



REVISED

## **GEOTECHNICAL BASE LINE REPORT**

Route S-41-37 Replacement Bridge over Rocky Creek  
Saluda 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: P038307

F&ME Project #: G6100.05.15

**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-41-37 Bridge over Rocky Creek  
Saluda County, South Carolina  
SCDOT Project ID: P038307  
F&ME Project No.: G6100.050.15

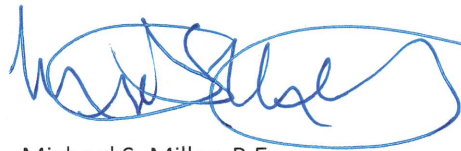
Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc. (FME) revised Geotechnical Base Line Report (GBLR) for the Route S-41-37 Replacement Bridge over Rocky Creek. Revisions to our previously submitted report include the correct state route numerical designation and 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 horizontal line.

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-41-37 Replacement Bridge over Rocky Creek located in Saluda 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 July 11 through 15, 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-1501	Paved Roadway	18.5	10.6	29.1	33.892035	-81.851602	472.1
B-1502	Paved Roadway	13.2	10.4	23.6	33.891924	-81.851711	472.4
Totals	-	31.7	21.0	52.7			



## 2.2 Groundwater

Groundwater depths were recorded at the time of boring (TOB) for soil test borings B-1501 and B-1502, 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-1501	7/11/2019	8.0	8.1
B-1502	7/15/2019	7.2	8.2

## 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. XXX (X) 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
Atterberg Limits	4	AASHTO T89/T90
Natural Moisture Content	6	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	441	0	ML	9	-
Residuum	439	2	SM, ML, CL	13	-
PWR	431	10		100+	-
Bed Rock	430	11	N/A	N/A	Meta-Tuff

## 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 may 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 insufficient to resist the assumed lateral loading conditions and drilled piles may be likely at one or both bridge abutments. Due to relatively shallow depth to PWR and/or rock as indicated by boring B-1401 location, shallow foundation concepts may be feasible at this abutment location due to the estimated bearing depth and given groundwater conditions 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 will not be feasible based on an insufficient soil thickness above rock to resist the lateral loads. As such, we anticipate that drilled shafts will be utilized at 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 from 1,520 psi to 4,245 psi.

# **S-41-37 Replacement Bridge over Rocky 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-41-37 Replacement Bridge over Rocky Creek

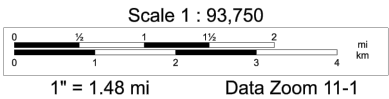
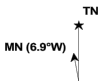
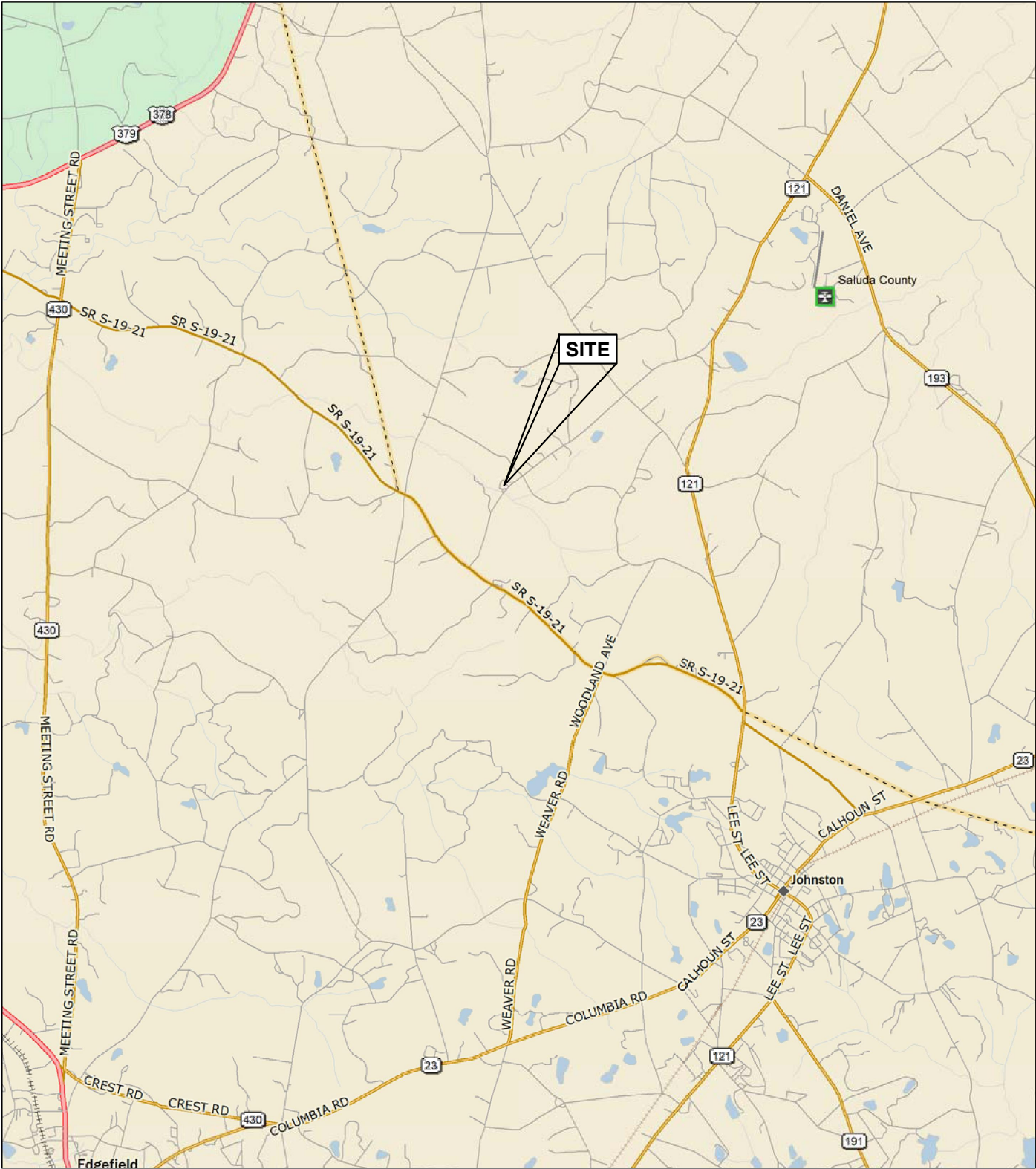
## Geotechnical Base Line Report

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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	SALUDA	P038307	S-41-377	



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	

ROCKY CREEK  
SALUDA COUNTY, SOUTH CAROLINA

SITE LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: AS NOTED

FIGURE 1

# S-41-37 Replacement Bridge over Rocky 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	SALUDA	P038307	S-41-377	



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

ROCKY CREEK  
SALUDA COUNTY, SOUTH CAROLINA

BORING LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: 1"=30'

FIGURE 2



# S-41-37 Replacement Bridge over Rocky Creek

## Geotechnical Base Line Report

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# APPENDIX

## SECTION 3 DRILL RIG PHOTOS

# Drill Rig Setup Photographs

B-1501



# Drill Rig Setup Photographs

B-1502



# Drill Rig Setup Photographs

# **S-41-37 Replacement Bridge over Rocky 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

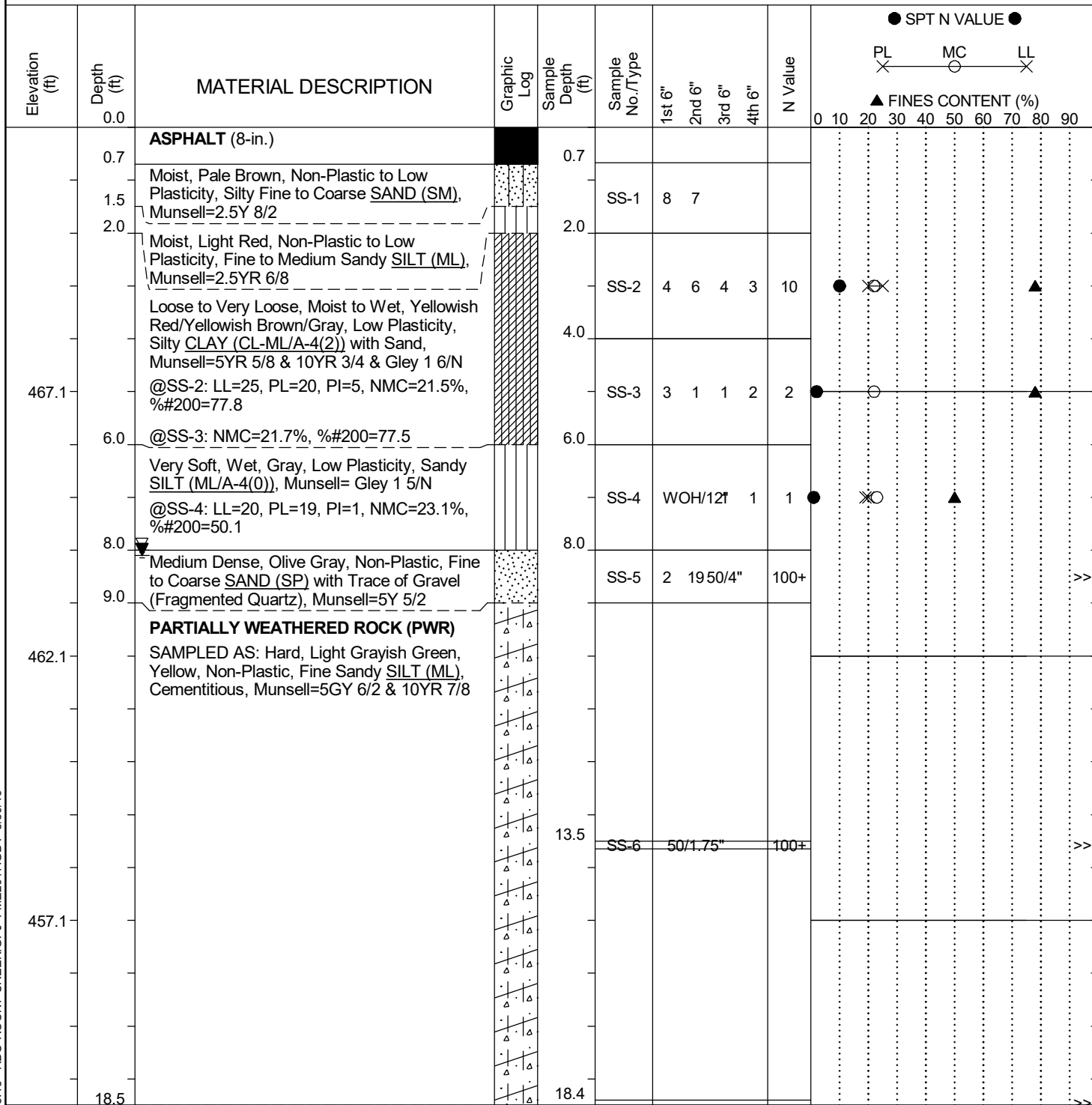
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS  (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS  (LITTLE OR NO FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF 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	LIQUID LIMIT LESS THAN 50		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	LIQUID LIMIT GREATER THAN 50		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				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

