

REVISED

## **GEOTECHNICAL BASE LINE REPORT**

Route S-1-218 Replacement Bridge over Branch of Penny Creek  
Abbeville County, South Carolina



### **PREPARED FOR**

SCDOT

955 Park Street

Columbia, South Carolina 29201

### **PREPARED BY**

F&ME Consultants, Inc.

1825 Blanding Street

Columbia, South Carolina 29201

SCDOT Project ID: P038056

FME Project No.: G6100.05.01

**October 23, 2019**

October 23, 2019

Trapp Harris, P.E.  
Design-Build Group Geotechnical Engineer  
South Carolina Department of Transportation  
955 Park Street  
Columbia, South Carolina 29201

Re: Closed and Load-Restricted Bridge Package 2020-1  
REVISED Geotechnical Base Line Report  
Route S-1-218 Bridge over Branch of Penny Creek  
Abbeville County, South Carolina  
SCDOT Project ID: P038056  
F&ME Project No.: G6100.050.01

Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc. (FME) revised Geotechnical Base Line Report (GBLR) for the Route S-1-218 Replacement Bridge over Branch of Penny Creek. Revisions to our previously submitted report include the corrosion series laboratory test results. This report contains findings from our subsurface field exploration, results from the laboratory testing program, and conceptual geotechnical assessment of embankments and bridge foundation systems.

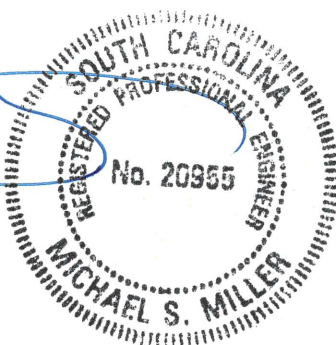
It has been a pleasure working with you on this project and we appreciate the opportunity to be of service. Please notify us if there are any questions or if we may be of further assistance.

Sincerely,

F&ME Consultants, Inc.

A handwritten signature in blue ink, appearing to read 'Michael S. Miller', written over a circular professional engineer stamp.

Michael S. Miller, P.E.  
Senior Geotechnical Engineer



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## 1.0 INTRODUCTION

FME performed geotechnical soil test borings and laboratory testing for the Route S-1-218 Replacement Bridge over Branch of Penny Creek located in Abbeville County, South Carolina. A Site Location Plan is presented as Figure 1 in Section 1 in the Appendix of this report. The South Carolina Department of Transportation (SCDOT) Scope of Services Work Request for the geotechnical subsurface exploration and laboratory testing was issued on March 1, 2019.

The field investigation consisted of performing soil test borings (STB's) with associated Standard Penetration Testing (SPT) and rock core sampling. Laboratory testing was performed on selected soil and rock core samples collected from the test borings. The exploration methods and laboratory procedures were conducted in general accordance with the current 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 Geotechnical Base Line Report was prepared in general accordance with the 2019 SCDOT Geotechnical Design Manual (GDM), Version 2.0. along with PCDM-11 Supplemental Design Criteria for Low Volume Bridge Replacement Projects.

## 2.0 FIELD EXPLORATION SUMMARY

On June 16, 2019, F&ME performed two (2) soil test borings (STB's). The test boring locations were performed in proximity to the existing bridge end bent locations. The intent of the subsurface investigation was to provide a broad indication of the subsurface conditions at the site.

The STB's were advanced using a CME 45B trailer mounted drill rig with an automatic standard penetration test (SPT) hammer system. Rotary wash drilling techniques were used during drilling to maintain a stable borehole. Standard split-spoon sampling was performed continuously over the first ten (10) feet of the boring depth and at five (5) foot intervals thereafter. Soil test borings were advanced to a drilling refusal condition and subsequently advanced into rock using NQ rock coring techniques. Details of each STB are included on the individual Soil Test Boring Logs in Section 4 in the Appendix of this report.

### 2.1 Soil Test Borings (STB's)

The following table is a summary of the STB designations, exploration depths, locations, and ground surface elevations of the test boring locations.

Table 1 – Soil Test Boring Summary Table

SOIL TEST BORINGS (STB)							
Test Hole No.	Surface Condition	Soil Depth (ft.)	Rock Core Depth (ft.)	Total Boring Depth (ft.)	Latitude	Longitude	Elev. (ft.-MSL)
B-901	Paved Roadway	42.1	10.0	52.1	34.263886	-82.518783	553.6
B-902	Paved Roadway	30.0	10.0	40.0	34.263841	-82.518955	553.3
Totals	-	72.1	20.0	92.1			



## 2.2 Groundwater

Groundwater depths were recorded at the time of boring (TOB) for soil test borings B-901 and B-902, with the recorded measurements noted on the individual Soil Test Boring Logs in Section 4 of the Appendix to this report. Groundwater measurements were also made twenty-four (24) hours following boring completion. The following table is a summary of the groundwater measurements for the soil test borings at time of boring and at twenty-four (24) hours following boring completion.

Table 2 – Groundwater Depth Summary Table

GROUNDWATER DEPTH			
Boring No.	Date of TOB Groundwater Measurement	TOB Groundwater Depth (ft.)	24-hr. Groundwater Depth (ft.)
B-901	6/19/2019	10.3	12.5
B-902	6/19/2019	10.6	12.5

## 3.0 LABORATORY TESTING

Following completion of F&ME's field investigation, select split-spoon samples were tested in FME's AASHTO accredited laboratory to determine applicable physical and engineering properties. Four (4) rock core specimens were sent to Geotechnical Testing Services, Inc. and tested for unconfined compressive strength testing and Young's Modulus determinations. One (1) split-spoon sample was sent to an off-site AASHTO accredited laboratory for corrosion series testing. All laboratory testing was performed in general accordance with procedures set forth in the most current AASHTO and ASTM standards.

The laboratory testing performed for the split-spoon samples and rock cores are detailed in the table below. Data sheets containing the results of the laboratory testing program are provided in Section 7 of the Appendix.

Table 3 – Laboratory Testing Summary Table

LABORATORY SOIL AND ROCK TESTING		
Type of Test	Quantity	Procedure
Grain Size Analysis with Hydrometer	6	AASHTO T88
Grain Size Analyses with Wash 200	2	AASHTO T11
Atterberg Limits	4	AASHTO T89/T90
Natural Moisture Content	7	ASTM D2216
pH	1	AASHTO T289
Resistivity	1	AASHTO T288
Chloride Content	1	AASHTO T291
Sulfate Content	1	AASHTO T290
Rock Core Compressive Strength and Young's Modulus	4	ASTM D7012 Methods C and D

## 4.0 SUBSURFACE STRATIGRAPHY

The following table summarizes the soil and rock stratigraphy based on conditions as encountered in the soil test borings performed during this geotechnical subsurface investigation.

Table 4 – Stratigraphy Summary Table

SOIL AND ROCK STRATIGRAPHY					
Strata	Elevation of Top Layer (ft-MSL)	Depth to Top of Layer (ft.)	USCS Soil Type	Avg. SPT N Value (bpf)	Comments
Fill	553	0	CL, ML, SM	6	-
Alluvium	541	12	SP, SP-SM, SM	11	-
Residuum	528	25	SM	14	-
PWR	519	34	SM	100+	-
Bed Rock	517	36	N/A	N/A	Gneiss

## 5.0 CONCEPTUAL GEOTECHNICAL ASSESSMENT

Relative to the SCDOT's Supplemental Design Criteria for Low Volume Bridge Replacement Projects, the soil subgrade below the new embankment areas are anticipated to be adequate for embankment construction.

We anticipate that pile foundations will be preferred for support of the bridge abutments. The Strength Case axial loadings will likely govern the geotechnical pile design. We anticipate that the soil thickness above rock is sufficient to resist the assumed lateral loading conditions, and drilled pile will not be likely. We anticipate that the piles will be driven to a practical refusal pile driving condition on weathered rock or sound bedrock. To avoid excessive pile driving stresses, we anticipate that pile driving termination criteria will be based on encountering a pile driving practical refusal condition. Shallow foundation concepts are likely not feasible due to the estimated bearing depth and the presence of groundwater at that depth.

If a multi-span concept is pursued, the selection of the interior bent foundation type will be predicated on the scour depth relative to the bent location(s). For an assumed scour depth and channel geometry, FME anticipates that driven pile concepts may or may not be feasible based on the soil thickness above rock to resist the lateral loads. We anticipate that drilled shafts will be the most feasible foundation type for the interior bent(s). The drilled shafts will consist of construction casing and rock sockets below the casing tip elevation. We expect the Strength Case axial loadings will govern the drilled shaft design. Based on the performed borings, the rock strengths range on the order of 8,000 psi to 15,000 psi.

# **S-1-218 Replacement Bridge over Branch of Penny Creek**

## **Geotechnical Base Line Report**

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# **APPENDIX**

<b>SECTION 1</b>	<b>SITE LOCATION PLAN</b>
<b>SECTION 2</b>	<b>BORING LOCATION PLAN</b>
<b>SECTION 3</b>	<b>DRILL RIG PHOTOS</b>
<b>SECTION 4</b>	<b>TEST BORING LOGS</b>
<b>SECTION 5</b>	<b>GENERALIZED SUBSURFACE PROFILE</b>
<b>SECTION 6</b>	<b>ROCK CORE PHOTOS</b>
<b>SECTION 7</b>	<b>LABORATORY TEST RESULTS</b>

# S-1-218 Replacement Bridge over Branch of Penny Creek

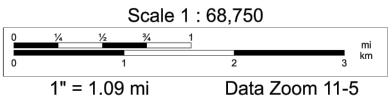
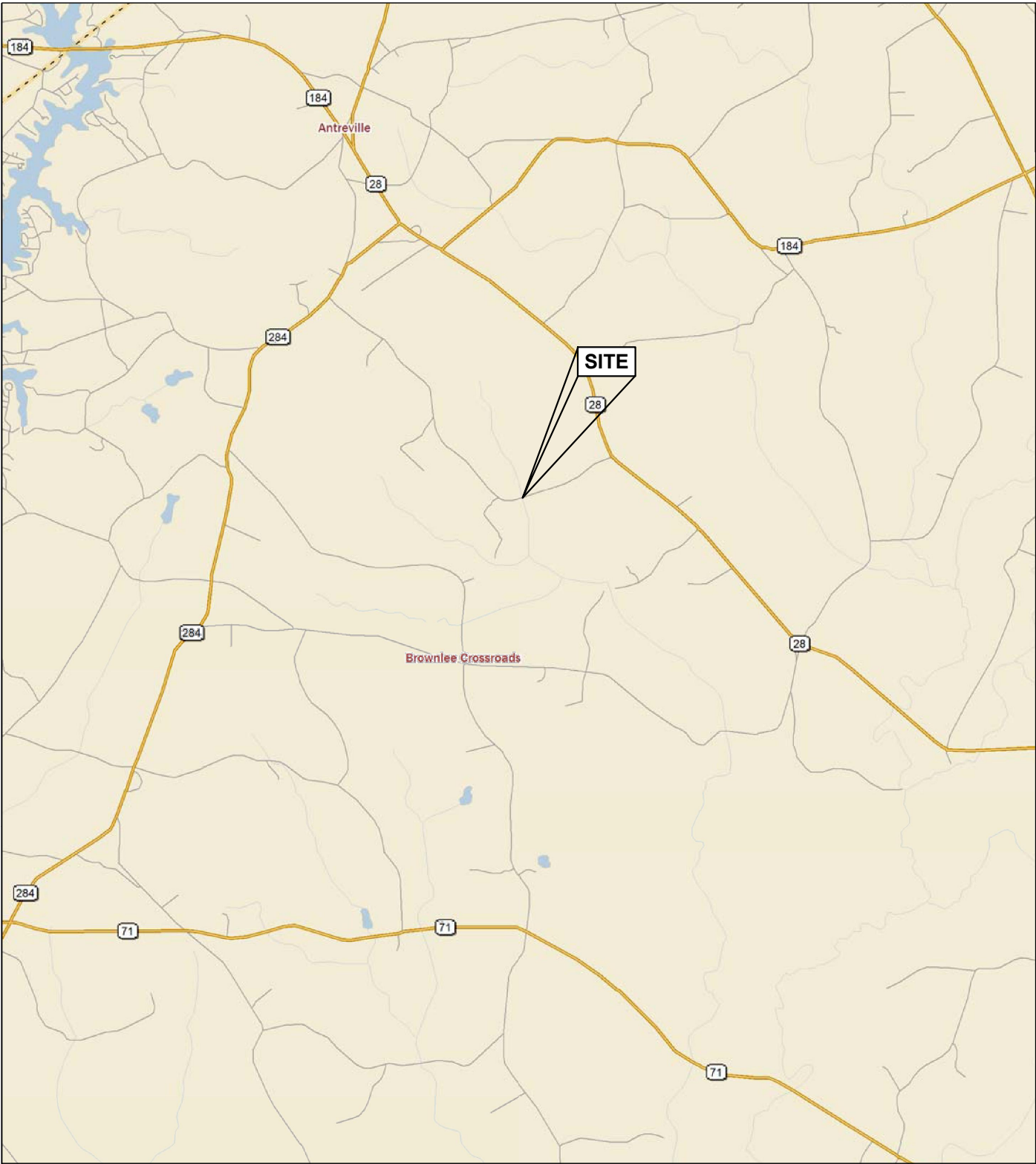
## Geotechnical Base Line Report

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# APPENDIX

## SECTION 1 SITE LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	ABBEVILLE	P038056	S-1-218	



F&ME CONSULTANTS, INC.  
COLUMBIA, SC

4			
3			
2			
1			
REV.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	CTC	DATE 6.3.19	GROUP - -
R/W		DATE	

BRANCH OF PENNY CREEK  
NEWBERRY COUNTY, SOUTH CAROLINA

SITE LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: AS NOTED

FIGURE 1

# S-1-218 Replacement Bridge over Branch of Penny Creek

## Geotechnical Base Line Report

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# APPENDIX

## SECTION 2 BORING LOCATION PLAN



FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD/ROUTE NO.	SHEET NO.
3	SC	ABBEVILLE	P038056	S-1-218	





**LEGEND:**

SOIL TEST BORING LOCATION

4			
3			
2			
1			
REV.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	CTC	DATE 6.3.19	GROUP -- --
R/W		DATE	



F&ME CONSULTANTS, INC.

