



REVISED

GEOTECHNICAL BASE LINE REPORT

Route S-36-272 Replacement Bridge over Tributary to Second Creek
Newberry 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: P038066

F&ME Project #: G6100.05.10

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-36-272 Bridge over Tributary to Second Creek
Newberry County, South Carolina
SCDOT Project ID: P038066
F&ME Project No.: G6100.050.10

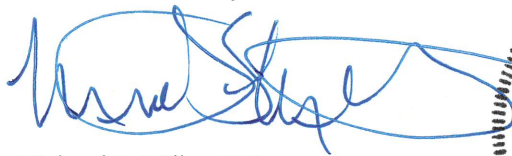
Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc. (FME) revised Geotechnical Base Line Report (GBLR) for the Route S-36-272 Replacement Bridge over Tributary to Second 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 seal.

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-36-272 Replacement Bridge over Tributary to Second Creek located in Newberry 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 May 13 and 14, 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-301	Paved Roadway	31.0	10.0	41.0	34.341934	-81.443442	318.7
B-302	Paved Roadway	23.5	12.6	36.1	34.342115	-81.443263	318.4
Totals	-	54.5	22.6	77.1			

2.2 Groundwater

Groundwater depths were recorded at the time of boring (TOB) for soil test borings B-301 and B-302, with the recorded measurements noted on the individual Soil Test Boring Logs in Section 4 of the Appendix to this report. In test boring B-301 groundwater measurement was 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, when recorded.

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-301	5/13/2019	13.5	13.5
B-302	5/14/2019	13.0	Backfilled

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. Two (2) 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	10	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	2	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	318	0	SP-SM, SM, SC	7	-
Alluvium	311	7	SC, SC-SM, CL	5	-
Residuum	302	16	SM	8	-
PWR	295	23	SM	100+	-
Bed Rock	291	27	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 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 on the order from 15,500 psi to 16,500 psi.

S-36-272 Replacement Bridge over Tributary to Second Creek

Geotechnical Base Line Report

APPENDIX

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

S-36-272 Replacement Bridge over Tributary to Second Creek

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APPENDIX

SECTION 1 SITE LOCATION PLAN

[illegible]

Scale 1 : 62,500

mi
km

1" = 5,208.3 ft

Data Zoom 11-6



FIGURE 1

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

S-36-272 Replacement Bridge over Tributary to Second Creek

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SECTION 2 BORING LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD/ROUTE NO.	SHEET NO.
3	SC	NEWBERRY	P038066	S-36-272	



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

TRIBUTARY TO SECOND CREEK
NEWBERRY COUNTY, SOUTH CAROLINA

BORING LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: 1"=30'

FIGURE 2

APPENDIX

SECTION 3 DRILL RIG PHOTOS

Drill Rig Setup Photographs

B-301



Drill Rig Setup Photographs

B-302



S-36-272 Replacement Bridge over Tributary to Second Creek

Geotechnical Base Line Report

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

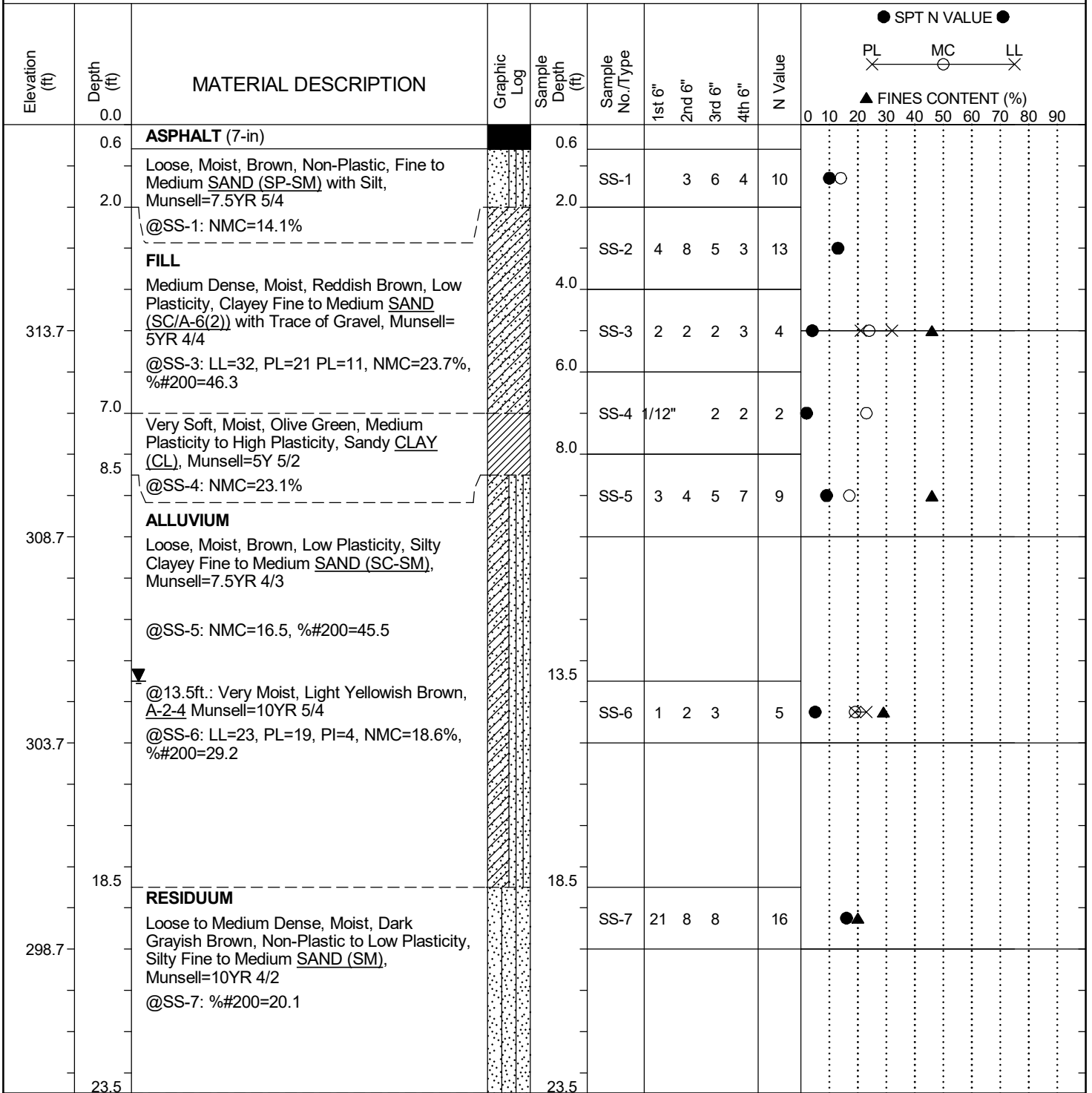
SOIL CLASSIFICATION CHART

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	
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
	SAND AND SANDY SOILS	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	
		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



Project ID: P038066				County: Newberry		Boring No.: B-301	
Site Description:		S-36-272 Replacement Bridge over Tributary to Second Creek					Route: S-36-272
Eng./Geo.: R. Wessinger		Boring Location: N/A		Offset: N/A		Alignment: Existing	
Elev.:	318.7 ft	Latitude:	34.341934	Longitude:	-81.443442	Date Started:	5/13/2019
Total Depth:	41 ft	Soil Depth:	31 ft	Core Depth:	10 ft	Date Completed:	5/13/2019
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 13.5 ft	24HR	13.5 ft



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

Project ID:	P038066	County:	Newberry	Boring No.:	B-301
Site Description:	S-36-272 Replacement Bridge over Tributary to Second Creek			Route:	S-36-272
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	318.7 ft	Latitude:	34.341934	Longitude:	-81.443442
Date Started:	5/13/2019				
Total Depth:	41 ft	Soil Depth:	31 ft	Core Depth:	10 ft
Date Completed:	5/13/2019				
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	13.5 ft	24HR
				13.5 ft	

