

GEOTECHNICAL SUBSURFACE DATA REPORT

EMERGENCY BRIDGE PACKAGE 5 US-301 REPLACEMENT BRIDGES OVER BLACK RIVER CLARENDON COUNTY, SOUTH CAROLINA

PREPARED FOR



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

PREPARED BY

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3112 Devine Street
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JANUARY 22, 2016

January 22, 2016

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

Re: Geotechnical Subsurface Data Report
Emergency Bridge Package 5
US-301 Replacement Bridges over Black River
Clarendon County, South Carolina
F&ME Project No.: G5500.08 (Revision 1)

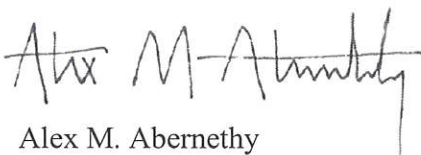
Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc.'s (F&ME) Geotechnical Subsurface Data Report (GSDR) for the Emergency Bridge Package 5. This report contains findings from our subsurface field investigation and soil laboratory testing program.

It has been a pleasure working with you on this project and we appreciate the opportunity to be of service. Please notify us if there are any questions or if we may be of further assistance.

Sincerely,

F&ME



Alex M. Abernethy
Geotechnical Staff Professional



Jason P. Stewart, P.E.
Project Engineer

Enclosures



GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

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I. INTRODUCTION

A. General

The Emergency Bridge Package 5 project is located in Clarendon County, South Carolina. We understand that the primary objective for the project is to replace the existing bridges on alignment. Four (4) existing bridges will be replaced along US-301 south of Black River Road and north of State Road S-14-50. The length of the new bridge structures will vary. Currently the existing bridge structures range from 130 feet to 400 feet. A Site Location Plan is presented as Figure 1 in Appendix A of this report.

B. Scope

F&ME performed a geotechnical subsurface investigation and laboratory testing for the bridge portion of the Emergency Bridge Package 5 project. The South Carolina Department of Transportation (SCDOT) request and scope for the geotechnical subsurface investigation was issued on December 14, 2015. A copy of the Scope of Services can be found in Appendix F of this report.

The field investigation included soil test borings (STB), electro-piezcone soundings (CPT), and multi-channel analysis of surface waves (MASW). Laboratory testing was performed on soil samples collected from the test borings. All exploration methods and laboratory procedures were conducted in accordance with the most recent American Association of State Highway and Transportation Officials (AASHTO), American Society of Testing and Materials (ASTM) Standards, and the SCDOT Geotechnical Design Manual (GDM). This report was prepared in general accordance with the 2010 SCDOT Geotechnical Design Manual (GDM), Version 2.0.

II. FIELD INVESTIGATION SUMMARY

From December 21, 2015 through January 8, 2016, F&ME performed eight (8) soil test borings (STB), eight (8) electro-piezcone soundings (CPT), and four (4) multi-channel analyses of surface waves (MASW) for the four (4) bridge locations along US-301. A Scope of Services with the field investigation details were provided by the SCDOT.

The soil test borings were advanced using a CME 550 ATV mounted drill rig with an automatic standard penetration test (SPT) hammer system. Soil test borings were advanced to the individual target depths provided by the SCDOT or to refusal. Rotary wash drilling techniques were used to maintain a stable borehole. Borings were advanced with standard split-spoon sampling to the boring termination depths. Details of each boring are included on the individual Soil Test Boring Logs in Appendix B.

A. Soil Test Borings (STB)

The following table is a summary of the soil test boring designations, depths, locations, and surface elevations. Soil Test Boring locations are shown on Figures 2A through 2D in Appendix A.

SOIL TEST BORINGS (STB)					
Test Hole No.	Soil Depth (ft.)	Surface Condition	Latitude	Longitude	TOB Elev. (ft.-MSL)
B-1 (Bridge 4)	100	Asphalt Roadway	33.8169859	80.1074057	88.3
B-2 (Bridge 4)	100	Asphalt Roadway	33.8172855	80.107153	88.2
B-3 (Bridge 3)	100	Asphalt Roadway	33.8129291	80.1108129	88.2
B-4 (Bridge 3)	100	Asphalt Roadway	33.8126310	80.1110636	88.2
B-5 (Bridge 2)	100	Asphalt Roadway	33.8096518	80.1135956	89.6
B-6 (Bridge 2)	100	Asphalt Roadway	33.8086801	80.1143269	89.7
B-7 (Bridge 1)	100	Asphalt Roadway	33.8035154	80.1187237	88.0
B-8 (Bridge 1)	88.5	Asphalt Roadway	33.8030499	80.1190712	88.3
Totals	788.5				

B. Electro-Piezocone Soundings (CPT)

The following table is a summary of the electro-piezocone sounding designations, depths, locations, and surface elevations. CPT testing was performed at the approach embankments at each end of the four (4) emergency bridges. CPT's were advanced using a CME 45B drill rig and were pushed until refusal. CPT locations are shown on Figures 2A through 2D in Appendix A. Detailed descriptions of each CPT are also shown in Appendix B of this report. A CD with an electronic copy of the spreadsheet meeting SCDOT requirements for CPT will be delivered with the report.

ELECTRO-PIEZOCONC SOUNDINGS (CPT)					
Test Hole No.	Soil Depth (ft.)	Surface Condition	Latitude	Longitude	TOB Elev. (ft.-MSL)
CPT-1 (Bridge 4)	32.2	Asphalt Roadway	33.8172793	80.1071279	88.0
CPT-2 (Bridge 4)	26.7	Asphalt Roadway	33.8169738	80.1073829	88.1
CPT-3 (Bridge 3)	32.8	Asphalt Roadway	33.8129255	80.1107829	88.1
CPT-4 (Bridge 3)	35.9	Asphalt Roadway	33.8126172	80.1110418	88.0
CPT-5 (Bridge 2)	26.4	Asphalt Roadway	33.8096302	80.1135477	89.6
CPT-6 (Bridge 2)	30.8	Asphalt Roadway	33.8087053	80.1143738	89.4
CPT-7 (Bridge 1)	28.2	Asphalt Roadway	33.8034961	80.1186991	87.7
CPT-8 (Bridge 1)	40.7	Asphalt Roadway	33.8030652	80.1191101	87.8
Totals	253.7				

C. Multi-Channel Analysis of Surface Waves (MASW)

On December 23 through 28, 2015, F&ME performed a Multi-channel Analysis of Surface Waves (MASW) at each of the four (4) emergency bridges to determine the average shear wave velocities to a depth of 100 feet at the array locations shown in Figures 3A through 3D in Appendix D of this report. A more detailed description of the MASW array locations and results can be found in Appendix D of this report. The following table provides a summary of the locations of each MASW array performed.

MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)				
Test Hole No.	Begin		End	
	Latitude	Longitude	Latitude	Longitude
MASW (Bridge 1)	33.802071	80.119857	33.802579	80.119434
MASW (Bridge 2)	33.807352	80.115539	33.807857	80.115112
MASW (Bridge 3)	33.811409	80.112019	33.811915	80.111594
MASW (Bridge 4)	33.816315	80.108017	33.816788	80.107621

D. Groundwater

Groundwater depth measurements were made at the time of boring for all soil test borings, and are noted on the individual Soil Test Boring Logs in Appendix B. Groundwater measurements were also made twenty-four (24) hours following boring completion for all soil test borings. Time of boring groundwater measurements for electro-piezocene soundings were interpreted from the cone penetration testing logs.

The following table is a summary of the groundwater measurements for the soil test borings and cone penetration tests at time of boring (TOB) and twenty-four (24) hours following boring completion.

GROUNDWATER DEPTH			
Boring No.	Date of TOB Groundwater Measurement	TOB Groundwater Depth (ft.)	24-hr. Groundwater Depth (ft.)
B-1 (Bridge 4)	12-28-2015	10.0	8.3
B-2 (Bridge 4)	12-21-2015	10.0	9.5
B-3 (Bridge 3)	12-29-2015	8.0	8.9
B-4 (Bridge 3)	12-30-2015	8.0	8.5
B-5 (Bridge 2)	01-04-2016	10.0	11.5
B-6 (Bridge 2)	01-05-2016	10.0	10.2
B-7 (Bridge 1)	01-06-2016	8.0	5.5
B-8 (Bridge 1)	01-07-2016	8.0	4.8
CPT-1 (Bridge 4)	01-08-2016	9.5	Backfilled at Completion of Drilling
CPT-2 (Bridge 4)	01-08-2016	8.3	Backfilled at Completion of Drilling
CPT-3 (Bridge 3)	01-09-2016	8.9	Backfilled at Completion of Drilling
CPT-4 (Bridge 3)	01-09-2016	8.5	Backfilled at Completion of Drilling
CPT-5 (Bridge 2)	01-09-2016	11.5	Backfilled at Completion of Drilling
CPT-6 (Bridge 2)	01-09-2016	10.2	Backfilled at Completion of Drilling
CPT-7 (Bridge 1)	01-09-2016	5.5	Backfilled at Completion of Drilling
CPT-8 (Bridge 1)	01-09-2016	4.7	Backfilled at Completion of Drilling

III. SOIL LABORATORY TESTING

Following completion of F&ME's field investigation, preliminary soil test boring logs were prepared based on visual soil classification in the field. Based on the data represented in these logs, soil samples were selected by F&ME for laboratory testing. The selected split-spoon samples were tested in F&ME's laboratory to determine applicable physical and engineering properties. All laboratory testing was performed in accordance with procedures set forth in the most recently published AASHTO and ASTM standards.

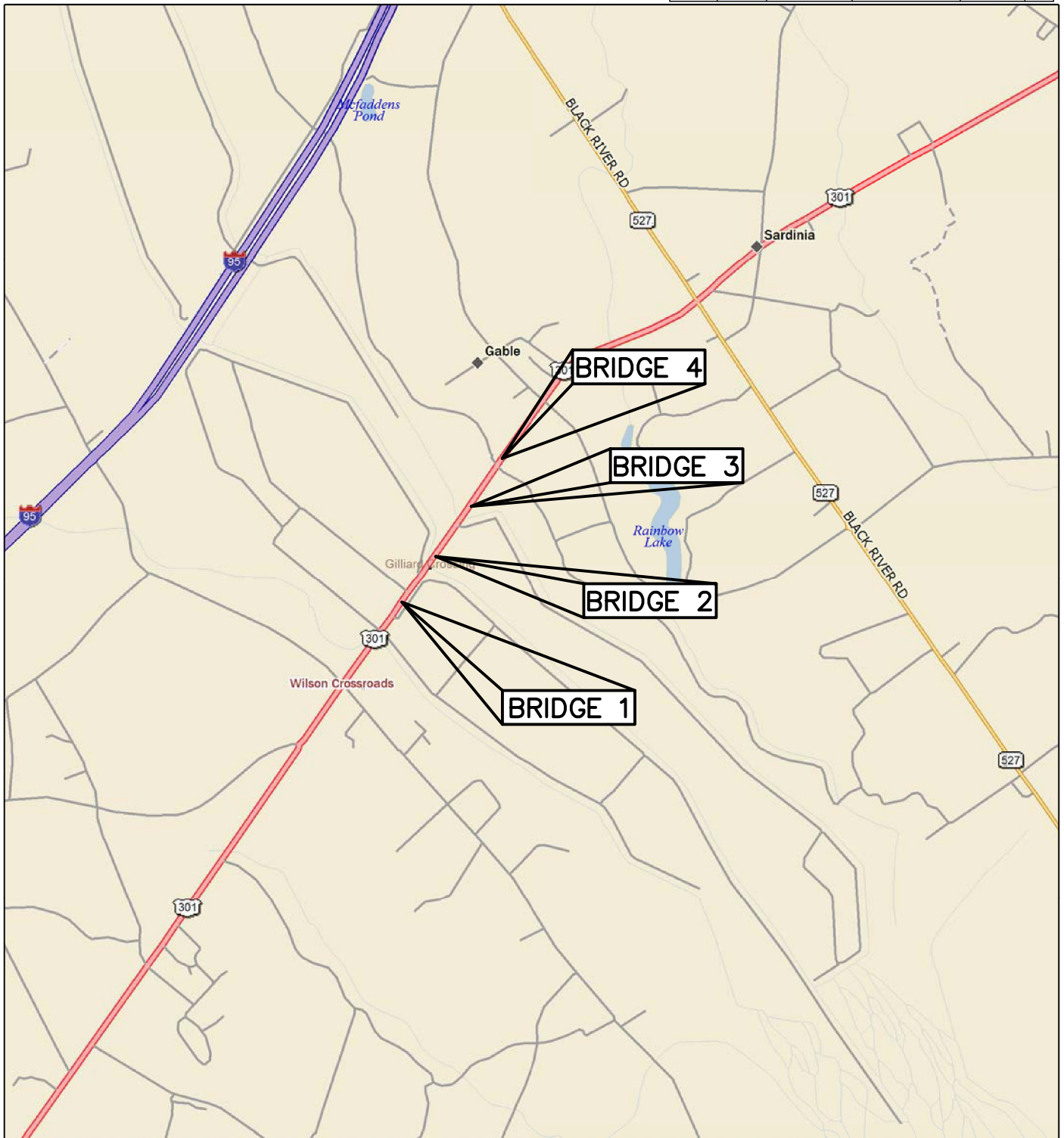
The laboratory testing performed for the split-spoon samples are detailed in the table below. Data sheets containing the results of the laboratory testing are provided in Appendix C of this report.

LABORATORY SOIL TESTING (SPLIT-SPOON SAMPLES)		
Type of Test	Quantity	Procedure
Wash #200	31	AASHTO T11
Atterberg Limits	15	AASHTO T89/T90
Moisture Content	31	ASTM D2216

APPENDIX A

Location Plans

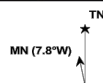
FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



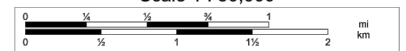
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Scale 1 : 50,000



1" = 4,166.7 ft Data Zoom 12-0

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COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

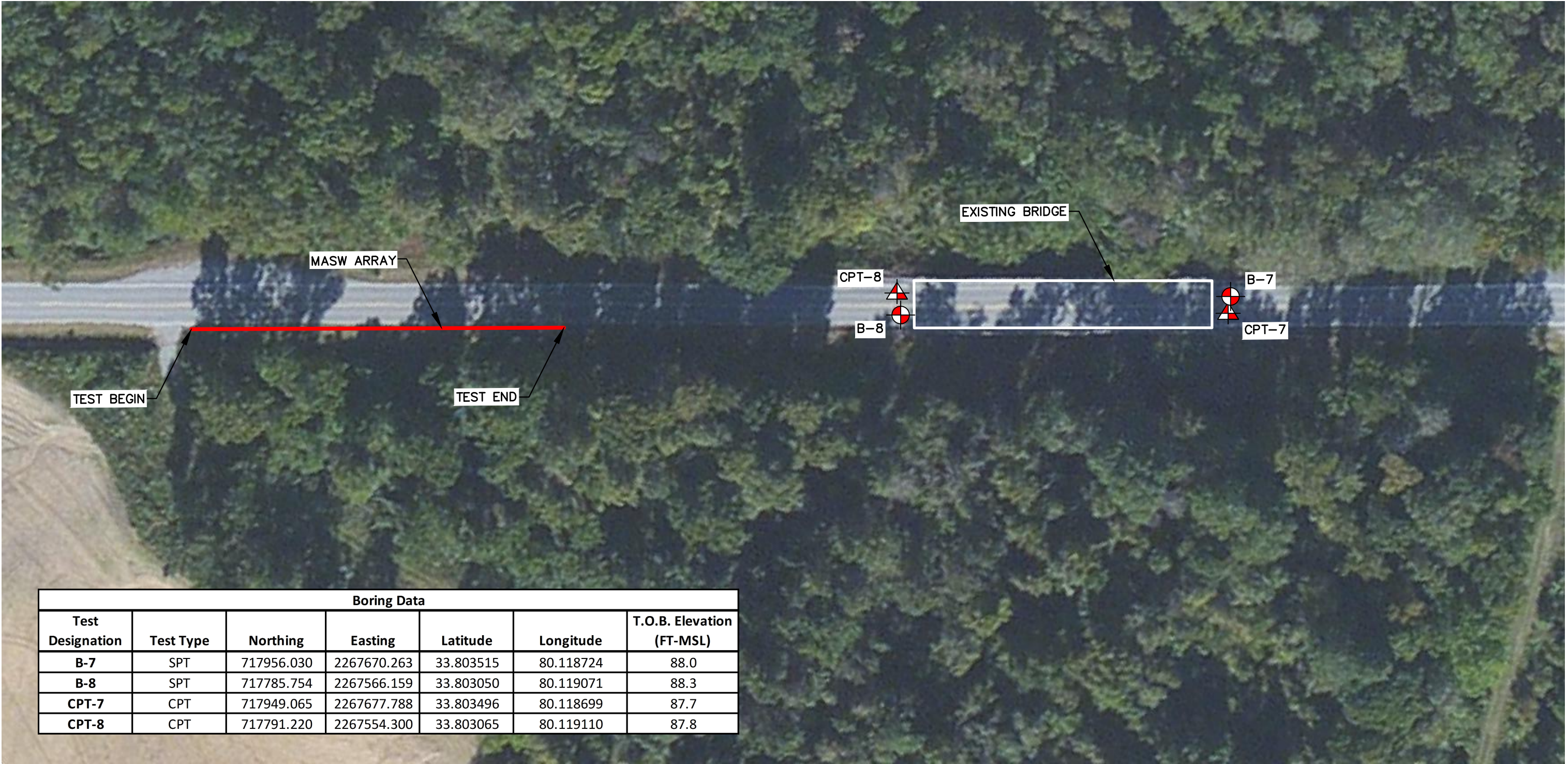
SITE LOCATION PLAN

4			
3			
2			
1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG. CTC		1/12/2016	GROUP - -
R/W		DATE	

SCALE = AS NOTED

F&ME JOB NO. G5500.08

FIGURE 1

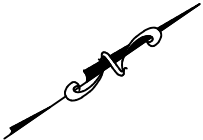


Boring Data						
Test Designation	Test Type	Northing	Easting	Latitude	Longitude	T.O.B. Elevation (FT-MSL)
B-7	SPT	717956.030	2267670.263	33.803515	80.118724	88.0
B-8	SPT	717785.754	2267566.159	33.803050	80.119071	88.3
CPT-7	CPT	717949.065	2267677.788	33.803496	80.118699	87.7
CPT-8	CPT	717791.220	2267554.300	33.803065	80.119110	87.8

LEGEND:

SOIL TEST BORING LOCATION

CONE PENETRATION TEST LOCATION



REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			
TOPO.	DATE		
DWG. CTC	DATE 1/12/2016	GROUP ____ - ____	
R/W	DATE		

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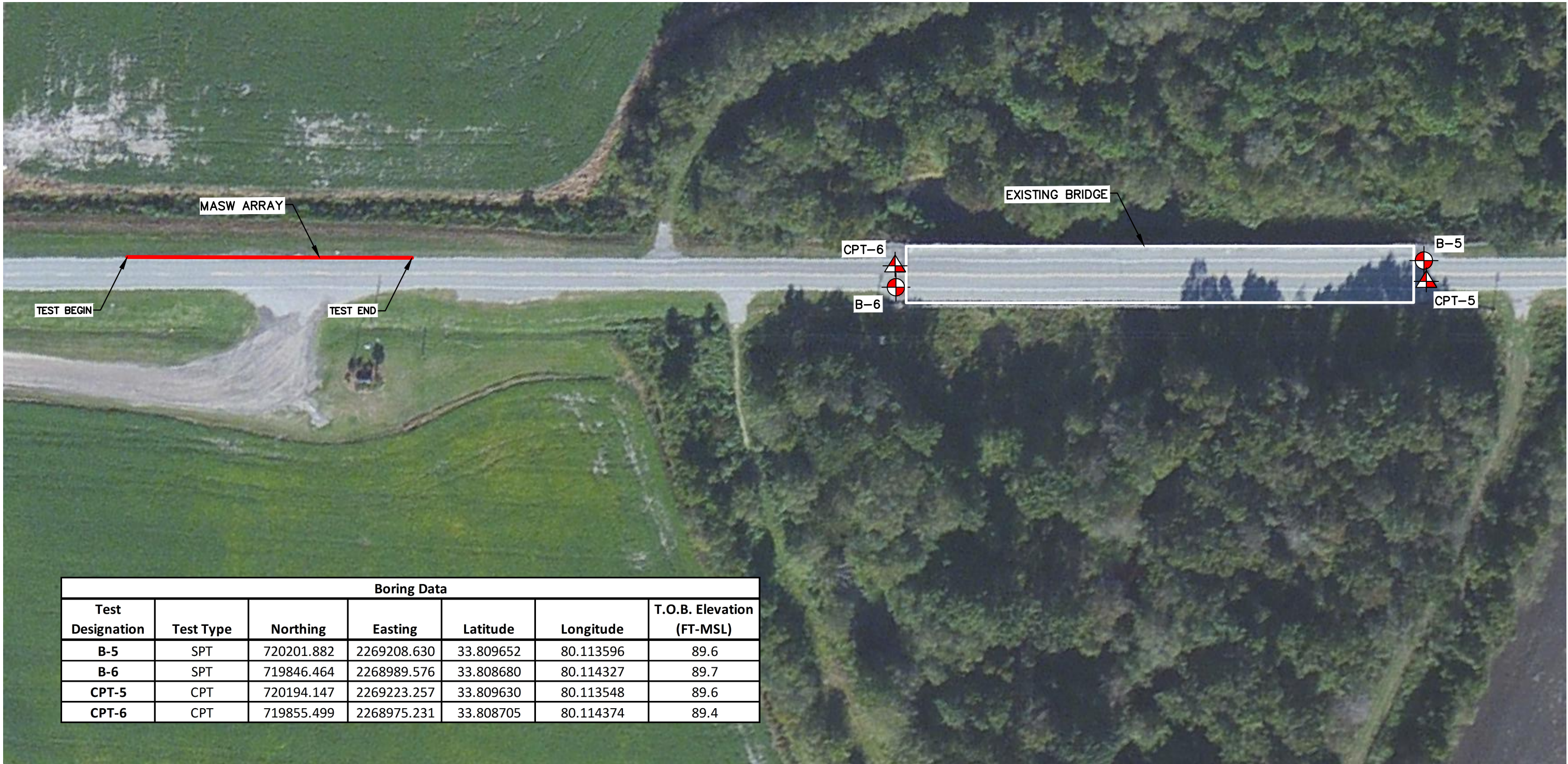
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US-301 BRIDGE (#1) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SOIL TEST BORING LOCATION PLAN

SCALE = NTS	F&ME JOB NO. G5500.08 FIGURE 2A
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FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	

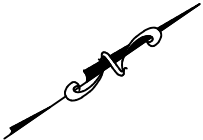


Boring Data						
Test Designation	Test Type	Northing	Easting	Latitude	Longitude	T.O.B. Elevation (FT-MSL)
B-5	SPT	720201.882	2269208.630	33.809652	80.113596	89.6
B-6	SPT	719846.464	2268989.576	33.808680	80.114327	89.7
CPT-5	CPT	720194.147	2269223.257	33.809630	80.113548	89.6
CPT-6	CPT	719855.499	2268975.231	33.808705	80.114374	89.4

LEGEND:

 SOIL TEST BORING LOCATION

 CONE PENETRATION TEST LOCATION



	4			
	3			
	2			
	1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.	DATE			
DWG. CTC	DATE 1/12/2016	GROUP		
R/W	DATE			

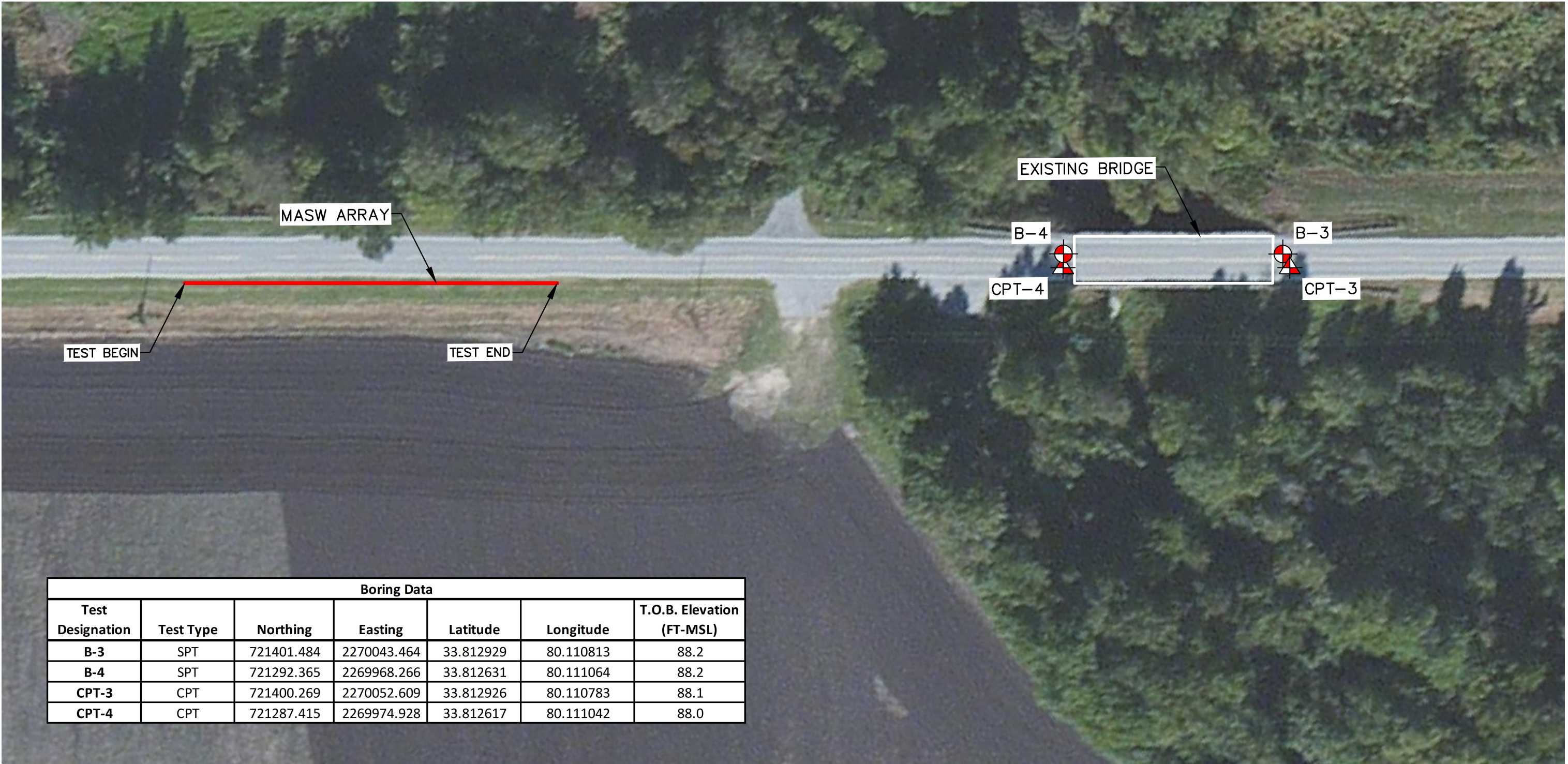
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COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#2) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SOIL TEST BORING LOCATION PLAN

	F&ME JOB NO. G5500.08
SCALE = NTS	FIGURE 2B

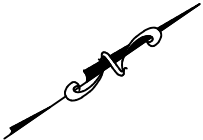


Boring Data						
Test Designation	Test Type	Northing	Easting	Latitude	Longitude	T.O.B. Elevation (FT-MSL)
B-3	SPT	721401.484	2270043.464	33.812929	80.110813	88.2
B-4	SPT	721292.365	2269968.266	33.812631	80.111064	88.2
CPT-3	CPT	721400.269	2270052.609	33.812926	80.110783	88.1
CPT-4	CPT	721287.415	2269974.928	33.812617	80.111042	88.0

LEGEND:

SOIL TEST BORING LOCATION

CONE PENETRATION TEST LOCATION



REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			
TOPO.	DATE		
DWG. CTC	DATE 1/12/2016	GROUP ____ - ____	
R/W	DATE		

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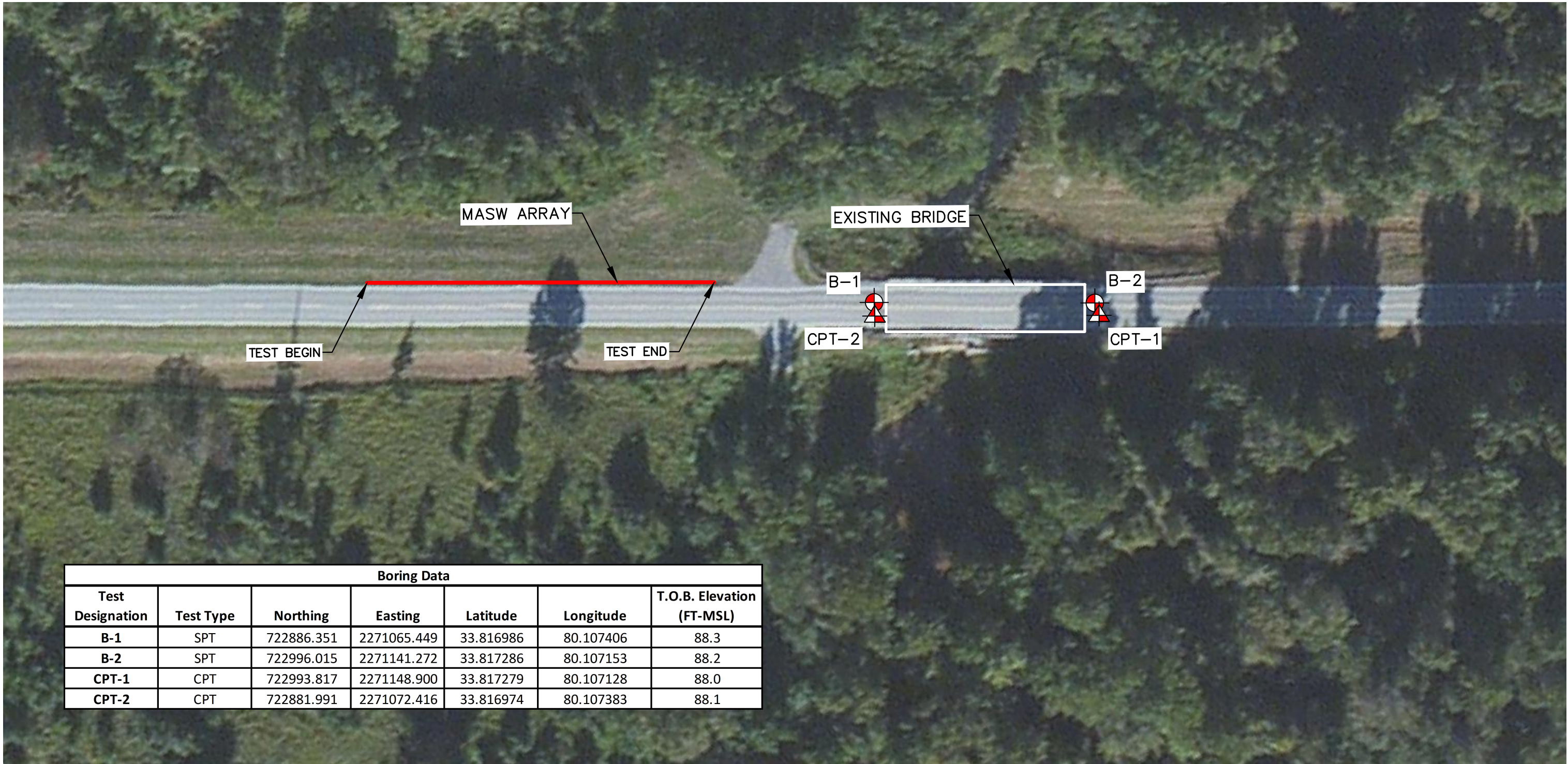
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COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#3) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SOIL TEST BORING LOCATION PLAN

SCALE = NTS	F&ME JOB NO. G5500.08 FIGURE 2C
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FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	

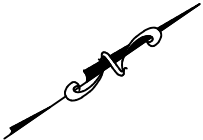


Boring Data						
Test Designation	Test Type	Northing	Easting	Latitude	Longitude	T.O.B. Elevation (FT-MSL)
B-1	SPT	722886.351	2271065.449	33.816986	80.107406	88.3
B-2	SPT	722996.015	2271141.272	33.817286	80.107153	88.2
CPT-1	CPT	722993.817	2271148.900	33.817279	80.107128	88.0
CPT-2	CPT	722881.991	2271072.416	33.816974	80.107383	88.1

LEGEND:

 SOIL TEST BORING LOCATION

 CONE PENETRATION TEST LOCATION



	4			
	3			
	2			
	1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.		DATE		
DWG. CTC		DATE 1/12/2016	GROUP ____ - ____	
R/W		DATE		

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COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#4) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SOIL TEST BORING LOCATION PLAN

	F&ME JOB NO. G5500.08
SCALE = NTS	FIGURE 2D

APPENDIX B

Geotechnical Subsurface Exploration

Soil Test Boring Log Descriptors

Correlation of Penetration Resistance with Relative Density and Consistency

Coarse Grained (Sands/Gravels)		Fine Grained (Clay/Silt)	
SPT Blow Count	Relative Density	SPT Blow Count	Relative Density
<4	Very Loose	<2	Very Soft
5 – 10	Loose	3 – 4	Soft
11 – 30	Medium Dense	5 – 8	Firm
31 – 50	Dense	9 – 15	Stiff
>51	Very Dense	16 – 30	Very Stiff
		>31	Hard

Particle Size Identification

Gravel	Sieve Size
Fine	#4 to ¾ inch
Coarse	¾ inch to 3 inch

Sand	Sieve Size
Fine	#200 to #40
Medium	#40 to #10
Coarse	#10 to #4

Clay/Silt	Sieve Size
Fines Content	<#200

	SCCT	CONCRETE
	SCAT	ASPHALT
	SCTS	TOPSOIL/PEAT
	SCSAND	SAND
	SCSTSAND	SILTY SAND/SANDY SILT
	SCCLSAND	CLAYEY SAND/SANDY CLAY
	SCCLAY	CLAY
	SCSILT	SILT
	SCSTCLAY	SILTY CLAY/CLAYEY SILT
	SCSAP	SAPROLITE
	SCLS	LIMESTONE
	SCBR	GRANITE (BEDROCK)
	SCMARL	MARL