COLUMBIA, SC

BRANCH OF PENNY CREEK ABBEVILLE COUNTY, SOUTH CAROLINA	
BORING LOCATION PLAN	
F&ME JOB NO. G6100.050	
SCALE: 1"=30'	FIGURE 2



# S-1-218 Replacement Bridge over Branch of Penny Creek

## Geotechnical Base Line Report

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# APPENDIX

## SECTION 3 DRILL RIG PHOTOS

# Drill Rig Setup Photographs

B-901





# Drill Rig Setup Photographs

B-902



# S-1-218 Replacement Bridge over Branch of Penny Creek

## Geotechnical Base Line Report

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# APPENDIX

## SECTION 4 TEST BORING LOGS

## Soil Test Boring Log Descriptors

### Correlation of Penetration Resistance with Relative Density and Consistency














Coarse Grained Soils (Sands/Gravel)		Fine Grained Soils (Silt/Clay)	
SPT Blow Count	Relative Density	SPT Blow Count	Consistency
≤ 4	Very Loose	≤ 2	Very Soft
5 – 10	Loose	3 – 4	Spft
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

Gravel	Sieve Size
Fines Content	< #200

SYMBOL	PRINT CODE*	TYPICAL DESCRIPTION
	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		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
FINE GRAINED SOILS	SILTS AND CLAYS	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
				ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	SILTS AND CLAYS			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
				MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
HIGHLY ORGANIC SOILS	SILTS AND CLAYS			CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



# SCDOT Soil Test Log

<b>Project ID:</b>	P038056	<b>County:</b>	Abbeville	<b>Boring No.:</b>	B-901
<b>Site Description:</b>	S-1-218 Replacement Bridge over Branch of Penny Creek			<b>Route:</b>	S-1-218
<b>Eng./Geo.:</b>	C. Piercy	<b>Boring Location:</b>	N/A	<b>Offset:</b>	N/A
<b>Elev.:</b>	553.6 ft	<b>Latitude:</b>	34.263886	<b>Longitude:</b>	-82.518783
<b>Date Started:</b>	6/19/2019				
<b>Total Depth:</b>	52.1 ft	<b>Soil Depth:</b>	42.1 ft	<b>Core Depth:</b>	10 ft
<b>Date Completed:</b>	6/19/2019				
<b>Bore Hole Diameter (in):</b>	4	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)	<b>Drill Machine:</b>	CME 45B	<b>Drill Method:</b>	RW/RC
<b>Hammer Type:</b>	Automatic	<b>Energy Ratio:</b>	92%	<b>Core Size:</b>	NQ
<b>Driller:</b>	L. Guempel	<b>Groundwater:</b>	TOB	10.3 ft	24HR
					12.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ●	PL MC LL	▲ FINES CONTENT (%)
	0.0												
	0.2	ASPHALT (2.5-in.)		0.2									
	0.8	FILL											
	2.0	Loose, Moist, Brown, Non-Plastic to Low Plasticity, Silty Fine to Coarse SAND (SM) with Trace of Gravel, Munsell=10YR 4/3		2.0	SS-1	4	4	4		8	●		
	4.3	Firm, Moist, Red, Low Plasticity to Medium Plasticity, Fine to Medium Sandy CLAY (CL), Munsell=2.5YR 4/8		4.0	SS-2	3	4	4	4	8	●		
548.6	6.0	Firm, Moist, Yellowish Red, Non-Plastic to Low Plasticity, Fine to Medium Sandy SILT (ML), Munsell=2.5YR 4/6		6.0	SS-3	5	4	4	5	8	●		
		Loose, Moist, Yellowish Red, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=5YR 5/6		8.0	SS-4	2	3	4	5	7	●		
		Firm to Soft, Moist, Reddish Brown, Non-Plastic to Low Plasticity, Fine to Medium Sandy SILT (ML), Munsell=5YR 5/4			SS-5	2	1	2	2	3	●	XX	▲
543.6		@8-ft.: A-4(2) @SS-5: LL=29, PL=24, PI=5, NMC=32.0%, %200=63.1											
	12.0	ALLUVIUM											
		Very Loose to Loose, Moist, Gray, Non-Plastic, Fine to Medium SAND (SP-SM) with Silt, Munsell=10YR 5/1		13.5	SS-6	1	1/12"			1	●▲	○	
538.6		@SS-6: NMC=29.1%, %200=6.8											
		@18.5-ft.: Wet, Reddish Yellow/Light Yellowish Brown, Fine to Coarse Sands, with Trace of Gravel, Munsell= 7.5YR 6/6 & 2/5Y 6/3		18.5	SS-7	5	5	4		9	▲●		
533.6		@SS-7: %200=5.3											
	22.0												

## LEGEND

Continued Next Page

SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD	
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

# SCDOT Soil Test Log

<b>Project ID:</b>	P038056	<b>County:</b>	Abbeville	<b>Boring No.:</b>	B-901
<b>Site Description:</b>	S-1-218 Replacement Bridge over Branch of Penny Creek			<b>Route:</b>	S-1-218
<b>Eng./Geo.:</b>	C. Piercy	<b>Boring Location:</b>	N/A	<b>Offset:</b>	N/A
<b>Elev.:</b>	553.6 ft	<b>Latitude:</b>	34.263886	<b>Longitude:</b>	-82.518783
<b>Date Started:</b>	6/19/2019				
<b>Total Depth:</b>	52.1 ft	<b>Soil Depth:</b>	42.1 ft	<b>Core Depth:</b>	10 ft
<b>Date Completed:</b>	6/19/2019				
<b>Bore Hole Diameter (in):</b>	4	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)	<b>Drill Machine:</b>	CME 45B	<b>Drill Method:</b>	RW/RC
<b>Hammer Type:</b>	Automatic	<b>Energy Ratio:</b>	92%	<b>Core Size:</b>	NQ
<b>Driller:</b>	L. Guempel	<b>Groundwater:</b>	TOB	<b>10.3 ft</b>	<b>24HR</b>
<b>12.5 ft</b>					

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ●	PL X MC X LL X	▲ FINES CONTENT (%)
528.6	23.5	<b>RESIDUUM</b> Loose, Wet, Light Olive Brown, Non-Plastic, Silty Fine to Medium SAND (SM/A-2-4), Micaceous, Munsell=2.5Y 5/3 @SS-8: LL=NP, PL=NP, PI=NP, NMC=31.6%, %200=15.2			SS-8	3	3	4		7	●	▲	○
523.6	28.5	@28.5-ft.: Light Olive Brown/White, Munsell=2.5Y 5/3 & 2.5Y 8/1 @SS-9: NMC=24.8%, %200=18.2			SS-9	5	5	8		13	●	▲	○
518.6	33.5				SS-10	8	9	12		21	●		
513.6	38.5	<b>PARTIALLY WEATHERED ROCK (PWR)</b> SAMPLED AS: Very Dense, Wet, Light Olive Brown/White/Black, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Micaceous, Munsell=2.5Y 5/3 & 2.5Y 8/1 & 2.5Y 2.5/1			SS-11 50/5"					100+			
42.1	42.0	<b>GNEISS</b> @NQ-1: Metamorphic, Black/White, Fine to Coarse Grained, Thinly Laminated to Laminated Foliations, Quartz/Feldspar/Biotite,			SS-12 50/0"					100+			

## 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

<b>Project ID:</b>	P038056	<b>County:</b>	Abbeville	<b>Boring No.:</b>	B-901
<b>Site Description:</b>	S-1-218 Replacement Bridge over Branch of Penny Creek			<b>Route:</b>	S-1-218
<b>Eng./Geo.:</b>	C. Piercy	<b>Boring Location:</b>	N/A	<b>Offset:</b>	N/A
<b>Elev.:</b>	553.6 ft	<b>Latitude:</b>	34.263886	<b>Longitude:</b>	-82.518783
<b>Date Started:</b>	6/19/2019				
<b>Total Depth:</b>	52.1 ft	<b>Soil Depth:</b>	42.1 ft	<b>Core Depth:</b>	10 ft
<b>Date Completed:</b>	6/19/2019				
<b>Bore Hole Diameter (in):</b>	4	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)				
<b>Drill Machine:</b>	CME 45B	<b>Drill Method:</b>	RW/RC	<b>Hammer Type:</b>	Automatic
<b>Energy Ratio:</b>	92%				
<b>Core Size:</b>	NQ	<b>Driller:</b>	L. Guempel	<b>Groundwater:</b>	TOB 10.3 ft
<b>24HR</b>	12.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ● PL X MC X LL X ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
508.6		Highly to Slightly Weathered, Very Strong, Occasional Joints, Joints Dip from 10 to 40 Degrees, Moderately Wide to Very Narrow, Surface Stain, Iron Oxide, Planar/Irregular, Very Close, Smooth to Very Rough Joints, RMR=41, Class III @42.3-ft.: UC Strength= 11,503 psi		47.3	NQ-1						%REC=92, %RQD=73, 2.3 min/ft, GSI=20-30
503.6		@NQ-2: Slightly Weathered to Fresh, Joints Dip 40 Degrees, Very Narrow, No Infilling, Planar, Slightly Rough Joints, RMR=69, Class II @48.4-ft.: UC Strength= 8,330 psi			NQ-2						%REC=87, %RQD=87, 2.7 min/ft, GSI=45-55
52.1		Boring Terminated at 52.1 Feet									
498.6											
493.6											
488.6											

## 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

<b>Project ID:</b>	P038056	<b>County:</b>	Abbeville	<b>Boring No.:</b>	B-902
<b>Site Description:</b>	S-1-218 Replacement Bridge over Branch of Penny Creek			<b>Route:</b>	S-1-218
<b>Eng./Geo.:</b>	C. Piercy	<b>Boring Location:</b>	N/A	<b>Offset:</b>	N/A
<b>Elev.:</b>	553.3 ft	<b>Latitude:</b>	34.263841	<b>Longitude:</b>	-82.518955
<b>Date Started:</b>	6/19/2019				
<b>Total Depth:</b>	40 ft	<b>Soil Depth:</b>	30 ft	<b>Core Depth:</b>	10 ft
<b>Date Completed:</b>	6/19/2019				
<b>Bore Hole Diameter (in):</b>	4	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)	<b>Drill Machine:</b>	CME 45B	<b>Drill Method:</b>	RW/RC
<b>Hammer Type:</b>	Automatic	<b>Energy Ratio:</b>	92%	<b>Core Size:</b>	NQ
<b>Driller:</b>	L. Guempel	<b>Groundwater:</b>	TOB	10.6 ft	24HR
					12.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ●	PL MC LL	▲ FINES CONTENT (%)
	0.0												
	0.2	ASPHALT (1.75-in.)		0.2									
	0.5	FILL											
		Very Loose, Moist, Brown, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=7.5YR 5/2											
		Soft to Firm, Moist, Yellowish Red/Strong Brown, Low Plasticity, Fine to Medium Sandy CLAY (CL), Munsell=5YR 4/6 & 7.5YR 5/8											
	4.0	@SS-2: LL=43, PL=34, PI=9, NMC=23.3											
548.3		@2-ft.: Red, Fine to Coarse Sands, Munsell=2.5YR 4/6											
	6.7	Loose to Very Loose, Moist, Yellowish Red, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Micaceous, Munsell=5YR 5/6											
	8.0	@5.3-ft.: Brown, Fine to Coarse Sands, with Trace of Organics (Roots), Munsell=7.5YR 4/4											
		@6.2-ft.: Red, Fine to Medium Sands, Munsell=2.5YR 4/6											
543.3		Soft, Moist, Reddish Brown, Non-Plastic to Low Plasticity, SILT (ML) with Fine to Medium Sand, Munsell=5YR 5/3											
	12.0	Firm, Moist, Reddish Brown, Low Plasticity, Fine to Medium Sandy SILT (ML/A-4(3)), Micaceous, Munsell=5YR 5/4											
		@SS-5: LL=36, PL=31, PI=5, NMC=26.6%, %200=67.8											
538.3		ALLUVIUM											
		Loose, Wet, Bluish Gray, Non-Plastic to Low Plasticity, Silty Fine to Coarse SAND (SM), Munsell=10B 5/1											
		@SS-6: %200=13.9											
	17.0	@14.1-ft.: Olive, Munsell=5Y 5/4											
		Medium Dense, Wet, Pale Brown, Non-Plastic, Fine to Coarse SAND (SP) with Trace of Gravel, Munsell=2.5Y 7/3											
		@SS-7: NMC=13.4%, %200=5.1											
533.3													
	22.0												