Project ID: P038307				County: Saluda		Boring No.: B-1501		
Site Description:		S-41-37 Replacment Bridge over Rocky Creek					Route: S-41-37	
Eng./Geo.: M. Touchberry		Boring Location: N/A			Offset: N/A		Alignment: Mainline	
Elev.: 472.1 ft		Latitude: 33.892035		Longitude: -81.851602		Date Started: 7/11/2019		
Total Depth: 29.1 ft		Soil Depth: 18.5 ft		Core Depth: 10.6 ft		Date Completed: 7/11/2019		
Bore Hole Diameter (in): 4		Sampler Configuration			Liner Required: Y (N)		Liner Used: Y (N)	
Drill Machine: CME 45B		Drill Method: RW/RC		Hammer Type: Automatic		Energy Ratio: 92%		
Core Size: NQ/8		Driller: L. Guempel		Groundwater: TOB 8 ft		24HR 8.1 ft		



## LEGEND

Continued Next Page

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

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

# SCDOT Soil Test Log

Project ID: P038307				County: Saluda		Boring No.: B-1501		
Site Description:		S-41-37 Replacment Bridge over Rocky Creek					Route: S-41-37	
Eng./Geo.: M. Touchberry		Boring Location: N/A		Offset: N/A		Alignment: Mainline		
Elev.: 472.1 ft		Latitude: 33.892035		Longitude: -81.851602		Date Started: 7/11/2019		
Total Depth: 29.1 ft		Soil Depth: 18.5 ft		Core Depth: 10.6 ft		Date Completed: 7/11/2019		
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)		
Drill Machine: CME 45B		Drill Method: RW/RC		Hammer Type: Automatic		Energy Ratio: 92%		
Core Size: NQ/8		Driller: L. Guempel		Groundwater: TOB 8 ft		24HR 8.1 ft		

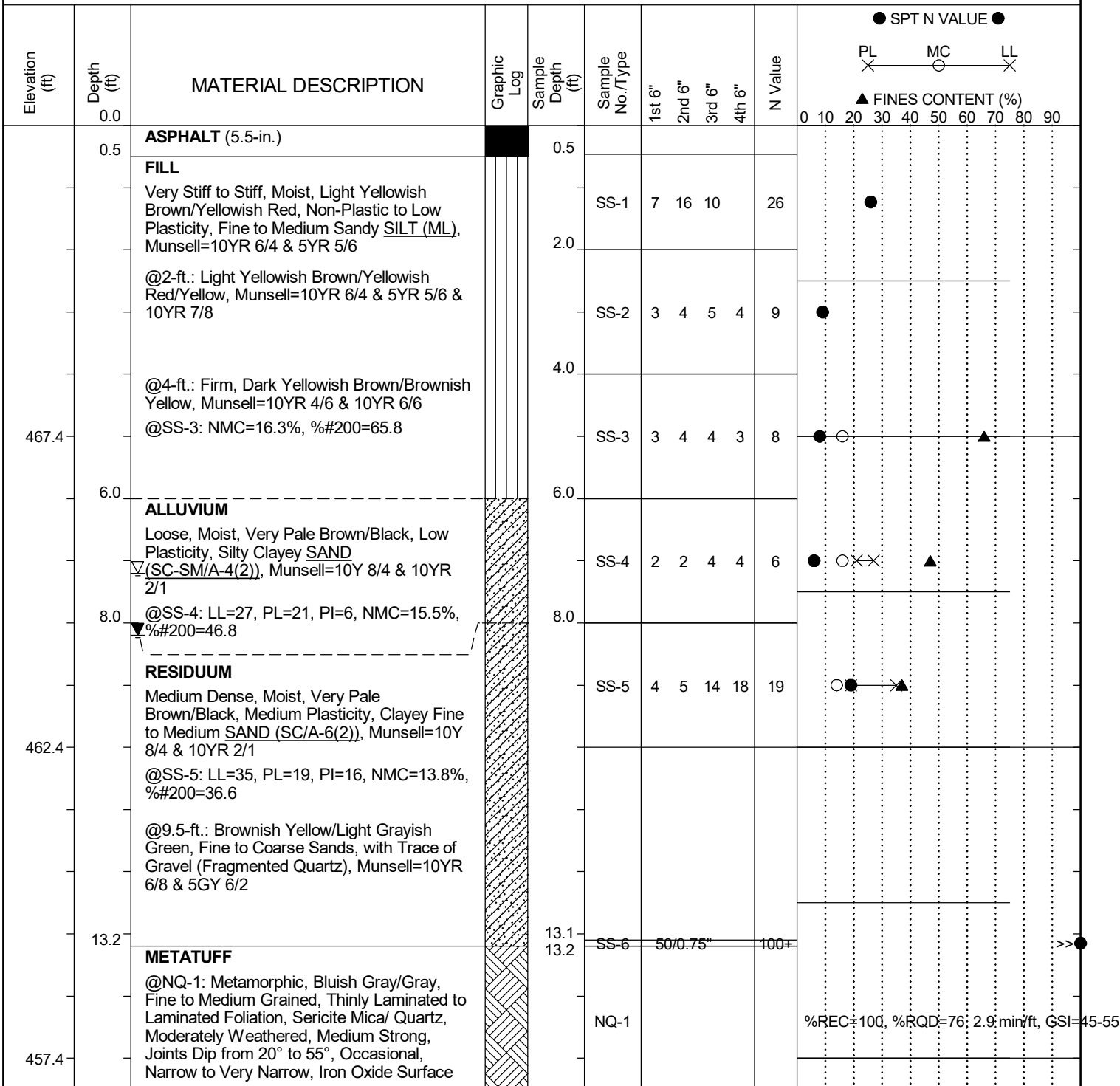
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	<div> <div>● SPT N VALUE ●</div> <div> <div>PL</div> <div>MC</div> <div>LL</div> </div> <div> <div>▲ FINES CONTENT (%)</div> <div>0 10 20 30 40 50 60 70 80 90</div> </div> </div>
452.1		<b>METATUFF</b> @NQ-1: Metamorphic, Bluish Gray/Gray, Fine to Medium Grained, Thinly Laminated to Laminated Foliations, Sericite Mica/Quartz, Moderatley to Slightly Weathered, Weak, Occasional Joints, Joints Dip from 40 to 50 Degrees, Moderatley Wide to Very Narrow, Surface Stain, Iron Oxide, Planar/Stepped, Very Close, Smooth to Slightly Rough, RMR=50, Class III @18.7-ft.: UC Strength=1,826 psi @NQ-2: Highly to Slightly Weathered, Numerous Joints, Joints Dip from 5 to 50 Degrees, RMR=50, Class III @24.7-ft.: UC Strength=1,519 psi		18.5	SS-7	50	0.75			100+	%REC=74, %RQD=32, 3.1 min/ft, GSI=35-45
447.1				21.1	NQ-1						
					NQ-2						%REC=90, %RQD=57, 2.4 min/ft, GSI=40-50
				26.1	NQ-3						%REC=67, %RQD=0, 3.7 min/ft, GSI=10-20
442.1	29.1	Boring Terminated at 29.1 Feet									
437.1											

## 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:	P038307				County:	Saluda		Boring No.:	B-1502	
Site Description:	S-41-37 Replacment Bridge over Rocky Creek							Route:	S-41-37	
Eng./Geo.:	M. Touchberry		Boring Location:	N/A		Offset:	N/A		Alignment:	Mainline
Elev.:	472.4 ft		Latitude:	33.891924		Longitude:	-81.851711		Date Started:	7/11/2019
Total Depth:	23.6 ft		Soil Depth:	13.2 ft		Core Depth:	10.4 ft		Date Completed:	7/15/2019
Bore Hole Diameter (in):	4		Sampler Configuration			Liner Required:	Y (N)		Liner Used:	Y (N)
Drill Machine:	CME 45B		Drill Method:	RW/RC		Hammer Type:	Automatic		Energy Ratio:	92%
Core Size:	NQ/8		Driller:	L. Guempel		Groundwater:	TOB	7.2 ft	24HR	8.2 ft



