

REVISED

GEOTECHNICAL BASE LINE REPORT

Route S-36-342 Replacement Bridge over Big Beaver Dam 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: P038068

F&ME Project #: G6100.05.12

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-36-342 Bridge over Big Beaver Dam Creek
Newberry County, South Carolina
SCDOT Project ID: P038068
F&ME Project No.: G6100.050.12

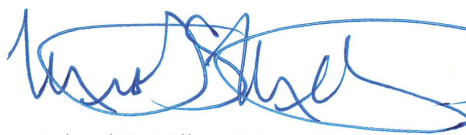
Dear Mr. Harris:

Submitted herein is F&ME Consultants, Inc. (FME) revised Geotechnical Base Line Report (GBLR) for the Route S-36-342 Replacement Bridge over Big Beaver Dam. 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 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-36-342 Replacement Bridge over Big Beaver Dam 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 April 10 and 11, 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-101	Paved Roadway	26.8	9.7	36.5	34.331392	-81.695534	480.0
B-102	Paved Roadway	23.8	6.8	30.6	34.331502	-81.695425	480.2
Totals	-	50.6	16.5	67.1			

2.2 Groundwater

Groundwater depths were recorded at the time of boring (TOB) for soil test borings B-101 and B-102, with the recorded measurements noted on the individual Soil Test Boring Logs in Section 4 of the Appendix to this report. Groundwater measurement 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-101	4/11/2019	15.2	15.2
B-102	4/10/2019	15.3	15.3

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 TESTING (SPLIT-SPOON SAMPLES)		
Type of Test	Quantity	Procedure
Grain Size Analysis with Hydrometer	7	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	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	480	0	SM	8	-
Alluvium	475	5	SC-SM, ML	4	-
Residuum	467	13	SP-SM, SM	20	-
Bed Rock	454	26	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. As such, 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 from 12,800 psi to 17,800 psi.

S-36-342 Replacement Bridge over Big Beaver Dam 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

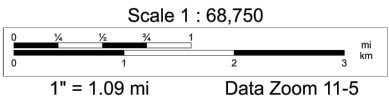
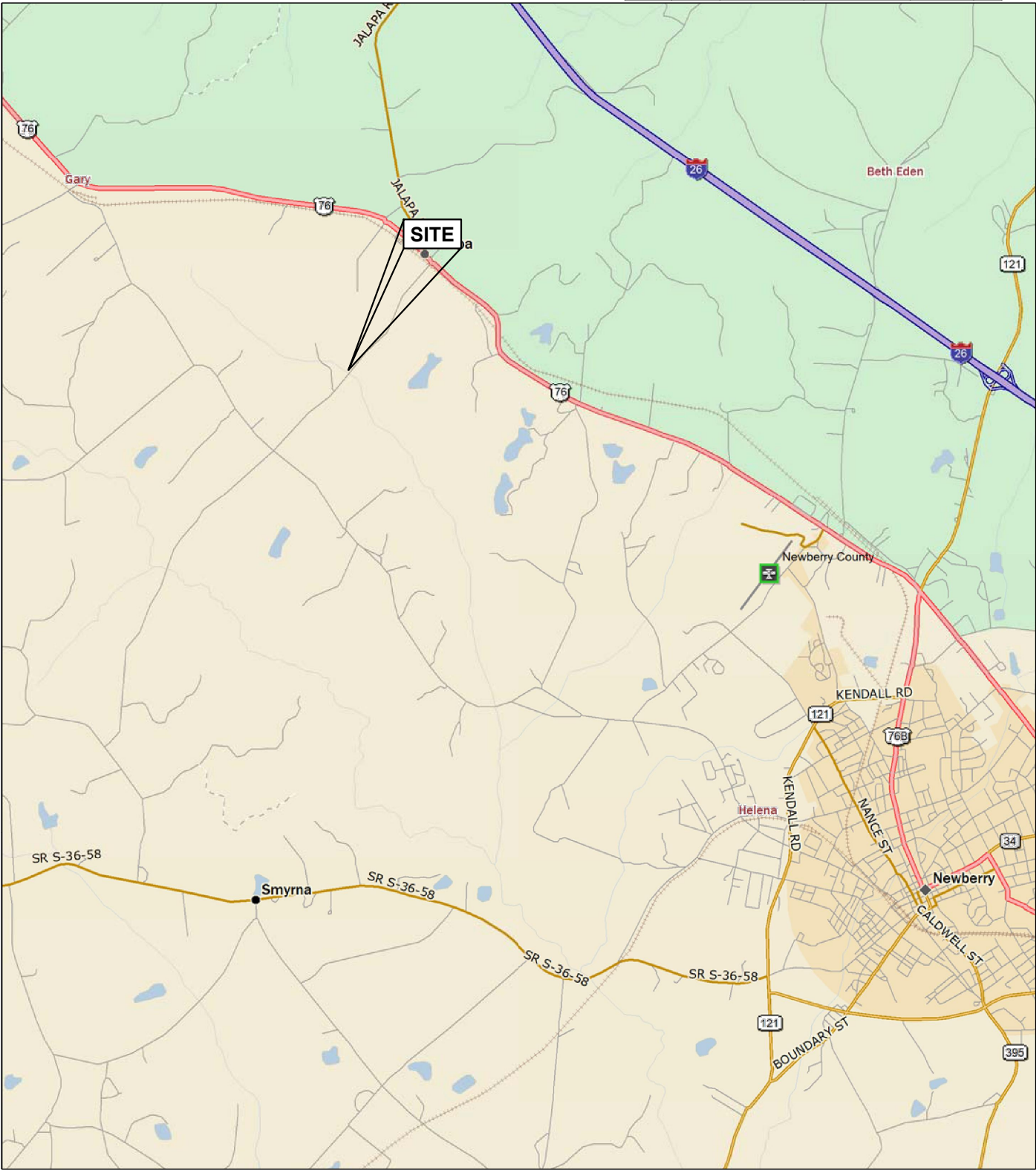
S-36-342 Replacement Bridge over Big Beaver Dam Creek

Geotechnical Base Line Report

APPENDIX

SECTION 1 SITE LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	NEWBERRY	P038068	S-36-342	



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	

BIG BEAVER DAM CREEK
NEWBERRY COUNTY, SOUTH CAROLINA

SITE LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: AS NOTED

FIGURE 1

S-36-342 Replacement Bridge over Big Beaver Dam Creek


Geotechnical Base Line Report

APPENDIX

SECTION 2 BORING LOCATION PLAN

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD/ROUTE NO.	SHEET NO.
3	SC	NEWBERRY	P038068	S-36-342	





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

BIG BEAVER DAM CREEK
NEWBERRY COUNTY, SOUTH CAROLINA

BORING LOCATION PLAN

F&ME JOB NO. G6100.050

SCALE: 1"=30'

FIGURE 2

S-36-342 Replacement Bridge over Big Beaver Dam Creek

Geotechnical Base Line Report

APPENDIX

SECTION 3 DRILL RIG PHOTOS

Drill Rig Setup Photographs

B-101



Drill Rig Setup Photographs

B-102



S-36-342 Replacement Bridge over Big Beaver Dam 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
		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



Project ID: P038068				County: Newberry		Boring No.: B-101		
Site Description:		S-36-342 Replacement Bridge over Big Beaver Dam Creek					Route: S-36-342	
Eng./Geo.: R. Wessinger		Boring Location: N/A		Offset: N/A		Alignment: Existing		
Elev.: 480.0 ft		Latitude: 34.331392		Longitude: -81.695534		Date Started: 4/11/2019		
Total Depth: 36.5 ft		Soil Depth: 26.8 ft		Core Depth: 9.7 ft		Date Completed: 4/11/2019		
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 15.2 ft		24HR 15.2 ft		

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LEGEND

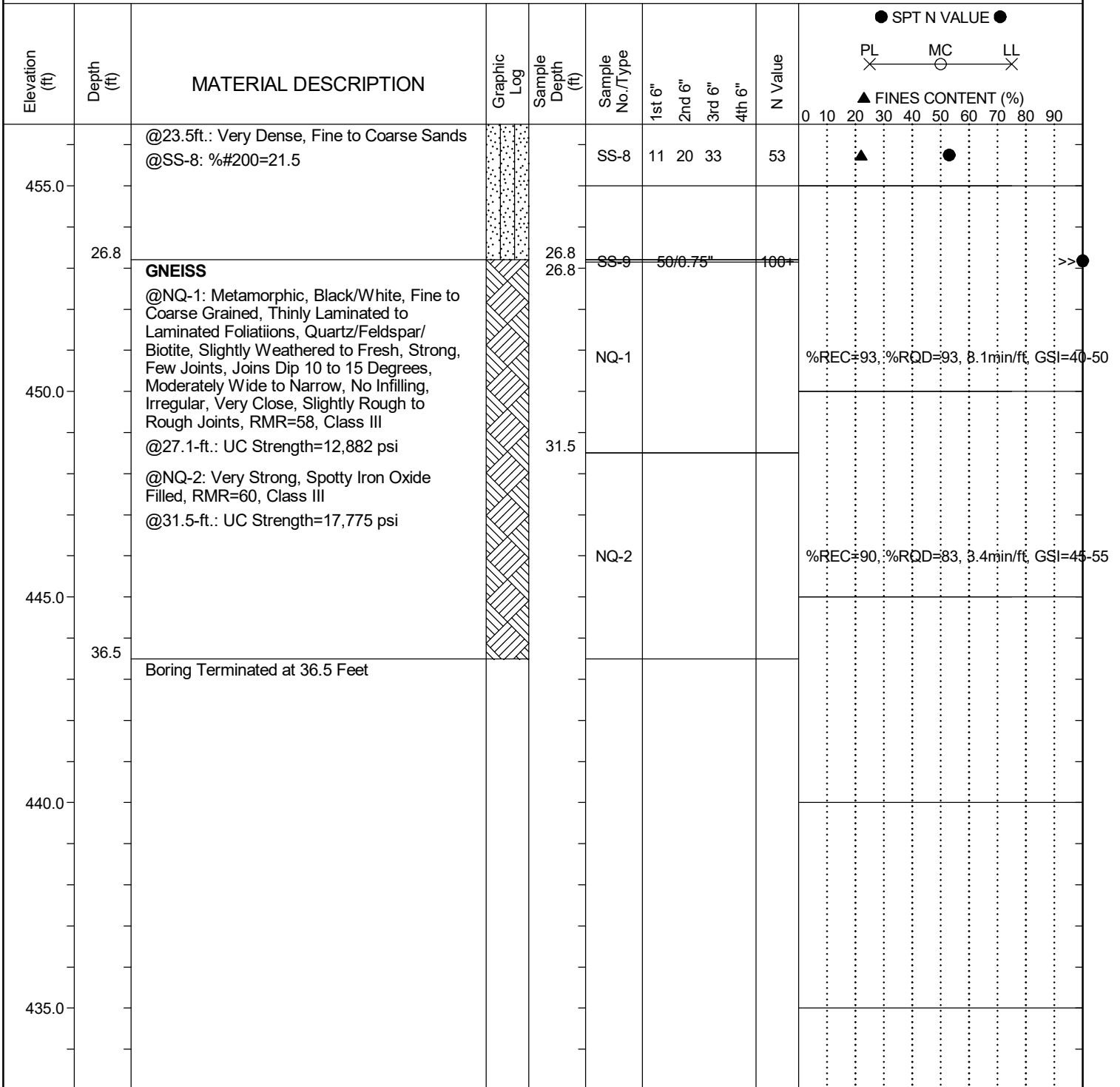
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SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

