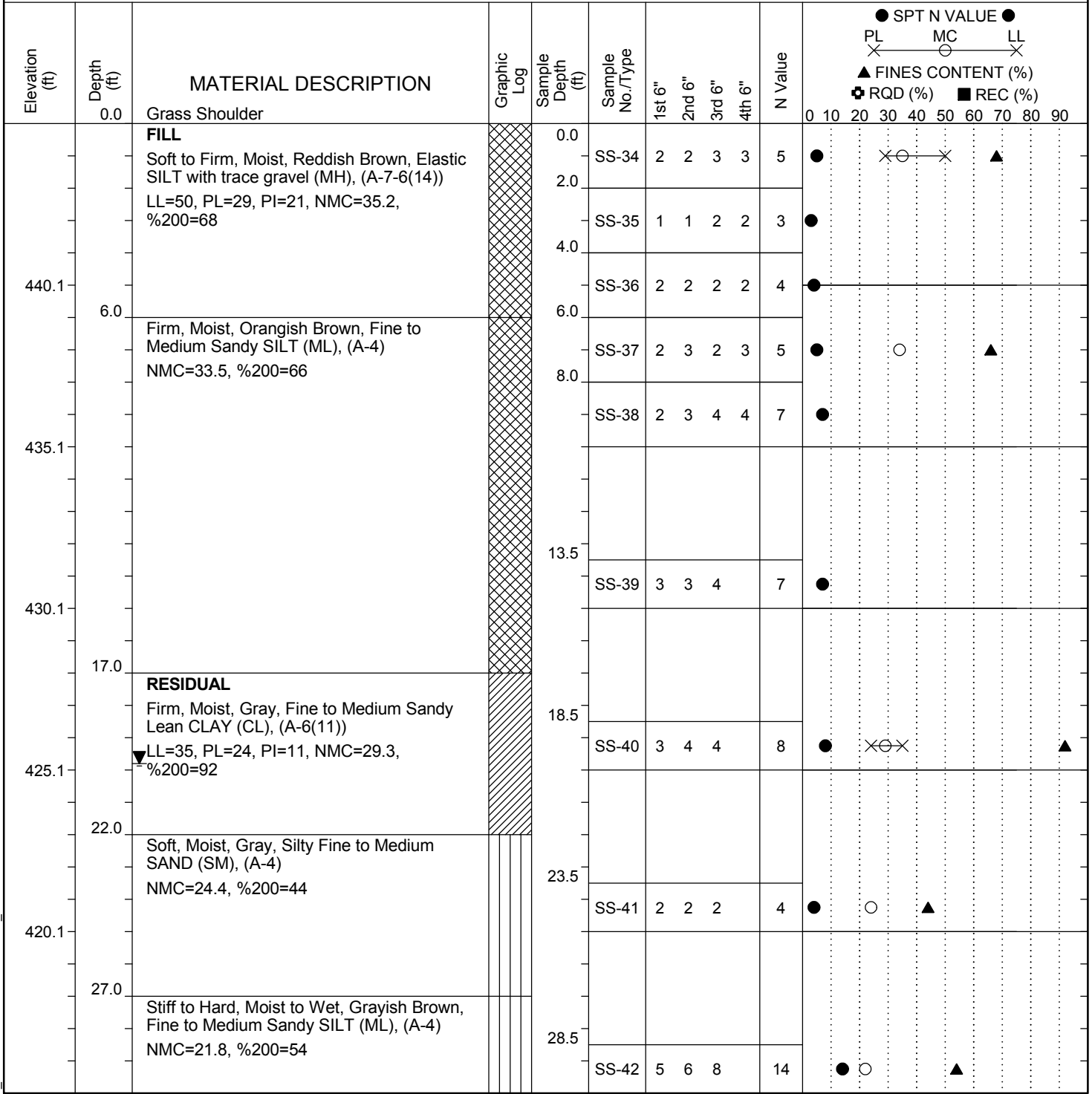
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-6
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 445.1 ft	Latitude: 34.986308	Longitude: -81.471667
Total Depth: 80 ft	Soil Depth: 65 ft	Core Depth: 80 ft
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic
Core Size: HQ	Driller: Betts	Energy Ratio: 73%
Groundwater: TOB	N/A	24HR: 19.8 ft



LEGEND

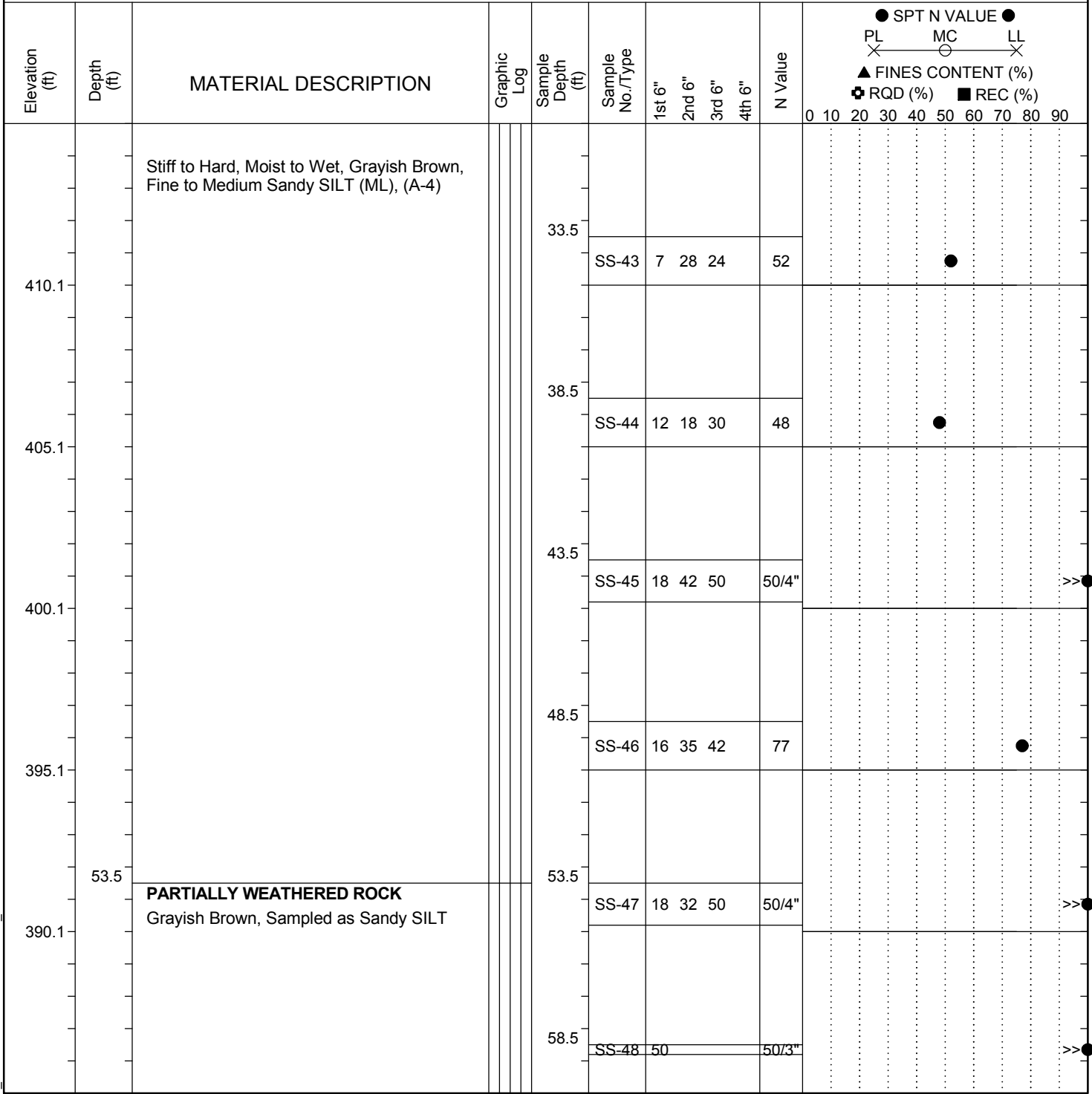
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-6
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 445.1 ft	Latitude: 34.986308	Longitude: -81.471667
Total Depth: 80 ft	Soil Depth: 65 ft	Core Depth: 80 ft
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic
Core Size: HQ	Driller: Betts	Energy Ratio: 73%
Groundwater: TOB	N/A	24HR: 19.8 ft



LEGEND

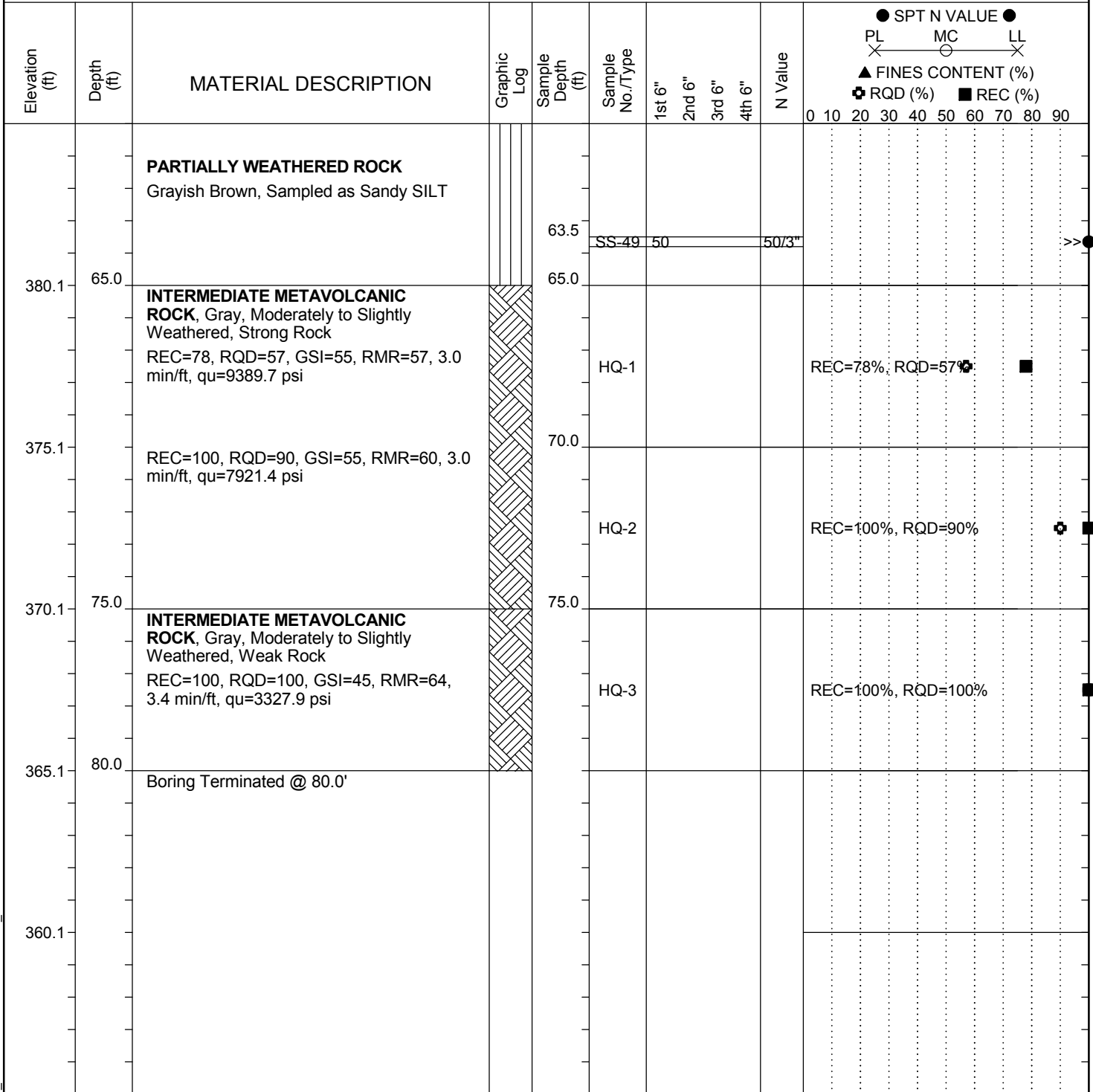
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT S-46-816 YORK COUNTY.GPJ SCDOT DATATEMPLATE.GDT 3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York		Boring No.: B-6
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816	
Eng./Geo.: J. Garrick	Boring Location:		Offset:
Elev.: 445.1 ft	Latitude: 34.986308	Longitude: -81.471667	Date Started: 3/10/2020
Total Depth: 80 ft	Soil Depth: 65 ft	Core Depth: 80 ft	Date Completed: 3/10/2020
Bore Hole Diameter (in): 6	Sampler Configuration		Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic	Energy Ratio: 73%
Core Size: HQ	Driller: Betts	Groundwater: TOB N/A	24HR: 19.8 ft



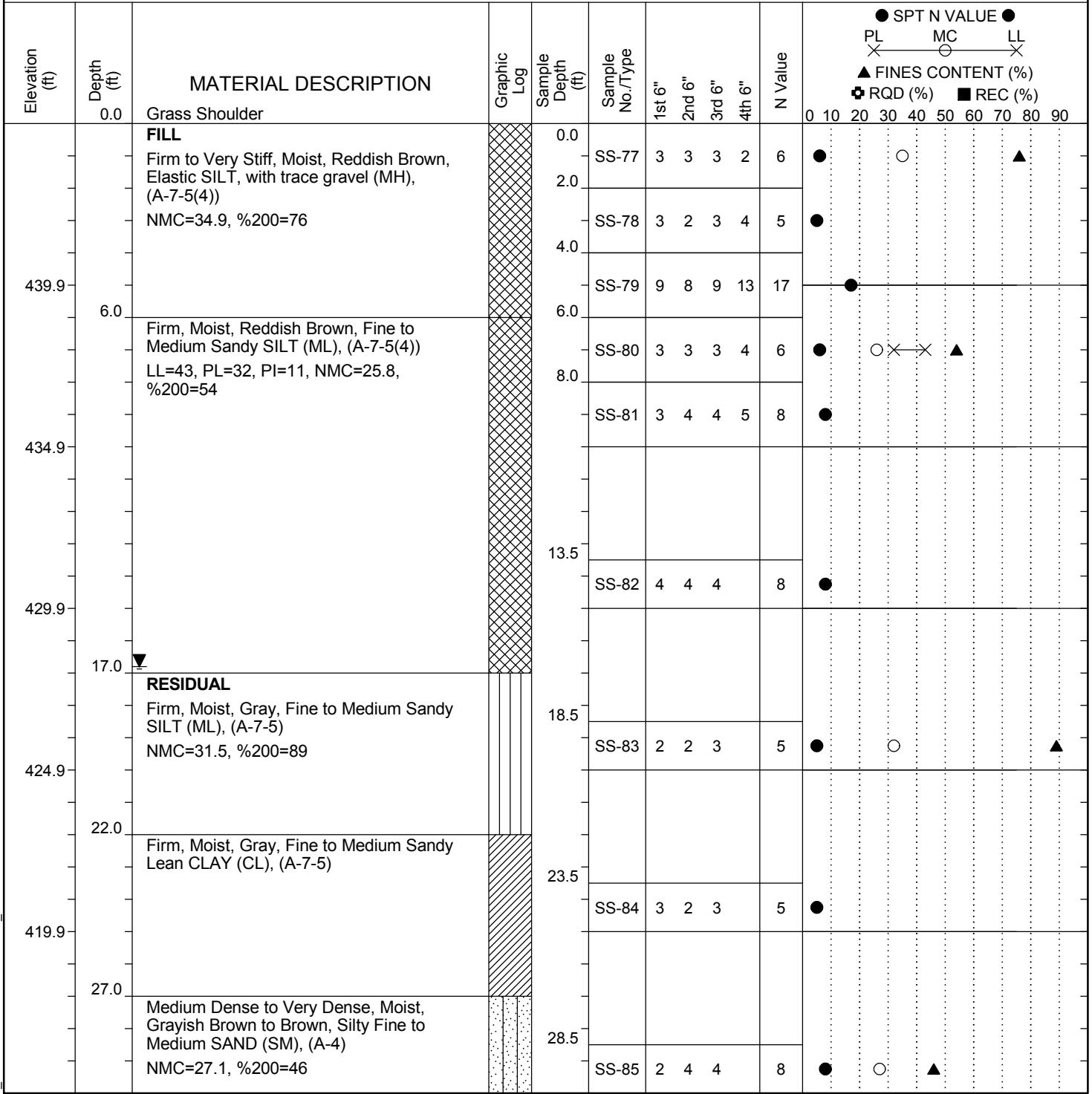
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-7
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 444.9 ft	Latitude: 34.986736	Longitude: -81.471736
Total Depth: 86 ft	Soil Depth: 86 ft	Core Depth: N/A ft
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic
Core Size: N/A	Driller: Betts	Groundwater: TOB N/A
		Energy Ratio: 73%
		24HR: 16.8 ft



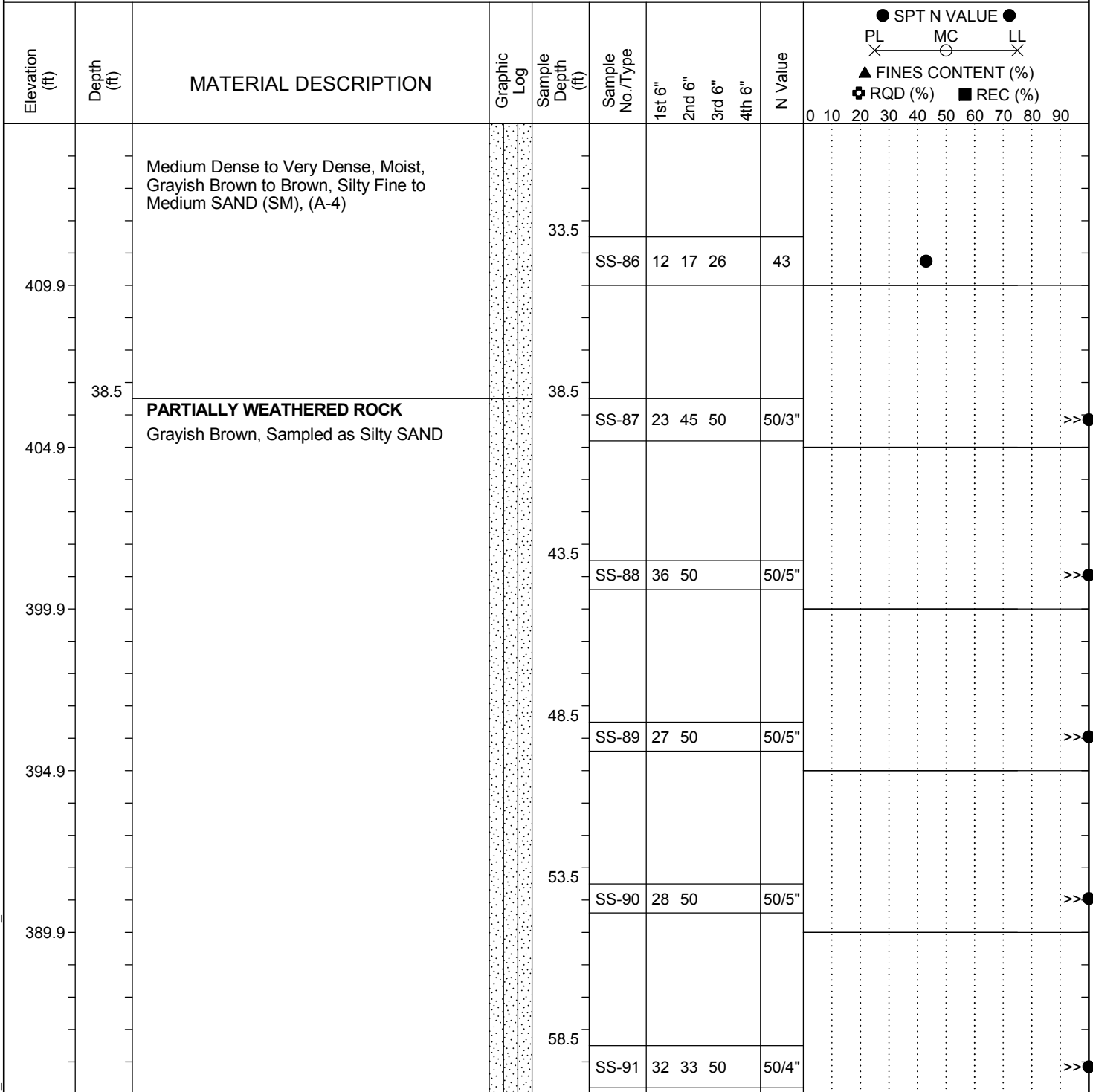
LEGEND Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT S-46-816 YORK COUNTY.GPJ SCDOT_DATATEMPLATE.GDT 3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-7
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 444.9 ft	Latitude: 34.986736	Longitude: -81.471736
Total Depth: 86 ft	Soil Depth: 86 ft	Date Started: 3/12/2020
Core Depth: N/A ft	Date Completed: 3/13/2020	
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Liner Used: Y (N)	Drill Machine: CME 75	Drill Method: Wash Rotary
Hammer Type: Automatic	Energy Ratio: 73%	
Core Size: N/A	Driller: Betts	Groundwater: TOB N/A
24HR: 16.8 ft		



LEGEND

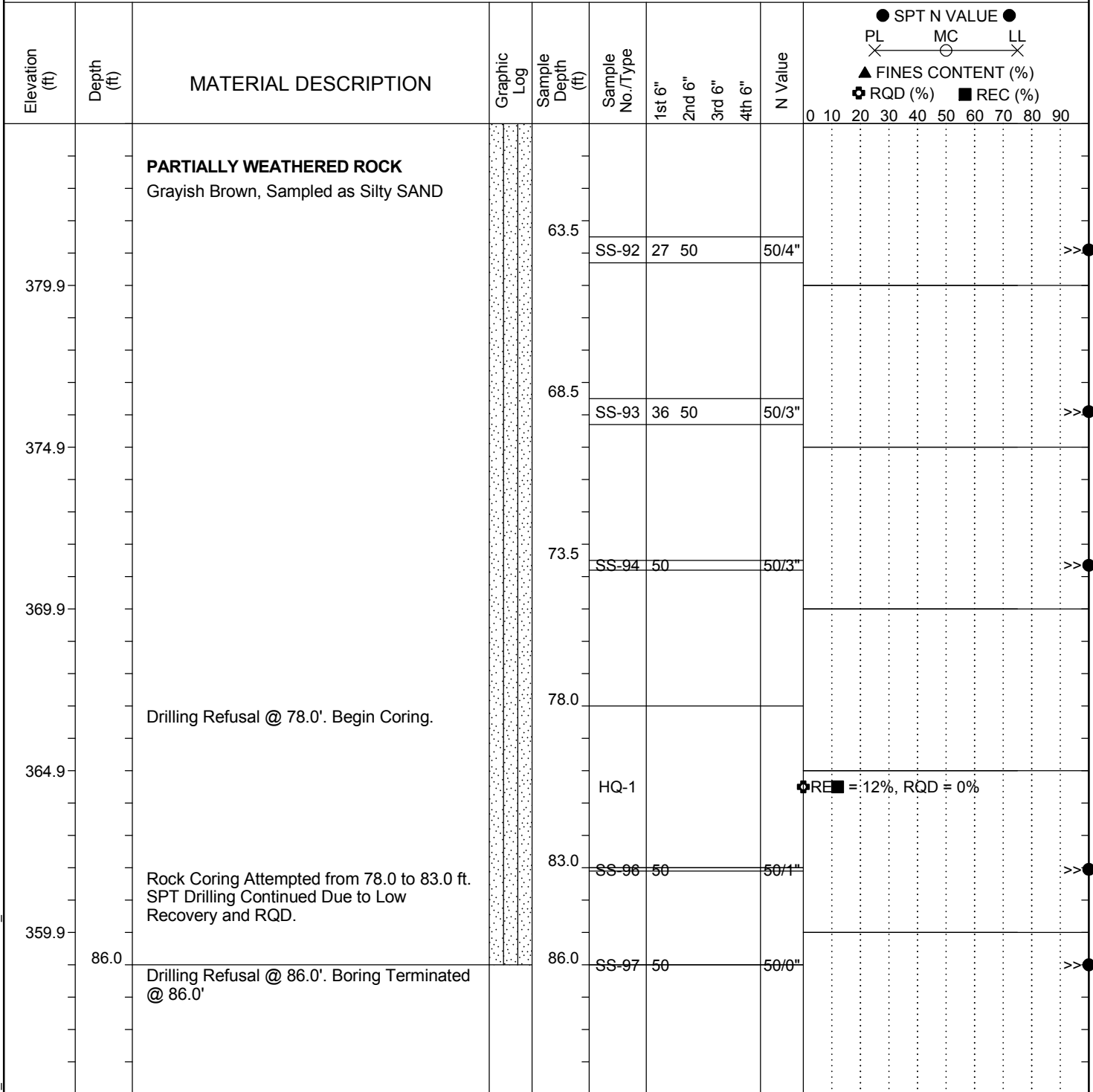
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York		Boring No.: B-7	
Site Description: Emergency Bridge Package 2020-1			Route: S-46-816	
Eng./Geo.: J. Garrick		Boring Location:		Offset:
Elev.: 444.9 ft		Latitude: 34.986736		Longitude: -81.471736
Total Depth: 86 ft		Soil Depth: 86 ft		Core Depth: N/A ft
Bore Hole Diameter (in): 6		Sampler Configuration		Liner Required: Y (N)
Drill Machine: CME 75		Drill Method: Wash Rotary		Hammer Type: Automatic
Core Size: N/A		Driller: Betts		Energy Ratio: 73%
		Groundwater: TOB		N/A
		24HR		16.8 ft