SOIL CLASSIFICATION CHART				
MAJOR DIVISIONS			SYMBOLS GRAPH LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW
		GRAVELS WITH FINES (APPROPRIABLE AMOUNT OF FINES)		GP
				GM
				GC
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW
				SP
		SANDS WITH FINES (APPROPRIABLE AMOUNT OF FINES)		SM
				SC
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50			ML
				CL
				OL
				MH
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			CH
				OH
HIGHLY ORGANIC SOILS				PT

NOTE: PLUS, MINUS OR SLASH USED TO INDICATE INORGANIC OR SILT, CLAY OR SANDY CONTENT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-1 (Bridge 4)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	P.H./R.W.	Boring Location:		Offset:	
Elev.:	88.3 ft	Latitude:	33.8169859	Longitude:	80.1074057
Date Started:	12/28/2015				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	12/31/2015				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 550	Drill Method:	RW
Hammer Type:	Automatic	Energy Ratio:	74%		
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR:	8.3 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ●	PL MC LL	▲ FINES CONTENT (%)
	0.0	Asphalt Roadway										
	0.6	ASPHALT (7.0")		0.6	SS-1	4	7	7	14	●		
	2.0	FILL		2.0	SS-2	3	4	3	7	●		
	4.0	Medium Dense to Loose, Moist, Dark Yellowish Brown, Low Plasticity, Clayey Fine to Coarse SAND (SC), Munsell=10YR 5/8		4.0	SS-3	5	7	7	14	●		4th 6" = 3 Blows
83.3	6.0	=> Light Olive Brown, Munsell=2.5Y 5/4		6.0	SS-4	3	3	4	7	●		4th 6" = 4 Blows
8.0	8.0	ALLUVIUM		8.0	SS-5	2	2	2	4	●		4th 6" = 4 Blows
78.3	10.0	Soft, Moist, Black, Low Plasticity, Sandy SILT (ML), with Organics, Munsell=5Y 2.5/1										
		LL=31, PL=27, PI=4, NMC=65.3%, %200=50.7										
	13.5	Very Loose, Wet, Gray, Non-Plastic, Fine to Medium SAND (SP-SM), with Silt, Munsell=5Y 6/1		13.5	SS-6	8	8	12	20	●		
73.3	18.5	=> Medium Dense		18.5	SS-7	WOH/18"	WOH	WOH	WOH	●		
68.3	23.5	=> Very Loose, Olive Gray, Munsell=5Y 4/2		23.5	SS-8	5	6	8	14	●		
63.3	28.5	NMC=26.8%, %200=10.1		28.5	SS-9	12	7	7	14	●		
	33.5	=> Medium Dense		33.5	SS-10	12	18	12	30	●		
28.5	38.5	Medium Dense, Wet, Olive Brown, None to Low Plasticity, Silty Fine to Coarse SAND (SM), Munsell=2.5Y 5/4		38.5	SS-11	6	17	20	37	●		
58.3	43.5	NMC=27.3%, %200=14.5		43.5	SS-12	18	11	11	22	●		
53.3	48.5	Medium Dense, Moist, Very Dark Gray, Non-Plastic, Fine to Coarse SAND (SP), Munsell=5Y 3/1		48.5	SS-13	4	6	9	15	●		
48.3	53.5	BLACK MINGO GROUP		53.5								
		Very Stiff, Moist, Very Dark Gray, Low Plasticity, CLAY (CL), with Coarse Sand, Munsell=GLE1 3/1										
43.5		Dense, Moist, Very Dark Gray, Low Plasticity, Clayey Fine to Coarse SAND (SC), Munsell=5Y 3/1										
43.3		Very Stiff, Moist, Very Dark Gray, Low Plasticity, SILT (ML), Munsell=5Y 3/1										
48.5		Medium Dense, Moist, Very Dark Gray, None to Low Plasticity, Silty Fine to Coarse SAND (SM), Munsell=5Y 3/1										
38.3												
53.5												

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	

SCDOT Soil Test Log

Project ID: N/A				County: Clarendon		Boring No.: B-1 (Bridge 4)		
Site Description:		US-301 Replacement Bridge over Black River					Route: US-301	
Eng./Geo.: P.H./R.W.		Boring Location:		Offset:		Alignment: On		
Elev.: 88.3 ft		Latitude: 33.8169859		Longitude: 80.1074057		Date Started: 12/28/2015		
Total Depth: 100 ft		Soil Depth: 100 ft		Core Depth: 0 ft		Date Completed: 12/31/2015		
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)		
Drill Machine: CME 550		Drill Method: RW		Hammer Type: Automatic		Energy Ratio: 74%		
Core Size: N/A		Driller: D. Harris		Groundwater: TOB 10 ft		24HR 8.3 ft		

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
33.3		Very Stiff, Moist, Very Dark Gray, Low Plasticity, <u>SILT (ML)</u> , with Fine Sand Laminations, Lignite & Plant Fossils, Micaceous, Munsell=5Y 3/1			SS-14	6	7	10	17	●
58.5				58.5						
28.3		Dense, Moist, Very Dark Grayish Green, Non-Plastic, Fine <u>SAND (SP-SM)</u> , with Silt, Munsell=5GY 3/2			SS-15	6	19	25	44	●
63.5				63.5						
23.3		Loose, Moist, Very Dark Grayish Green, None to Low Plasticity, Silty Fine <u>SAND (SM)</u> , Munsell=5GY 3/2			SS-16	5	4	4	8	● ▲ ○
68.5		NMC=29.3%, %200=21.5		68.5						
18.3		Hard, Moist, Light Gray, Low Plasticity, Sandy <u>SILT (ML)</u> , with Gravel & Thin Cemented Lenses, Munsell=2.5Y 7/1			SS-17	48	23	46	69	●
73.5				73.5						
13.3		Very Dense, Moist, Very Dark Gray, None to Low Plasticity, Silty Fine <u>SAND (SM)</u> , Munsell=2.5Y 3/1			SS-18	19	25	40	65	●
8.3		=> Medium Dense		78.5						
83.5		=> Cemented Layer @ 82.0'		83.5						
3.3		LIMESTONE			SS-20	17	22	40	62	●
88.5		Very Dense, Moist, Gray, Non-Plastic, <u>GRAVEL (GP-GC)</u> , with Clay and Sand (Strong HCl Reactivity), Munsell=2.5Y 5/1		88.5	SS-21	50/4.5"			100±	>>●
-1.7		Very Dense, Moist, Dark Gray, None to Low Plasticity, Silty Fine to Medium <u>SAND (SM)</u> , Munsell=2.5Y 4/1								
-6.7		=> Medium Dense, with Trace of Shell Fragments		93.5	SS-22	5	6	8	14	●
-11.7	100.0	Boring Terminated at 100.0 feet		98.5	SS-23	6	8	9	17	●
-16.7										

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	

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-2 (Bridge 4)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R.W./P.H.	Boring Location:		Offset:	
Elev.:	88.2 ft	Latitude:	33.8172855	Longitude:	80.107153
Date Started:	12/21/2015				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	12/28/2015				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR:	9.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
	0.0	Asphalt Roadway								
	0.9	ASPHALT (10.5")		0.9						
		FILL		2.0	SS-1	6	10			
		Loose to Medium Dense, Moist, Reddish Yellow, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=7.5YR 6/8		4.0	SS-2	6	5	4	9	● 4th 6" = 5 Blows
		=> Strong Brown, Munsell=7.5YR 5/6		6.0	SS-3	4	6	7	13	● 4th 6" = 8 Blows
	7.5	ALLUVIUM		8.0	SS-4	4	5	4	9	● 4th 6" = 5 Blows
		Loose to Very Loose, Moist to Wet, Olive Brown, Low Plasticity, Clayey Fine to Medium SAND (SC), Munsell=2.5Y 4/6			SS-5	5	2	1	3	● × 4th ▲ = 1 Blow
		LL=22, PL=14, PI=8, NMC=21.7%, %200=42.6								
	13.5	=> Grayish Brown, with Wood Fragments and Peat, Munsell=2.5Y 5/2		13.5	SS-6	WOH/18"			WOH	× × ○ ▲
		Very Soft, Wet, Dark Olive Brown, Low Plasticity, Sandy Lean CLAY (CL), with Organics, Munsell=2.5Y 3/3								
	18.5	LL=33, PL=23, PI=10, NMC=52.6%, %200=65.3		18.5	SS-7	7	8	12	20	●
		Medium Dense, Wet, Grayish Brown, Non-Plastic, Fine to Coarse SAND (SP), Munsell=2.5Y 5/2								
	23.5	BLACK MINGO GROUP		23.5	SS-8	WOH/18"			WOH	▲ ○
		Very Loose, Wet, Gray, None to Low Plasticity, Silty Fine to Coarse SAND (SM), Munsell=10YR 5/1								
		NMC=37.9%, %200=24.9								
	28.5	Stiff to Very Stiff, Wet to Moist, Gray, Low Plasticity, Sandy Lean CLAY (CL), Munsell=10YR 5/1		28.5	SS-9	4	6	3	9	● ○ ▲
		NMC=53.7%, %200=57.2								
		=> Dark Gray, with Fine Sand Laminations, Micaceous, Munsell=5Y 4/1		33.5	SS-10	5	6	11	17	●
	38.5			38.5						

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	

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-2 (Bridge 4)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R.W./P.H.	Boring Location:		Offset:	
Elev.:	88.2 ft	Latitude:	33.8172855	Longitude:	80.107153
Date Started:	12/21/2015				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	12/28/2015				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR:	9.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
48.2		Very Stiff, Wet to Moist, Dark Gray, High Plasticity, <u>ELASTIC SILT (MH)</u> , Munsell=5Y 4/1 LL=53, PL=29, PI=24, NMC=60.3%, % _{#200} =85.5			SS-11	5	7	7	14	●
43.5		Medium Dense to Dense, Moist, Dark Greenish Gray/Dark Gray, Low Plasticity, Clayey Fine to Medium <u>SAND (SC)</u> , with Lignite Lenses, Munsell=5GY 4/2 & 5Y 3/1		43.5	SS-12	10	11	14	25	●
48.5		=> Dark Gray, with Laminated Fine Sand and Clay Lenses, Glauconitic, Munsell=5Y 4/1			SS-13	8	16	31	47	●
53.5					SS-14	12	11	17	28	●
58.5		Very Dense, Moist, Gray, Non-Plastic, Fine <u>SAND (SP-SC)</u> , with Clay Laminations, Micaceous, Munsell=5Y 5/1		58.5	SS-15	11	20	41	61	●
63.5		Medium Dense, Moist, Gray, Low Plasticity, Clayey Fine to Medium <u>SAND (SC)</u> , Munsell=5Y 5/1		63.5	SS-16	7	8	11	19	●
68.5		Medium Dense, Moist, Very Dark Greenish Gray, Non-Plastic, Fine <u>SAND (SP-SC)</u> , with Clay & Shell Fragments, Munsell=5GY 3/2		68.5	SS-17	6	8	11	19	●
73.5					SS-18	9	11	19	30	●

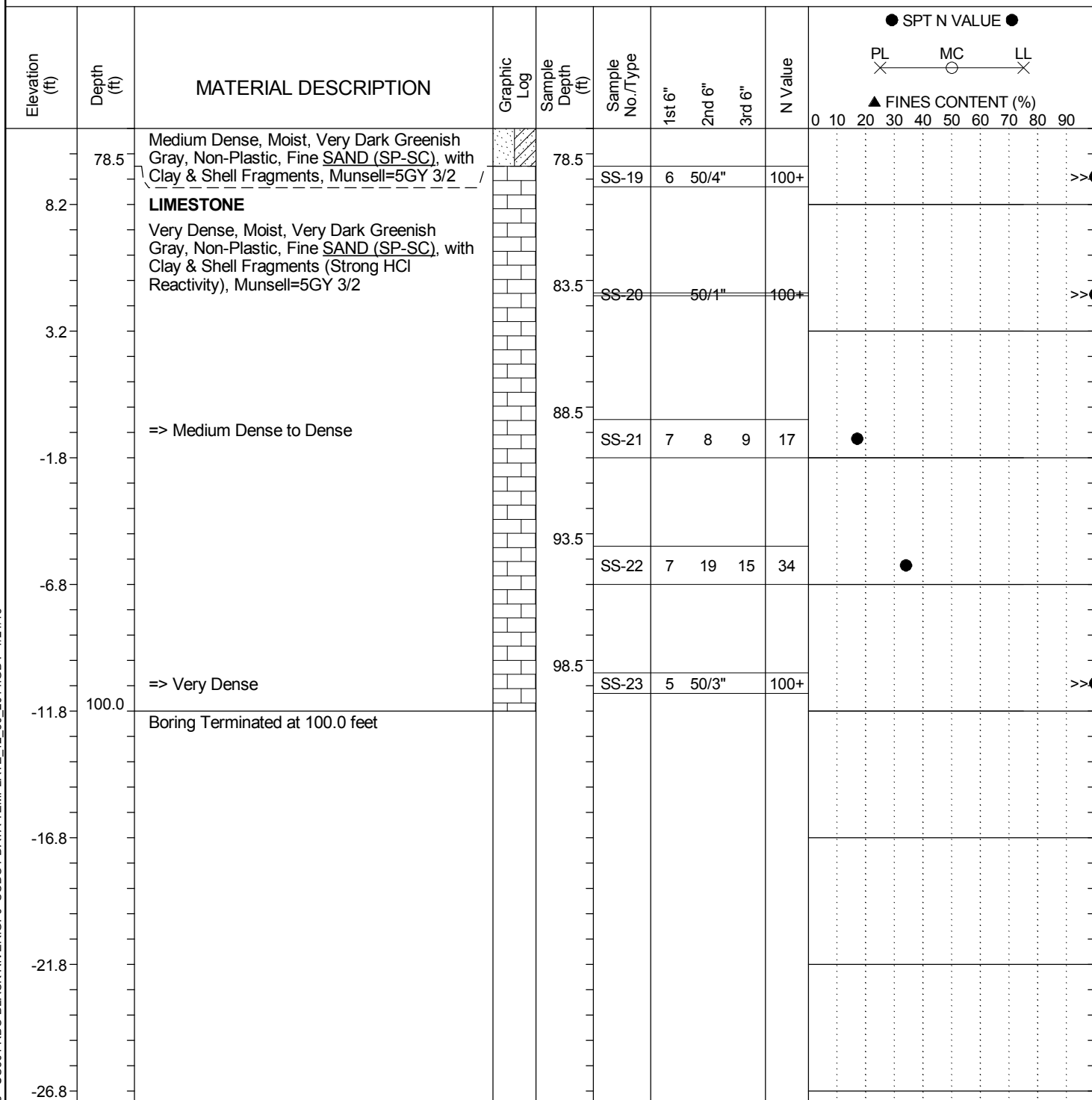
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID:				N/A				County:		Clarendon		Boring No.:		B-2 (Bridge 4)			
Site Description:			US-301 Replacement Bridge over Black River										Route:		US-301		
Eng./Geo.:			R.W./P.H.			Boring Location:			Offset:			Alignment:		On			
Elev.:		88.2 ft		Latitude:		33.8172855		Longitude:		80.107153		Date Started:		12/21/2015			
Total Depth:		100 ft		Soil Depth:		100 ft		Core Depth:		0 ft		Date Completed:		12/28/2015			
Bore Hole Diameter (in):				4		Sampler Configuration				Liner Required:		Y (N)		Liner Used:		Y (N)	
Drill Machine:		CME 550			Drill Method:		RW		Hammer Type:		Automatic		Energy Ratio:		74%		
Core Size:		N/A			Driller:		D. Harris			Groundwater:		TOB 10 ft		24HR		9.5 ft	

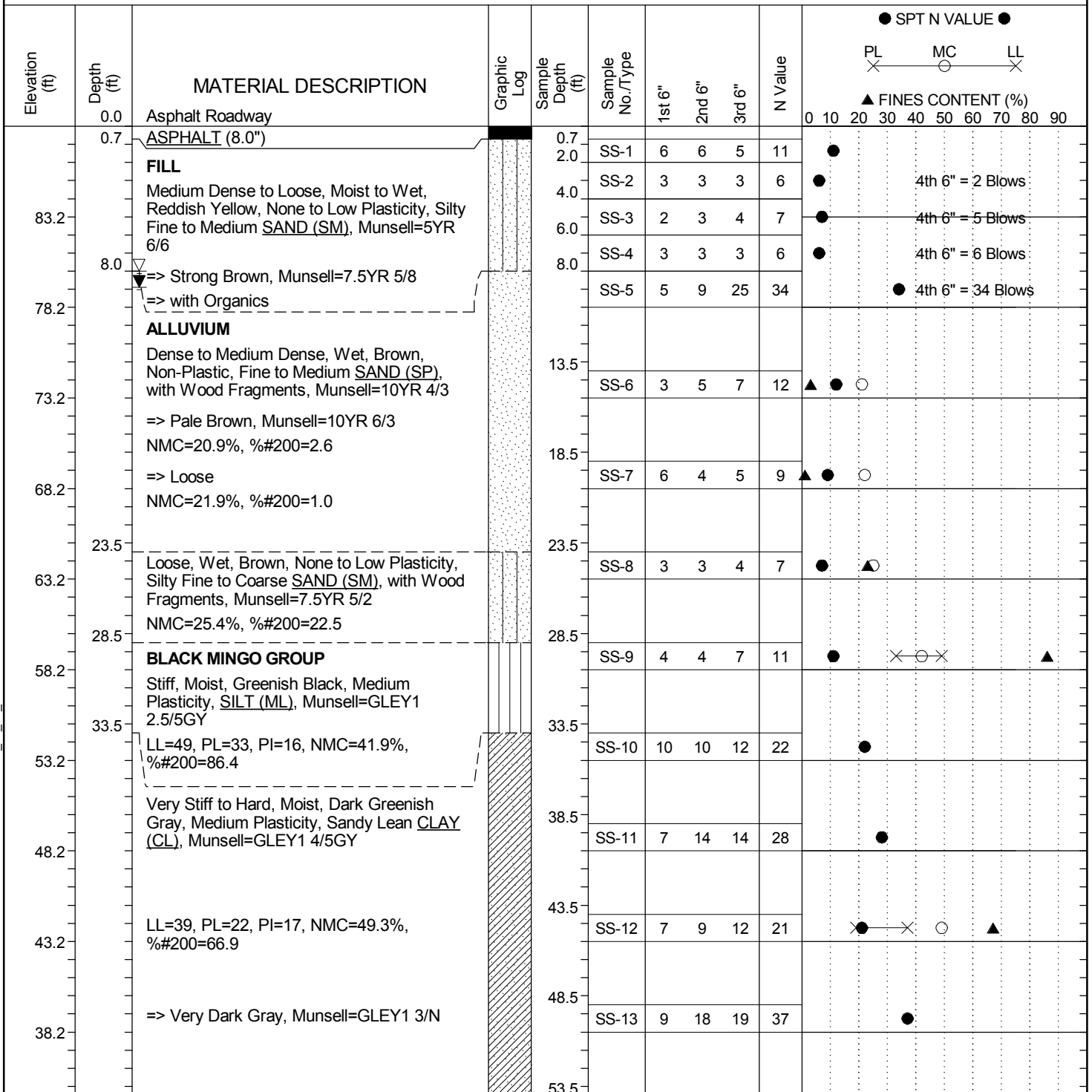


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SAMPLER TYPE			DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"		HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings		CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube		DC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

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-3 (Bridge 3)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R.W./L.G.	Boring Location:		Offset:	
Elev.:	88.2 ft	Latitude:	33.8129291	Longitude:	80.1108129
Date Started:	12/29/2015				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	12/30/2015				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR:	8.9 ft				



LEGEND

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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	

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-3 (Bridge 3)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R.W./L.G.	Boring Location:		Offset:	
Elev.:	88.2 ft	Latitude:	33.8129291	Longitude:	80.1108129
Date Started:	12/29/2015				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	12/30/2015				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR:	8.9 ft				

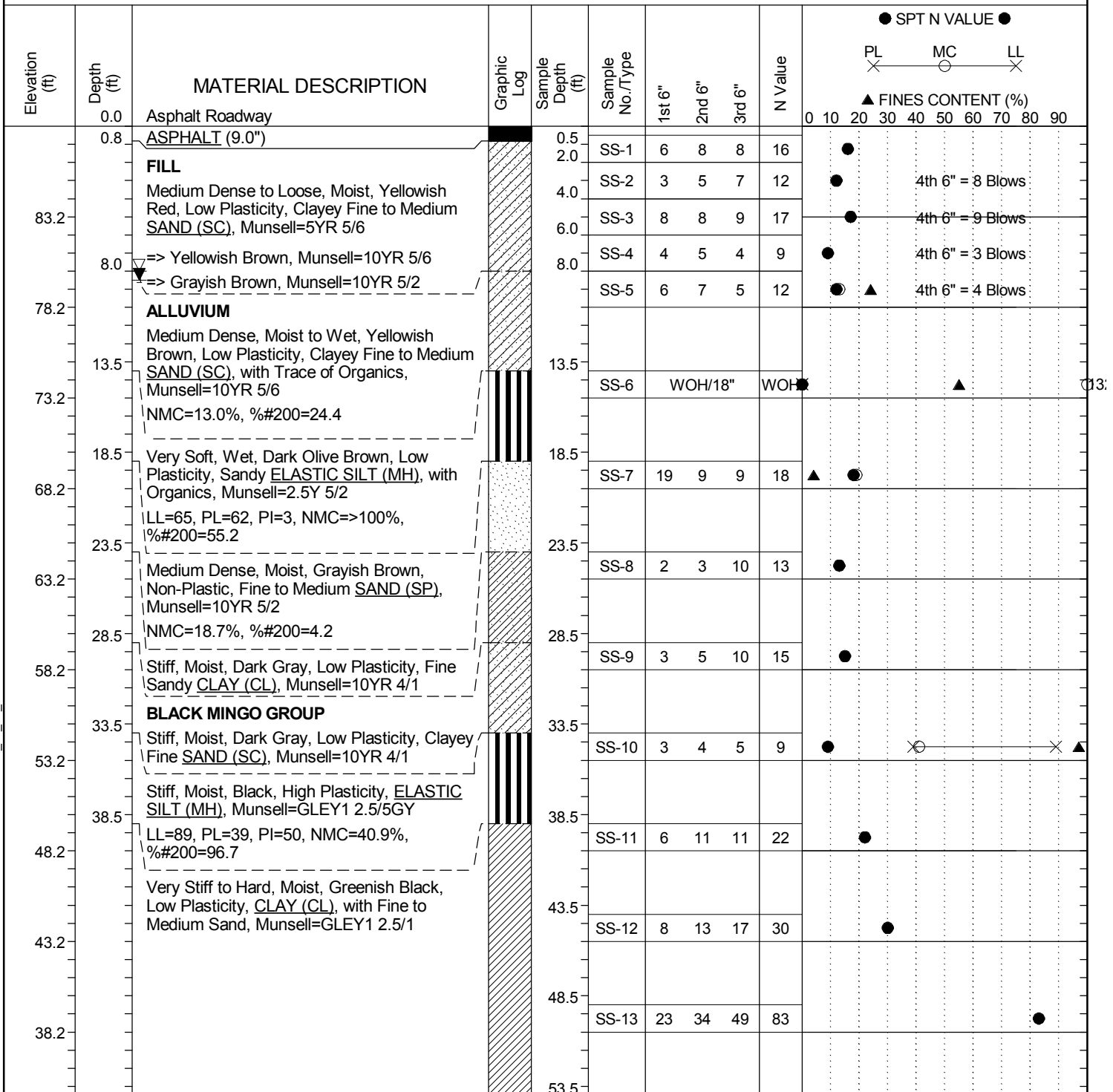
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
33.2		Hard, Moist, Very Dark Gray, Medium Plasticity, Sandy Lean CLAY (CL), Munsell=GLE Y1 3/N			SS-14	14	25	49	74	
28.2				58.5	SS-15	12	16	24	40	
63.5		Medium Dense, Moist, Greenish Black, Non-Plastic, Fine SAND (SP-SC), with Clay, Munsell=GLE Y1 2.5/5GY		63.5	SS-16	7	8	12	20	
23.2		=> Very Dense		68.5	SS-17	19	26	25	51	
18.2		=> Medium Dense, with Shell Fragments		73.5	SS-18	8	7	12	19	
13.2				78.5	SS-19	50/5.5"			100+	>>
8.2		LIMESTONE Very Dense, Moist, Greenish Black, Non-Plastic, Fine SAND (SP-SC), with Clay & Gravel (Strong HCl Reactivity), Munsell=GLE Y1 2.5/5GY		83.5	SS-20	5	8	9	17	
3.2		=> Medium Dense		88.5	SS-21	6	9	10	19	
-1.8				93.5	SS-22	6	34	50/1.5"	84+	
-6.8		=> Very Dense		98.5	SS-23	7	8	10	18	
-11.8	100.0	=> Medium Dense								
-16.8		Boring Terminated at 100 feet								

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	

SCDOT Soil Test Log

Project ID:	N/A				County:	Clarendon		Boring No.:	B-4 (Bridge 3)		
Site Description:		US-301 Replacement Bridge over Black River						Route:	US-301		
Eng./Geo.:	L.G./P.H.		Boring Location:				Offset:			Alignment:	On
Elev.:	88.2 ft		Latitude:	33.812631		Longitude:	80.1110636		Date Started:	12/30/2015	
Total Depth:	100 ft		Soil Depth:	100 ft		Core Depth:	0 ft		Date Completed:	12/30/2015	
Bore Hole Diameter (in):			4		Sampler Configuration		Liner Required:	Y (N)		Liner Used:	Y (N)
Drill Machine:	CME 550		Drill Method:	RW		Hammer Type:	Automatic		Energy Ratio:	74%	
Core Size:	N/A		Driller:	D. Harris		Groundwater:	TOB	8 ft		24HR	8.5 ft



LEGEND

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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	

SCDOT Soil Test Log

Project ID: N/A				County: Clarendon		Boring No.: B-4 (Bridge 3)	
Site Description:		US-301 Replacement Bridge over Black River					Route: US-301
Eng./Geo.: L.G./P.H.		Boring Location:		Offset:		Alignment: On	
Elev.: 88.2 ft	Latitude: 33.812631	Longitude: 80.1110636	Date Started: 12/30/2015				
Total Depth: 100 ft	Soil Depth: 100 ft	Core Depth: 0 ft	Date Completed: 12/30/2015				
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)	
Drill Machine: CME 550	Drill Method: RW	Hammer Type: Automatic		Energy Ratio: 74%			
Core Size: N/A	Driller: D. Harris	Groundwater: TOB 8 ft		24HR: 8.5 ft			

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
33.2		Hard, Moist, Greenish Black, Low Plasticity, <u>CLAY (CL)</u> , with Fine to Medium Sand, Munsell=GLE Y1 2.5/1			SS-14	6	10	30	40	
28.2				58.5	SS-15	8	13	24	37	
63.5		Very Dense, Moist, Greenish Black, Non-Plastic, Fine to Medium <u>SAND (SP)</u> , Munsell=10Y 2.5/1		63.5	SS-16	34	41	31	72	
68.5		Medium Dense, Moist, Greenish Black, Non-Plastic, Fine to Medium <u>SAND (SP-SM)</u> , with Silt, Munsell=GLE Y1 5GY 2.5/1		68.5	SS-17	9	12	16	28	
13.2		=> Very Dense		73.5	SS-18	7	50/5"		100+	>>
78.5		LIMESTONE		78.5	SS-19		50/4"		100+	>>
8.2		Very Dense to Dense, Moist, Greenish Black, Non-Plastic, Fine to Medium <u>SAND (SP-SM)</u> , with Silt (Strong HCl Reactivity), Munsell=GLE Y1 5GY 2.5/1		83.5	SS-20	5	7	50/5"	57+	
3.2				88.5	SS-21	12	18	14	32	
-1.8				93.5	SS-22		50/2.5"		100+	>>
-6.8				98.5	SS-23	14	8	11	19	
-11.8	100.0	=> Medium Dense, with Shell Fragments								
-16.8		Boring Terminated at 100.0 feet								

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	

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-5 (Bridge 2)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	89.6 ft	Latitude:	33.8096518	Longitude:	80.1135956
Date Started:	1/4/2016				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	1/4/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 550	Drill Method:	RW
Hammer Type:	Automatic	Energy Ratio:	74%		
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR	11.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE	PL	MC	LL	FINES CONTENT (%)
	0.0	Asphalt Roadway												
	0.6	ASPHALT (7.0")		0.6	SS-1	4	4	3	7	●				
	2.0	FILL		2.0	SS-2	2	2	3	5	●				
	4.0	Loose to Very Loose, Moist, Yellowish Brown, Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=10YR 5/4		4.0	SS-3	2	2	2	4	●				
	6.0	=> Yellowish Brow/Yellowish Red, Munsell=10YR 5/4 & 7.5YR 6/6		6.0	SS-4	2	2	2	4	●				
	8.0	=> Brownish Yellow, with Kaolin, Munsell=10YR 6/6		8.0	SS-5	2	1	3	4	●				
	13.5	ALLUVIUM		13.5	SS-6	10	12	12	24	●				
	18.5	Medium Dense to Loose, Wet, Light Yellowish Brown, Non-Plastic, Fine to Medium SAND (SP), Munsell=2.5Y 6/3		18.5	SS-7	5	6	4	10	●				
	23.5	=> Very Pale Brown, Munsell=10YR 7/3 NMC=20.9%, %200=1.3		23.5	SS-8	17	14	13	27	●				
	28.5	BLACK MINGO GROUP		28.5	SS-9	7	10	8	18	●				
	33.5	Medium Dense, Wet, Dark Olive Gray, Non-Plastic, Fine to Coarse SAND (SP-SC), with Clay Lenses, Munsell=5Y 3/2		33.5	SS-10	3	9	15	24	●				
	38.5	=> Very Dark Grayish Green, Munsell=5GY 3/2		38.5	SS-11	9	9	6	15	●				
	43.5	Stiff, Wet, Very Dark Greenish Gray, Low Plasticity, Fine Sandy CLAY (CL), Micaceous, Munsell=5GY 3/2		43.5	SS-12	7	15	23	38	●				
	48.5	Hard to Very Stiff, Wet, Very Dark Greenish Gray, High Plasticity, Lean CLAY (CL), with Sand & Lignite Seams, Munsell=5GY 3/2		48.5	SS-13	6	12	16	28	●				
	53.5			53.5										

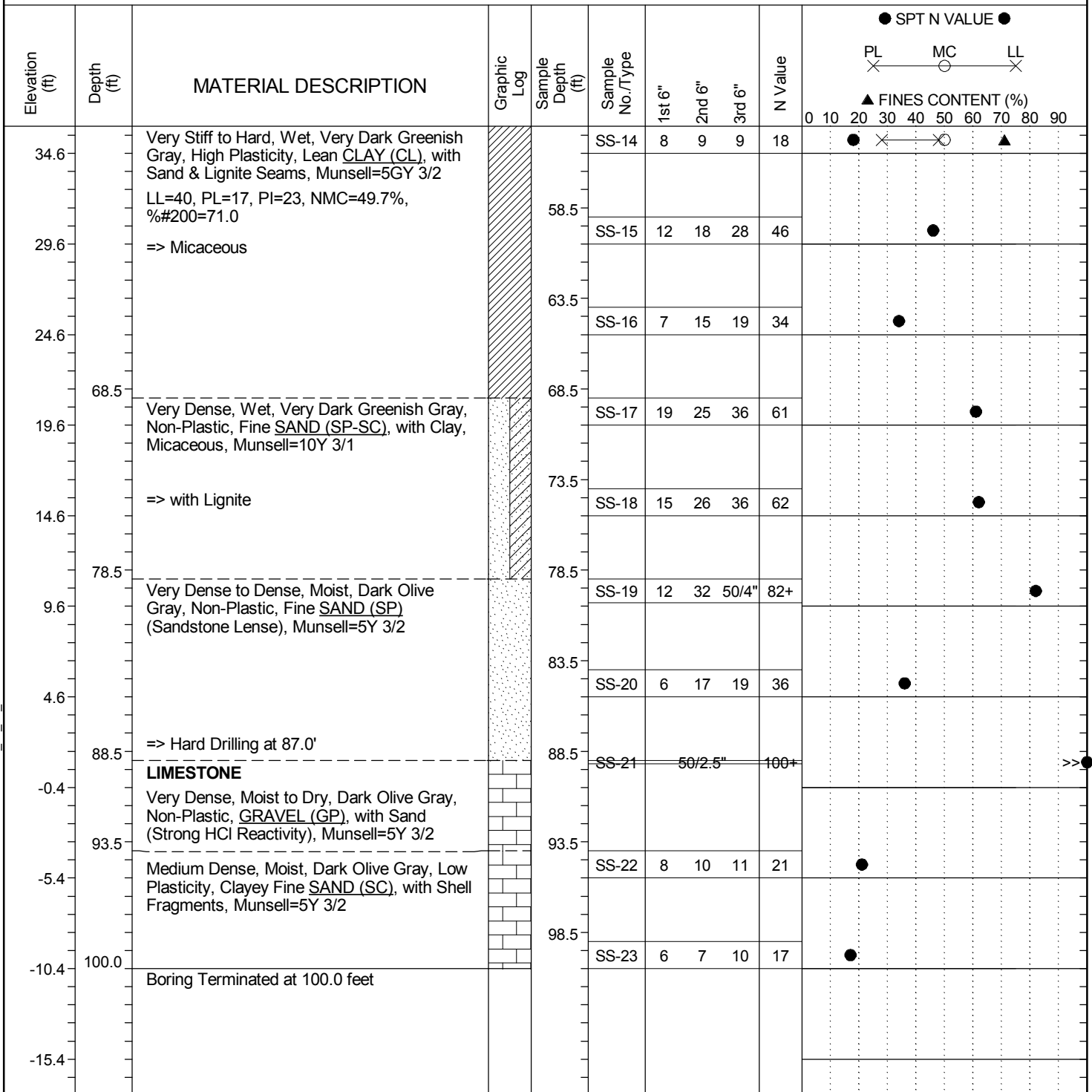
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-5 (Bridge 2)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	89.6 ft	Latitude:	33.8096518	Longitude:	80.1135956
Date Started:	1/4/2016				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	1/4/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR	11.5 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	