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:	P038068	County:	Newberry	Boring No.:	B-101
Site Description:	S-36-342 Replacement Bridge over Big Beaver Dam Creek			Route:	S-36-342
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	480.0 ft	Latitude:	34.331392	Longitude:	-81.695534
Date Started:	4/11/2019				
Total Depth:	36.5 ft	Soil Depth:	26.8 ft	Core Depth:	9.7 ft
Date Completed:	4/11/2019				
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	15.2 ft	24HR
					15.2 ft

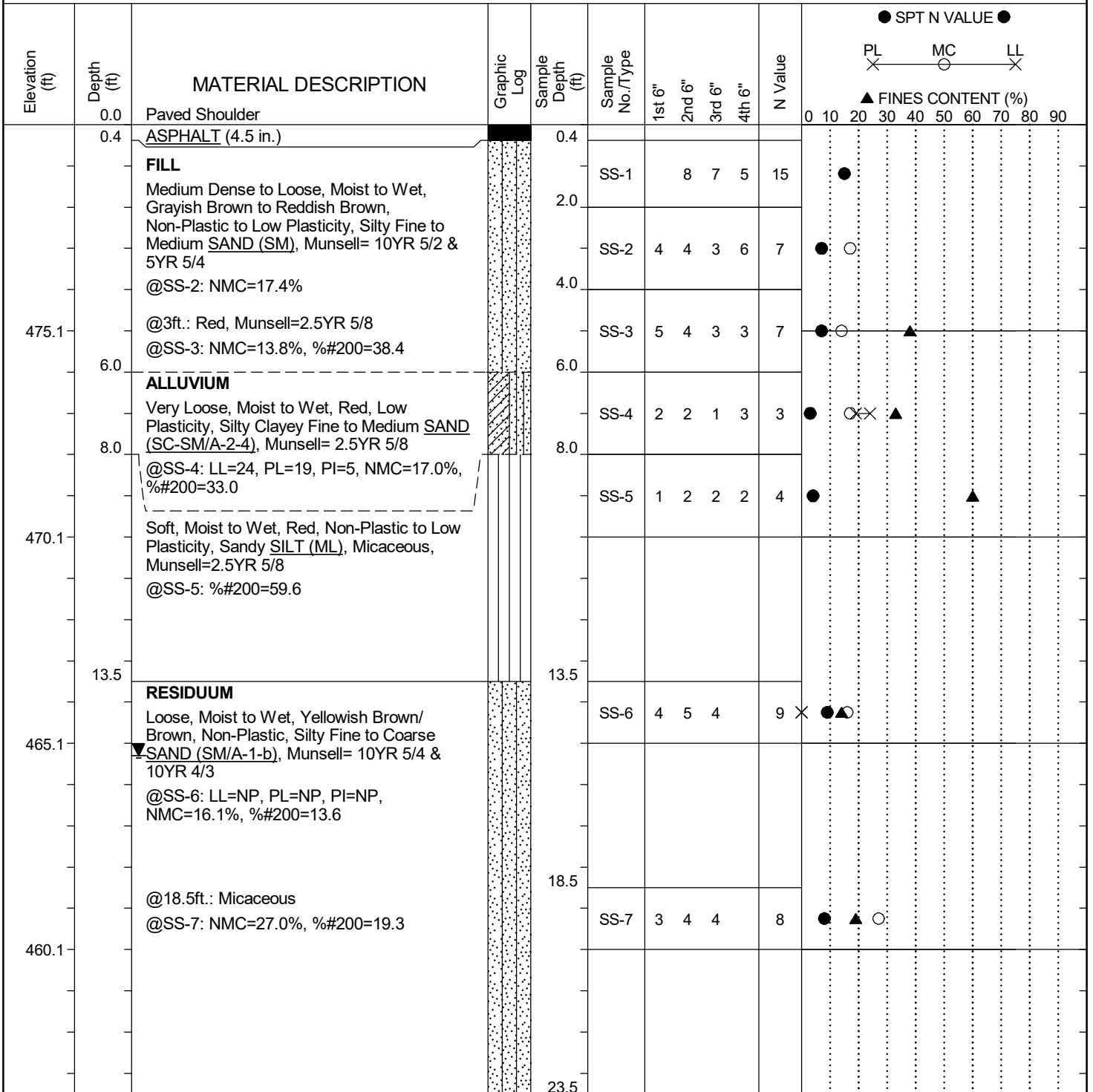


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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving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

SCDOT Soil Test Log

Project ID:	P038068	County:	Newberry	Boring No.:	B-102
Site Description:	S-36-342 Replacement Bridge over Big Beaver Dam Creek			Route:	S-36-342
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	480.1 ft	Latitude:	34.331502	Longitude:	-81.695425
Date Started:	4/10/2019				
Total Depth:	30.6 ft	Soil Depth:	23.8 ft	Core Depth:	6.8 ft
Date Completed:	4/10/2019				
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	15.3 ft	24HR
					15.3 ft



LEGEND

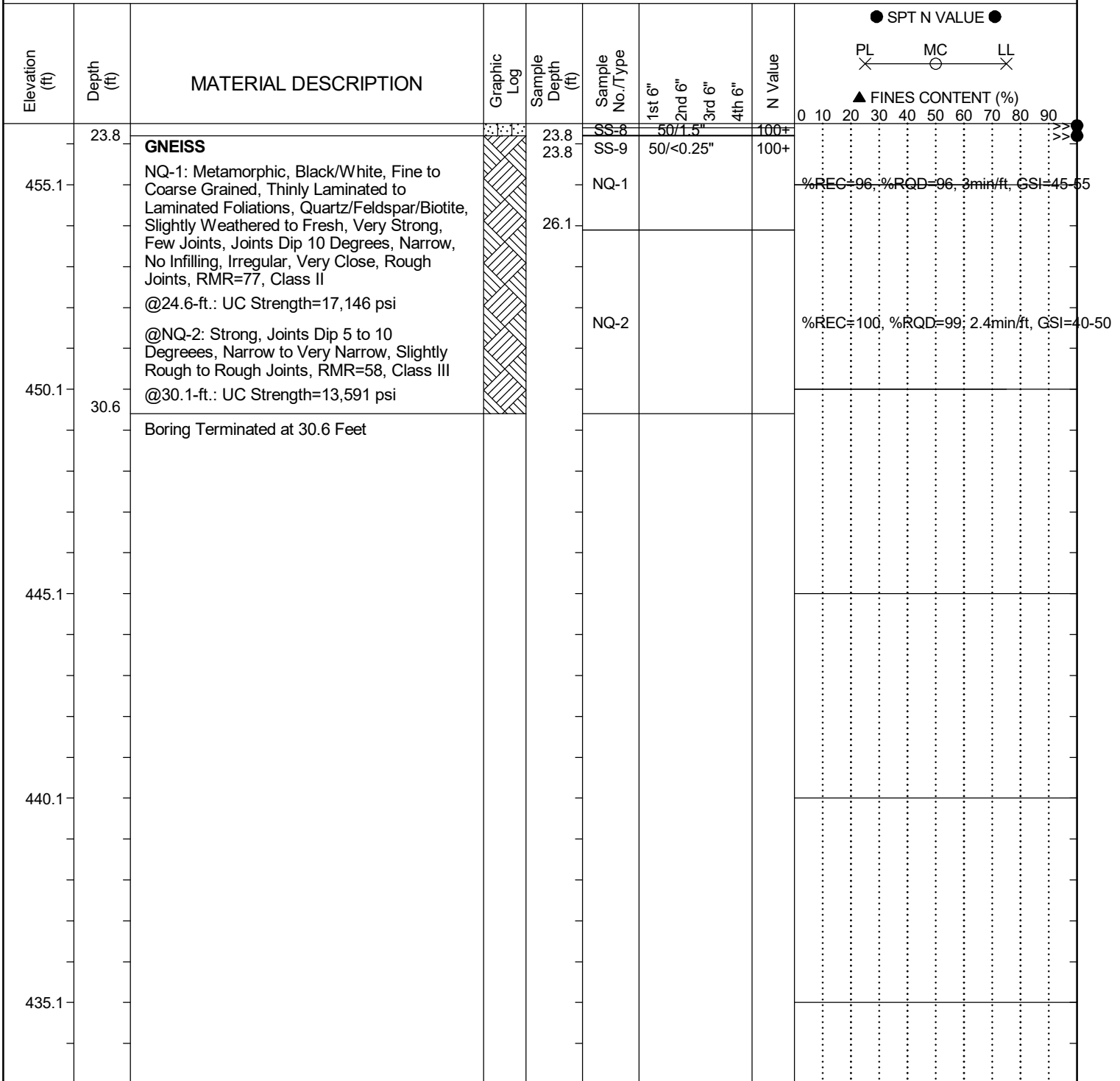
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SAMPLER TYPE	
SS - Split Spoon	NQ - Rock Core, 1-7/8"
UD - Undisturbed Sample	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

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:	P038068	County:	Newberry	Boring No.:	B-102
Site Description:	S-36-342 Replacement Bridge over Big Beaver Dam Creek			Route:	S-36-342
Eng./Geo.:	R. Wessinger	Boring Location:	N/A	Offset:	N/A
Elev.:	480.1 ft	Latitude:	34.331502	Longitude:	-81.695425
Date Started:	4/10/2019				
Total Depth:	30.6 ft	Soil Depth:	23.8 ft	Core Depth:	6.8 ft
Date Completed:	4/10/2019				
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	15.3 ft	24HR
					15.3 ft



LEGEND

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

S-36-342 Replacement Bridge over Big Beaver Dam 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-36-342 Bridge Replacement over Big Beaver Dam Creek)


PROJECT COUNTY


Newberry


LITHOLOGIC SYMBOLS
(Unified Soil Classification System)


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
 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