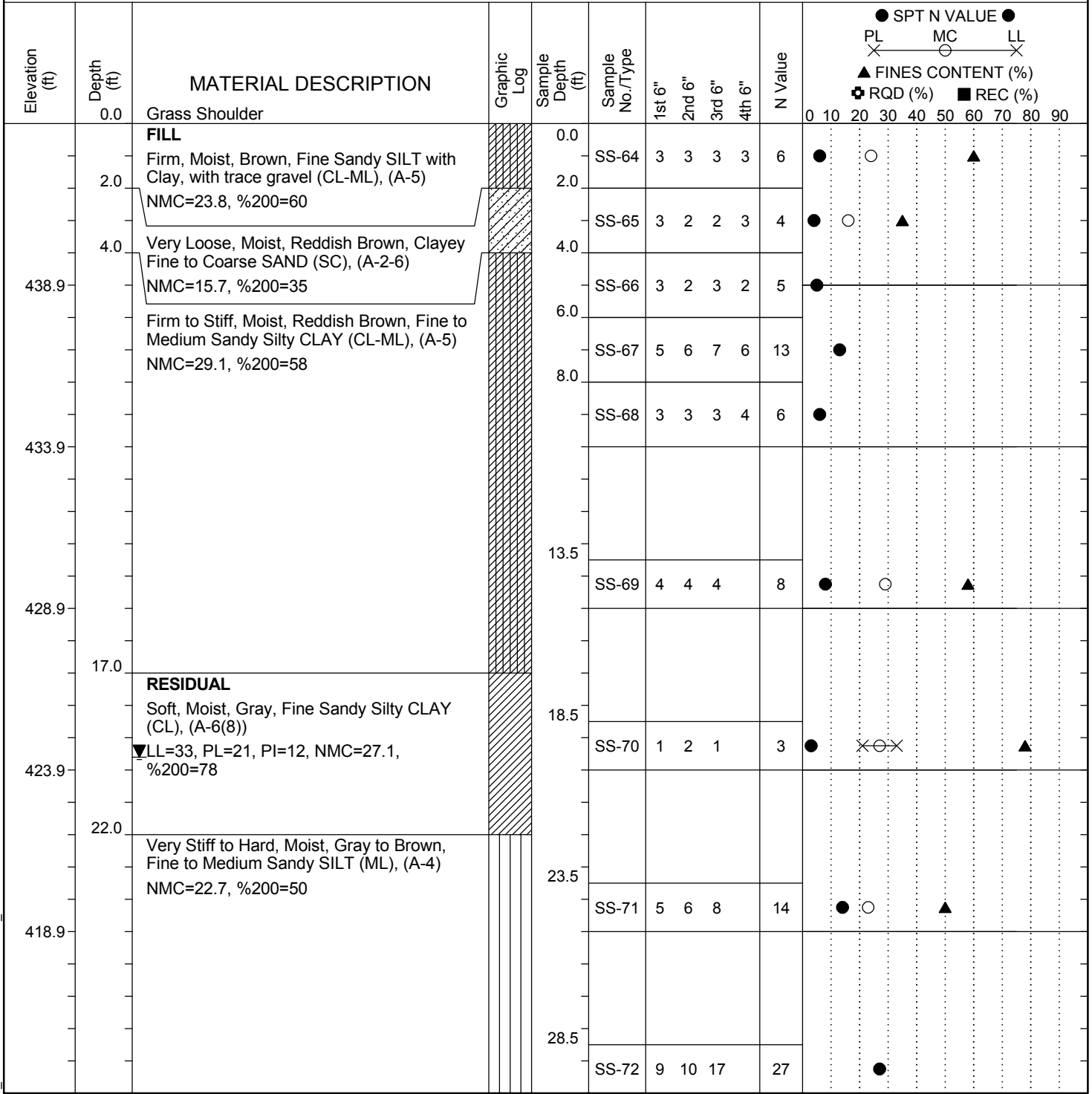
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT S-46-816 YORK COUNTY.GPJ SCDOT DATATEMPLATE.GDT 3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-8
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 443.9 ft	Latitude: 34.986889	Longitude: -81.471758
Total Depth: 49.2 ft	Soil Depth: 49.2 ft	Core Depth: N/A ft
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Hammer Type: Automatic
Core Size: N/A	Driller: Betts	Groundwater: TOB N/A
		Energy Ratio: 73%
		24HR: 19.6 ft



LEGEND

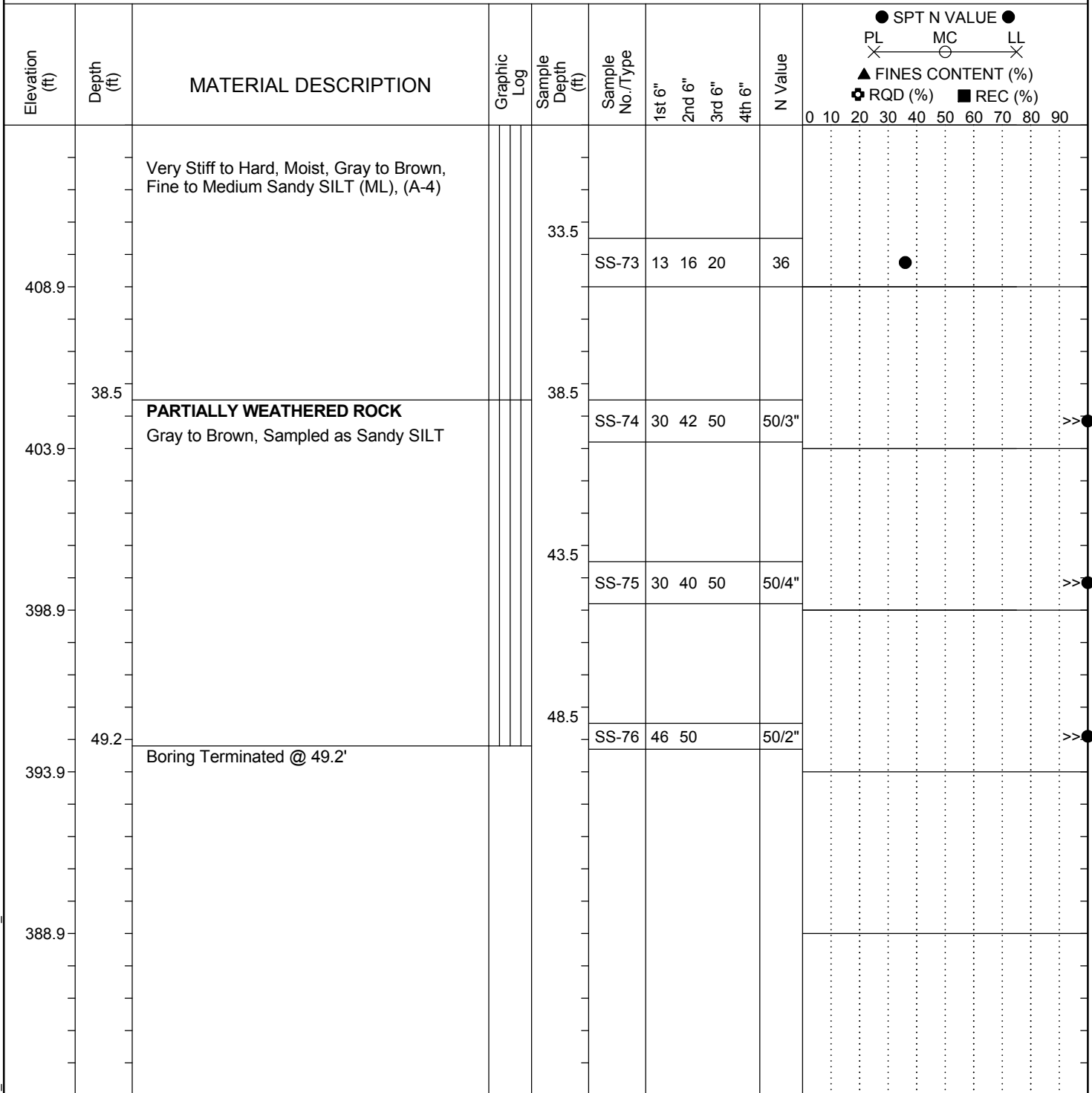
Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20

SCDOT Soil Test Log

Project ID: P039639	County: York	Boring No.: B-8
Site Description: Emergency Bridge Package 2020-1		Route: S-46-816
Eng./Geo.: J. Garrick	Boring Location:	Offset:
Elev.: 443.9 ft	Latitude: 34.986889	Longitude: -81.471758
Total Depth: 49.2 ft	Soil Depth: 49.2 ft	Date Started: 3/11/2020
Core Depth: N/A ft	Date Completed: 3/11/2020	
Bore Hole Diameter (in): 6	Sampler Configuration	Liner Required: Y (N)
Drill Machine: CME 75	Drill Method: Wash Rotary	Liner Used: Y (N)
Hammer Type: Automatic	Energy Ratio: 73%	
Core Size: N/A	Driller: Betts	Groundwater: TOB N/A
		24HR: 19.6 ft



LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT_S-46-816_YORK COUNTY.GPJ_SCDOT_DATATEMPLATE.GDT_3/24/20



ECS Southeast, LLP
1812 Center Park Drive, Ste D
Charlotte, NC 28217
Phone: 704-525-5152

ROCK CORE PHOTO LOG

Boring B-6

Project Name: 2020-1 SCDOT Emergency Bridge Package
Bridge Replacement over Mud Creek on Smith Ford Road

Project Number:
08:14113

Project Location: York County, South Carolina

Date: 3/18/2020

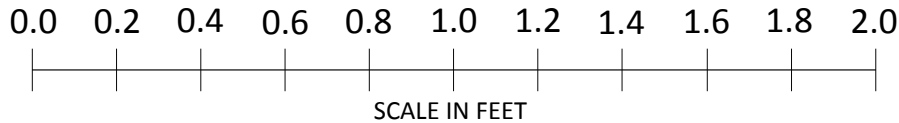
Begin HQ-1
65.0 ft



End HQ-1
70.0 ft

Begin HQ-2
70.0 ft

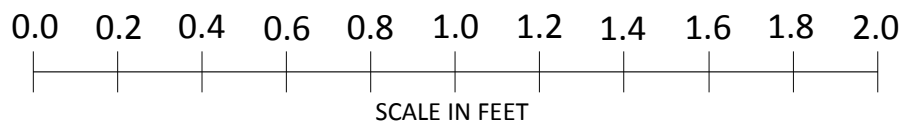
End HQ-2
75.0 ft



Begin HQ-3
75.0 ft



End HQ-3
80.0 ft





ECS Southeast, LLP
1812 Center Park Drive, Ste D
Charlotte, NC 28217
Phone: 704-525-5152

ROCK CORE PHOTO LOG

Boring B-7

Project Name: 2020-1 SCDOT Emergency Bridge Package
Bridge Replacement over Mud Creek on Smith Ford Road

Project Number:
08:14113

Project Location: York County, South Carolina

Date: 3/18/2020

Begin HQ-1
78.0 ft

End HQ-1
83.0 ft



0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

SCALE IN FEET



ECS Southeast, LLP
1812 Center Park Drive, STE D
Charlotte, North Carolina 28217
(704)525-5152

PHOTO LOG

Project Name: Emergency Bridge Package 2020-1
S-816 Bridge on Smith Ford Road over Mud Creek

Project Number:
08:14113

Project Location: York County, South Carolina

Date: 03/20/2020



Photo 1: Drill Rig at Boring B-5



Photo 2: Drill Rig at Boring B-6



ECS Southeast, LLP
1812 Center Park Drive, STE D
Charlotte, North Carolina 28217
(704)525-5152

PHOTO LOG

Project Name: Emergency Bridge Package 2020-1
S-816 Bridge on Smith Ford Road over Mud Creek

Project Number:
08:14113

Project Location: York County, South Carolina

Date: 03/20/2020



Photo 3: Drill Rig at Boring B-7



Photo 4: Drill Rig at Boring B-7

APPENDIX C – Laboratory Testing

Summary of Laboratory Results

Laboratory Data Sheets

Rock Coring Summary

Uniaxial Compressive Strength Reports (3 sheets)

SUMMARY OF LABORATORY RESULTS

PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%-<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B-5	8.0	62	42	20	4.76	79	MH	40.8			
B-5	18.5				2	87	CL	30.4			
B-6	0.0	50	29	21	4.76	68	MH	35.2			
B-6	6.0				2	66	ML	33.5			
B-6	18.5	35	24	11	0.841	92	CL	29.3			
B-6	23.5				2	44	SM	24.4			
B-6	28.5				2	54	ML	21.8			
B-7	0.0				2	76	MH	34.9			
B-7	6.0	43	32	11	2	54	ML	25.8			
B-7	18.5				2	89	ML	31.5			
B-7	28.5				2	46	SM	27.1			
B-8	0.0				4.76	60	CL-ML	23.8			
B-8	2.0				2	35	SC	15.7			
B-8	13.5				4.76	78	CL-ML	29.1			
B-8	18.5	33	21	12	4.76	78	CL	27.1			
B-8	23.5				4.76	50	ML	22.7			



**TIMELY
ENGINEERING
SOIL
TESTS, LLC**

1874 Forge Street Tucker, GA 30084

Phone: 770-938-8233

Fax: 770-923-8973

Web: www.test-llc.com



Tested By

EB

Date

03/19/20

Checked By

LB

Client Pr. #	08:14113	Lab. PR. #	2020B-03-1
Pr. Name	Emergency Bridge Package 2020-1	S. Type	Bulk (Composite)
Sample ID	33521/SS-34 & SS-38	Depth/Elev.	0-10'
Location	B-6	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content

Remarks

Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	NA
Calibrated Volume of Soil Box, ft ³	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-		
Reported Soil Resistivity, ohms-cm		NA	

Determination of Minimum Soil Resistivity

TEST DATA

Trials at Various Moisture Content

TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	11.6	10.8	10.1	9.8	9.8				
Reading of Meter Range Multiplier	K	K	K	K	K				
Measured Resistance, ohms	11600	10800	10100	9800	9800				
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0	1.0	1.0				
Measured Resistivity, ohms-cm	11600	10800	10100	9800	9800				

Reported Soil Minimum Resistivity, ohms-cm **9800**

Note: Material passed # 10 sieve used for testing

Oven ID #	496/610
Balance ID #	563/700
Soil Box ID #	612/613/707
Resistivity Meter ID #	706

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA



INDEX PROPERTIES VERSUS DEPTH

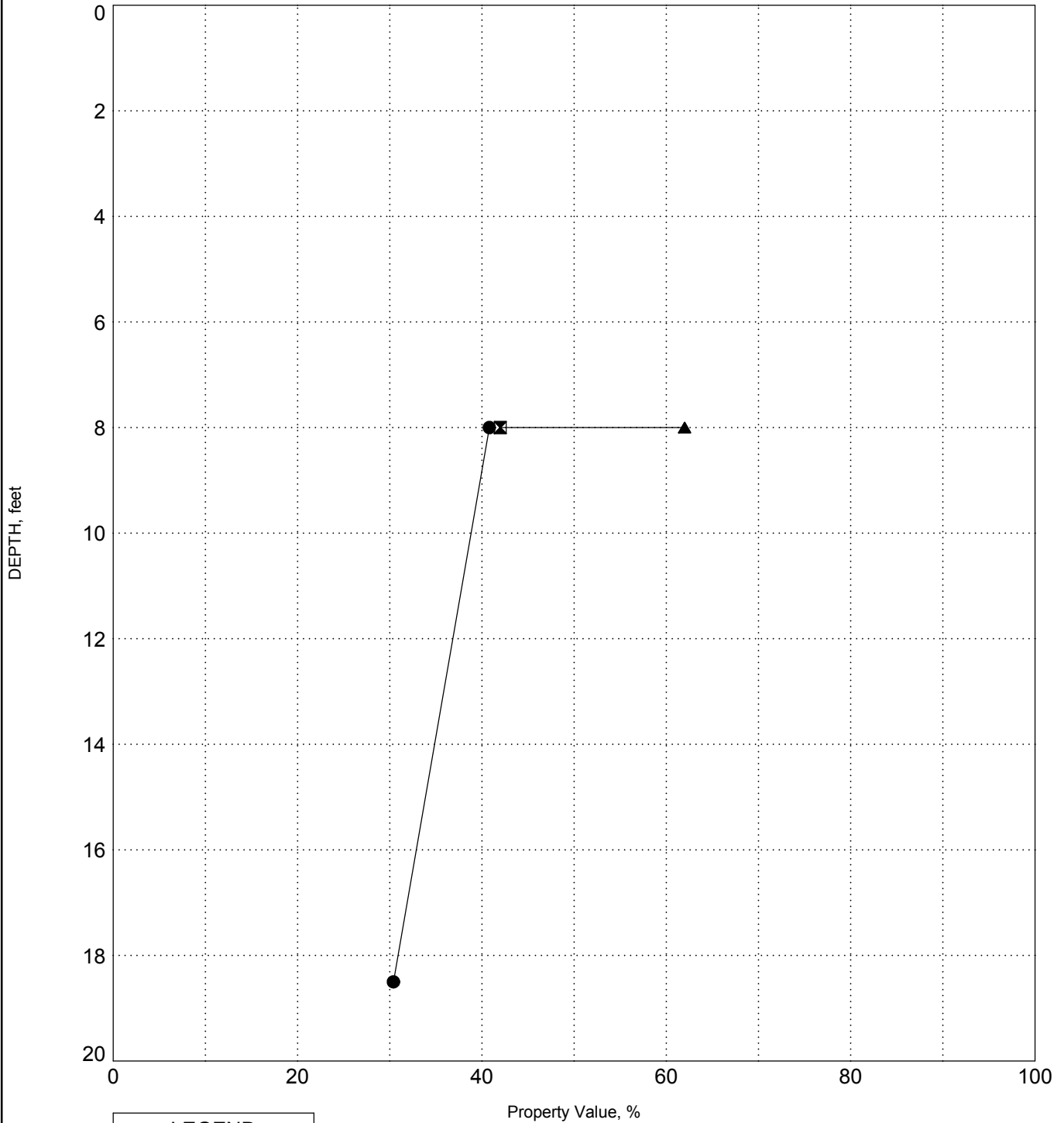
PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

SURFACE ELEVATION: 445.0

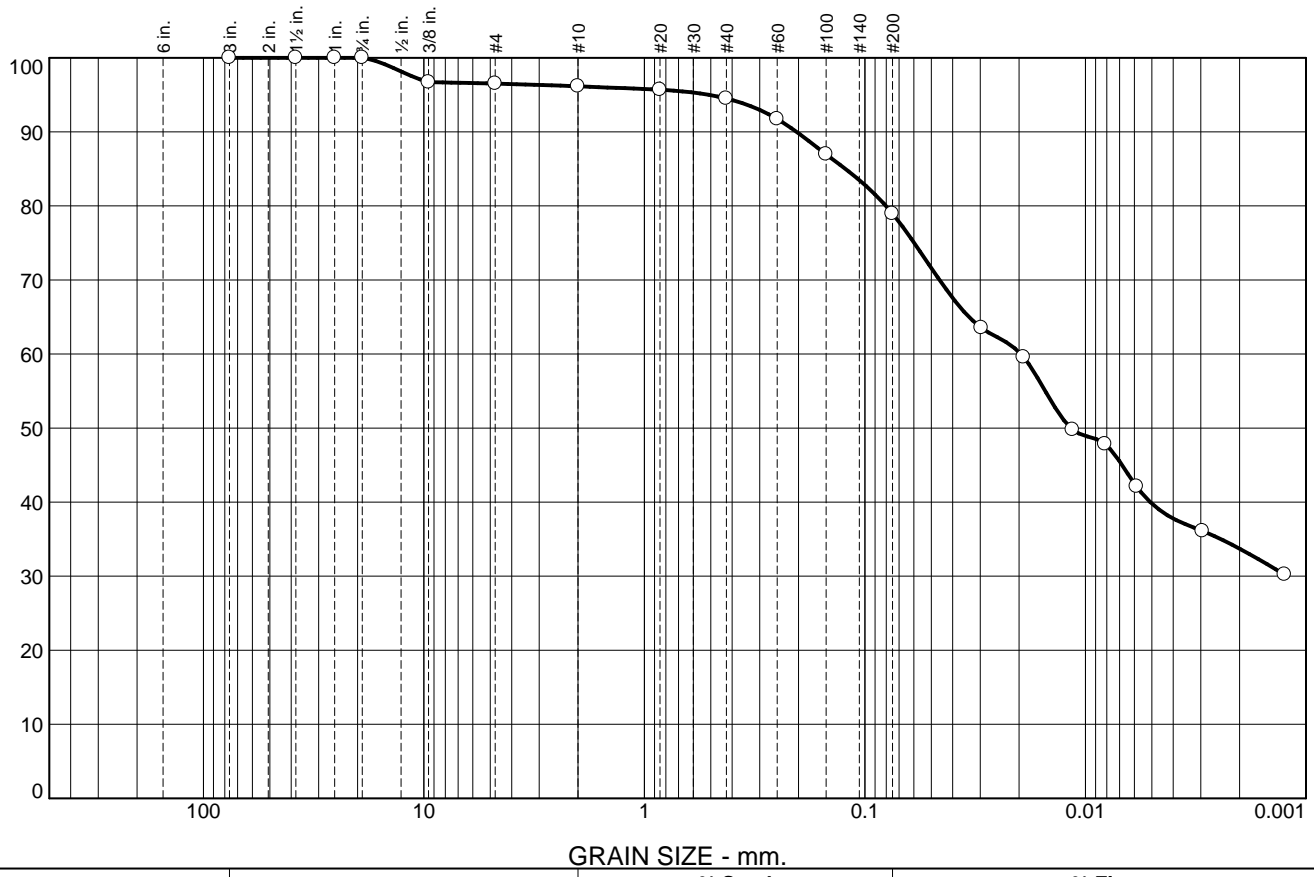
BORING B-5



LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	4	1	16	45	34

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	97		
#4	97		
#10	96		
#20	96		
#40	95		
#60	92		
#100	87		
#200	79		
0.0296 mm.	64		
0.0191 mm.	60		
0.0144 mm.	50		
0.0081 mm.	48		
0.0059 mm.	42		
0.0029 mm.	36		
0.0013 mm.	30		

* (no specification provided)

Soil Description

Orange Silty Clay (A-7-5(20))

Atterberg Limits

PL= 42 LL= 62 PI= 20

Coefficients

D₉₀= 0.2043 D₈₅= 0.1227 D₆₀= 0.0196
D₅₀= 0.0117 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO= A-7-5(20)

Remarks

F.M.=0.39

Sample Number: B-5 **Depth:** 8.0-10.0'

