FROEHLING & ROBERTSON, INC.

Geotechnical Subsurface Data Report

S-45 (Lester Road) Over Little Pee Dee Swamp - Two Bridge Replacements
Dillon County, South Carolina

Prepared For:

South Carolina Department of Transportation
Pee Dee Regional Production Group - 2
955 Park Street
Columbia, South Carolina, 29201

By:
FROEHLING & ROBERTSON, INC.
18 Woods Lake Road
Greenville, South Carolina 29607

F&R Project No. 65V-0174

SCDOT Project No. P031751

March 22, 2018

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881

18 Woods Lake Road
Greenville, South Carolina 29607
T 864.271.2840 I F 864.271.8124

March 22, 2018

F&R Project No. 65V-0174

South Carolina Department of Transportation
Pee Dee Regional Production Group - 2
955 Park Street
Columbia, South Carolina 29201

Attn: Ms. Nathalia Chandler, P.E.

Re: **Geotechnical Subsurface Data Report**
S-45 (Lester Road) Over Little Pee Dee Swamp - Two Bridge Replacements
Dillon County, South Carolina

Dear Ms. Chandler:

Froehling & Robertson, Inc. (F&R) is pleased to present this geotechnical subsurface data report for the proposed S-45 (Lester Road) over Little Pee Dee Swamp bridge replacement project in Dillon County, South Carolina.

The purpose of this geotechnical subsurface data report is to present the results of the subsurface exploration program and laboratory testing undertaken by Froehling & Robertson, Inc. (F&R). Our services were performed in general accordance with your work order Number FR#14-18-031751 dated February 14, 2018, and as authorized by your office per our On-Call Contract with SCDOT (Contract Number S-147-14).

The attached report presents our understanding of the project, reviews our exploration and testing procedures, describes existing site and general subsurface conditions at the boring locations and presents the results of our field and laboratory tests.

We have enjoyed working with you on this project. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

Mar 22 2018 12:20 PM

Benedictus K. Azumah, P.E.
Geotechnical Services Manager

Mar 22 2018 1:50 PM

Marving L. Farmer, P.E.
Branch Manager, Senior Engineer

BKA/RAF/KCR/MLF

Email Distribution: ChandlerNR@scdot.org

F:\Projects 65V\65V-0174 (SCDOT - Lester Road S-45, Dillon SC)\Reports (drafts to be deleted upon issuance of final reports)\Geotechnical Data Report\65V-0174-GEO1 (GSDR - S-45 Lester Road Over Little Pee Dee Swamp, Dillon Co., SC).docx

TABLE OF CONTENTS

SECTION		PAGE
1.0	PURPOSE & SCOPE OF SERVICE	1
2.0	PROJECT INFORMATION	2
2.1	SITE LOCATION AND DESCRIPTION	2
2.2	PROJECT INFORMATION AND PROPOSED CONSTRUCTION	3
3.0	SUBSURFACE EXPLORATION PROCEDURES	4
3.1	SOIL TEST BORINGS	4
3.2	CONE PENETRATION TEST SOUNDING	6
3.3	TEST LOCATION CONTROL	7
3.4	GEOPHYSICAL TESTING	7
3.5	LABORATORY REVIEW AND TESTING OF SOIL SAMPLES	8
4.0	LIMITATIONS	8

APPENDICES

APPENDIX I

Figure No. 1: Site Vicinity Map
Figure No. 2: Test Location Plan
Figure Nos. 3A through 3F: Photographs of Tests Being Performed

APPENDIX II

SCDOT Material Description, Classification, and Logging
Key to Soil Classifications
Soil Classification Chart
Soil Test Boring Logs (STB-103, STB-103A, and STB-104A)
Auger Probe Boring Logs (HA-01, HA-02, HA-03, and HA-04)
Subsurface Soil Profile (Figure No. 4)

APPENDIX III

Cone Penetration Test Specification Sheet
Cone Penetration Test Results – (CPT-103, CPT-104, CPT-103A, and CPT-104A)