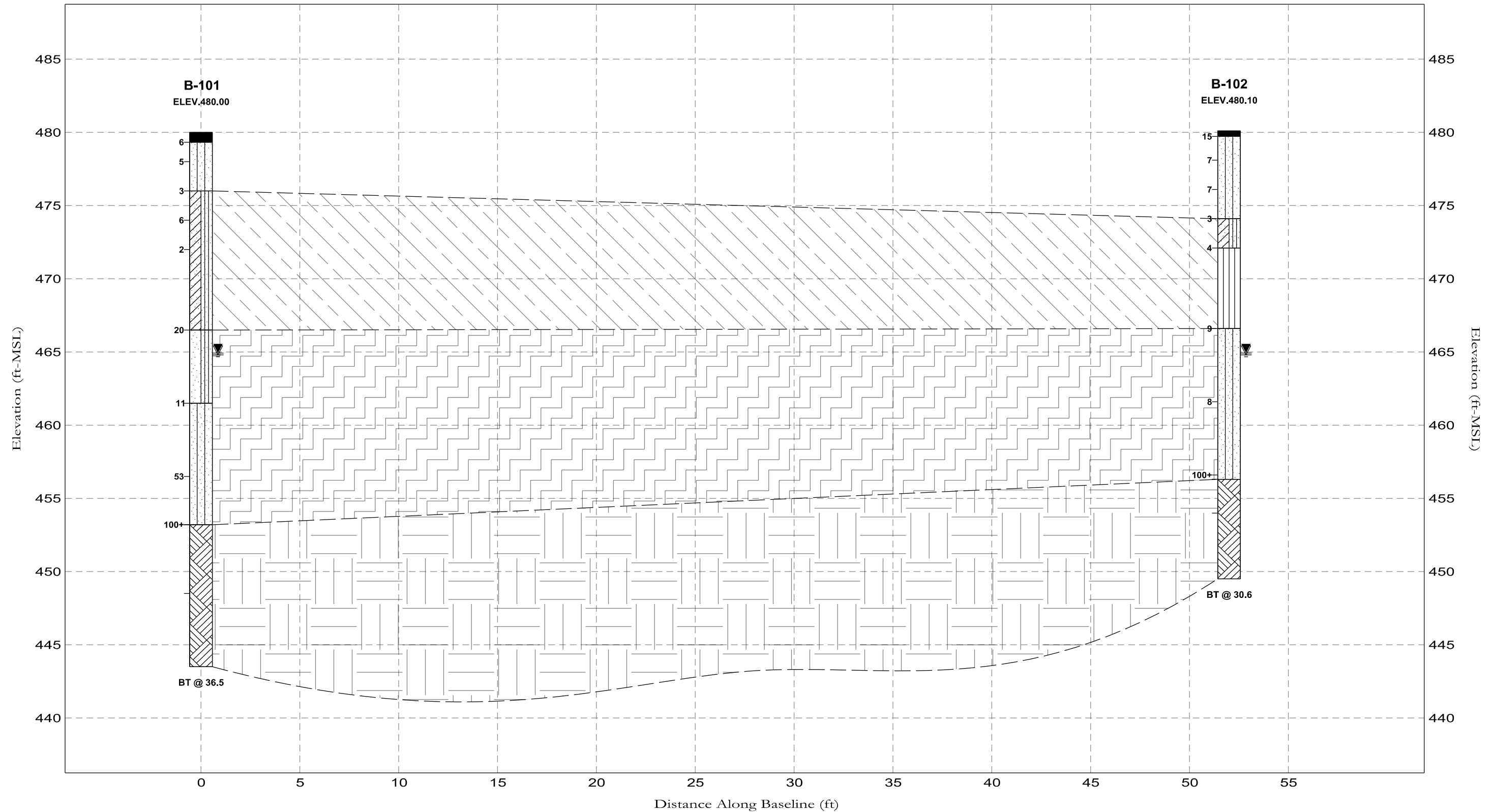
LL - LIQUID LIMIT (%)
PL - PLASTIC LIMIT (%)
PI - PLASTIC INDEX (%)
NMC - MOISTURE CONTENT (%)
NP - NON PLASTIC
%#200 - PERCENT PASSING NO. 200 SIEVE

 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.



ALLUVIUM



RESIDUUM



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-36-342 BRIDGE REPLACEMENT
OVER BIG BEAVER DAM CREEK**

GENERALIZED SUBSURFACE PROFILE

HRZ SCALE = NTS

VRT SCALE = NTS

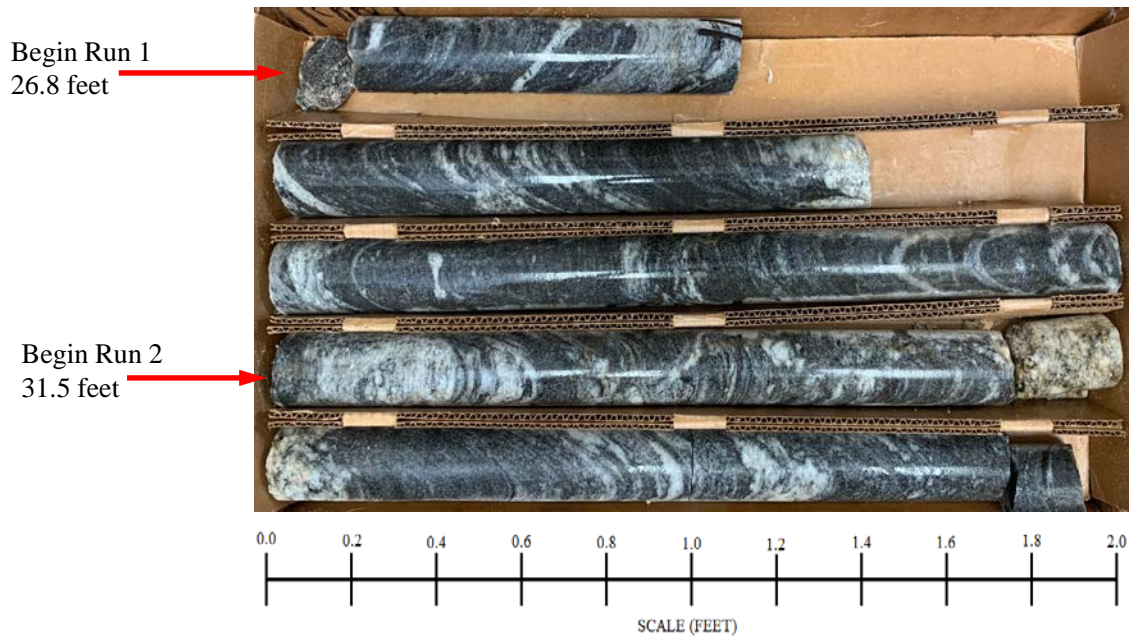
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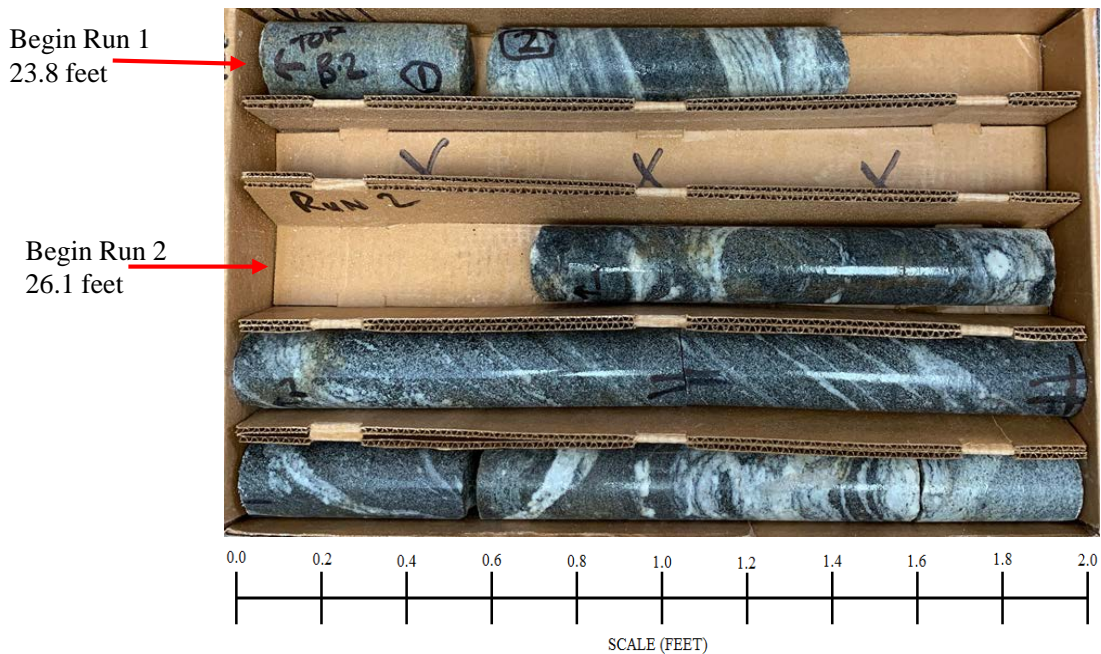
APPENDIX

SECTION 6 ROCK CORE PHOTOS

Boring B-101



Boring B-102



S-36-342 Replacement Bridge over Big Beaver Dam Creek

Geotechnical Base Line Report

APPENDIX

SECTION 7 LABORATORY TEST RESULTS



SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry

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-101	10.0	23	19	4	2	39	SC-SM	21.7			
B-101	15.0				4.76	10		15.6			
B-101	20.0	NP	NP	NP	4.76	21	SM	23.0			
B-101	25.0				4.76	21					
B-102	6.0				9.51	38		13.8			
B-102	8.0	24	19	5	9.51	33	SC-SM	17.0			
B-102	10.0				4.76	60					
B-102	15.0	NP	NP	NP	4.76	14	SM	16.1			
B-102	20.0				4.76	19		27.0			



Rock Coring Summary

Project ID: P038068

Project Name: S-36-342 RBO Big Beaver Dam 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-101	NQ-1	26.8	93	93	12,882	0.22	6.30E+03	169	58
									40-50
	NQ-2	31.5	90	83	17,775	0.23	6.90E+03	164	60
									45-55
B-102	NQ-1	23.8	96	96	17,146	0.31	6.60E+03	168	77
									45-55
	NQ-2	26.1	100	99	13,591	0.27	5.80E+03	173	58
									40-50

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

MOISTURE CONTENT DETERMINATION
(AASHTO T265)