## LEGEND

Continued Next Page

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

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

# SCDOT Soil Test Log

Project ID: P038307				County: Saluda		Boring No.: B-1502		
Site Description:		S-41-37 Replacment Bridge over Rocky Creek					Route: S-41-37	
Eng./Geo.: M. Touchberry		Boring Location: N/A		Offset: N/A		Alignment: Mainline		
Elev.: 472.4 ft		Latitude: 33.891924		Longitude: -81.851711		Date Started: 7/11/2019		
Total Depth: 23.6 ft		Soil Depth: 13.2 ft		Core Depth: 10.4 ft		Date Completed: 7/15/2019		
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)		
Drill Machine: CME 45B		Drill Method: RW/RC		Hammer Type: Automatic		Energy Ratio: 92%		
Core Size: NQ/8		Driller: L. Guempel		Groundwater: TOB 7.2 ft		24HR 8.2 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
452.4		Stained, Planar/ Irregular, Very Close, Smooth to Slithgly Rough Joints, RMR=61, Class II @14.5-ft.: UC Strength=4,064 psi @NQ-2: Joints Dip from 10° to 60°, Numerous, Calcite Filled/ Partially Filled, RMR=42, Class III		15.6							
					NQ-2						%REC=100, %RQD=45, 6.8 min/ft, GSI=35-45
				20.6							
		@NQ-3: Joints Dip from 15° to 55°, Occasional, Moderately Wide to Narrow, Planar/Stepped/Irregular, RMR=52, Class III			NQ-3						%REC=72, %RQD=33, 6 min/ft, GSI=35-45
		@21.7-ft.: UC Strength=4,245 psi									
23.6		Boring Terminated at 23.6 Feet									
447.4											
442.4											

## 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	

# **S-41-37 Replacement Bridge over Rocky 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-41-37 Bridge Replacement over Rocky Creek)
PROJECT COUNTY	Saluda

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

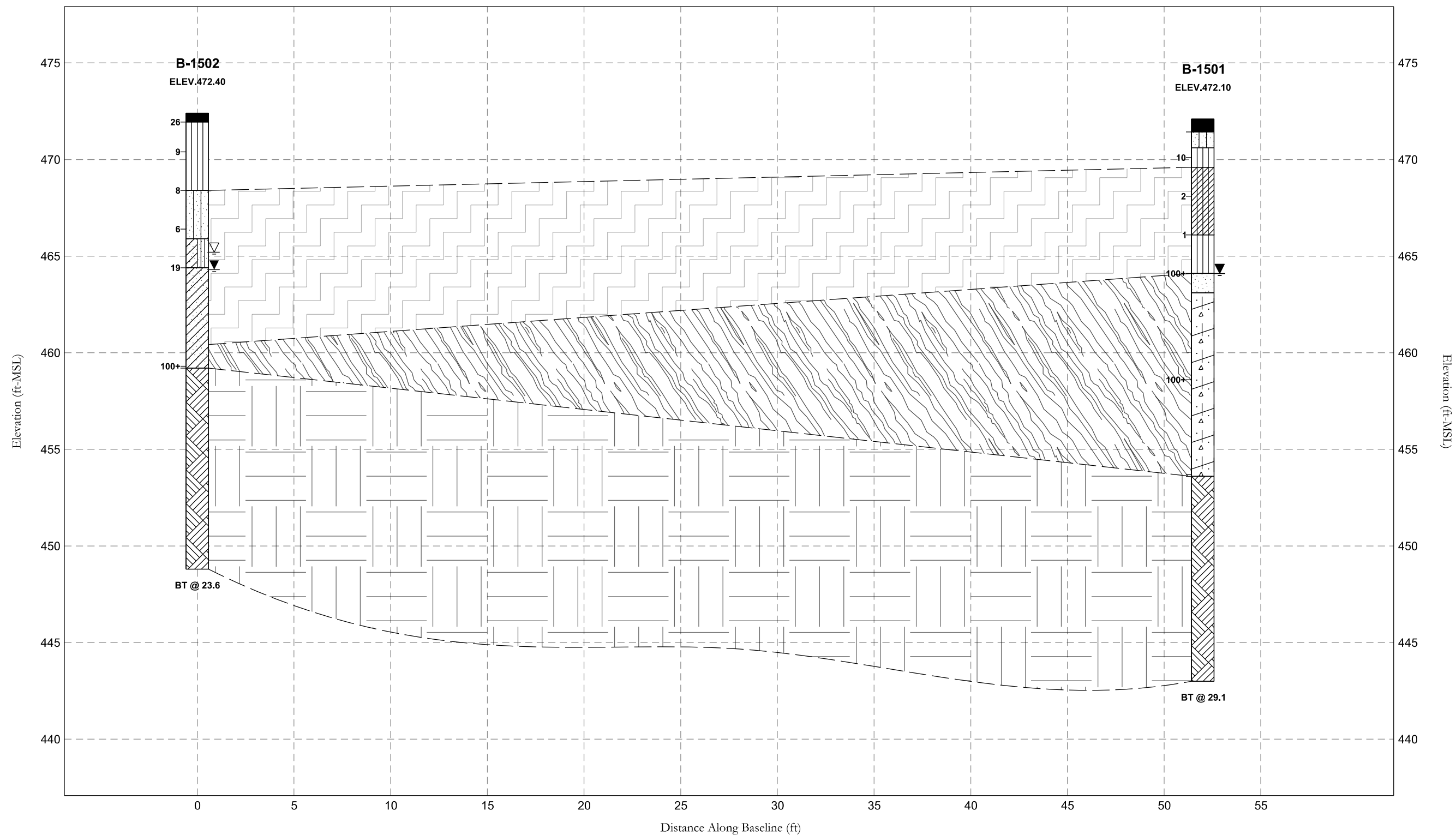
ABBREVIATIONS

- 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

- 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.



RESIDUUM PWR BEDROCK

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-41-37 BRIDGE REPLACEMENT  
OVER ROCKY CREEK**

**GENERALIZED SUBSURFACE PROFILE**

HRZ SCALE = NTS

VRT SCALE = NTS

# S-41-37 Replacement Bridge over Rocky Creek

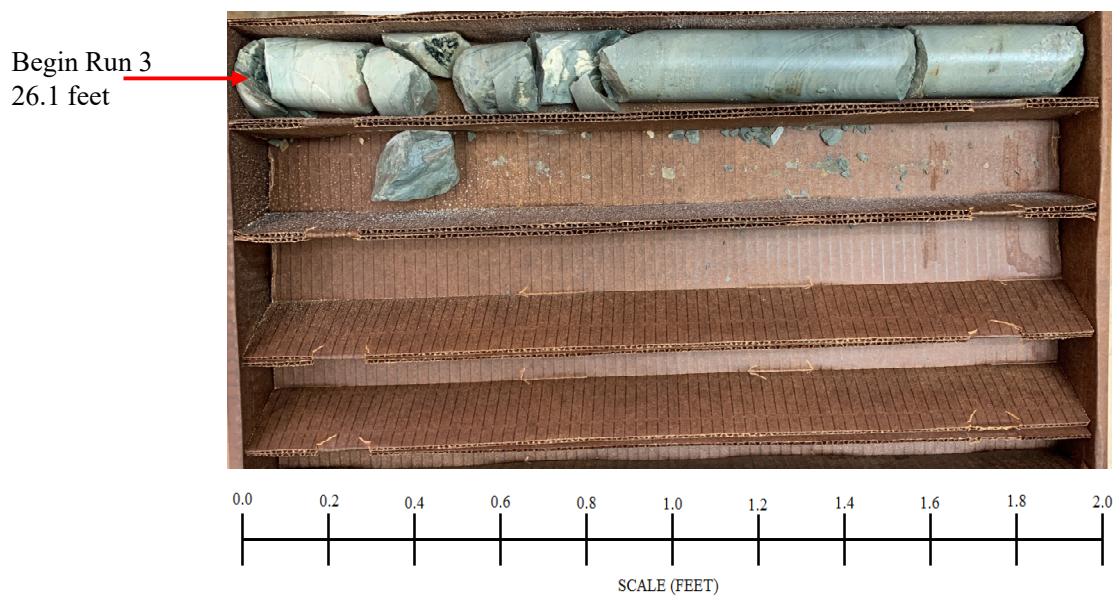
## Geotechnical Base Line Report

---

# APPENDIX

## SECTION 6 ROCK CORE PHOTOS

S-41-37 RBO Rocky Creek  
Boring B-1501



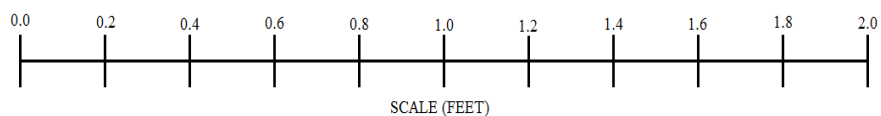


S-41-37 RBO Rocky Creek  
Boring B-1502

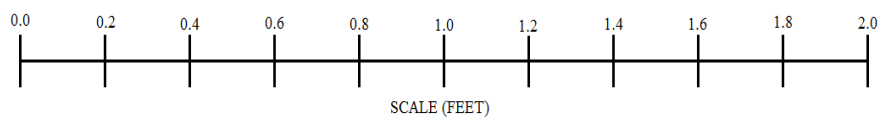


Begin Run 1  
13.2 feet

Begin Run 2  
15.6 feet



Begin Run 3  
20.6 feet



# **S-41-37 Replacement Bridge over Rocky Creek**

## **Geotechnical Base Line Report**

---

# **APPENDIX**

## **SECTION 7 LABORATORY TEST RESULTS**





# SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B-1501	4.0	25	20	5	4.76	78	CL-ML	21.5			
B-1501	6.0				4.76	78		21.7			
B-1501	8.0	20	19	1	4.76	50	ML	23.1			
B-1502	6.0				4.76	66		16.3			
B-1502	8.0	27	21	6	4.76	47	SC-SM	13.5			
B-1502	10.0	35	19	16	4.76	37	SC	13.8			