SCDOT Soil Test Log

Project ID:	N/A				County:	Clarendon			Boring No.:	B-6 (Bridge 2)				
Site Description:		US-301 Replacement Bridge over Black River							Route:	US-301				
Eng./Geo.:	R. Wessinger		Boring Location:					Offset:			Alignment:	On		
Elev.:	89.7 ft		Latitude:		33.8086801		Longitude:		80.1143269		Date Started:	1/5/2016		
Total Depth:		100 ft		Soil Depth:		100 ft		Core Depth:		0 ft		Date Completed:	1/6/2016	
Bore Hole Diameter (in):			4		Sampler Configuration			Liner Required:		Y (N)		Liner Used:	Y (N)	
Drill Machine:		CME 550		Drill Method:			RW		Hammer Type:		Automatic		Energy Ratio:	74%
Core Size:		N/A		Driller:		D. Harris			Groundwater:		TOB 10 ft		24HR	10.2 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
	0.0	Asphalt Roadway								
	0.8	ASPHALT (9.0")		0.8						
	1.2	STONE BASE (5.0")		2.0	SS-1	2	3			
	3.0	FILL								
	4.0	Loose, Moist, Yellowish Red, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=5YR 5/8		4.0	SS-2	2	2	3	5	● 4th 6" = 4 Blows
84.7		Loose, Moist, Yellow, Non-Plastic, Fine to Medium SAND (SP), Munsell=2.5Y 7/8		6.0	SS-3	2	2	2	4	● 4th 6" = 3 Blows
	8.0	Very Loose to Loose, Moist, Dark Yellowish Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=10YR 4/6		8.0	SS-4	3	3	5	8	● 4th 6" = 6 Blows
79.7		=> Dark Yellowish Brown/Gray, Munsell=10YR 4/6 & 6/1			SS-5	3	1	1	2	● 4th 6" = 2 Blows
	13.5	ALLUVIUM								
	13.5	Very Loose, Wet, Yellowish Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=10YR 5/4		13.5	SS-6	6	2	2	4	●
74.7		ORGANICS (WOOD)								
	18.5	Loose to Medium Dense, Wet, Pale Brown, Non-Plastic, Fine to Medium SAND (SP), Munsell=2.5Y 7/3		18.5	SS-7	5	4	4	8	▲ ● ○
69.7		NMC=25.0%, %200=1.7								
	23.5			23.5	SS-8	6	7	6	13	●
64.7										
	28.5	BLACK MINGO GROUP		28.5	SS-9	3	3	3	6	● ○ × ▲
59.7		Firm, Moist, Greenish Black, Medium Plasticity, ELASTIC SILT (MH), with Sand, Munsell=GLE Y1 10GY 2.5/1								
	33.5	LL=62, PL=43, PI=19, NMC=44.7%, %200=75.3		33.5	SS-10	12	9	10	19	●
54.7		Medium Dense, Moist, Greenish Black, Non-Plastic, Fine to Coarse SAND (SP-SM), with Silt and Lignite, Munsell=GLE Y1 10GY 2.5/1								
	38.5			38.5						

LEGEND

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

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-6 (Bridge 2)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	89.7 ft	Latitude:	33.8086801	Longitude:	80.1143269
Date Started:	1/5/2016				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	1/6/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 550	Drill Method:	RW
Hammer Type:	Automatic	Energy Ratio:	74%		
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 10 ft
24HR:	10.2 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL — MC — LL ▲ FINES CONTENT (%)
49.7		Stiff, Moist, Greenish Black, High Plasticity, <u>ELASTIC SILT (MH)</u> , with Sand, Munsell=GLE Y1 10GY 2.5/1 LL=67, PL=46, PI=21, NMC=44.2%, %200=82.3 => with Micaceous Fine Sand Seams			SS-11	4	4	7	11	● ○ — ○ ▲
44.7				43.5	SS-12	4	6	7	13	●
48.5				48.5	SS-13	6	17	19	36	●
53.5		Dense, Wet, Very Dark Greenish Gray, Low Plasticity, Clayey Fine to Medium <u>SAND (SP)</u> , with Glauconite, Munsell=5GY 3/2		53.5	SS-14	5	11	20	31	●
58.5				58.5	SS-15	14	14	20	34	●
63.5		=> Greenish Black, Micaceous, Munsell=10Y 2.5/1		63.5	SS-16	7	14	20	34	●
68.5				68.5	SS-17	5	20	42	62	●
73.5		Dense, Moist, Dark Gray, Non-Plastic, Fine to Medium <u>SAND (SP-SC)</u> , with Clay, Micaceous, Munsell=5Y 4/1		73.5	SS-18	6	17	20	37	●

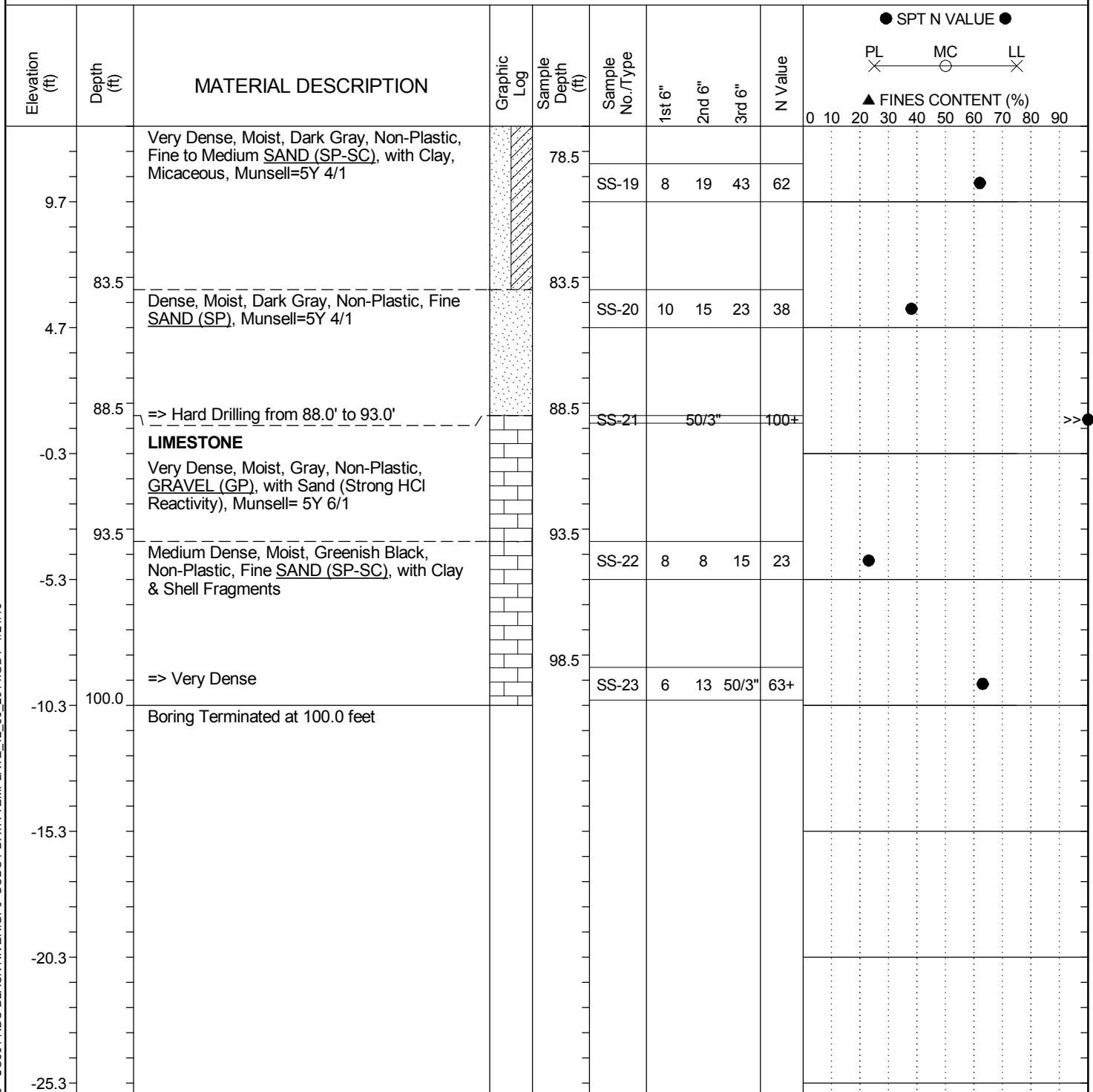
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID: N/A				County: Clarendon		Boring No.: B-6 (Bridge 2)	
Site Description:		US-301 Replacement Bridge over Black River					Route: US-301
Eng./Geo.: R. Wessinger		Boring Location:		Offset:		Alignment: On	
Elev.: 89.7 ft	Latitude: 33.8086801	Longitude: 80.1143269	Date Started: 1/5/2016				
Total Depth: 100 ft	Soil Depth: 100 ft	Core Depth: 0 ft	Date Completed: 1/6/2016				
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)	
Drill Machine: CME 550	Drill Method: RW	Hammer Type: Automatic		Energy Ratio: 74%			
Core Size: N/A	Driller: D. Harris	Groundwater: TOB 10 ft		24HR: 10.2 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 G5600.08 - US301 RBO BLACK RIVER.GPJ SCDOT DATA TEMPLATE_12_30_2014.GDT 1/21/16

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-7 (Bridge 1)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	88.0 ft	Latitude:	33.8035154	Longitude:	80.1187237
Date Started:	1/6/2016				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	1/7/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 550	Drill Method:	RW
Hammer Type:	Automatic	Energy Ratio:	74%		
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR	5.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ●	PL MC LL	▲ FINES CONTENT (%)
	0.0	Asphalt Roadway										
	0.5	ASPHALT (6.0")		0.5								
		FILL										
		Loose, Moist, Yellowish Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=10YR 5/6		2.0	SS-1	4	5	5	10	●		
	3.0				SS-2	3	4	6	10	●		4th 6" = 8 Blows
	4.0	Loose, Moist, Brown, Non-Plastic, Fine to Medium SAND (SP), Munsell=10YR /43		4.0	SS-3	5	5	4	9	●		4th 6" = 4 Blows
83.0	6.0	Loose, Moist, Olive Brown, Low Plasticity, Clayey Fine to Medium SAND (SC), Munsell=2.5Y 4/6		6.0	SS-4	6	6	4	10	●		4th 6" = 3 Blows
	8.0	Loose, Moist to Wet, Grayish Brown, Non-Plastic, Fine to Medium SAND (SP), Munsell=10YR 5/2		8.0	SS-5	3	2	1	3	●		4th 6" = 2 Blows
		ALLUVIUM										
		Very Loose, Wet, Very Dark Grayish Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), with Organics, Munsell=2.5Y 3/2										
		NMC=22.2%, %200=33.3										
	13.5			13.5								
	14.0	Stiff, Wet, Pale Brown, Low Plasticity, Organic SILT (OH), Munsell=10YR 6/3		13.5	SS-6	3	7	8	15	●	▲	
73.0		Medium Dense, Wet, Pale Brown, Non-Plastic, Silty Fine to Medium SAND (SM), Munsell=10YR 6/3										
		NMC=39.3%, %200=24.9										
	18.5	=> No Recovery		18.5								
					SS-7	9	7	7	14	●		
68.0												
	23.5			23.5								
		Medium Dense, Wet, Brownish Yellow/Grayish Green, Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=10YR 6/8 & 5GY 5/2		23.5	SS-8	3	4	7	11	●	▲	
63.0		NMC=34.8%, %200=36.7										
	28.5			28.5								

LEGEND

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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	

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-7 (Bridge 1)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	88.0 ft	Latitude:	33.8035154	Longitude:	80.1187237
Date Started:	1/6/2016				
Total Depth:	100 ft	Soil Depth:	100 ft	Core Depth:	0 ft
Date Completed:	1/7/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR	5.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%)
58.0		BLACK MINGO GROUP Dense, Wet, Very Dark Greenish Gray, Low Plasticity, Silty Fine to Medium <u>SAND (SM)</u> , Micaceous, Munsell=5GY 3/1			SS-9	15	17	18	35	●
33.5		Stiff to Very Stiff, Moist to Wet, Dark Olive Gray, Medium Plasticity, <u>ELASTIC SILT (MH)</u> , Munsell=5Y 3/2 LL=62, PL=45, PI=17, NMC=51.9%, %200=88.0		33.5	SS-10	3	4	5	9	●
53.0		=> with Lignite Seams								
39.0		Medium Dense, Wet, Dark Olive Gray, Non-Plastic, Fine to Medium <u>SAND (SP)</u> , Micaceous, Munsell=5Y 3/2		38.5	SS-11	4	9	13	22	●
48.0		=> with Lignite Seams								
43.0				43.5	SS-12	6	11	13	24	●
				48.5	SS-13	6	8	17	25	●
38.0										
				53.5	SS-14	6	16	35	51	●
33.0		=> Very Dense, Greenish Gray, with Lignite, Micaceous, Munsell=10Y 5/1								

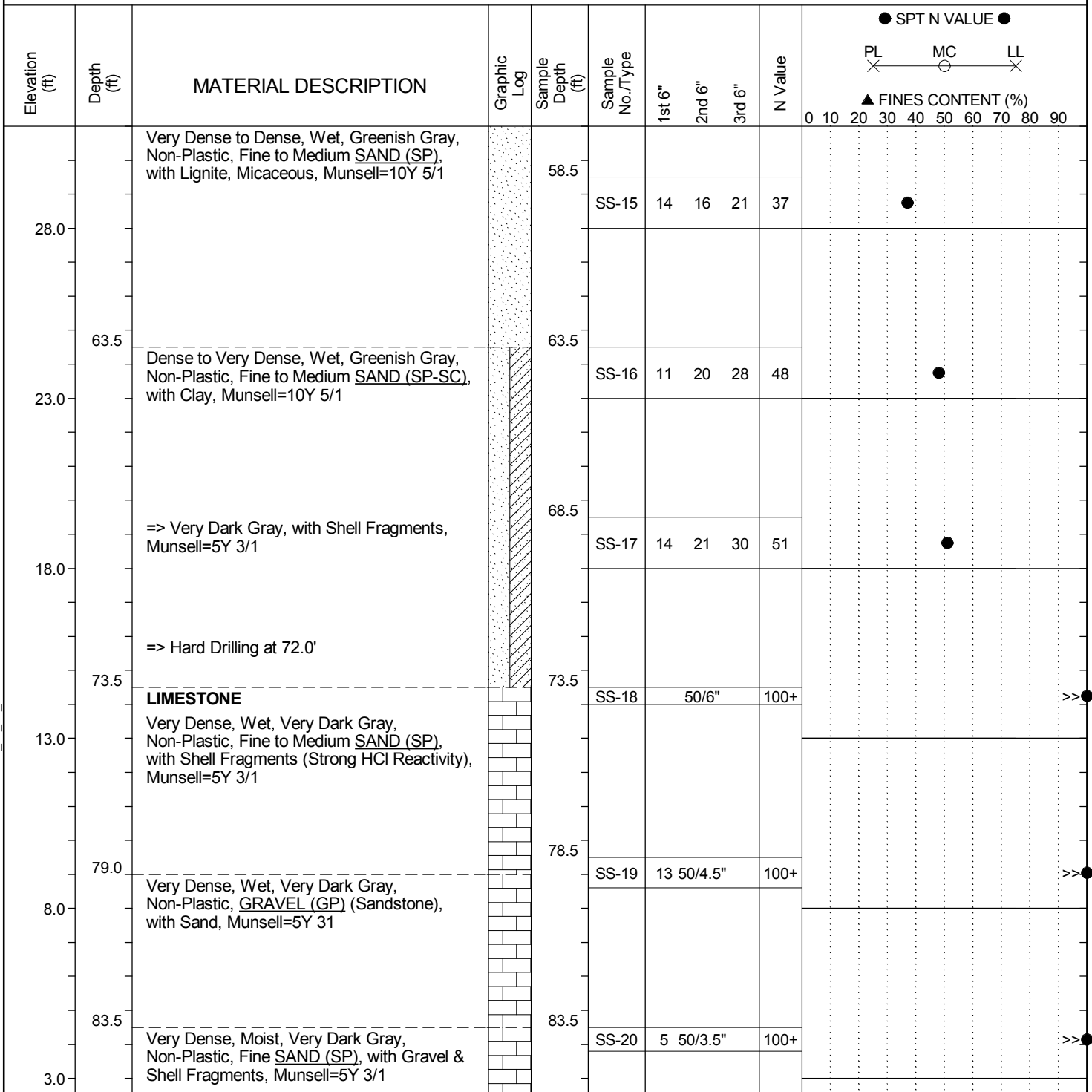
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID: N/A				County: Clarendon		Boring No.: B-7 (Bridge 1)	
Site Description:		US-301 Replacement Bridge over Black River					Route: US-301
Eng./Geo.: R. Wessinger		Boring Location:		Offset:		Alignment:	On
Elev.: 88.0 ft	Latitude: 33.8035154	Longitude: 80.1187237	Date Started: 1/6/2016				
Total Depth: 100 ft	Soil Depth: 100 ft	Core Depth: 0 ft	Date Completed: 1/7/2016				
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)	Liner Used: Y (N)		
Drill Machine: CME 550	Drill Method: RW	Hammer Type: Automatic		Energy Ratio: 74%			
Core Size: N/A	Driller: D. Harris	Groundwater: TOB	8 ft		24HR: 5.5 ft		



LEGEND

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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	

SCDOT Soil Test Log

Project ID: N/A				County: Clarendon		Boring No.: B-7 (Bridge 1)	
Site Description:		US-301 Replacement Bridge over Black River					Route: US-301
Eng./Geo.: R. Wessinger		Boring Location:		Offset:		Alignment:	On
Elev.: 88.0 ft	Latitude: 33.8035154	Longitude: 80.1187237	Date Started: 1/6/2016				
Total Depth: 100 ft	Soil Depth: 100 ft	Core Depth: 0 ft	Date Completed: 1/7/2016				
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)	Liner Used: Y (N)		
Drill Machine: CME 550	Drill Method: RW	Hammer Type: Automatic		Energy Ratio: 74%			
Core Size: N/A	Driller: D. Harris	Groundwater: TOB	8 ft		24HR: 5.5 ft		

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type				N Value	● SPT N VALUE ● PL — MC — LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90									
						1st 6"	2nd 6"	3rd 6"											
		Very Dense to Dense, Moist, Very Dark Gray, Non-Plastic, Fine SAND (SP), with Gravel & Shell Fragments, Munsell=5Y 3/1		88.5	SS-21	19 50/2.5"			100+										
-2.0																			
		=> Dark Gray, Munsell=5Y 4/1		93.5	SS-22	22	18	17	35										
-7.0																			
				98.5	SS-23	13	20	23	43										
-12.0	100.0	Dense, Moist, Dark Olive Gray, Low Plasticity, Clayey Fine SAND (SC), Munsell=5Y 3/2		98.5															
		Boring Terminated at 100.0 feet																	
-17.0																			
-22.0																			

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		

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-8 (Bridge 1)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	88.3 ft	Latitude:	33.8030499	Longitude:	80.1190712
Date Started:	1/7/2016				
Total Depth:	88.5 ft	Soil Depth:	88.5 ft	Core Depth:	0 ft
Date Completed:	1/8/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)	Drill Machine:	CME 550	Drill Method:	RW
Hammer Type:	Automatic	Energy Ratio:	74%		
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR:	4.8 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE	PL	MC	LL	FINES CONTENT (%)
	0.0	Asphalt Roadway												
	0.5	ASPHALT (6.0")		0.5	SS-1	4	7	6	13					
	2.0	FILL		2.0	SS-2	3	3	4	7					
	5.0	Medium Dense to Loose, Moist, Strong Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=7.5YR 5/6		4.0	SS-3	5	7	8	15					4th 6" = 5 Blows
83.3	5.0	ALLUVIUM		6.0	SS-4	5	3	4	7					4th 6" = 8 Blows
	8.0	Medium Dense to Loose, Moist, Light Olive Brown, None to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=2.5Y 5/4		8.0	SS-5	2	1	1	2					4th 6" = 3 Blows
78.3	8.0	=> Very Loose, Wet, with Organics												4th 6" = 1 Blow
	13.5	NMC=15.0%, %200=24.1		13.5	SS-6	1	2	4	6					
73.3	13.5	Firm, Wet, Light Olive Brown, Low Plasticity, SILT (ML), with Sand, Munsell=2.5Y 5/4												
	18.5	LL=34, PL=24, PI=10, NMC=41.8%, %200=74.1		18.5	SS-7	8	7	8	15					
68.3	18.5	Medium Dense to Loose, Wet, Pale Brown, Medium Plasticity, Fine to Coarse SAND (SP-SC), with Clay & Organics, Munsell=2.5Y 7/3												
	24.5	LL=35, PL=24, PI=11, NMC=20.1%, %200=10.3		23.5	SS-8	9	3	3	6					
63.3	24.5	BLACK MINGO GROUP												
	28.5	Firm to Stiff, Wet to Moist, Dark Gray, Medium Plasticity, Sandy Lean CLAY (CL), Munsell=5GY 4/1		28.5	SS-9	2	5	4	9					
58.3	28.5	=> Dark Greenish Gray, Munsell=5GY 4/1												
	34.0	LL=34, PL=19, PI=15, NMC=38.8%, %200=54.4		33.5	SS-10	3	5	6	11					
53.3	34.0	Stiff to Very Stiff, Wet, Dark Greenish Gray, Low Plasticity, CLAY (CL), Munsell=5GY 4/1												
	39.5	Medium Dense to Dense, Wet to Moist, Dark Greenish Gray, Non-Plastic, Fine to Medium SAND (SP), Micaceous, Munsell=5GY 4/1		38.5	SS-11	3	6	16	22					
48.3	39.5	=> with Glauconite, Lignite, and Clay Laminations												
	43.3			43.5	SS-12	5	9	16	25					
43.3	43.3													
	48.5			48.5	SS-13	6	16	20	36					
38.3	48.5													
	53.5			53.5										

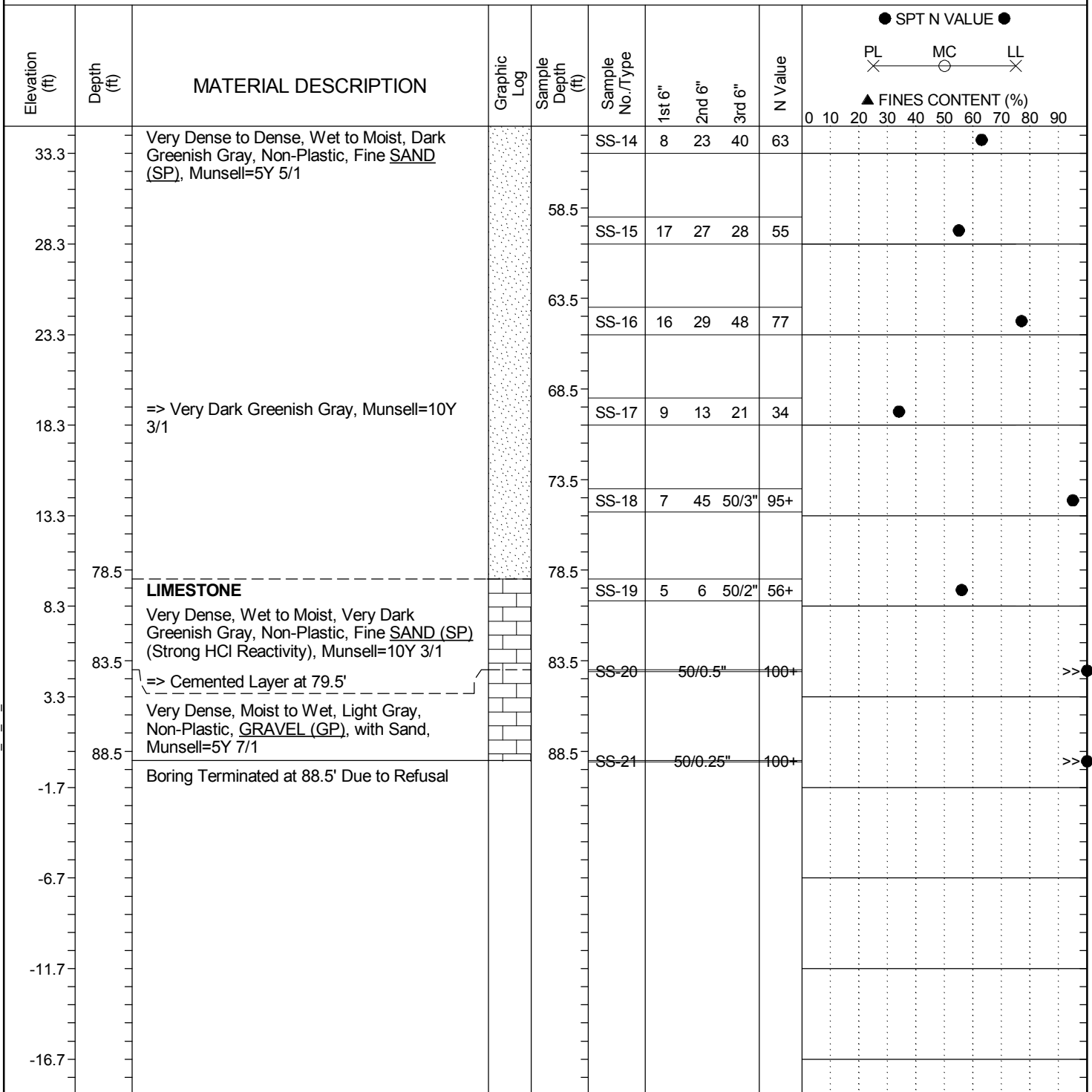
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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID:	N/A	County:	Clarendon	Boring No.:	B-8 (Bridge 1)
Site Description:	US-301 Replacement Bridge over Black River			Route:	US-301
Eng./Geo.:	R. Wessinger	Boring Location:		Offset:	
Elev.:	88.3 ft	Latitude:	33.8030499	Longitude:	80.1190712
Date Started:	1/7/2016				
Total Depth:	88.5 ft	Soil Depth:	88.5 ft	Core Depth:	0 ft
Date Completed:	1/8/2016				
Bore Hole Diameter (in):	4	Sampler Configuration		Liner Required:	Y (N)
Liner Used:	Y (N)				
Drill Machine:	CME 550	Drill Method:	RW	Hammer Type:	Automatic
Energy Ratio:	74%				
Core Size:	N/A	Driller:	D. Harris	Groundwater:	TOB 8 ft
24HR	4.8 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	

Cone Penetrometer Log Cover Page

Test Methods:

F&ME performs in-situ testing in general accordance with the currently published ASTM procedures along with generally acceptable industry practices. Applicable procedures include:

- Piezo Cone Penetration Tests (CPTu): D5778

Instrumentation

- All of F&ME's probes are manufactured and are calibrated at least annually by Vertek.
- The equipment used for the exploration includes electronic VTK 10 cm² digital cones.

Rig

- F&ME uses a CME 45B drill rig to advance the cones.

Software

- F&ME uses Bentley's, gINT and Dataforensic's, RapidCPT to process and output the raw data collected.

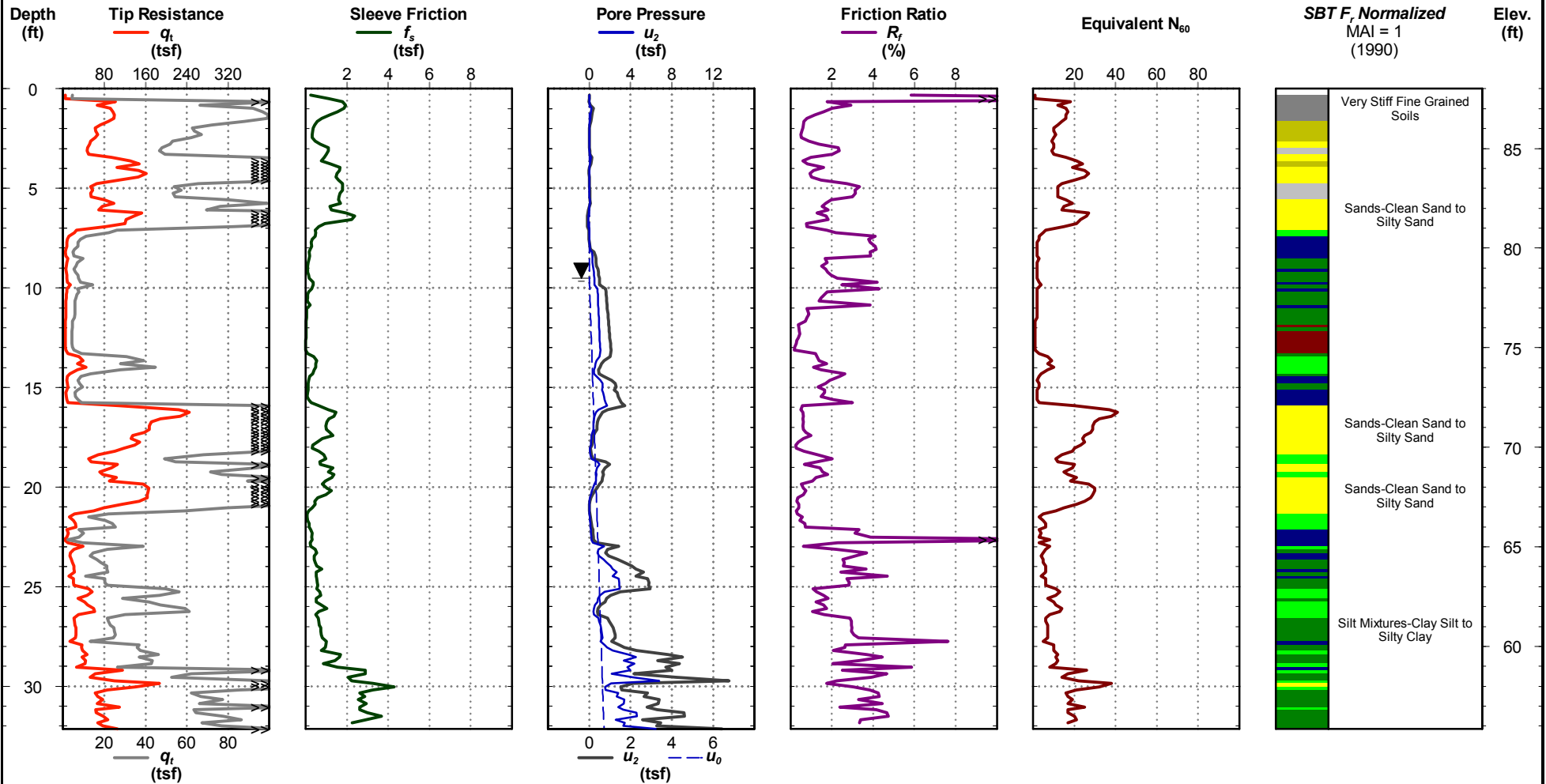
SBT Material Correlations Legend (Robertson and Campanella: 1990)

	1 – Sensitive, Fine Grained Soils		4 – Silt Mixtures-Clay Silt to Silty Clay		7 – Gravelly Sand to Sand
	2 – Organic Soils, Peats		5 – Sand Mixtures-Silty Sand to Sandy Silt		8 – Very Stiff Clay to Clayey Sand
	3 – Clays-Clay to Silty Clay		6 – Sands-Clean Sand to Silty Sand		9 – Very Stiff Fine Grained Soils

Date: Jan. 8, 2016
Estimated Water Depth: 9.5 ft
Rig/Operator: P. Hainer

Latitude: 33.8172793
Longitude: 80.1071279
Elevation: 88.0MSL

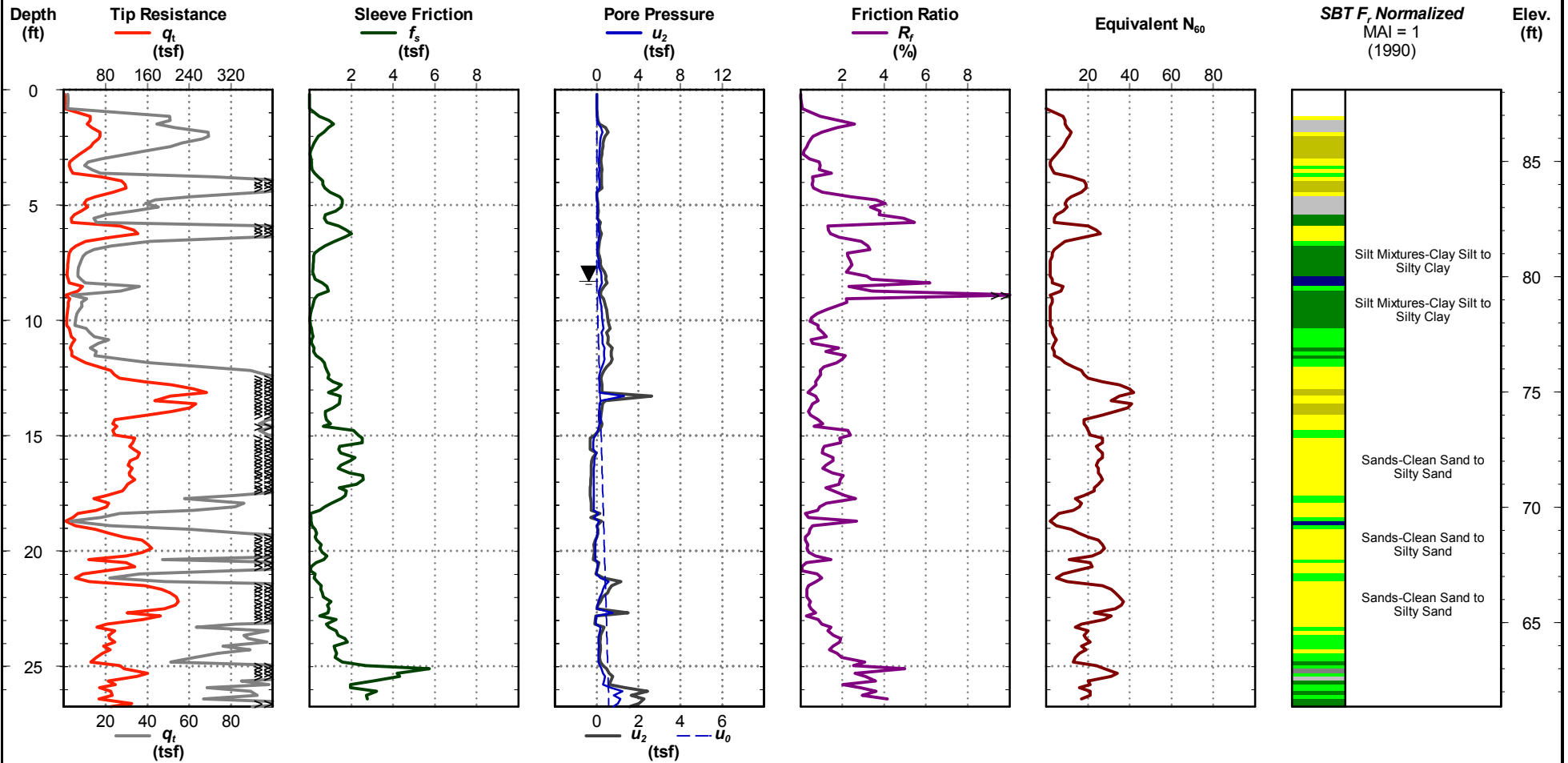
Total Depth: 32.2 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 8, 2016
Estimated Water Depth: 8.3 ft
Rig/Operator: P. Hainer