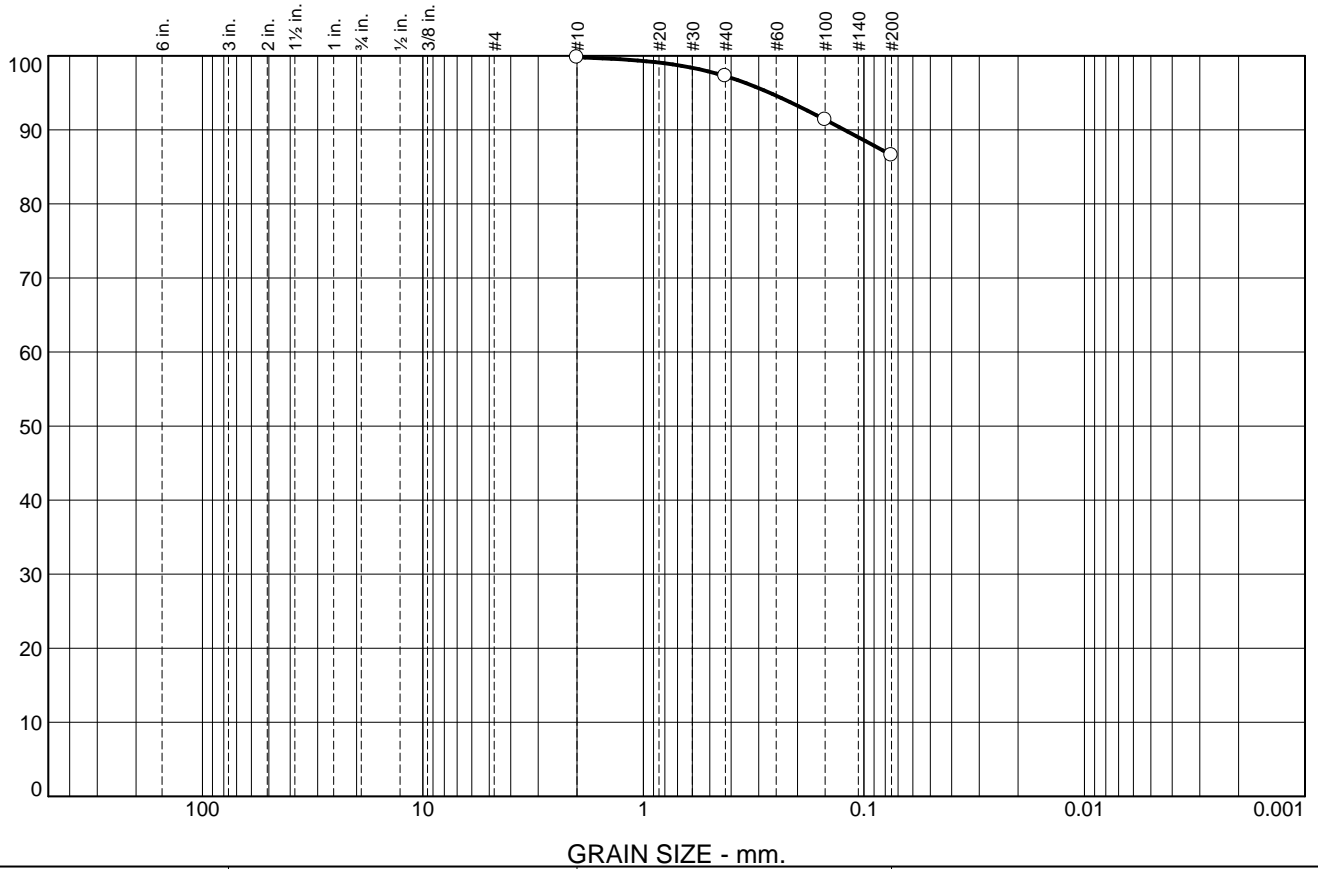
Date: 3.19

ECS SOUTHEAST, LLP 1812 Center Park Drive, Suite D Charlotte, NC 28217 Phone: (704) 525-5152 Fax: (704) 357-0023	<p>Client: SCDOT</p> <p>Project: Emergency Bridge Package 2020-1 - York County</p> <p>Project No: 14113</p> <p style="text-align: right;">Figure</p>
---	--

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		3	10	87	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#40	97		
#100	91		
#200	87		

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.1225 D₈₅= D₆₀=

D₅₀= D₃₀= D₁₅=

D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 30.4%

F.M.=0.15

* (no specification provided)

Sample Number: B-5

Depth: 18.5-20.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
 1812 Center Park Drive, Suite D
 Charlotte, NC 28217
 Phone: (704) 525-5152
 Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

Project No: 14113

Figure

Tested By: CER



INDEX PROPERTIES VERSUS DEPTH

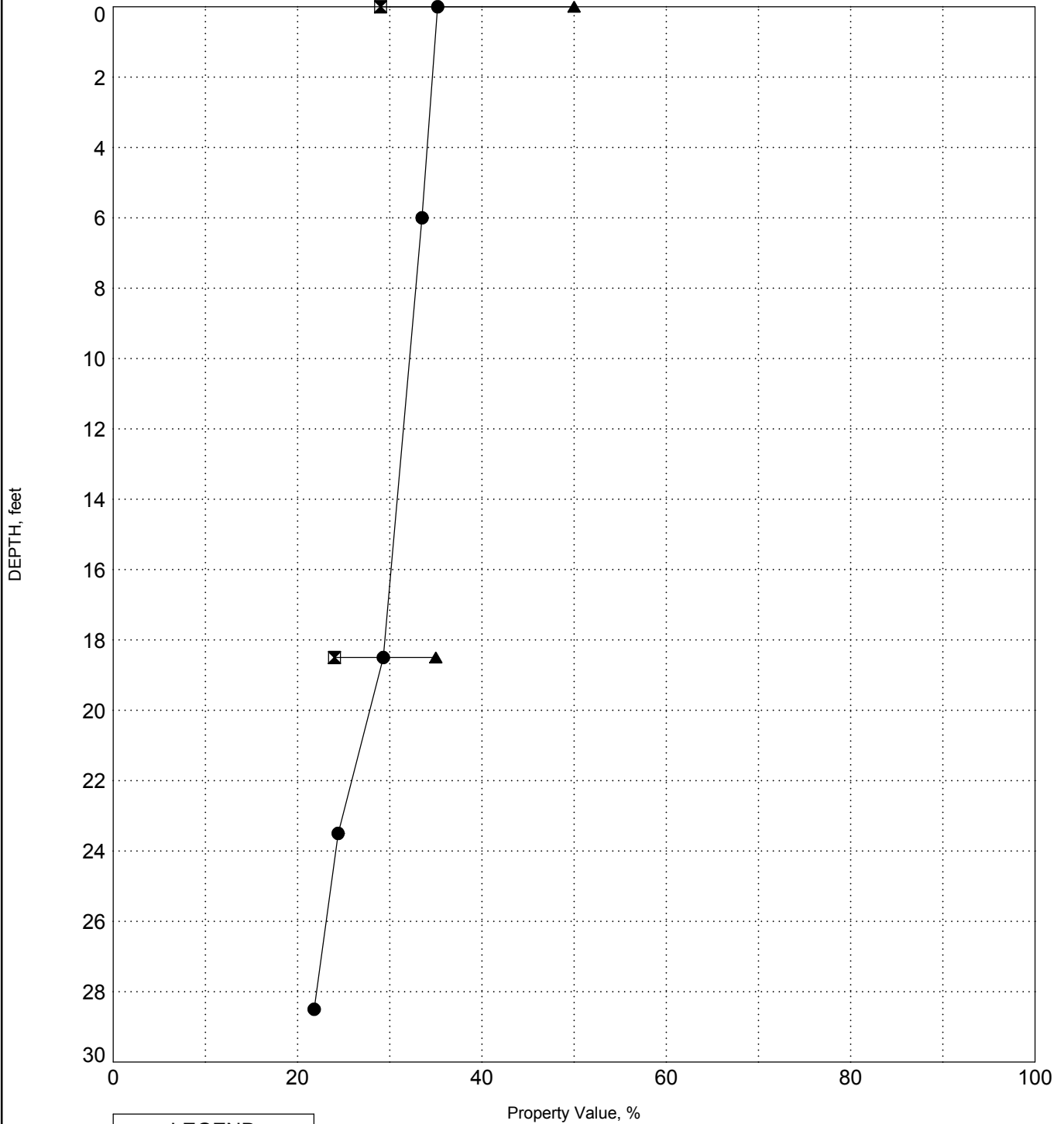
PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

SURFACE ELEVATION: 445.1

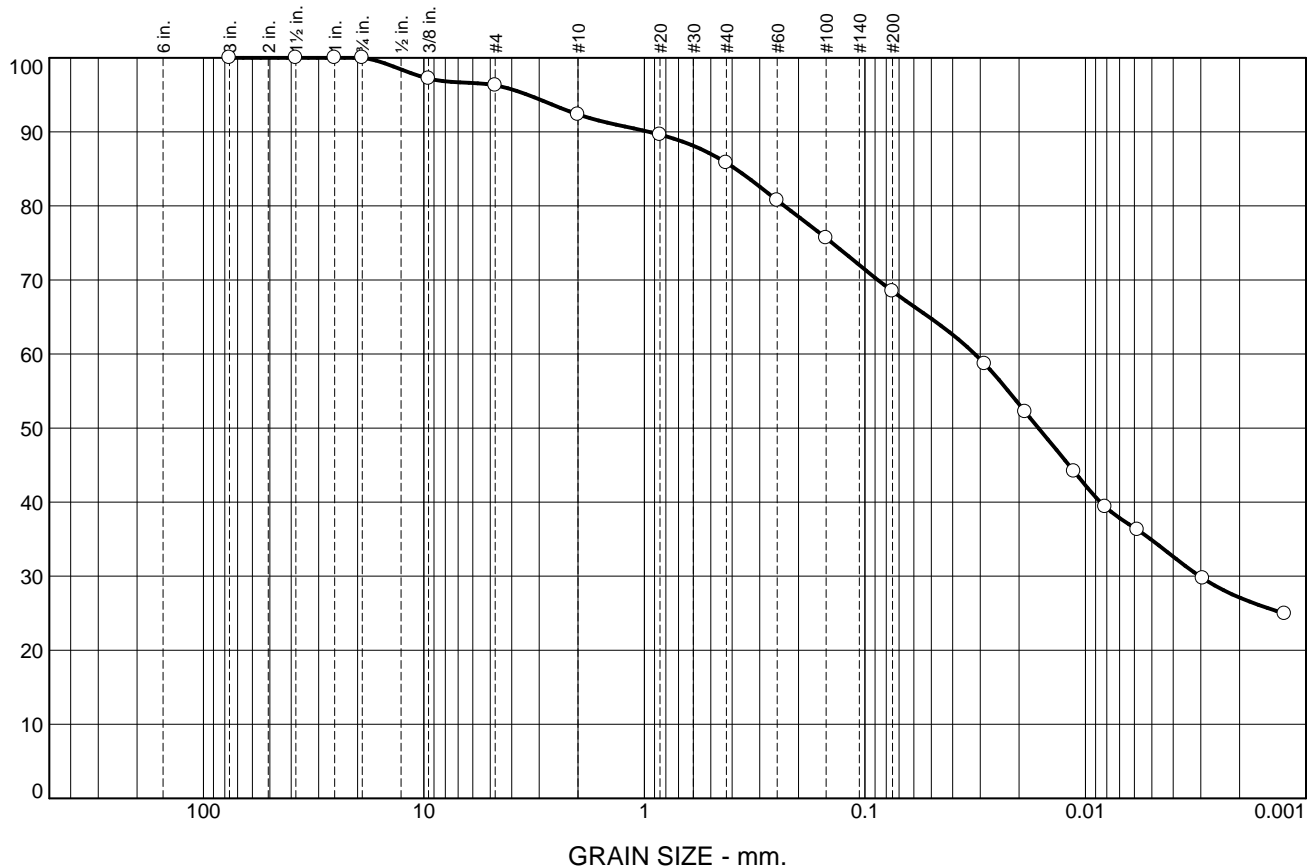
BORING B-6



LEGEND	
●	Water Content
☒	Plastic Limit
▲	Liquid Limit
★	Fines

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	8	6	18	41	27

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	97		
#4	96		
#10	92		
#20	90		
#40	86		
#60	81		
#100	76		
#200	68		
0.0286 mm.	59		
0.0188 mm.	52		
0.0113 mm.	44		
0.0081 mm.	39		
0.0058 mm.	36		
0.0029 mm.	30		
0.0012 mm.	25		

* (no specification provided)

Soil Description

Dark red/brown Silty Clay (A-7-6(14))

Atterberg Limits

PL= 29 LL= 50 PI= 21

Coefficients

D₉₀= 0.9548 D₈₅= 0.3855 D₆₀= 0.0317
D₅₀= 0.0163 D₃₀= 0.0030 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO= A-7-6(14)

Remarks

Natural Moisture: 35.2%
F.M.=0.76

Sample Number: B-6 **Depth:** 0-2.0'

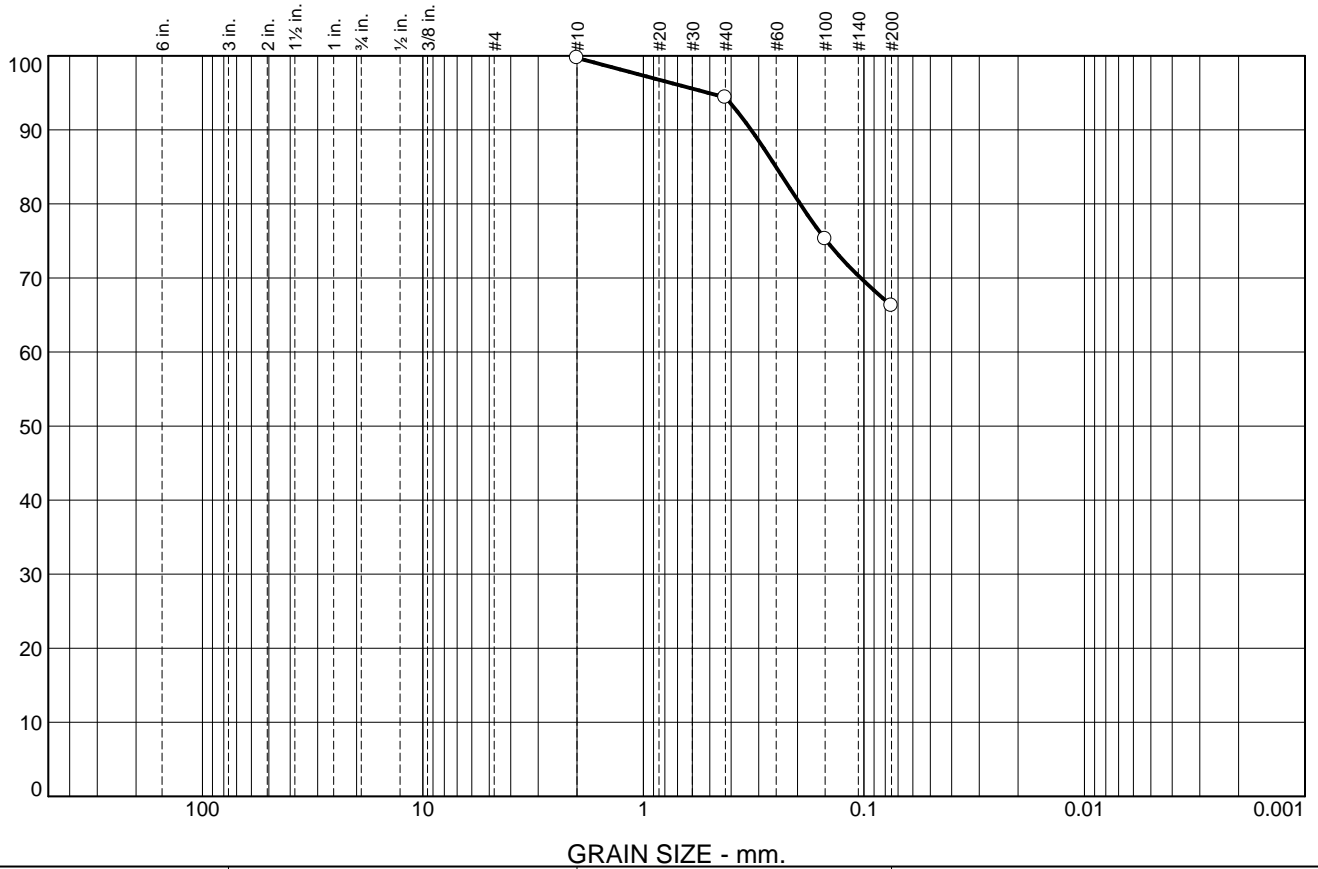
Date: 3.20.2020

ECS SOUTHEAST, LLP 1812 Center Park Drive, Suite D Charlotte, NC 28217 Phone: (704) 525-5152 Fax: (704) 357-0023	Client: SCDOT Project: Emergency Bridge Package 2020-1 - York County Project No: 14113 Figure
---	---

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		6	28	66	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#40	94		
#100	75		
#200	66		

Soil Description

Firm, moist, orange/brown, fine to medium Sandy Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.3248 D₈₅= 0.2505 D₆₀=

D₅₀= D₃₀= D₁₅=

D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 33.5
F.M.=0.43

* (no specification provided)

Sample Number: B-6 **Depth:** 6.0-8.0'

Date: 3.20.020



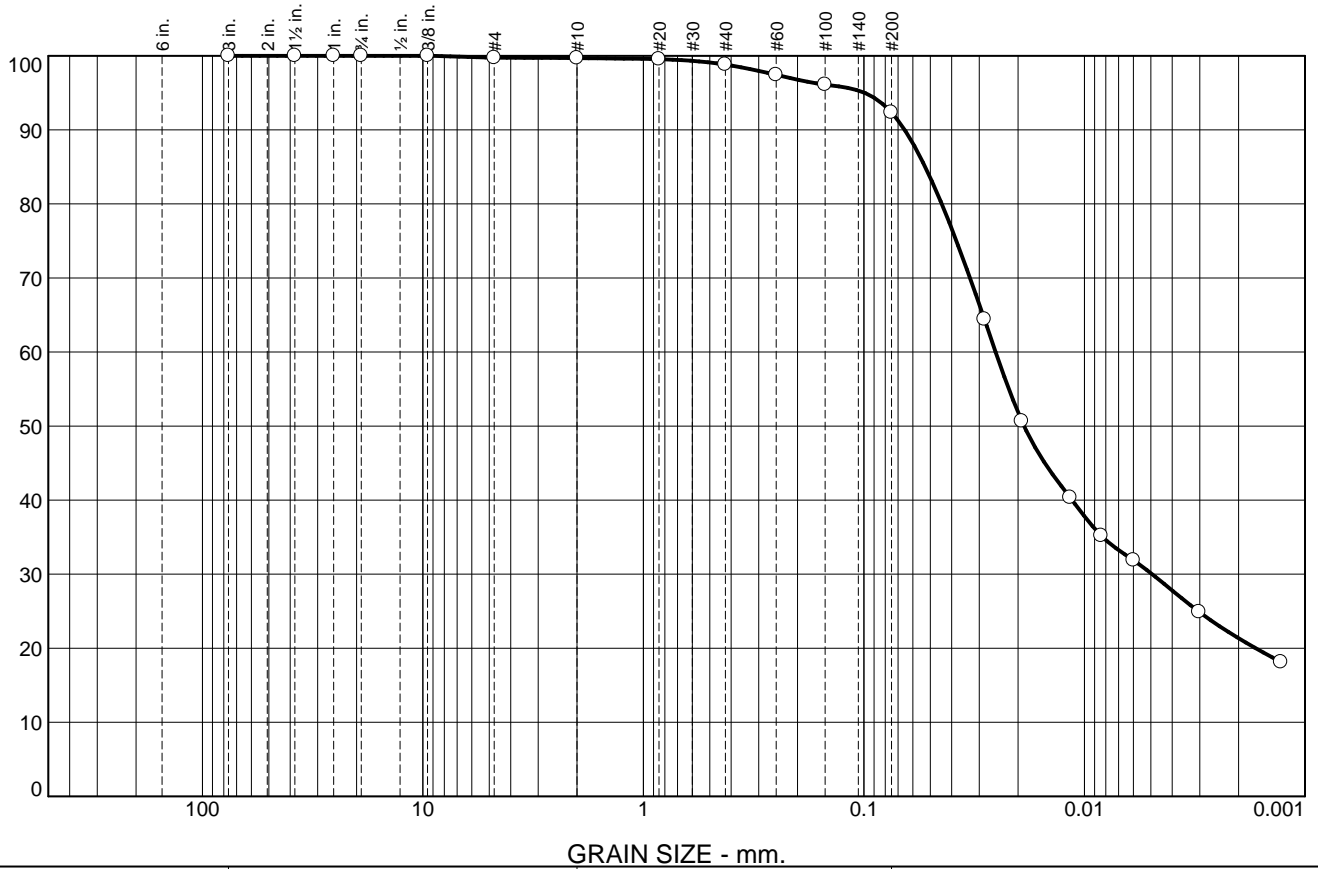
ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County
Project No: 14113 **Figure**

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	0	1	7	71	21

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	100		
#40	99		
#60	97		
#100	96		
#200	92		
0.0284 mm.	64		
0.0192 mm.	51		
0.0116 mm.	40		
0.0084 mm.	35		
0.0060 mm.	32		
0.0030 mm.	25		
0.0013 mm.	18		

* (no specification provided)

Soil Description

Light brown/green Sandy Clay (A-6(11))

Atterberg Limits

PL= 24 LL= 35 PI= 11

Coefficients

D₉₀= 0.0654 D₈₅= 0.0528 D₆₀= 0.0253
D₅₀= 0.0188 D₃₀= 0.0049 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO= A-6(11)

Remarks

Natural Moisture: 29.3%
F.M.=0.08

Sample Number: B-6

Depth: 18.5-20.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

Project No: 14113

Figure

Tested By: CER

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	0	4	52	44	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#40	96		
#100	63		
#200	44		

Soil Description

Soft, moist, gray fine to medium Sandy Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.3314 D₈₅= 0.2825 D₆₀= 0.1349
D₅₀= 0.0946 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 24.4%
F.M.=0.54

* (no specification provided)

Sample Number: B-6

Depth: 23.5-25.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

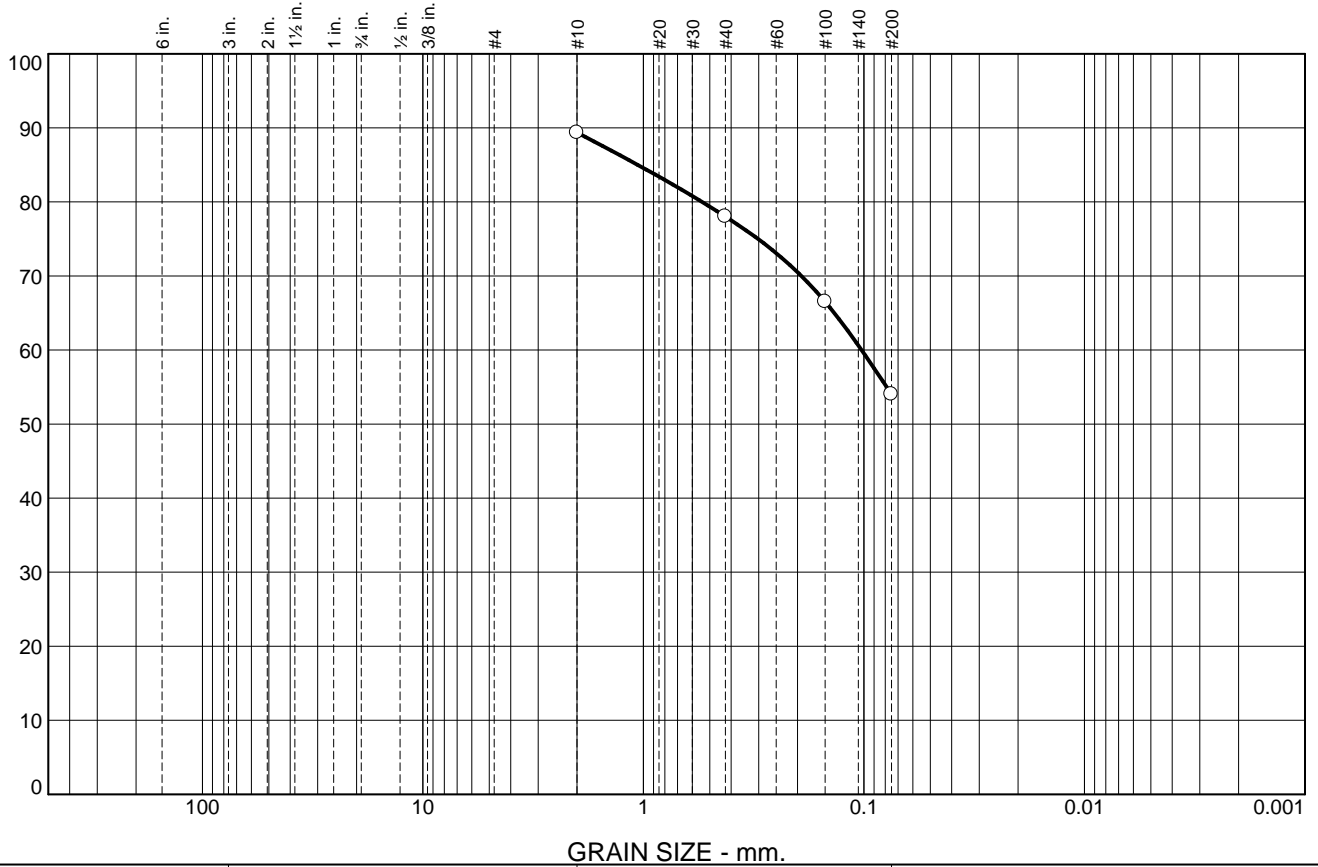
Project No: 14113

Figure

Tested By: CER

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		11	24	54	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	89		
#40	78		
#100	67		
#200	54		