APPENDIX IV

Soil Laboratory Test Assignment Sheet
Summary of Laboratory Test Results
Laboratory Test Summary Sheets (STB-103A and STB-104A)
- Atterberg Limits, Index Properties versus Depth

Laboratory Test Data Sheets (HA-01 through HA-04)
- Electrochemical Test Results

APPENDIX V

Geophysical Testing Result at S-45 – Refraction Microtremor (ReMi)

APPENDIX VI

Geoprofessional Business Association (GBA) Document

1.0 PURPOSE & SCOPE OF SERVICE

The purpose of this geotechnical subsurface data report is to provide the SCDOT with geotechnical information in the area of the proposed S-45 (Lester Road) replacement bridges over Little Pee Dee Swamp in Dillon County, South Carolina. Froehling & Robertson, Inc. (F&R) received the SCDOT Work Order No. FR#14-18-031751 dated February 14, 2018, in reference to this project.

F&R's scope of services included the following:

- A site reconnaissance to observe existing surface conditions and layout proposed borings at locations as close as possible to the test boring and sounding locations shown on the Test Location Plan provided to us by your office.
- Coordination of underground utility location and clearance with Palmetto Utility Protection Service (PUPS) – South Carolina 811.
- Completion of two soil test borings with Standard Penetration Testing (SPT), four auger probe borings with collection of bulk soil samples, two cone penetration test (CPT) soundings, and one shear wave velocity measurement using surface methods.

  The soil test borings (STB) were designated as Borings STB-103, STB-103A and STB-104A. The auger probe borings were designated as HA-01 through HA-04. The CPT soundings were designated as CPT-103, CPT-103A, CPT-104, and CPT-104A. Boring STB-103, CPT sounding CPT-103, and Auger Probe boring HA-03 were located adjacent to the south end of Bridge No. 2 with structure No. 1770004500200 and near Latitude 34.332833 and Longitude -79.324381. CPT sounding CPT-104, and Auger Probe Boring HA-04 were located adjacent to the north end of Bridge No. 2. Boring STB-103A, CPT sounding CPT-103A, and Auger Probe Boring HA-01 were located adjacent to the south end of Bridge No. 3 with structure No. 1770004500300 and near Latitude 34.333789 and Longitude -79.323477. Boring STB-104A, CPT sounding CPT-104A, and Auger Probe Boring HA-02 were located adjacent to the north end of Bridge No. 3. Borings STB-103, STB-103A, and STB-104A were advanced to termination depths of approximately 18 feet, 100 feet and 100 feet, respectively. CPT soundings CPT-103, CPT-104, CPT-103A, and CPT-104A were advanced to termination depths of approximately 43 feet, 31.5 feet, 36.5 feet, and 43.9 feet, respectively.

Auger probe Borings HA-01 through HA-04 were advanced to a termination depth of approximately 10 feet.

The shear wave velocity array was located near Bridge No. 3.

The exploration also included making observations for the presence of ground water, dense soil strata, and measuring their depths below the existing ground surface.

- Preparation of STB logs using the South Carolina Department of Transportation (SCDOT) gINT format. Provision of raw data generated from CPT soundings.

- Performing soil laboratory testing including Wash No. 200, Atterberg limits, water content and Corrosion Series on selected soil samples obtained from the borings.

- Preparation of this geotechnical data report summarizing our work on the project including a description of the subsurface conditions encountered at the existing bridge locations.

F&R's geotechnical services did not include recommendations regarding the proposed project, topographic or field surveying, development of quantity estimates, preparation of plans and specifications, or the identification and evaluation of wetlands or other environmental aspects of the project site.

2.0 PROJECT INFORMATION

2.1 Site Location and Description

The project site is located along S-45 (Lester Road) at the crossing of Little Pee Dee Swamp in Dillon County, South Carolina. Three existing bridges are present; the southern, middle, and the northern bridge. The proposed two bridge replacement includes the middle and the northern bridge. For reference, middle bridge is referred to as Bridge No. 2 with structure No. 1770004500200 and the northern bridge is referred to as Bridge No. 3 with structure No. 1770004500300. Bridge No. 2 is about 90 feet long and Bridge No. 3 is about 150 feet long. Little Pee Dee Swamp flows towards the east.