Latitude: 33.8169738
Longitude: 80.1073829
Elevation: 88.1MSL

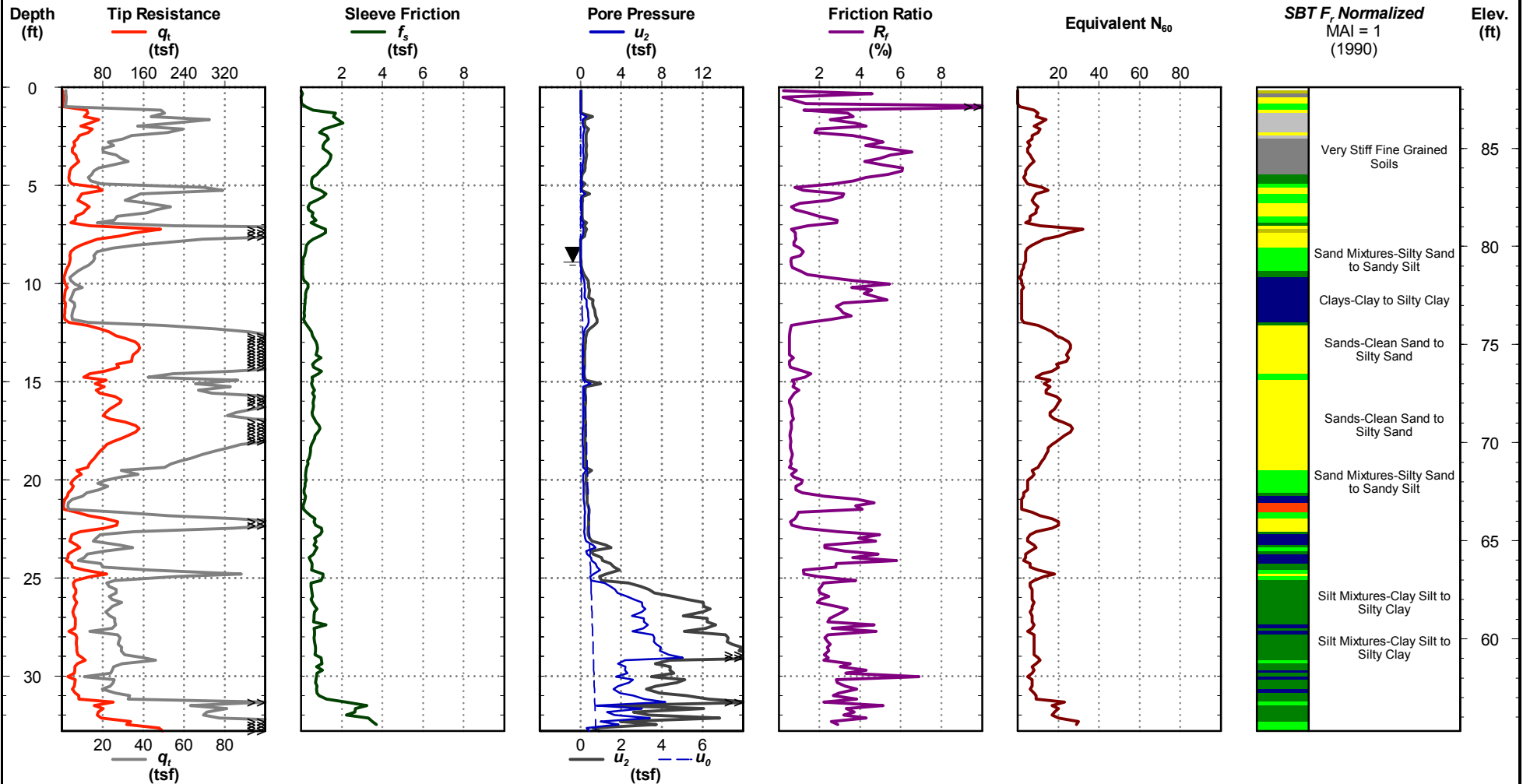
Total Depth: 26.7 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 9, 2016
Estimated Water Depth: 8.9 ft
Rig/Operator: P. Hainer

Latitude: 33.8129255
Longitude: 80.1107829
Elevation: 88.1MSL

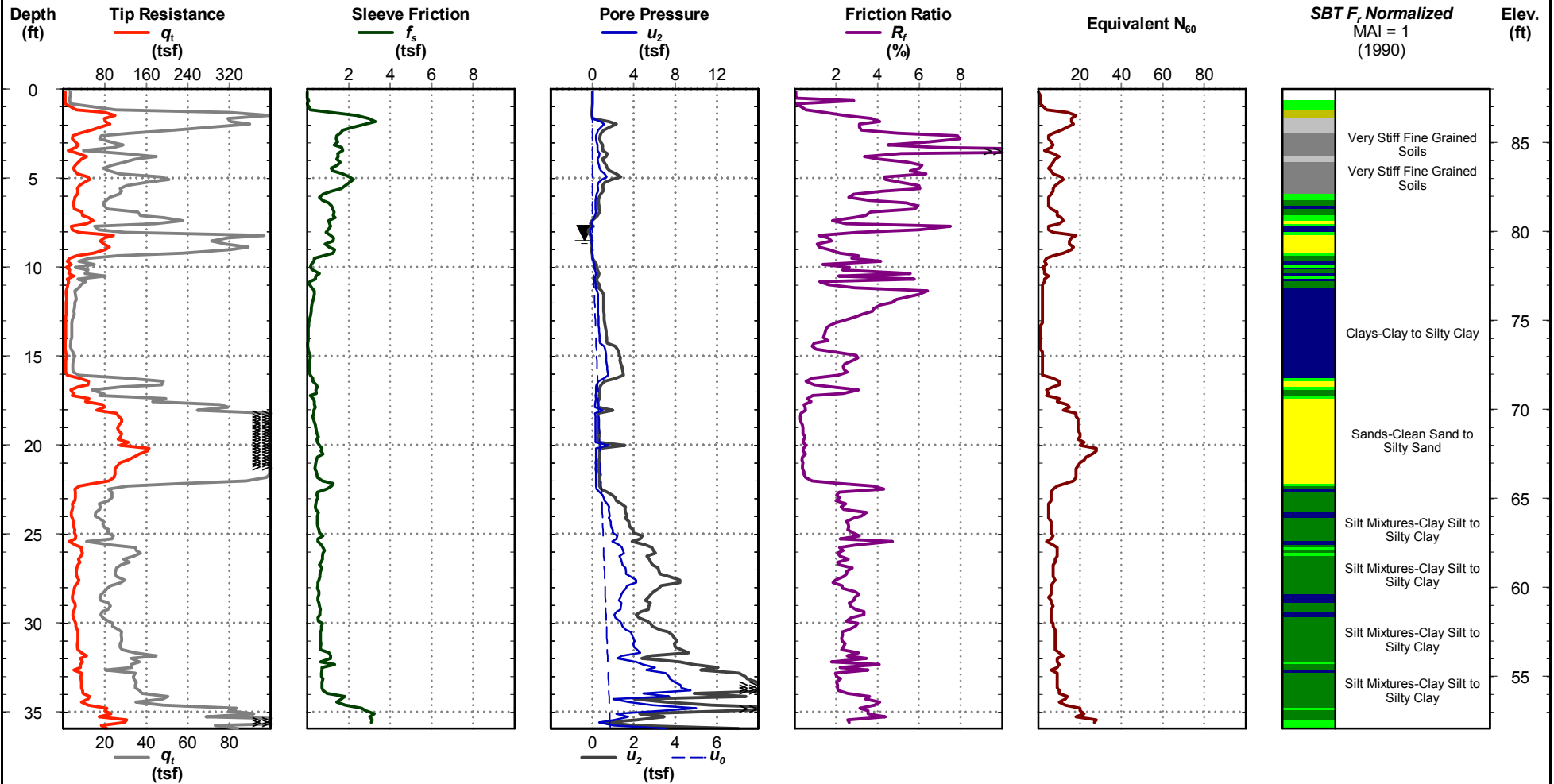
Total Depth: 32.8 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 9, 2016
Estimated Water Depth: 8.5 ft
Rig/Operator: P. Hainer

Latitude: 33.8126172
Longitude: 80.1110418
Elevation: 88.0MSL

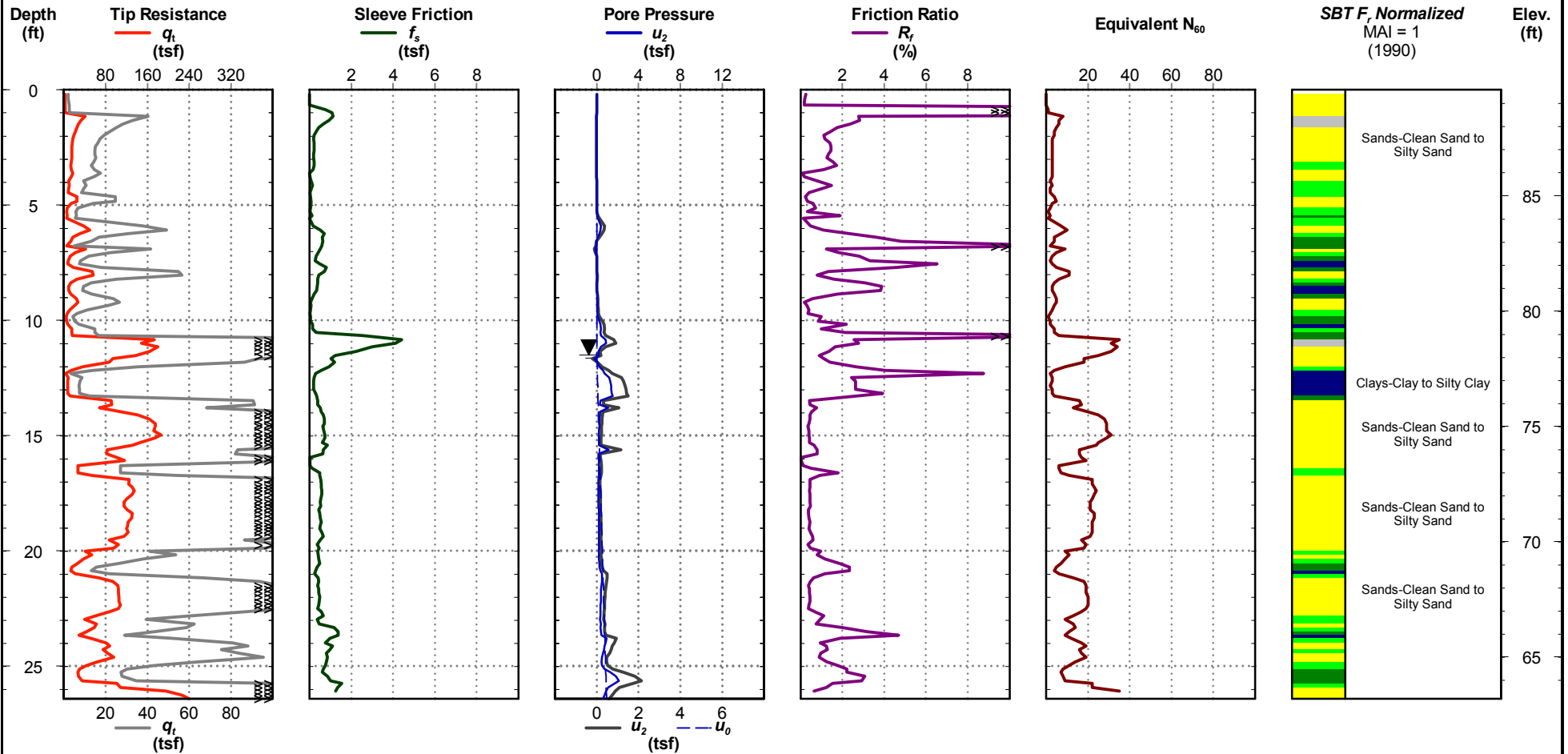
Total Depth: 35.9 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 9, 2016
Estimated Water Depth: 11.5 ft
Rig/Operator: P. Hainer

Latitude: 33.8096302
Longitude: 80.1135477
Elevation: 89.6MSL

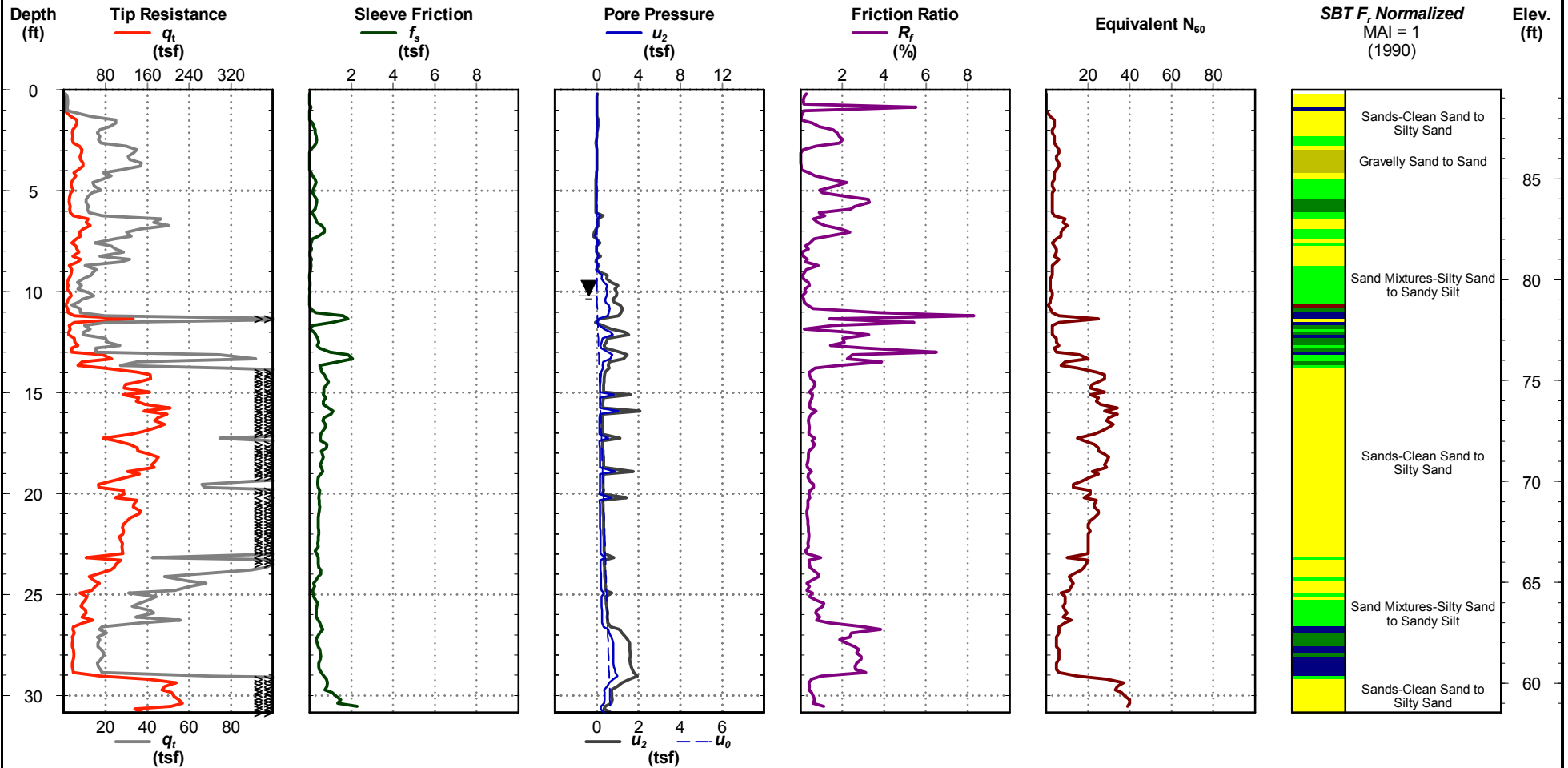
Total Depth: 26.4 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 9, 2016
Estimated Water Depth: 10.2 ft
Rig/Operator: P. Hainer

Latitude: 33.8087053
Longitude: 80.1143738
Elevation: 89.4MSL

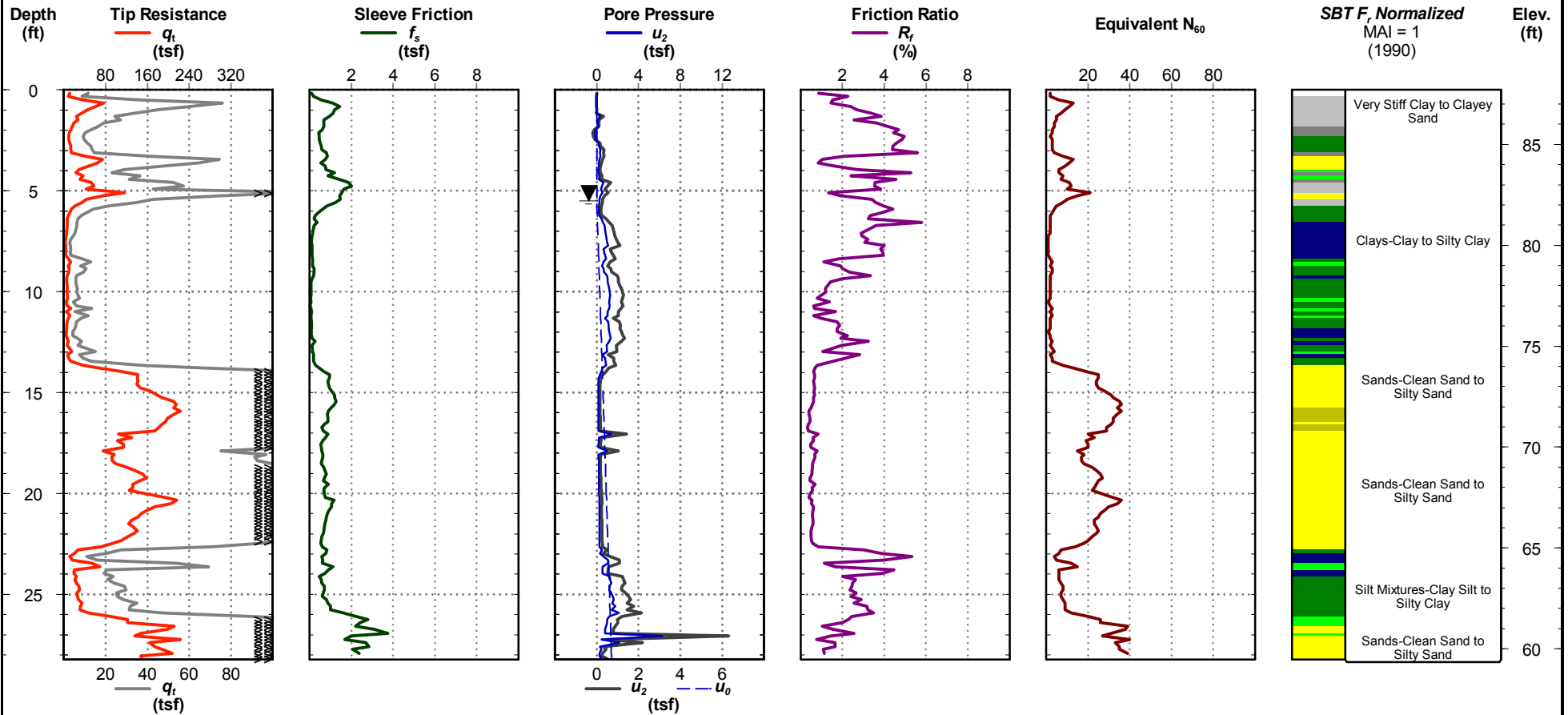
Total Depth: 30.8 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



Date: Jan. 9, 2016
Estimated Water Depth: 5.5 ft
Rig/Operator: P. Hainer

Latitude: 33.8034961
Longitude: 80.1186991
Elevation: 87.7MSL

Total Depth: 28.2 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



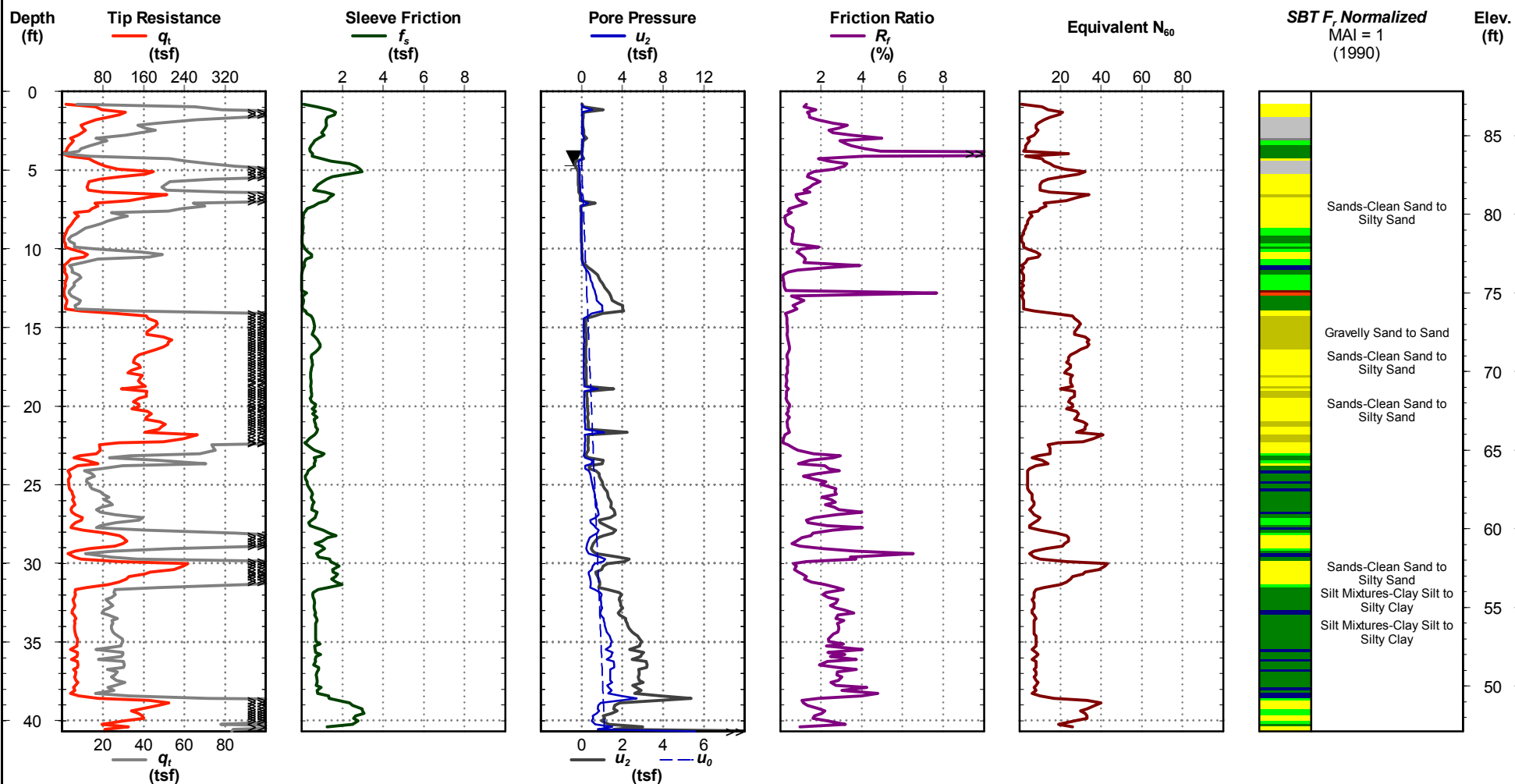
Cone Penetration Test

CPT-8

Date: Jan. 9, 2016
Estimated Water Depth: 4.7 ft
Rig/Operator: P. Hainer

Latitude: 33.8030652
Longitude: 80.1191101
Elevation: 87.8MSL

Total Depth: 40.7 ft
Termination Criteria: Maximum Reaction Force
Cone Size:



CPT REPORT - STANDARD G5500.08 CPT.GPJ CPT TEST.GPJ 1/20/16

APPENDIX C

Laboratory Test Results



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B-1 (Bridge 4)	10.0	31	27	4	0.075	51	ML	65.3			
B-1 (Bridge 4)	20.0				0.075	10	SP-SM	26.8			
B-1 (Bridge 4)	30.0				0.075	15	SM	27.3			
B-1 (Bridge 4)	65.0				0.075	22	SM	29.3			
B-2 (Bridge 4)	10.0	22	14	8	0.075	43	SC	21.7			
B-2 (Bridge 4)	15.0	33	23	10	0.075	65	CL	52.6			
B-2 (Bridge 4)	25.0				0.075	25	SM	37.9			
B-2 (Bridge 4)	30.0				0.075	57	CL	53.7			
B-2 (Bridge 4)	40.0	53	29	24	0.075	86	MH	60.3			
B-3 (Bridge 3)	15.0				0.075	3	SP	20.9			
B-3 (Bridge 3)	20.0				0.075	1	SP	21.9			
B-3 (Bridge 3)	25.0				0.075	23	SM	25.4			
B-3 (Bridge 3)	30.0	49	33	16	0.075	86	ML	41.9			
B-3 (Bridge 3)	45.0	39	22	17	0.075	67	CL	49.3			
B-4 (Bridge 3)	10.0				0.075	24	SC	12.9			
B-4 (Bridge 3)	15.0	65	62	3	0.075	55	MH	132.4			
B-4 (Bridge 3)	20.0				0.075	4	SP	18.7			
B-4 (Bridge 3)	35.0	89	39	50	0.075	97	MH	40.9			
B-5 (Bridge 2)	20.0				0.075	1	SP	20.9			
B-5 (Bridge 2)	55.0	40	17	23	0.075	71	CL	49.7			
B-6 (Bridge 2)	20.0				0.075	2	SP	25.0			
B-6 (Bridge 2)	30.0	62	43	19	0.075	75	MH	44.7			
B-6 (Bridge 2)	40.0	67	46	21	0.075	82	MH	44.2			
B-7 (Bridge 1)	10.0				0.075	33	SM	22.2			
B-7 (Bridge 1)	15.0				0.075	25	SM	39.3			
B-7 (Bridge 1)	25.0				0.075	37	SM	34.8			
B-7 (Bridge 1)	35.0	62	45	17	0.075	88	MH	51.9			
B-8 (Bridge 1)	10.0				0.075	24	SM	14.9			
B-8 (Bridge 1)	15.0	34	24	10	0.075	74	ML	41.8			
B-8 (Bridge 1)	25.0	35	24	11	0.075	10	SP-SC	20.1			
B-8 (Bridge 1)	30.0	34	19	15	0.075	54	CL	38.8			



INDEX PROPERTIES VERSUS DEPTH

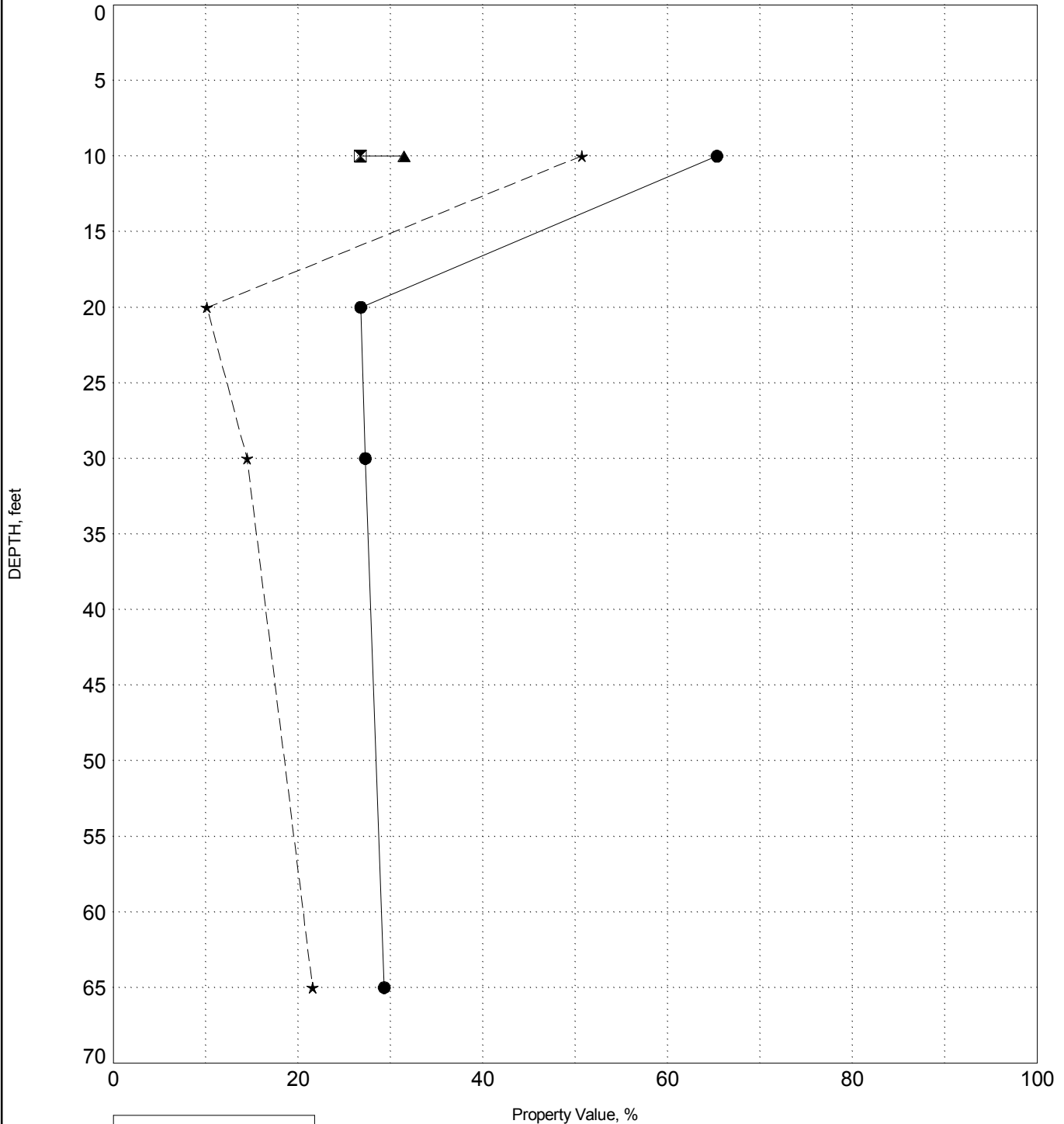
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.3

BORING B-1 (Bridge 4)



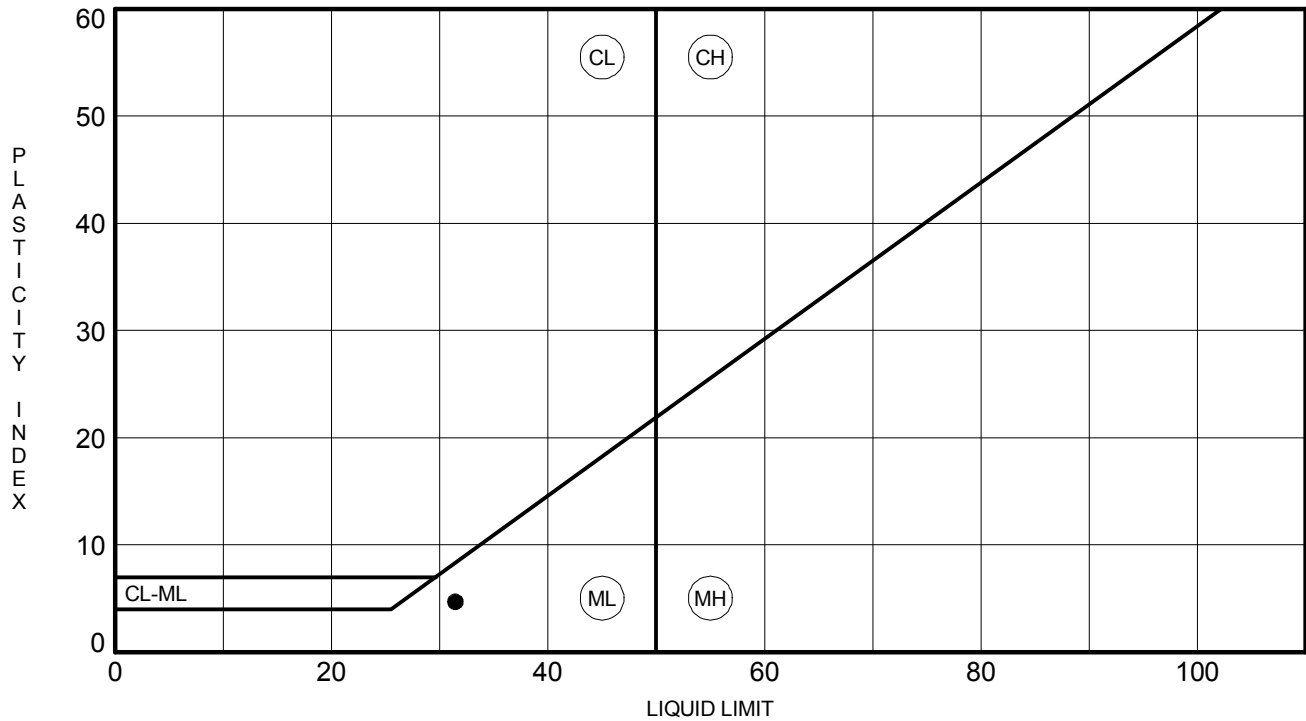
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