PROJECT:	<u>S-36-342 Replacement Bridge over Big Beaver Dam Creek</u>	PROJECT NO.:	<u>P038068</u>
SAMPLE NUMBER:	<u>19-1256</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-101	B-101	B-101	B-101	B-101
SAMPLE NO.	SS-3	SS-4	SS-5	SS-6	SS-7
SAMPLE DEPTH	4-6'	6-8'	8-10'	13.5-15'	18.5-20
WATER CONTENT, W%	19.3	17.1	21.7	15.6	23.0

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%					

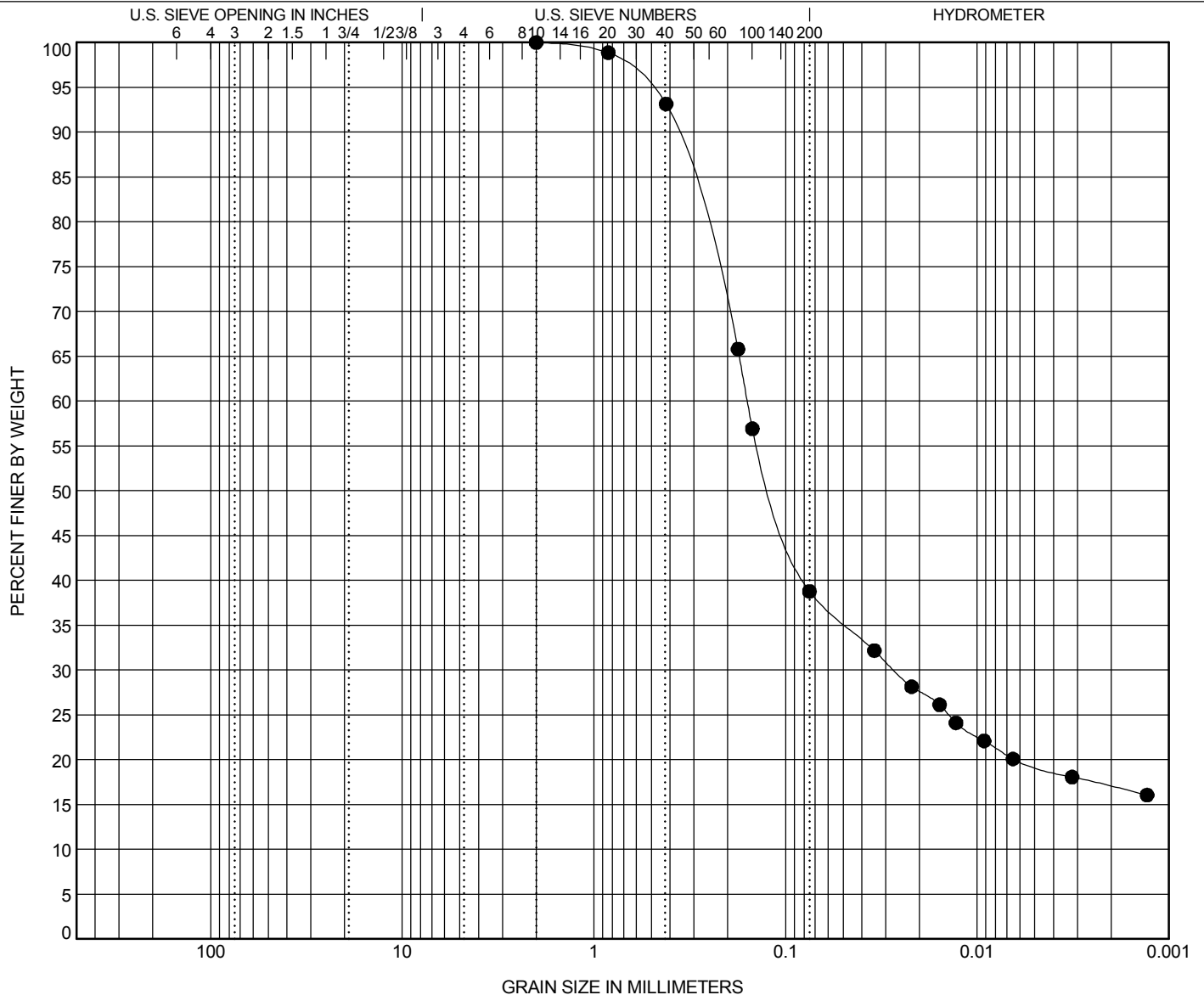


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



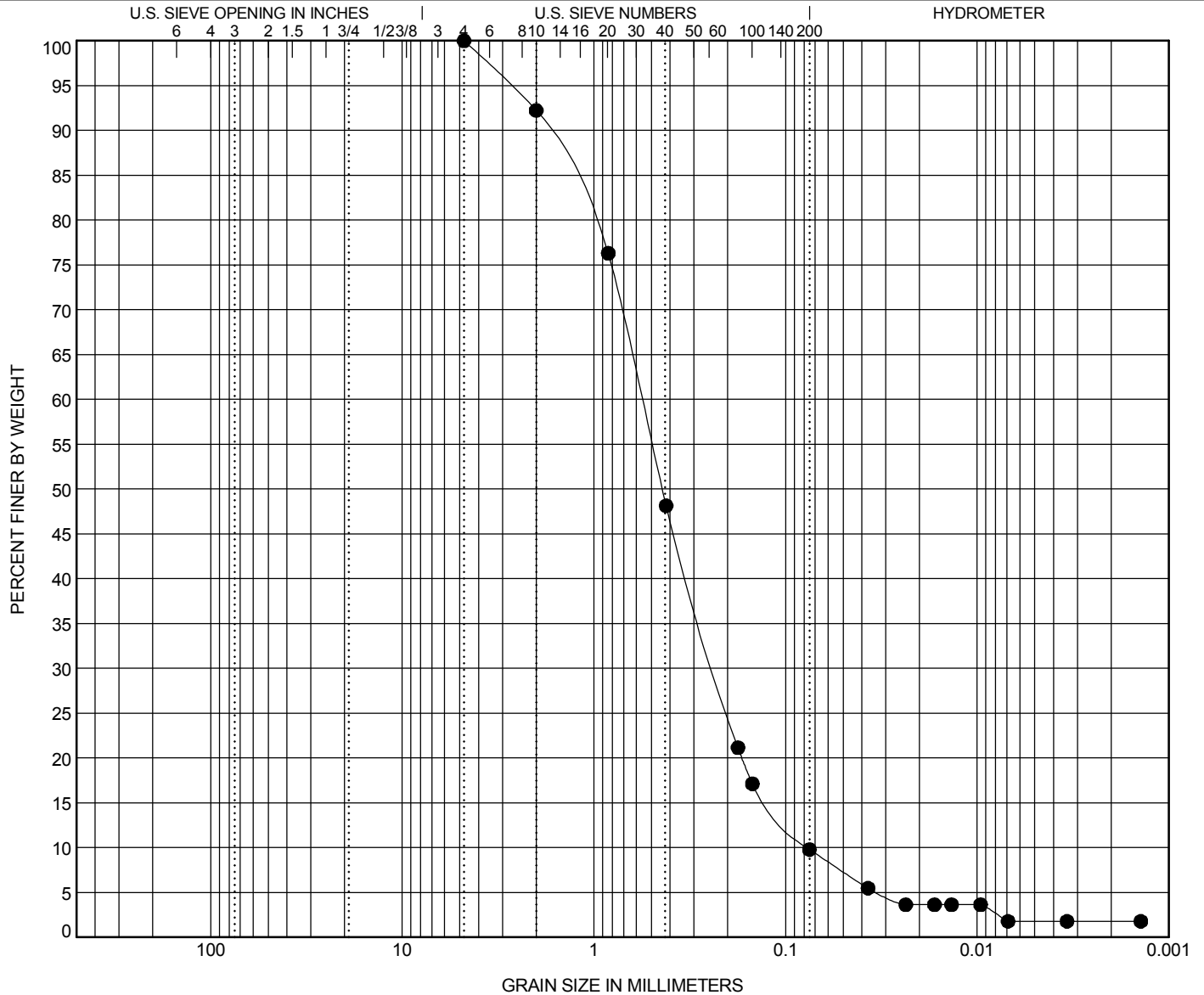


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-101	15.0	SAND (SP-SM) with Silt								1.28	7.36
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-101	15.0	4.76	2.723	0.44	0.076	0.0	90.2	8.0	1.8		

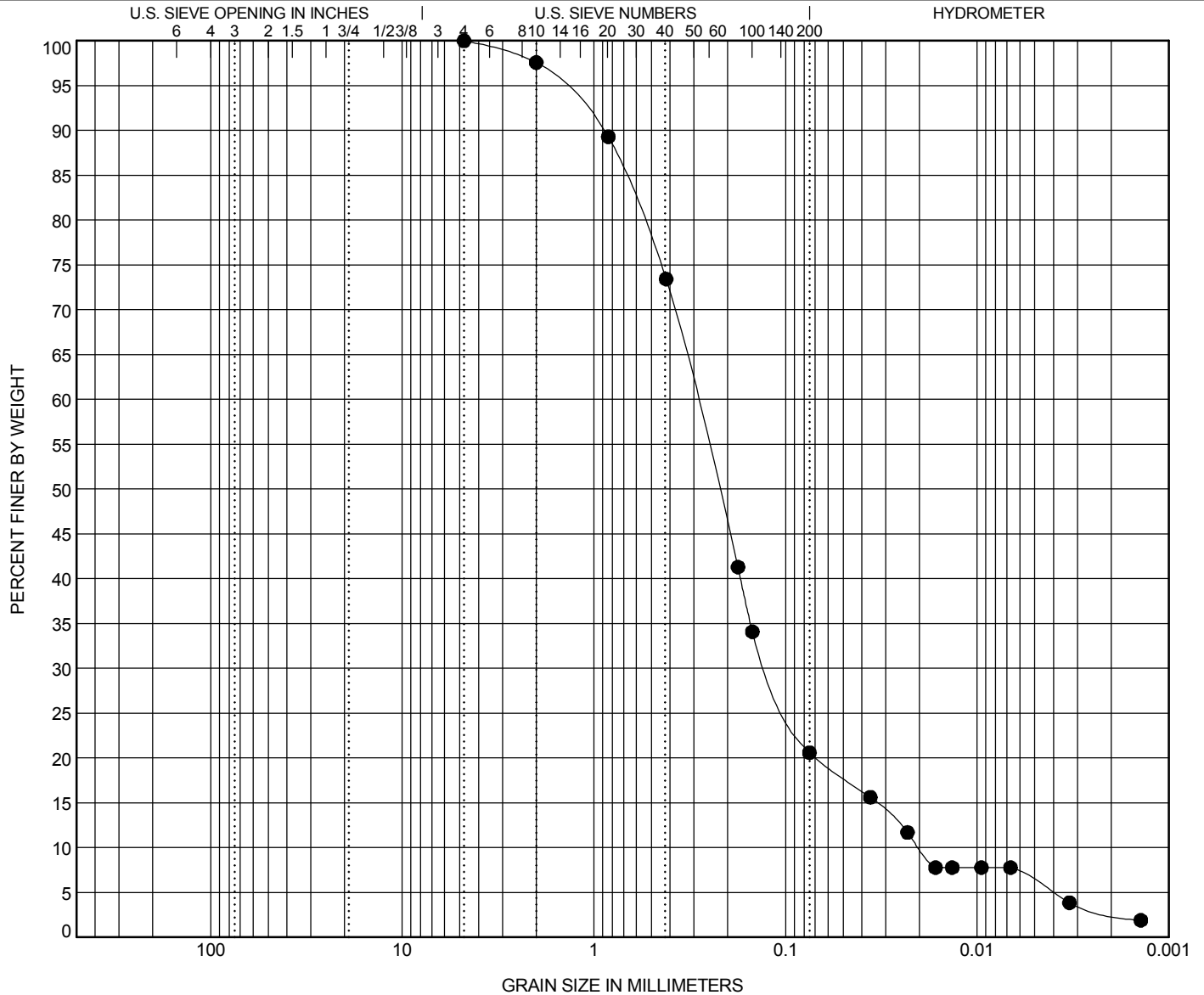


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-101	20.0	Silty SAND (SM/A-2-4)					NP	NP	NP	2.51	14.67
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-101	20.0	4.76	1.525	0.224	0.02	0.0	79.4	14.4	6.2		