## Rock Coring Summary

Project ID: P038307

Project Name: S-41-37 RBO Rocky Creek

Project County: Saluda

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-1501	NQ-1	18.5	74	32	1,826	0.14	4.40E+03	169	50
									35-45
	NQ-2	21.1	90	57	1,519	0.20	1.30E+03	167	50
									40-50
	NQ-3	26.1	67	0	N/A	N/A	N/A	N/A	37
									10-20
B-1502	NQ-1	13.2	100	76	4,064	0.35	1.60E+03	171	61
									45-55
	NQ-2	15.6	100	45	N/A	N/A	N/A	N/A	42
									35-45
	NQ-3	20.6	72	33	4,245	0.44	7.10E+03	174	52
									35-45

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

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

<b>PROJECT:</b>	<u>S-41-37 Replacment Bridge over Rocky Creek</u>	<b>PROJECT NO.:</b>	<u>P038307</u>
<b>SAMPLE NUMBER:</b>	<u>19-1919</u>	<b>DATE SAMPLE RECEIVED:</b>	<u>7/22/2019</u>
<b>DESCRIPTION OF SOIL:</b>	<u>VARIOUS</u>		
<b>TESTED BY:</b>	<u>JH</u>	<b>DATE OF TESTING:</b>	<u>8/6/2019</u>
<b>WEIGHED</b>	<u>JH</u>	<b>DATE OF WEIGHING:</b>	<u>8/7/2019</u>
<b>RY:</b>			

BORING NO.	B-1501	B-1501	B-1501		
SAMPLE NO.	SS-2	SS-3	SS-4		
SAMPLE DEPTH	2-4'	4-6'	6-8'		
WATER CONTENT, W%	21.5	21.7	23.1		

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%					

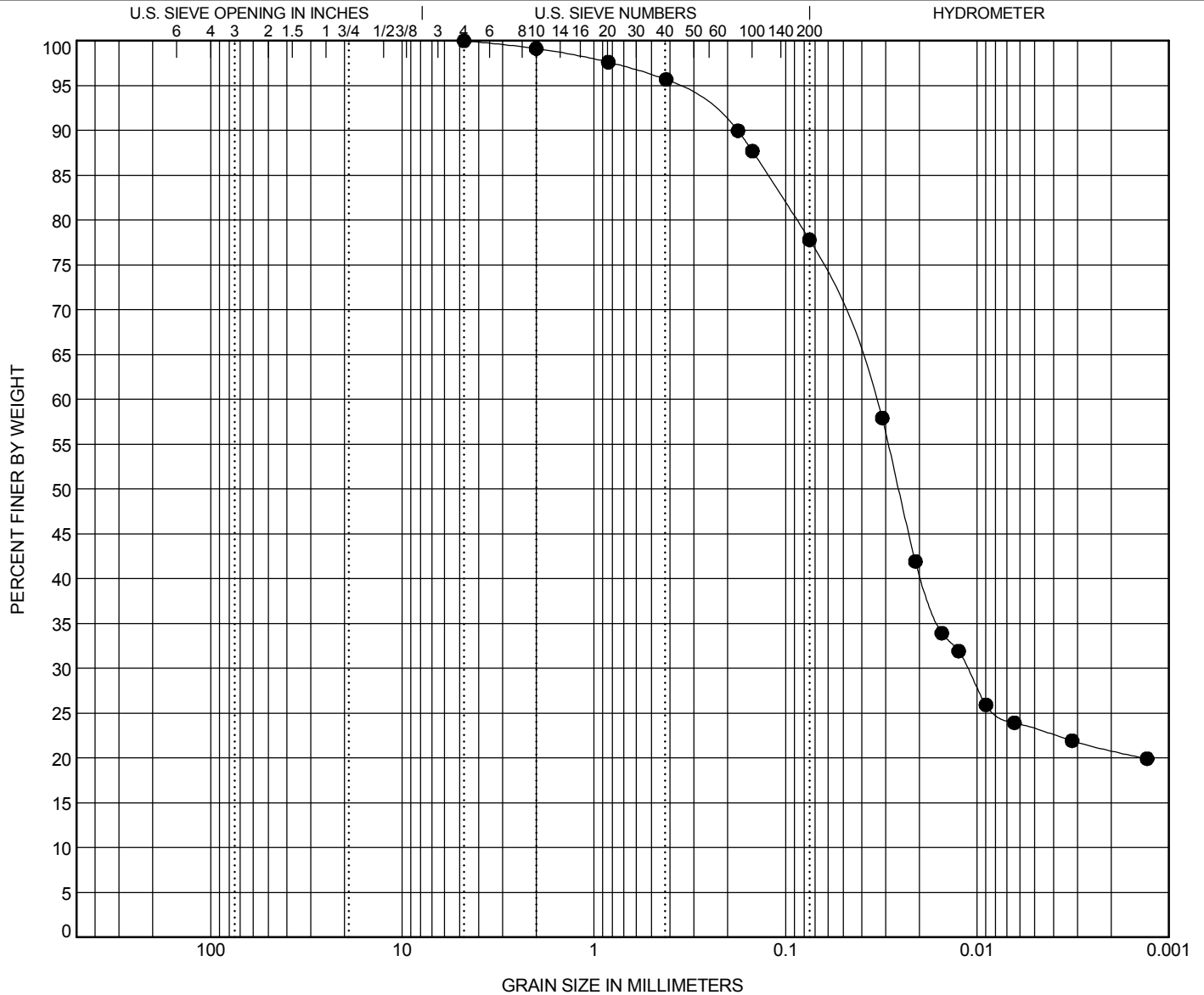


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-1501	4.0	Silty CLAY (CL-ML/A-4(2)) with Sand					25	20	5		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-1501	4.0	4.76	0.378	0.026		0.0	22.2	54.6	23.2		