Both bridges are oriented to the northeast-southwest and carry two travel lanes of Lester Road across Little Pee Dee Swamp. Bridge approach embankments are about eight to ten feet tall and

embankment slopes are approximately 2H to 1V or flatter. The areas adjacent to the bridges are wooded with mature trees and brush.

Based on site plans provided to F&R, the stationing at several site features described above are included in the table below for reference.

Table 1 – Site Features and Stations

Site Feature	Approx. Begin Station	Approx. End Station	Alignment
South Bridge (Bridge No. 1)	38+15	38+75	S-45 Existing Center Line
Middle Bridge (Bridge No. 2)	45+45	46+45	S-45 Existing Center Line
North Bridge (Bridge No. 3)	49+80	51+30	S-45 Existing Center Line

The topography of the site is generally level and flat with ground surface elevations on the pavement ranging from about Elevation (EL) 78 to 79.

The site location is shown on the attached Site Vicinity Map in Appendix I, Figure No. 1. F&R obtained information regarding the site from the Test Location Plan: S-45 (Lester Road) over the Little Pee Dee Swamp; 2 Bridge Replacements which was provided to us by your office. F&R obtained additional site information during our site visits and through our review of available site aerial photography.

2.2 Project Information and Proposed Construction

The proposed project includes replacement of the two existing S-45 Bridge Numbers 2 and 3 over Little Pee Dee Swamp in Dillon County, South Carolina. As part of the project planning requirements, F&R was requested to perform a geotechnical subsurface exploration including soil test borings, auger probe borings, CPT soundings, shear wave velocity measurements, and soil laboratory testing of the site soils and to provide a geotechnical subsurface data report for the proposed development. F&R received a Work Order Request for Subsurface Exploration and Laboratory Testing dated January 11, 2018 (revised February 9, 2018).

Existing Bridges No. 2 and No. 3 will be removed and replaced with new bridges on the same alignment. Per the Test Location Plan, two soil test boring (STB) locations, two CPT locations and four auger probe boring locations were identified and marked for our use during our subsurface

exploration. The subsurface exploration at the STB locations included Standard Penetration Testing (SPT) to a depth of 100 feet. The CPT sounding depth was 100 feet. The stationing at the as-drilled test boring or sounding locations described above, the tests depths, and soil samples obtained are presented in the table below for reference.

Table 2 – Test Locations and Stations

Soil Test Location	Relative Location to Bridge	Station of As-Drilled Boring Location	Test Depth (ft)	Remarks
STB-103	South End Bridge No. 2	45+27.49 5.45 ft RT	18	Location conflict. Terminated at 18 ft and re-drilled as STB-103A
CPT-103	South End Bridge No. 2	45+33.55 2.99 ft LT	43	Location conflict. Re-drilled as CPT-103A
CPT-104	North End Bridge No. 2	46+51.27 11.86 ft LT	31.5	Location conflict. Re-drilled as CPT-104A
STB-103A	South End Bridge No. 3	49+64.15 5.71 ft RT	100	Obtain Split Spoon SPT Samples
STB-104A	North End Bridge No. 3	51+44.02 3.09 ft LT	100	Obtain Split Spoon SPT Samples
CPT-103A	South End Bridge No. 3	49+68.15 12.0 ft LT	36.5	CPT Sounding
CPT-104A	North End Bridge No. 3	51+45 13 ft LT	43.9	CPT Sounding
HA-01	South End Bridge No. 3	49+61.88 5.71 ft RT	10	Bulk Sample for Corrosion Series
HA-02	North End Bridge No. 3	51+49.00 3.09 ft LT	10	Bulk Sample for Corrosion Series
HA-03	South End Bridge No. 2	45+36.34 0.98 ft LT	10	Bulk Sample for Corrosion Series
HA-04	North End Bridge No. 2	46+46.90 0.34 ft LT	10	Bulk Sample for Corrosion Series
Shear Wave Vel.	Near Bridge No. 3	-	100	ReMi Test

The soil laboratory testing scope provided by SCDOT included water content, Atterberg limits, Wash No. 200, corrosion potential series including pH, resistivity, chloride and sulfate content tests. A description of the various subsurface exploration tests and soil laboratory tests performed are presented in subsequent sections of this report.