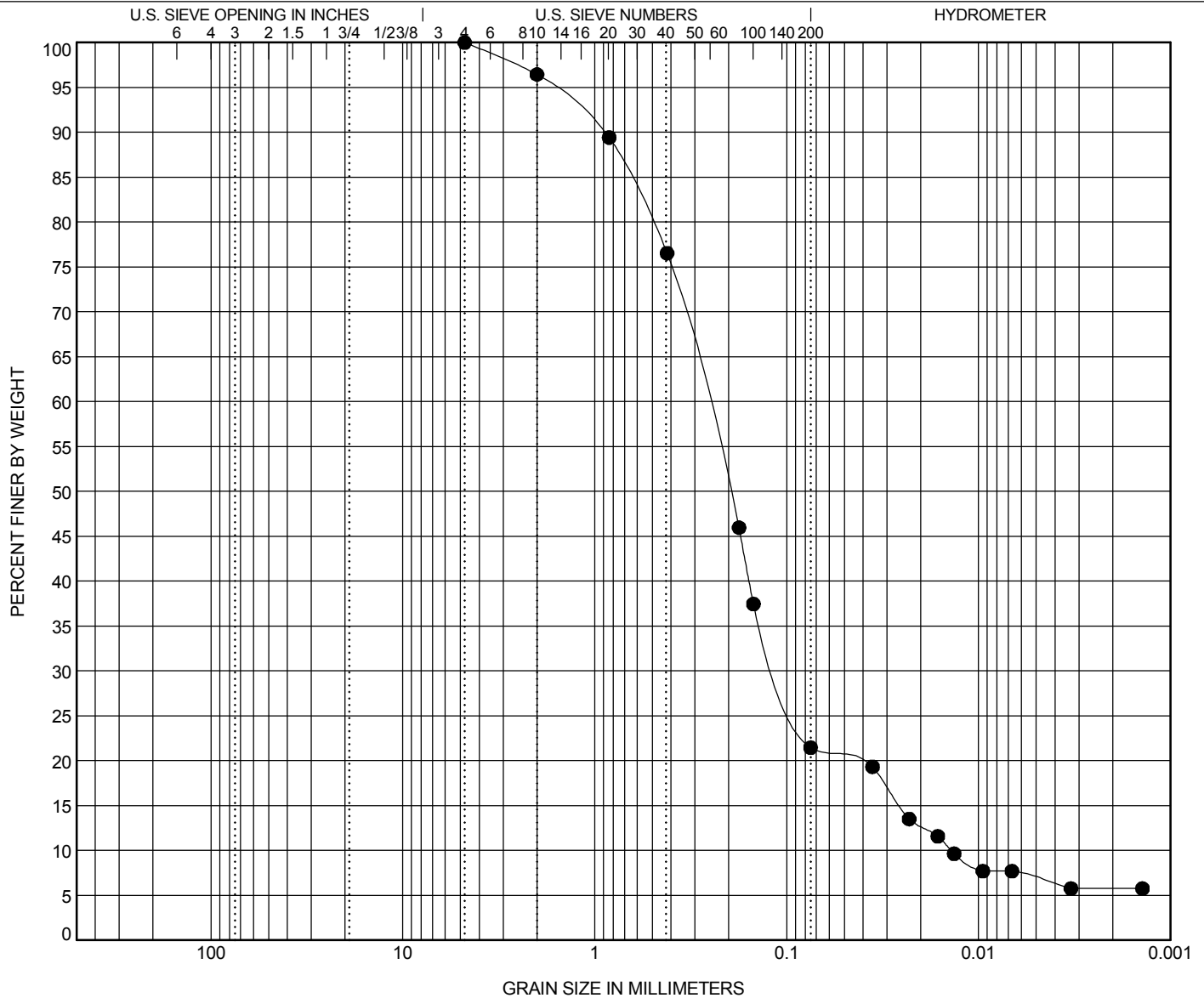


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

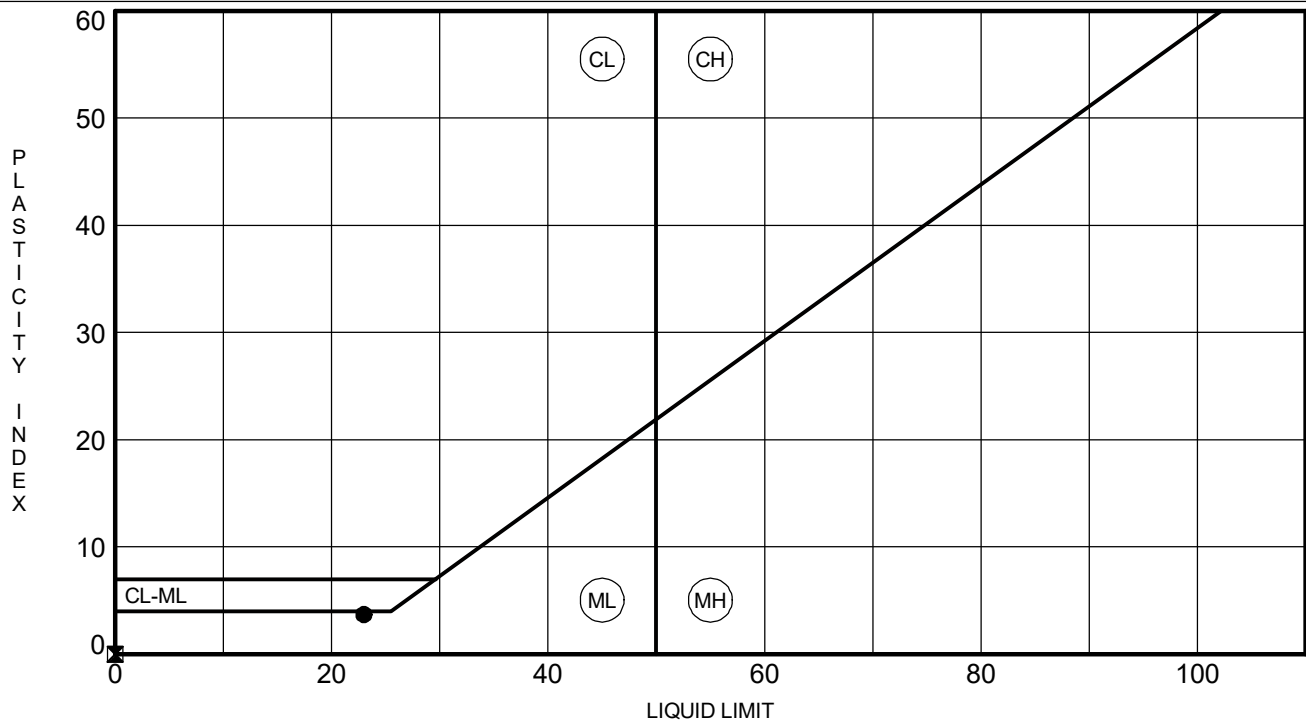
BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-101	25.0	Silty SAND (SM)								3.20	18.93
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-101	25.0	4.76	1.672	0.198	0.014	0.0	78.5	14.6	6.9		

ATTERBERG LIMITS' RESULTS

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry

[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 G6100.050.00012 - Big Beaver Dam Creek
 Depth 27.1' - 27.4'
 Sample RC-101.1
 Lab ID number 42140029

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
8.43E-04	-1.85E-04	6381
3.40E-04	-7.60E-05	3224

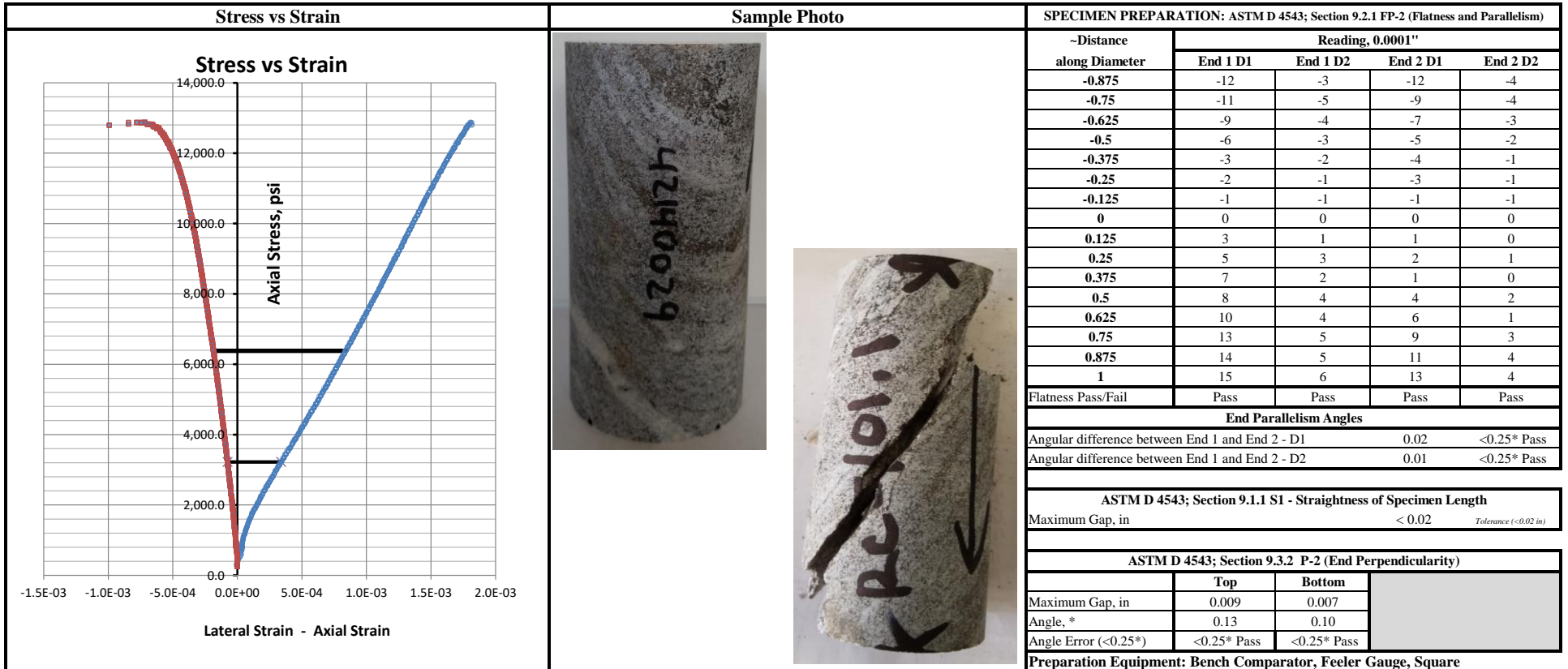
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.069
Mid Height Diameter #1, in	1.865
Mid Height Diameter #2, in	1.866
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.73
L/D Ratio (2.0-2.5)	2.18