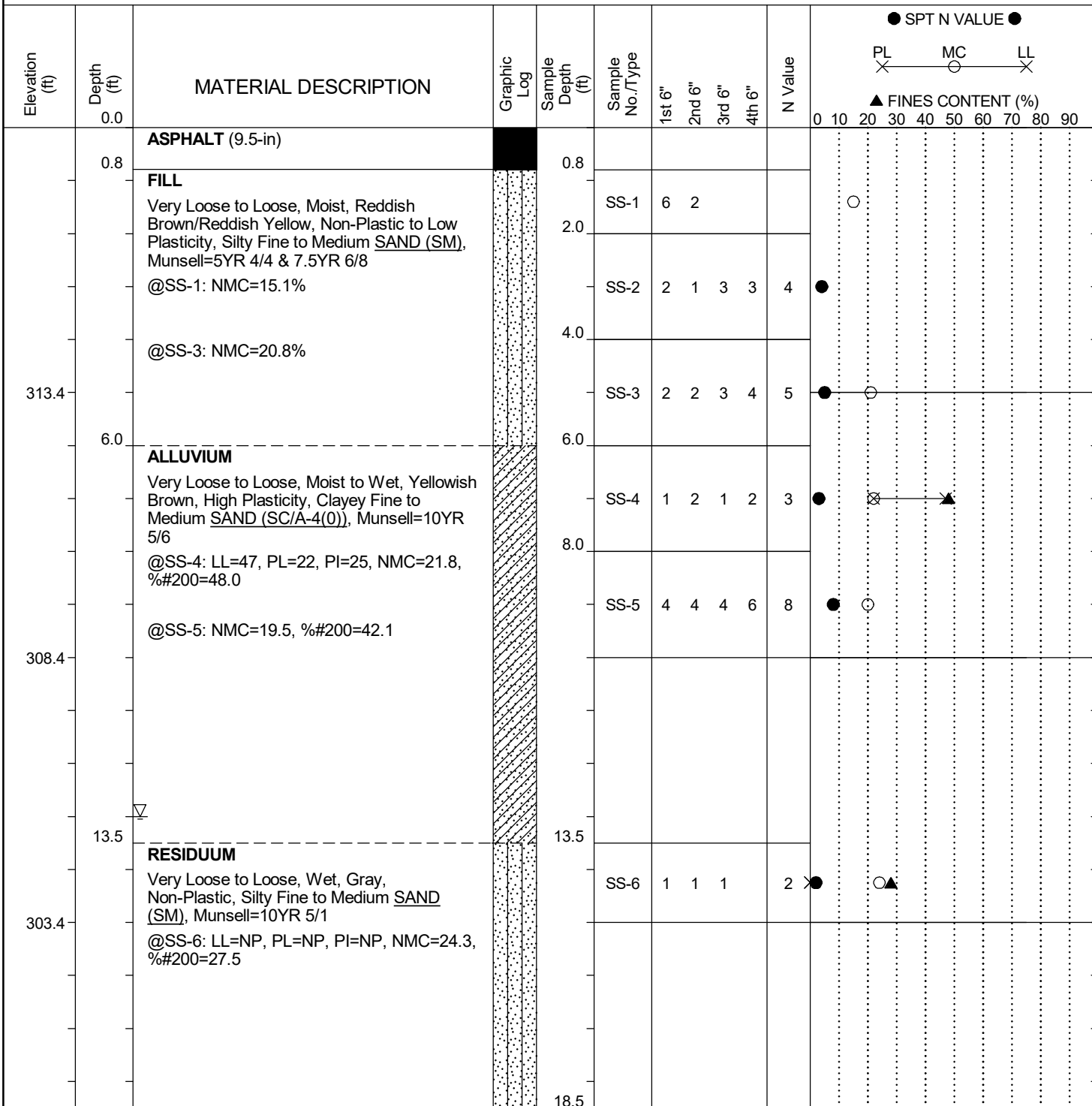
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	<div> <div>● SPT N VALUE ●</div> <div> <div>PL X</div> <div>MC ○</div> <div>LL X</div> </div> <div>▲ FINES CONTENT (%)</div> <div>0 10 20 30 40 50 60 70 80 90</div> </div>
293.7		PARTIALLY WEATHERED ROCK (PWR) Sampled As: Very Dense, Moist to Dry, White, Non-Plastic to Low Plasticity, Silty Fine to Medium SAND (SM), Munsell=7.5YR 8/1			SS-8	50/3.5"				100+	>>●
				28.5	SS-9	50/3.5"				100+	>>●
288.7				30.9	SS-10	50/0"				100+	>>●
283.7	31.0	GNEISS @NQ-1: Black/White, Fine to Coarse Grained, Thinly Laminated to Laminated Foliations, Quartz/Feldspar/Biotite, Moderately Weathered to Fresh, Very Strong, Numerous Joints, Joints Dip 10 to 55 Degrees, Moderately Wide to Very Narrow, Surface Stain, Iron Oxide, Planar/Irregular, Very Close, Slightly Rough to Rough Joints, RMR=41, Class III @33.5-ft.: UC Strength= 15,486 psi			NQ-1						%REC=90, %RQD=60, 4.2min/ft, GSI=30-40
		@NQ-2: Slightly Weathered to Fresh, Narrow to Tight, Filled, Healed, Wavy/Planar/Irregular, Smooth to Rough Joints, RMR=45, Class III @37.5-ft.: UC Strength=16,538 psi			NQ-2						%REC=99, %RQD=85, 2min/ft, GSI=45-55
278.7	41.0	Boring Terminated at 41 Feet									
273.7											

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:	P038066	County:	Newberry	Boring No.:	B-302
Site Description:	S-36-272 Replacement Bridge over Tributary to Second Creek			Route:	S-36-272
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	318.4 ft	Latitude:	34.342115	Longitude:	-81.443263
Total Depth:	36.1 ft	Soil Depth:	23.5 ft	Core Depth:	12.6 ft
Date Started:	5/14/2019				
Date Completed:	5/14/2019				
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	13 ft	24HR
					NR



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:	P038066	County:	Newberry	Boring No.:	B-302
Site Description:	S-36-272 Replacement Bridge over Tributary to Second Creek			Route:	S-36-272
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	318.4 ft	Latitude:	34.342115	Longitude:	-81.443263
Date Started:	5/14/2019				
Total Depth:	36.1 ft	Soil Depth:	23.5 ft	Core Depth:	12.6 ft
Date Completed:	5/14/2019				
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	13 ft	24HR
					NR

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>▲ FINES CONTENT (%)</div> </div>
298.4		@18.5-ft.: Fine to Coarse Sands, with Trace of Gravel @SS-7: % $\#200=9.1$			SS-7	4	3	4		7	
293.4	23.5	GNEISS @NQ-1: Metamorphic, Black/White, Fine to Coarse grained, Thinly Laminated to Laminated Foliations, Quartz/Biotite/Feldspar, Moderately Weathered to Slightly Weathered, Occasional Joints, Joints Dip From 30 to 75 Degrees, Moderately Wide to Narrow, Surface Stain, Iron Oxide, Wavy/Planar/Irregular, Very Close, Slightly Rough to Rough, RMR=13, Class V @NQ-2: Black/White/Brown, Completely Weathered, Planar/Irregular, RMR=8, Class V		23.5	SS-8	50/-0.5"				100	
288.4				26.1	NQ-1						%REC=55, %RQD=16, 1.5min/ft, GSI=15-25
					NQ-2						%REC=18, %RQD=7, 1min/ft, GSI=5-15
283.4	31.1	@NQ-3: Completely Weathered Rock (Soil), Reddish Brown/Gray, RMR=8, Class V			NQ-3						%REC=5, %RQD=0, 0.4min/ft, GSI=0-10
	36.1	Boring Terminated at 36.1 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	

S-36-272 Replacement Bridge over Tributary to Second Creek

Geotechnical Base Line Report

APPENDIX

SECTION 5 GENERALIZED SUBSURFACE PROFILE

KEY TO SYMBOLS


PROJECT NAME


Closed and Load-Restricted Bridge Package 2020-1
(S-36-272 Bridge Replacement over Tributary to Second Creek)


PROJECT COUNTY


Newberry


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



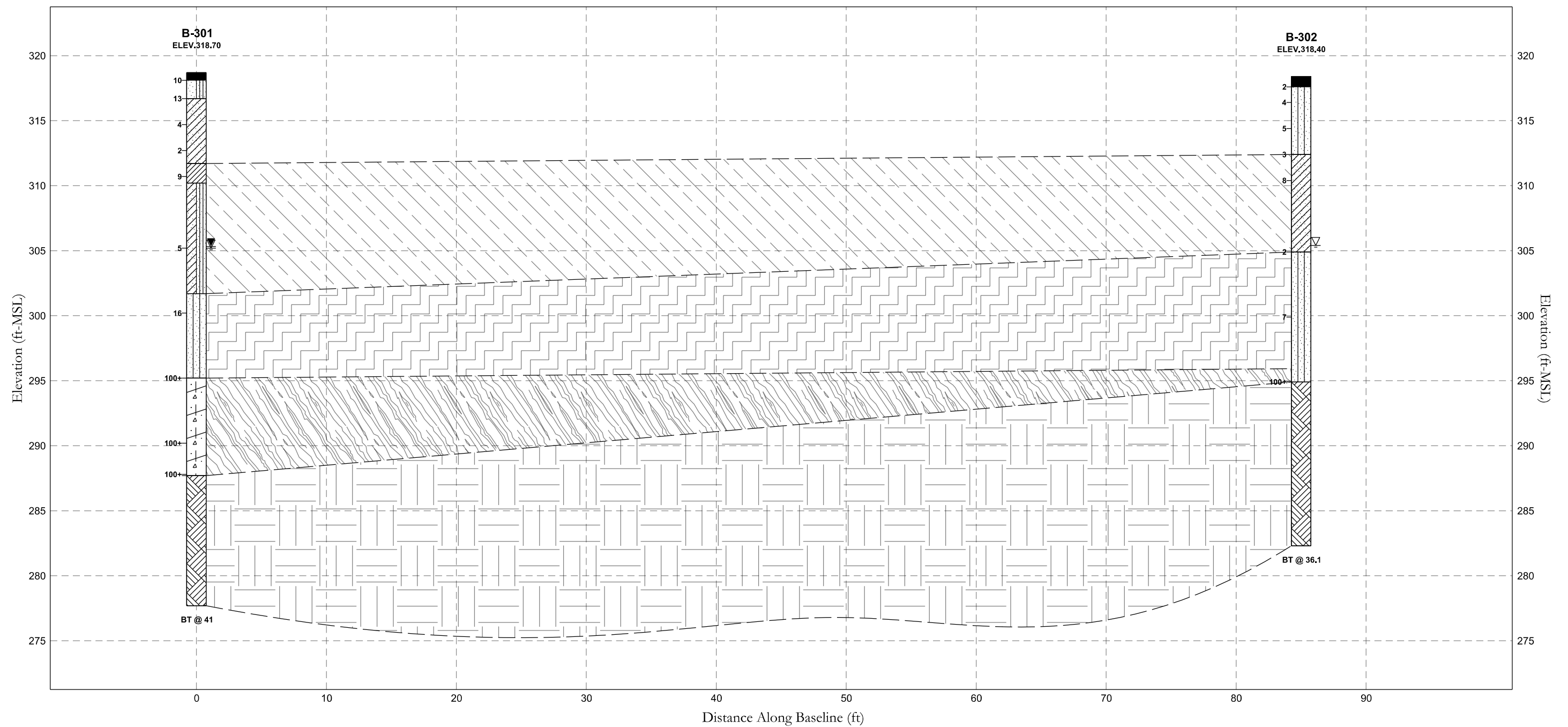
Water Level at Time
Drilling, or as Shown