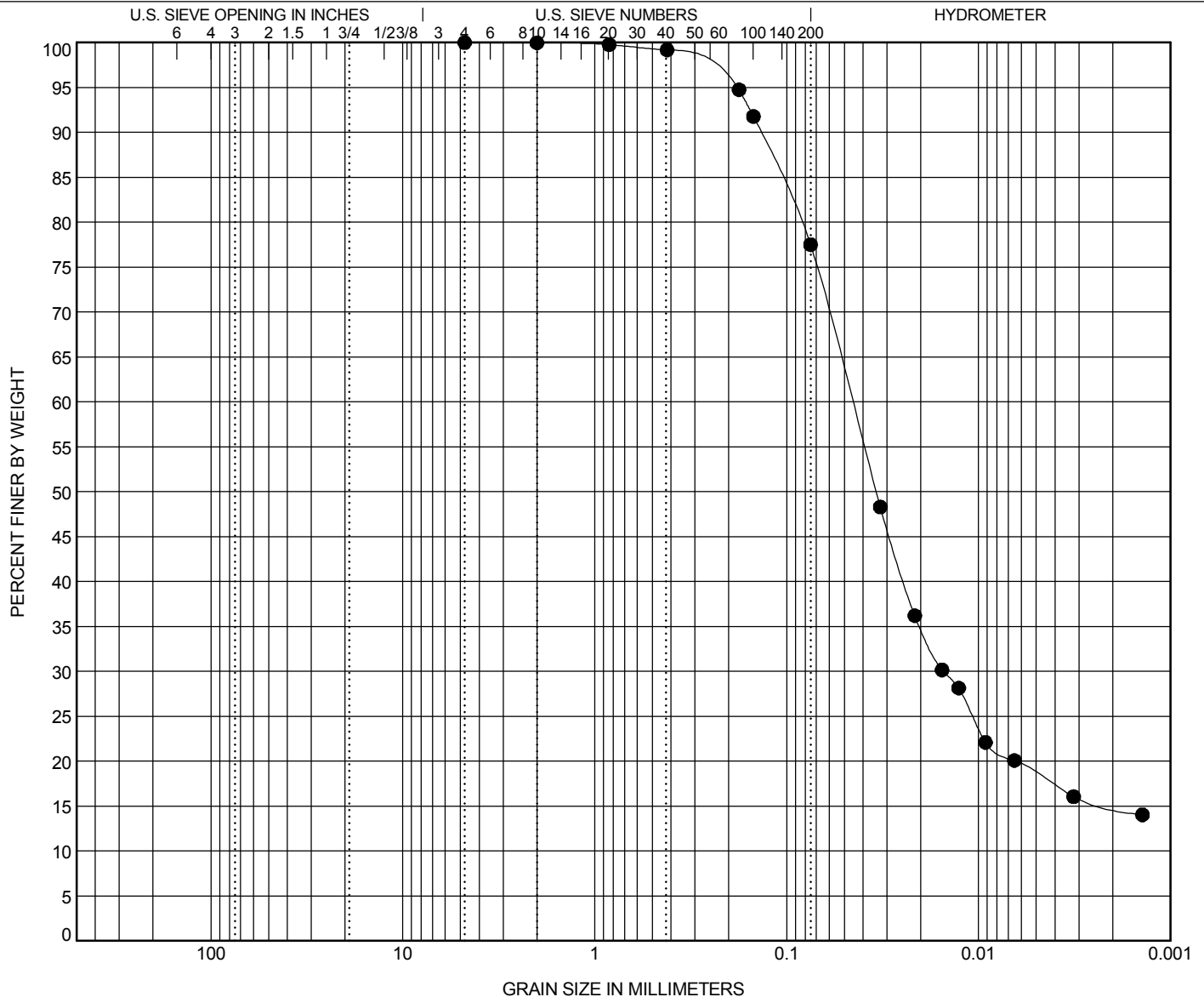


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda



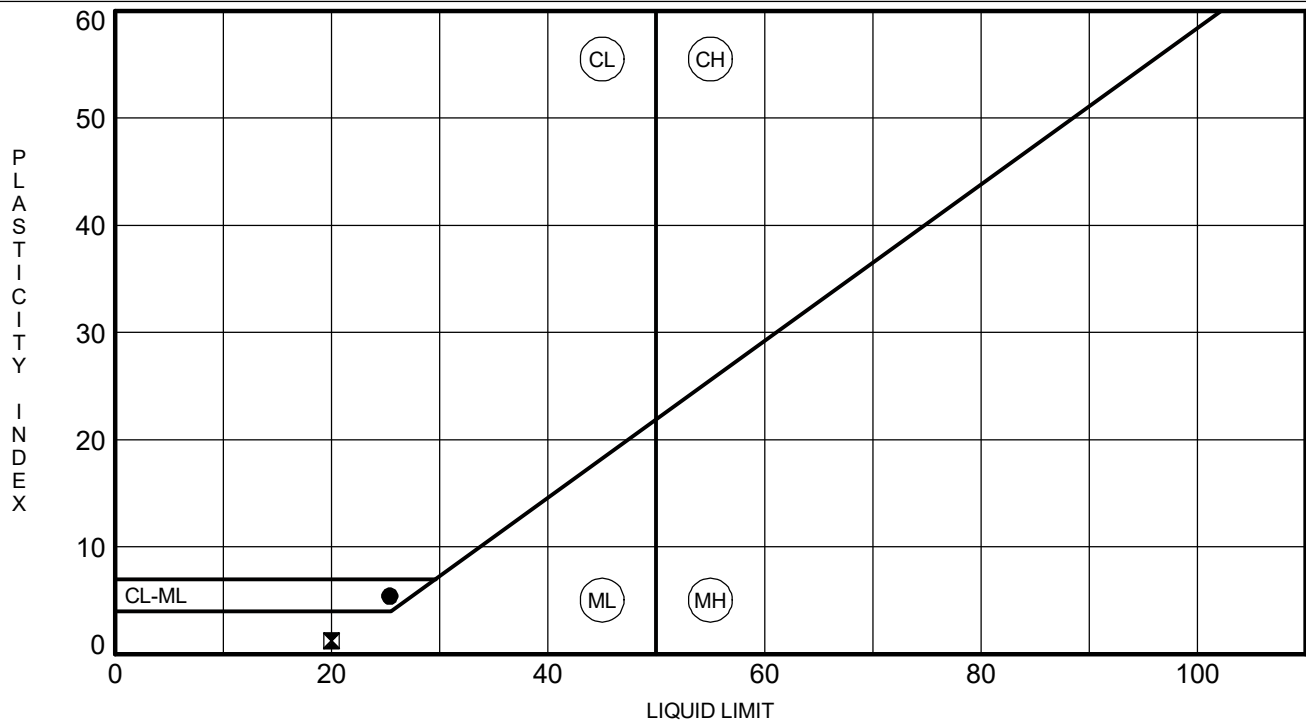


## ATTERBERG LIMITS' RESULTS

**PROJECT ID** P038307

**PROJECT NAME** S-41-37 Replacment Bridge over Rocky Creek

**PROJECT COUNTY** Saluda

[illegible]

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

**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 50% and 75% of the total Compressive strength (psi) - other values possible

Client F&ME Consultants  
 Client Project G6100.050 Load Restricted Bridge Package  
 Project Number 42301  
 Boring G6100.050.00015 - S-41-37 RBO Rocky Creek  
 Depth 18.7' - 19.0'  
 Sample RC-1501.1  
 Lab ID number 42301009

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

Axial Strain	Diametric Strain	Axial Stress psi
1.46E-04	-1.55E-05	887
2.70E-04	-3.34E-05	1429

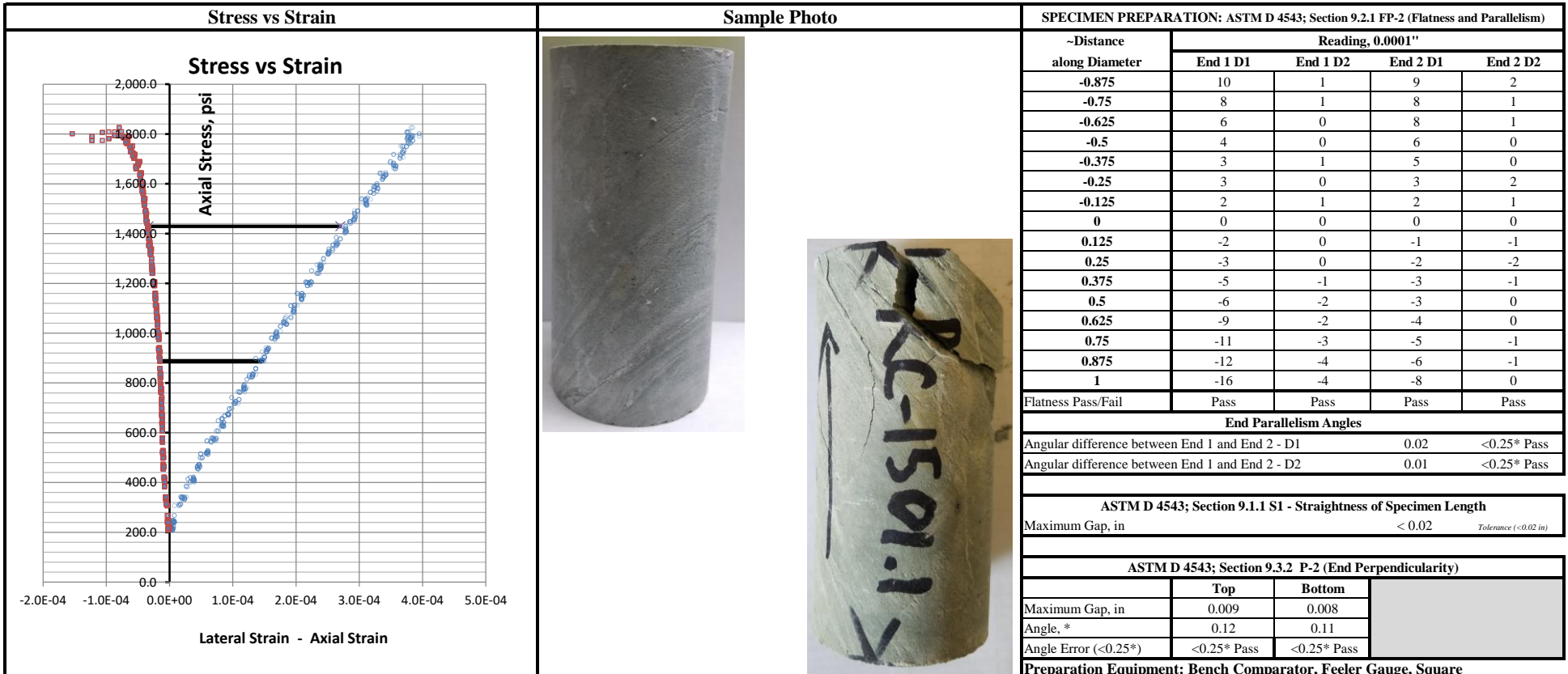
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.146
Mid Height Diameter #1, in	1.864
Mid Height Diameter #2, in	1.863
Average Mid. Height Diameter, in.	1.86
Sample Area, in <sup>2</sup>	2.73
<b>L/D Ratio (2.0-2.5)</b>	<b>2.22</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	502.83	
Sample Volume, cc	185	
Wet Density, pcf	169	

Test Results	
Overall Loading Rate, psi/sec	20
Peak Load, lbs	4979
<b>Unconfined Compressive Strength, psi</b>	<b>1,826</b>
<b>Youngs Modulus, E psi</b>	<b>4.4 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-30.4 E+06</b>
<b>Poisson's Ratio</b>	<b>0.14</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 8/28/2019



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

**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 50% and 75% of the total Compressive strength (psi) - other values possible

Client F&ME Consultants  
 Client Project G6100.050 Load Restricted Bridge Package  
 Project Number 42301  
 Boring G6100.050.00015 - S-41-37 RBO Rocky Creek  
 Depth 24.7' - 25.0'  
 Sample RC-1501.2  
 Lab ID number 42301010

Description: Green Fine Grained Sandstone  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
6.98E-04	-1.23E-04	1191
3.70E-04	-5.80E-05	758