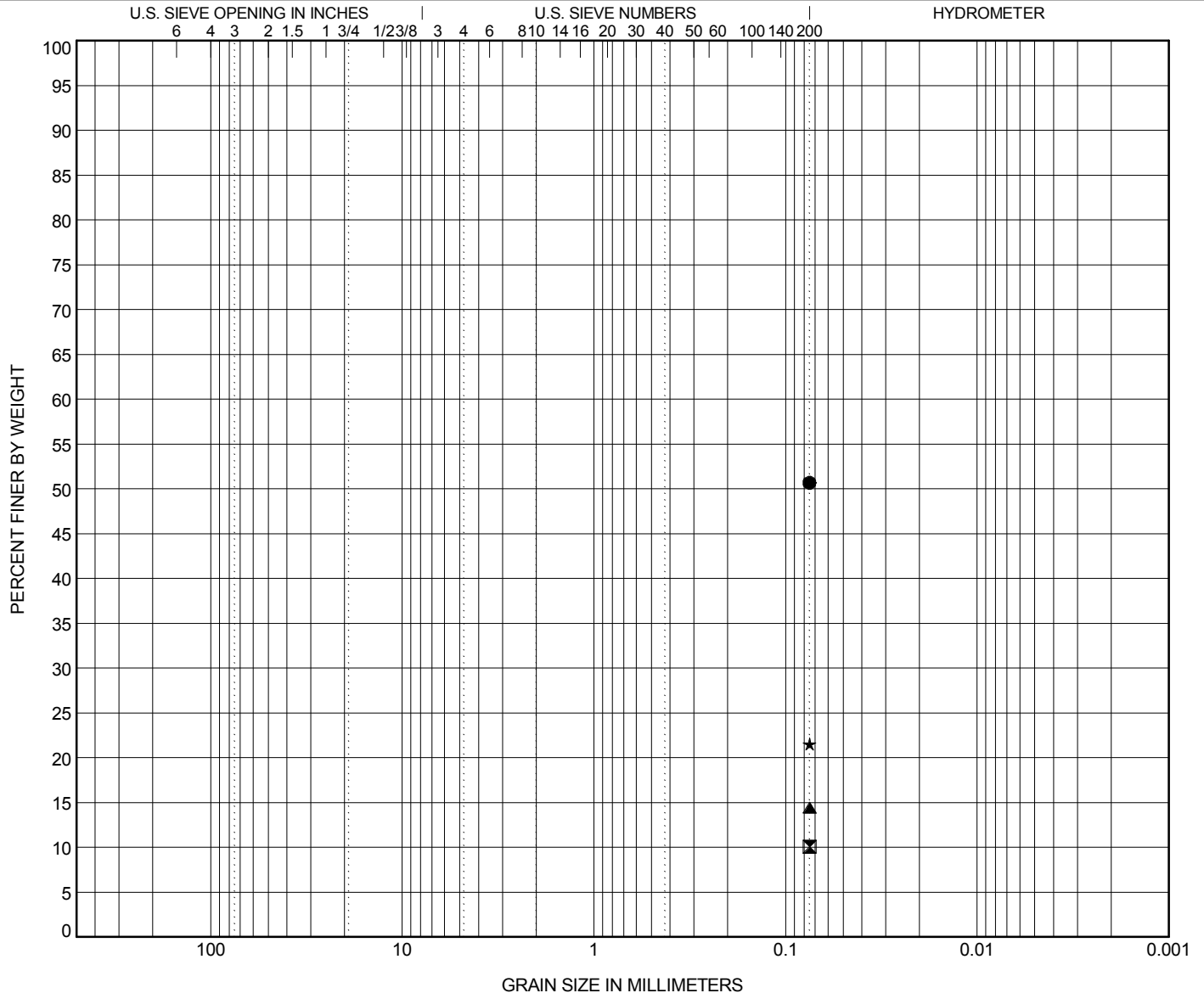


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification						LL	PL	PI	Cc	Cu
● B-1 (Bridge 4)	10.0	Sandy SILT (ML)						31	27	4		
☒ B-1 (Bridge 4)	20.0	SAND (SP-SM), with Silt										
▲ B-1 (Bridge 4)	30.0	Silty SAND (SM)										
★ B-1 (Bridge 4)	65.0	Silty SAND (SM)										
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay			
● B-1 (Bridge 4)	10.0	0.075						50.7				
☒ B-1 (Bridge 4)	20.0	0.075						10.1				
▲ B-1 (Bridge 4)	30.0	0.075						14.5				
★ B-1 (Bridge 4)	65.0	0.075						21.5				

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0001	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-1	B-1	B-1	B-1	
SAMPLE NO.	16-0001C	16-0001E	16-0001G	16-0001I	
SAMPLE DEPTH	8.0-10.0'	18.5-20.0'	28.5-30.0'	63.5-65'	
WATER CONTENT, W%	65.3	26.8	27.3	29.3	

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

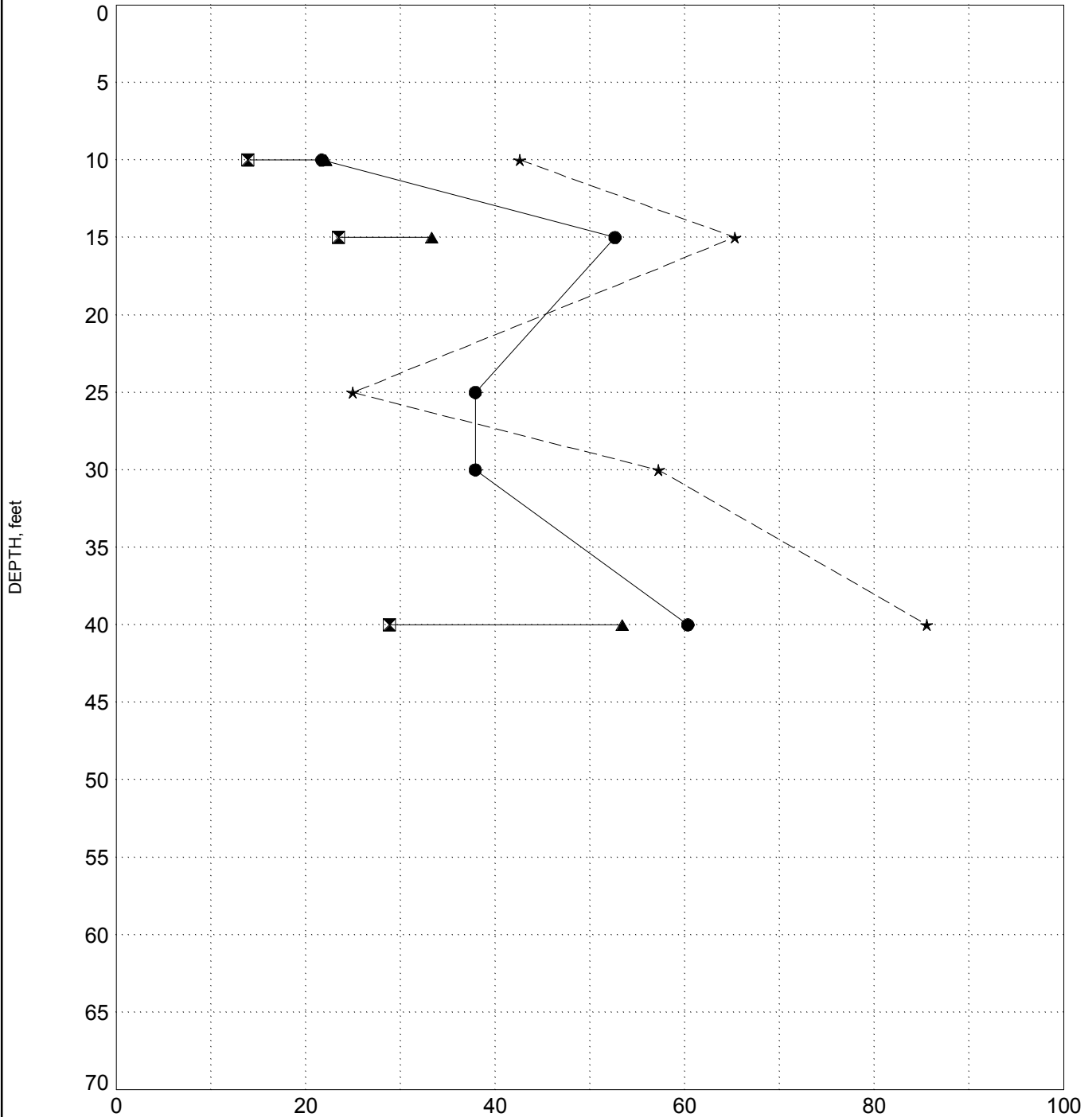
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.2

BORING B-2 (Bridge 4)



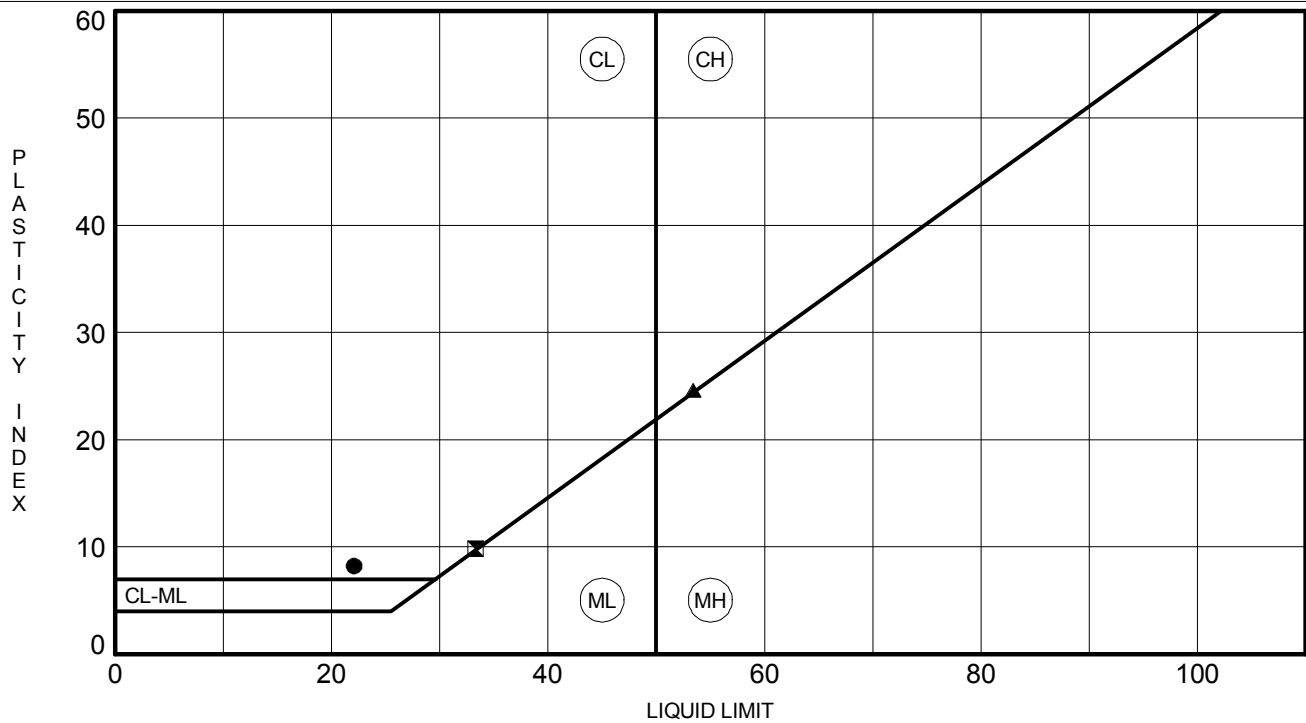
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

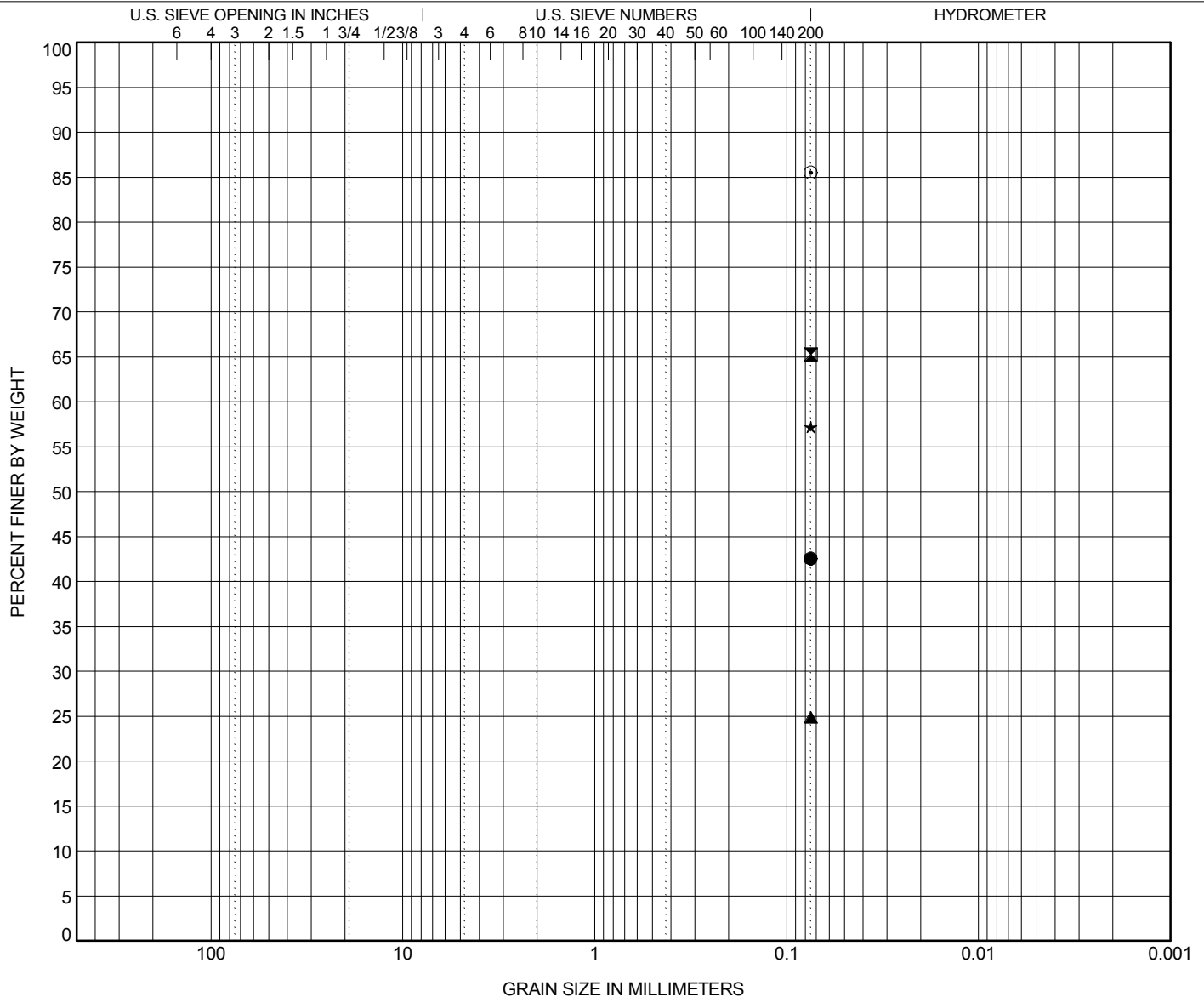


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-2 (Bridge 4)	10.0	Clayey SAND (SC)					22	14	8		
☒ B-2 (Bridge 4)	15.0	Sandy Lean CLAY (CL)					33	23	10		
▲ B-2 (Bridge 4)	25.0	Silty SAND (SM)									
★ B-2 (Bridge 4)	30.0	Sandy Lean CLAY (CL)									
◎ B-2 (Bridge 4)	40.0	ELASTIC SILT (MH)					53	29	24		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-2 (Bridge 4)	10.0	0.075						42.6			
☒ B-2 (Bridge 4)	15.0	0.075						65.3			
▲ B-2 (Bridge 4)	25.0	0.075						24.9			
★ B-2 (Bridge 4)	30.0	0.075						57.2			
◎ B-2 (Bridge 4)	40.0	0.075						85.5			

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0002	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-2	B-2	B-2	B-2	B-2
SAMPLE NO.	16-0002C	16-0002F	16-0002H	16-0002J	16-0002M
SAMPLE DEPTH	8.0-10.0'	13.5-15.0'	23.5-25.0'	28.5-30.0'	38.5-40.0'
WATER CONTENT, W%	21.7	52.6	37.9	53.7	60.3

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

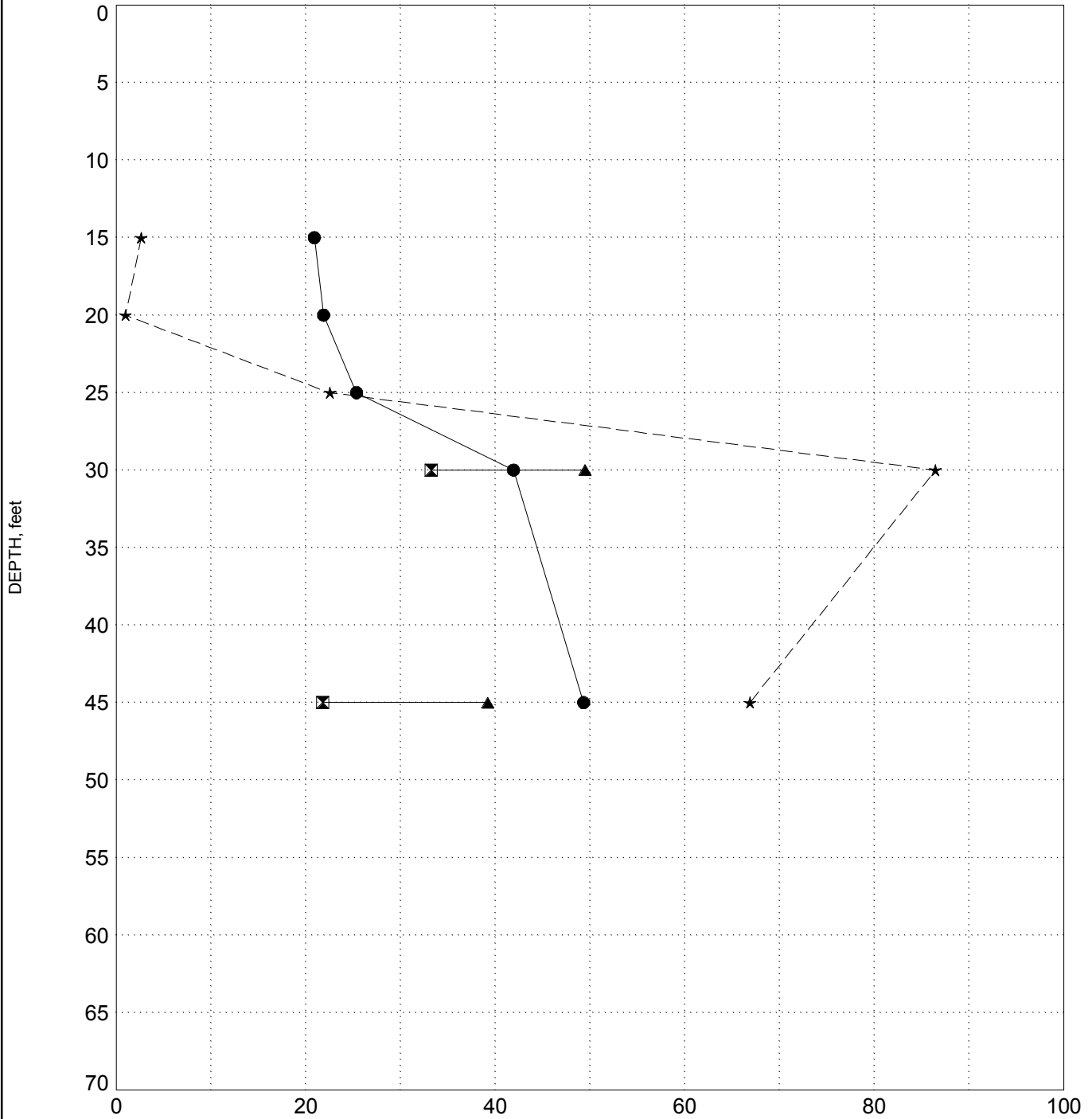
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.2

BORING B-3 (Bridge 3)



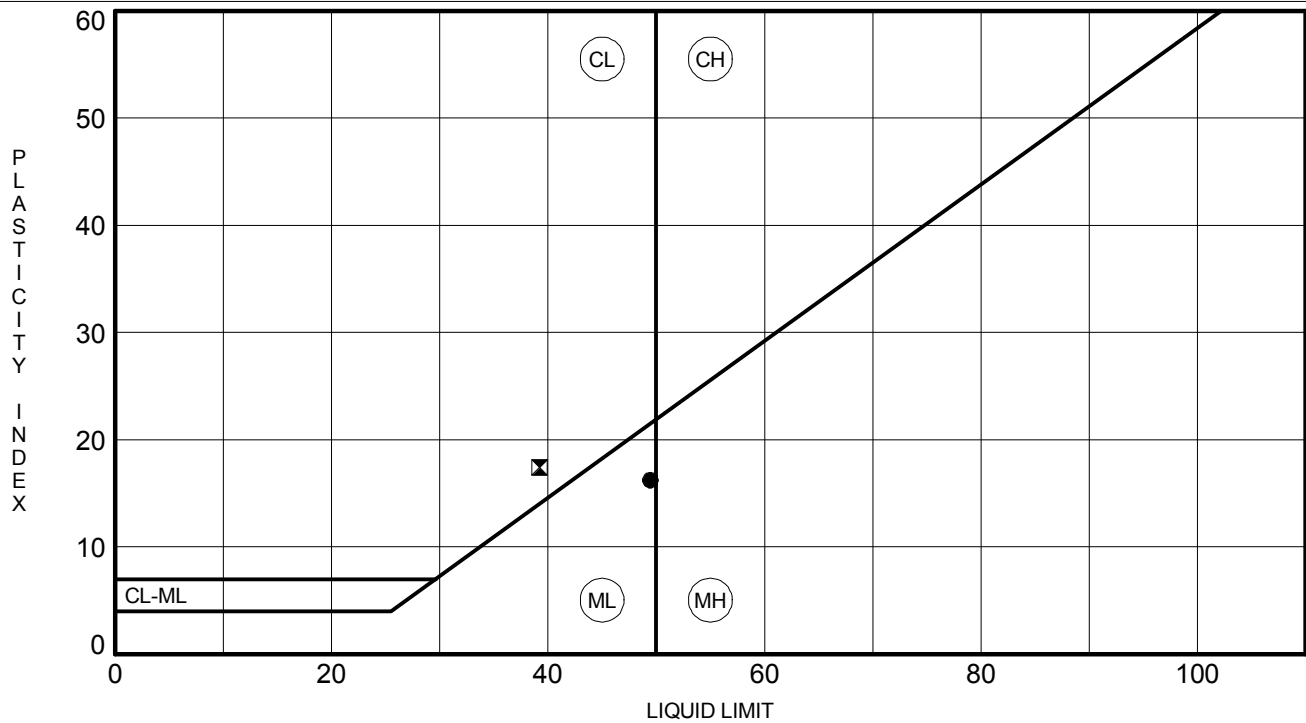
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

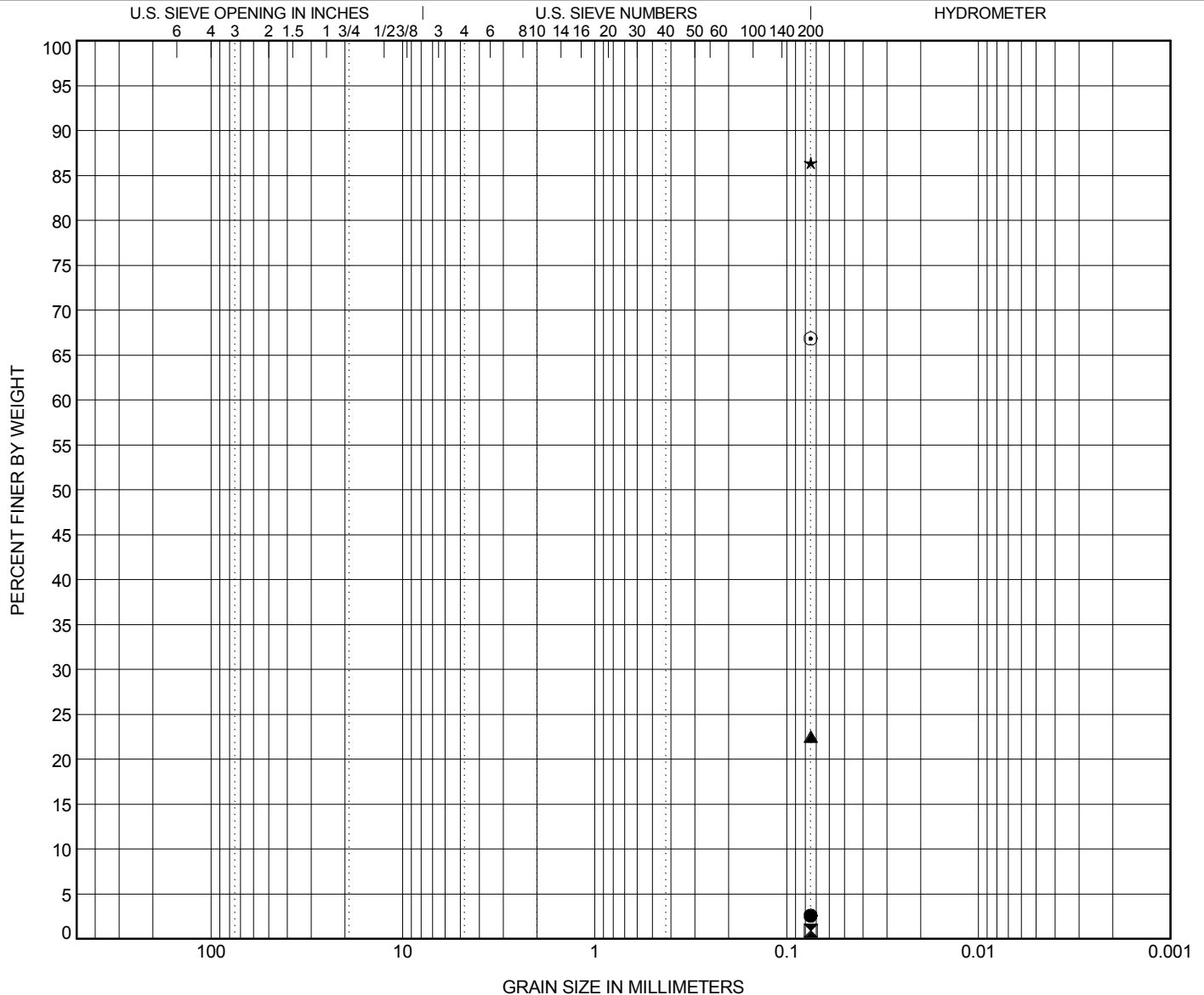


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification				LL	PL	PI	Cc	Cu
● B-3 (Bridge 3)	15.0	SAND (SP)								
☒ B-3 (Bridge 3)	20.0	SAND (SP)								
▲ B-3 (Bridge 3)	25.0	Silty SAND (SM)								
★ B-3 (Bridge 3)	30.0	SILT (ML)				49	33	16		
◎ B-3 (Bridge 3)	45.0	Sandy Lean CLAY (CL)				39	22	17		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay	
● B-3 (Bridge 3)	15.0	0.075							2.6	
☒ B-3 (Bridge 3)	20.0	0.075							1.0	
▲ B-3 (Bridge 3)	25.0	0.075							22.5	
★ B-3 (Bridge 3)	30.0	0.075							86.4	
◎ B-3 (Bridge 3)	45.0	0.075							66.9	

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	15-2098	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-3	B-3	B-3	B-3	B-3
SAMPLE NO.	15-2098B	15-2098D	15-2098F	15-2098I	15-2098L
SAMPLE DEPTH	13.5-15.0'	18.5-20.0'	23.5-25.0'	28.5-30.0'	43.5-45.0'
WATER CONTENT, W%	20.9	21.9	25.4	41.9	49.3

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

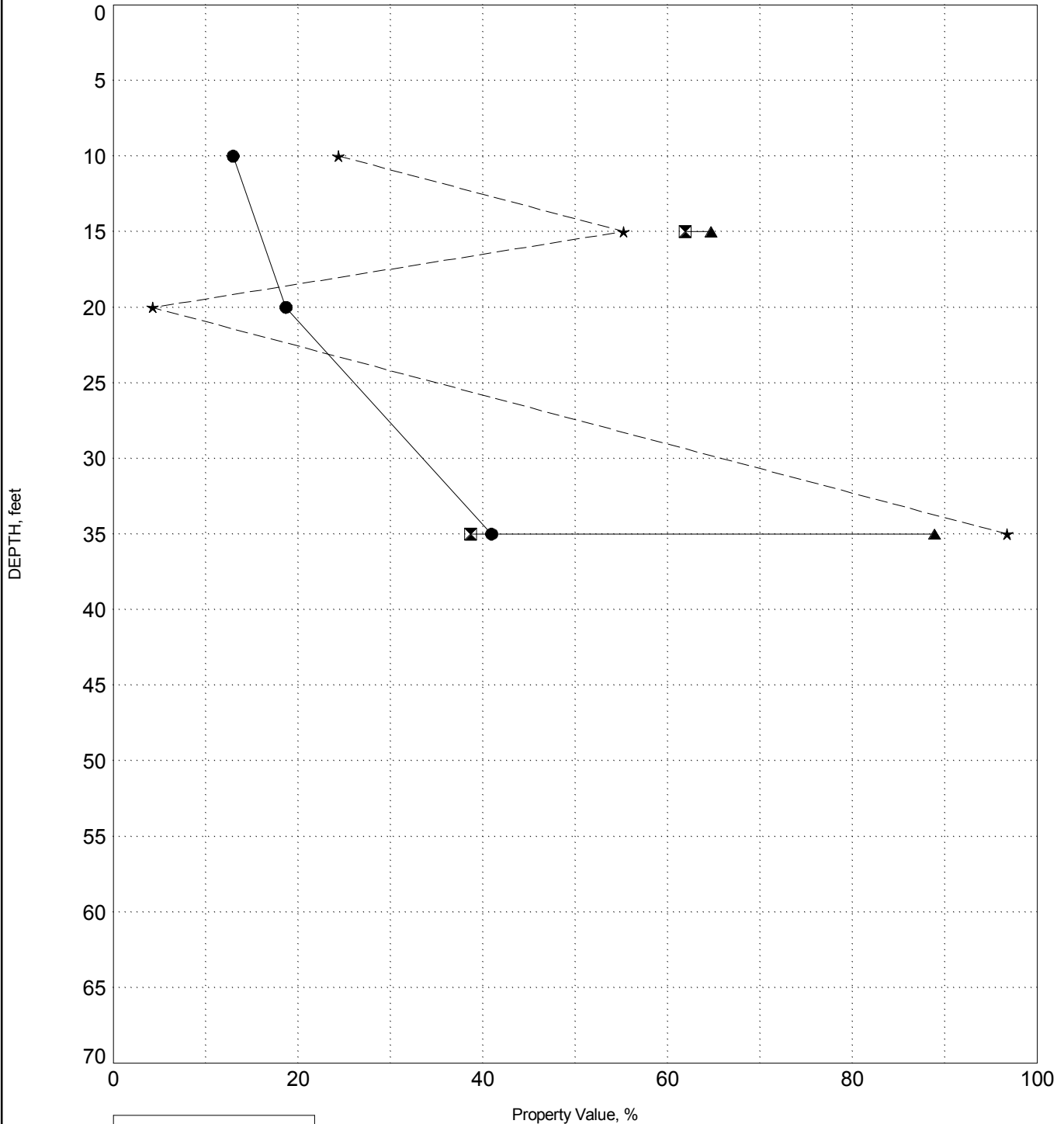
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.2

BORING B-4 (Bridge 3)



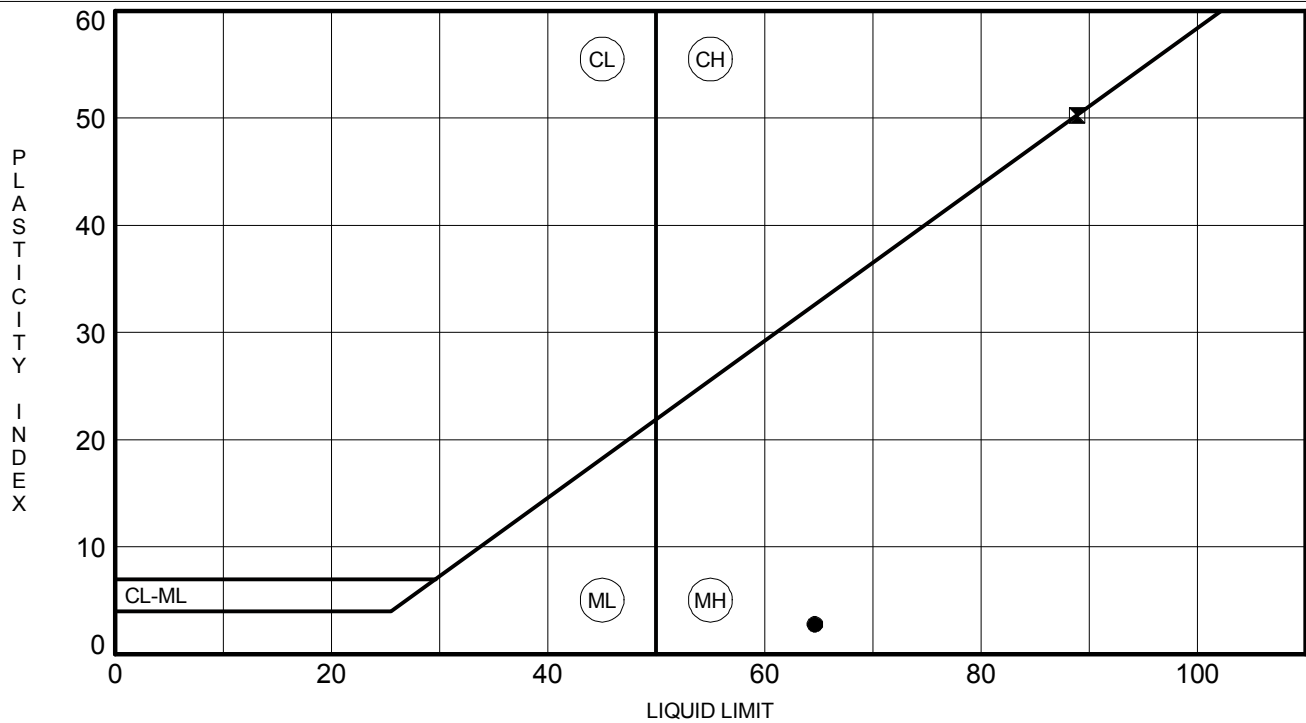
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