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.	JFH	8.27.19	GROUP - -
OWG.			
R/W			

S-36-272 BRIDGE REPLACEMENT
OVER TRIBUTARY TO SECOND CREEK

GENERALIZED SUBSURFACE PROFILE

HRZ SCALE = NTS	
VRT SCALE = NTS	

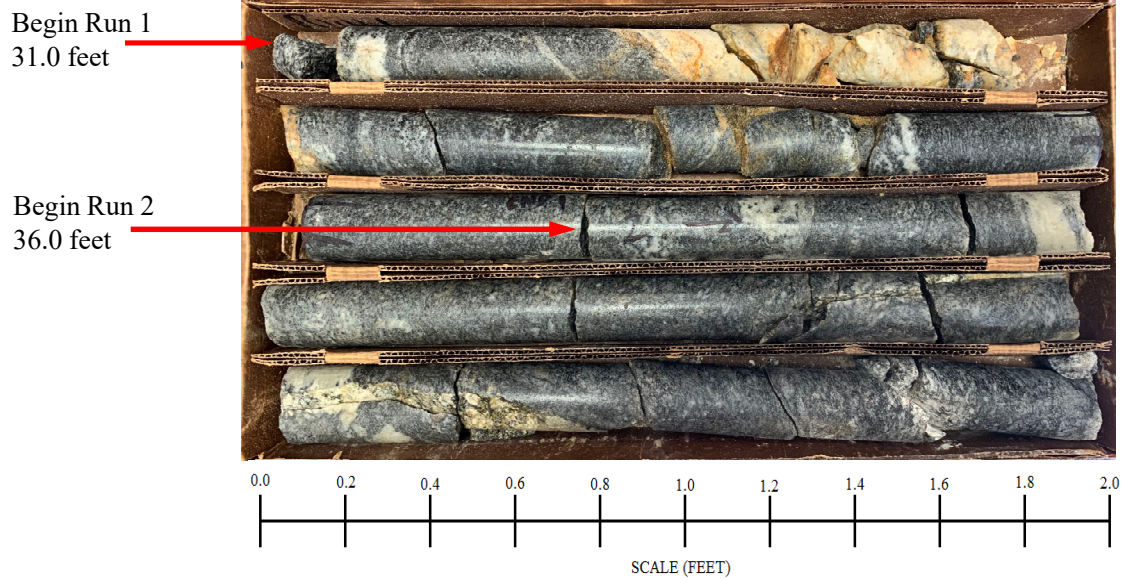
S-36-272 Replacement Bridge over Tributary to Second Creek

Geotechnical Base Line Report

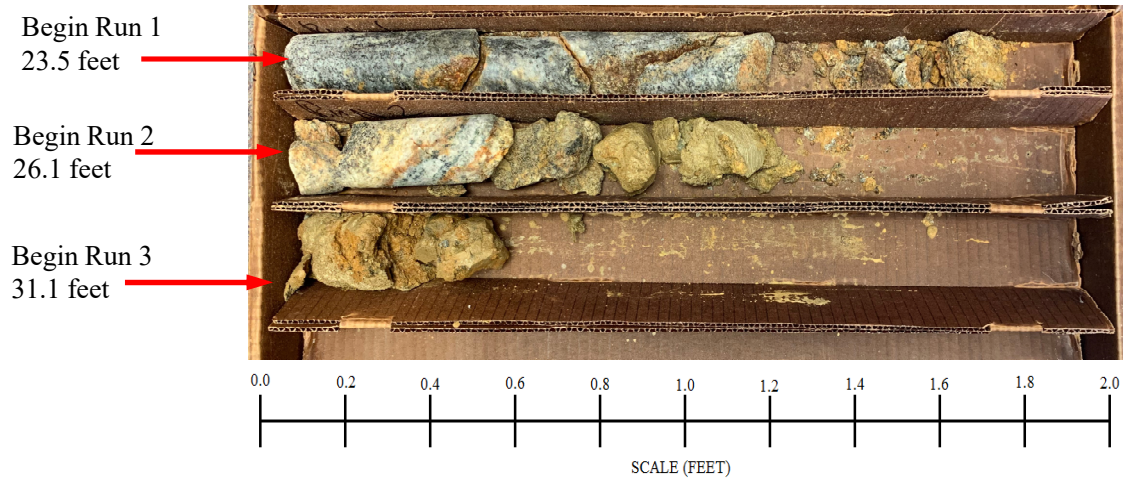
APPENDIX

SECTION 6 ROCK CORE PHOTOS

S-36-272 RBO Tributary of Second Creek
Boring B-301



Boring B-302



APPENDIX

SECTION 7 LABORATORY TEST RESULTS



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
B-301	6.0	32	21	11	9.51	46	SC	23.7			
B-301	10.0				4.76	45		16.5			
B-301	15.0	23	19	4	4.76	29	SC-SM	15.0			
B-301	20.0				4.76	20					
B-302	8.0	47	22	25	9.51	48	SC	21.8			
B-302	10.0				4.76	42		19.5			
B-302	15.0	NP	NP	NP	2	27	SM	24.3			
B-302	20.0				4.76	9					



Rock Coring Summary

Project ID: P038066

Project Name: S-36-272 RBO Tributary to Second Creek

Project County: Newberry

Borehole	Core Run Number	Core Run Top Depth (ft)	REC (%)	RQD (%)	q _u (psi)	Poisson's Ratio	Elastic Modulus (ksi)	Unit Weight (pcf)	RMR
									GSI
B-301	NQ-1	31.0	90	60	15,486	0.27	5.80E+03	172	41
									30-40
	NQ-2	36.0	99	85	16,538	0.33	5.80E+03	173	45
									45-55
B-302	NQ-1	23.5	55	16	N/A	N/A	N/A	N/A	13
									15-25
	NQ-2	26.1	18	7	N/A	N/A	N/A	N/A	8
									5-15
	NQ-3	31.1	5	0	N/A	N/A	N/A	N/A	8
									0-10

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

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	<u>S-36-272 Replacement Bridge over Tributary to Second Creek</u>	PROJECT NO.:	<u>P038066</u>
SAMPLE NUMBER:	<u>19-1458</u>	DATE SAMPLE RECEIVED:	<u>6/13/2019</u>
DESCRIPTION OF SOIL:	<u>VARIOUS</u>		
TESTED BY:	<u>JH</u>	DATE OF TESTING:	<u>8/6/2019</u>
WEIGHED	<u>JH</u>	DATE OF WEIGHING:	<u>8/7/2019</u>
RY:			

BORING NO.	B-301	B-301	B-301	B-301	B-301
SAMPLE NO.	SS-1	SS-3	SS-4	SS-5	SS-6
SAMPLE DEPTH	0-2'	4-6'	6-8'	8-10'	13.5-15'
WATER CONTENT, W%	14.1	23.7	23.1	16.5	18.6