## LEGEND

Continued Next Page

SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD	
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

# SCDOT Soil Test Log

<b>Project ID:</b>	P038056	<b>County:</b>	Abbeville	<b>Boring No.:</b>	B-902
<b>Site Description:</b>	S-1-218 Replacement Bridge over Branch of Penny Creek			<b>Route:</b>	S-1-218
<b>Eng./Geo.:</b>	C. Piercy	<b>Boring Location:</b>	N/A	<b>Offset:</b>	N/A
<b>Elev.:</b>	553.3 ft	<b>Latitude:</b>	34.263841	<b>Longitude:</b>	-82.518955
<b>Date Started:</b>	6/19/2019				
<b>Total Depth:</b>	40 ft	<b>Soil Depth:</b>	30 ft	<b>Core Depth:</b>	10 ft
<b>Date Completed:</b>	6/19/2019				
<b>Bore Hole Diameter (in):</b>	4	<b>Sampler Configuration</b>		<b>Liner Required:</b>	Y (N)
<b>Liner Used:</b>	Y (N)				
<b>Drill Machine:</b>	CME 45B	<b>Drill Method:</b>	RW/RC	<b>Hammer Type:</b>	Automatic
<b>Energy Ratio:</b>	92%				
<b>Core Size:</b>	NQ	<b>Driller:</b>	L. Guempel	<b>Groundwater:</b>	TOB 10.6 ft
<b>24HR:</b>	12.5 ft				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	<div> <div>● SPT N VALUE ●</div> <div>PL X MC X LL X</div> <div>▲ FINES CONTENT (%)</div> </div>
528.3		Medium Dense, Wet, Light Olive Brown, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Micaceous, Munsell=2.5Y 5/4		23.5							
					SS-8	7	6	6		12	●
				28.5							
		@28.5-ft.: Very Dense, Light Olive Brown/Dark Gray/Strong Brown, Munsell=2.5Y 5/4 & 2.5Y 4/1 & 7.5YR 5/6			SS-9	6	13	46		59	●
523.3	30.0	<b>GNEISS</b>		30.0	SS-10 50/60"						
		@NQ-1: Metamorphic, Black/White, Fine to Coarse Grained, Thinly Laminated to Laminated Foliations, Biotite/Quartz/ Feldspar, Slightly Weathered, Very Strong to Strong, No Joints, No Infilling, RMR=72, Class II		31.3	NQ-1						%REC=90, %RQD=90, 3.0 min/ft, GSI=45-55
		@30.2-ft.: UC Strength= 14,639 psi									
		@NQ-2: Slightly Weathered to Fresh, Few Joints, Joints Dip from 15 to 75 Degrees, Narrow to Very Narrow, Wavy/Planar/Irregular, Very Close, Slightly Rough to Rough Joints, RMR=65, Class II			NQ-2						%REC=97, %RQD=97, 1.2 min/ft, GSI=45-55
518.3				36.3							
		@NQ-3: Joints Dip 10 Degrees, Spotty, Iron Oxide, Planar, Slightly Rough Joints, RMR=55, Class III			NQ-3						%REC=84, %RQD=76, 2.7 min/ft, GSI=45-55
		@36.8-ft.: UC Strength= 12,787 psi									
513.3	40.0	Boring Terminated at 40.0 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	

## Soil Test Boring Log Descriptors

### Correlation of Penetration Resistance with Relative Density and Consistency














Coarse Grained Soils (Sands/Gravel)		Fine Grained Soils (Silt/Clay)	
SPT Blow Count	Relative Density	SPT Blow Count	Consistency
≤ 4	Very Loose	≤ 2	Very Soft
5 – 10	Loose	3 – 4	Spft
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

Gravel	Sieve Size
Fines Content	< #200

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



# **S-1-218 Replacement Bridge over Branch of Penny Creek**

## **Geotechnical Base Line Report**

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# **APPENDIX**

## **SECTION 5 GENERALIZED SUBSURFACE PROFILE**

KEY TO SYMBOLS


PROJECT NAME


Closed and Load-Restricted Bridge Package 2020-1  
(S-1-218 Bridge Replacement over Branch of Penny Creek)


PROJECT COUNTY


Abbeville


LITHOLOGIC SYMBOLS  
(Unified Soil Classification System)


 ASPHALT


 GABC (Graded Aggregate Base Course)


 PWR: Partially Weathered Rock


 BEDROCK: Bedrock


 CH: USCS High Plasticity Clay


 CL: USCS Low Plasticity Clay


 CL-ML: USCS Low Plasticity Silty Clay


 MH: USCS Elastic Silt


 ML: USCS Silt


 SP: USCS Poorly Graded Sand


 SM: USCS Silty Sand

 SC: USCS Clayey Sand

 SP-SM: USCS Poorly Graded Sand w/ Silt

 SC-SM: USCS Silty, Clayey Sand



 SP-SC: USCS Poorly Graded Sand w/ Clay

 No Recovery

SOIL TEST ID'S

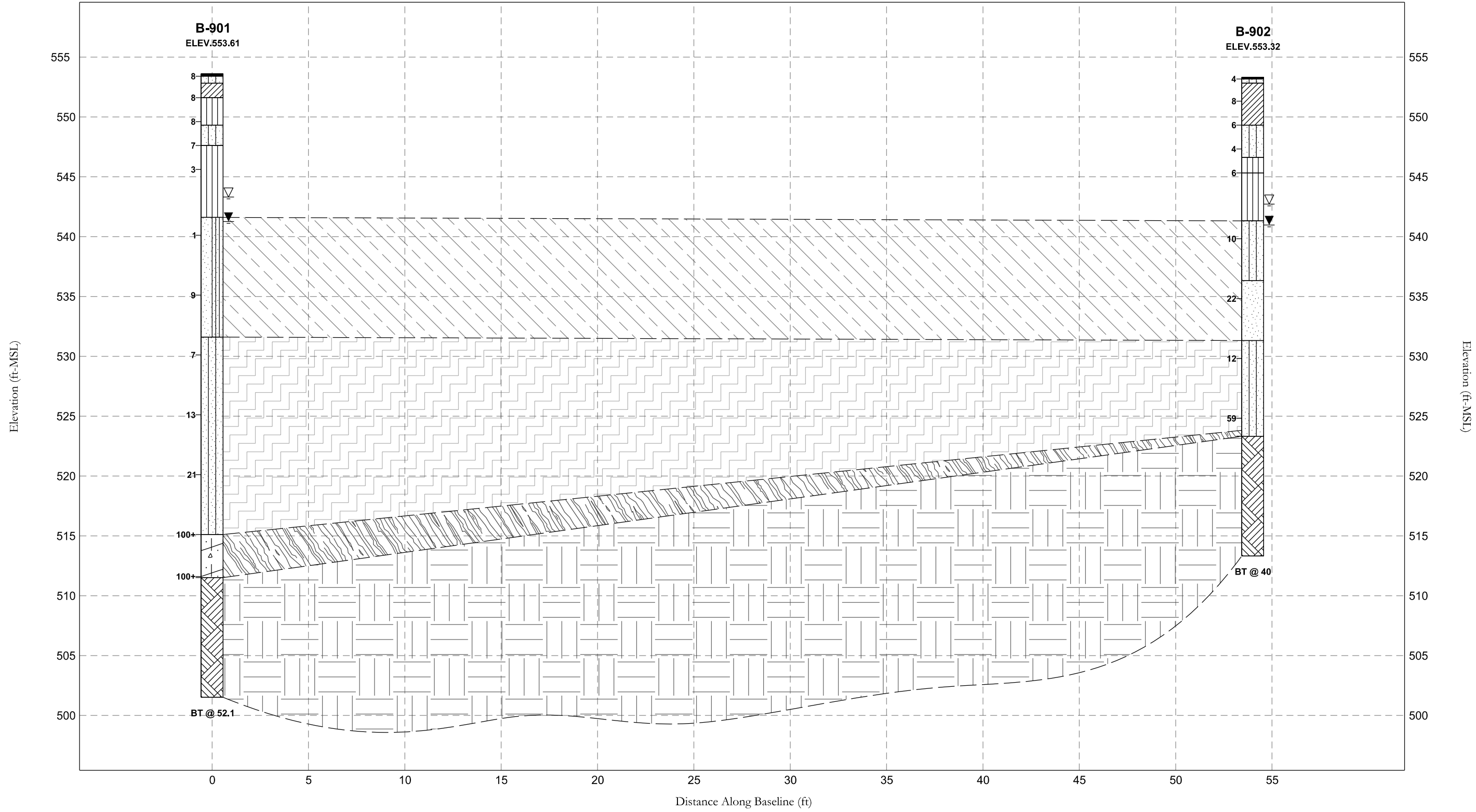
B-#      SOIL TEST BORING

ABBREVIATIONS

- LL - LIQUID LIMIT (%)  
PL - PLASTIC LIMIT (%)  
PI - PLASTIC INDEX (%)  
NMC - MOISTURE CONTENT (%)  
NP - NON PLASTIC  
%#200 - PERCENT PASSING NO. 200 SIEVE
-  Water Level at Time  
Drilling, or as Shown
-  Water Level at End of  
Drilling, or as Shown

NOTES

1. THE GENERALIZED SUBSURFACE PROFILES ARE PROVIDED ONLY FOR ILLUSTRATIVE PURPOSES. THE INTENT OF THESE DRAWINGS IS TO PROVIDE THE READER WITH VERY GENERAL INFORMATION ON SUBSURFACE CONDITIONS AT THE TIME OF THE INVESTIGATION. VARIATIONS IN THE INDICATED SUBSURFACE CONDITIONS WILL BECOME EVIDENT ONCE ADDITIONAL BORINGS ARE PERFORMED. THE INDICATED STRATIGRAPHY BETWEEN TESTING LOCATIONS WAS GENERATED USING STRAIGHT-LINE LINEAR INTERPOLATION, AND DOES NOT REPRESENT THE TRUE STRATIGRAPHY.



The generalized subsurface profile is provided for illustrative purposes. The intent of this drawing is to provide the reader with very general information on soil stratigraphy at the bridge site. Variations in the indicated subsurface conditions will become evident once additional borings are performed.

4			
3			
2			
1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	JFH	DATE 8.27.19	GROUP - -
R/W		DATE	

**S-1-218 BRIDGE REPLACEMENT  
OVER BRANCH OF PENNY CREEK**

**GENERALIZED SUBSURFACE PROFILE**

HRZ SCALE = NTS

VRT SCALE = NTS



# S-1-218 Replacement Bridge over Branch of Penny Creek

## Geotechnical Base Line Report

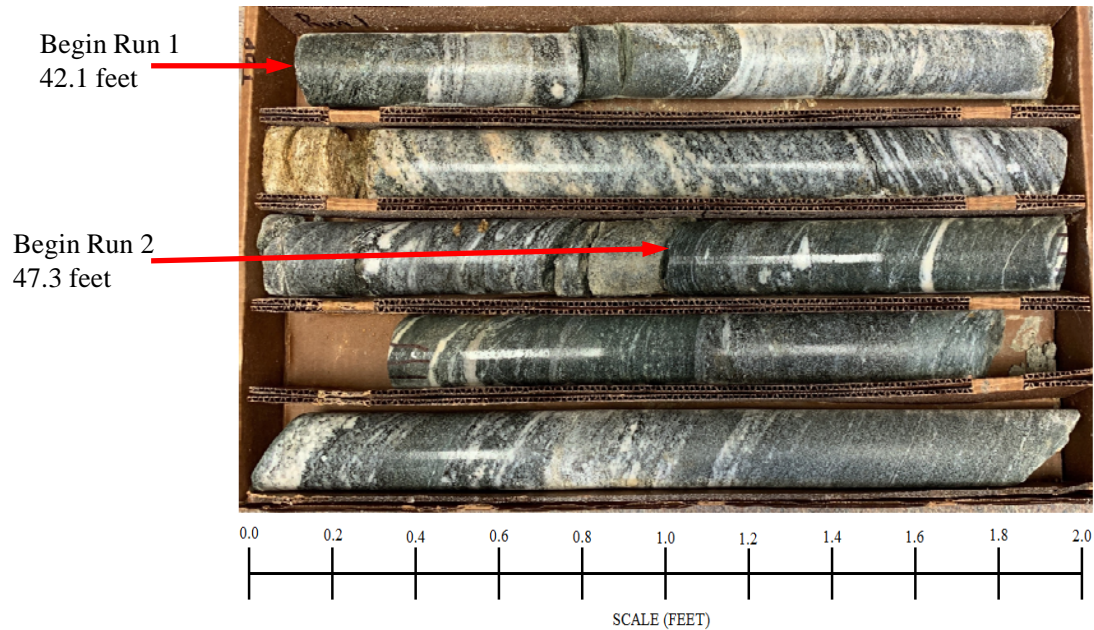
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# APPENDIX