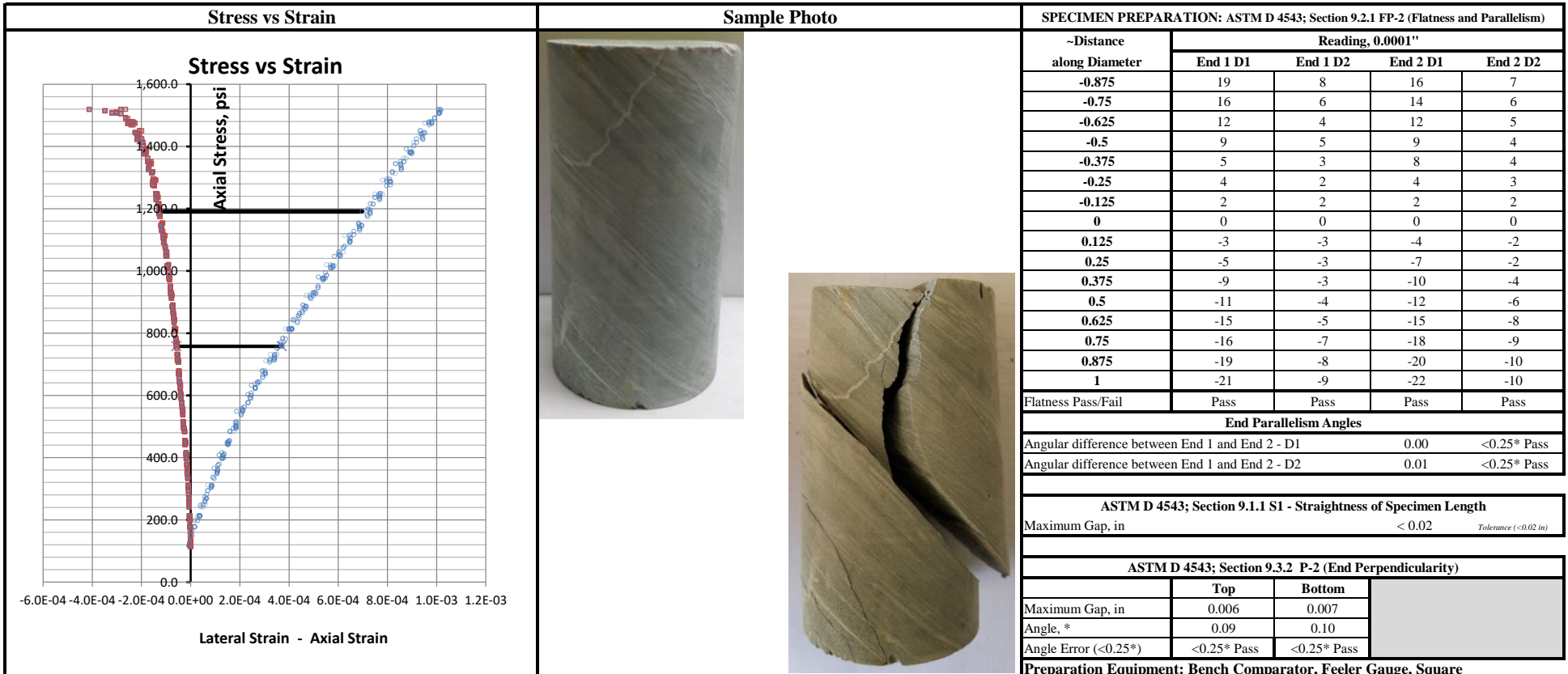
ASTM D 4543; Section 4.2 & 5.6	
Length, in	3.84
Mid Height Diameter #1, in	1.863
Mid Height Diameter #2, in	1.865
Average Mid. Height Diameter, in.	1.86
Sample Area, in^2	2.73
<b>L/D Ratio (2.0-2.5)</b>	<b>2.06</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	459.11	
Sample Volume, cc	172	
Wet Density, pcf	167	

Test Results	
Overall Loading Rate, psi/sec	20
Peak Load, lbs	4145
<b>Unconfined Compressive Strength, psi</b>	<b>1,519</b>
<b>Youngs Modulus, E psi</b>	<b>1.3 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-6.6 E+06</b>
<b>Poisson's Ratio</b>	<b>0.20</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 8/28/2019

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

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

<b>PROJECT:</b>	<u>S-41-37 Replacment Bridge over Rocky Creek</u>	<b>PROJECT NO.:</b>	<u>P038307</u>
<b>SAMPLE NUMBER:</b>	<u>19-1921</u>	<b>DATE SAMPLE RECEIVED:</b>	<u>7/22/2019</u>
<b>DESCRIPTION OF SOIL:</b>	<u>VARIOUS</u>		
<b>TESTED BY:</b>	<u>JH</u>	<b>DATE OF TESTING:</b>	<u>8/6/2019</u>
<b>WEIGHED</b>	<u>JH</u>	<b>DATE OF WEIGHING:</b>	<u>8/7/2019</u>
<b>RY:</b>			

BORING NO.	B-1502	B-1502	B-1502		
SAMPLE NO.	SS-3	SS-4	SS-5		
SAMPLE DEPTH	4-6'	6-8'	8-10'		
WATER CONTENT, W%	16.3	15.5	13.8		

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%					

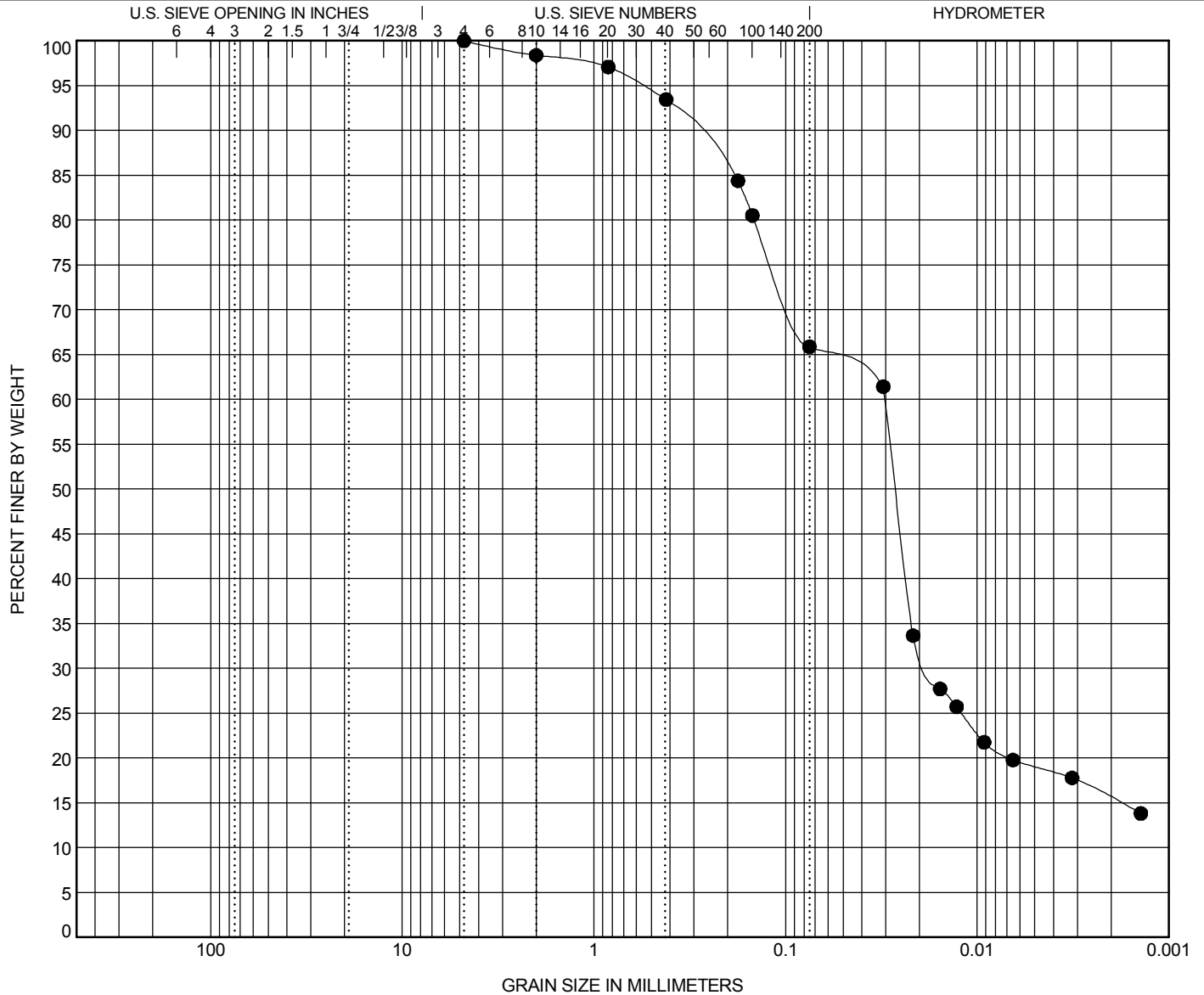


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-1502	6.0	Sandy SILT (ML)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-1502	6.0	4.76	0.564	0.027		0.0	34.1	46.8	19.0		