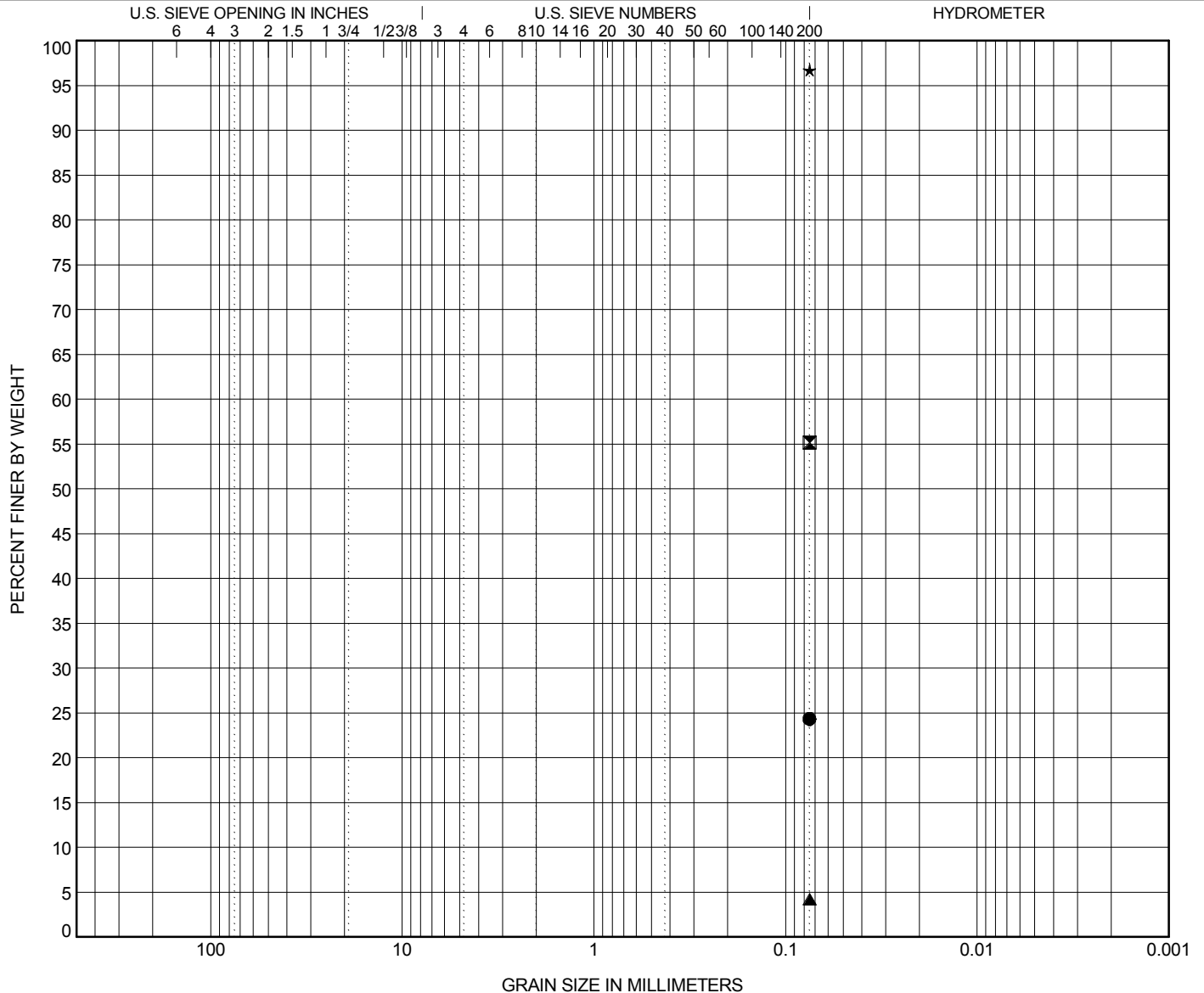


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
●	B-4 (Bridge 3)	10.0	Clayey SAND (SC)								
☒	B-4 (Bridge 3)	15.0	Sandy Elastic SILT (MH)					65	62	3	
▲	B-4 (Bridge 3)	20.0	SAND (SP)								
★	B-4 (Bridge 3)	35.0	ELASTIC SILT (MH)					89	39	50	
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
●	B-4 (Bridge 3)	10.0	0.075					24.4			
☒	B-4 (Bridge 3)	15.0	0.075					55.2			
▲	B-4 (Bridge 3)	20.0	0.075					4.2			
★	B-4 (Bridge 3)	35.0	0.075					96.7			

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0016	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-4	B-4	B-4	B-4	
SAMPLE NO.	16-0016B	16-0016E	16-0016G	16-0016J	
SAMPLE DEPTH	8.0-10.0'	13.5-15.0'	18.5-20.0'	33.5-35.0'	
WATER CONTENT, W%	13.0	132.4	18.7	40.9	

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

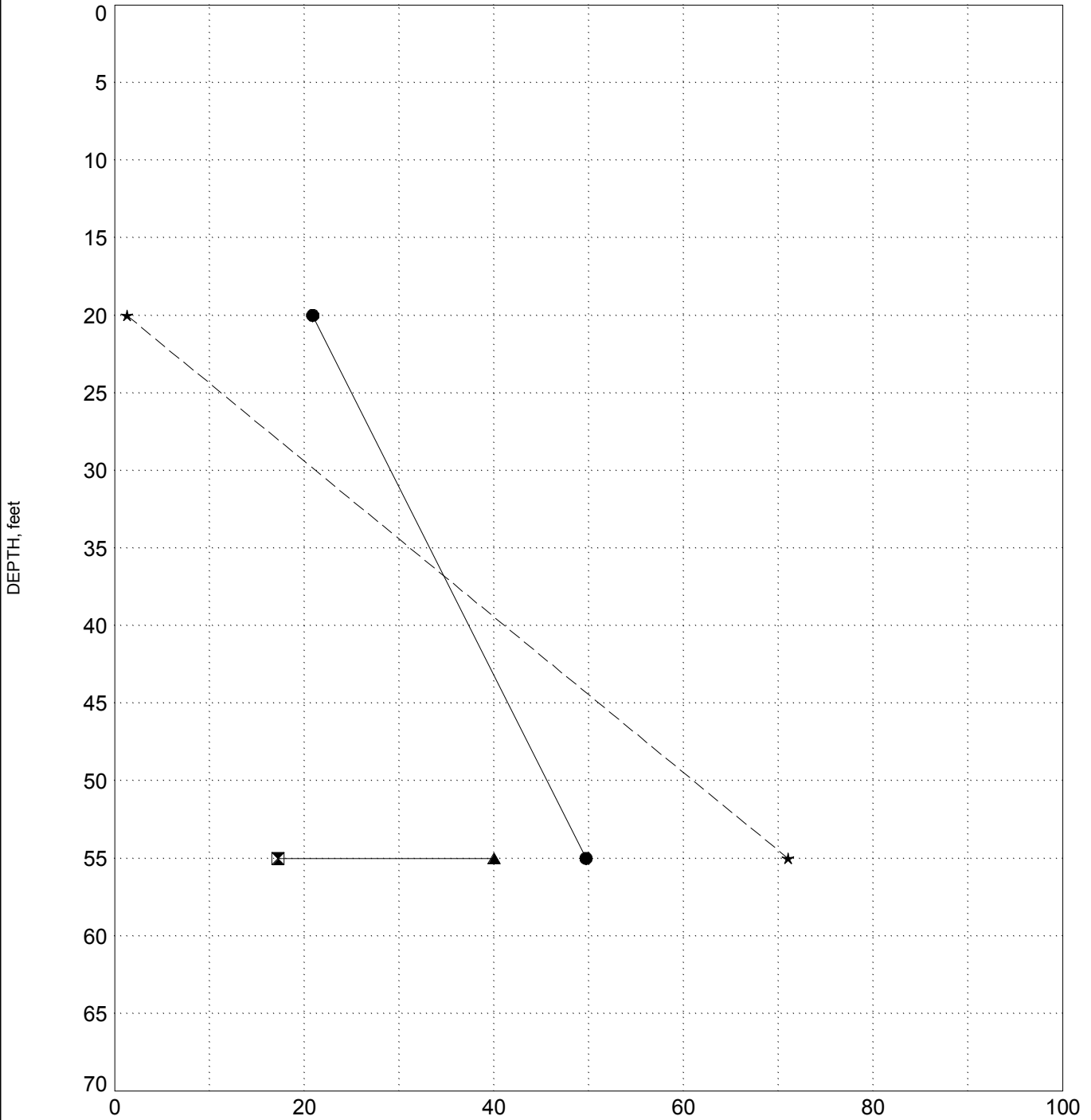
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 89.6

BORING B-5 (Bridge 2)



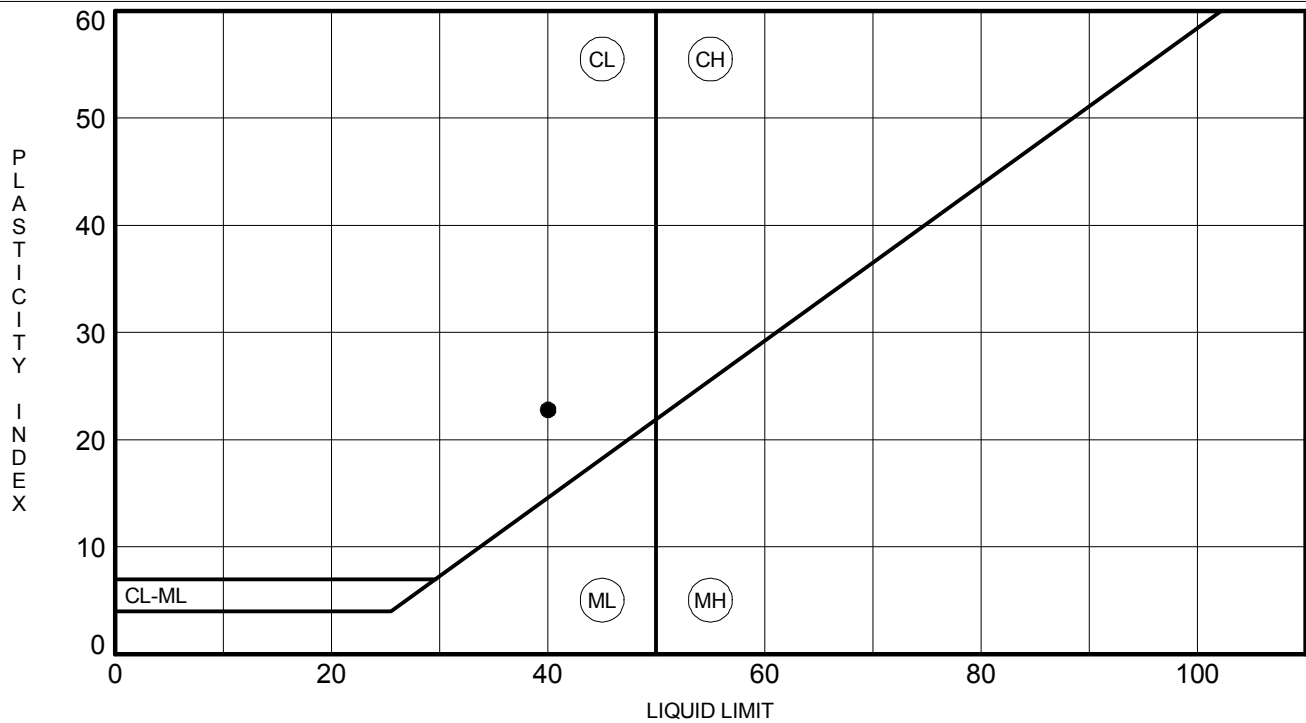
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

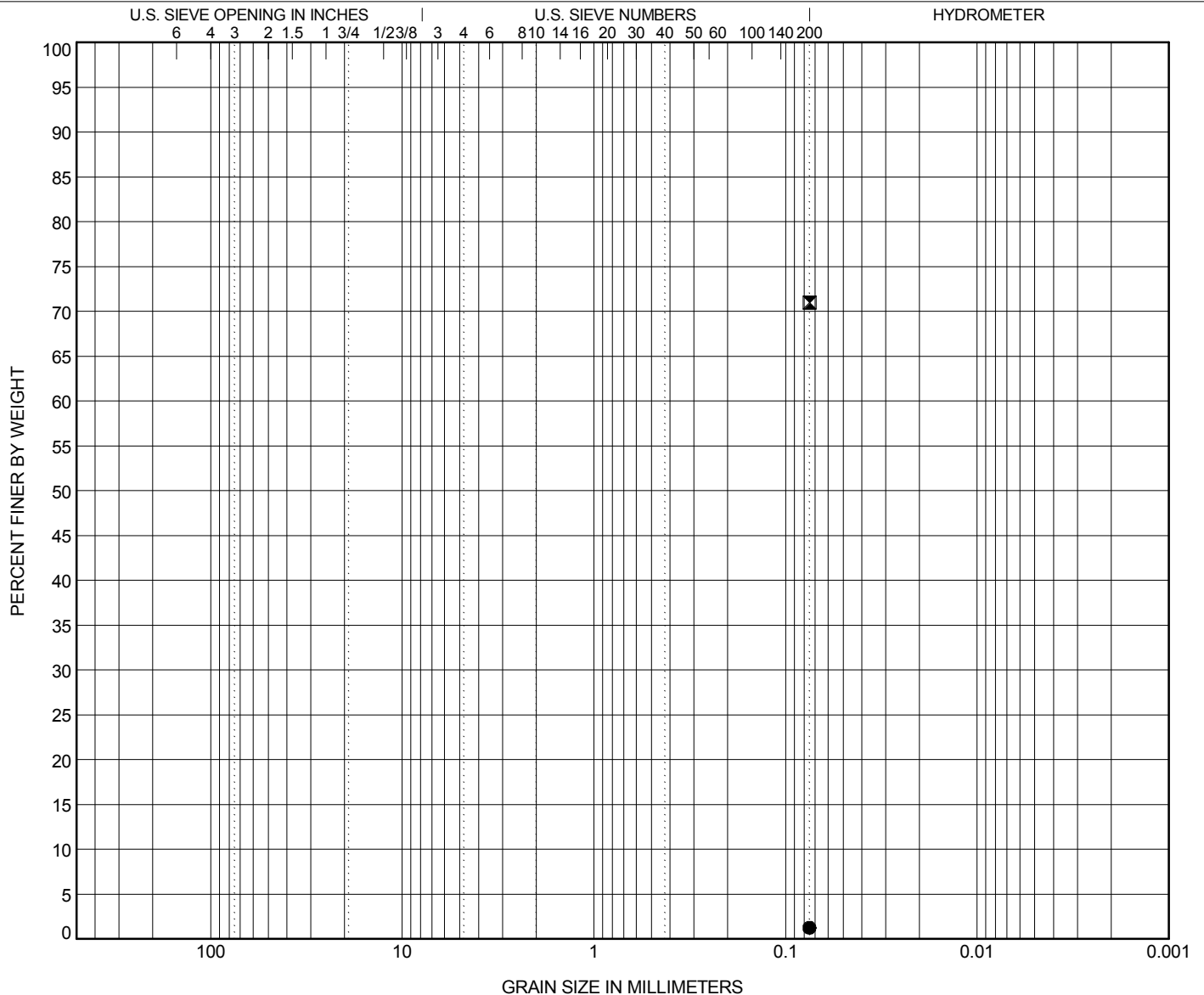
PROJECT COUNTY Clarendon

[illegible]



GRAIN SIZE DISTRIBUTION

PROJECT ID N/A PROJECT NAME US-301 Replacement Bridge over Black River
PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-5 (Bridge 2)	20.0	SAND (SP)									
✕ B-5 (Bridge 2)	55.0	Lean CLAY (CL) with Sand					40	17	23		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-5 (Bridge 2)	20.0	0.075						1.3			
✕ B-5 (Bridge 2)	55.0	0.075						71.0			

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0033	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-5	B-5			
SAMPLE NO.	16-0033B	16-0033E			
SAMPLE DEPTH	18.5-20.0'	53.5-55.0'			
WATER CONTENT, W%	20.9	49.7			

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

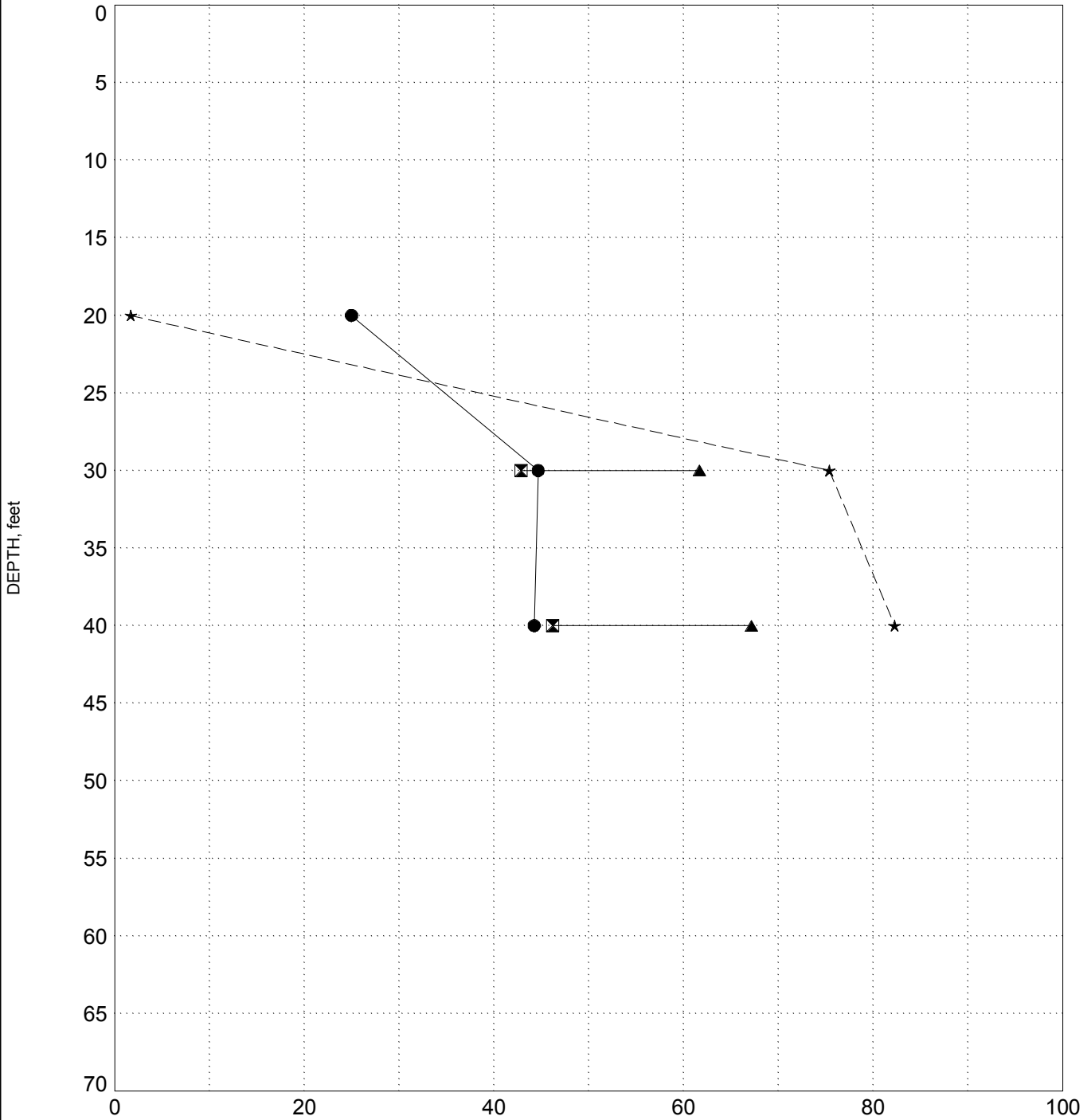
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 89.7

BORING B-6 (Bridge 2)



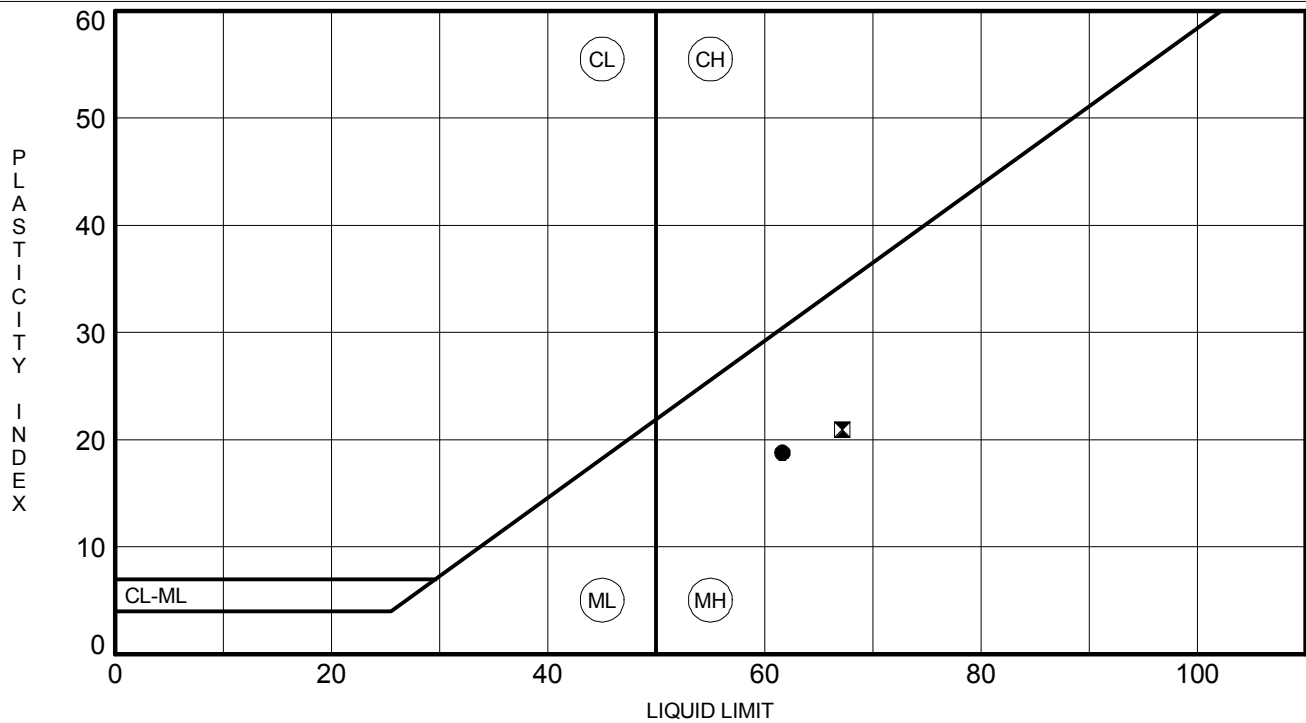
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

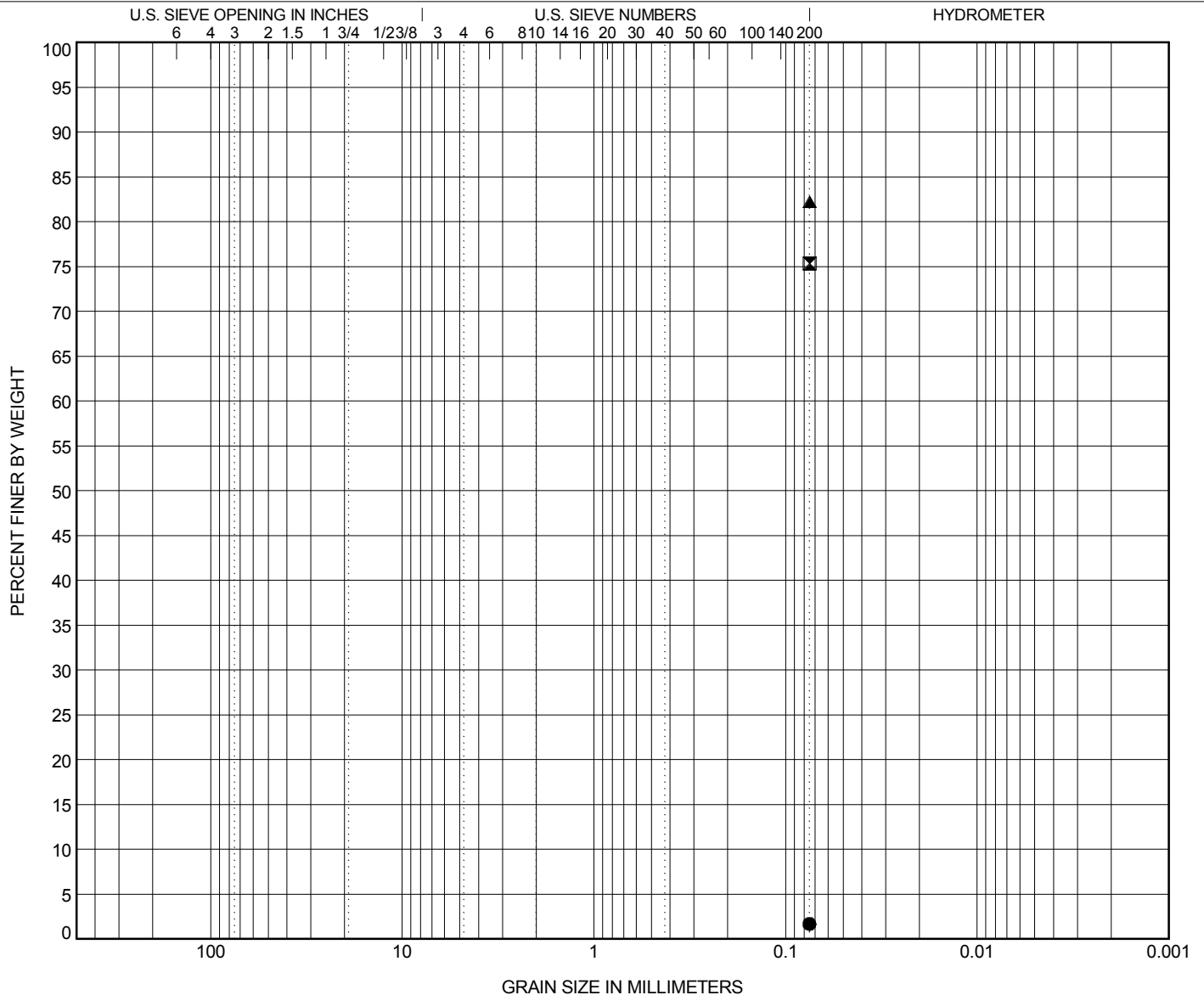


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-6 (Bridge 2)	20.0	SAND (SP)									
☒ B-6 (Bridge 2)	30.0	ELASTIC SILT (MH) with Sand					62	43	19		
▲ B-6 (Bridge 2)	40.0	ELASTIC SILT (MH) with Sand					67	46	21		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-6 (Bridge 2)	20.0	0.075						1.7			
☒ B-6 (Bridge 2)	30.0	0.075						75.3			
▲ B-6 (Bridge 2)	40.0	0.075						82.3			

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0034	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-6	B-6	B-6		
SAMPLE NO.	16-0034E	16-0034H	16-0034K		
SAMPLE DEPTH	18.5-20.0'	28.5-30.0'	38.5-40.0'		
WATER CONTENT, W%	25.0	44.7	44.2		

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

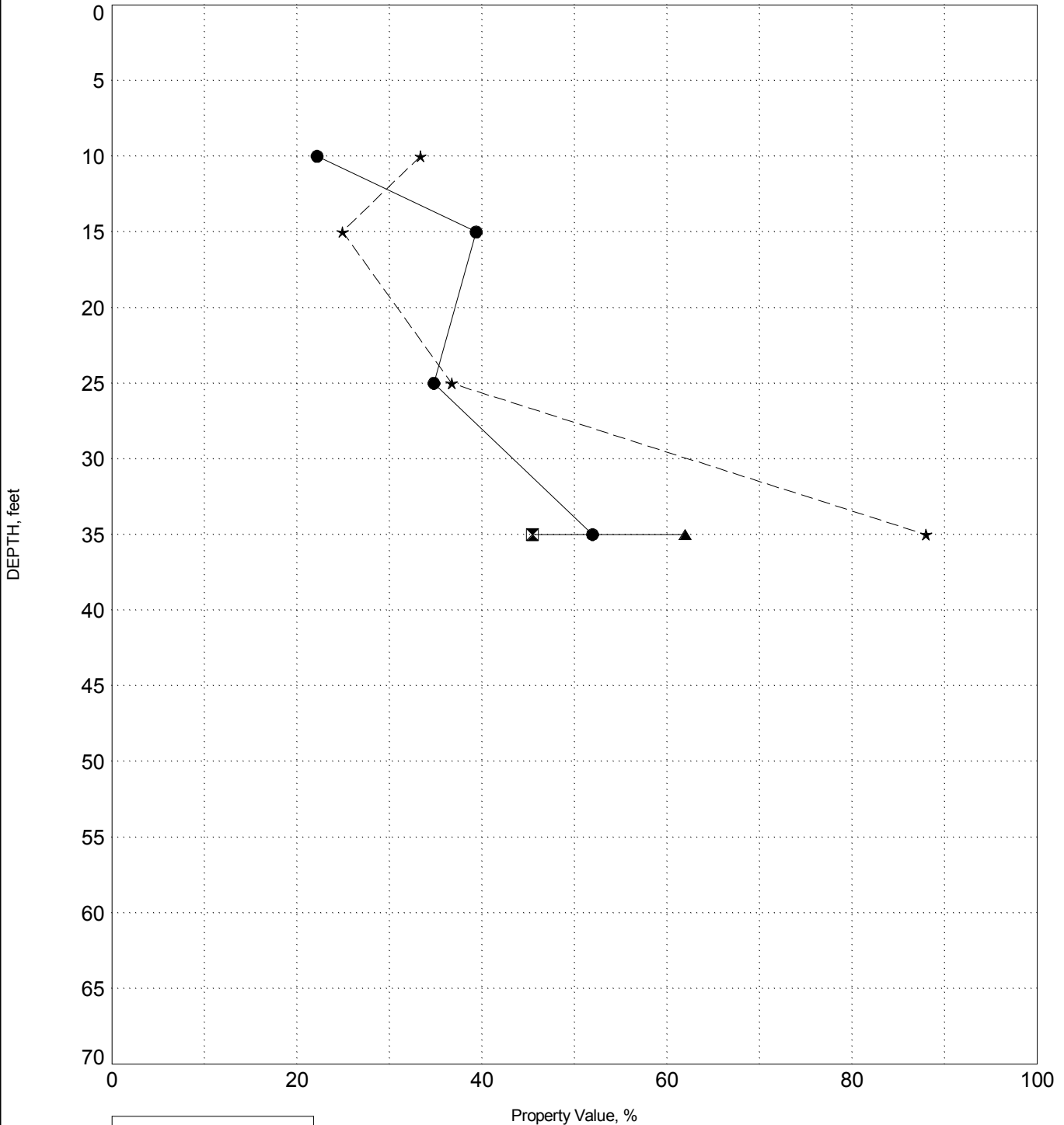
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.0

BORING B-7 (Bridge 1)



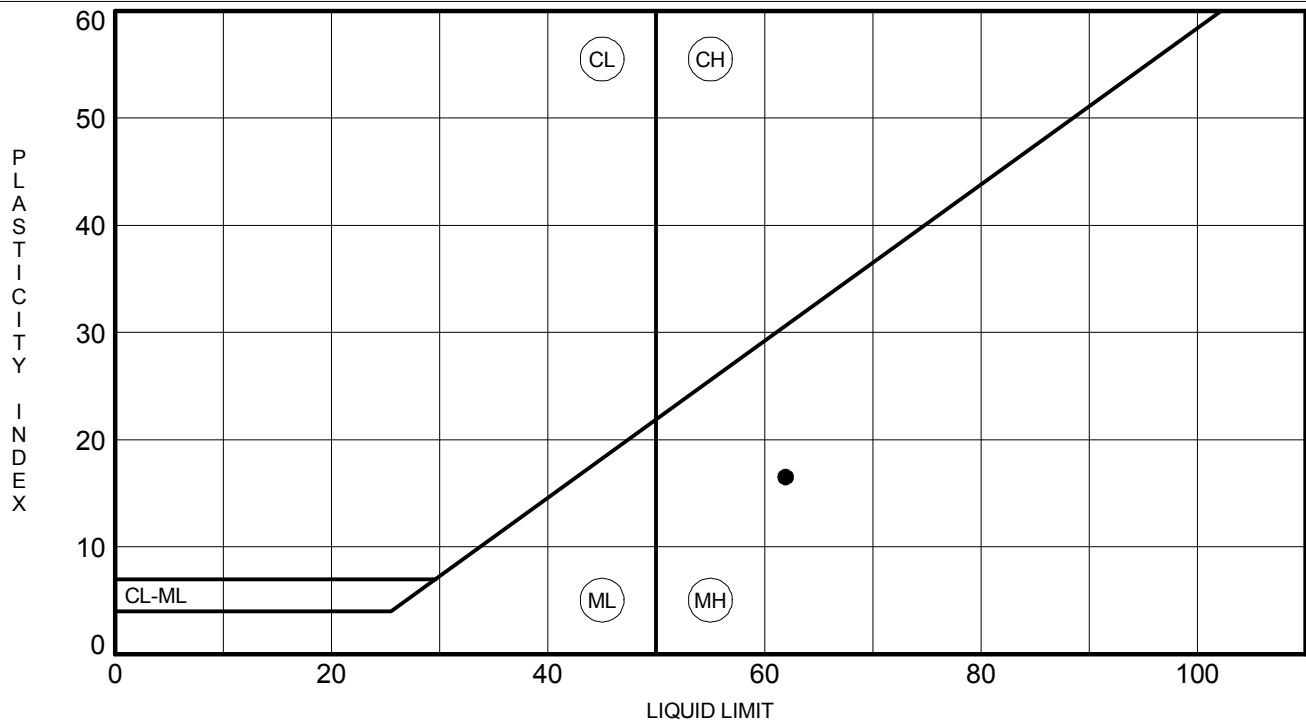
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