Soil Description
Gray/brown fine to medium Sandy Silt

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= D₈₅= 1.0614 D₆₀= 0.1025
 D₅₀= D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= AASHTO=

Remarks
 Natural Moisture: 21.8%
 F.M.=0.92

* (no specification provided)

Sample Number: B-6

Depth: 28.5-30.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
 1812 Center Park Drive, Suite D
 Charlotte, NC 28217
 Phone: (704) 525-5152
 Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

Project No: 14113

Figure

Tested By: CER



INDEX PROPERTIES VERSUS DEPTH

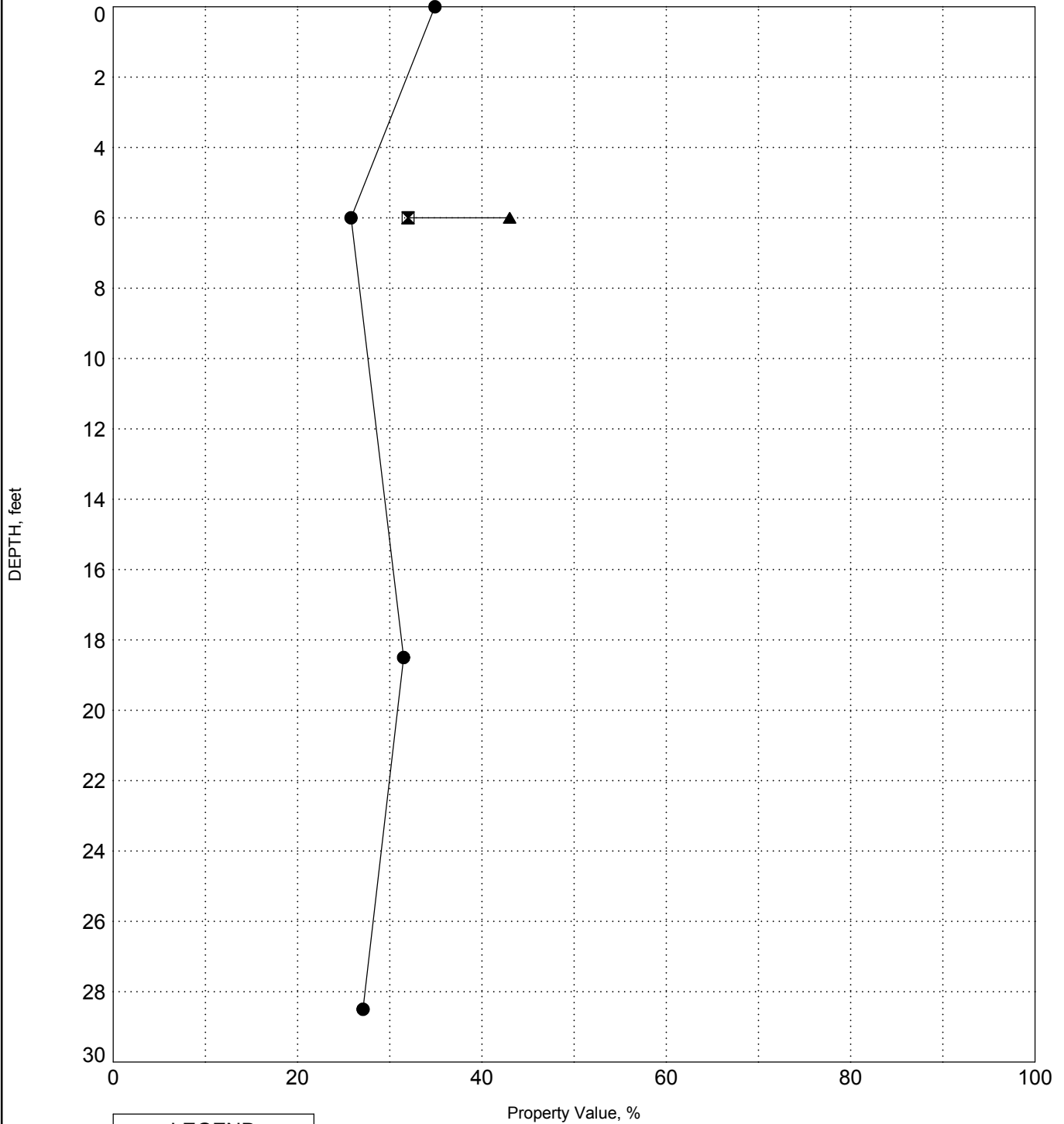
PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

SURFACE ELEVATION: 444.9

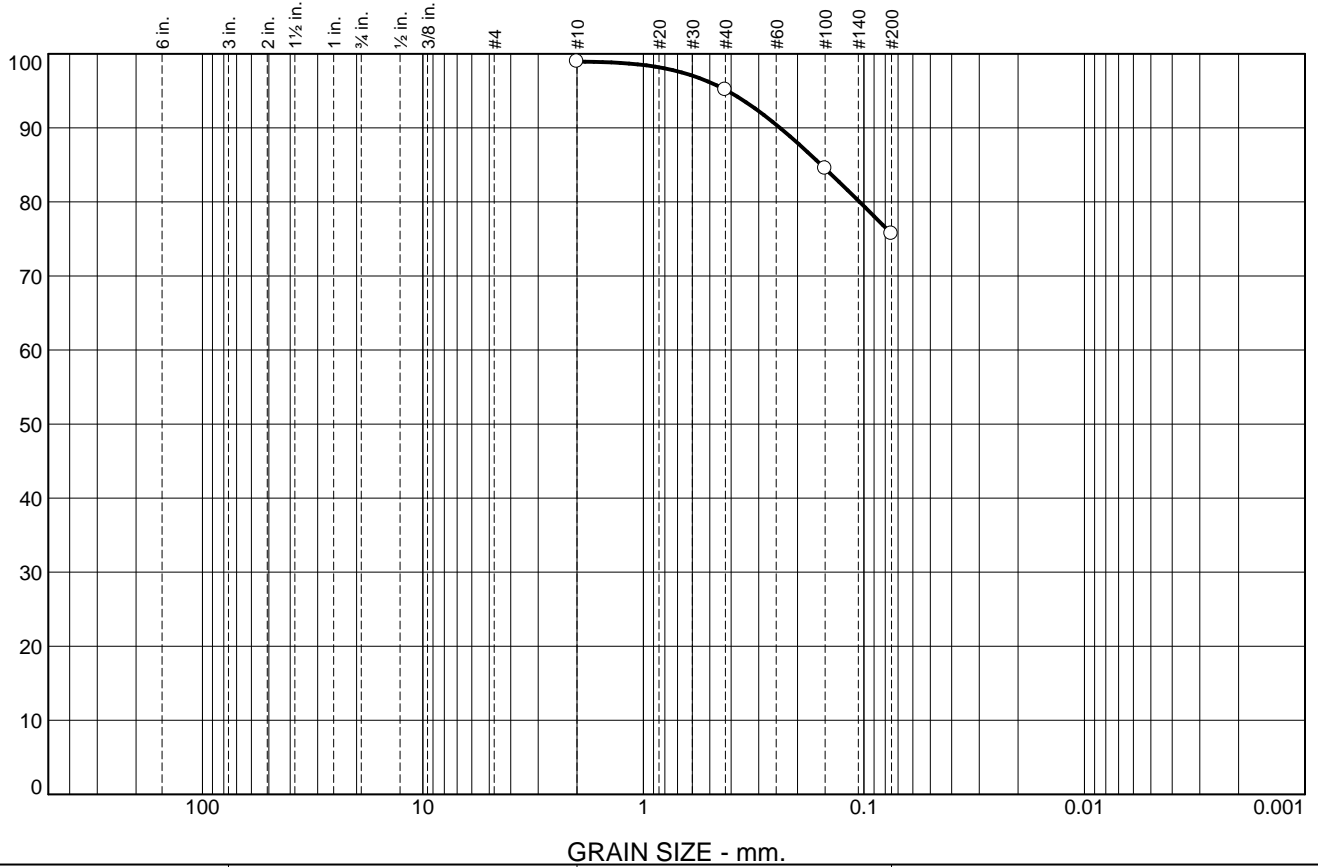
BORING B-7



LEGEND	
●	Water Content
☒	Plastic Limit
▲	Liquid Limit
★	Fines

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		4	19	76	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	99		
#40	95		
#100	85		
#200	76		

Soil Description

Red/brown Elastic Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.2403 D₈₅= 0.1561 D₆₀=

D₅₀= D₃₀= D₁₅=

D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 34.9%

F.M.=0.27

* (no specification provided)

Sample Number: B-7 **Depth:** 0.0-2.0'

Date: 3.20.2020



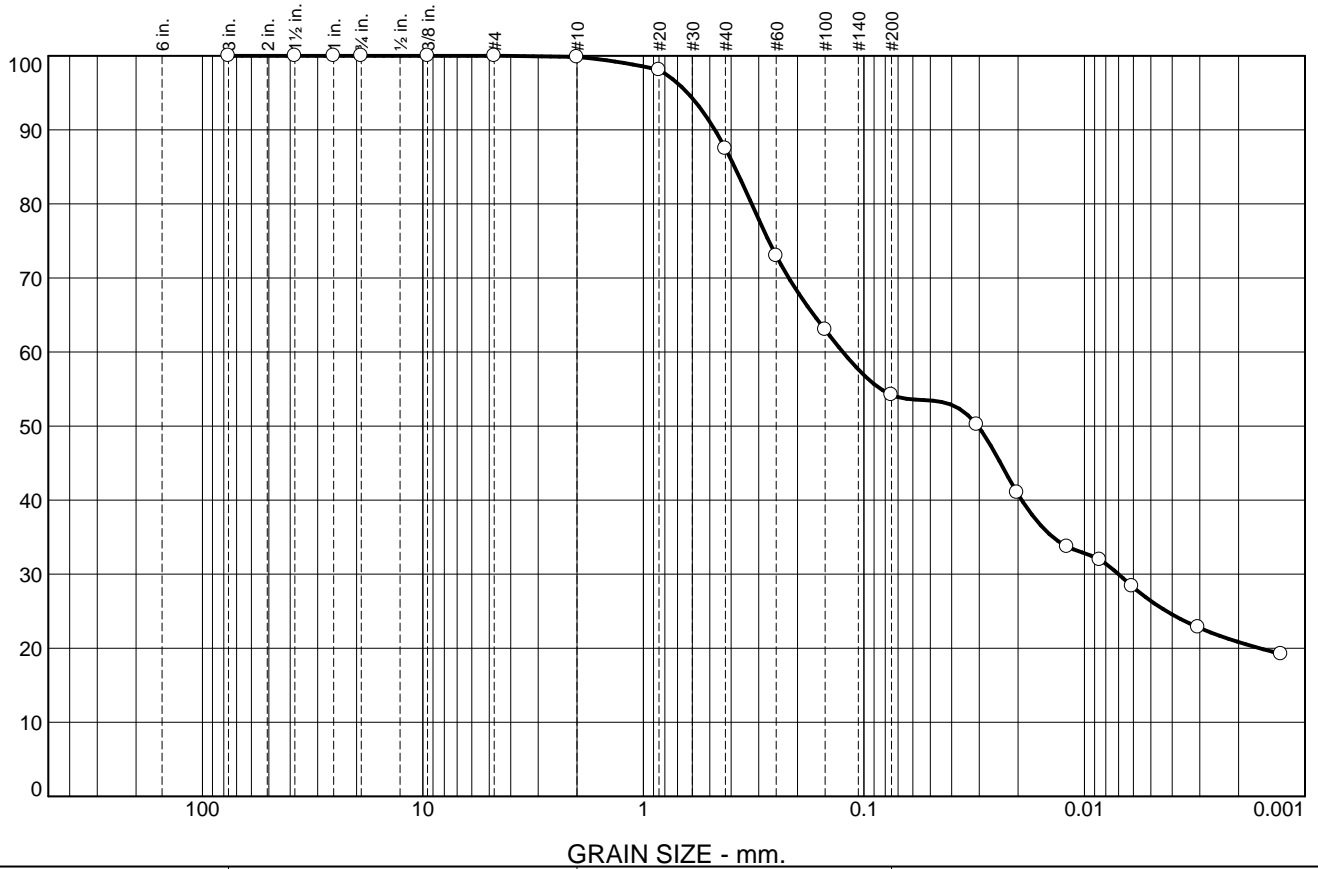
ECS SOUTHEAST, LLP
 1812 Center Park Drive, Suite D
 Charlotte, NC 28217
 Phone: (704) 525-5152
 Fax: (704) 357-0023

Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County
Project No: 14113 **Figure**

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	0	13	33	33	21

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	98		
#40	87		
#60	73		
#100	63		
#200	54		
0.0308 mm.	50		
0.0202 mm.	41		
0.0120 mm.	34		
0.0085 mm.	32		
0.0061 mm.	28		
0.0031 mm.	23		
0.0013 mm.	19		

* (no specification provided)

Soil Description

Orange/brown Silty Clay (a-7-5(4))

Atterberg Limits

PL= 32 LL= 43 PI= 11

Coefficients

D₉₀= 0.4741 D₈₅= 0.3859 D₆₀= 0.1246
D₅₀= 0.0304 D₃₀= 0.0070 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-7-5(4)

Remarks

Natural Moisture: 25.8%
F.M.=0.66

Sample Number: B-7 **Depth:** 6.0-8.0'

Date: 3.20.2020



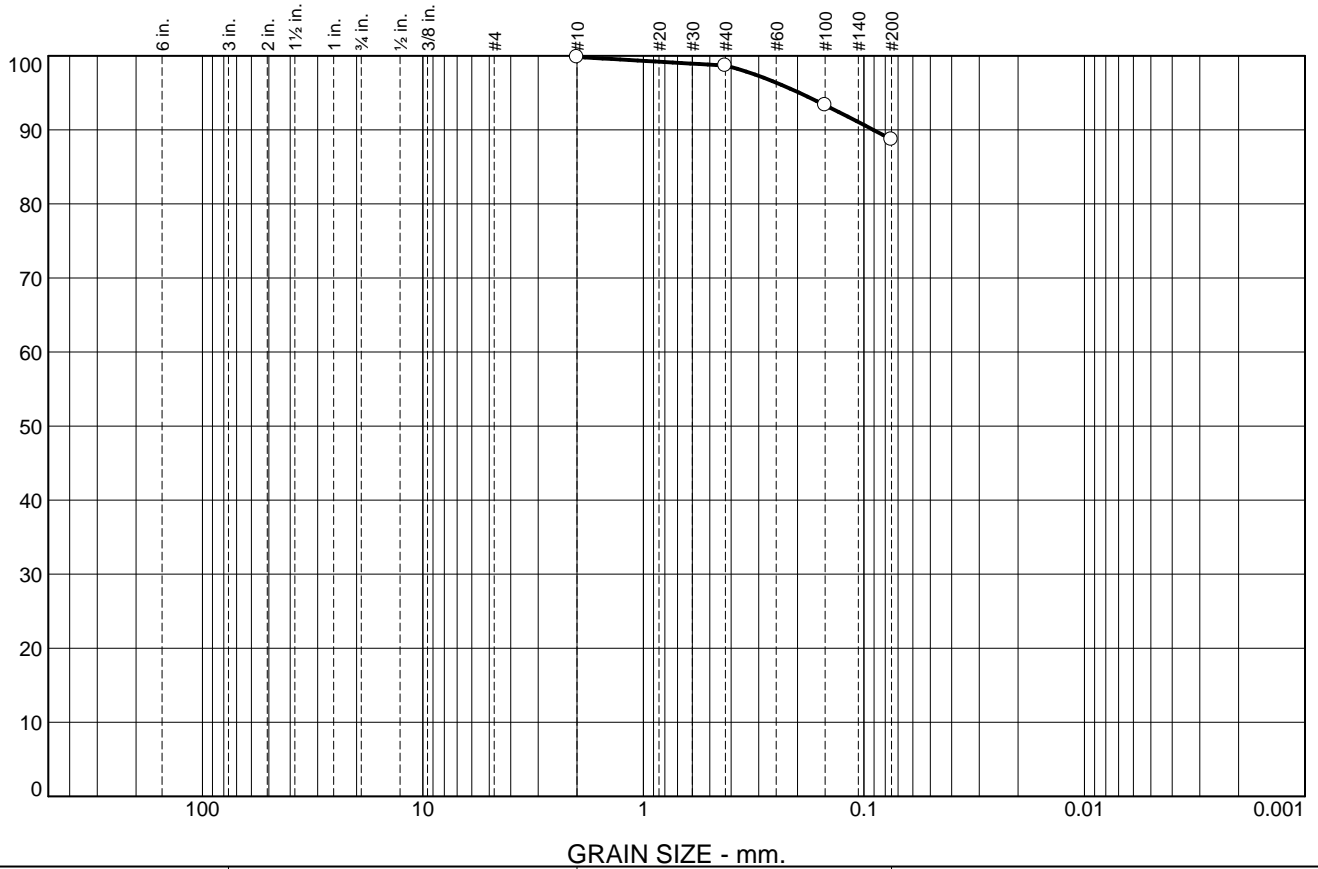
ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County
Project No: 14113 **Figure**

Tested By: CER

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		1	10	89	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#40	99		
#100	93		
#200	89		

Soil Description
Gray/brown, fine to medium Sandy Silt

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 0.0908 D₈₅= D₆₀=
 D₅₀= D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= AASHTO=

Remarks
 Natural Moisture: 31.5%
 F.M.=0.11

* (no specification provided)

Sample Number: B-7

Depth: 18.5-20.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
 1812 Center Park Drive, Suite D
 Charlotte, NC 28217
 Phone: (704) 525-5152
 Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

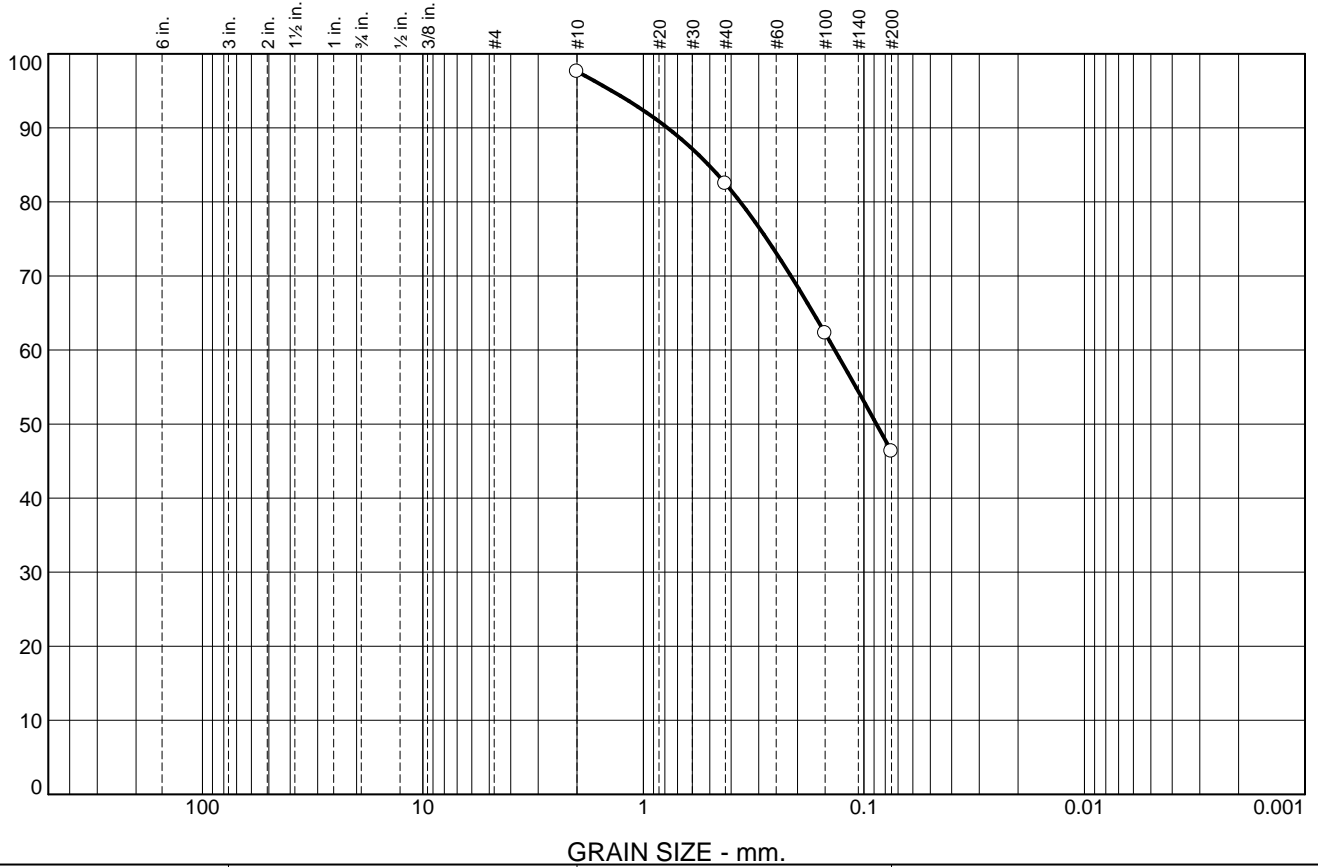
Project No: 14113

Figure

Tested By: CER

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		16	36	46	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	98		
#40	82		
#100	62		
#200	46		

Soil Description
Gray/brown, fine to medium Silty Sand

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 0.7777 D₈₅= 0.5066 D₆₀= 0.1355
 D₅₀= 0.0878 D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= AASHTO=

Remarks
 Natural Moisture: 27.1%
 F.M.=0.80

* (no specification provided)

Sample Number: B-7

Depth: 28.5-30

Date: 3.20.2020



ECS SOUTHEAST, LLP
 1812 Center Park Drive, Suite D
 Charlotte, NC 28217
 Phone: (704) 525-5152
 Fax: (704) 357-0023

Client: SCDOT

Project: Emergency Bridge Package 2020-1 - York County

Project No: 14113

Figure

Tested By: CER



INDEX PROPERTIES VERSUS DEPTH

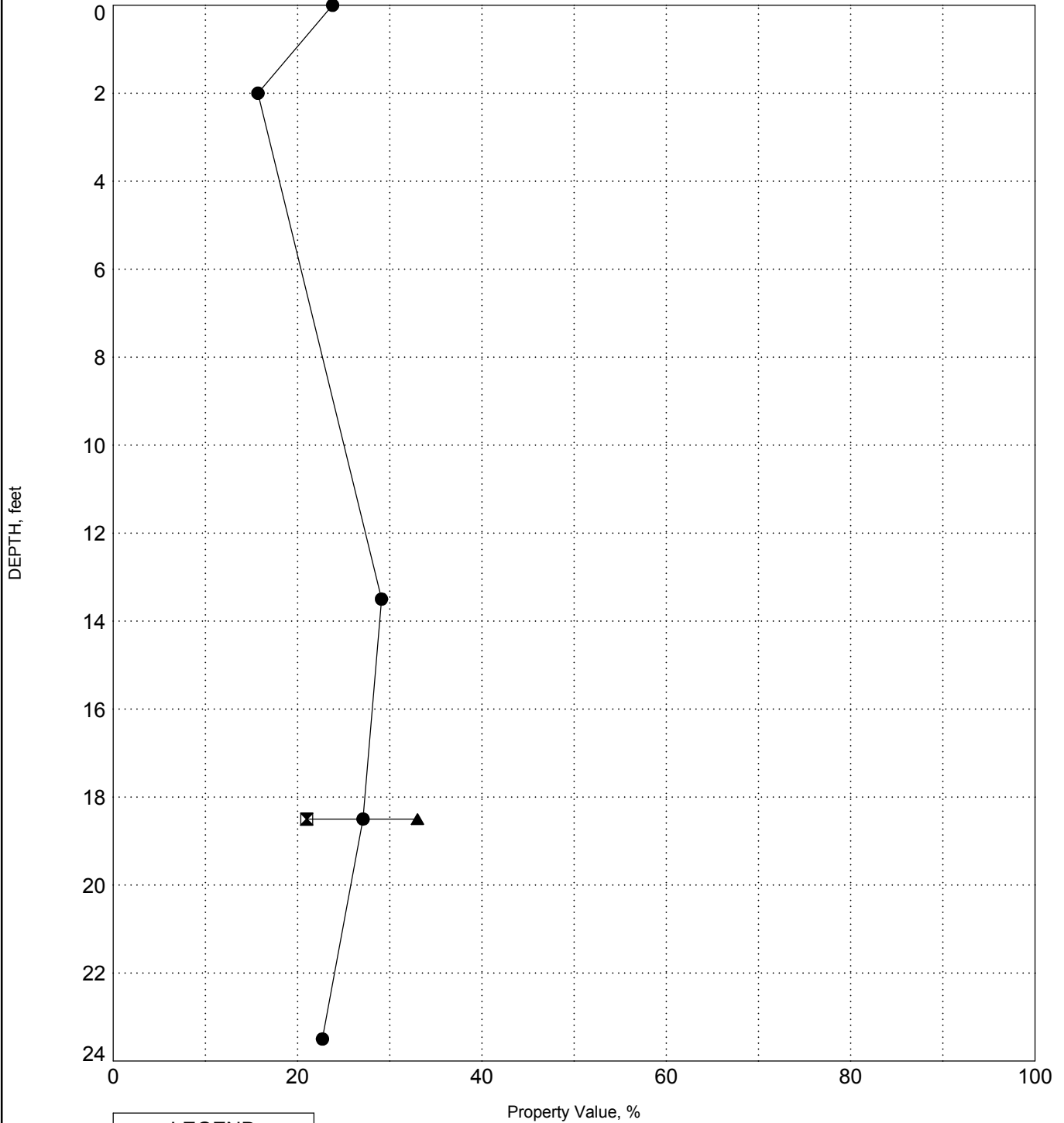
PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