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%					

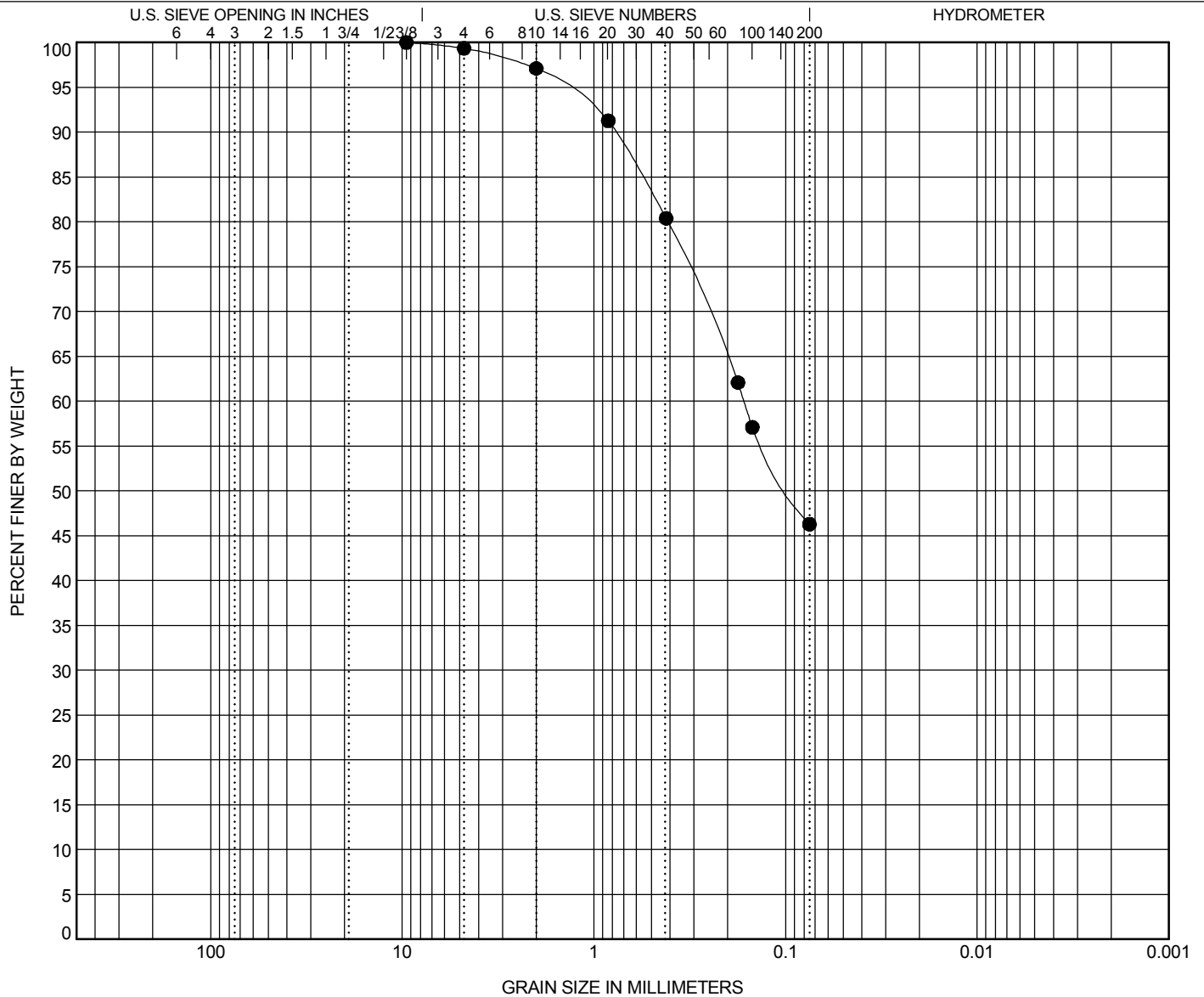


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-301	6.0	Clayey SAND (SC/A-6(2))					32	21	11		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-301	6.0	9.51	1.46	0.095		0.6	53.1	46.3			

GRAIN SIZE G6100.05.10 - RBO TRIBUTARY TO SECOND CREEK.GPJ FME2017.GDT 9/10/19

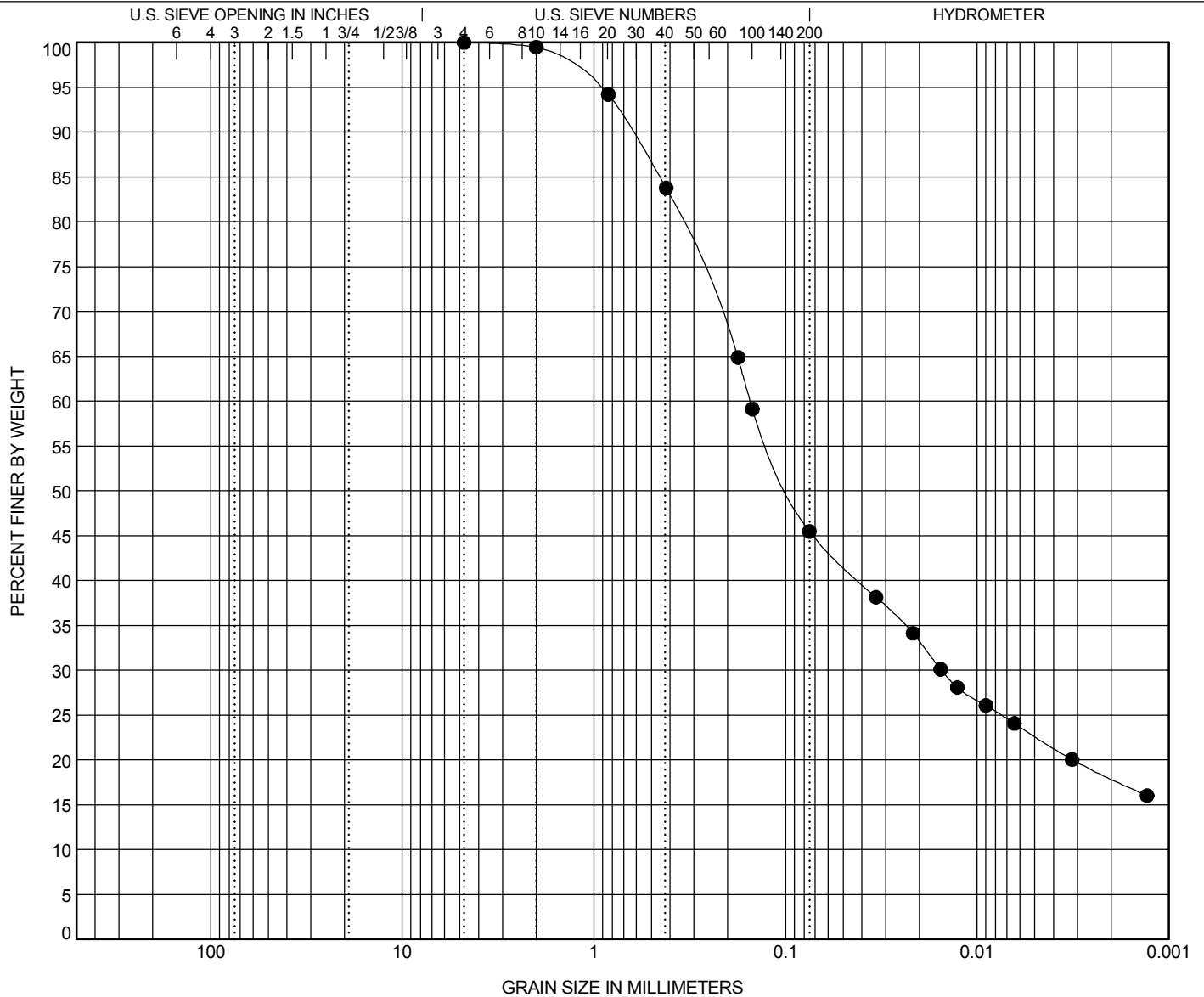


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-301	10.0	Silty, Clayey SAND (SC-SM)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-301	10.0	4.76	0.956	0.094		0.0	54.5	22.9	22.6		