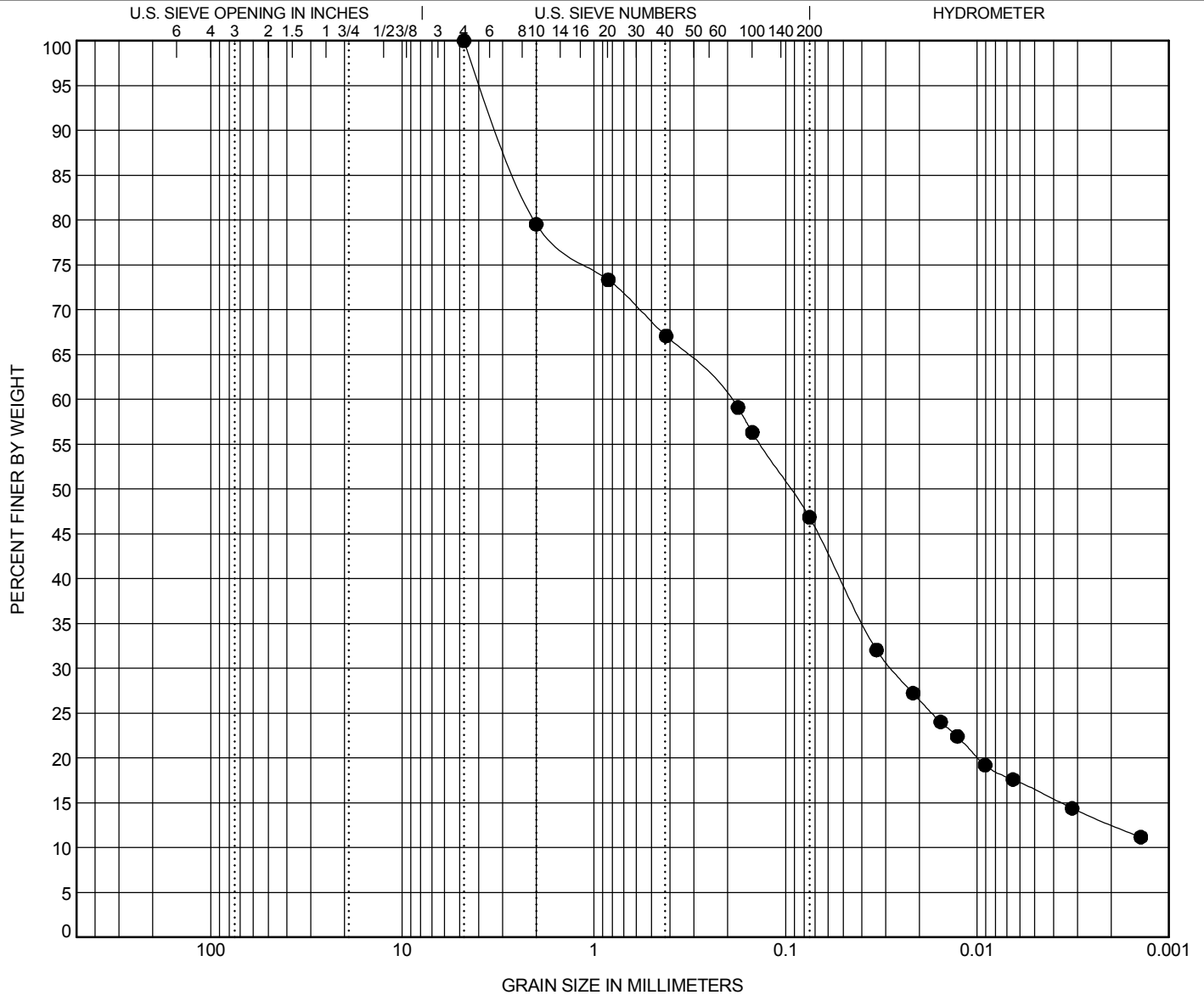


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-1502	8.0	Silty Clayey SAND (SC-SM/A-4(2))					27	21	6		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-1502	8.0	4.76	3.851	0.094		0.0	53.1	30.4		16.4	

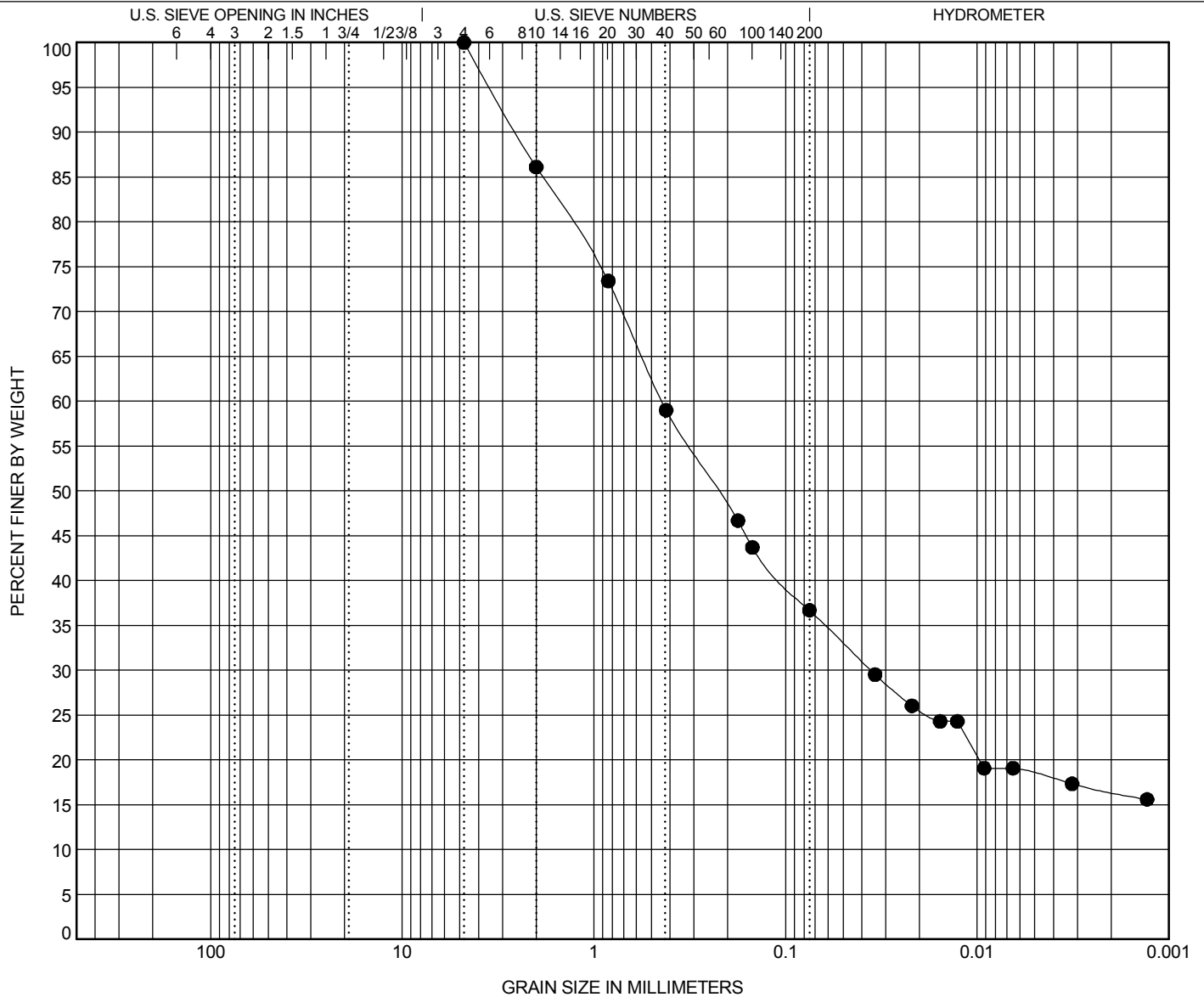


# GRAIN SIZE DISTRIBUTION

PROJECT ID P038307

PROJECT NAME S-41-37 Replacement Bridge over Rocky Creek

PROJECT COUNTY Saluda

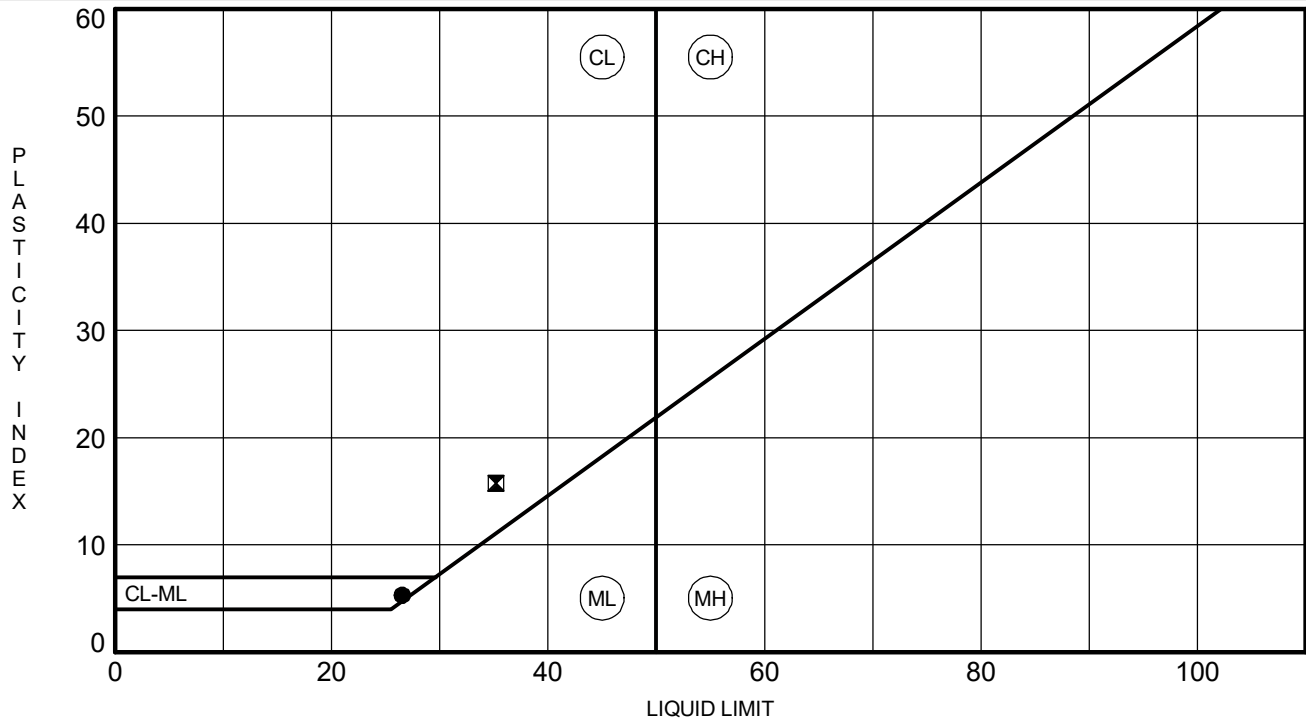


## ATTERBERG LIMITS' RESULTS

**PROJECT ID** P038307

**PROJECT NAME** S-41-37 Replacment Bridge over Rocky Creek

**PROJECT COUNTY** Saluda

[illegible]

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

**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 50% and 75% of the total Compressive strength (psi) - other values possible