BORING B-8

SURFACE ELEVATION: 443.9

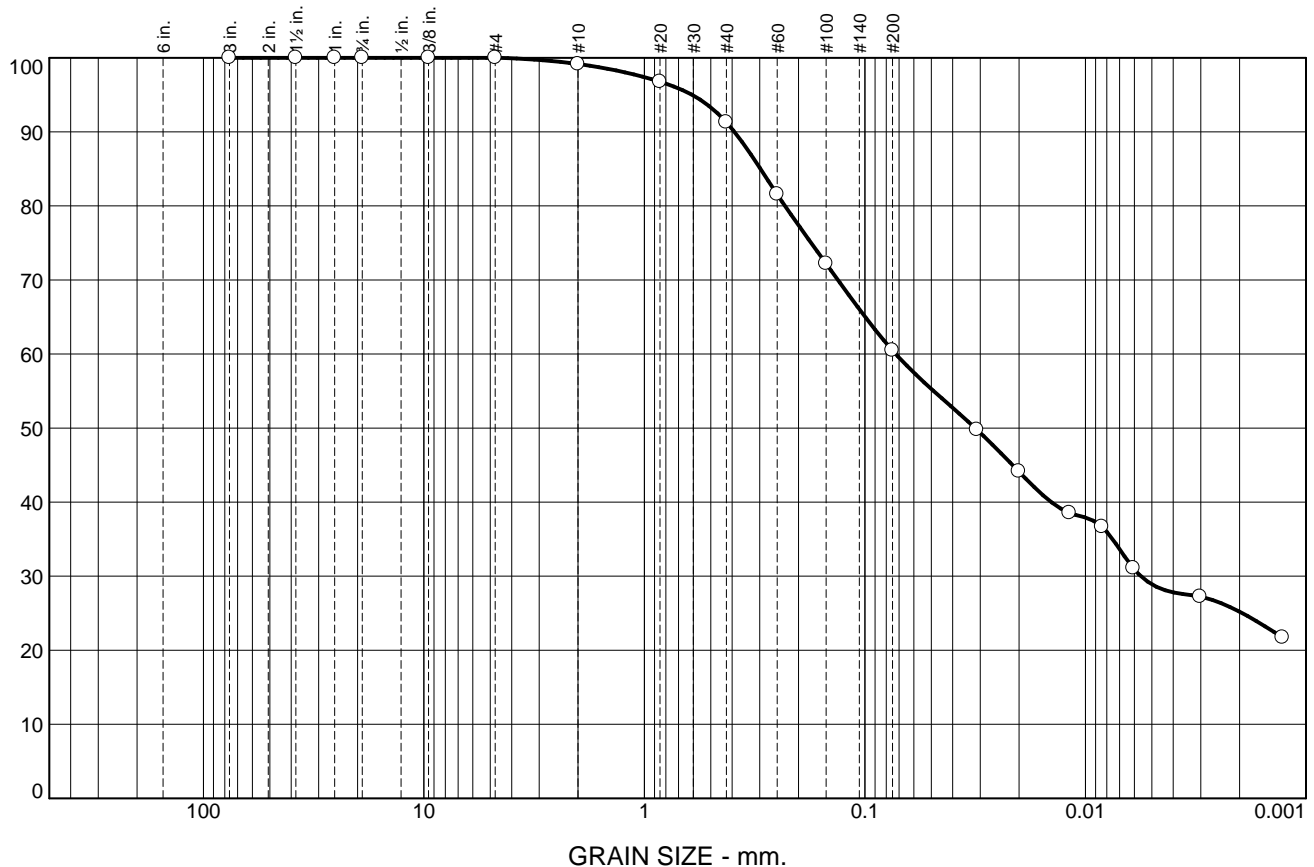


LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

INDEX PROPS S-46-816_YORK COUNTY.GPJ SCDOT_DATATEMPLATE.GDT 3/22/20

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	8	31	31	29

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	99		
#20	97		
#40	91		
#60	82		
#100	72		
#200	60		
0.0311 mm.	50		
0.0201 mm.	44		
0.0118 mm.	39		
0.0084 mm.	37		
0.0061 mm.	31		
0.0030 mm.	27		
0.0013 mm.	22		

Soil Description

Brown/red Silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.3908 D₈₅= 0.2977 D₆₀= 0.0725

D₅₀= 0.0316 D₃₀= 0.0056 D₁₅=

D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 23.8%

F.M.=0.50

* (no specification provided)

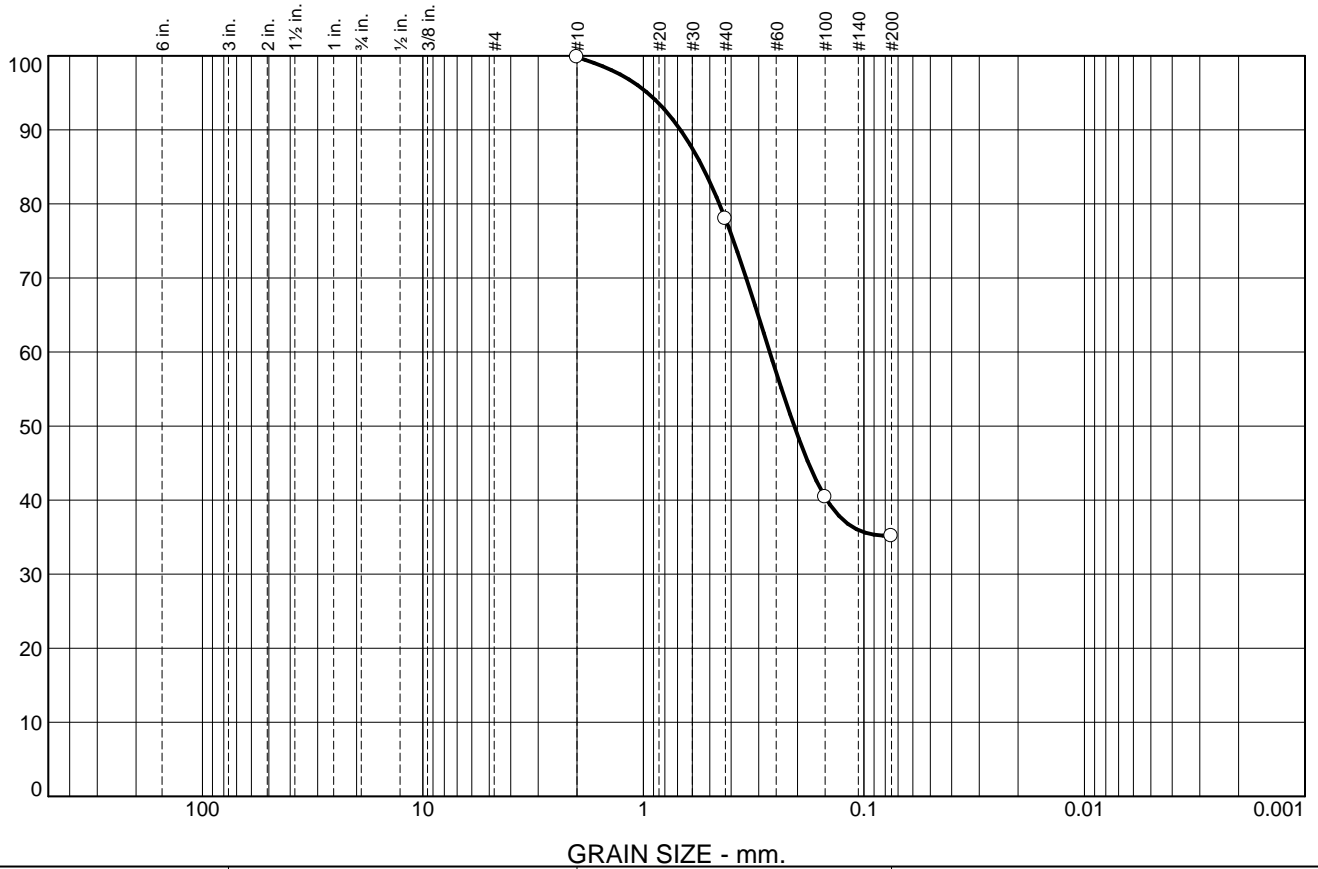
Sample Number: B-8 **Depth:** 0.0-2.0' **Date:** 3.20.2020

ECS SOUTHEAST, LLP 1812 Center Park Drive, Suite D Charlotte, NC 28217 Phone: (704) 525-5152 Fax: (704) 357-0023	<p>Client: SCDOT</p> <p>Project: Emergency Bridge Package 2020-1 - York County</p> <p>Project No: 14113</p> <p style="text-align: right;">Figure</p>
---	--

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
		22	43	35	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100		
#40	78		
#100	40		
#200	35		

Soil Description

Red/brown Silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.6793 D₈₅= 0.5399 D₆₀= 0.2675
D₅₀= 0.2071 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 15.7%
F.M.=1.10

* (no specification provided)

Sample Number: B-8 **Depth:** 2.0-4.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

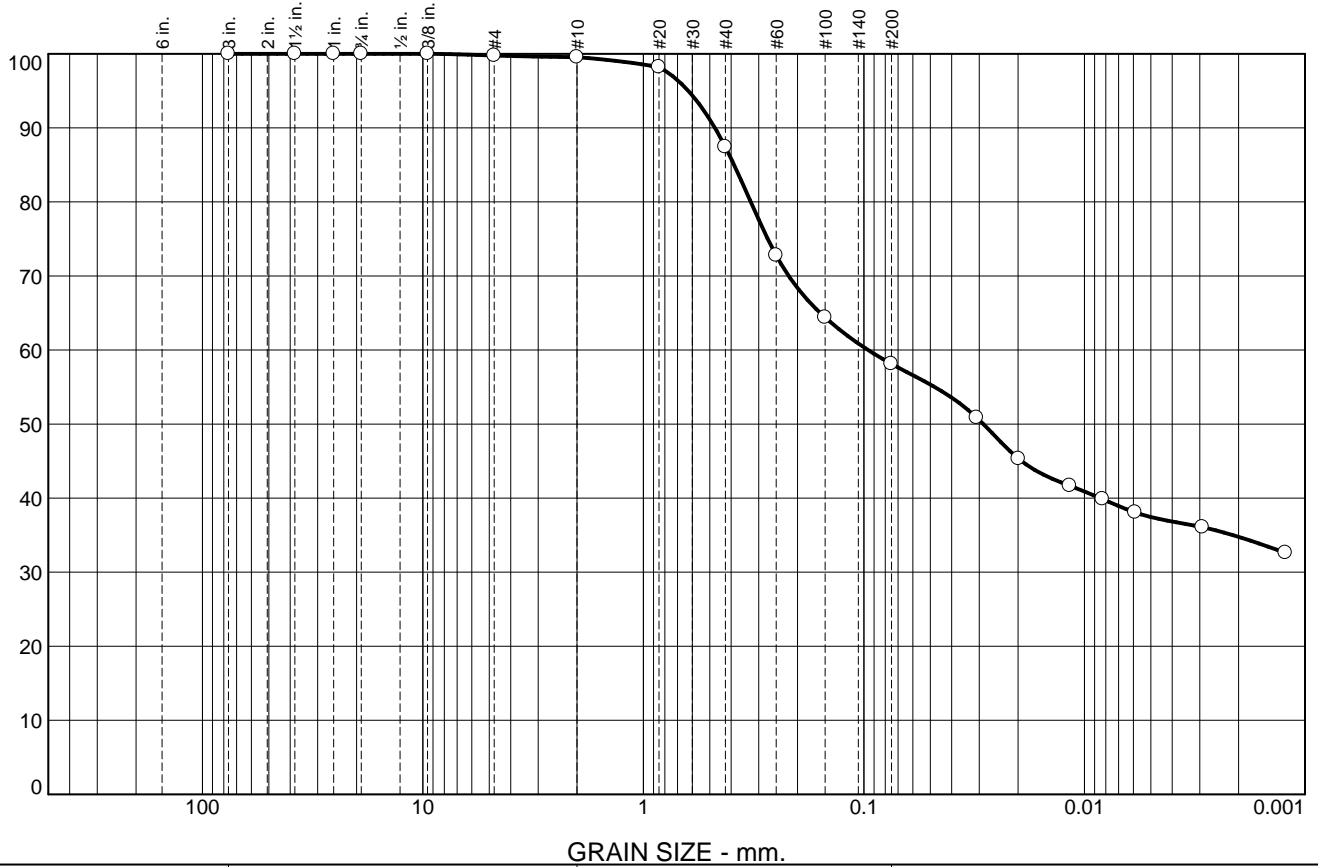
Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County

Project No: 14113 **Figure**

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	0	13	29	23	35

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	98		
#40	87		
#60	73		
#100	64		
#200	58		
0.0308 mm.	51		
0.0199 mm.	45		
0.0116 mm.	42		
0.0083 mm.	40		
0.0059 mm.	38		
0.0029 mm.	36		
0.0012 mm.	33		

* (no specification provided)

Soil Description

Dark red/brown

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.4739 D₈₅= 0.3880 D₆₀= 0.0958
D₅₀= 0.0287 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 29.1%
F.M.=0.65

Sample Number: B-8 **Depth:** 13.5-15.0'

Date: 3.20.2020



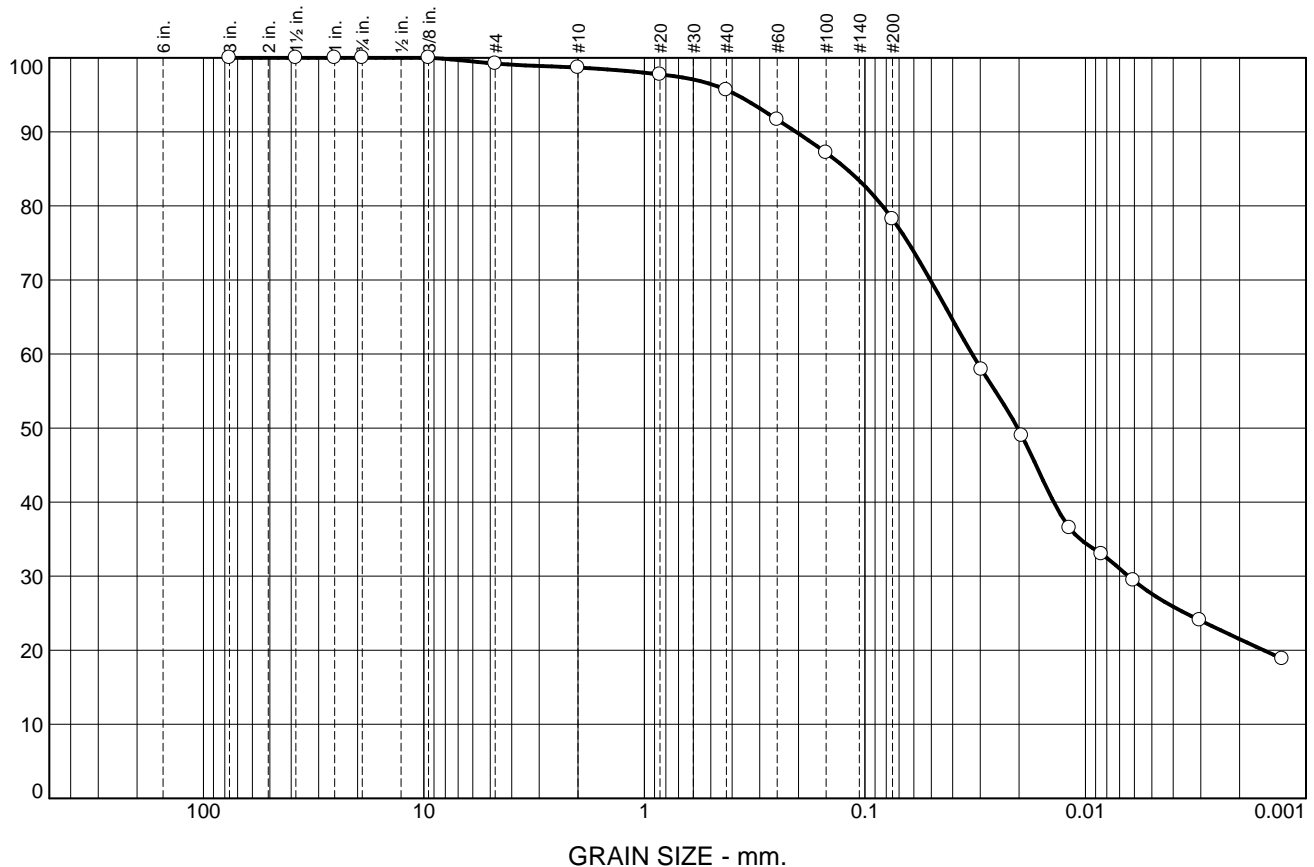
ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County
Project No: 14113 **Figure**

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	1	3	18	56	22

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	99		
#10	99		
#20	98		
#40	96		
#60	92		
#100	87		
#200	78		
0.0296 mm.	58		
0.0195 mm.	49		
0.0118 mm.	37		
0.0085 mm.	33		
0.0061 mm.	29		
0.0030 mm.	24		
0.0013 mm.	19		

Soil Description
Green/gray Sandy Clay (A-6(8))

Atterberg Limits
 PL= 21 LL= 33 PI= 12

Coefficients
 D₉₀= 0.2056 D₈₅= 0.1213 D₆₀= 0.0327
 D₅₀= 0.0203 D₃₀= 0.0064 D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= AASHTO= A-6(8)

Remarks
 Natural Moisture: 27.1%
 F.M.=0.26

* (no specification provided)

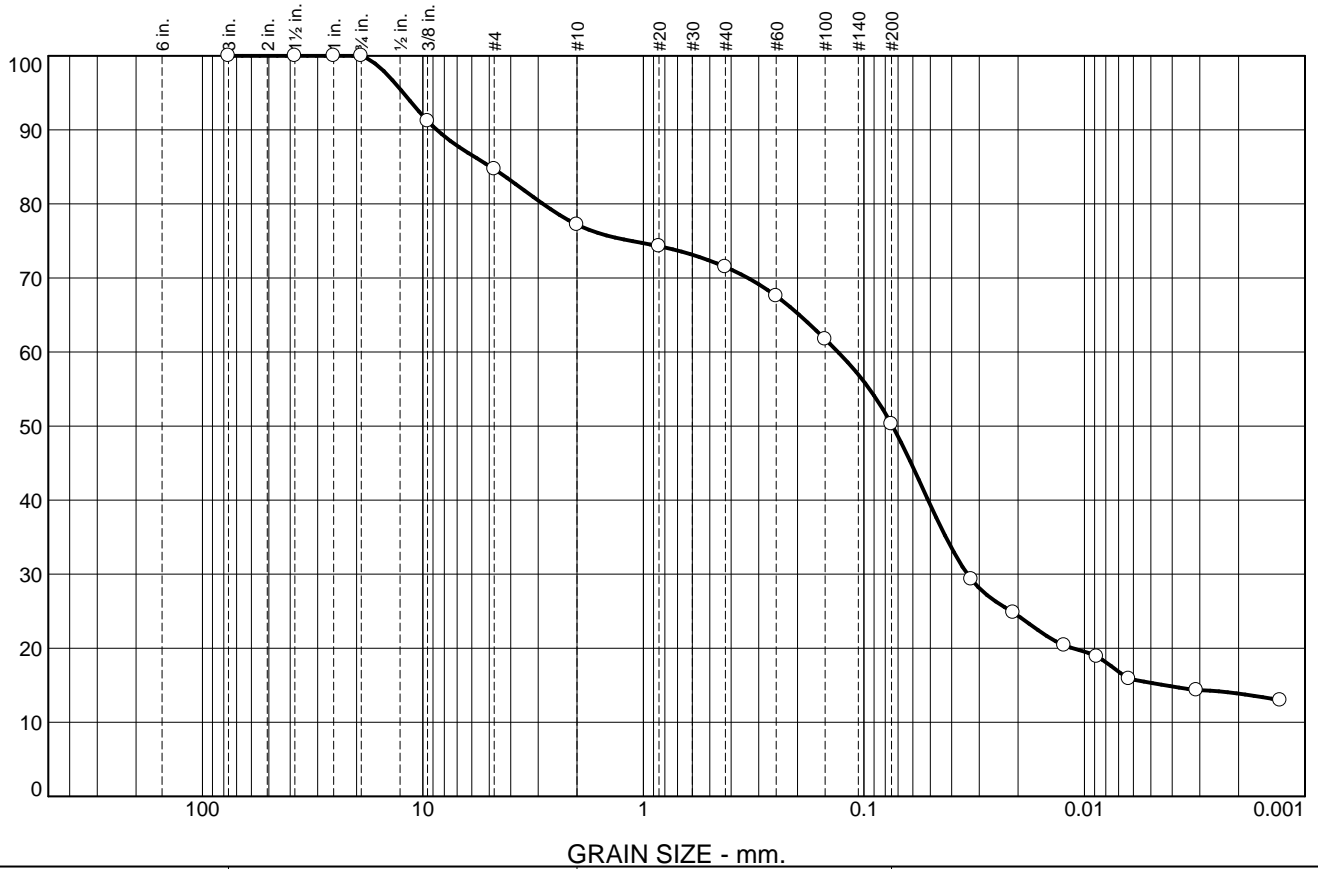
Sample Number: B-8 **Depth:** 18.5-20.0' **Date:** 3.20.2020

ECS SOUTHEAST, LLP 1812 Center Park Drive, Suite D Charlotte, NC 28217 Phone: (704) 525-5152 Fax: (704) 357-0023	Client: SCDOT Project: Emergency Bridge Package 2020-1 - York County Project No: 14113 Figure
---	--

Tested By: CER _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicative of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	23	6	21	36	14

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
1.5	100		
1	100		
.75	100		
.375	91		
#4	85		
#10	77		
#20	74		
#40	71		
#60	68		
#100	62		
#200	50		
0.0326 mm.	29		
0.0210 mm.	25		
0.0124 mm.	20		
0.0088 mm.	19		
0.0063 mm.	16		
0.0031 mm.	14		
0.0013 mm.	13		

* (no specification provided)

Soil Description

Gray/blue

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 8.6508 D₈₅= 4.9230 D₆₀= 0.1311
D₅₀= 0.0741 D₃₀= 0.0339 D₁₅= 0.0043
D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Moisture: 22.7%
F.M.=1.67

Sample Number: B-8 **Depth:** 23.5-25.0'

Date: 3.20.2020



ECS SOUTHEAST, LLP
1812 Center Park Drive, Suite D
Charlotte, NC 28217
Phone: (704) 525-5152
Fax: (704) 357-0023

Client: SCDOT
Project: Emergency Bridge Package 2020-1 - York County
Project No: 14113 **Figure**

Tested By: CER



Rock Coring Summary

PROJECT ID N/A

PROJECT NAME Emergency Bridge Package 2020-1

PROJECT COUNTY York

Borehole	Core Run Number	Core Run Top Depth	REC (%)	RQD (%)	q _u (psi)	Poisson's Ratio	Secant Modulus (ksi)	Unit Weight (pcf)	RMR	GSI
B-6	HQ-1	65.0	78	57	9390	0.24	8699	199	57	55
B-6	HQ-2	70.0	100	90	7921	0.19	8677	183	60	55
B-6	HQ-3	75.0	100	100	3328	0.23	6845	173	64	45
B-7	HQ-1	78.0	12	0						