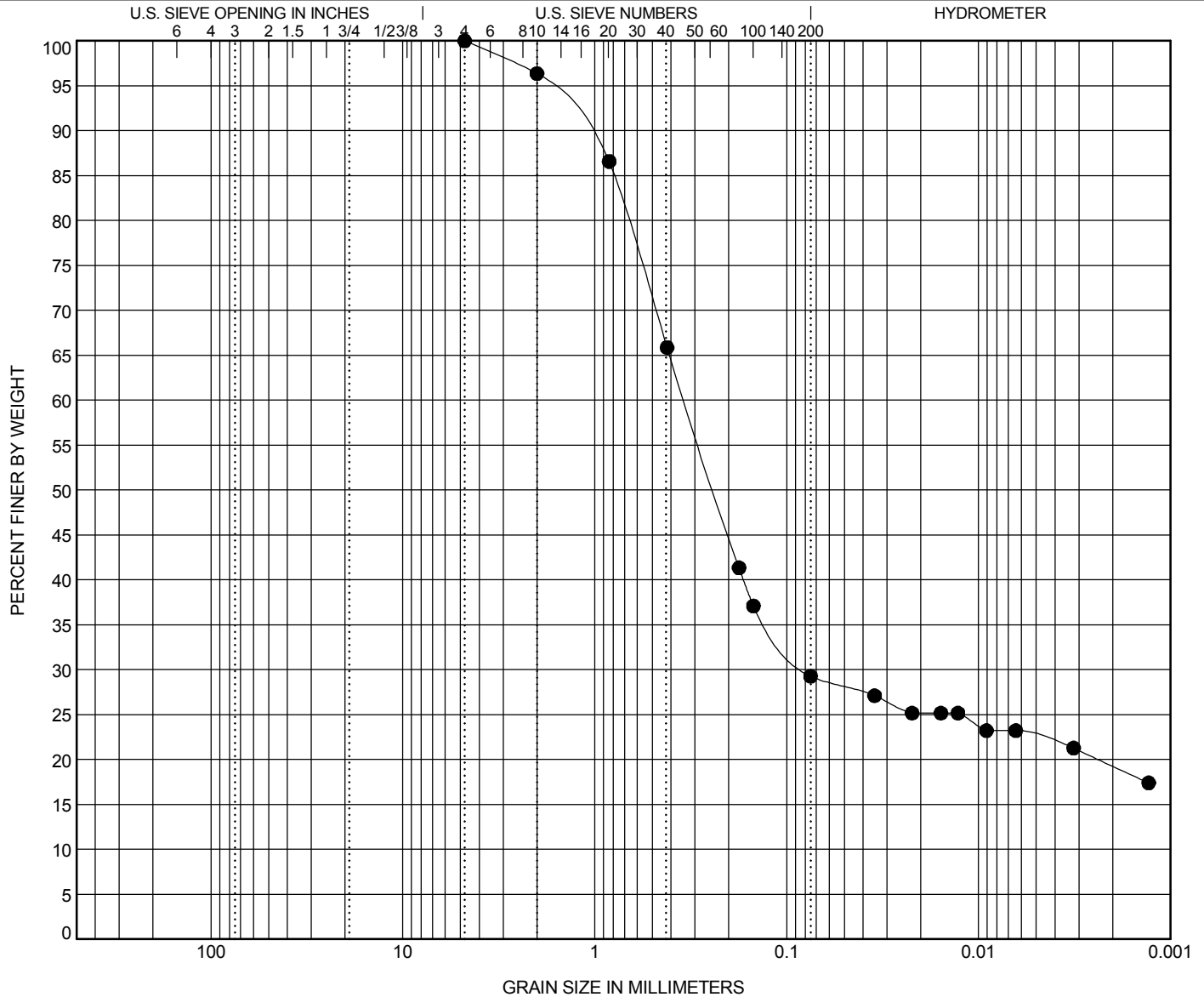


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-301	15.0	Silty Clayey SAND (SC-SM/A-2-4)					23	19	4		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-301	15.0	4.76	1.771	0.24		0.0	70.7	6.7	22.5		

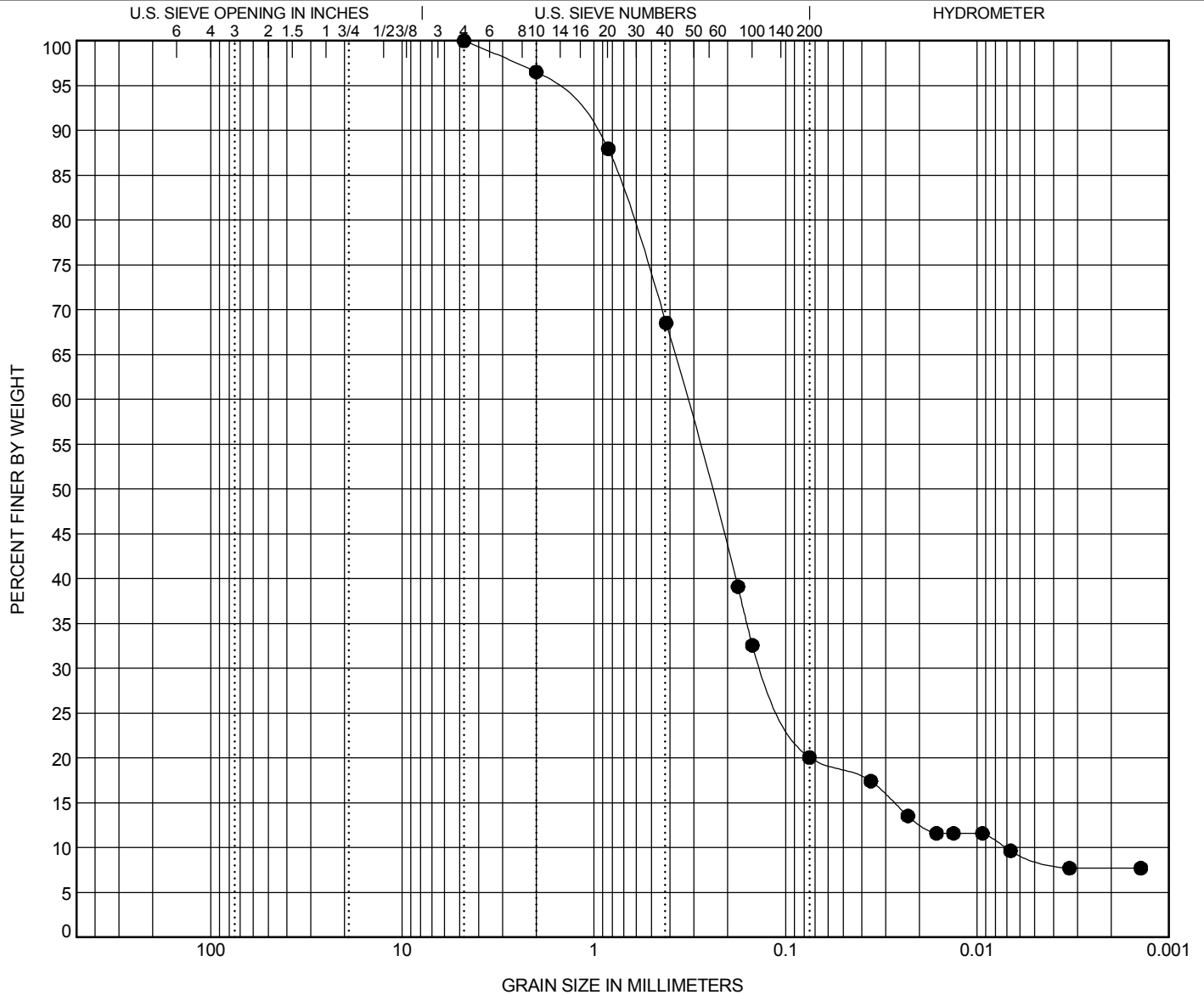


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry

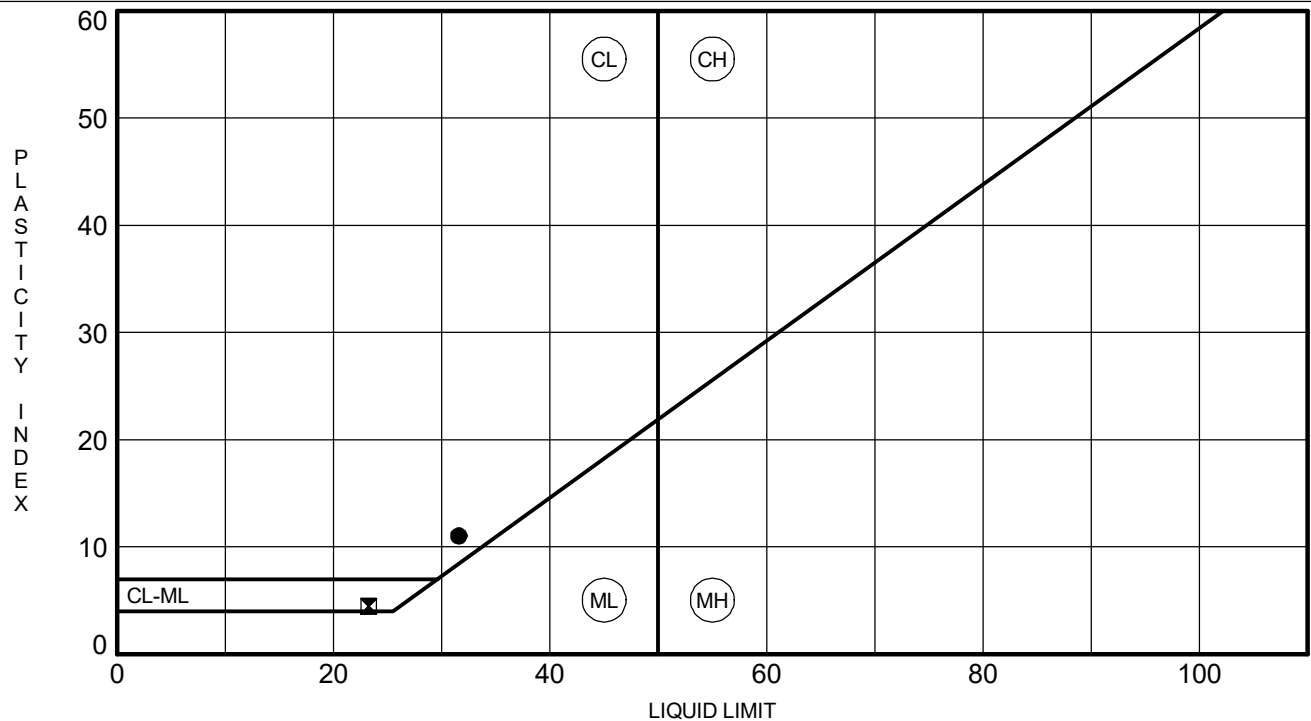




PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry

[illegible]

ATTERBERG LIMITS G6100.05.10 - RBO TRIBUTARY TO SECOND CREEK.GPJ FME2017.GDT 8/27/19

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 G6100.050.00010 - Tributary to 2nd Creek
 Depth 33.5' - 33.8'
 Sample RC-301.1
 Lab ID number 42140025

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
1.32E-03	-2.96E-04	7739
6.54E-04	-1.19E-04	3875