Client F&ME Consultants  
 Client Project G6100.050 Load Restricted Bridge Package  
 Project Number 42301  
 Boring G6100.050.00015 - S-41-37 RBO Rocky Creek  
 Depth 14.5' - 14.8'  
 Sample RC-1502.3  
 Lab ID number 42301011

Description: Green Fine Grained Sandstone  
 As-Received Condition: Useable L/D < 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
9.98E-04	-2.13E-04	2083
1.63E-03	-4.35E-04	3089

ASTM D 4543; Section 4.2 & 5.6	
Length, in	3.661
Mid Height Diameter #1, in	1.864
Mid Height Diameter #2, in	1.863
Average Mid. Height Diameter, in.	1.86
Sample Area, in^2	2.73
<b>L/D Ratio (2.0-2.5)</b>	<b>1.96</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	448.73	
Sample Volume, cc	164	
Wet Density, pcf	171	

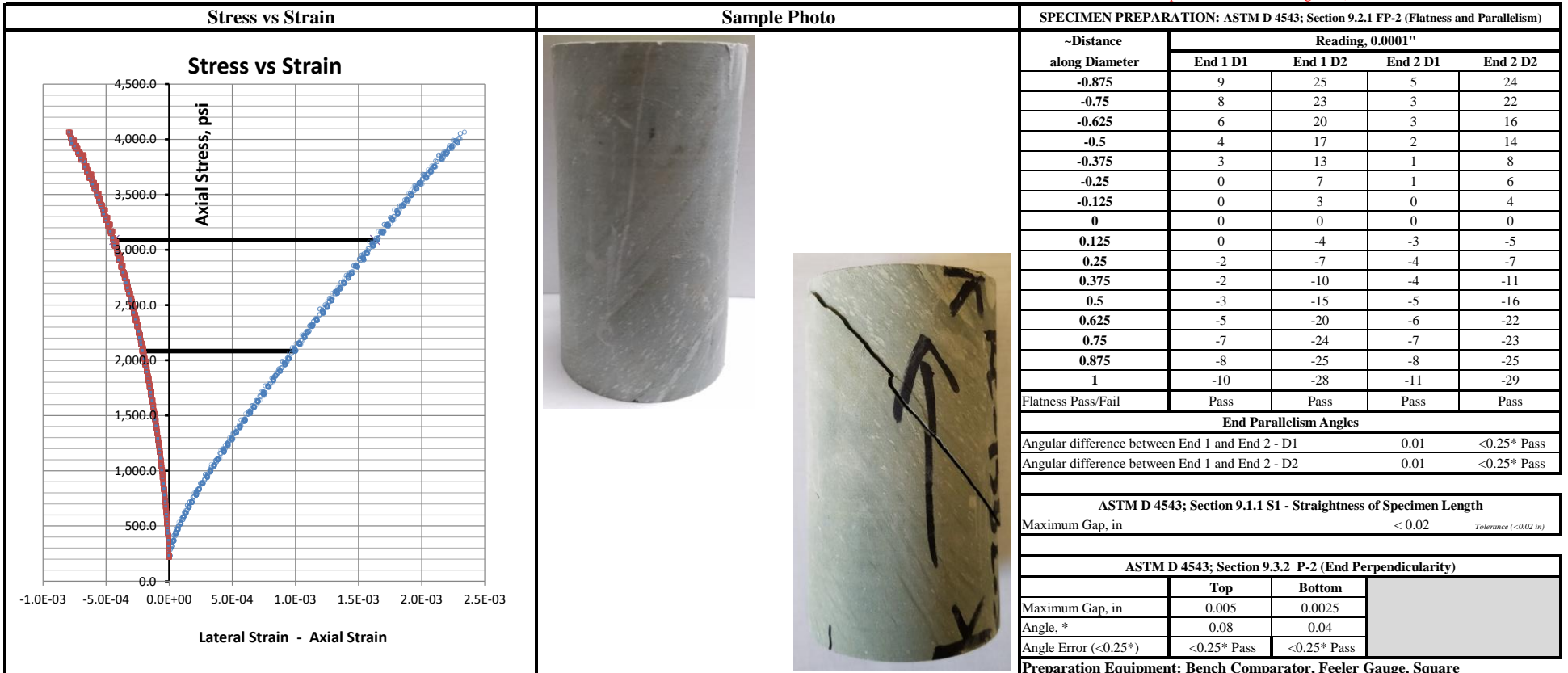
Test Results	
Overall Loading Rate, psi/sec	20
Peak Load, lbs	11085
<b>Unconfined Compressive Strength, psi</b>	<b>4,064</b>
<b>Youngs Modulus, E psi</b>	<b>1.6 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-4.5 E+06</b>
<b>Poisson's Ratio</b>	<b>0.35</b>

Load Application in Relation to Lithology: Angle

**Note: L/D does not meet ASTM Requirements**

PennDot Specified Correction Factor = 1.0022

PennDot Specified Corrected Strength = 4,056



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 8/28/2019

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

**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 50% and 75% of the total Compressive strength (psi) - other values possible

Client F&ME Consultants  
 Client Project G6100.050 Load Restricted Bridge Package  
 Project Number 42301  
 Boring G6100.050.00015 - S-41-37 RBO Rocky Creek  
 Depth 21.7' - 22.0'  
 Sample RC-1502.4  
 Lab ID number 42301012

Description: Green Fine Grained Sandstone  
 As-Received Condition: Useable L/D > 2  
 Sample Preparation: Diamond saw blade cut, surface ground flat

Axial Strain	Diametric Strain	Axial Stress psi
2.50E-04	-7.38E-05	2096
4.09E-04	-1.44E-04	3219

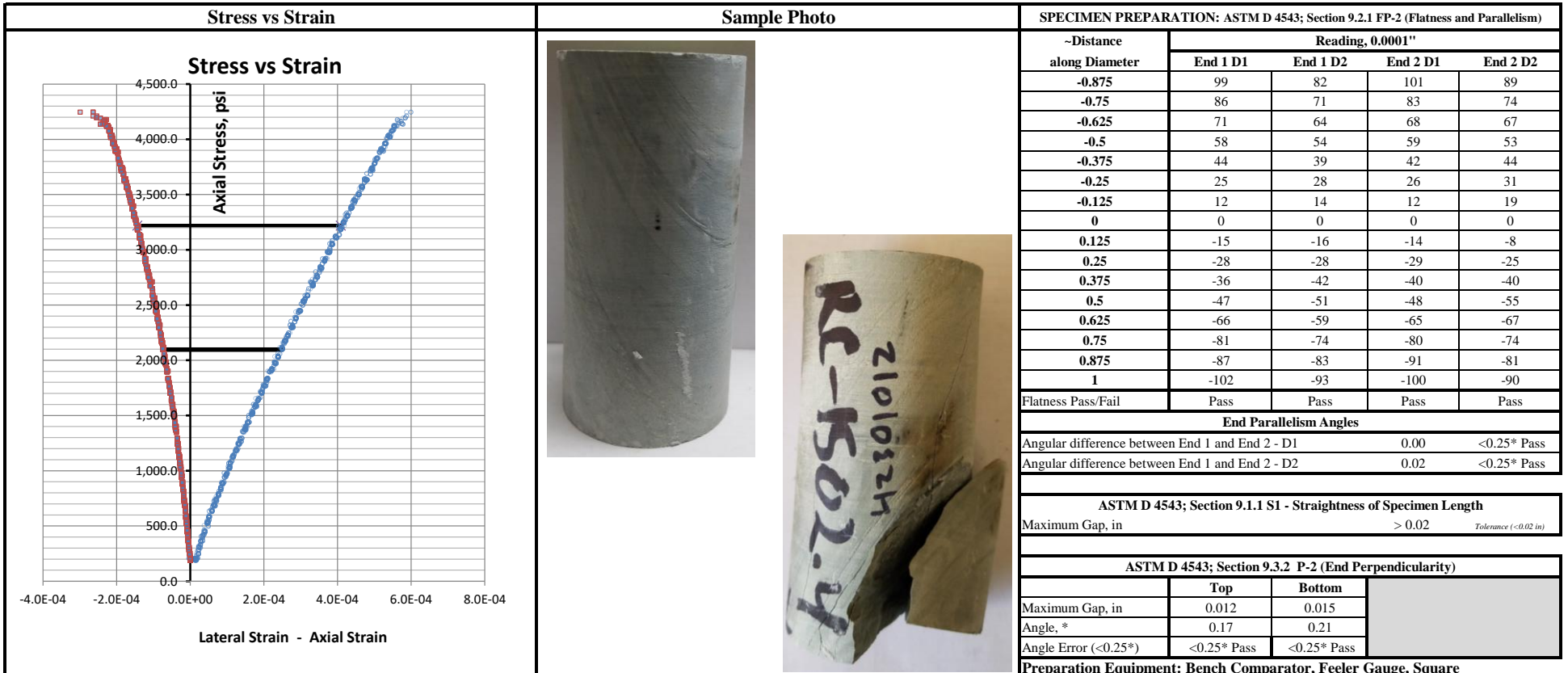
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.138
Mid Height Diameter #1, in	1.854
Mid Height Diameter #2, in	1.86
Average Mid. Height Diameter, in.	1.86
Sample Area, in^2	2.71
<b>L/D Ratio (2.0-2.5)</b>	<b>2.23</b>

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	512.43	
Sample Volume, cc	184	
Wet Density, pcf	174	

Test Results	
Overall Loading Rate, psi/sec	20
Peak Load, lbs	11496
<b>Unconfined Compressive Strength, psi</b>	<b>4,245</b>
<b>Youngs Modulus, E psi</b>	<b>7.1 E+06</b>
<b>Slope of Lateral Curve, psi</b>	<b>-16.0 E+06</b>
<b>Poisson's Ratio</b>	<b>0.44</b>

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 8/28/2019



### 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