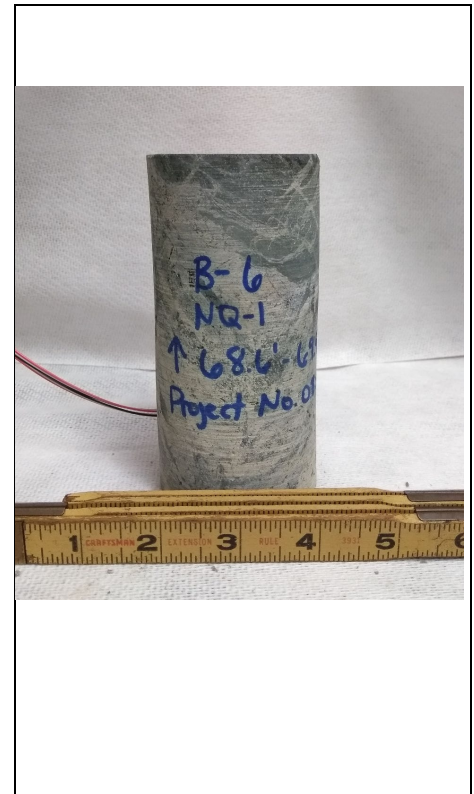


Uniaxial Compressive Strength of Intact Rock Core Specimens

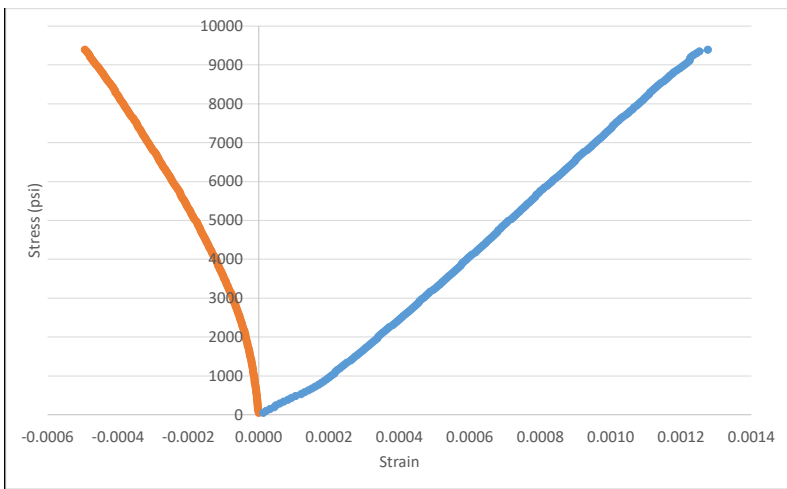
References:
ASTM D7012-14 Method D

Project No.:	08:14113	Borehole:	B6
Project:	S-816 Bridge over Mud Creek	Sample No.:	HQ-1
Location:	York County, SC	Depth:	68.6-69.4 ft
Client:		Lab ID No:	B6-HQ1
Date Received:	03/16/2020		
Date Tested:	03/19/2020		

Testing Results			Sample Measurements		
Max Load	45,728 lbs		Diameter	2.490 in	
	203.4 kN			6.32 cm	
UCS	9391 psi		Height	5.273 in	
	64.7 MPa			13.39 cm	
Elastic Modulus	8699 ksi		Area	4.870 in ²	
	59.98 GPa			31.42 cm ²	
Loading Rate	14000 lbs/min		Volume	25.679 in ³	
	1.04 kN/s			420.80 cm ³	
Lithology	Intermediate Metavolcanic Rock, gray, slightly weathered, strong rock		Mass	2.951 lbs	
				1338.55 g	
Failure Mode	Vertical splitting		Bulk Density	198.58 lbs/ft ³	
				3180.97 kg/m ³	
Poisson's Ratio	0.243				



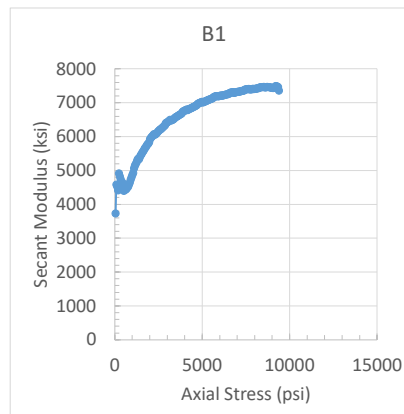
Before Test



After Test

Comments

1. Sample was received trimmed and was cut to size and repolished
2. One vertical and one lateral strain gages were attached
3. Elastic Modulus and Poisson's ratio was calculated at about 50% failure load



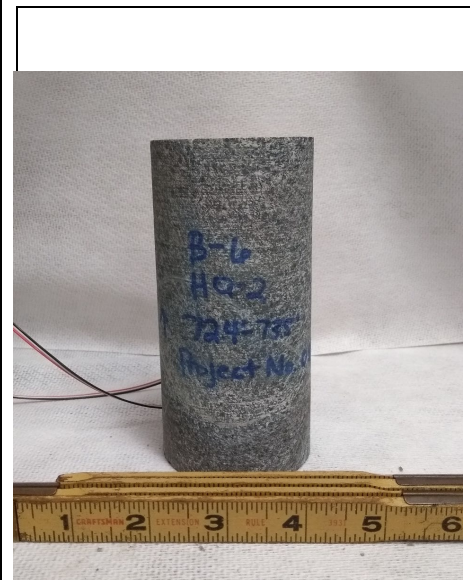


Uniaxial Compressive Strength of Intact Rock Core Specimens

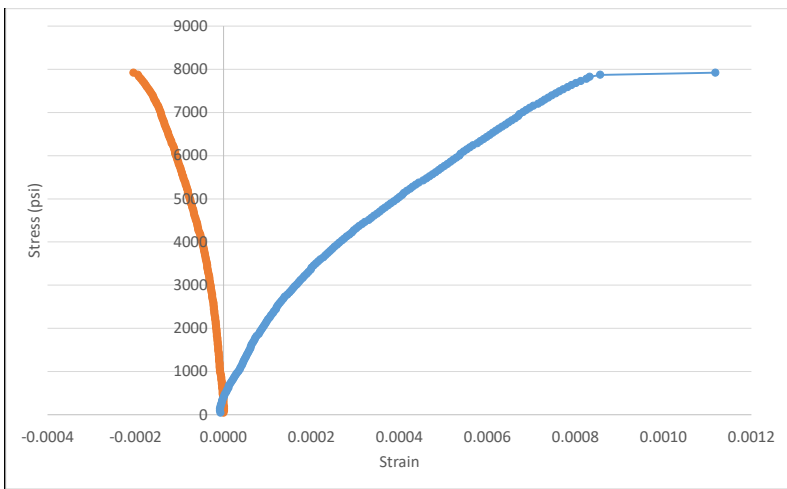
References:
ASTM D7012-14 Method D

Project No.:	08:14113	Borehole:	B6
Project:	S-816 Bridge over Mud Creek	Sample No.:	HQ-2
Location:	York County, SC	Depth:	72.4-73.5 ft
Client:		Lab ID No:	B6-HQ2
Date Received:	03/16/2020		
Date Tested:	03/19/2020		

Testing Results			Sample Measurements		
Max Load	38,490 lbs		Diameter	2.487 in	
	171.2 kN			6.32 cm	
UCS	7921 psi		Height	5.297 in	
	54.6 MPa			13.46 cm	
Elastic Modulus	8687 ksi		Area	4.859 in ²	
	59.89 GPa			31.35 cm ²	
Loading Rate	14000 lbs/min		Volume	25.740 in ³	
	1.04 kN/s			421.81 cm ³	
Lithology	Intermediate Metavolcanic Rock, gray, slightly weathered, strong rock		Mass	2.732 lbs	
				1239.21 g	
Failure Mode	Vertical splitting		Bulk Density	183.40 lbs/ft ³	
				2937.85 kg/m ³	
Poisson's Ratio	0.190				



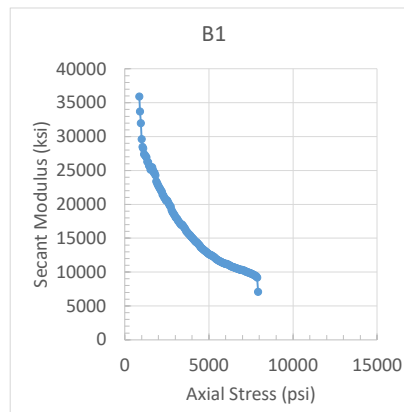
Before Test



After Test

Comments

1. Sample was received trimmed and was cut to size and repolished
2. One vertical and one lateral strain gages were attached
3. Elastic Modulus and Poisson's ratio was calculated at about 50% failure load



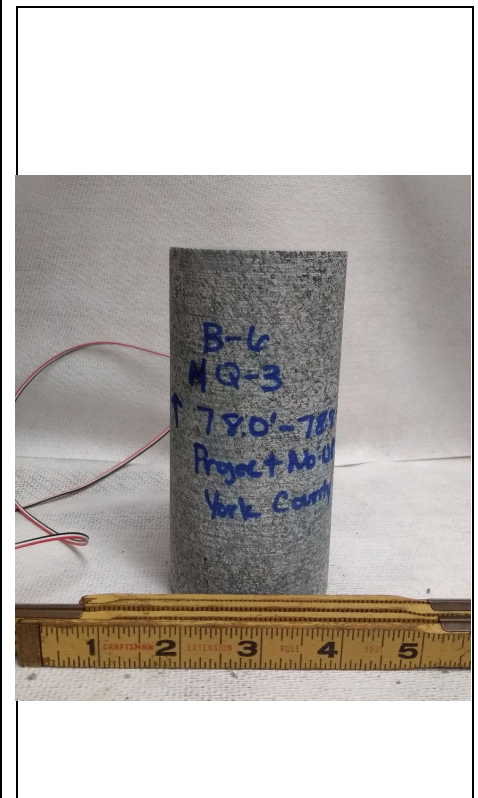


Uniaxial Compressive Strength of Intact Rock Core Specimens

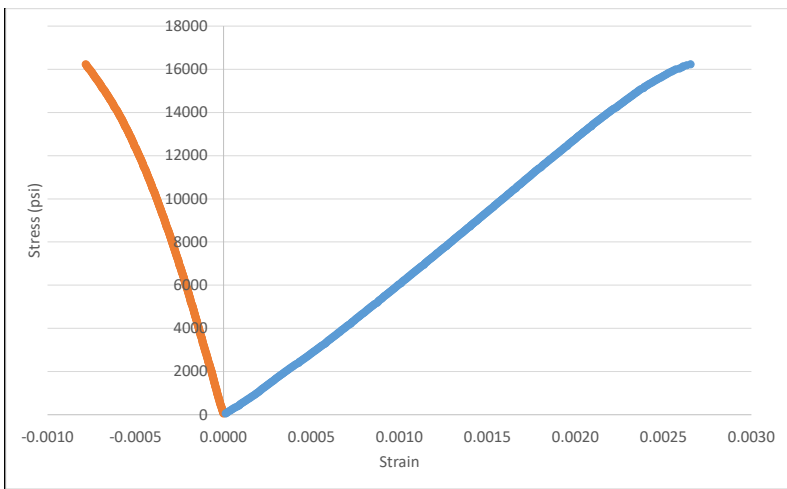
References:
ASTM D7012-14 Method D

Project No.:	08:14113	Borehole:	B6
Project:	S-816 Bridge over Mud Creek	Sample No.:	HQ-3
Location:	York County, SC	Depth:	78.0-78.8 ft
Client:		Lab ID No.:	B6-HQ3
Date Received:	03/16/2020		
Date Tested:	03/19/2020		

Testing Results			Sample Measurements		
Max Load	79,122	lbs	Diameter	2.492	in
	352.0	kN		6.33	cm
UCS	16227	psi	Height	5.286	in
	111.9	MPa		13.43	cm
Elastic Modulus	6845	ksi	Area	4.876	in ²
	47.20	GPa		31.46	cm ²
Loading Rate	14000	lbs/min	Volume	25.775	in ³
	1.04	kN/s		422.37	cm ³
Lithology	Intermediate Metavolcanic Rock, gray, slightly weathered, strong rock			Mass	2.580 lbs
Failure Mode	Diagonal shear plane(s)			Density	1170.27 g
				Bulk Density	172.97 lbs/ft ³
Poisson's Ratio	0.228			Density	2770.68 kg/m ³



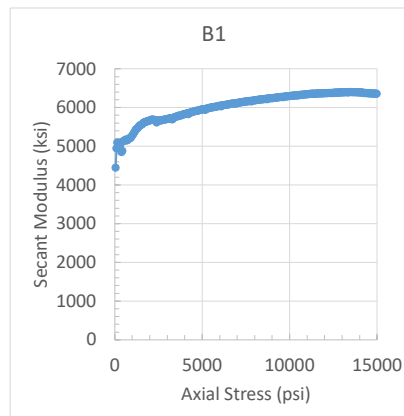
Before Test



After Test

Comments

1. Sample was received trimmed and was cut to size and repolished
2. One vertical and one lateral strain gages were attached
3. Elastic Modulus and Poisson's ratio was calculated at about 50% failure load



APPENDIX D – Supplemental Report Documents

Hammer Calibration



UNIVERSAL ENGINEERING SCIENCES

Consultants In: Geotechnical Engineering • Environmental Engineering • Construction Materials Testing •
Threshold Inspection • Private Provider Inspection • Geophysical Studies

Offices In:

- Daytona Beach, FL
- Fort Myers, FL
- Fort Pierce, FL
- Gainesville, FL
- Jacksonville, FL
- Leesburg, FL
- Miami, FL
- Norcross, GA
- Ocala, FL
- Orlando, FL
- Palm Coast, FL
- Panama City, FL
- Pensacola, FL
- Rockledge, FL
- Sarasota, FL
- St. Augustine, FL
- Tampa, FL
- West Palm Beach, FL

Betts Environmental
361 Airport Square
Adel, Georgia 31620

April 18, 2019

Subject: **Dynamic Testing Report**
 SPT Hammer Energy Measurement- CME-75 (S/N 164447)
 156 N Johnson Street
 Newborn, Georgia 30056
 UES Project 0950.1900024.0000

UES has completed the high strain dynamic (i.e. PDA) testing for the Soil Test Boring drill rig designated CME-75 in use at the above referenced project. Dynamic monitoring was conducted during performance of a soil test boring in order to determine energy transferred by the Standard Penetration Test hammer to the drill rods during split spoon sampling. The dynamic testing was conducted using the Pile Driving Analyzer™ (PDA) Model 8G, which records, digitizes, and processes the force and acceleration signals. The dynamic testing was carried out in accordance with ASTM D4945 *Standard Test Method for High Strain Dynamic Testing of Piles* and ASTM D4633 *Standard Test Method for Energy Measurement for Dynamic Penetrometers*.

PROJECT DESCRIPTION

Overview

The SPT hammer calibration testing was performed on site at the property located at 156 N Johnson Street in Newborn, Georgia. The SPT hammer calibration testing was performed at five (5) depths during sampling of an SPT Test Boring on April 12, 2019. The SPT hammer calibration testing was performed the following sampling depths; 33.5 to 35.0 feet (Sample 1), 38.5 to 40.0 feet (Sample 2), 43.5 to 45.0 feet (Sample 3), 48.5 to 50.0 feet (Sample 4), and 53.5 to 55.0 feet (Sample 5).

SPT Testing Overview

Numerous technical publications exist regarding the Standard Penetration Test (SPT). Of these publications, ASTM D1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* is considered to be the industry standard. This standard was last approved in January, 1999. In addition, U.S. Army Corp of Engineers Engineering Technical Letter (ETL) 1110-1-138 (dated March, 1988) is also a commonly used standard reference.

The Standard Penetration Test (SPT) consists of a drive weight assembly (i.e. hammer and anvil), split spoon sampler, and drill rods. The drive weight system consists of a 140 lb hammer raised by a number of mechanical means. The split spoon sampler is placed at the end of the drill rods in a borehole. The 140 lb hammer is raised 30 inches and then dropped to impact the drill rods. This procedure is repeated until the sampler has penetrated 18 inches into the underlying soil. The number of blows required to advance the split spoon sampler 12 inches is recorded as the “N” value for the test. Typically, the test is performed every 2 ½ ft for the upper 10 ft of a boring and then at 5 ft intervals thereafter. The standard dimensions of the split spoon sampler are shown in Figure 1, while a typical SPT setup is presented in Figure 2.

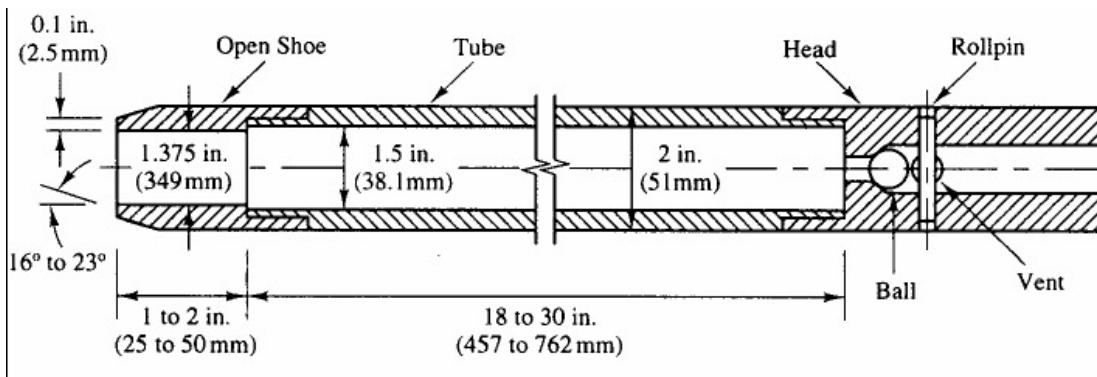


Figure 1. Split Spoon Sampler (after Rogers, 2004, adapted from ASTM D1586).

There are three (3) types of SPT hammers currently used in drilling practice today: the donut hammer, the automatic hammer, and the safety hammer. In addition, there are three (3) main types of hammer lifting mechanisms: cathead-rope system, spooling wench, or chain driven systems. Drill rods vary from AW (1 ¾ in O.D.) to NW (2 5/8 in O.D.), with drill rod lengths varying between 2 ft to 10 ft increments. Methods for advancing boreholes for the SPT test include mud rotary drilling, hollow stem augers, and water drilling with steel casing.



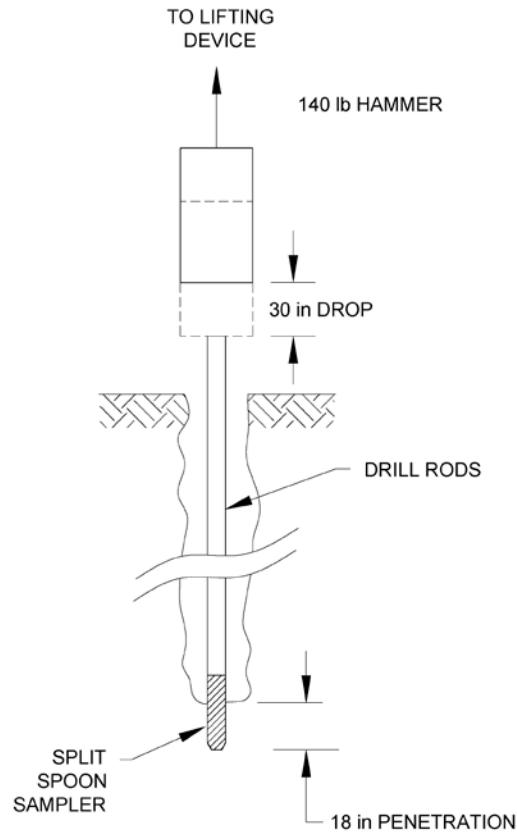


Figure 2. Typical SPT Setup.

SPT Energy Measurements

A number of factors can influence the SPT test and the subsequent N value. These include but are not limited to the following:

- Hammer
- Hammer Lifting System
- Operator Field Procedures
- Drill Rod Diameter and Length
- Borehole Drilling Method and Size
- Split Spoon Sampler

A graphical representation of various SPT system variables is provided in Figure 3.



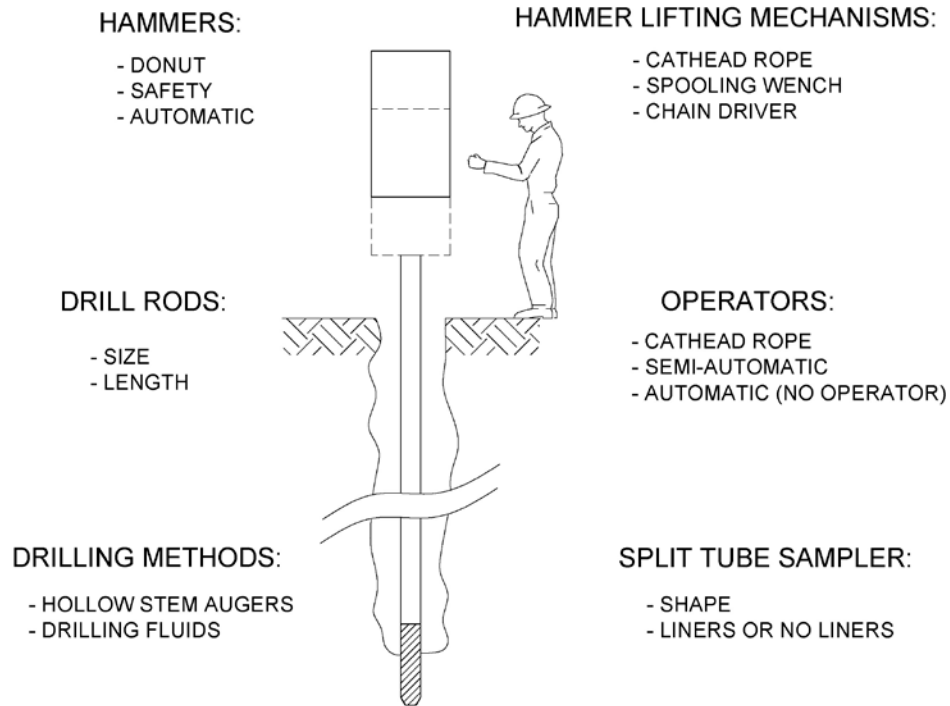


Figure 3. SPT Testing System Variables (after Lamb, 1997).

In order to account for these system variables, standardized SPT corrections have been developed. The corrected blow count is referred to as the N_{60} value. The N_{60} value is derived from the assumed efficiency of the original SPT (Mohr) hammer (Rogers, 2004). The following equation defines N_{60} values:

$$N_{60} = C_{60}C_bC_sC_rN$$

Where:

N_{60} = SPT N Value corrected for field procedures and apparatus

C_{60} = Hammer Efficiency Correction

C_b = Borehole Diameter Correction

C_s = Sample Barrel Correction

C_r = Rod Length Correction

N = Raw SPT value

In addition, the N value is influenced by the overburden pressure. Laio and Whitman (1986) proposed the following overburden correction for N_{60} , termed $(N_1)_{60}$:

$$(N_1)_{60} = N_{60} \frac{\sqrt{2000 \text{ psf}}}{\sigma'_v}$$



Where:

σ'_v = Effective vertical overburden stress

The hammer efficiency correction (C_{60}) is based on the Energy Transfer Efficiency (ER_i) and the 60% of the theoretical transferred hammer energy of 350 ft-lbs (i.e. 140 lbs multiplied by a 30 inch drop). The following equations show the derivation of C_{60} :

$$ER_i = \frac{E_i}{E_{th}}$$

Where:

ER_i = Energy Transfer Efficiency

E_i = Measured Transferred Energy

E_{th} = Theoretical Transferred Energy (i.e. 350 ft-lb)

and

$$C_{60} = \frac{ER_i}{60\%}$$

For liquefaction analysis using SPT N values, transferred energy measurements are required to determine $(N_1)_{60}$. The methods for determining the normalized penetration resistance for liquefaction potential are presented in ASTM D6066 *Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential*.

Transferred (i.e. delivered) energy measurements of SPT testing (i.e. the energy delivered by the hammer to the drill rods) are commonly taken in engineering practice through the use of several types of instruments. The most common of these is the Pile Driving Analyzer (PDA), developed and marketed by Pile Dynamics Inc. of Cleveland, Ohio. The PDA is a computer fitted with a data acquisition and a signal conditioning system and is typically used to conduct high strain dynamic load testing of driven piles, which is analogous to the SPT test. Strain gages and accelerometers which are connected to the PDA are attached to the pile or drill rods (for SPT testing). During pile driving or SPT testing, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The PDA saves selected hammer blows containing this information to disk and determines the compressive stresses, displacement, and



energy at the point of measurement (pile top). The maximum transferred energy (EMX) is derived from the dynamic measurements using the following equation:

$$EMX = \int_b^a F(t)V(t)dt$$

Where:

a = Time Energy Transfer Begins

b = Time Energy Transfer End

F = Force

V = Velocity

t = Time

Refer to Abou-matar and Goble (1997) for additional details of SPT energy measurements using the PDA. Literature regarding the PDA is provided in the Appendix.

SPT Rig/Hammer System

The tested drill rig is designated CME-75 and is manufactured by Central Mine Equipment, Inc. The drill rig was parked on existing grade in a grassy area for this project. We understand that the drill rig was built on October 29, 1984 and is identified with Serial Number 164447. The CME-75 drill rig is fitted with an automatically operated hammer system. The drill rig and SPT hammer were operated by Mr. Chris Golden.