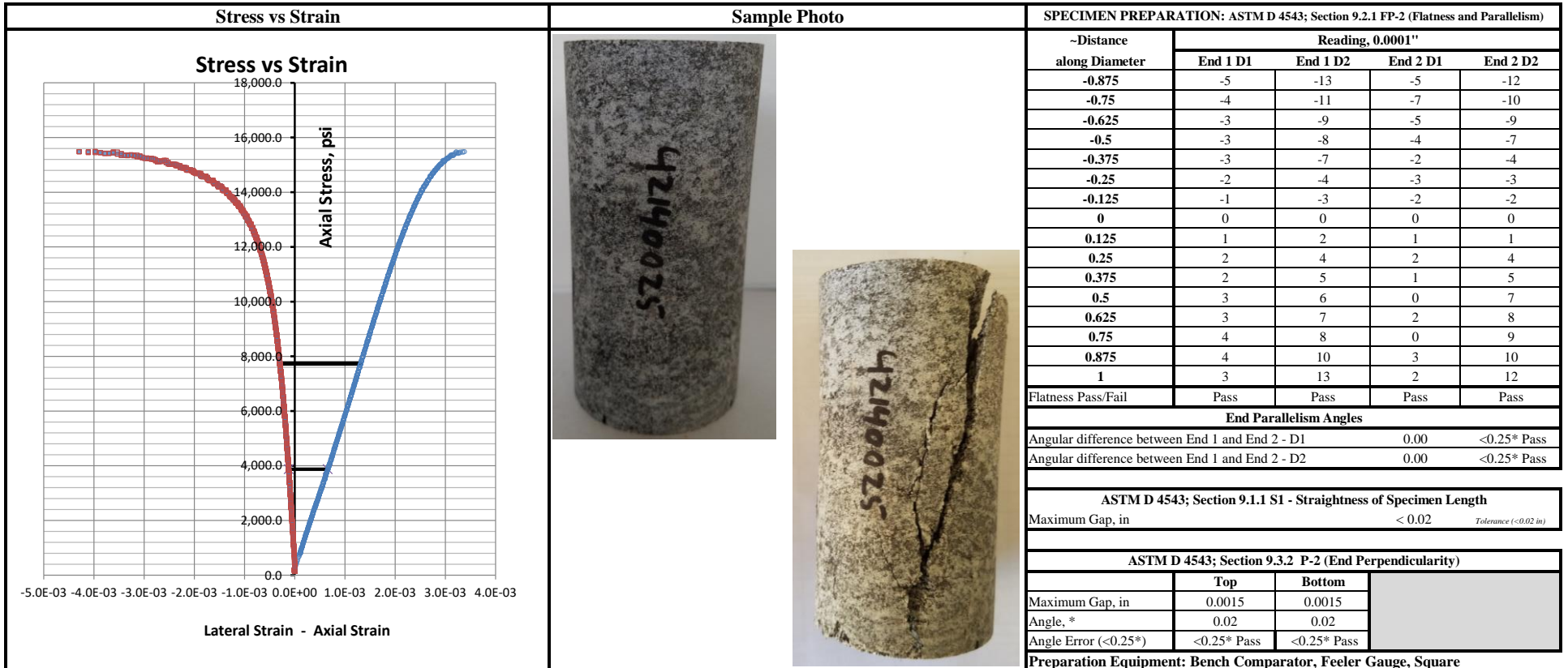
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.069
Mid Height Diameter #1, in	1.864
Mid Height Diameter #2, in	1.861
Average Mid. Height Diameter, in.	1.86
Sample Area, in ²	2.72
L/D Ratio (2.0-2.5)	2.18

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	500.8	
Sample Volume, cc	182	
Wet Density, pcf	172	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	42191
Unconfined Compressive Strength, psi	15,486
Youngs Modulus, E psi	5.8 E+06
Slope of Lateral Curve, psi	-21.8 E+06
Poisson's Ratio	0.27

Load Application in Relation to Lithology:

Unable to Determine



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 G6100.050.00010 - Tributary to 2nd Creek
 Depth 37.5' - 37.8'
 Sample RC-301.2
 Lab ID number 42140026

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
1.50E-03	-3.72E-04	8284
7.89E-04	-1.35E-04	4162

ASTM D 4543; Section 4.2 & 5.6	
Length, in	3.71
Mid Height Diameter #1, in	1.866
Mid Height Diameter #2, in	1.871
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.74
L/D Ratio (2.0-2.5)	1.99

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	463.27	
Sample Volume, cc	167	
Wet Density, pcf	173	

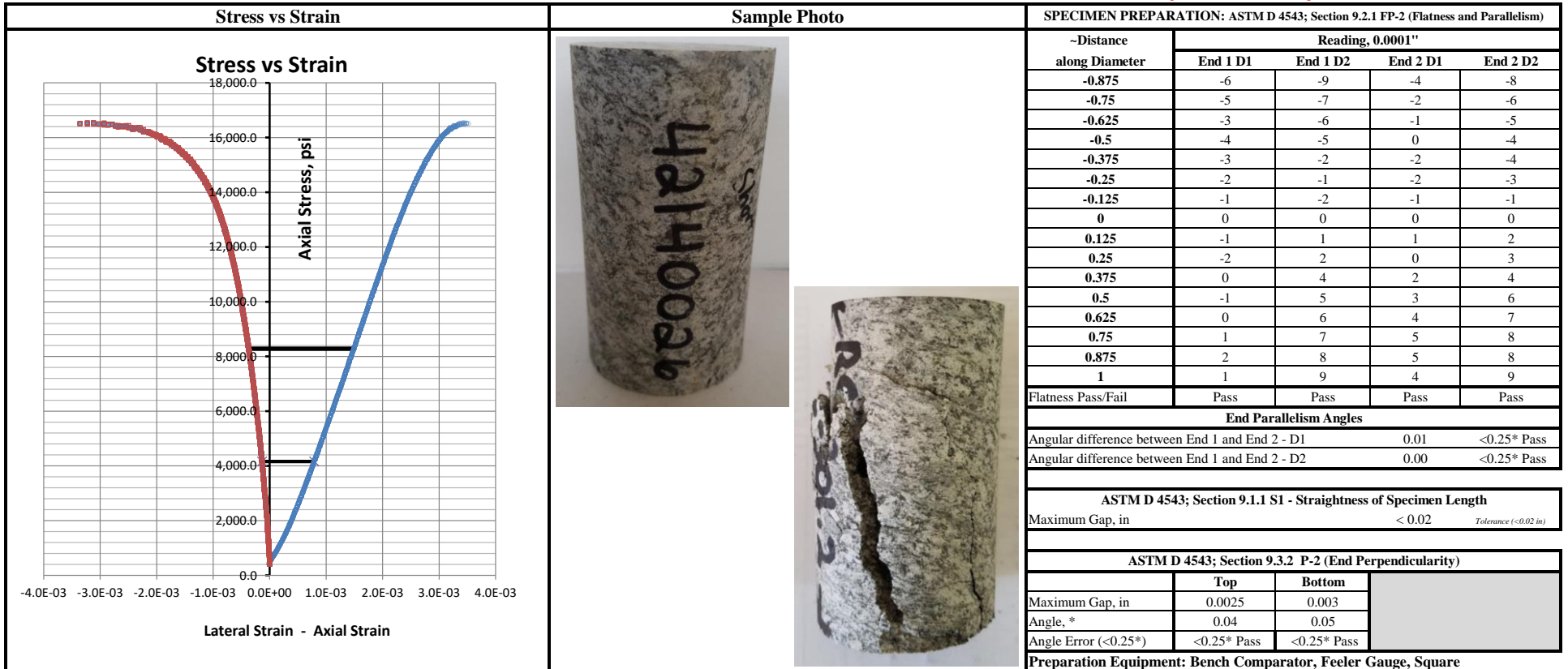
Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	45348
Unconfined Compressive Strength, psi	16,538
Youngs Modulus, E psi	5.8 E+06
Slope of Lateral Curve, psi	-17.4 E+06
Poisson's Ratio	0.33

Load Application in Relation to Lithology: Unable to Determine

Note: L/D does not meet ASTM Requirements

PennDot Specified Correction Factor = 1.0009

PennDot Specified Corrected Strength = 16,524



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/24/2019

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

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	S-36-272 Replacement Bridge over Tributary to Second Creek	PROJECT NO.:	P038066
SAMPLE NUMBER:	19-1459	DATE SAMPLE RECEIVED:	6/13/2019
DESCRIPTION OF SOIL:	VARIOUS		
TESTED BY:	JH	DATE OF TESTING:	8/6/2019
WEIGHED BY:	JH	DATE OF WEIGHING:	8/7/2019

BORING NO.	B-302	B-302	B-302	B-302	B-302
SAMPLE NO.	SS-1	SS-3	SS-4	SS-5	SS-6
SAMPLE DEPTH	0-2'	4-6'	6-8'	8-10'	13.5-15'
WATER CONTENT, W%	15.1	20.8	21.8	19.5	24.3