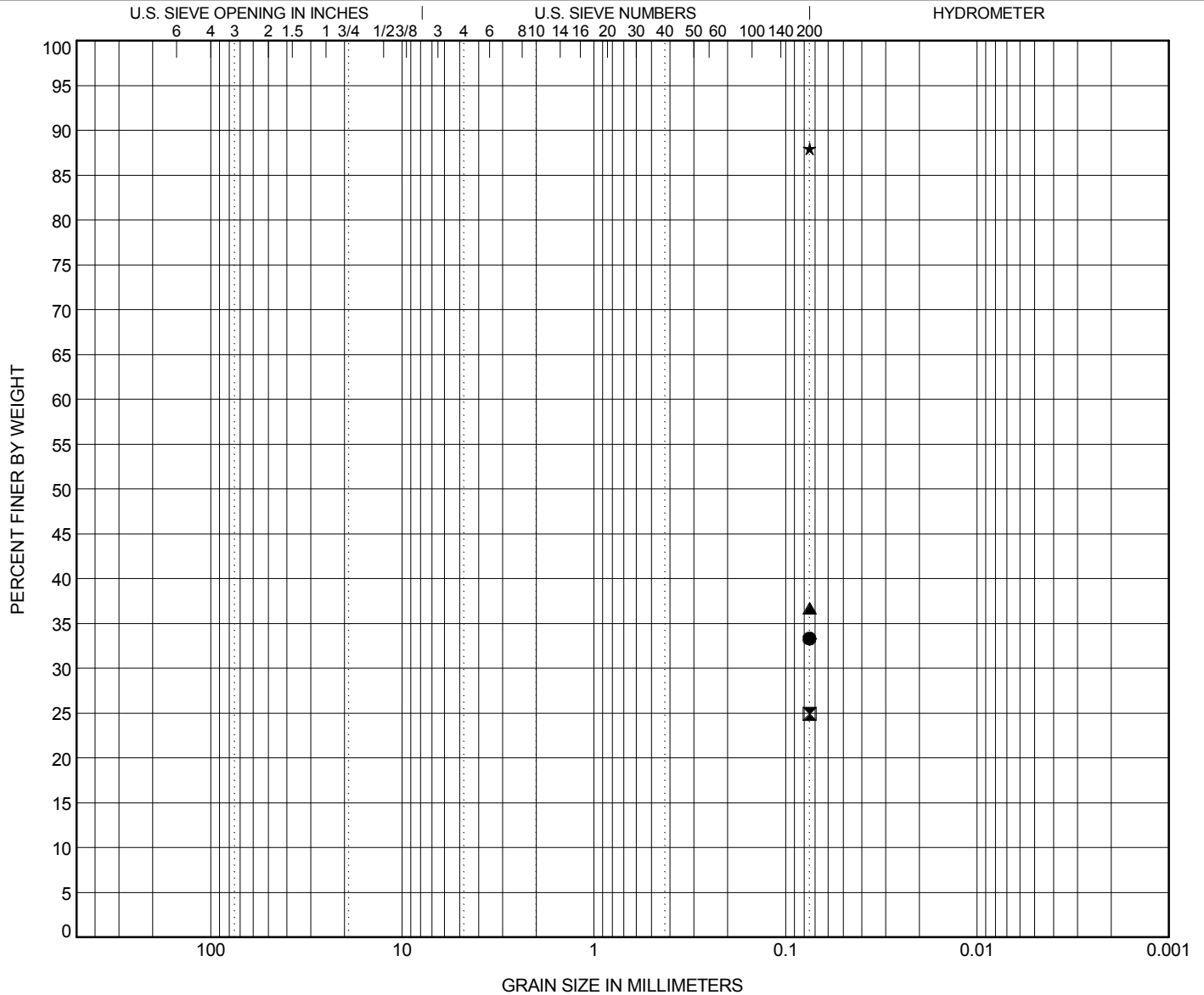


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification				LL	PL	PI	Cc	Cu
● B-7 (Bridge 1)	10.0	Silty SAND (SM)								
☒ B-7 (Bridge 1)	15.0	Silty SAND (SM)								
▲ B-7 (Bridge 1)	25.0	Silty SAND (SM)								
★ B-7 (Bridge 1)	35.0	ELASTIC SILT (MH)				62	45	17		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay	
● B-7 (Bridge 1)	10.0	0.075						33.3		
☒ B-7 (Bridge 1)	15.0	0.075						24.9		
▲ B-7 (Bridge 1)	25.0	0.075						36.7		
★ B-7 (Bridge 1)	35.0	0.075						88.0		

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0035	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-7	B-7	B-7	B-7	
SAMPLE NO.	16-0035B	16-0035D	16-0035F	16-0035I	
SAMPLE DEPTH	8.0-10.0'	13.5-15.0'	23.5-25.0'	33.5-35.0'	
WATER CONTENT, W%	22.2	39.3	34.8	51.9	

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					



INDEX PROPERTIES VERSUS DEPTH

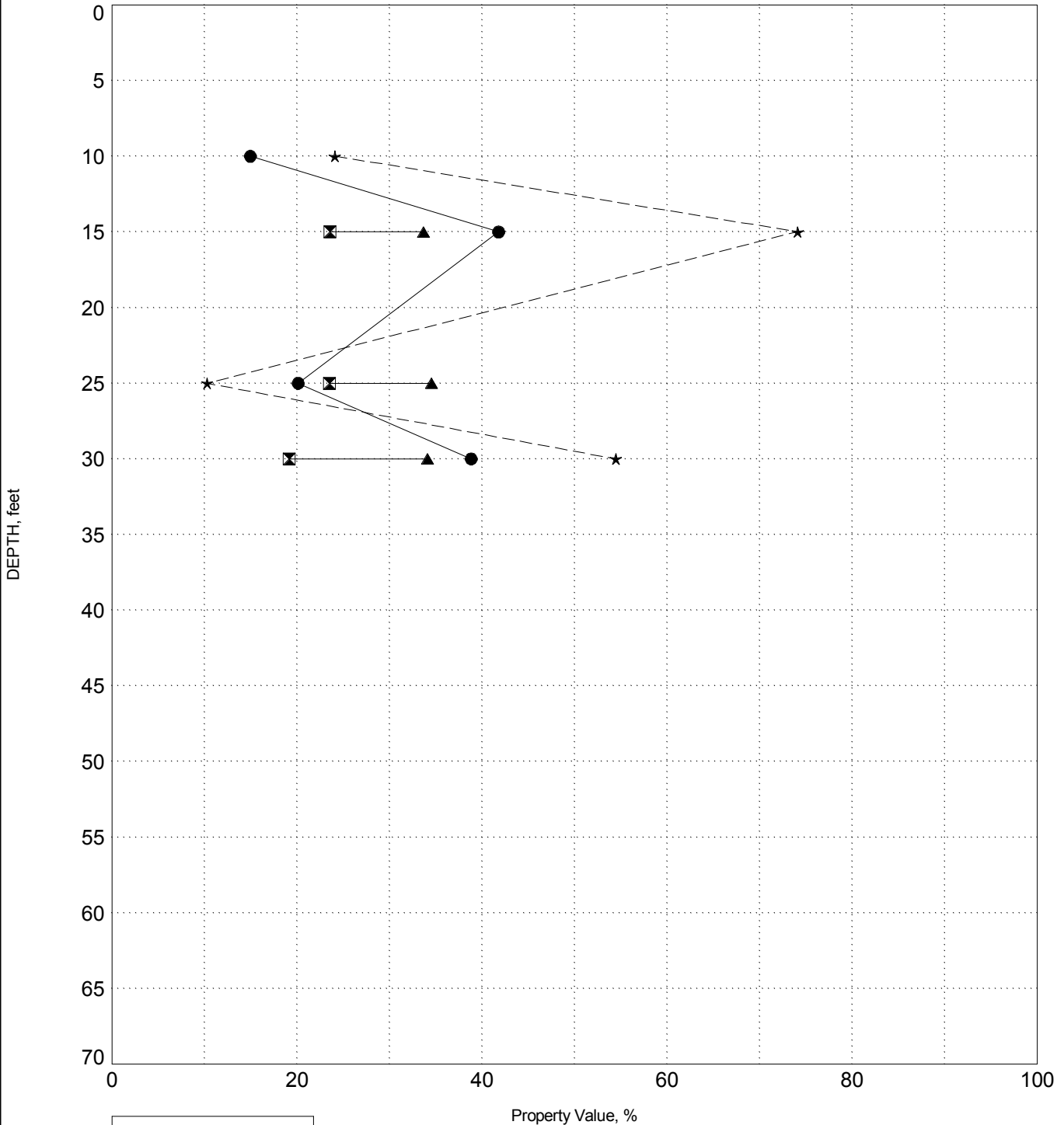
PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

SURFACE ELEVATION: 88.3

BORING B-8 (Bridge 1)



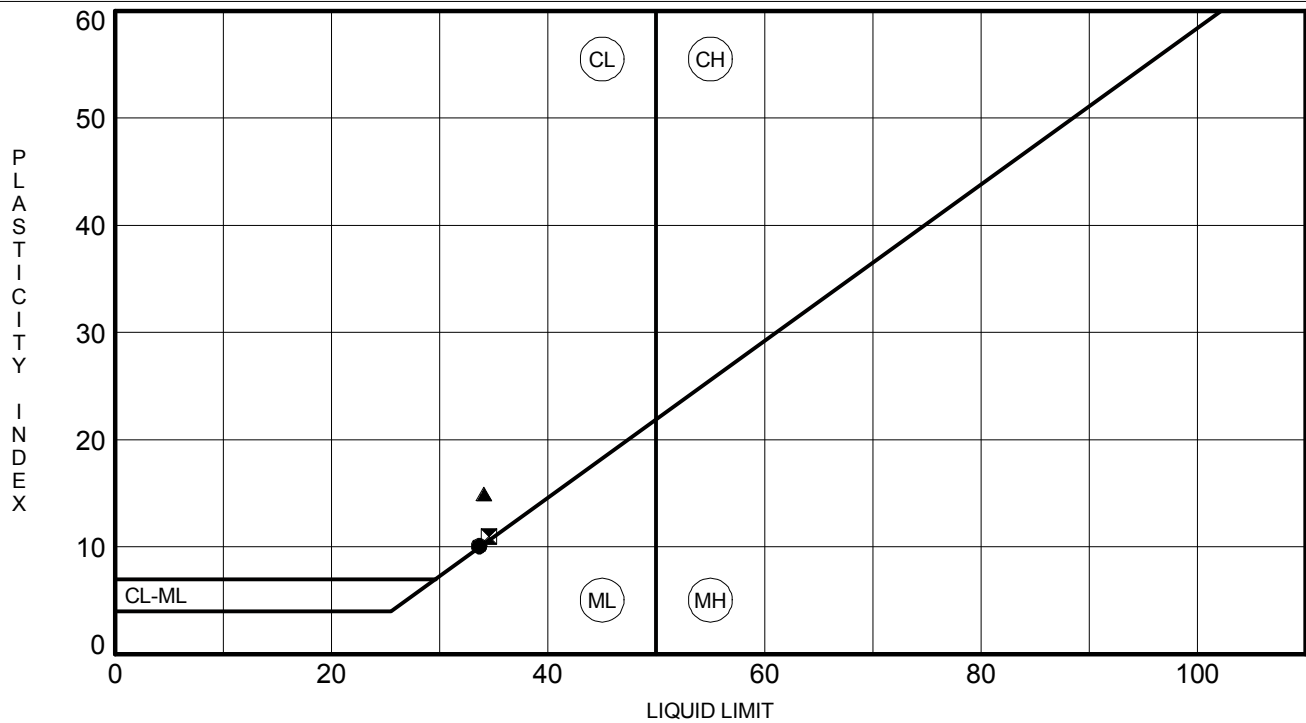
LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines

ATTERBERG LIMITS' RESULTS

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon

[illegible]

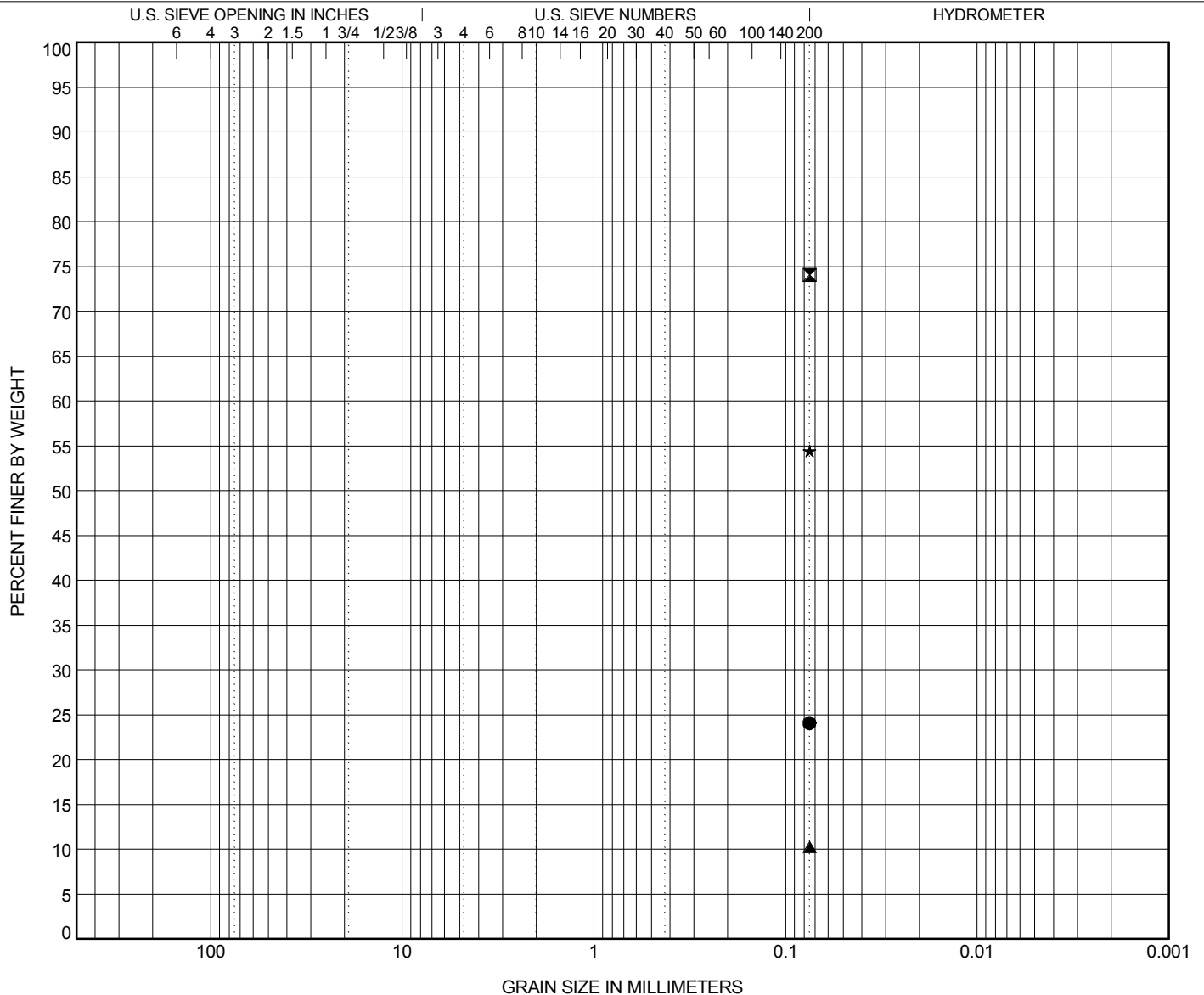


GRAIN SIZE DISTRIBUTION

PROJECT ID N/A

PROJECT NAME US-301 Replacement Bridge over Black River

PROJECT COUNTY Clarendon



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification						LL	PL	PI	Cc	Cu	
●	B-8 (Bridge 1)	10.0	Silty SAND (SM)										
☒	B-8 (Bridge 1)	15.0	SILT (ML) with Sand						34	24	10		
▲	B-8 (Bridge 1)	25.0	SAND (SP-SC) with Clay						35	24	11		
★	B-8 (Bridge 1)	30.0	Sandy Lean CLAY (CL)						34	19	15		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay				
●	B-8 (Bridge 1)	10.0	0.075					24.1					
☒	B-8 (Bridge 1)	15.0	0.075					74.1					
▲	B-8 (Bridge 1)	25.0	0.075					10.3					
★	B-8 (Bridge 1)	30.0	0.075					54.4					

F&ME CONSULTANTS
3112 Devine Street
Columbia, South Carolina 29205

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	US-301 Replacement Bridge over Black River	PROJECT NO.:	G5500.08
SAMPLE NUMBER:	16-0043	DATE SAMPLE RECEIVED:	1/13/2016
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	MB	DATE OF TESTING:	1/13/2016
		DATE OF WEIGHING:	1/14/2016

BORING NO.	B-8	B-8	B-8	B-8	
SAMPLE NO.	16-0043B	16-0043E	16-0043H	16-0043K	
SAMPLE DEPTH	8.0-10.0'	13.5-15.0'	23.5-25.0'	28.5-30.0'	
WATER CONTENT, W%	15.0	41.8	20.1	38.8	

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

BORING NO.					
SAMPLE NO.					
SAMPLE DEPTH					
WATER CONTENT, W%					

APPENDIX D

Multi-Channel Analysis of Surface Waves (MASW)

January 20, 2016

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

Re: Report of Spectral Analysis of Surface Waves
Emergency Bridge Package 5
US-301 Replacement Bridges over Black River
Clarendon County, South Carolina
F&ME Project No.: G5500.08

Dear Mr. Harris:

On December 23 through 28, 2015, F&ME Consultants performed four (4) Spectral Analysis of Surface Waves (SASW) tests at each of the four (4) bridges to determine the average shear wave velocity to a depth of 100 feet at the locations shown in Figures 3A through 3D in Appendix D of this Report. A 16-channel Geometrics ES-3000 seismograph with 4.5 Hz geophones was used for data collection. Active survey data was obtained using a 225 foot linear array with 16 geophones spaced at 15 feet. Passive survey data was obtained using a 225 foot liner array with 16 geophones spaced at 15 feet.

A 16 pound sledge hammer striking an aluminum block and a polyethylene block were used as the energy source for the active survey. The block was struck at varying offsets from the arrays and at each end. Resultant vibrations were recorded with a sample rate of 0.5 milliseconds and a recording length of 2 seconds after each hammer blow. The data was stacked five times at each location to minimize the effect of unknown ambient vibrations commonly referred to as noise. The stacking process increases the signal to noise ratio.

The passive survey consisted of the collection of ambient background vibrations. Due to the location, manmade vibrations were minimal. Eighty (80) recordings with a record length of 32 seconds and a sample rate of 2 milliseconds were made during this phase of data acquisition.

Prior to departing the site the data collected from both the passive and active surveys were reviewed and checked for variations from what would be typically expected from the prevailing area geology.

After completion of passive and active survey the data was processed and analyzed using Geometric's SeisImager software suite (Pickwin and WaveEq). This resulted in a one-dimensional subsurface shear wave velocity curve that is developed utilizing both the passive and active survey data. The data from the active survey defines the near surface shear wave velocities, while the passive survey data defines deeper shear wave velocities due to the lower frequencies. The resulting curve represents the average shear wave velocities below the surface arrays to a depth of 100 feet.

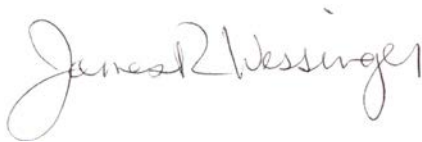
Each Shear Wave Velocity Curve, Vs100, for the locations defined herein can be found in Appendix D of this report. The following table summarizes the average shear wave velocity (Vs100) at the four (4) locations.

AVERAGE SHEAR WAVE VELOCITIES		
Boring No.	Average Shear Wave Velocity (Vs100)	Corresponding Seismic Site Class
MASW (Bridge 1)	1008.1 ft/sec	Site Class D
MASW (Bridge 2)	891.7 ft/sec	Site Class D
MASW (Bridge 3)	868.8 ft/sec	Site Class D
MASW (Bridge 4)	873.4 ft/sec	Site Class D
Average	910.5 ft/sec	Site Class D

It has been a pleasure working for you on this project and we appreciate the opportunity to be of service. Please contact us if you have any questions or concerns.

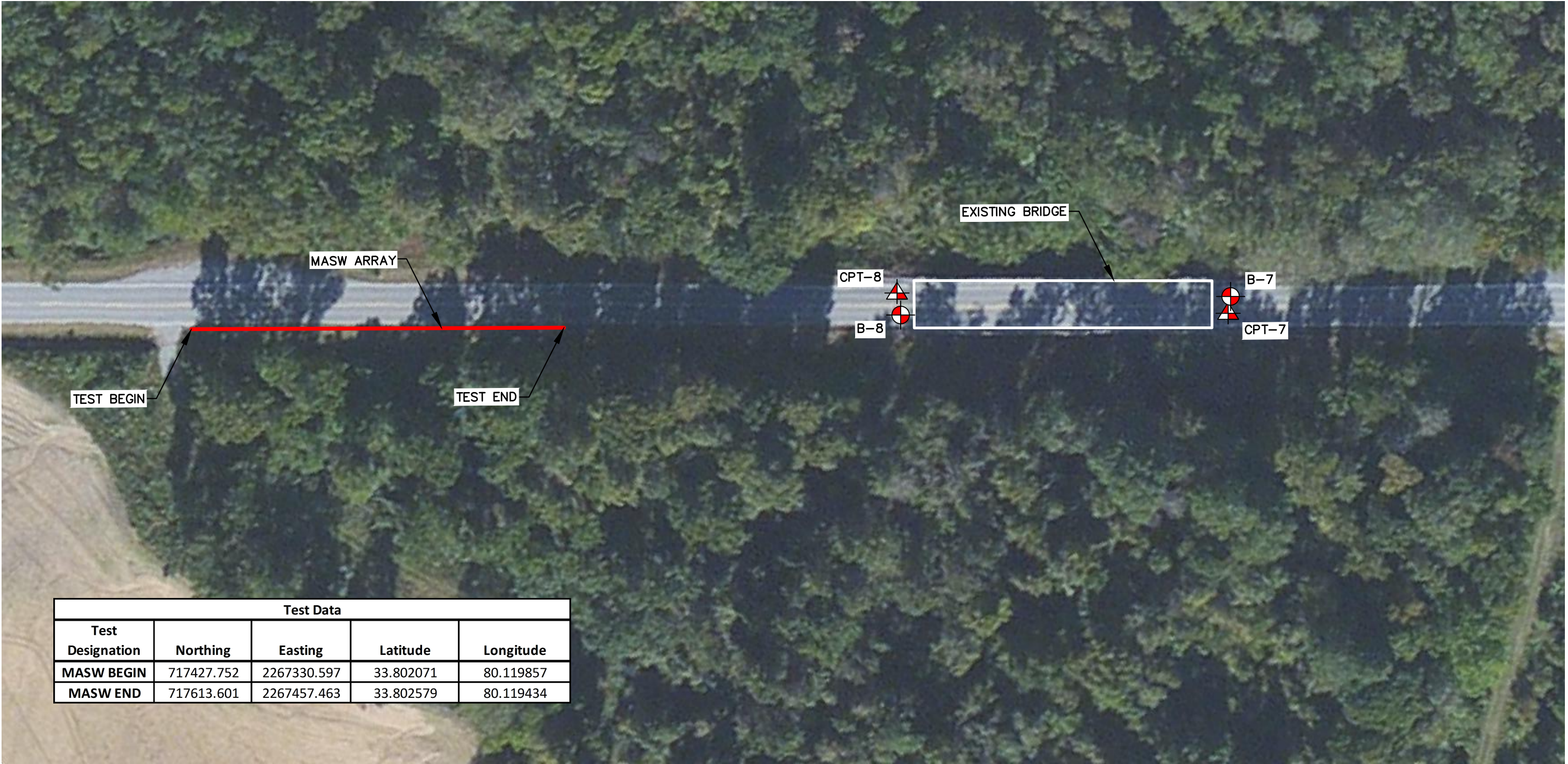
Sincerely,

F&ME CONSULTANTS



James R. Wessinger, P.G.
Staff Geologist

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



Test Data				
Test Designation	Northing	Easting	Latitude	Longitude
MASW BEGIN	717427.752	2267330.597	33.802071	80.119857
MASW END	717613.601	2267457.463	33.802579	80.119434

LEGEND:



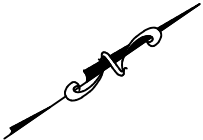
SOIL TEST BORING LOCATION



CONE PENETRATION TEST LOCATION



MASW TEST LOCATION



	4			
	3			
	2			
	1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.	DATE			
DWG. CTC	DATE 1/12/2016	GROUP		
R/W	DATE			

F&ME
CONSULTANTS

GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

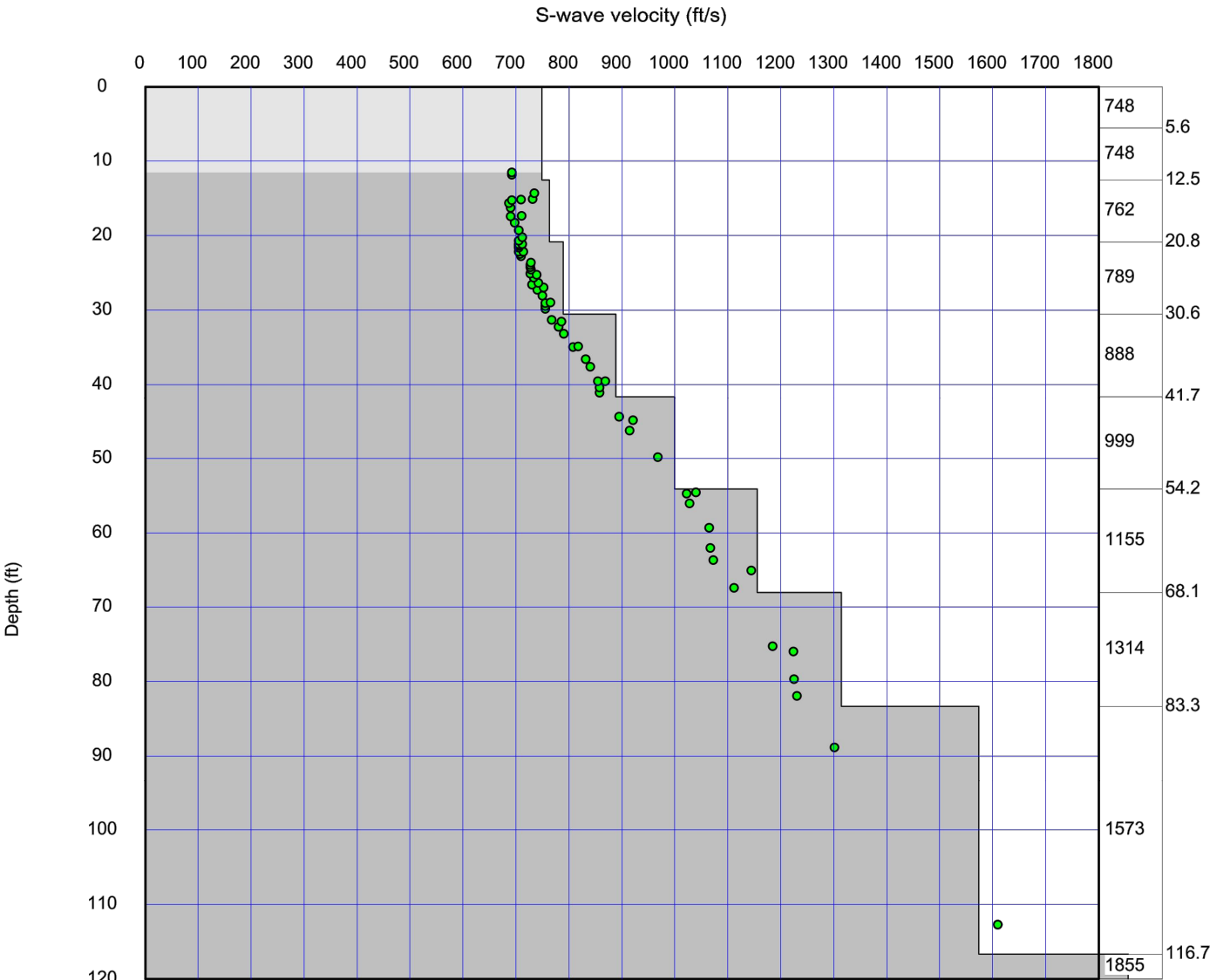
US-301 BRIDGE (#1) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SEISMIC TEST LOCATION PLAN

SCALE = NTS

F&ME JOB NO. G5500.08
FIGURE 3A

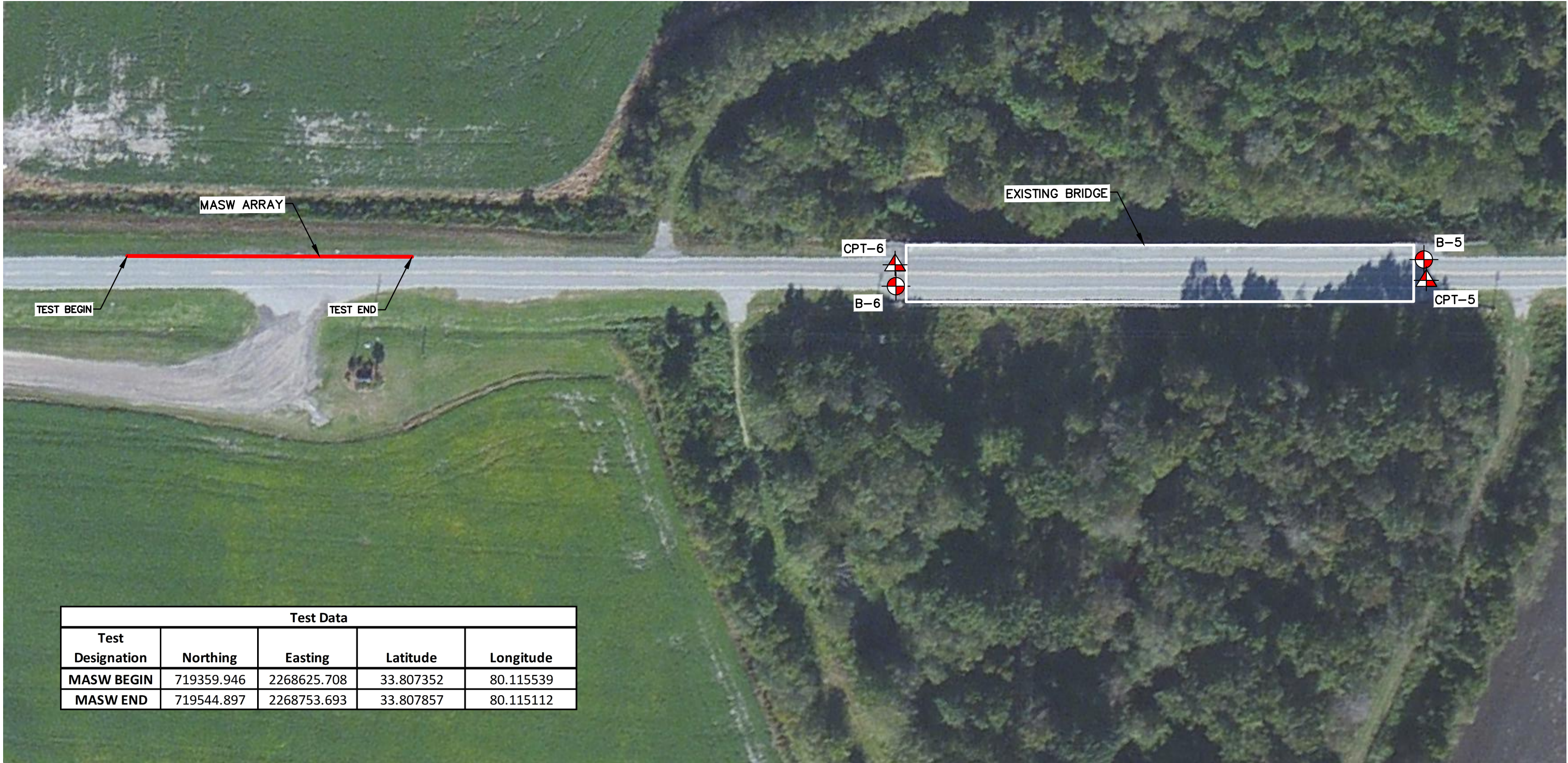
FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



S-wave velocity model (initial) : Bridge1final.rst
Average Vs 100ft = 1008.1 ft/sec

				F&ME CONSULTANTS GEOTECHNICAL – ENVIRONMENTAL – MATERIALS COLUMBIA, SOUTH CAROLINA	
4				US-301 BRIDGE (#1) REPLACEMENT OVER BLACK RIVER CLARENDON COUNTY, SC MASW SHEAR WAVE VELOCITY CURVE	
3					
2					
1					
REV. NO.	BY	DATE	DESCRIPTION OF REVISION		
TOPO.		DATE			
DWG. CTC		DATE 1/12/2016	GROUP ____ - ____	F&ME JOB NO. G5500.08	
R/W		DATE			

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



Test Data				
Test Designation	Northing	Easting	Latitude	Longitude
MASW BEGIN	719359.946	2268625.708	33.807352	80.115539
MASW END	719544.897	2268753.693	33.807857	80.115112

LEGEND:



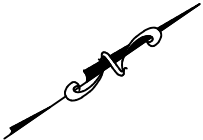
SOIL TEST BORING LOCATION



CONE PENETRATION TEST LOCATION



MASW TEST LOCATION



	4			
	3			
	2			
	1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.	DATE			
DWG. CTC	DATE 1/12/2016	GROUP		
R/W	DATE			

F&ME

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GEOTECHNICAL – ENVIRONMENTAL – MATERIALS

COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#2) REPLACEMENT OVER BLACK RIVER

CLARENDON COUNTY, SC

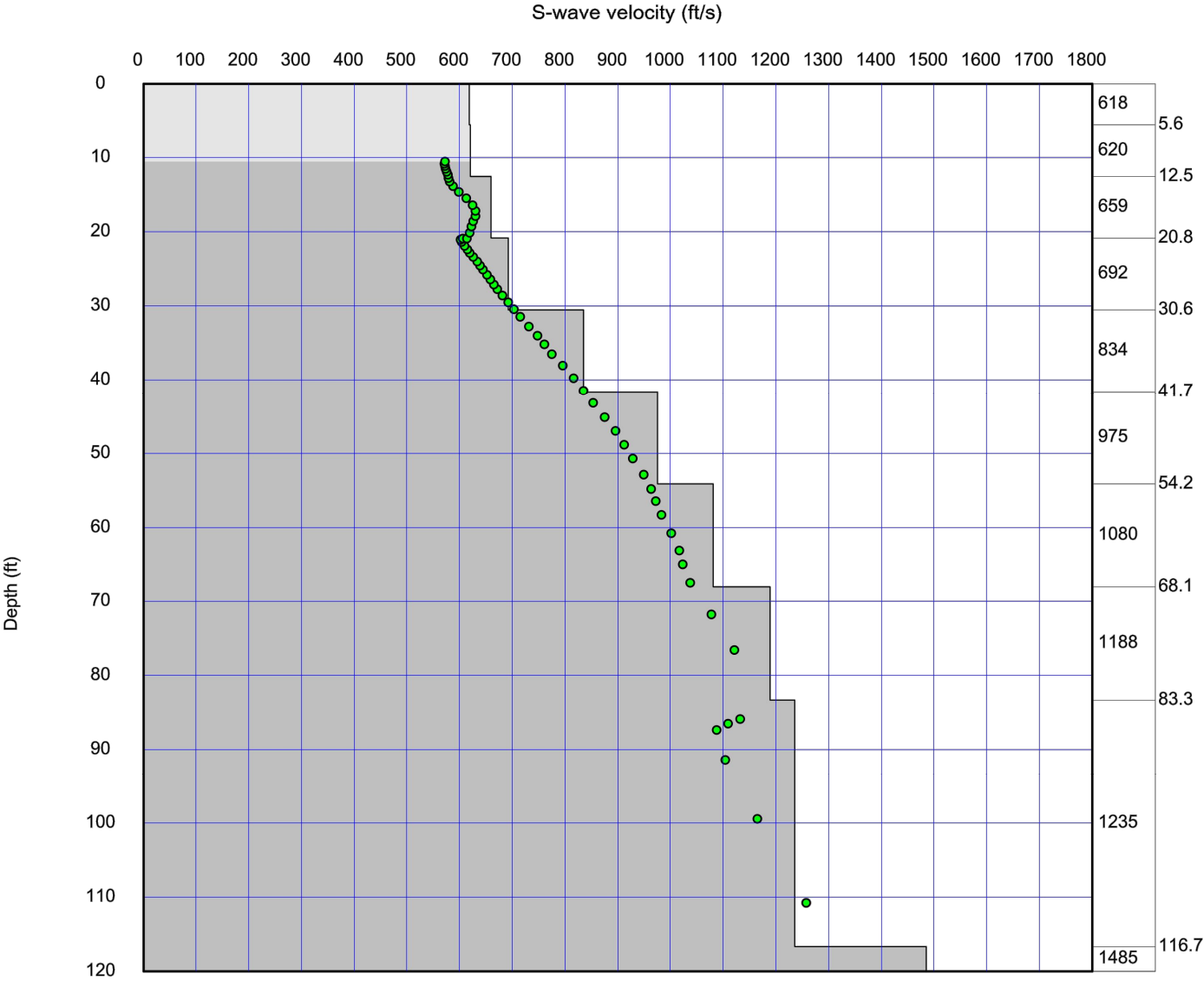
SEISMIC TEST LOCATION PLAN

F&ME JOB NO. G5500.08

SCALE = NTS

FIGURE 3B

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



S-wave velocity model (initial) : Bridge2final.rst
Average Vs 100ft = 891.7 ft/sec

4

3

2

1

REV. NO.