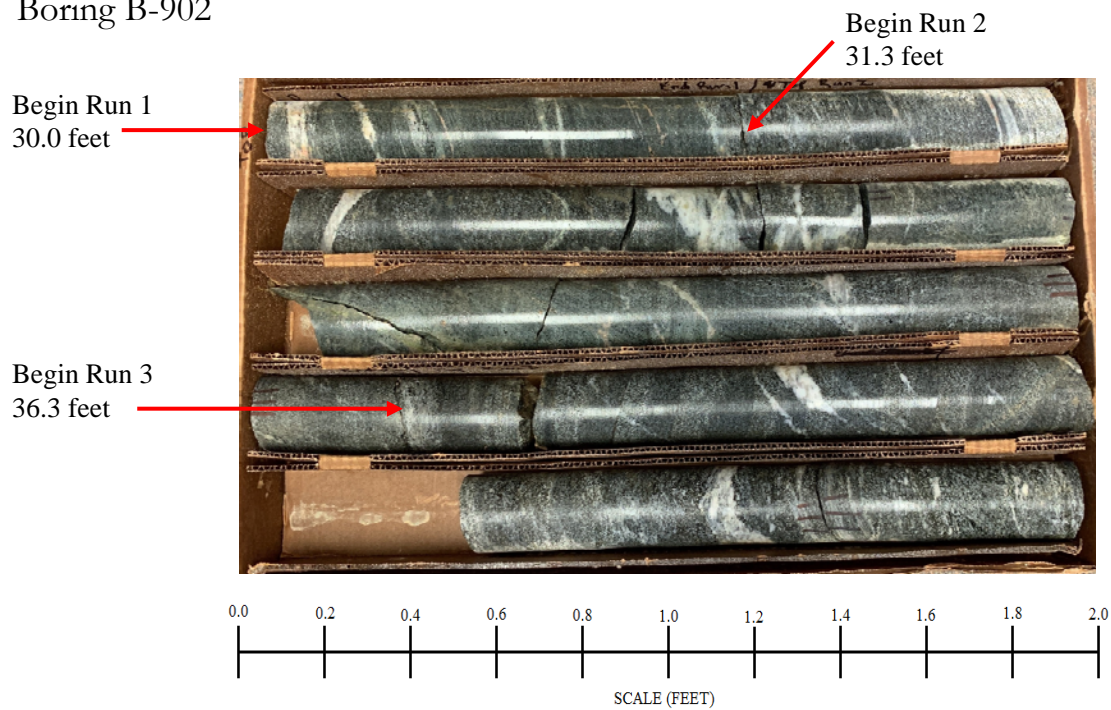
## SECTION 6 ROCK CORE PHOTOS

# S-1-218 RBO Branch of Penny Creek

## Boring B-901



## Boring B-902



# S-1-218 Replacement Bridge over Branch of Penny Creek

## Geotechnical Base Line Report

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# APPENDIX

## SECTION 7      LABORATORY TEST RESULTS



# SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-901	10.0	29	24	5	19	63	ML	32.0			
B-901	15.0				4.76	7		29.1			
B-901	20.0				4.76	5					
B-901	25.0	NP	NP	NP	4.76	15	SM	31.6			
B-901	30.0				4.76	18		24.8			
B-902	4.0	43	34	9				23.3			
B-902	10.0	36	31	5	4.76	68	ML	26.6			
B-902	15.0				4.76	14					
B-902	20.0				4.76	5		13.4			



## Rock Coring Summary

Project ID: P038056

Project Name: S-1-218 RBO Branch of Penny Creek

Project County: Abbeville

Borehole	Core Run Number	Core Run Top Depth (ft)	REC (%)	RQD (%)	q <sub>u</sub> (psi)	Poisson's Ratio	Elastic Modulus (ksi)	Unit Weight (pcf)	RMR
									GSI
B-901	NQ-1	42.1	92	73	11,503	0.31	7.60E+03	175	41
									20-30
	NQ-2	47.3	87	87	8,330	0.19	6.40E+03	176	69
									45-55
	NQ-1	30.0	90	90	14,639	0.28	1.09E+04	184	72
									45-55
	NQ-2	31.3	97	97	N/A	N/A	N/A	N/A	65
									45-55
	NQ-3	36.3	84	76	12,787	0.45	8.40E+03	176	55
									45-55

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

**MOISTURE CONTENT DETERMINATION**  
**(AASHTO T265)**

**PROJECT:** S-1-218 Replcament Bridge over Branch of Penny Creek

**PROJECT NO.:** P038056

**SAMPLE NUMBER:** 19-1699

**DATE SAMPLE RECEIVED:** 7/5/2019

**DESCRIPTION OF SOIL:** VARIOUS

**TESTED BY:** AMC

**DATE OF TESTING:** 7/30/2019

**WEIGHED BY:** AMC

**DATE OF WEIGHING:** 8/2/2019

<b>BORING NO.</b>	B-901	B-901	B-901	B-901	
<b>SAMPLE NO.</b>	SS-5	SS-6	SS-8	SS-9	
<b>SAMPLE DEPTH</b>	8-10'	13.5-15'	23.5-25'	28.5-30'	
<b>WATER CONTENT, W%</b>	32.0	29.1	31.6	24.8	

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

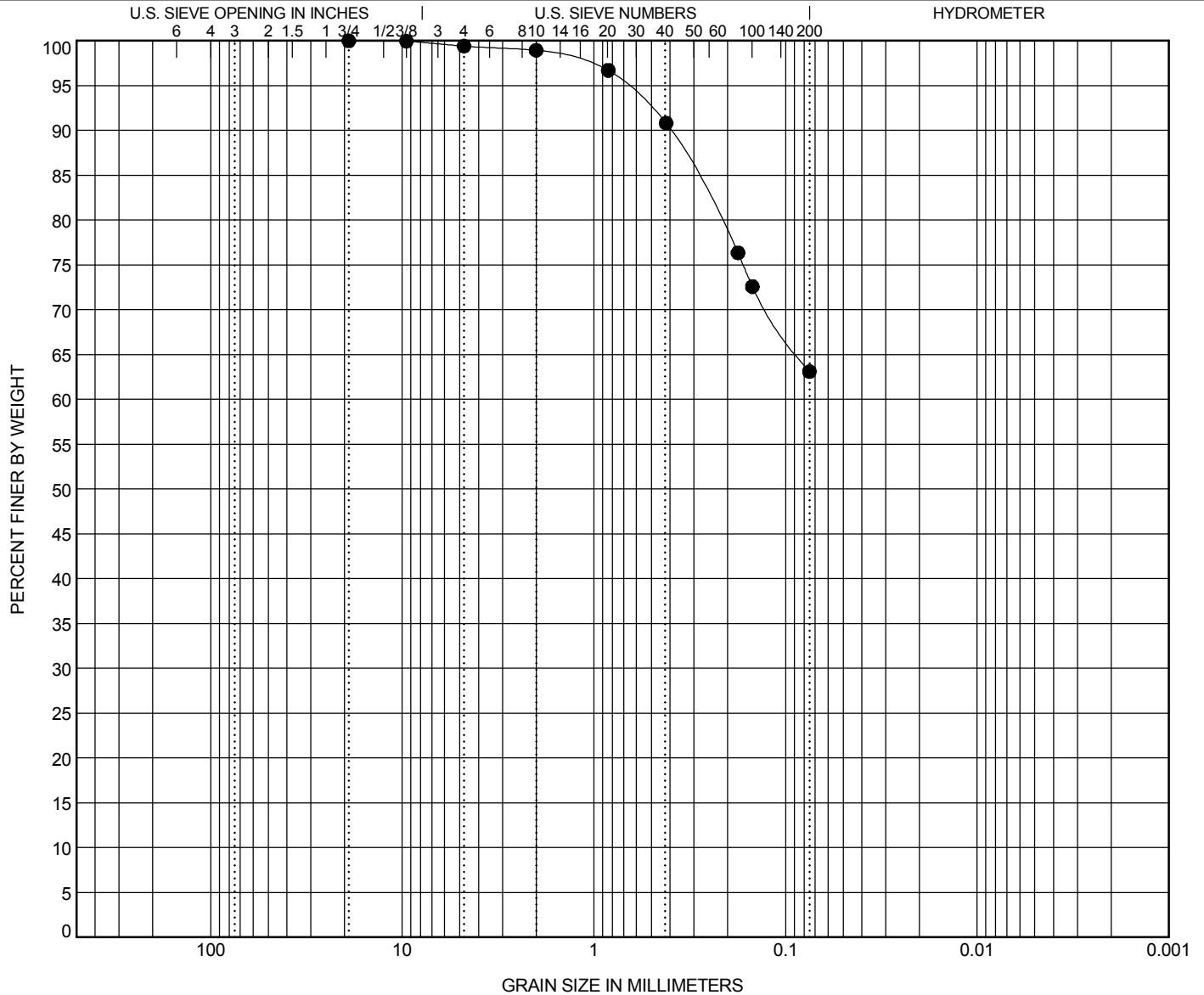


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville





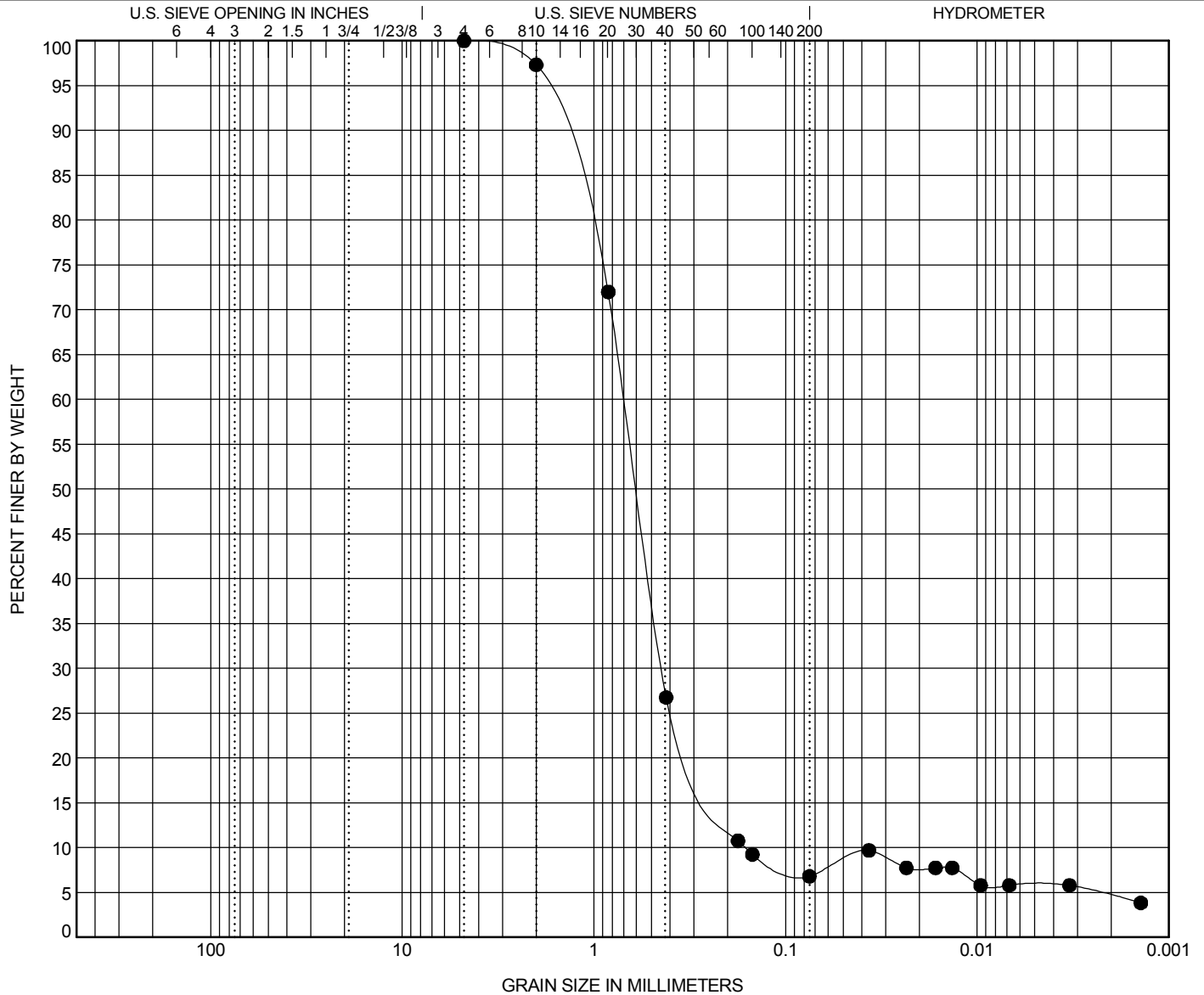


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-901	15.0	SAND (SP-SM) with Silt								4.90	12.30
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-901	15.0	4.76	1.847	0.6	0.057	0.0	93.2	1.0	5.8		