The method of drilling for the rig during testing was hollow stem auger (HSA), with Standard Penetration Testing being performed with AWJ drill rods. AWJ drill rod sections have nominal outside diameter of 1-5/8 inches and wall thickness of 3/16 inches. The instrumented sub-assembly (i.e. where gauges were attached) consisted of a two feet long section of AWJ rod that was threaded into the top drill rod at each testing interval.

Dynamic Load Test Instrumentation

The dynamic pile testing instrumentation consisted of a 2-foot long AWJ instrumented drill rod which is fitted with two strain gauges by Pile Dynamic Inc., in addition two (2) accelerometer transducers are attached a distance of approximately 1 foot below the top (i.e. in the center) of a two feet long instrumented AWJ drill rod. One strain gauge and one accelerometer are on opposite faces of the sub-assembly to minimize the effects of uneven hammer impact and rod bending.

A Model 8G Pile Driving Analyzer™ (PDA), manufactured by Pile Dynamics Inc., was used to collect the instrumentation data. The PDA is a computer fitted with a data acquisition and a



signal conditioning system. During driving, the strain and acceleration signals are recorded and processed for each hammer blow. The strain signal is converted to a force record and the acceleration signal is converted to a velocity record. The sampling frequency used during the SPT Energy Measurement Testing was 20,000 hertz (20 kHz). The PDA saves selected hammer blows containing this information to disk and determines the energy at the point of measurement.

DYNAMIC TESTING RESULTS

Hammer Performance

The transferred energy monitored during the sampling is summarized in Table 1. Note that the values are those recorded during the second and third 6-inch sampling interval at each depth. Hammer Efficiency is based on measured transferred energy divided by the energy generated with a 140 pound hammer dropping 30 inches (0.35 kip-ft).

Table 1. CME-75 Rig SPT Energy Measurement Summary

SPT 1 Sample Depth (feet)	SPT Blow Count (Per 6 inch)	Hammer Efficiency (%)			
		Min	Max	Average	Standard Deviation
33.5 to 35.0	3-4-4	73.70	75.96	75.02	0.71
38.5 to 40.0	5-12-14	70.58	74.11	72.25	0.92
43.5 to 45.0	5-12-21	70.22	74.76	71.98	1.13
48.5 to 50.0	8-12-25	71.29	74.62	72.84	0.80
53.5 to 55.0	20-22-29	70.49	74.32	72.31	0.78
OVERALL¹:		71.26	74.75	72.88	0.87

The following figure shows the SPT rig tested.





Figure 1: SPT drill rig.



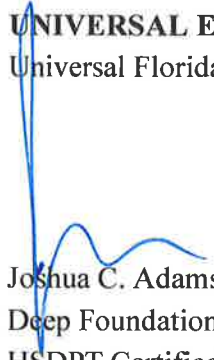
CONCLUSIONS AND RECOMMENDATIONS

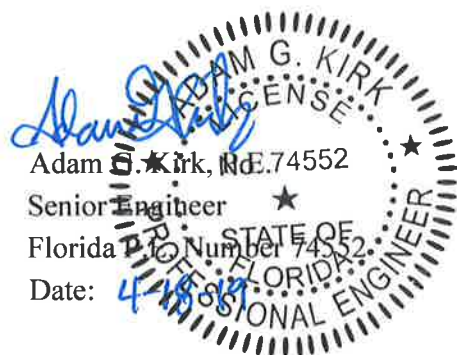
It is our opinion that the SPT hammer on the drill rig designated CME-75 is operating within a normal range for a semi-automatic SPT hammer.

UES appreciates the opportunity to provide this report. This report is for the sole use of this project and should not be relied upon otherwise. Should the project change significantly, we can review and modify our recommendations as needed. If you have questions concerning the contents herein, please contact us.

Sincerely,

UNIVERSAL ENGINEERING SCIENCES, INC.
Universal Florida Certificate of Authorization No. 549


Joshua C. Adams
Deep Foundation Engineer
HSDPT Certified – Master Level

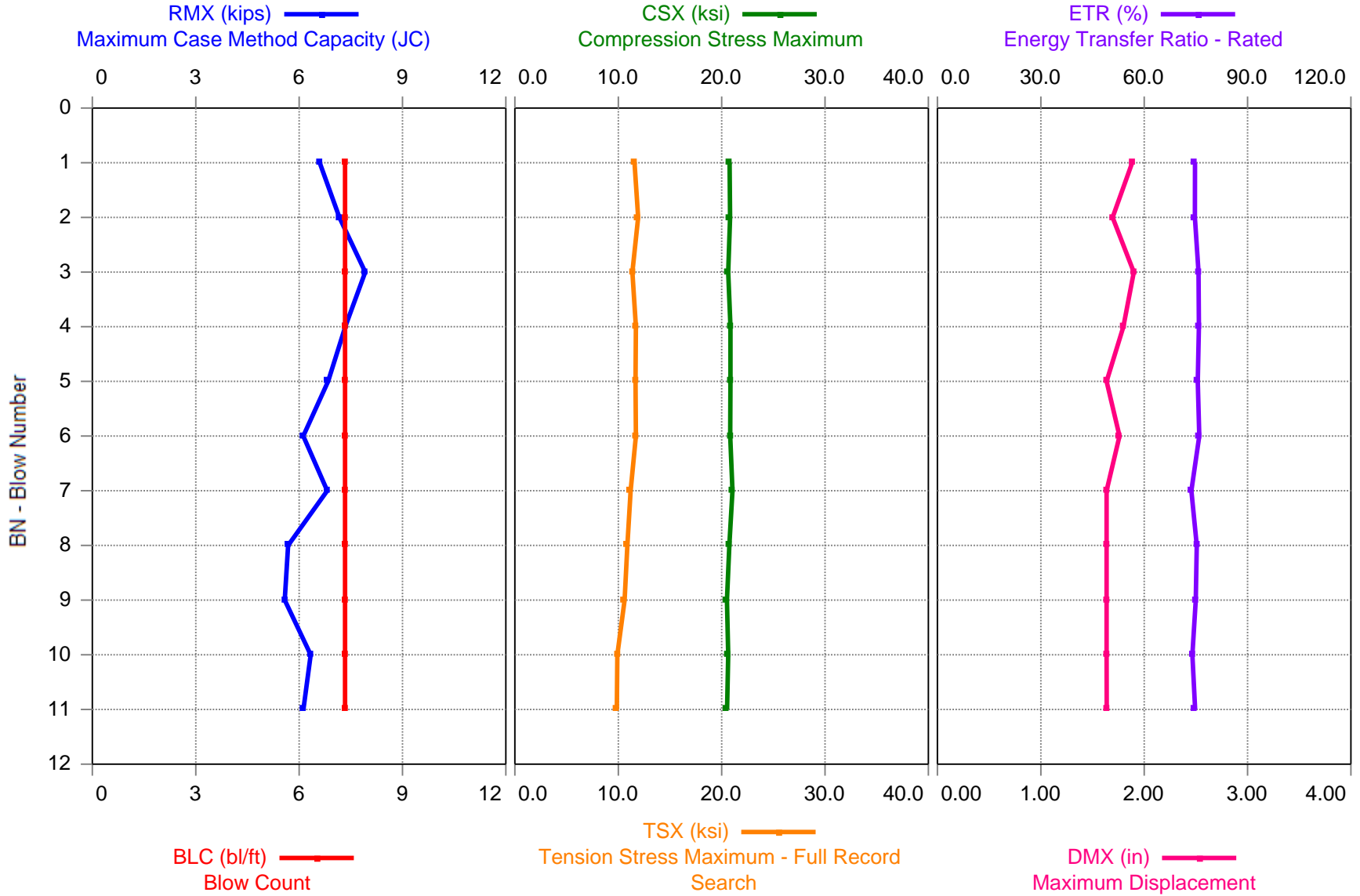


Attachments: PDA Data Output (PDI PLOT Graphs and Tables)





Georgia SPT - SPT 2 Sample1



Georgia SPT - SPT 2 Sample1
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 44.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC) CSB: Compression Stress at Bottom of Pile
CSX: Compression Stress Maximum DMX: Maximum Displacement
TSX: Tension Stress Maximum - Full Record Search SFR: Skin Friction (Crude Damping Correction)
STK: Hammer Stroke ETR: Energy Transfer Ratio - Rated
CSI: Compression Stress Maximum - Individual Sensor

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	33.64	7	6.6	20.8	11.6	0.00	20.8	15.0	1.88	3	74.72
2	33.77	7	7.2	20.8	11.9	0.00	21.0	14.5	1.69	4	74.72
3	33.91	7	7.9	20.6	11.4	0.00	21.1	15.1	1.90	4	75.75
4	34.05	7	7.3	20.8	11.7	0.00	21.1	14.6	1.80	4	75.86
5	34.18	7	6.8	20.9	11.7	0.00	21.1	14.6	1.64	3	75.54
6	34.32	7	6.1	20.8	11.7	0.00	21.1	15.0	1.76	2	75.96
7	34.45	7	6.8	21.0	11.2	0.00	21.3	15.3	1.64	3	73.70
8	34.59	7	5.7	20.7	10.9	0.00	21.0	14.7	1.64	2	75.25
9	34.73	7	5.6	20.5	10.6	0.00	20.8	14.6	1.64	2	74.95
10	34.86	7	6.3	20.6	9.9	0.00	20.9	14.4	1.64	3	73.99
11	35.00	7	6.1	20.5	9.9	0.00	20.8	14.6	1.64	3	74.78
Average			6.6	20.7	11.1	**	21.0	14.8	1.71	3	75.02
Std. Dev.			0.7	0.2	0.7	**	0.1	0.3	0.10	1	0.71
Maximum			7.9	21.0	11.9	**	21.3	15.3	1.90	4	75.96
Minimum			5.6	20.5	9.9	**	20.8	14.4	1.64	2	73.70

Total number of blows analyzed: 11

BL# Sensors

1-11 F1: [357AWJ1] 212.0 (1.02); F4: [357AWJ2] 211.2 (1.02); A2: [55385] 915.0 (0.98);
A3: [50148] 1065.0 (0.98)

BL# Comments

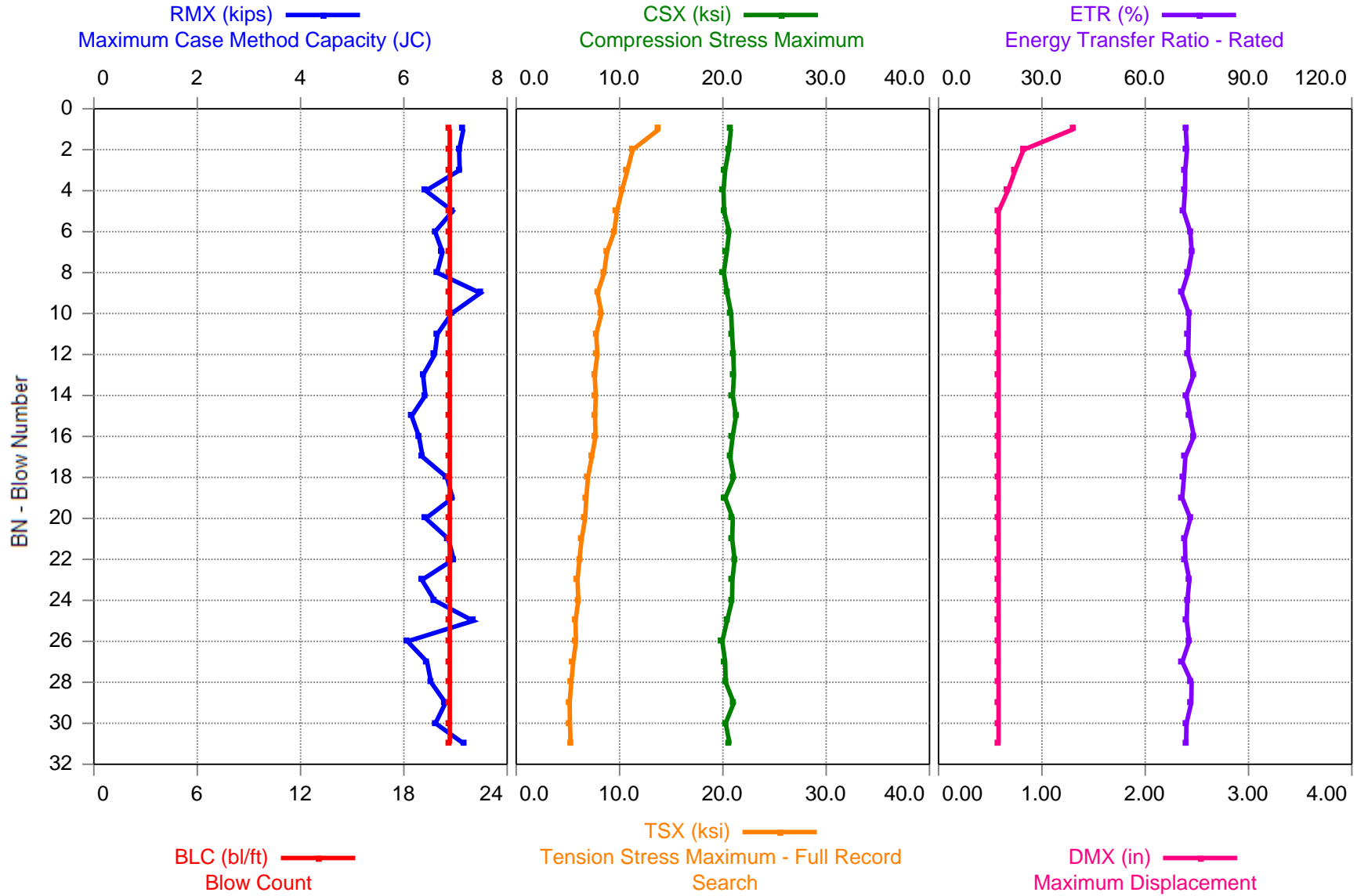
11 End of Set 1. n=10

Time Summary

Drive 13 seconds 1:46 PM - 1:46 PM BN 1 - 11



Georgia SPT - SPT 2 Sample 2



Georgia SPT - SPT 2 Sample 2
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 50.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC) CSB: Compression Stress at Bottom of Pile
CSX: Compression Stress Maximum DMX: Maximum Displacement
TSX: Tension Stress Maximum - Full Record Search SFR: Skin Friction (Crude Damping Correction)
STK: Hammer Stroke ETR: Energy Transfer Ratio - Rated
CSI: Compression Stress Maximum - Individual Sensor

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	38.55	21	7.2	20.8	13.8	0.00	20.9	15.4	1.31	3	71.76
2	38.60	21	7.1	20.6	11.3	0.00	20.6	14.9	0.82	3	72.14
3	38.65	21	7.1	20.2	10.8	0.00	20.5	14.7	0.74	3	71.63
4	38.69	21	6.4	20.1	10.2	0.00	20.3	14.2	0.67	3	71.53
5	38.74	21	6.9	20.1	9.8	0.00	20.3	14.5	0.58	3	71.16
6	38.79	21	6.6	20.6	9.5	0.00	20.9	14.4	0.58	3	73.06
7	38.84	21	6.7	20.4	8.8	0.00	20.4	14.7	0.58	3	73.52
8	38.89	21	6.6	20.1	8.5	0.00	20.1	13.9	0.58	3	72.45
9	38.94	21	7.5	20.4	7.9	0.00	20.4	14.3	0.58	3	70.58
10	38.98	21	6.9	20.8	8.3	0.00	21.0	14.9	0.58	3	72.72
11	39.03	21	6.6	20.9	7.7	0.00	21.0	14.7	0.58	3	72.58
12	39.08	21	6.6	21.0	7.9	0.00	21.2	14.8	0.58	3	72.44
13	39.13	21	6.4	21.1	7.6	0.00	21.1	14.7	0.58	3	74.07
14	39.18	21	6.4	21.0	7.7	0.00	21.2	14.4	0.58	3	71.92
15	39.23	21	6.1	21.3	7.6	0.00	21.3	14.8	0.58	3	72.94
16	39.27	21	6.3	20.9	7.7	0.00	21.2	15.0	0.58	2	74.11
17	39.32	21	6.4	20.7	7.3	0.00	20.8	14.4	0.58	3	71.63
18	39.37	21	6.8	21.1	6.9	0.00	21.1	15.2	0.58	3	71.24
19	39.42	21	6.9	20.2	6.8	0.00	20.4	14.9	0.58	3	70.74
20	39.47	21	6.4	21.0	6.7	0.00	21.0	15.1	0.58	3	73.12
21	39.52	21	6.9	20.9	6.3	0.00	21.0	15.2	0.58	3	71.50
22	39.56	21	7.0	21.1	6.1	0.00	21.3	15.1	0.58	3	71.65
23	39.61	21	6.3	20.9	5.9	0.00	21.0	15.0	0.58	3	72.81
24	39.66	21	6.6	20.9	6.0	0.00	21.0	15.0	0.58	3	72.22
25	39.71	21	7.3	20.4	5.7	0.00	20.7	14.9	0.58	3	72.04
26	39.76	21	6.1	19.9	5.8	0.00	20.0	14.2	0.58	2	72.76
27	39.81	21	6.4	20.2	5.5	0.00	20.5	14.8	0.58	3	70.77
28	39.85	21	6.5	20.3	5.3	0.00	20.5	14.7	0.58	3	73.48
29	39.90	21	6.8	21.1	5.2	0.00	21.3	15.2	0.58	3	73.35
30	39.95	21	6.6	20.3	5.2	0.00	20.6	14.3	0.58	3	71.99
31	40.00	21	7.2	20.7	5.3	0.00	20.9	15.1	0.58	3	71.85
Average			6.7	20.6	7.6	**	20.8	14.8	0.62	3	72.25
Std. Dev.			0.3	0.4	2.0	**	0.4	0.4	0.14	0	0.92
Maximum			7.5	21.3	13.8	**	21.3	15.4	1.31	3	74.11
Minimum			6.1	19.9	5.2	**	20.0	13.9	0.58	2	70.58

Total number of blows analyzed: 31

BL# Sensors

1-31 F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88);
A3: [50148] 1065.0 (0.88)

Georgia SPT - SPT 2 Sample 2
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL# Comments

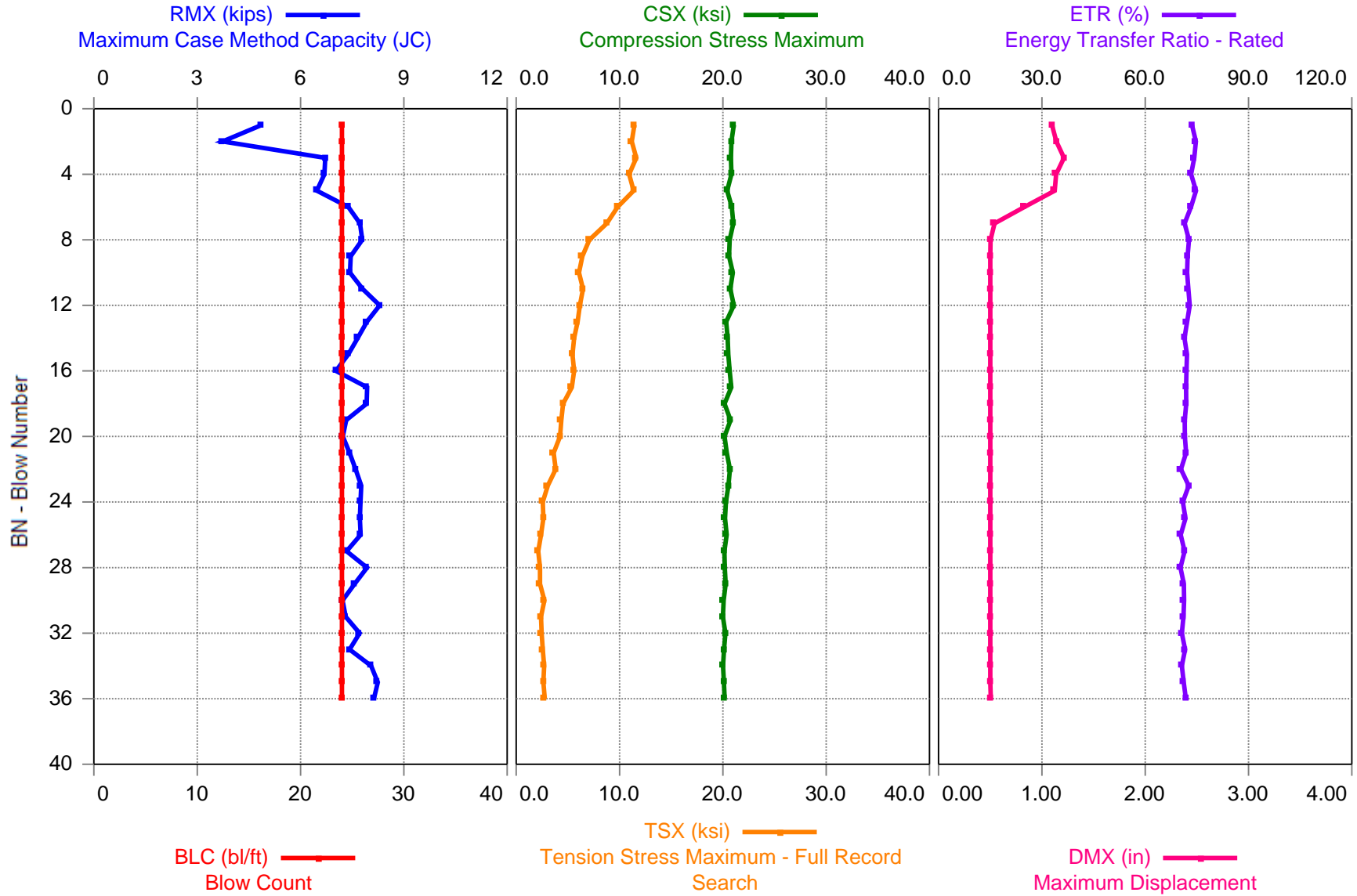
31 end of set 2. N=28

Time Summary

Drive 41 seconds 1:56 PM - 1:56 PM BN 1 - 31



Georgia SPT - SPT 2 Sample 3



Georgia SPT - SPT 2 Sample 3

Rod of area 1.18 square inches on CME 75

OP: NVT

Date: 12-April-2019

AR: 1.18 in²

SP: 0.492 k/ft³

LE: 55.00 ft

EM: 30,000 ksi

WS: 16,807.9 f/s

JC: 0.60

RMX: Maximum Case Method Capacity (JC)

CSB: Compression Stress at Bottom of Pile

CSX: Compression Stress Maximum

DMX: Maximum Displacement

TSX: Tension Stress Maximum - Full Record Search

SFR: Skin Friction (Crude Damping Correction)