3.0 SUBSURFACE EXPLORATION PROCEDURES

3.1 Soil Test Borings

The soil test borings were conducted by our drilling subcontractor, Soil Consultants, Inc., of Charleston, South Carolina, between February 15 and 20, 2018, under the supervision of a

licensed Professional Engineer from F&R. The Standard Penetration Test (SPT) was performed at the boring locations in general accordance with ASTM D1586, "Standard Test Method for Penetration test and Split Barrel Sampling of Soils."

The drill rig used for this project was an All-Terrain-Vehicle (ATV)-mounted, CME-550X, equipped with an automatic hammer. The test holes were advanced using the rotary wash technique. A 3⅞-inch diameter tri-cone roller bit attached to hollow AW drilling rods and several lineal feet of 4-inch diameter steel casings were used in the drilling process. A viscous slurry mixture consisting of bentonite powder and water was introduced into the soil borings to wash out the soil cuttings and keep the walls of the boring open.

The subsurface exploration program included two SPT borings and four auger probe borings. The SPT borings and auger probe borings were designated as Borings STB-103, STB-104, and HA-01 through HA-04, respectively. Due to conflicts in the test location descriptions provided to us, STB-103 was incorrectly located in the field and drilled to a depth of 18 feet below the existing ground surface. As soon as the test location conflict was resolved, this boring was re-located and re-drilled at the correct location and designated as STB-103A. STB-104A, however, was drilled at the correct location. Borings STB-103A and STB-104A were advanced to a termination depth of approximately 100 feet below the existing ground surface.

SPT was performed continuously from the existing ground surface to a maximum depth of 20 feet in the Borings STB-103, STB-103A and STB-104A. Thereafter, boreholes were advanced and SPT performed at approximate 5-foot intervals to their termination depth. In auger probe borings HA-01 through HA-04, 3¾-inch internal diameter hollow stem augers were used to advance these borings to a depth of 10 feet in order to obtain bulk soil samples.

Approximate boring locations are identified on Figure No. 2 – Test Location Plan, which is included in Appendix I of this report. Boring and sounding locations were staked at the site by personnel from F&R. We staked the borings and soundings by measuring from existing site features including the existing bridges and pavement edges by referencing the borings and soundings to the site features shown on the provided site plan. As such, the boring and sounding locations as shown in the figures should be considered approximate.

Soil samples were obtained with a standard 2-inch O.D. and 30-inch long split-spoon sampler with each SPT being driven with a 140-lb automatic hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and are shown on the boring logs. The first six-inch increment is used to seat the sampler with the sum of the second and third penetration increments being termed the SPT value, "N." A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, and returned to our laboratory for review and testing. The boring logs provided in Appendix II show the subsurface conditions encountered on the dates and at the approximate locations indicated.

The completed boreholes performed were partially backfilled with drilling spoils and capped with grout after 24-hour groundwater level readings were obtained. The augured holes through the asphalt pavement were backfilled with asphalt cold patch for the remaining depth up to the ground surface. By the nature of the work performed, the drilling activities result in disturbances to the site. The borehole backfill may subside at some time following our work. F&R assumes no responsibility for borehole subsidence after completion of the field exploration and departing the site. For continued safety, the boreholes should be occasionally observed by others with any needed additional backfilling then being performed.