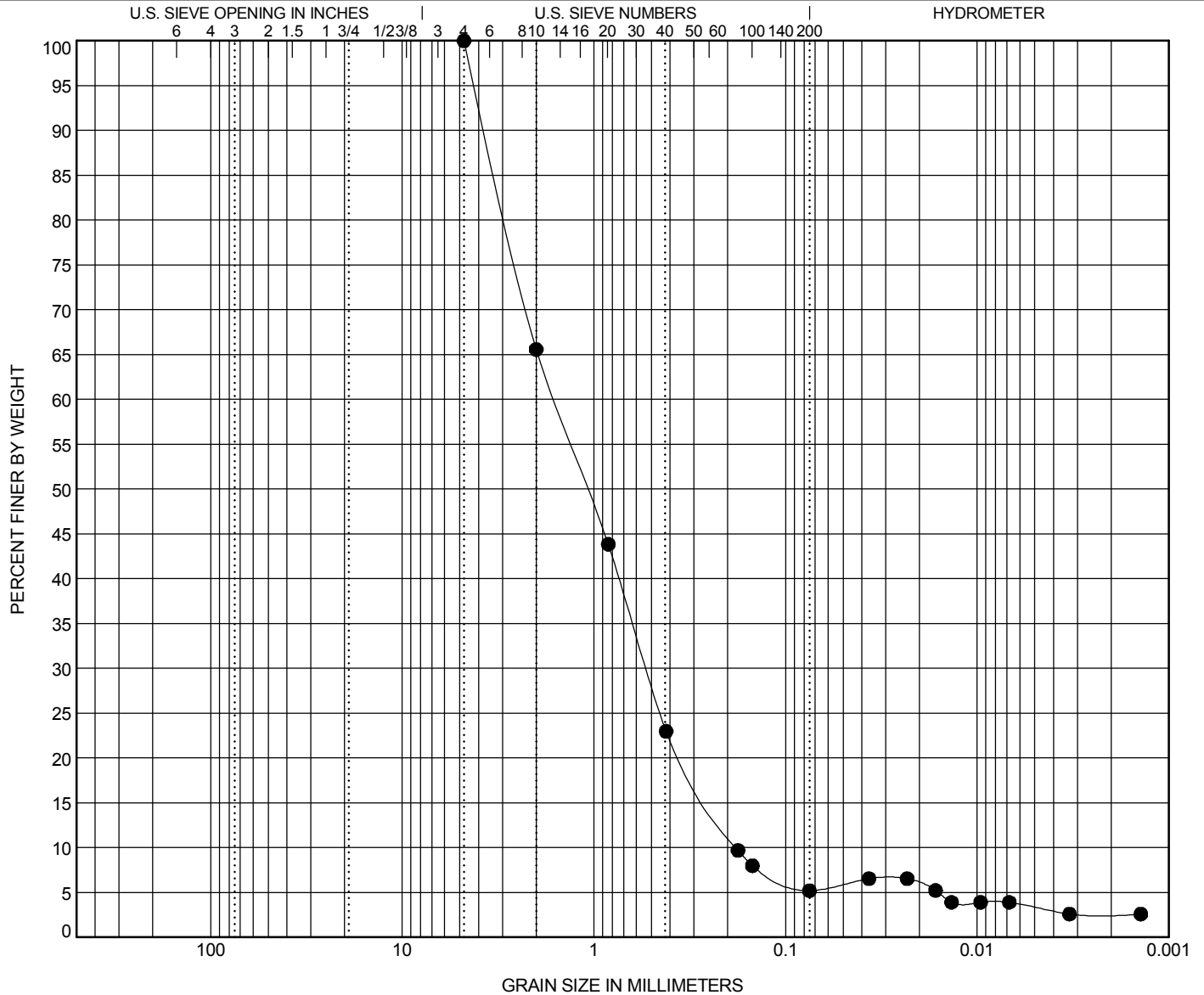


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-901	20.0	SAND (SP-SM) with Silt								0.97	8.87
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-901	20.0	4.76	4.197	1.075	0.181	0.1	94.7	1.9	3.4		

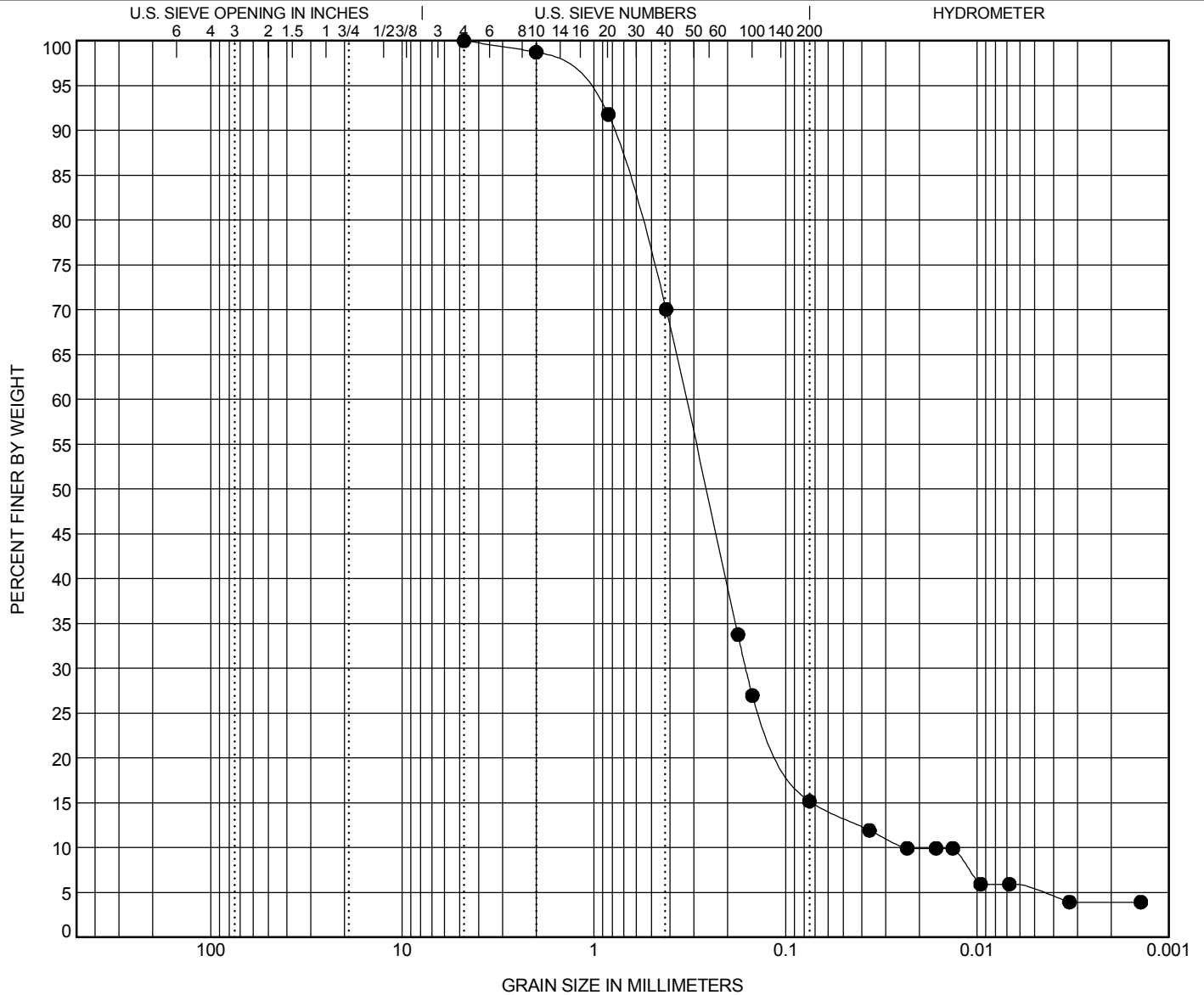


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-901	25.0	Silty SAND (SM/A-2-4)					NP	NP	NP	3.32	14.04
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-901	25.0	4.76	1.253	0.261	0.024	0.0	84.8	10.1	5.1		

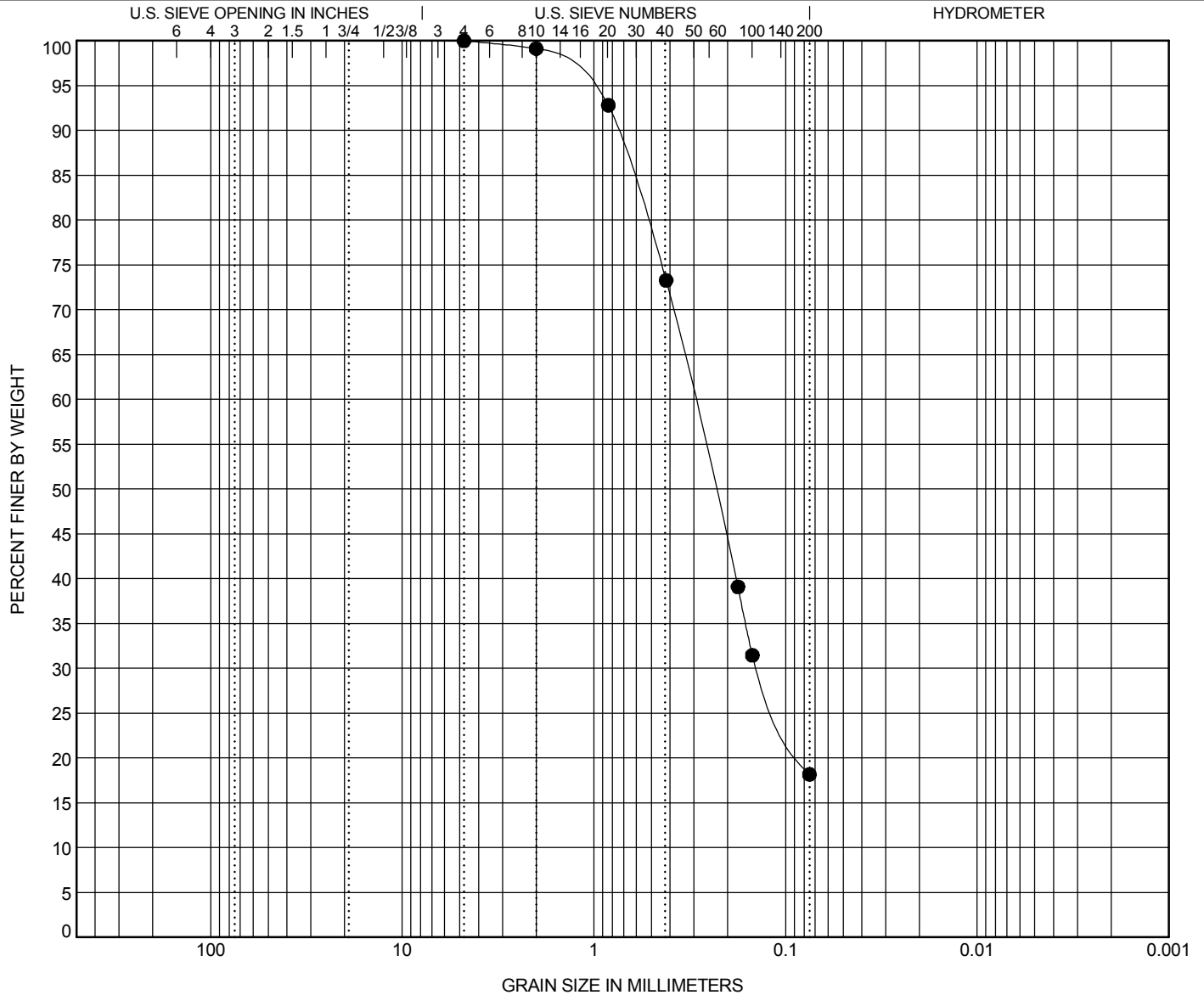


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

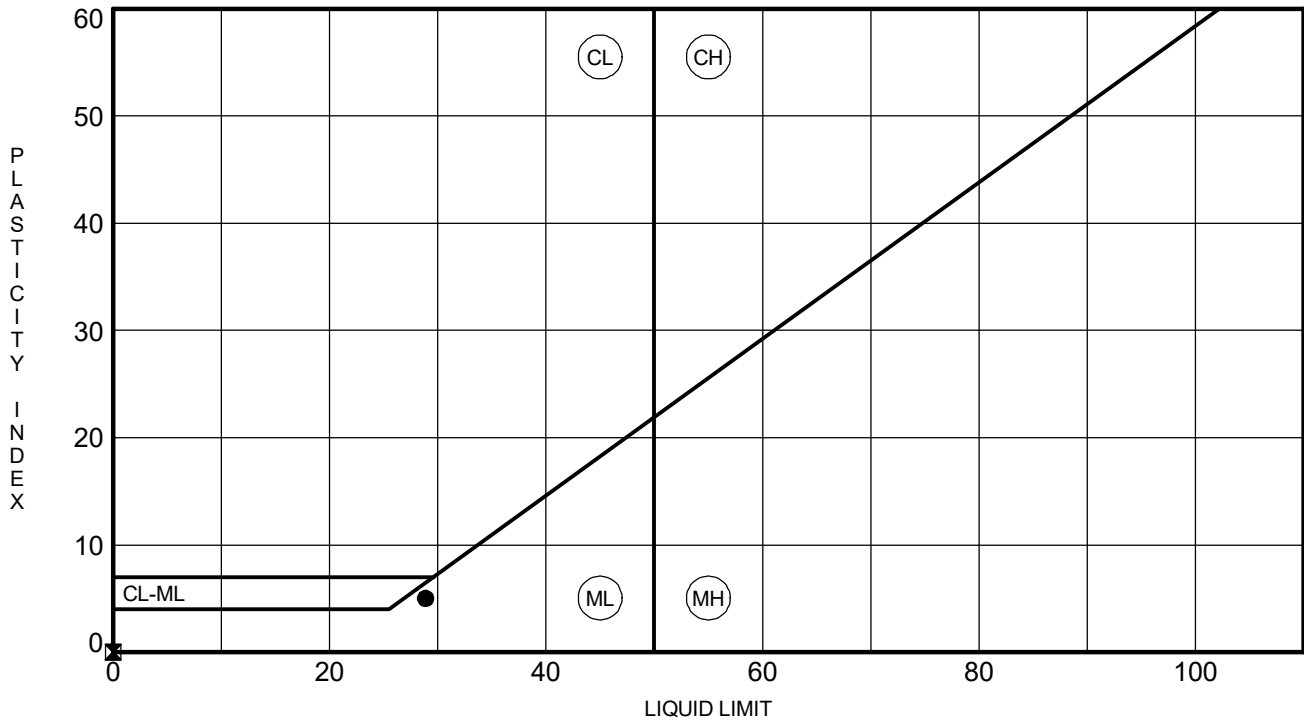
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-901	30.0	Silty SAND (SM)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-901	30.0	4.76	1.133	0.233		0.0	81.8	18.2			