BY

DATE

DESCRIPTION OF REVISION

TOPO.

DWG.

R/W

DATE

DATE

DATE

1/12/2016

GROUP

-

F&ME

CONSULTANTS

GEOTECHNICAL – ENVIRONMENTAL – MATERIALS

COLUMBIA, SOUTH CAROLINA

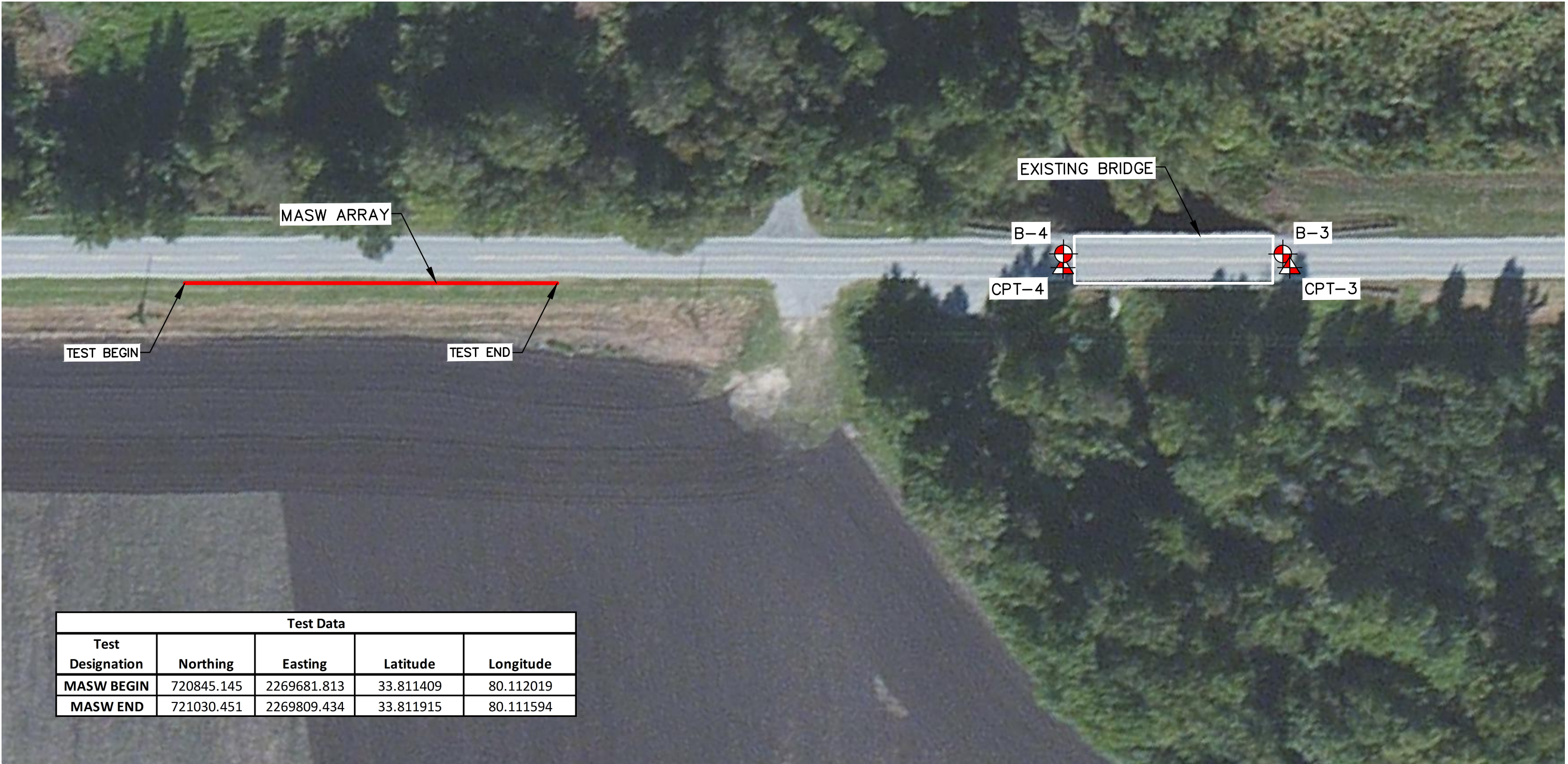
US-301 BRIDGE (#2) REPLACEMENT OVER BLACK RIVER

CLARENDON COUNTY, SC

MASW SHEAR WAVE VELOCITY CURVE

F&ME JOB NO. G5500.08

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



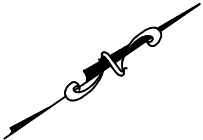
Test Data				
Test Designation	Northing	Easting	Latitude	Longitude
MASW BEGIN	720845.145	2269681.813	33.811409	80.112019
MASW END	721030.451	2269809.434	33.811915	80.111594

LEGEND:

 SOIL TEST BORING LOCATION

 CONE PENETRATION TEST LOCATION

 MASW TEST LOCATION



	4			
	3			
	2			
	1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.	DATE			
DWG. CTC	DATE 1/12/2016	GROUP		
R/W	DATE			

F&ME
CONSULTANTS

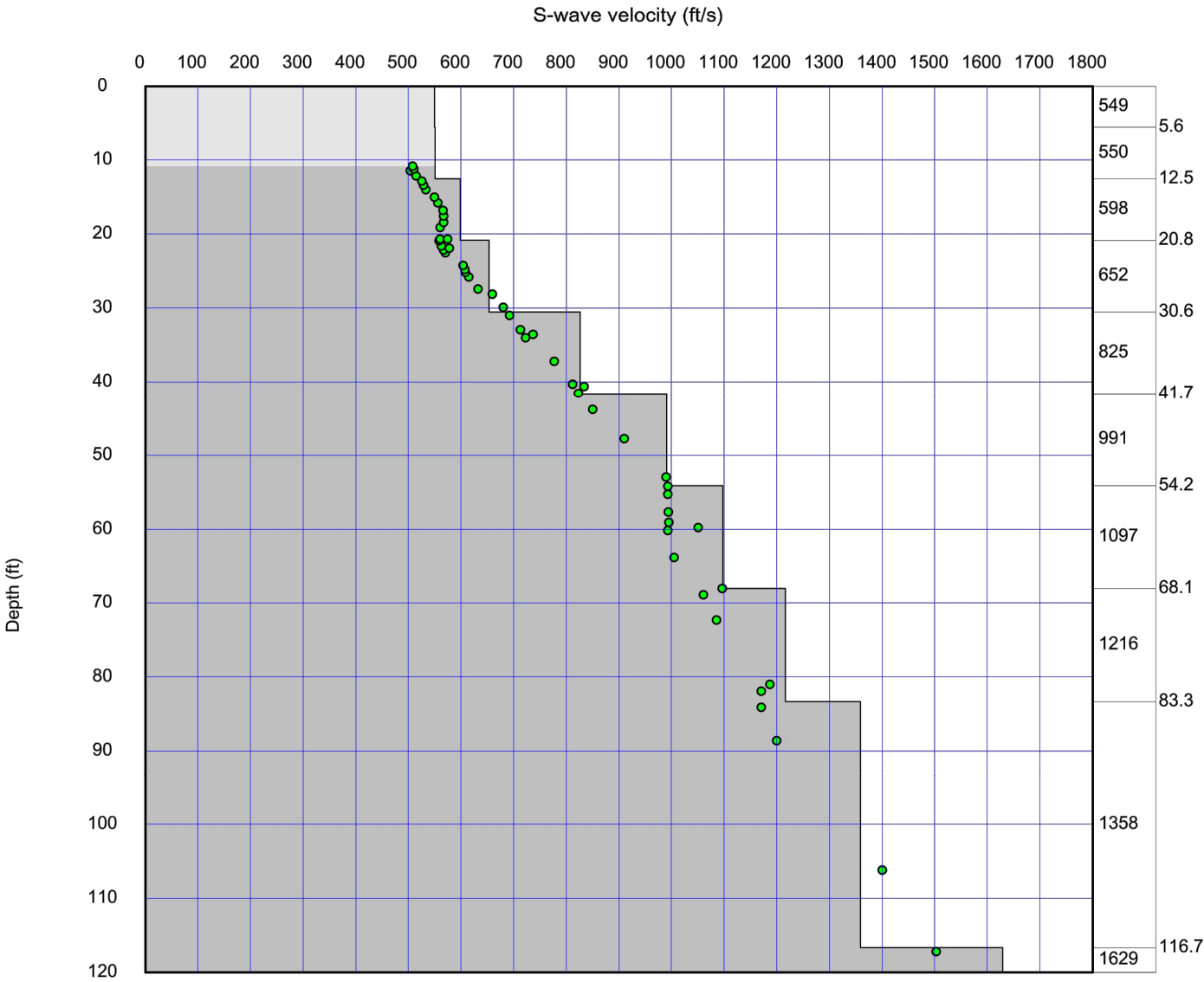
GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#3) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SEISMIC TEST LOCATION PLAN

SCALE = NTS	F&ME JOB NO. G5500.08 FIGURE 3C
-------------	------------------------------------

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



S-wave velocity model (initial) : finalBridge3.rst
Average Vs 100ft = 868.8 ft/sec

4

3

2

1

REV. NO.

BY

DATE

DESCRIPTION OF REVISION

TOPO.

DWG. CTC

R/W

DATE

DATE 1/12/2016

DATE

GROUP

-

F&ME CONSULTANTS

GEOTECHNICAL – ENVIRONMENTAL – MATERIALS

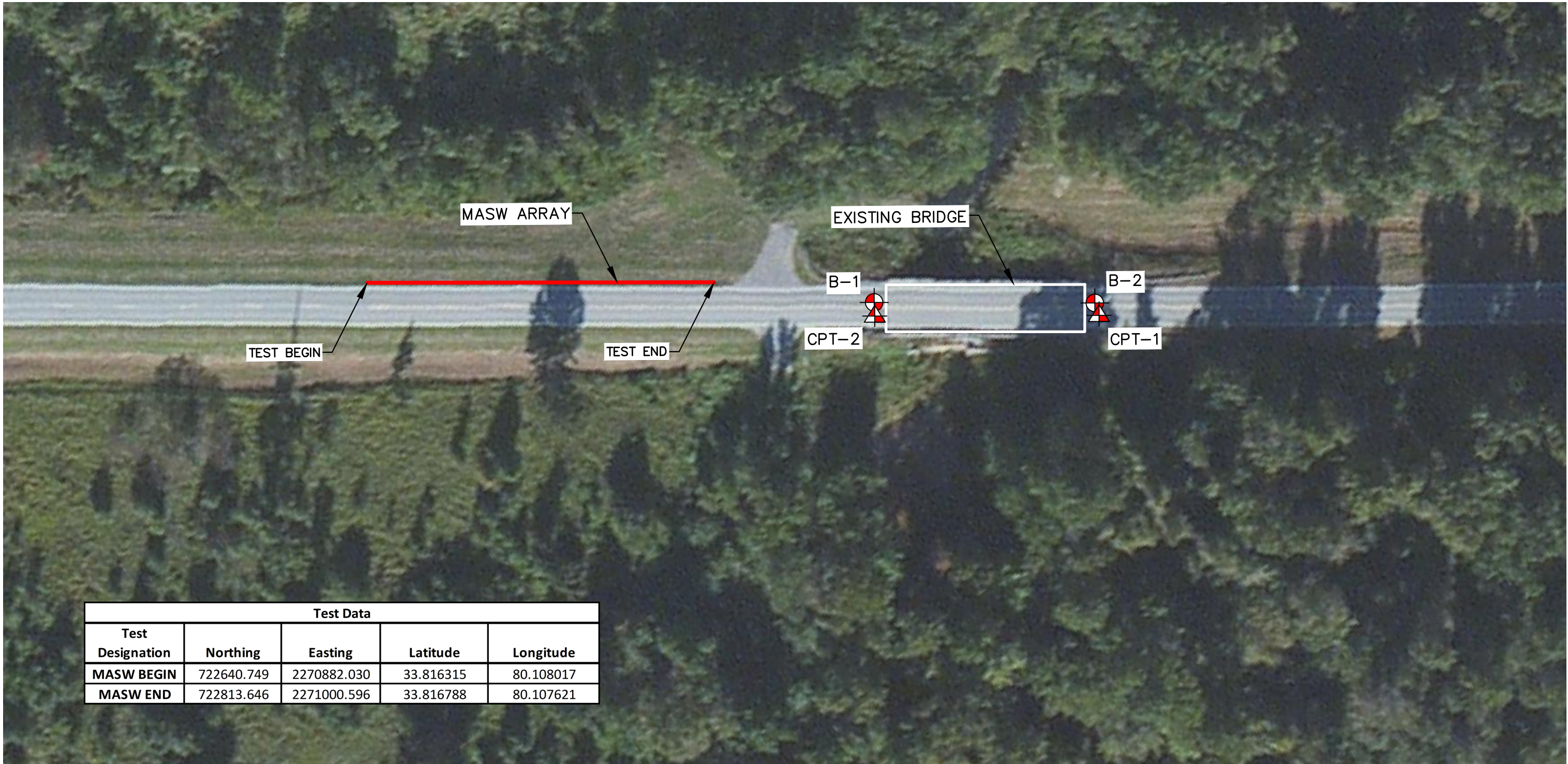
COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#3) REPLACEMENT OVER BLACK RIVER

CLARENDON COUNTY, SC

MASW SHEAR WAVE VELOCITY CURVE

F&ME JOB NO. G5500.08



Test Data				
Test Designation	Northing	Easting	Latitude	Longitude
MASW BEGIN	722640.749	2270882.030	33.816315	80.108017
MASW END	722813.646	2271000.596	33.816788	80.107621

LEGEND:



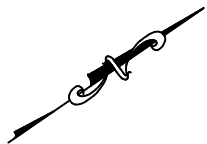
SOIL TEST BORING LOCATION



CONE PENETRATION TEST LOCATION



MASW TEST LOCATION



	REV. NO.	BY	DATE	DESCRIPTION OF REVISION
	4			
	3			
	2			
	1			
	TOPO.	DATE		
	DWG. CTC	DATE	1/12/2016	GROUP ____ - ____
	R/W	DATE		

F&ME
CONSULTANTS

GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

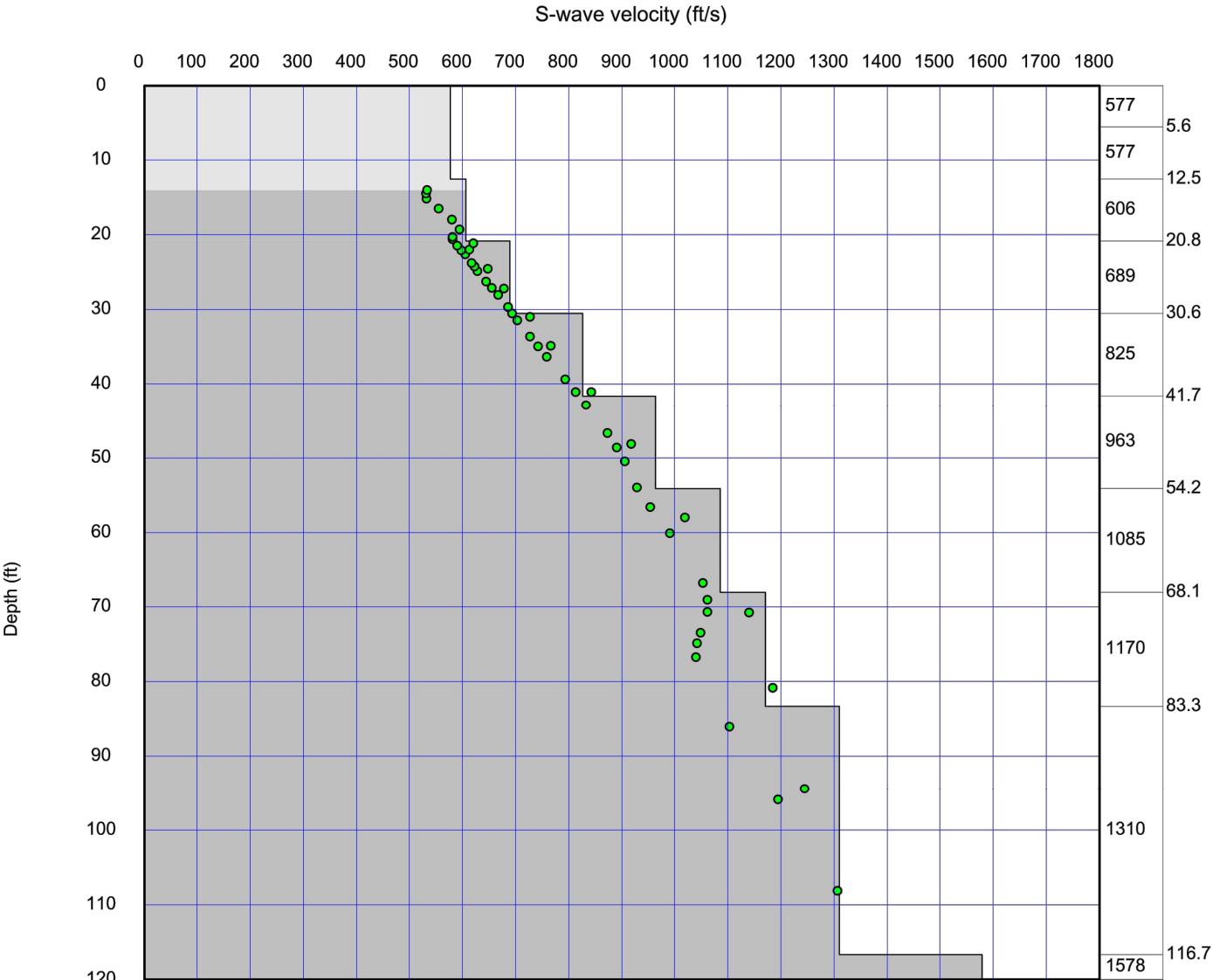
US-301 BRIDGE (#4) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

SEISMIC TEST LOCATION PLAN

SCALE = NTS

F&ME JOB NO. G5500.08
FIGURE 3D

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	CLARENDON		US-301	



S-wave velocity model (initial) : finalBridge4.rst
Average Vs 100ft = 873.4 ft/sec

4

3

2

1

REV. NO.

BY

DATE

DESCRIPTION OF REVISION

TOPO.

DWG. CTC

R/W

DATE

1/12/2016

DATE

GROUP

-

F&ME
CONSULTANTS

GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

US-301 BRIDGE (#4) REPLACEMENT OVER BLACK RIVER
CLARENDON COUNTY, SC

MASW SHEAR WAVE VELOCITY CURVE

F&ME JOB NO. G5500.08

APPENDIX E

On-Site Drill Rig Photos



B-1



B-2



B-3



B-4



B-5



B-6



B-7



B-8

APPENDIX F

Request For Work



SCOPE OF SERVICES

A work order request is issued for the following location:

Submittal Date:	December 14, 2015
County:	Clarendon County
Road:	US 301
Project ID:	N/A
Project Name:	Emergency Bridge Package 5
Local Route Name:	US 301
Project Manager:	Trapp Harris (803) 737-0776
Priority:	<u>Information needed by January 20, 2015</u>

This work order request is for the Emergency Bridge Package 5 project, which includes the US 301 over Black River Swamp bridges (4 bridges). Site soil testing will be required as described below and will consist of soil test borings (STB) and cone penetration test soundings (CPT). All field and lab testing along with reporting of the results shall be performed and provided in accordance with the 2010 Geotechnical Design Manual Version 1.1 (GDM). **Any deviations from this request or the requirements set forth in the GDM shall be approved by the D/B GDS prior to execution of the tasks.**

All test holes and sampling are to be conducted within the SCDOT Right-of-Way. Consultant shall perform one soil test boring as close as possible to each abutment location (two total) and one CPT sounding as close as possible to each abutment location (two total) of the bridge structure. A total of eight SPT borings and eight CPT soundings are planned for this scope of services. Soil test borings shall be performed using mud-rotary drilling techniques and shall be extended to 100 feet each. CPT soundings shall be extended to 50 feet each. Borings should be placed in one travel lane with the CPT soundings placed in the opposite travel lane.

The test hole depths shall be determined from the existing ground surface. Within the STBs, five split-spoon samples with Standard Penetration Test (SPT) N-value shall be obtained in the upper 10 feet and on 5-foot centers thereafter until the boring termination depth is reached. A field operations engineer or geologist shall be present during all drilling operations so that sampling efforts and soil classifications can be completed in the field. Traffic control is not anticipated to be required because the existing road is closed.

Geophysical testing consisting of MASW shear wave velocity testing shall be performed at each bridge site. One MASW test shall be performed at each bridge site for a total of four tests.

Laboratory Testing

Laboratory testing shall consist of performing up to 32 Wash No. 200 Sieve Analyses, 16 Atterberg Limits, and 32 Natural Moisture Contents.

Geotechnical Subsurface Data Report

After completion of the field and laboratory testing, the **CONSULTANT** will prepare a geotechnical subsurface data report. The data report shall be completed in accordance with the 2010 GDM Version 1.1;

specifically Chapter 21 along with Bridge Design Memorandum – DM0510, and shall include, but not be limited to the following:

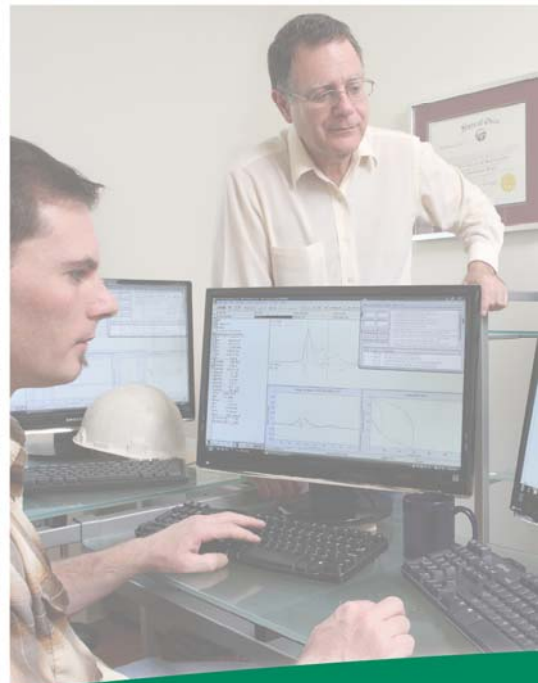
1. Site description with photographic documentation showing the drill rig on the test hole;
2. Drilling and testing procedures, along with charts illustrating the soil classification criteria and terminology;
3. Boring location plan which will include the locations of all testing and surface soil sampling performed;
4. STB and CPT logs which describe the various subsurface strata and graphically illustrate stratigraphy, SPT and CPT data, and **24-hour groundwater levels**;
5. Raw gINT and CPT data files;
6. Laboratory testing procedures and individual test data sheets.

Deliverables

Deliverables to the Department shall be an electronic copy of the final geotechnical subsurface data report. The electronic copy shall include both a WORD and PDF version of the report along with a DGN file of the test hole location plan. Boring logs file shall also be submitted in gINT data file format. Raw CPT data files shall also be included.

APPENDIX G

SPT Hammer Calibration



GRL
engineers, inc.

**Dynamic
Measurements
and Analyses**

Job No. 1159002-1

Report on: Standard Penetration Test Energy Measurements
Iron Station, NC

Prepared for Ameridrill
By Scott Webster, P.E. and Karen Webster
January 16, 2014

www.GRLengineers.com

info@GRLengineers.com



January 16, 2015

Ms. Debra Meatyard
Ameridrill
P.O. Box 2755
Huntersville, NC 28070

Re: Standard Penetration Test Energy Measurements
Iron Station, NC
GRL Job No. 159002-1

Dear Ms. Meatyard,

This report presents results of energy measurements obtained on January 9, 2015 during Standard Penetration Test (SPT) sampling. Three automatic hammers were tested. Two of the hammers were mounted on CME 550X ATV drill rigs and one of the hammers was mounted on a CME 55 truck drill rig. All dynamic tests were performed on AWJ drill rods. GRL Engineers, Inc. obtained the dynamic measurements with an instrumented AWJ subsection and a Model PAX Pile Driving Analyzer®. This report describes the testing procedures and summarizes the test results. Appendix A describes our measurement and analysis methods, Appendix B contains calibration information for the gages and equipment used, and Appendix C is a summary of the field data.

PURPOSE AND SCOPE OF WORK

At the request of Ameridrill, GRL conducted SPT energy measurements at a site in Iron Station, NC. The SPT energy measurements were obtained in accordance with ASTM D4633-10. Specifically, we recorded SPT energy measurements at 5-foot sample intervals between approximately 23.5 and 45.0 to 50.0 feet below the existing ground surface. In general, blank drilling was performed to a depth of approximately 23.5 feet where the first sample was collected. SPT samples were then collected continuously until the boring depth of approximately 45.0 or 50.0 feet was reached.

EQUIPMENT

Drilling and SPT Hammer Equipment

CME 550X (Serial # 269553)

SPT energy measurements were made on an automatic hammer mounted on a CME 550X ATV drill rig operated by Mr. Don Harris. The drilling method used to advance the boring was the hollow stem auger method. Energy measurements for this drill rig were collected at a dummy borehole location to a boring termination depth of 45.0 feet below grade. SPT energy measurement tests were performed at 5-foot sampling penetrations beginning at 23.5 feet. A total of five energy measurement events were monitored for this drill rig.

CME 550X (Serial # 249533)

SPT energy measurements were made on an automatic hammer mounted on a CME 550X ATV drill rig operated by Mr. Brian Boyce. The drilling method used to advance the boring was the hollow stem auger method. Energy measurements for this drill rig were collected at a dummy borehole location to a boring termination depth of 45.0 feet below grade. SPT energy measurement tests were performed at 5-foot sampling penetrations beginning at 23.5 feet. A total of five energy measurement events were monitored for this drill rig.

CME 55 (Serial # 306515)

SPT energy measurements were made on an automatic hammer mounted on a CME 55 truck drill rig operated by Mr. Chris Meatyard. The drilling method used to advance the boring was the hollow stem auger method. Energy measurements for this drill rig were collected at a dummy borehole location to a boring termination depth of 50.0 feet below grade. SPT energy measurement tests were performed at 5-foot sampling penetrations beginning at 23.5 feet. A total of six energy measurement events were monitored for this drill rig.

Instrumentation

A Model PAX Pile Driving Analyzer (PDA) data acquisition system (SN# 3797L) was used to collect and process the dynamic measurements of force and velocity. The data was collected using a two-foot long section of AWJ rod subsection (SN# 168AWJ) with a cross sectional area of 1.18 square inches and instrumented with two full bridge foil resistance strain gages and two piezoresistive accelerometers mounted in the midpoint location of the instrumented rod.

Analog signals from the strain gages and accelerometers were conditioned, digitized, stored and processed with the PDA. The sampling frequency used during the SPT testing was 50 kHz. Selected output from the PDA for each recorded impact included the energy transfer ratio (ETR), maximum rod top velocity (VMX), maximum energy transfer (EFV), maximum rod top force (FMX), and the hammer operating rate (BPM).

MEASUREMENTS AND CALCULATIONS

FV Method (EFV)

Energy transfer to the PDA gage location, EFV, was computed by the PDA using force, $F(t)$, and velocity, $v(t)$, records as follows:

$$EFV = \int_a^b F(t) \cdot v(t) dt$$

The time "a" corresponds to the start of the record when the energy transfer begins, and "b" is the time at which energy transferred to the rod reaches a maximum value. The FV Method is currently recognized in ASTM D4633-10, and is the theoretically correct result; therefore, no other energy calculation methods are reported.

Corrected SPT number (N_{60})

While the primary purpose of SPT energy testing is to calculate the maximum transferred energy (ETR) of each hammer blow, the overall average EFV value can be used to calculate the corrected SPT number (N_{60}). To adjust the SPT N-values for hammer performance, the following correction as suggested by Seed for N-value adjustment to 60% transfer efficiency (e.g. 210 ft-pounds) was used:

$$N_{60} = \left(\frac{E_m}{210} \right) N_m$$

Where:

N_{60} = Corrected N-value

E_m = overall average measured energy transfer (EFV)

N_m = number of blows for last 12 inches of sampler penetration

A general introduction to dynamic SPT testing methods is included in this report as Appendix A. References for more detailed descriptions of our testing and analysis methods are available upon request.

Any cross-sectional area difference between the GRL rod subsection and the drill rods, any loose connections or changes in area at section joints, or any cross-sectional area differences between the individual drill rod sections will result in stress wave reflections that can potentially influence the energy transfer. The EFV transferred energy calculation method, utilizing both force and velocity records, is theoretically correct and gives energy transfer results that are not adversely affected by cross-sectional area changes or loose connectors. The EFV results are included in Appendix C for all records collected and accepted after checking them for consistency.

RESULTS

Upon return to the office, the records collected by the PDA were checked for consistency and accuracy. For example, records from very weak startup or final impacts were not included in average results. Appendix C contains a representative plot of force and normalized velocity versus time, as well as plots and tables of PDA results for all hammer blows at each dynamically monitored sampling depth. The results include the EFV (transferred energy by the FV method, as recommended by ASTM D4633-10), ETR (energy transfer efficiency for the EFV method), BPM (hammer operating rate), DMX (maximum rod displacement), and VMX (maximum rod top velocity). The plots show

each calculated PDA result versus split-spoon penetration, while the tables show statistical summaries for each 6 inch increment. At the end of each table is a statistical evaluation of the results which include the average and standard deviation of the entire measurement sample.

The table below and Table 1 summarize the average transferred energy values calculated by the EFV method. The records consist of averaged hammer blows from the last 12 inches (i.e. N value) at each dynamically monitored sampling depth. The "energy transfer ratio" (ETR) is defined as the ratio of maximum transferred energy EFV divided by the theoretical hammer potential energy of 350 ft-lbs (i.e., computed per the 140 lb SPT hammer and the standard 30 inch drop as specified by ASTM D1586-08). The average hammer operating rate is reported in blows per minute (BPM). A summary of the dynamic measurements of the energy transfer to the drill rods using the EFV equation is provided in the table below.

Drill Rig	Avg. EFV (ft-lbs)	Avg ETR (%)	Range of EFV (ft-lbs)	Range of ETR (%)
CME 550 269553	258	74	245 – 268	70 - 77
CME 550 249533	291	83	289 – 296	83 - 85
CME 55 306515	302	87	296 – 316	85 - 90

CONCLUSIONS

Based upon the dynamic test data obtained, the following conclusions are presented:

1. Loose connections in the drill string were sometimes observed in the force and velocity records. However, energy transfer values calculated using the EFV equation are not adversely affected by the connectors and therefore are considered a better indication of transferred energy.
2. Dynamic measurements of the transferred energy to the drill rods using the EFV equation ranged from 245 to 268 ft-lbs for the CME 550X 269553 drill rig. This corresponds to a transfer efficiency ranging from 70 to 77% of the SPT hammer energy of 350 ft-lbs.
3. Dynamic measurements of the transferred energy to the drill rods using the EFV equation ranged from 289 to 296 ft-lbs for the CME 550X 249533 drill rig. This corresponds to a transfer efficiency ranging from 83 to 85% of the SPT hammer energy of 350 ft-lbs.
4. Dynamic measurements of the transferred energy to the drill rods using the EFV equation ranged from 296 to 316 ft-lbs for the CME 55 306515 drill rig. This corresponds to a transfer efficiency ranging from 85 to 90% of the SPT hammer energy of 350 ft-lbs.

January 16, 2015

Please review both ASTM D4633-10 and ASTM D1586-08 prior to applying these test results. The energy calibrations reported herein are valid for the same hammer/drill rig, with the same drill operator, same anvil dimensions, and same drilling methods.

We appreciate the opportunity to be of assistance to you on this project. Please contact our office should you have any questions regarding this submittal, require additional information, or if we may be of further service.

Sincerely,

GRL Engineers, Inc.

Karen Webster

Karen Webster

Scott D. Webster

Scott Webster, P.E.



SDW:KW:dms

TABLE 1: Summary of SPT Energy Measurements
Ameridrill SPT Calibration January 9, 2015
CME 550X ATV Serial # 269553

Soil Sample	Reported Sample Depth	Reported Rod Length	Reported Blow Count	SPT Field N Value	Avg. Energy Transferred FV Method	Energy Transfer Efficiency ¹	Blow per Minute	N ₆₀
	(feet)	(feet)	(blows/6")		(ft-lbs)	(%)	(bpm)	
SS-1	23.5 - 25.0	29.0	5,6,7	13	245	70	46	15
SS-2	28.5 - 30.0	34.0	3,5,6	11	257	73	48	13
SS-3	33.5 - 35.0	39.0	4,4,5	9	260	74	46	11
SS-4	38.5 - 40.0	44.0	2,5,9	14	268	77	49	18
SS-5	43.5 - 45.0	49.0	2,3,5	8	261	75	49	10
Average⁽²⁾					258	74	48	
Standard Dev.⁽²⁾					8	3	2	

Notes: 1 - Energy transfer efficiency is the energy calculated by the FV method divided by the SPT hammer potential energy of 140 lbs times 2.5 foot drop height or 350 ft-lbs.

2 - Average and standard deviation are calculated using averaged data from SPT hammer blows from the last two six inch increments (i.e. N value) from all sampling depths tested.