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	492.58	
Sample Volume, cc	182	
Wet Density, pcf	169	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	35209
Unconfined Compressive Strength, psi	12,882
Youngs Modulus, E psi	6.3 E+06
Slope of Lateral Curve, psi	-29.0 E+06
Poisson's Ratio	0.22

Load Application in Relation to Lithology:

Unable to Determine



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 G6100.050.00012 - Big Beaver Dam Creek
 Depth 31.5' - 31.8'
 Sample RC-101.2
 Lab ID number 42140030

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
1.81E-03	-2.71E-04	9086
1.16E-03	-1.19E-04	4615

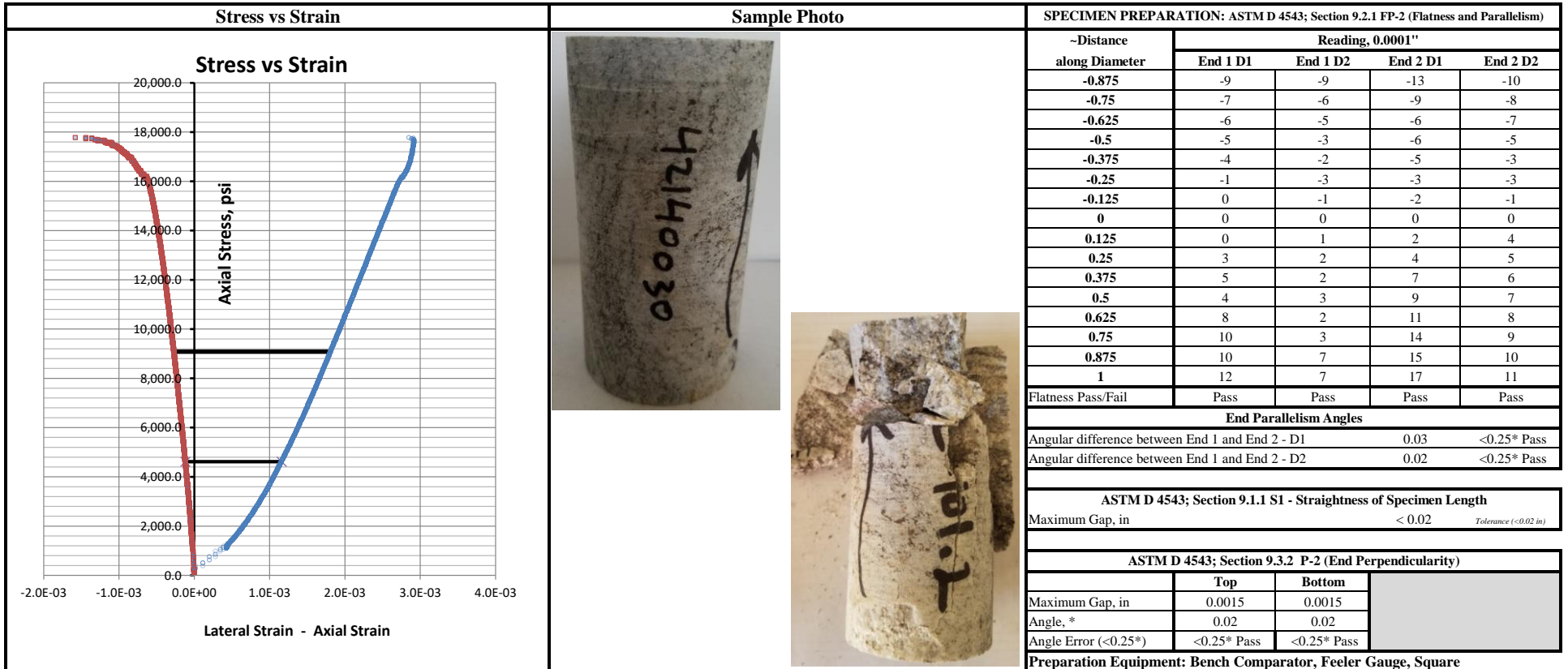
ASTM D 4543; Section 4.2 & 5.6	
Length, in	3.894
Mid Height Diameter #1, in	1.867
Mid Height Diameter #2, in	1.869
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.74
L/D Ratio (2.0-2.5)	2.08

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	460.18	
Sample Volume, cc	175	
Wet Density, pcf	164	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	48714
Unconfined Compressive Strength, psi	17,775
Youngs Modulus, E psi	6.9 E+06
Slope of Lateral Curve, psi	-29.4 E+06
Poisson's Ratio	0.23

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-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT NO.: P038068

SAMPLE NUMBER: 19-1257

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-102	B-102	B-102	B-102	B-102
SAMPLE NO.	SS-2	SS-3	SS-4	SS-6	SS-7
SAMPLE DEPTH	2-4'	4-6'	6-8'	13.5-15'	18.5-20"
WATER CONTENT, W%	17.4	13.8	17.0	16.1	27.0

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%					

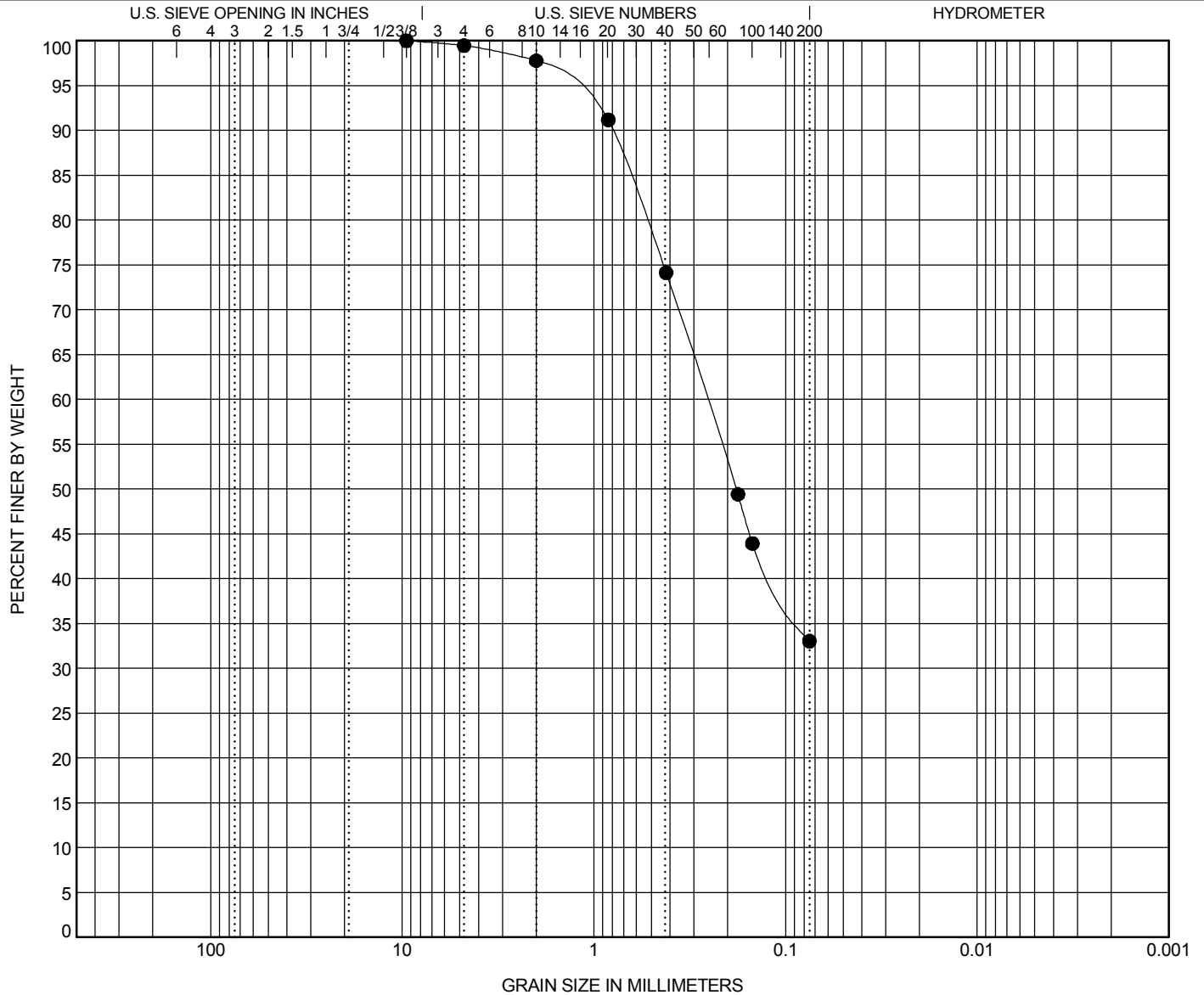


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-102	8.0	Silty Clayey SAND (SC-SM/A-2-4)					24	19	5		
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt		%Clay	
● B-102	8.0	9.51	1.387	0.181		0.5	66.4	33.0			