## ATTERBERG LIMITS' RESULTS

**PROJECT ID** P038056

**PROJECT NAME** S-1-218 Replacement Bridge over Branch of Penny Creek

**PROJECT COUNTY** Abbeville

[illegible]

**Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression**  
**ASTM D7012-14e1 (D) / D4543-08e1**

Client F&ME Consultants  
 Client Project G6100.050 - Load Restricted Bridge Projects  
 Project Number 42140

Boring G6100.050.00001 - Penny Creek  
 Depth 42.3' - 42.6'  
 Sample RC-901.1  
 Lab ID number 42140001

Description: Gray Granite  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

**Method of Calculating Young's Modulus from Axial Stress-Strain Curve**

**Average Modulus** - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Axial Strain	Diametric Strain	Axial Stress psi
5.96E-04	-2.08E-04	5749
2.23E-04	-9.28E-05	2901

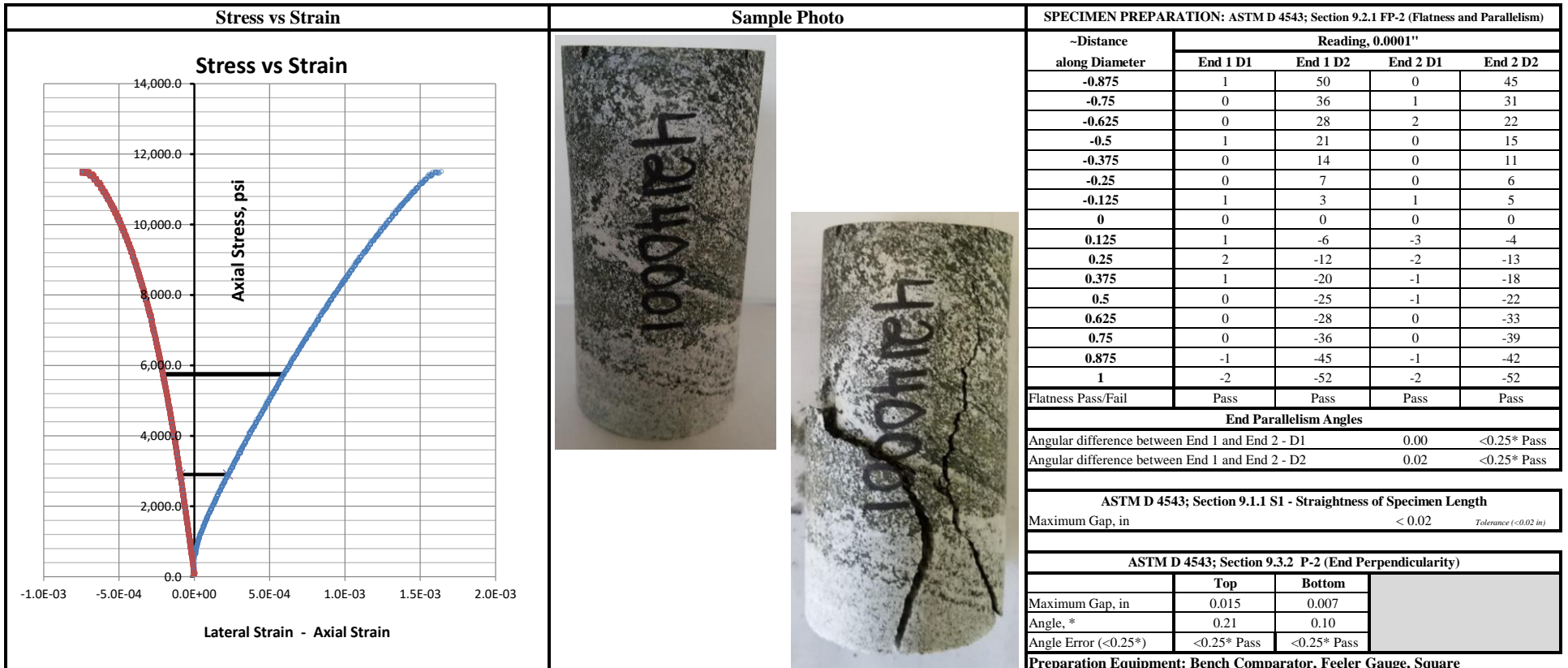
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.137
Mid Height Diameter #1, in	1.868
Mid Height Diameter #2, in	1.867
Average Mid. Height Diameter, in.	1.87
Sample Area, in <sup>2</sup>	2.74
<b>L/D Ratio (2.0-2.5)</b>	<b>2.22</b>

Test Parameters		
	Test Temperature	Room
	Moisture Condition	As-Received
	Sample Weight, gms	521.42
	Sample Volume, cc	186
	Wet Density, pcf	175

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	31509
<b>Unconfined Compressive Strength, psi</b>	<b>11,503</b>
<b>Youngs Modulus, E psi</b>	<b>7.6 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-24.6 E+06</b>
<b>Poisson's Ratio</b>	<b>0.31</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/24/2019

**Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression**  
**ASTM D7012-14e1 (D) / D4543-08e1**

Client F&ME Consultants  
 Client Project G6100.050 - Load Restricted Bridge Projects  
 Project Number 42140

Boring G6100.050.00001 - Penny Creek  
 Depth 48.4' - 48.7'  
 Sample RC-901.2  
 Lab ID number 42140002

Description: Gray Granite  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

**Method of Calculating Young's Modulus from Axial Stress-Strain Curve**

**Average Modulus** - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Axial Strain	Diametric Strain	Axial Stress psi
6.67E-04	-1.05E-04	4132
3.41E-04	-4.29E-05	2036

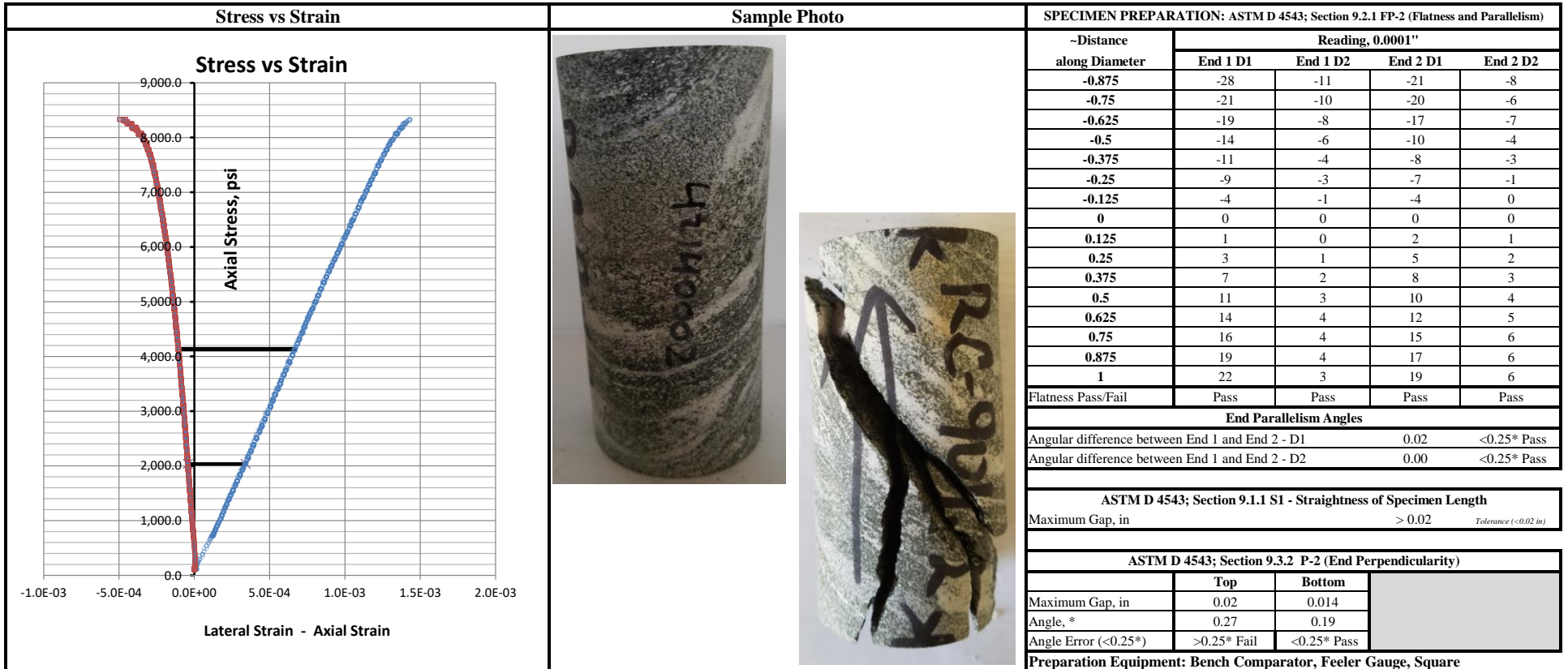
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.181
Mid Height Diameter #1, in	1.872
Mid Height Diameter #2, in	1.873
Average Mid. Height Diameter, in.	1.87
Sample Area, in <sup>2</sup>	2.75
<b>L/D Ratio (2.0-2.5)</b>	<b>2.23</b>

Test Parameters		
	Test Temperature	Room
	Moisture Condition	As-Received
	Sample Weight, gms	532.49
	Sample Volume, cc	189
	Wet Density, pcf	176

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	22938
<b>Unconfined Compressive Strength, psi</b>	<b>8,330</b>
<b>Youngs Modulus, E psi</b>	<b>6.4 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-33.7 E+06</b>
<b>Poisson's Ratio</b>	<b>0.19</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019



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

**MOISTURE CONTENT DETERMINATION**  
**(AASHTO T265)**

**PROJECT:** S-1-218 Replcament Bridge over Branch of Penny Creek

**PROJECT NO.:** P038056

**SAMPLE NUMBER:** 19-1701

**DATE SAMPLE RECEIVED:** 7/5/2019

**DESCRIPTION OF SOIL:** VARIOUS

**TESTED BY:** AMC

**DATE OF TESTING:** 7/30/2019

**WEIGHED BY:** AMC

**DATE OF WEIGHING:** 8/2/2019

<b>BORING NO.</b>	B-902	B-902	B-902		
<b>SAMPLE NO.</b>	SS-2	SS-5	SS-7		
<b>SAMPLE DEPTH</b>	2-4'	8-10'	18.5-20'		
<b>WATER CONTENT, W%</b>	23.3	26.6	13.4		