STK: Hammer Stroke

ETR: Energy Transfer Ratio - Rated

CSI: Compression Stress Maximum - Individual Sensor

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	43.54	24	4.9	21.1	11.4	0.00	21.6	13.3	1.10	3	73.56
2	43.58	24	3.7	20.8	11.2	0.00	21.3	12.7	1.14	2	74.69
3	43.63	24	6.7	20.8	11.6	0.00	21.2	14.4	1.21	3	74.22
4	43.67	24	6.7	20.8	10.9	0.00	21.4	13.9	1.14	4	73.33
5	43.71	24	6.5	20.4	11.4	0.00	20.9	13.8	1.12	3	74.76
6	43.75	24	7.4	20.9	9.8	0.00	21.5	14.5	0.83	4	73.27
7	43.79	24	7.7	21.0	8.8	0.00	21.6	14.4	0.54	4	71.45
8	43.83	24	7.8	20.7	7.1	0.00	21.3	14.5	0.50	4	72.71
9	43.88	24	7.5	20.6	6.4	0.00	21.2	14.7	0.50	3	72.31
10	43.92	24	7.4	21.0	6.1	0.00	21.6	14.8	0.50	3	72.14
11	43.96	24	7.8	20.7	6.5	0.00	21.4	14.8	0.50	4	72.51
12	44.00	24	8.3	21.1	6.2	0.00	21.9	15.1	0.50	4	72.92
13	44.04	24	7.9	20.3	5.9	0.00	20.8	14.8	0.50	4	72.14
14	44.08	24	7.7	20.5	5.6	0.00	21.2	14.6	0.50	4	71.40
15	44.13	24	7.4	20.5	5.4	0.00	21.3	14.9	0.50	3	72.12
16	44.17	24	7.0	20.7	5.6	0.00	21.4	14.6	0.50	3	71.96
17	44.21	24	7.9	20.8	5.4	0.00	21.5	15.1	0.50	4	71.86
18	44.25	24	7.9	20.2	4.5	0.00	20.7	14.4	0.50	4	71.91
19	44.29	24	7.3	20.7	4.4	0.00	21.5	14.2	0.50	4	71.45
20	44.33	24	7.2	20.2	4.2	0.00	20.7	14.2	0.50	3	71.52
21	44.38	24	7.4	20.4	3.6	0.00	21.1	14.4	0.50	4	71.86
22	44.42	24	7.6	20.7	3.8	0.00	21.3	14.4	0.50	4	70.36
23	44.46	24	7.8	20.5	3.0	0.00	21.4	14.7	0.50	4	72.62
24	44.50	24	7.7	20.3	2.6	0.00	20.9	14.1	0.50	4	70.92
25	44.54	24	7.7	20.2	2.6	0.00	20.8	13.9	0.50	4	71.70
26	44.58	24	7.7	20.4	2.4	0.00	21.1	14.3	0.50	4	70.31
27	44.63	24	7.3	20.1	2.1	0.00	20.8	14.0	0.50	4	71.44
28	44.67	24	7.9	20.2	2.3	0.00	20.7	14.0	0.50	4	70.22
29	44.71	24	7.6	20.3	2.3	0.00	20.9	14.2	0.50	4	71.23
30	44.75	24	7.2	20.1	2.7	0.00	20.7	14.1	0.50	4	71.27
31	44.79	24	7.3	20.0	2.4	0.00	20.6	13.8	0.50	4	71.10
32	44.83	24	7.7	20.2	2.5	0.00	20.8	14.3	0.50	4	70.64
33	44.88	24	7.4	20.1	2.6	0.00	20.7	13.8	0.50	4	71.58
34	44.92	24	8.0	20.0	2.7	0.00	20.5	14.0	0.50	4	70.62
35	44.96	24	8.2	20.1	2.6	0.00	20.7	14.2	0.50	4	71.18
36	45.00	24	8.1	20.2	2.8	0.00	20.6	14.3	0.51	4	71.80
Average			7.4	20.5	5.3	**	21.1	14.3	0.60	4	71.98
Std. Dev.			0.9	0.3	3.1	**	0.4	0.5	0.23	0	1.13
Maximum			8.3	21.1	11.6	**	21.9	15.1	1.21	4	74.76
Minimum			3.7	20.0	2.1	**	20.5	12.7	0.50	2	70.22

Total number of blows analyzed: 36

Georgia SPT - SPT 2 Sample 3
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL# Sensors

1-36 F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88);
A3: [50148] 1065.0 (0.88)

BL# Comments

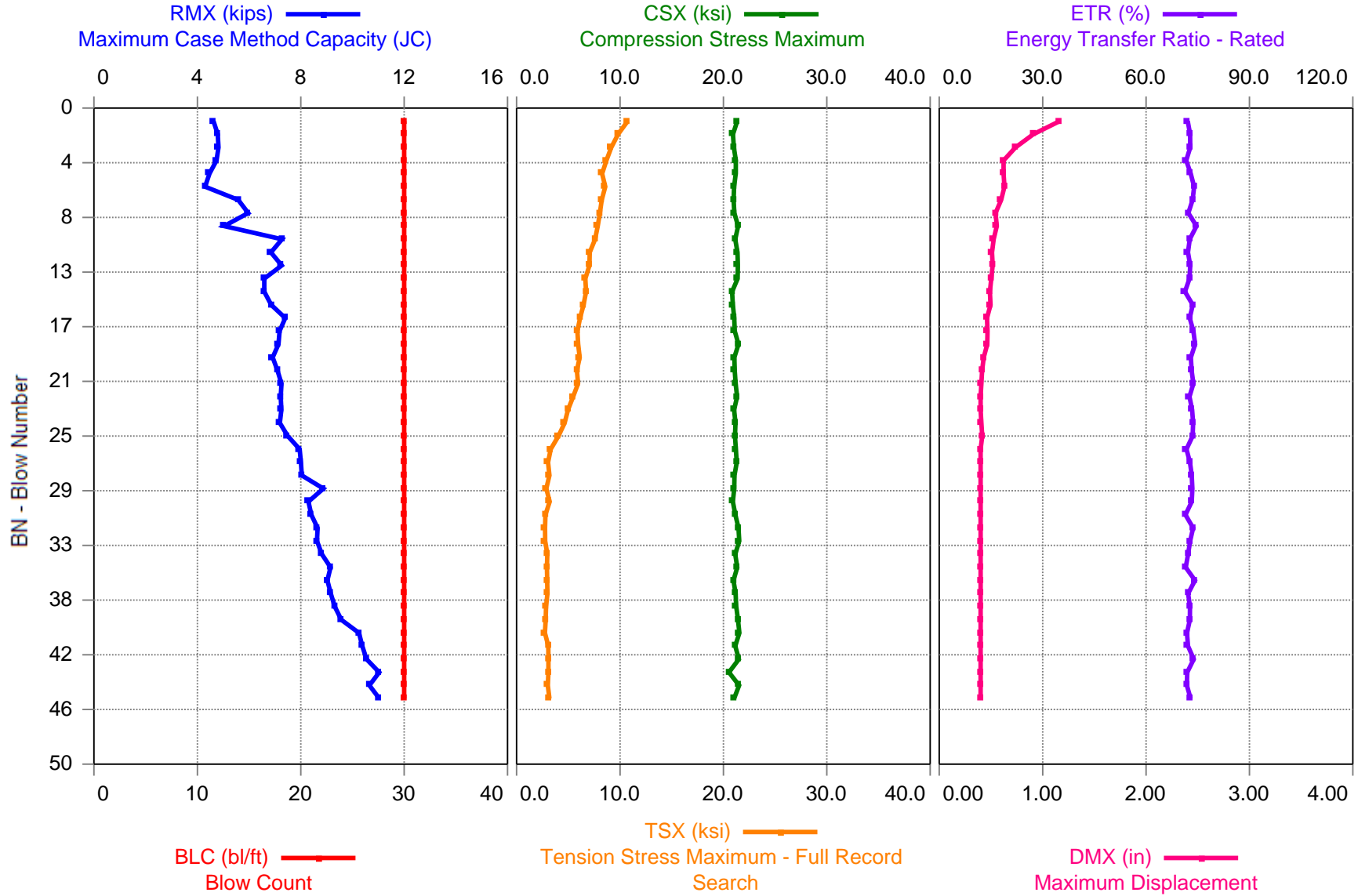
36 End of Set 3. n=33

Time Summary

Drive 49 seconds 2:14 PM - 2:14 PM BN 1 - 36



Georgia SPT - SPT 2 Sample 4



Georgia SPT - SPT 2 Sample 4
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 55.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC) CSB: Compression Stress at Bottom of Pile
CSX: Compression Stress Maximum DMX: Maximum Displacement
TSX: Tension Stress Maximum - Full Record Search SFR: Skin Friction (Crude Damping Correction)
STK: Hammer Stroke ETR: Energy Transfer Ratio - Rated
CSI: Compression Stress Maximum - Individual Sensor

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	48.53	30	4.6	21.3	10.7	0.00	21.5	15.0	1.17	1	72.09
2	48.57	30	4.8	20.9	9.8	0.00	21.1	13.1	0.91	2	72.78
3	48.60	30	4.8	21.0	9.2	0.00	21.0	13.8	0.74	2	72.83
4	48.63	30	4.7	21.2	8.7	0.00	21.2	14.1	0.62	2	71.63
5	48.67	30	4.5	21.2	8.3	0.00	21.2	14.6	0.62	1	72.96
6	48.70	30	4.3	21.0	8.6	0.00	21.1	14.3	0.63	2	73.93
7	48.73	30	5.6	21.0	8.2	0.00	21.0	15.0	0.60	2	73.49
8	48.77	30	6.0	21.1	8.0	0.00	21.1	15.2	0.54	2	72.26
9	48.80	30	5.0	21.4	7.8	0.00	21.5	14.4	0.56	2	74.62
10	48.83	30	7.3	21.1	7.6	0.00	21.2	15.6	0.53	3	72.65
11	48.87	30	6.8	21.4	7.1	0.00	21.4	15.6	0.51	3	72.17
12	48.90	30	7.3	21.4	7.0	0.00	21.5	15.8	0.52	3	72.82
13	48.93	30	6.6	21.4	6.6	0.00	21.5	15.5	0.50	2	72.61
14	48.97	30	6.6	20.8	6.7	0.00	20.9	15.4	0.49	2	71.29
15	49.00	30	6.9	20.9	6.5	0.00	21.0	15.8	0.50	2	73.55
16	49.03	30	7.4	21.0	6.1	0.00	21.1	15.7	0.46	3	72.67
17	49.07	30	7.2	21.1	5.9	0.00	21.2	15.9	0.47	3	73.71
18	49.10	30	7.1	21.5	6.0	0.00	21.7	15.8	0.46	3	74.24
19	49.13	30	6.9	21.1	6.1	0.00	21.1	15.3	0.43	2	73.00
20	49.17	30	7.1	21.1	5.8	0.00	21.1	15.9	0.41	2	73.21
21	49.20	30	7.3	21.2	5.9	0.00	21.3	16.0	0.41	2	73.71
22	49.23	30	7.2	21.3	5.5	0.00	21.5	15.9	0.40	2	72.58
23	49.27	30	7.2	21.0	5.0	0.00	21.1	15.9	0.40	2	73.35
24	49.30	30	7.2	21.2	4.6	0.00	21.2	16.1	0.41	2	73.66
25	49.33	30	7.5	21.1	4.0	0.00	21.1	15.8	0.42	3	73.49
26	49.37	30	8.0	21.2	3.3	0.00	21.4	14.8	0.40	3	71.73
27	49.40	30	8.0	21.3	3.0	0.00	21.4	15.8	0.40	3	72.73
28	49.43	30	8.0	21.1	3.2	0.00	21.1	15.8	0.40	3	73.24
29	49.47	30	8.9	21.0	2.9	0.00	21.1	16.0	0.40	3	73.44
30	49.50	30	8.3	20.9	3.2	0.00	21.0	15.8	0.40	3	73.26
31	49.53	30	8.4	21.2	2.8	0.00	21.2	15.5	0.40	3	71.45
32	49.57	30	8.7	21.5	2.8	0.00	21.7	15.7	0.40	3	73.66
33	49.60	30	8.6	21.5	2.8	0.00	21.8	16.2	0.40	3	72.79
34	49.63	30	8.8	21.1	3.0	0.00	21.3	15.8	0.40	3	72.19
35	49.67	30	9.2	21.3	2.9	0.00	21.6	15.2	0.40	4	71.50
36	49.70	30	9.0	21.0	3.0	0.00	21.2	15.9	0.40	3	74.18
37	49.73	30	9.2	21.2	3.0	0.00	21.2	15.7	0.40	3	72.21
38	49.77	30	9.3	21.2	2.9	0.00	21.4	15.9	0.40	4	72.74
39	49.80	30	9.6	21.4	2.8	0.00	21.6	15.9	0.40	4	72.69
40	49.83	30	10.3	21.5	2.7	0.00	21.8	15.9	0.40	4	71.86
41	49.87	30	10.4	21.1	3.1	0.00	21.3	16.2	0.40	4	72.14
42	49.90	30	10.5	21.5	3.1	0.00	21.7	15.8	0.40	4	73.82
43	49.93	30	11.0	20.5	3.1	0.00	20.6	15.9	0.40	4	71.92
44	49.97	30	10.7	21.5	3.0	0.00	21.6	16.4	0.40	4	71.82
45	50.00	30	11.0	21.0	3.2	0.00	21.1	15.8	0.40	4	72.92

Georgia SPT - SPT 2 Sample 4
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
	Average		7.6	21.2	5.2	**	21.3	15.5	0.48	3	72.84
	Std. Dev.		1.8	0.2	2.3	**	0.3	0.7	0.15	1	0.80
	Maximum		11.0	21.5	10.7	**	21.8	16.4	1.17	4	74.62
	Minimum		4.3	20.5	2.7	**	20.6	13.1	0.40	1	71.29

Total number of blows analyzed: 45

BL# Sensors

1-45 F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88);
A3: [50148] 1065.0 (0.88)

BL# Comments

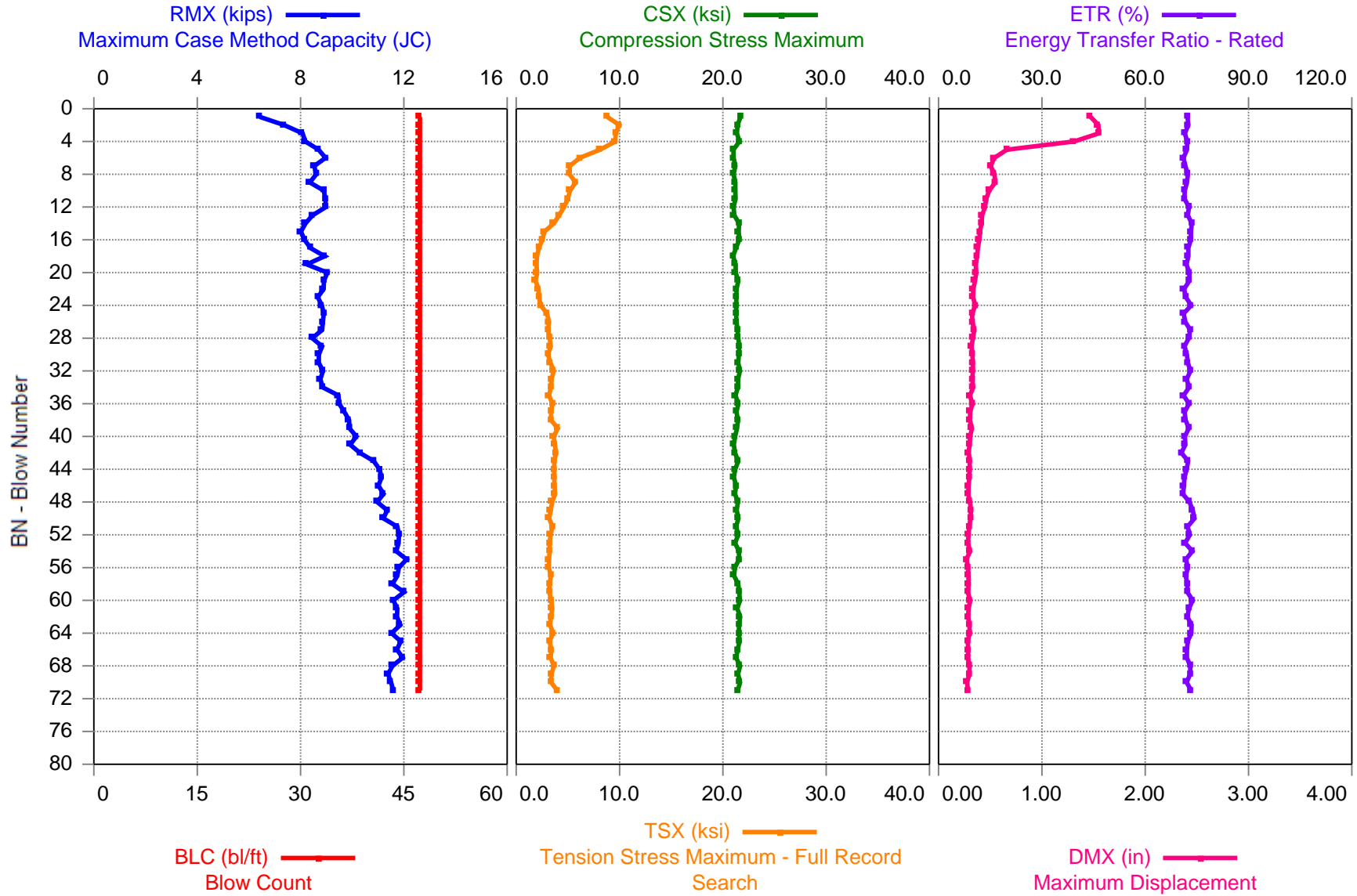
45 end of set 4. n=39

Time Summary

Drive 1 minute 2 seconds 2:27 PM - 2:28 PM BN 1 - 45



Georgia SPT - SPT 2 Sample 5



Georgia SPT - SPT 2 Sample 5
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

AR: 1.18 in² SP: 0.492 k/ft³
LE: 60.00 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.60

RMX: Maximum Case Method Capacity (JC) CSB: Compression Stress at Bottom of Pile
CSX: Compression Stress Maximum DMX: Maximum Displacement
TSX: Tension Stress Maximum - Full Record Search SFR: Skin Friction (Crude Damping Correction)
STK: Hammer Stroke ETR: Energy Transfer Ratio - Rated
CSI: Compression Stress Maximum - Individual Sensor

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
1	53.52	47	6.4	21.7	8.8	0.00	21.8	17.7	1.47	1	72.27
2	53.54	47	7.4	21.4	10.0	0.00	21.5	15.4	1.55	3	72.51
3	53.56	47	8.1	21.4	9.6	0.00	21.4	15.5	1.55	4	71.52
4	53.58	47	8.2	21.6	9.6	0.00	21.6	16.4	1.31	3	72.20
5	53.61	47	8.7	21.0	8.1	0.00	21.2	15.8	0.66	4	72.13
6	53.63	47	9.0	21.0	6.1	0.00	21.2	16.1	0.54	3	71.12
7	53.65	47	8.5	21.2	5.2	0.00	21.3	16.4	0.50	3	71.64
8	53.67	47	8.6	21.0	5.2	0.00	21.2	16.6	0.54	3	72.37
9	53.69	47	8.4	21.2	5.7	0.00	21.4	16.1	0.55	3	72.11
10	53.71	47	8.9	21.2	5.2	0.00	21.3	16.7	0.49	3	71.46
11	53.73	47	9.0	21.2	5.0	0.00	21.5	16.8	0.46	3	71.39
12	53.75	47	9.0	21.0	4.6	0.00	21.2	16.7	0.45	3	72.71
13	53.77	47	8.5	21.1	4.2	0.00	21.2	16.0	0.42	3	72.38
14	53.80	47	8.2	21.6	3.6	0.00	21.6	16.8	0.42	3	73.49
15	53.82	47	8.0	21.5	2.7	0.00	21.6	16.6	0.40	3	73.30
16	53.84	47	8.2	21.6	2.5	0.00	21.6	16.6	0.39	3	73.22
17	53.86	47	8.4	21.3	2.2	0.00	21.3	16.0	0.38	3	72.54
18	53.88	47	8.9	21.0	2.0	0.00	21.1	16.8	0.37	3	72.52
19	53.90	47	8.2	21.2	2.0	0.00	21.3	16.6	0.36	3	71.99
20	53.92	47	9.0	21.2	2.0	0.00	21.5	16.7	0.36	3	72.82
21	53.94	47	8.9	21.5	1.9	0.00	21.7	16.7	0.35	3	72.80
22	53.96	47	8.9	21.3	2.2	0.00	21.6	16.5	0.34	3	71.30
23	53.99	47	8.7	21.3	2.2	0.00	21.4	16.5	0.33	3	71.79
24	54.01	47	8.8	21.3	2.4	0.00	21.4	16.4	0.36	3	73.37
25	54.03	47	8.9	21.3	3.0	0.00	21.4	16.8	0.32	3	71.17
26	54.05	47	8.9	21.3	3.2	0.00	21.5	16.6	0.33	3	71.61
27	54.07	47	8.8	21.4	3.1	0.00	21.4	17.5	0.35	2	73.06
28	54.09	47	8.5	21.5	3.2	0.00	21.5	16.7	0.33	3	72.63
29	54.11	47	8.8	21.6	3.3	0.00	21.7	16.8	0.32	3	71.40
30	54.13	47	8.7	21.6	3.1	0.00	21.8	16.6	0.33	3	72.10
31	54.15	47	8.7	21.5	3.3	0.00	21.7	16.9	0.33	3	72.38
32	54.18	47	8.9	21.7	3.6	0.00	21.8	17.1	0.33	3	73.15
33	54.20	47	8.8	21.5	3.4	0.00	21.6	17.1	0.33	3	72.04
34	54.22	47	8.9	21.5	3.3	0.00	21.6	16.8	0.33	3	72.75
35	54.24	47	9.5	21.2	3.2	0.00	21.5	16.8	0.30	3	71.13
36	54.26	47	9.5	21.5	3.5	0.00	21.6	17.0	0.33	3	72.73
37	54.28	47	9.7	21.3	3.4	0.00	21.5	16.8	0.31	3	71.44
38	54.30	47	9.9	21.5	3.4	0.00	21.7	16.4	0.30	4	71.71
39	54.32	47	9.9	21.4	4.0	0.00	21.4	17.0	0.32	3	72.68
40	54.35	47	10.2	21.2	3.6	0.00	21.3	16.6	0.31	4	71.51
41	54.37	47	9.9	21.1	3.7	0.00	21.2	16.6	0.30	4	71.63
42	54.39	47	10.3	21.2	3.8	0.00	21.3	16.5	0.29	4	70.49
43	54.41	47	10.8	21.5	3.7	0.00	21.7	16.6	0.30	4	72.44
44	54.43	47	11.1	21.2	3.7	0.00	21.2	16.5	0.30	4	72.04
45	54.45	47	11.1	21.1	3.7	0.00	21.2	16.6	0.30	4	71.36

Georgia SPT - SPT 2 Sample 5
OP: NVT

Rod of area 1.18 square inches on CME 75
Date: 12-April-2019

BL#	Depth ft	BLC bl/ft	RMX kips	CSX ksi	TSX ksi	STK ft	CSI ksi	CSB ksi	DMX in	SFR kips	ETR (%)
46	54.47	47	11.0	21.3	3.7	0.00	21.5	16.5	0.29	4	71.27
47	54.49	47	11.2	21.2	3.8	0.00	21.3	16.3	0.29	4	70.87
48	54.51	47	11.0	21.5	3.5	0.00	21.6	16.6	0.30	4	72.83
49	54.54	47	11.4	21.3	3.3	0.00	21.4	16.7	0.31	4	73.80
50	54.56	47	11.2	21.5	3.2	0.00	21.7	16.9	0.31	4	74.32
51	54.58	47	11.7	21.3	3.5	0.00	21.3	16.3	0.30	4	72.31
52	54.60	47	11.8	21.5	3.3	0.00	21.7	16.5	0.29	5	72.94
53	54.62	47	11.8	21.2	3.2	0.00	21.3	16.7	0.28	4	71.57
54	54.64	47	11.7	21.6	3.2	0.00	21.6	16.3	0.30	5	73.68
55	54.66	47	12.1	21.6	3.2	0.00	21.6	16.2	0.27	5	71.81
56	54.68	47	11.8	21.2	3.2	0.00	21.3	16.5	0.29	5	72.43
57	54.70	47	11.7	21.1	3.4	0.00	21.2	16.6	0.29	4	71.75
58	54.73	47	11.6	21.5	3.2	0.00	21.7	16.3	0.29	5	72.23
59	54.75	47	12.0	21.6	3.2	0.00	21.7	16.1	0.28	5	72.28
60	54.77	47	11.6	21.6	3.4	0.00	21.7	16.4	0.31	5	73.76
61	54.79	47	11.7	21.4	3.5	0.00	21.5	15.7	0.29	5	72.69
62	54.81	47	11.7	21.7	3.4	0.00	21.7	16.8	0.29	4	72.24
63	54.83	47	11.9	21.5	3.3	0.00	21.6	15.9	0.30	5	73.48
64	54.85	47	11.5	21.6	3.6	0.00	21.6	15.8	0.30	5	73.37
65	54.87	47	11.9	21.6	3.2	0.00	21.7	16.5	0.28	5	72.35
66	54.89	47	11.7	21.4	3.4	0.00	21.5	16.4	0.29	5	72.12
67	54.92	47	12.0	21.3	3.3	0.00	21.3	16.5	0.28	5	72.10
68	54.94	47	11.6	21.7	3.6	0.00	21.8	16.7	0.30	5	73.06
69	54.96	47	11.4	21.5	3.4	0.00	21.5	16.6	0.30	5	73.07
70	54.98	47	11.5	21.7	3.4	0.00	21.8	16.4	0.28	5	72.03
71	55.00	47	11.6	21.4	4.0	0.00	21.5	16.1	0.28	5	73.35
Average			9.9	21.4	3.9	**	21.5	16.5	0.41	4	72.31
Std. Dev.			1.5	0.2	1.7	**	0.2	0.4	0.27	1	0.78
Maximum			12.1	21.7	10.0	**	21.8	17.7	1.55	5	74.32
Minimum			6.4	21.0	1.9	**	21.1	15.4	0.27	1	70.49

Total number of blows analyzed: 71

BL# Sensors

1-71 F1: [357AWJ1] 212.0 (1.12); F4: [357AWJ2] 211.2 (1.12); A2: [55385] 915.0 (0.88);
A3: [50148] 1065.0 (0.88)

BL# Comments

71 end of set 5. n=51

Time Summary

Drive 1 minute 41 seconds 2:42 PM - 2:43 PM BN 1 - 71