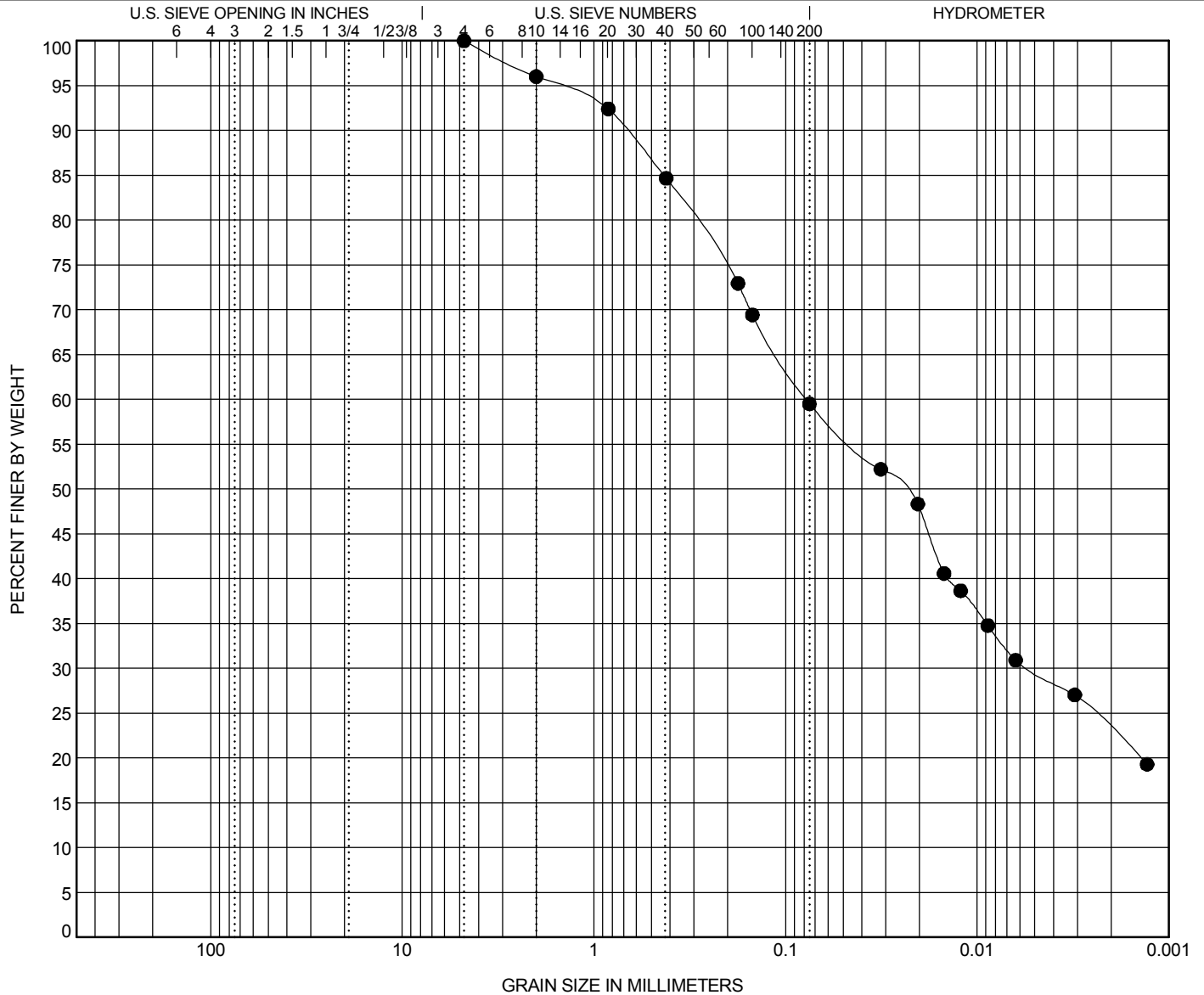


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-102	10.0	Sandy SILT (ML)									
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-102	10.0	4.76	1.568	0.025		0.0	40.5	29.9	29.7		

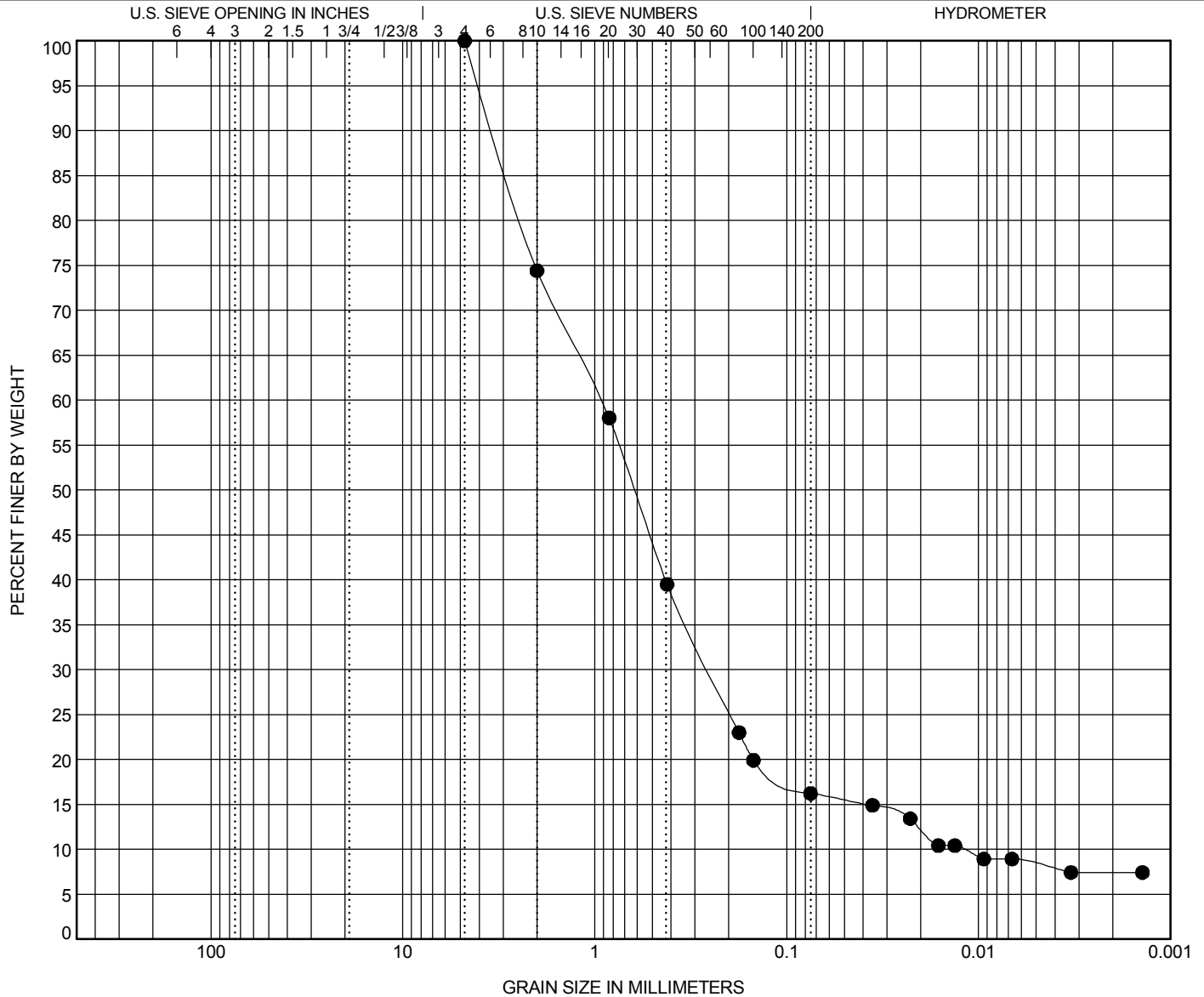


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-102	15.0	Silty SAND (SM/A-1-b)					NP	NP	NP	5.80	77.46
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-102	15.0	4.76	4.018	0.622	0.012	0.1	83.7	7.9	8.3		

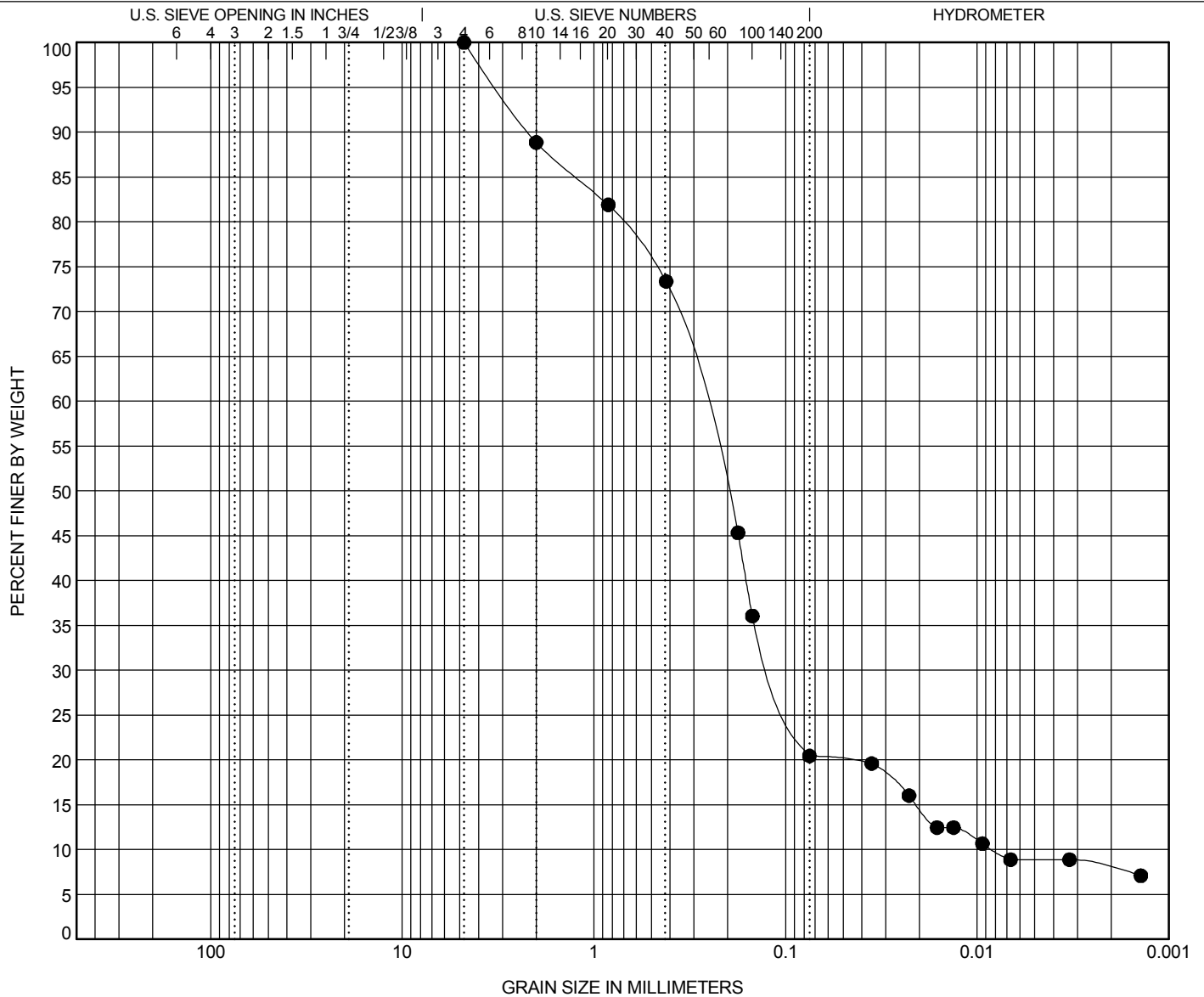


GRAIN SIZE DISTRIBUTION

PROJECT ID P038068

PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

PROJECT COUNTY Newberry



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification					LL	PL	PI	Cc	Cu
● B-102	20.0	Silty SAND (SM)								5.66	33.62
BOREHOLE	DEPTH	D100	D95	D50	D10	%Gravel	%Sand	%Silt	%Clay		
● B-102	20.0	4.76	3.225	0.204	0.008	0.0	79.5	11.6	8.9		