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

<b>BORING NO.</b>					
<b>SAMPLE NO.</b>					
<b>SAMPLE DEPTH</b>					
<b>WATER CONTENT, W%</b>					

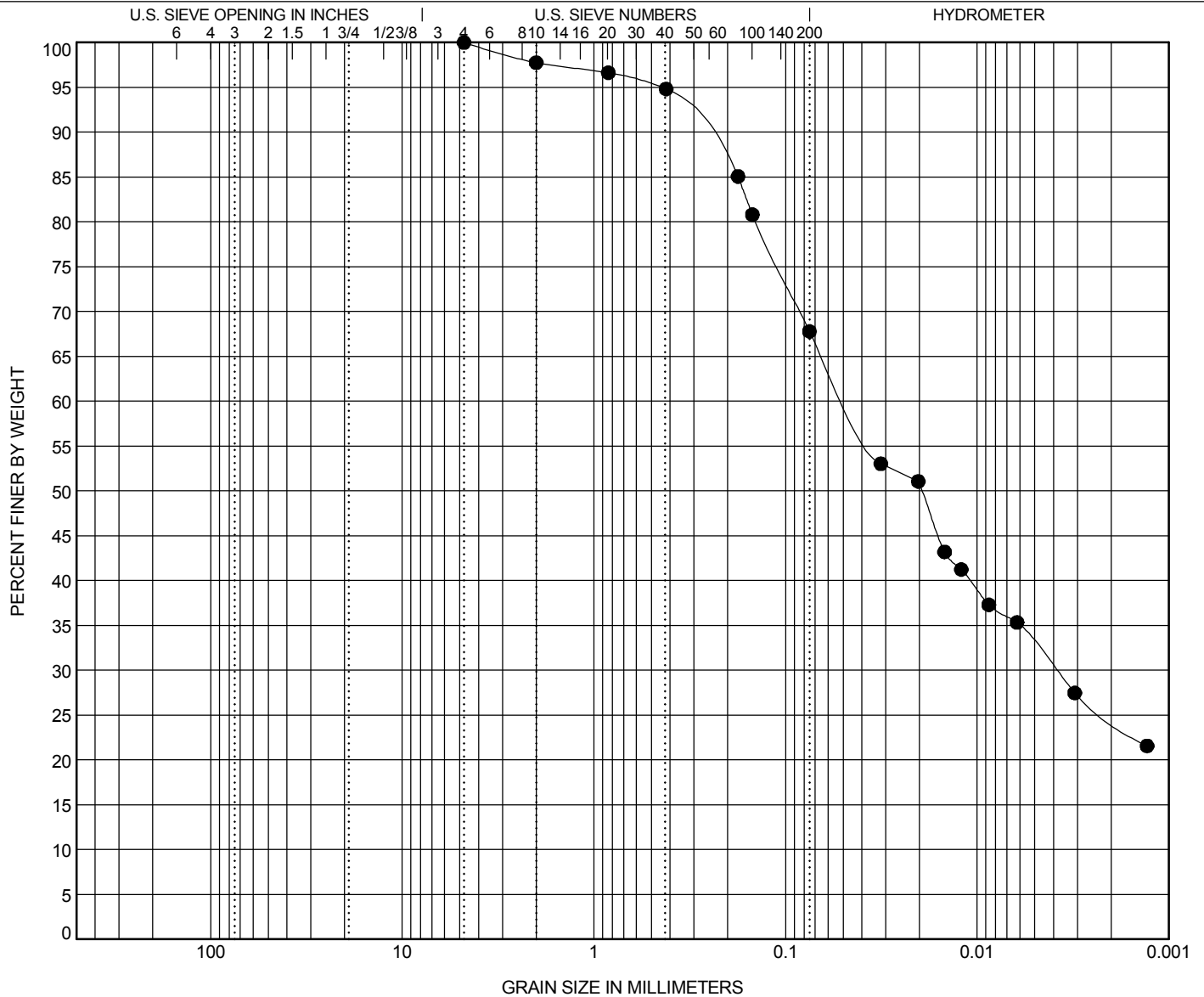


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-902	10.0	Sandy SILT (ML/A-4(3))					36	31	5		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-902	10.0	4.76	0.449	0.019		0.0	32.2	34.9	32.9		

GRAIN SIZE G6100.05.01 RBO BRANCH OF PENNY CREEK.GPJ FME2017.GDT 9/10/19

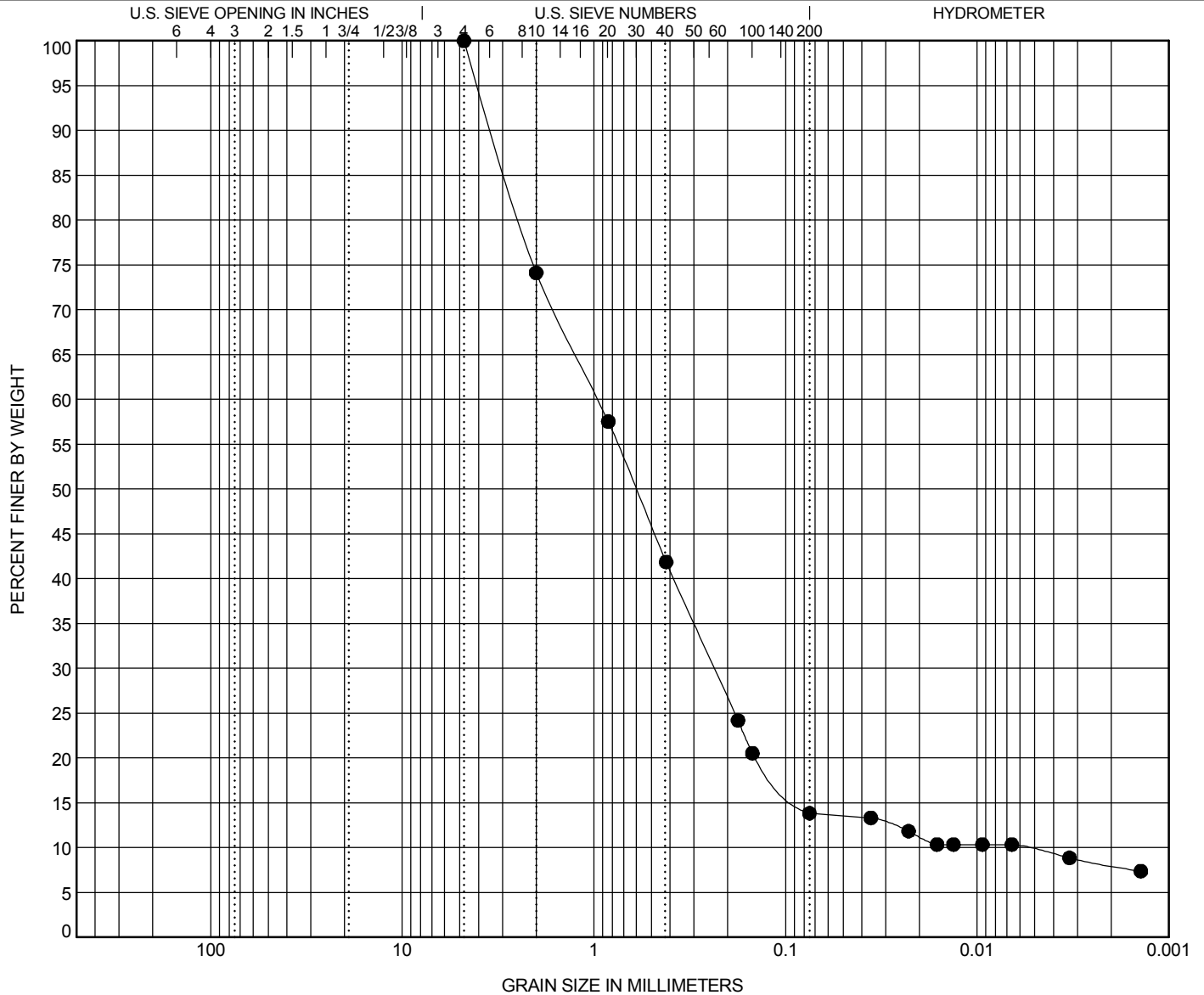


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-902	15.0	Silty SAND (SM)								10.34	171.27
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-902	15.0	4.76	4.026	0.602	0.006	0.1	86.1	4.1	9.8		

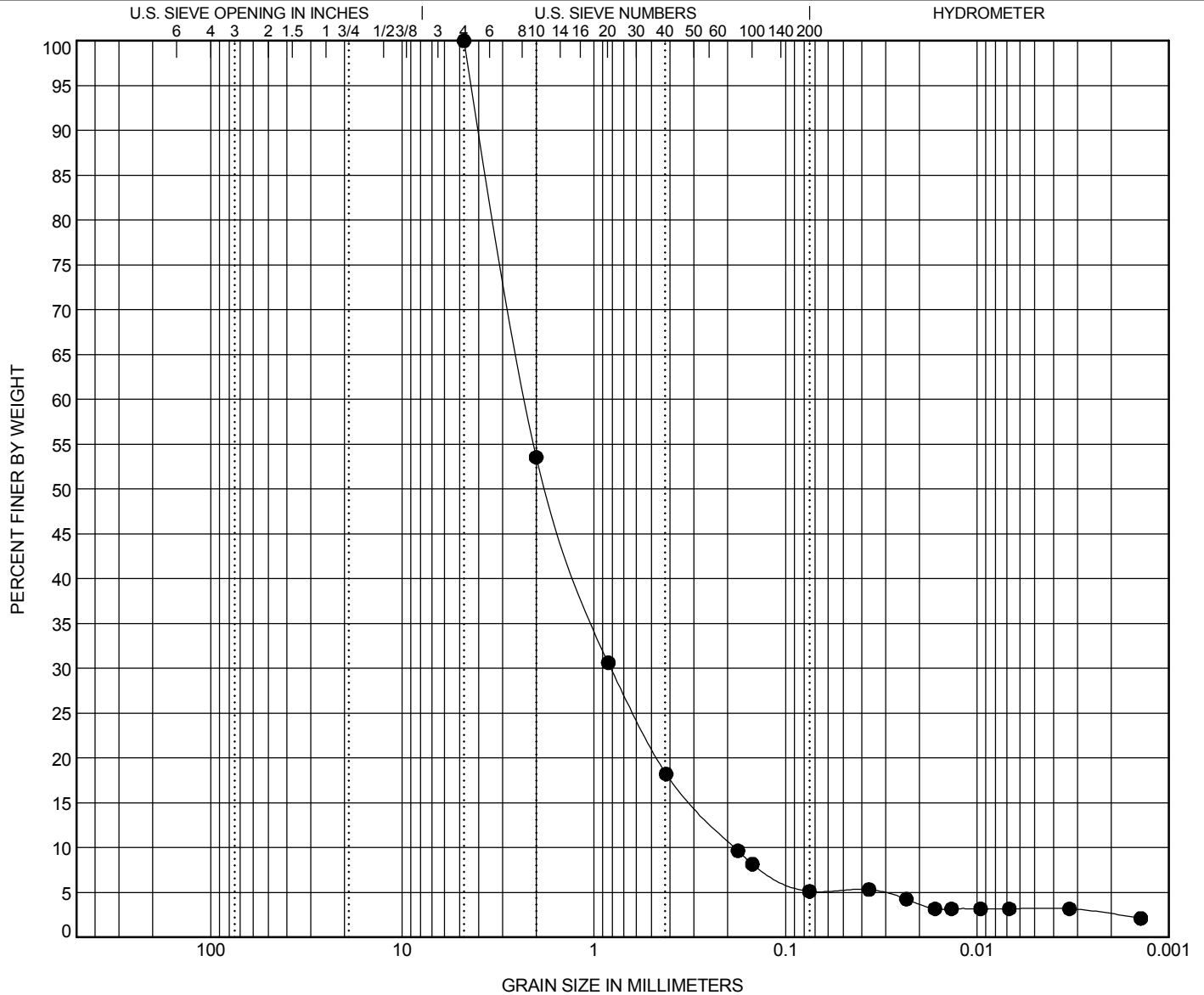


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038056

PROJECT NAME S-1-218 Replacement Bridge over Branch of Penny Creek

PROJECT COUNTY Abbeville



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

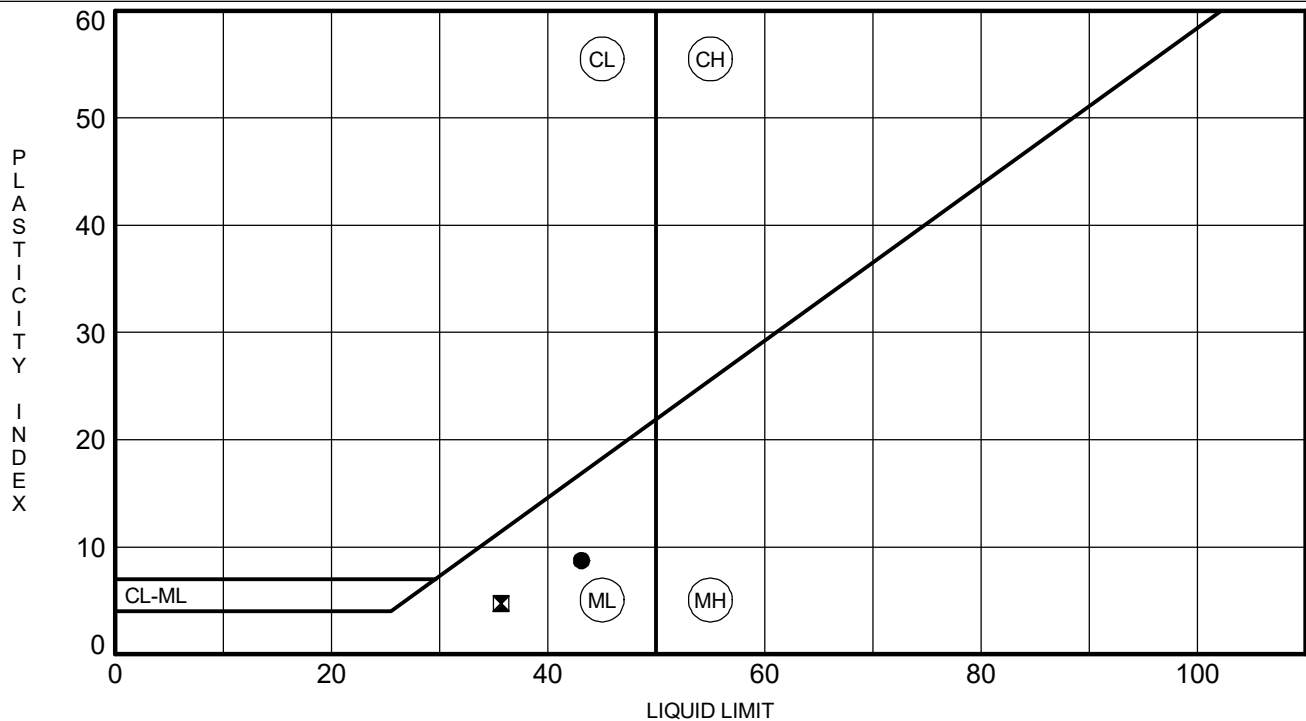
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-902	20.0	SAND (SP)								1.59	12.31
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-902	20.0	4.76	4.336	1.749	0.183	0.1	94.8	1.9	3.2		