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%					

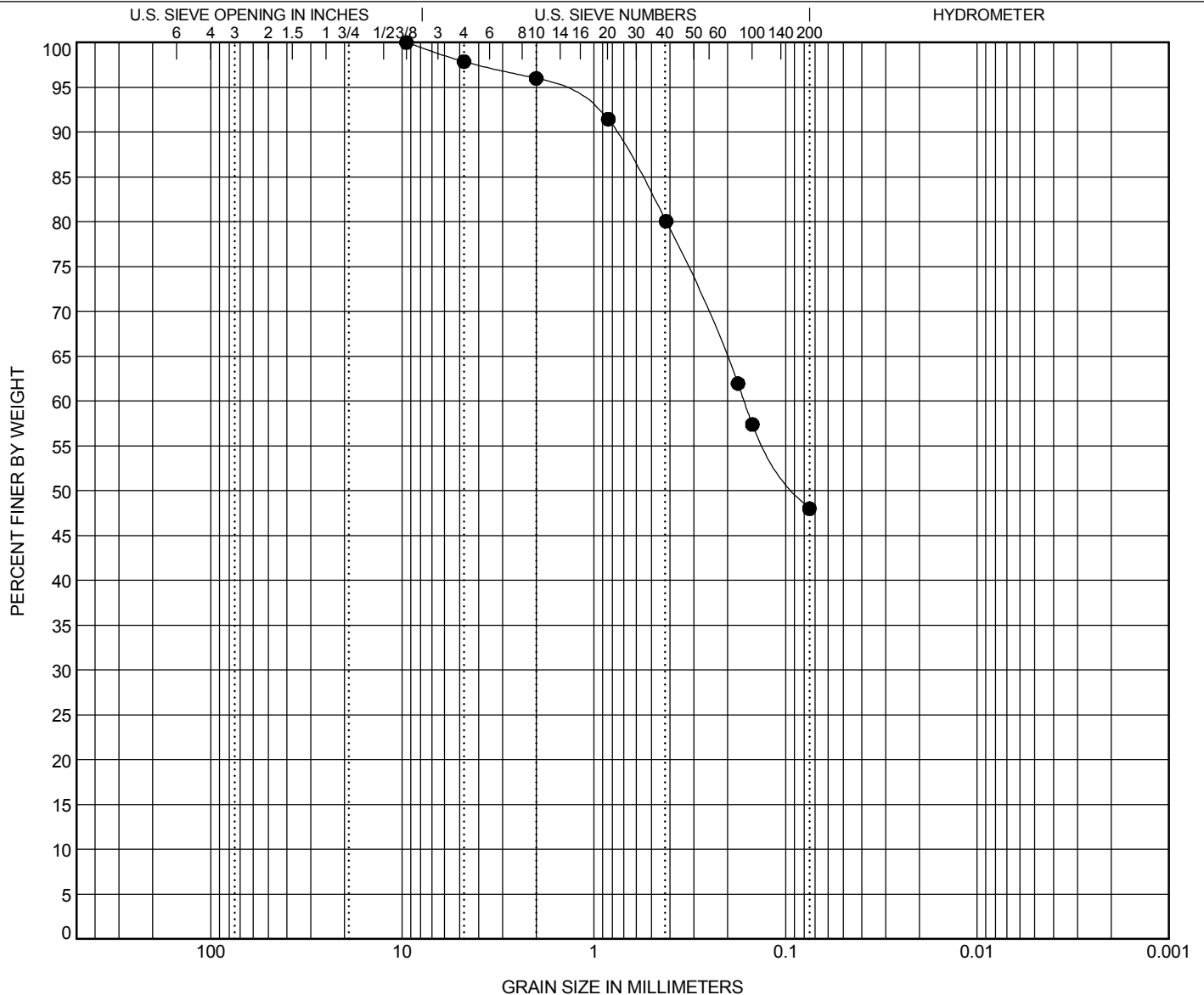


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-302	8.0	Clayey SAND (SC/A-4(0))					47	22	25		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-302	8.0	9.51	1.652	0.087		2.1	49.9	48.0			

GRAIN SIZE G6100.05.10 - RBO TRIBUTARY TO SECOND CREEK.GPJ FME2017.GDT 9/10/19

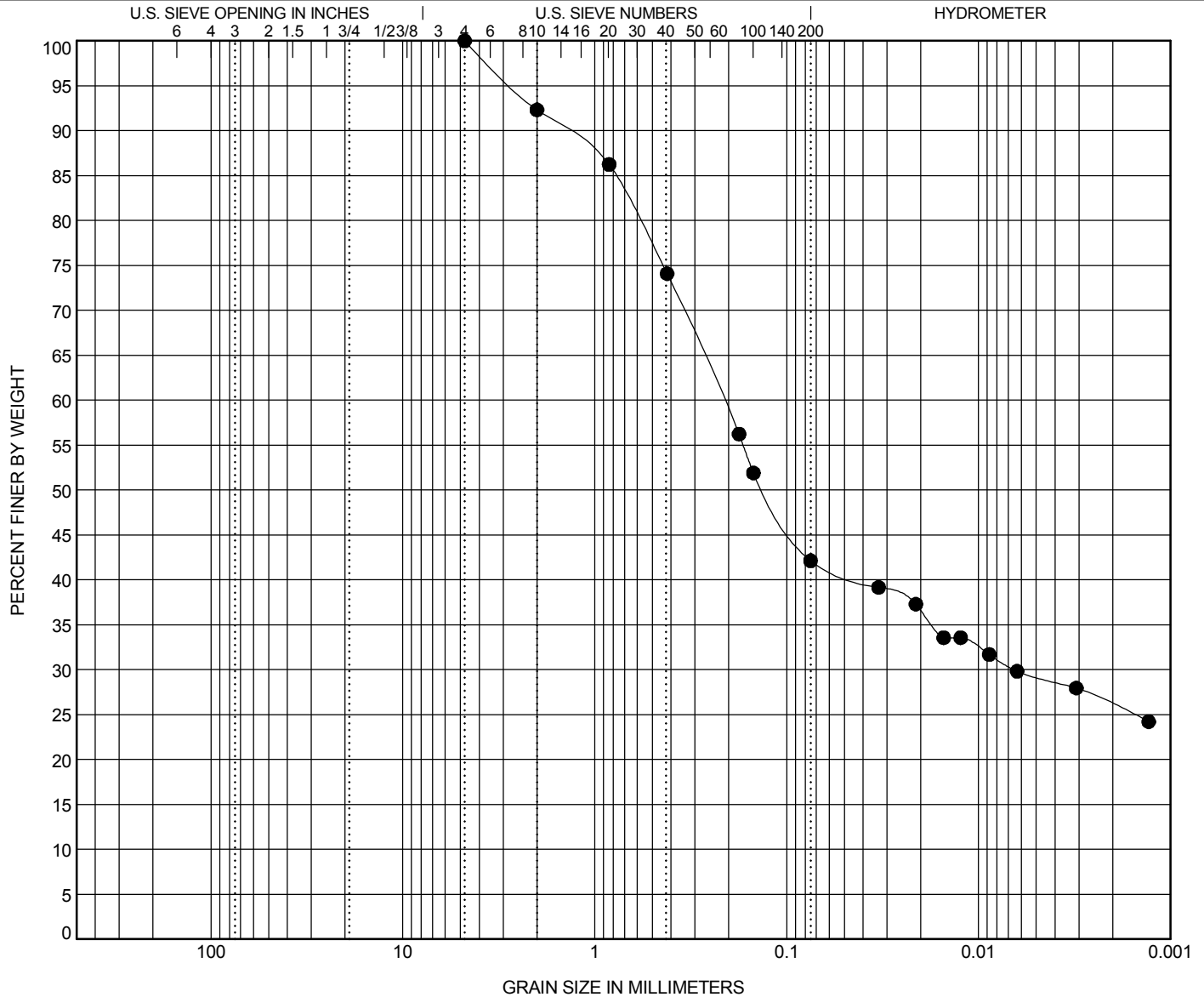


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-302	10.0	Clayey SAND (SC)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-302	10.0	4.76	2.706	0.13		0.0	57.8	12.9	29.2		