PROJECT NAME S-36-342 Replacement Bridge over Big Beaver Dam Creek

The graph plots Plasticity Index (Y-axis, 0 to 60) against Liquid Limit (X-axis, 0 to 100). A horizontal line at PI = 7 separates the CL-ML region (below) from the CH region (above). A vertical line at LL = 50 separates the ML region (left) from the MH region (right). A diagonal line (A-line) starts at (0,0) and passes through (100,60). A soil sample is plotted at approximately (25, 4), which falls within the CL-ML region.

[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 G6100.050.00012 - Big Beaver Dam Creek
 Depth 24.6' - 24.9'
 Sample RC-102.3
 Lab ID number 42140031

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
1.16E-03	-3.27E-04	8527
5.12E-04	-1.24E-04	4272

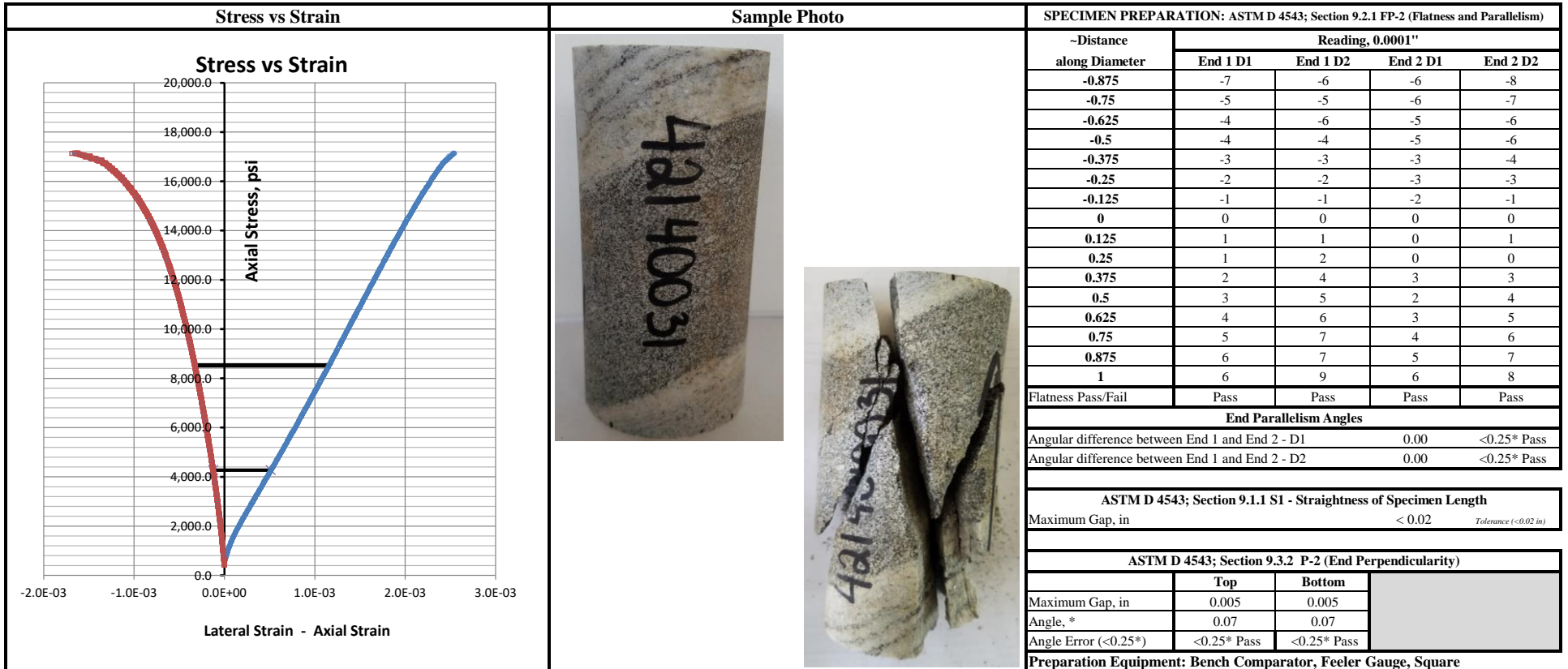
ASTM D 4543; Section 4.2 & 5.6	
Length, in	4.116
Mid Height Diameter #1, in	1.869
Mid Height Diameter #2, in	1.868
Average Mid. Height Diameter, in.	1.87
Sample Area, in ²	2.74
L/D Ratio (2.0-2.5)	2.20

Test Parameters		
	Test Temperature	Room
	Moisture Condition	As-Received
	Sample Weight, gms	499.09
	Sample Volume, cc	185
	Wet Density, pcf	168

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	47015
Unconfined Compressive Strength, psi	17,146
Youngs Modulus, E psi	6.6 E+06
Slope of Lateral Curve, psi	-21.0 E+06
Poisson's Ratio	0.31

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/23/2019

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 G6100.050.00012 - Big Beaver Dam Creek
 Depth 30.1' - 30.4'
 Sample RC-102.4
 Lab ID number 42140032

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
1.02E-03	-2.55E-04	6788
4.30E-04	-9.55E-05	3359

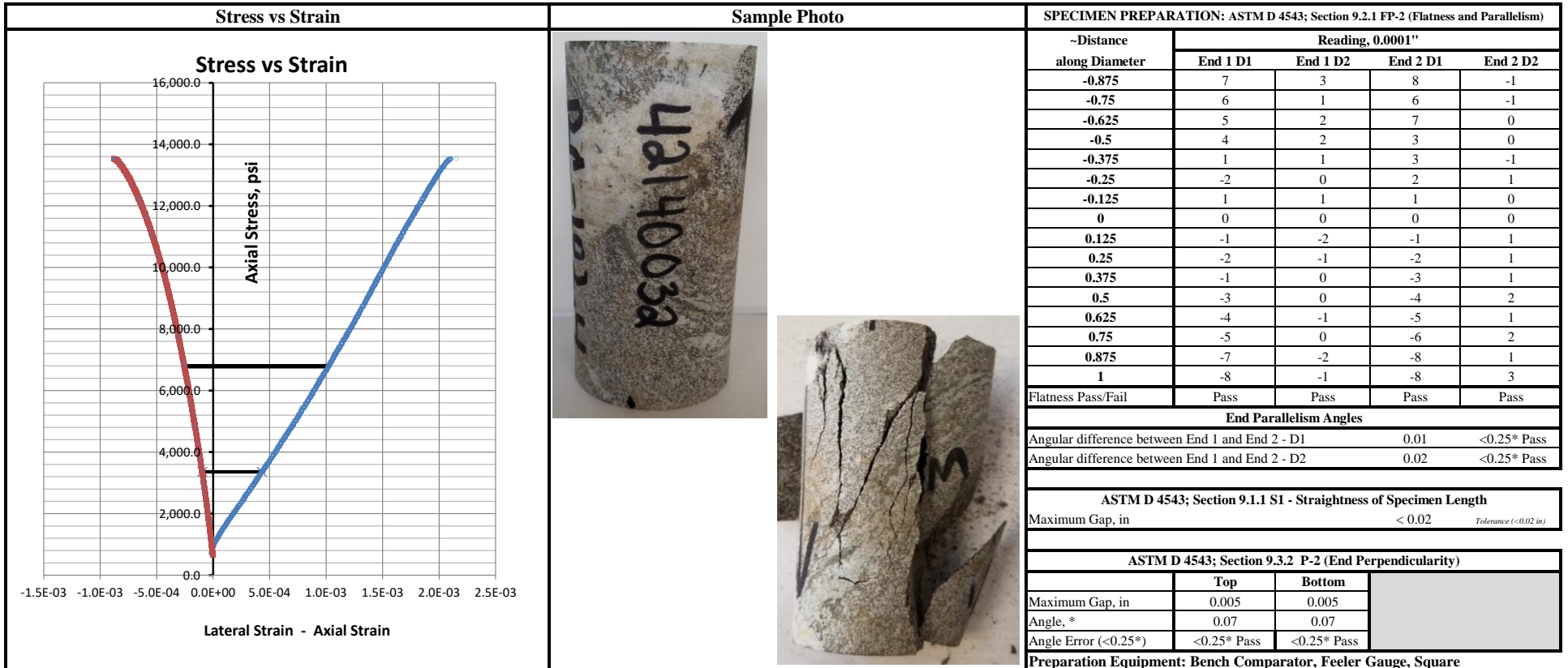
ASTM D 4543; Section 4.2 & 5.6	
Length, in	3.998
Mid Height Diameter #1, in	1.868
Mid Height Diameter #2, in	1.873
Average Mid. Height Diameter, in.	1.87
Sample Area, in^2	2.75
L/D Ratio (2.0-2.5)	2.14

Test Parameters		
Test Temperature	Room	
Moisture Condition	As-Received	
Sample Weight, gms	498.97	
Sample Volume, cc	180	
Wet Density, pcf	173	

Test Results	
Overall Loading Rate, psi/sec	40
Peak Load, lbs	37347
Unconfined Compressive Strength, psi	13,591
Youngs Modulus, E psi	5.8 E+06
Slope of Lateral Curve, psi	-21.5 E+06
Poisson's Ratio	0.27

Load Application in Relation to Lithology:

Angle



Performed By: MAK

Input Validation: MAK

Reviewed By: ALO

Date Tested: 7/23/2019

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	G6100.050.00014	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