## ATTERBERG LIMITS' RESULTS

**PROJECT ID** P038056

**PROJECT NAME** S-1-218 Replacement Bridge over Branch of Penny Creek

**PROJECT COUNTY** Abbeville

[illegible]

**Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression**  
**ASTM D7012-14e1 (D) / D4543-08e1**

Client F&ME Consultants  
 Client Project G6100.050 - Load Restricted Bridge Projects  
 Project Number 42140

Boring G6100.050.00001 - Penny Creek  
 Depth 30.2' - 30.5'  
 Sample RC-902.3  
 Lab ID number 42140003

**Method of Calculating Young's Modulus from Axial Stress-Strain Curve**

**Average Modulus** - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Description: Gray Granite  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
6.62E-04	-2.24E-04	7408
3.13E-04	-1.25E-04	3618

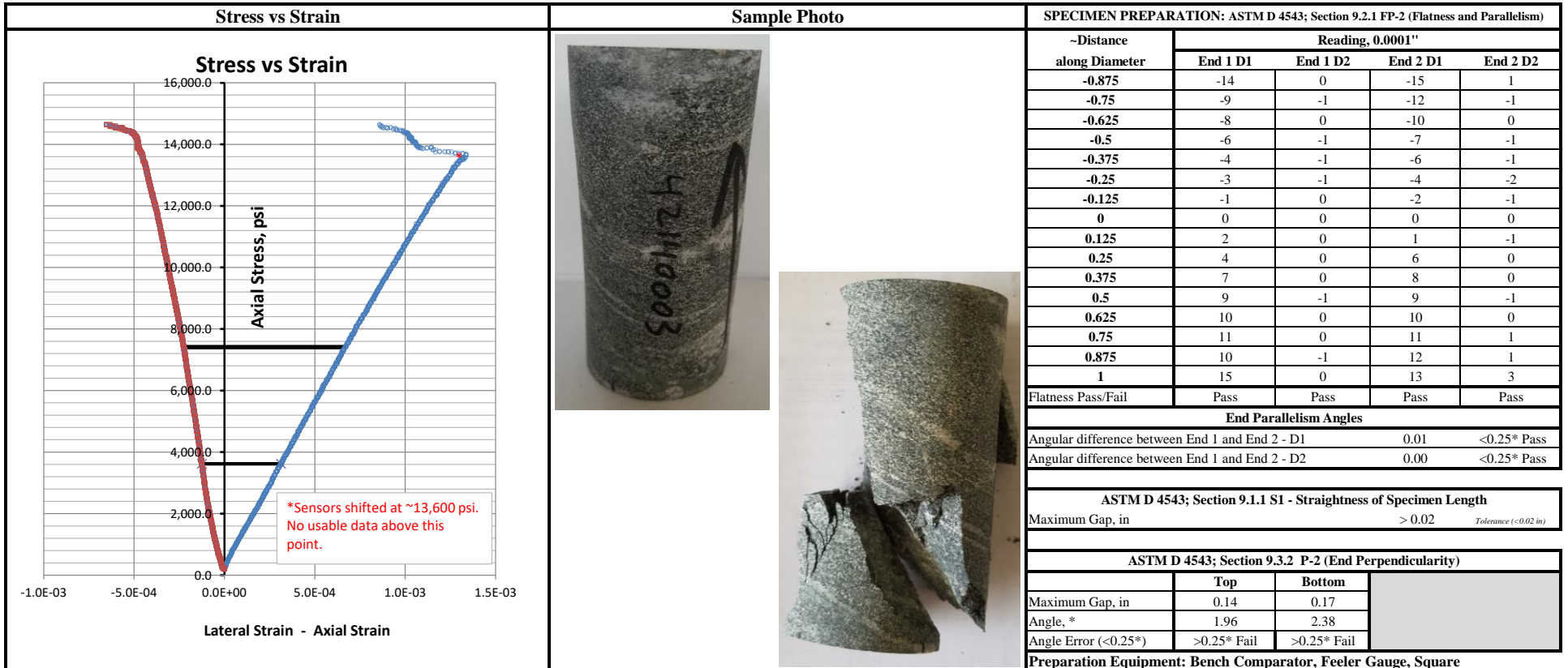
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.083
Mid Height Diameter #1, in	1.867
Mid Height Diameter #2, in	1.864
Average Mid. Height Diameter, in.	1.87
Sample Area, in <sup>2</sup>	2.73
<b>L/D Ratio (2.0-2.5)</b>	<b>2.19</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	538.57	
Sample Volume, cc	183	
Wet Density, pcf	184	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	40012
<b>Unconfined Compressive Strength, psi</b>	<b>14,639</b>
<b>Youngs Modulus, E psi</b>	<b>10.9 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-38.5 E+06</b>
<b>Poisson's Ratio</b>	<b>0.28</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019

**Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression**  
**ASTM D7012-14e1 (D) / D4543-08e1**

Client F&ME Consultants  
 Client Project G6100.050 - Load Restricted Bridge Projects  
 Project Number 42140  
 Description: Gray Granite  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

Boring G6100.050.00001 - Penny Creek  
 Depth 36.8' - 37.1'  
 Sample RC-902.4  
 Lab ID number 42140004

**Method of Calculating Young's Modulus from Axial Stress-Strain Curve**

**Average Modulus** - Linear Portion of Axial Stress Strain Curve

Manually selected by lab at 25% and 50% of the total Compressive strength (psi) - other values possible

Axial Strain	Diametric Strain	Axial Stress psi
6.36E-04	-2.59E-04	6289
2.66E-04	-9.42E-05	3180

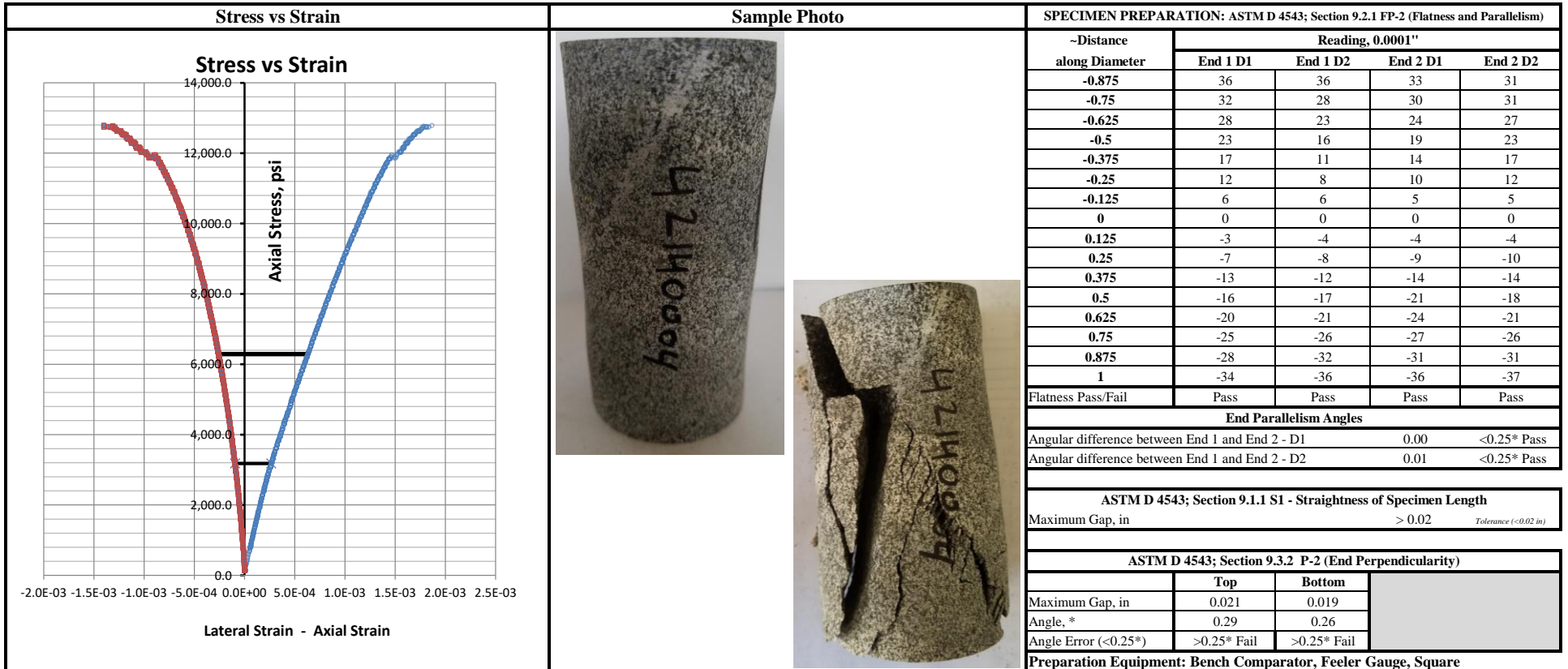
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.165
Mid Height Diameter #1, in	1.865
Mid Height Diameter #2, in	1.851
Average Mid. Height Diameter, in.	1.86
Sample Area, in <sup>2</sup>	2.71
<b>L/D Ratio (2.0-2.5)</b>	<b>2.24</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	521.14	
Sample Volume, cc	185	
Wet Density, pcf	176	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	34670
<b>Unconfined Compressive Strength, psi</b>	<b>12,787</b>
<b>Youngs Modulus, E psi</b>	<b>8.4 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-18.8 E+06</b>
<b>Poisson's Ratio</b>	<b>0.45</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/25/2019



### Corrosivity Testing

Client F&ME Consultants  
 Client Project G6100.050 Load Restricted Bridge Package 2020-1  
 Project No. 42301

Lab Sample ID	Boring	Depth	Sample	Matrix	pH AASHTO T289			Chloride AASHTO T291 (Method B)			Sulfate AASHTO T290 (Method B)			Min. Soil Resistivity AASHTO T288		
					Result	Date Tested	Tested By	Result mg/kg (ppm)	Date Tested	Tested By	Result mg/kg (ppm)	Date Tested	Tested By	Result, Ohm-cm	Date Tested	Tested By
42301013	G6100.050.00001	B-901	0.0' - 10.0'	Soil	5.3	8/27/2019	AMP	75	8/29/2019	AMP	<30	8/28/2019	AMP	16,500	8/27/2019	AMP
42301014	G6100.050.00002	B-802	0.0' - 10.0'	Soil	5.4	8/27/2019	AMP	47	8/29/2019	AMP	<30	8/28/2019	AMP	9,850	8/27/2019	AMP
42301015	G6100.050.00003	B-1001	0.0' - 10.0'	Soil	5.7	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	16,500	8/27/2019	AMP
42301016	G6100.050.00004	B-602	0.0' - 10.0'	Soil	5.6	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	15,500	8/27/2019	AMP
42301017	G6100.050.00005	B-501	0.0' - 10.0'	Soil	6.0	8/27/2019	AMP	75	8/29/2019	AMP	<30	8/28/2019	AMP	4,900	8/27/2019	AMP
42301018	G6100.050.00006	B-701	0.0' - 10.0'	Soil	5.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	18,000	8/27/2019	AMP
42301019	G6100.050.00007	B-1202	0.0' - 10.0'	Soil	5.5	8/27/2019	AMP	38	8/29/2019	AMP	88	8/28/2019	AMP	1,700	8/27/2019	AMP
42301020	G6100.050.00008	B-1602	0.0' - 10.0'	Soil	6.1	8/27/2019	AMP	136	8/29/2019	AMP	<30	8/28/2019	AMP	3,500	8/27/2019	AMP
42301021	G6100.050.00009	B-402	0.0' - 10.0'	Soil	5.9	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	10,500	8/29/2019	AMP
42301022	G6100.050.00010	B-301	0.0' - 10.0'	Soil	7.5	8/27/2019	AMP	40	8/29/2019	AMP	28	8/28/2019	AMP	2,200	8/29/2019	AMP
42301023	G6100.050.00011	B-202	0.0' - 10.0'	Soil	5.9	8/27/2019	AMP	<10	8/29/2019	AMP	36	8/28/2019	AMP	7,200	8/29/2019	AMP
42301024	G6100.050.00012	B-101	0.0' - 10.0'	Soil	6.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	6,000	8/29/2019	AMP
42301025	G6100.050.00013	B-1302	0.0' - 10.0'	Soil	4.9	8/27/2019	AMP	40	8/29/2019	AMP	<30	8/28/2019	AMP	8,500	8/28/2019	AMP
42301026	G6100.050.000014	B-1402	0.0' - 10.0'	Soil	5.2	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	11,000	8/28/2019	AMP
42301027	G6100.050.00015	B-1501	0.0' - 10.0'	Soil	5.8	8/27/2019	AMP	<10	8/29/2019	AMP	<30	8/28/2019	AMP	11,000	8/28/2019	AMP
42301028	G6100.050.00016	B-1102	0.0' - 10.0'	Soil	5.7	8/27/2019	AMP	78	8/29/2019	AMP	<30	8/28/2019	AMP	5,200	8/28/2019	AMP

Input Validation: AMP

Reviewed By: ALO