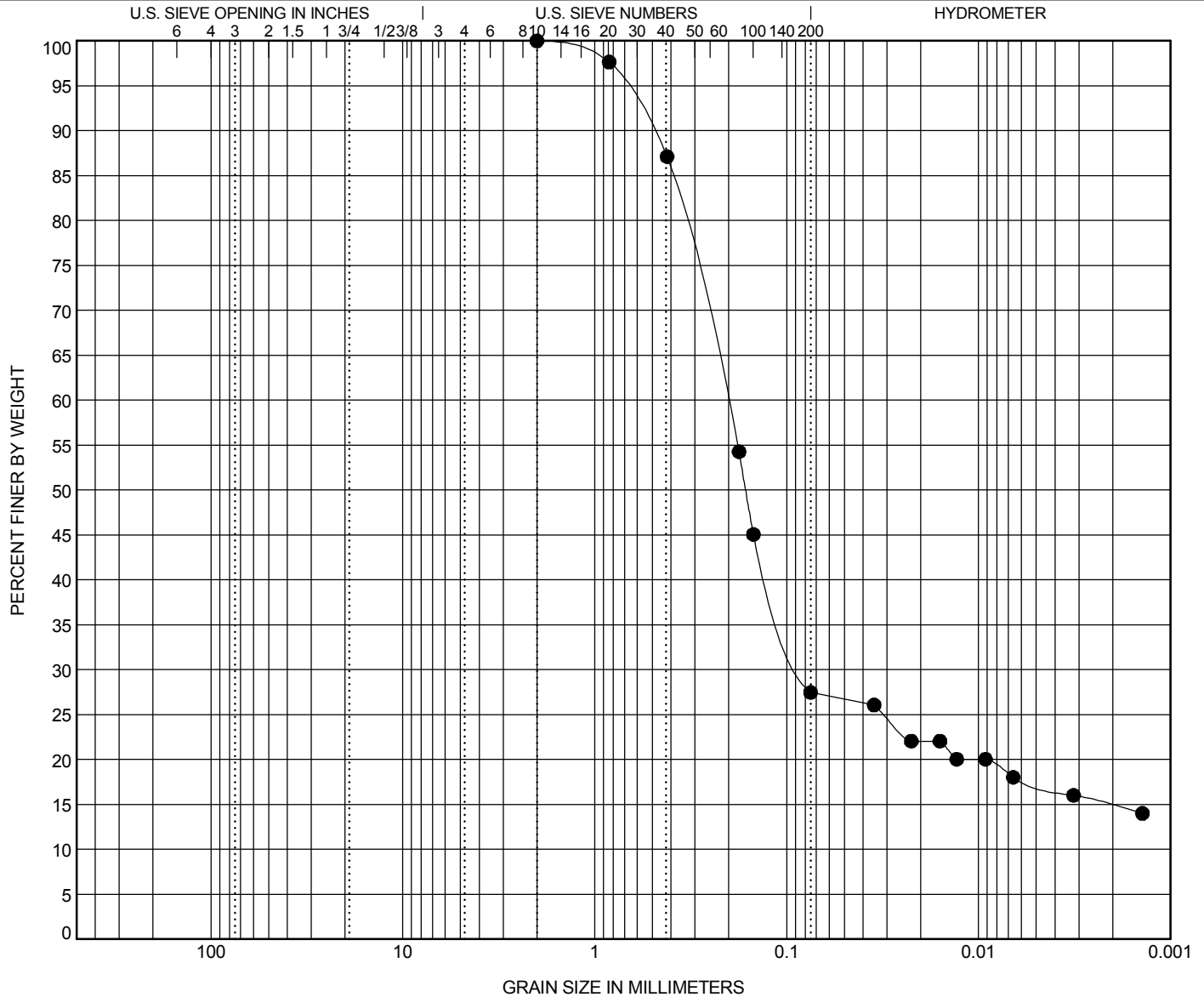


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



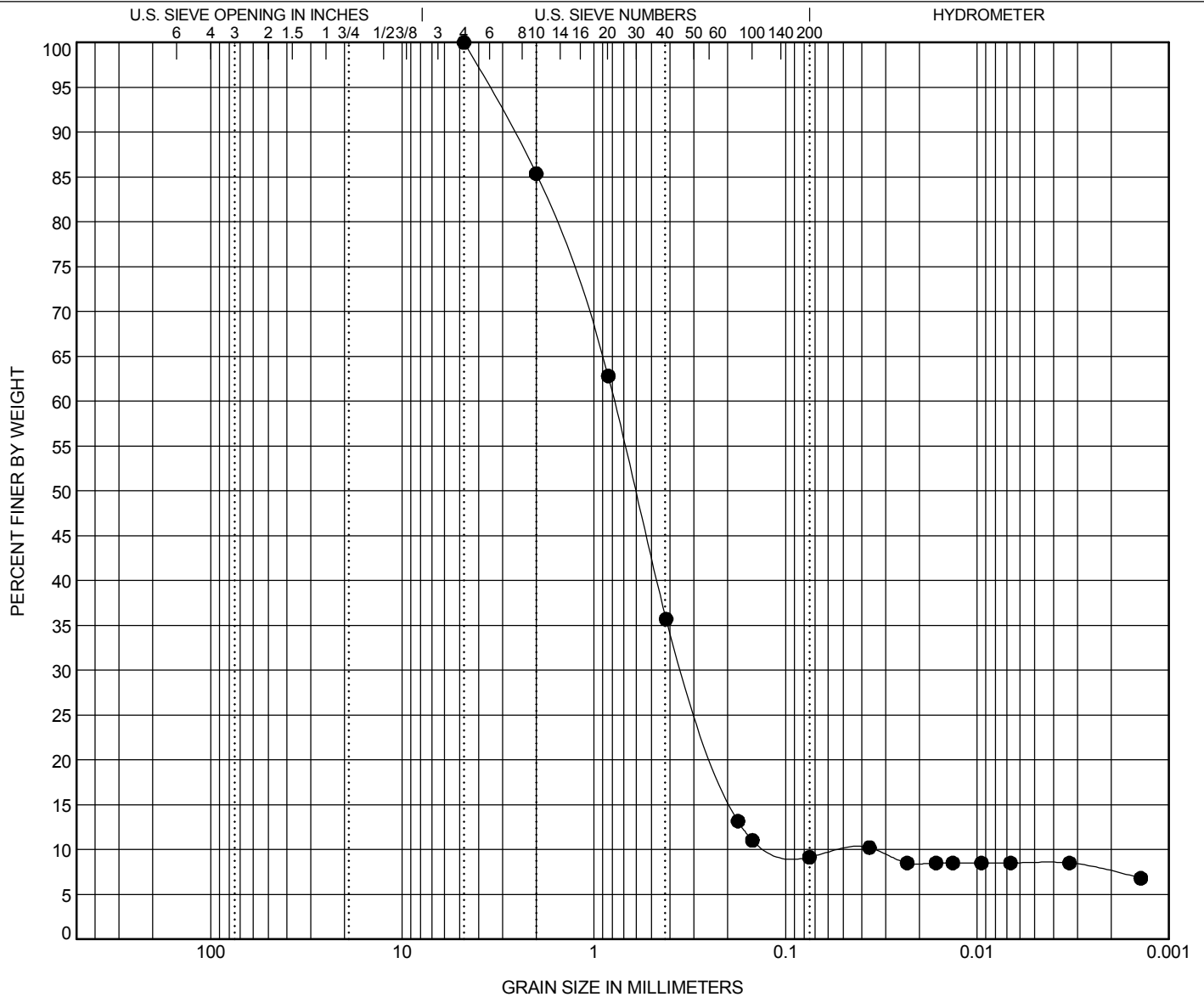


GRAIN SIZE DISTRIBUTION

PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

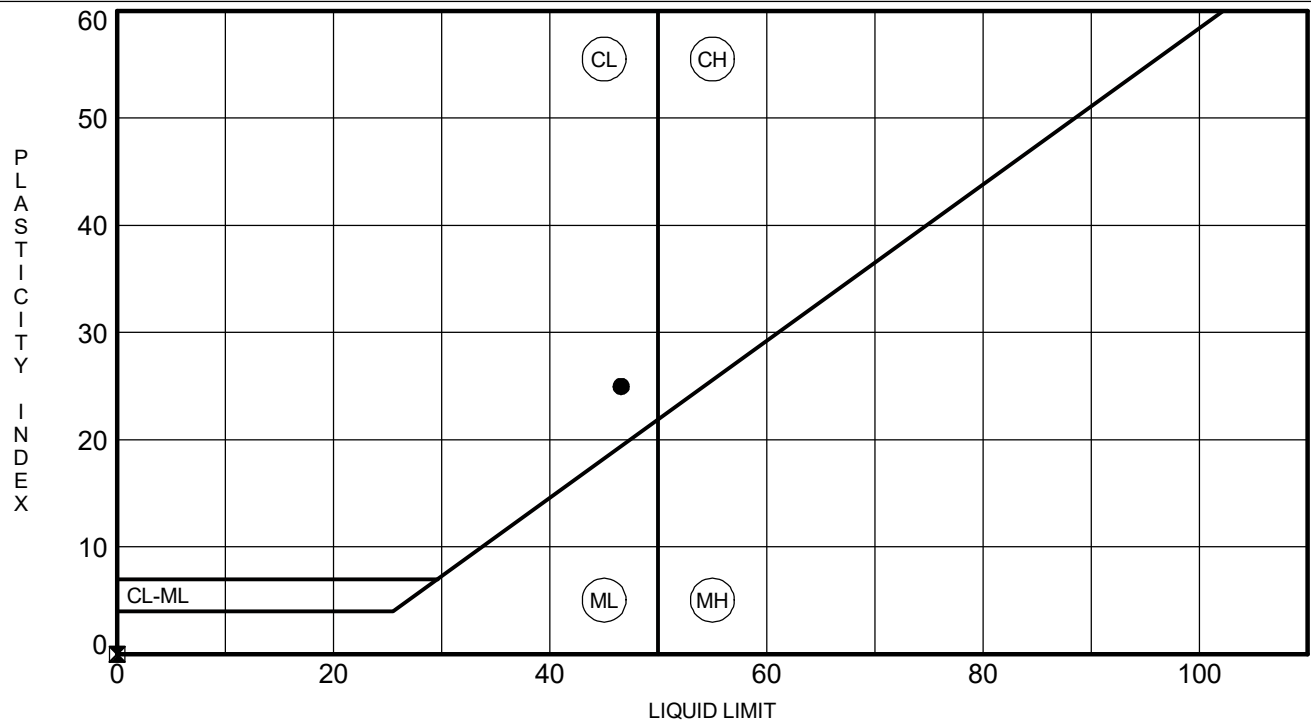
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-302	20.0	Silty SAND (SM)								3.41	18.33
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-302	20.0	4.76	3.539	0.606	0.043	0.0	90.8	0.6	8.5		



PROJECT ID P038066

PROJECT NAME S-36-272 Replacement Bridge over Tributary to Second Creek

PROJECT COUNTY Newberry

[illegible]

ATTERBERG LIMITS G6100.05.10 - RBO TRIBUTARY TO SECOND CREEK.GPJ FME2017.GDT 8/27/19

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