3.2 Cone Penetration Test Sounding

The CPT soundings conducted for our subsurface exploration were performed by our sub-contractor Palmetto Insitu, LLC, of Charleston, South Carolina, from February 15 through 20, 2018. The CPTs were performed as close as possible to each of the proposed test locations in general accordance with ASTM D5778 and ASTM D6635, respectively. The CPTs are designated as CPT-103 and CPT-104. Again, due to conflicts in the test location descriptions, CPT-103 and CPT-104 were incorrectly located in the field and drilled to refusal at depths of 43 feet for CPT-103 and 31.5 feet for CPT-104. As soon as the test location conflicts were resolved, these tests were performed at their correct locations and designated as CPT-103A and CPT-104A. The borings were advanced to refusal depths of 36.5 feet for CPT-103A and 43.9 feet for CPT-104A. The CPT locations are identified on Figure No. 2 - Test Location Plan included in Appendix I of this report.

The equipment used for the CPT exploration includes an electronic 15 cm^2 Vertek seismic cone. The equipment was hydraulically advanced into the soil using a Vertek S4 Scorpian CPT rig capable of 20 tons of thrust. The collected raw data was processed by Palmetto Insitu, LLC, using Bentley's gINT V8i SS2 software (version 08.30.04.206) and Dataforensics, RapidCPT software (version 4.2.2.0). The legend used for the SBT correlations is based on Robertson and Campanella: 1990 and is included with the CPT results provided in Appendix III. An electronic file (in .CSV file format) containing the CPT results is being submitted under separate cover.

3.3 Test Location Control

Upon completion of drilling and sounding, our surveying subcontractor, Chao and Associates, Inc., of Columbia, South Carolina, surveyed the as-drilled boring and sounding locations and obtained ground surface elevations, South Carolina State Plane northern and eastern GPS coordinates, latitude and longitude coordinates, and station and offset data in reference to the existing alignment of S-45. Surveying was performed in accordance with the rules and regulations governing the practice of surveying in the State of South Carolina. Horizontal datum was referenced to SCSPCS and Vertical datum was referenced to NGVD88. The survey data obtained from the as-drilled boring and sounding locations are presented on the soil boring and CPT logs in Appendices II and III of this report.

3.4 Geophysical Testing

A Refraction Microtremor (ReMi) survey was performed at one location (array) longitudinal to the road and just to the north side of Bridge No. 3. The ReMi survey was conducted to provide estimated measurements of the soil shear wave velocity in the upper 100 feet. The dispersive characteristic of Rayleigh waves when traveling through a layered medium is measured from the surface, which makes the method nondestructive and nonintrusive. A seismic source (ambient "noise") is applied at the ground surface where vertical transducers record the propagation of surface waves. By analyzing the phase information for each frequency contained in the wave train, the Rayleigh and shear wave velocity can be determined. The data was processed using SeisOpt® ReMi™ software to reveal a one-dimensional average shear-wave (S-wave) velocity structure for the array. The survey was performed to provide the average shear wave velocity to a depth of 100 feet used to determine the seismic Site Classification in accordance with Chapter

16 of the 2015 International Building Code (IBC). The result of the geophysical test is included in Appendix V of this report.

3.5 Laboratory Review and Testing of Soil Samples

The recovered split-spoon samples were visually classified by F&R engineers in general accordance with the ASTM D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Method)."

Laboratory testing was performed on several of the split-spoon and bulk samples obtained from various depths in the borings. The testing was performed for soil classification purposes in accordance with the Unified Soil Classification System (USCS) and American Association of State Highway and Transportation Officials (AASHTO). The testing consisted of 15 water content tests (ASTM D2216), 15 Wash No. 200 Sieve tests (ASTM D1140), 15 Atterberg Limit tests (ASTM D4318), and four corrosion series tests including pH, Chloride, Sulfate, and Resistivity (AASHTO T289, T291, T290, and ASTM G187).

Laboratory test results are presented in the Summary of Laboratory Test Results table included in Appendix IV of this report. Individual laboratory test data sheets are also included herein. We will retain the recovered soil samples in our laboratories up to the completion of construction for the proposed structures or seven years from the date of this report.

4.0 LIMITATIONS

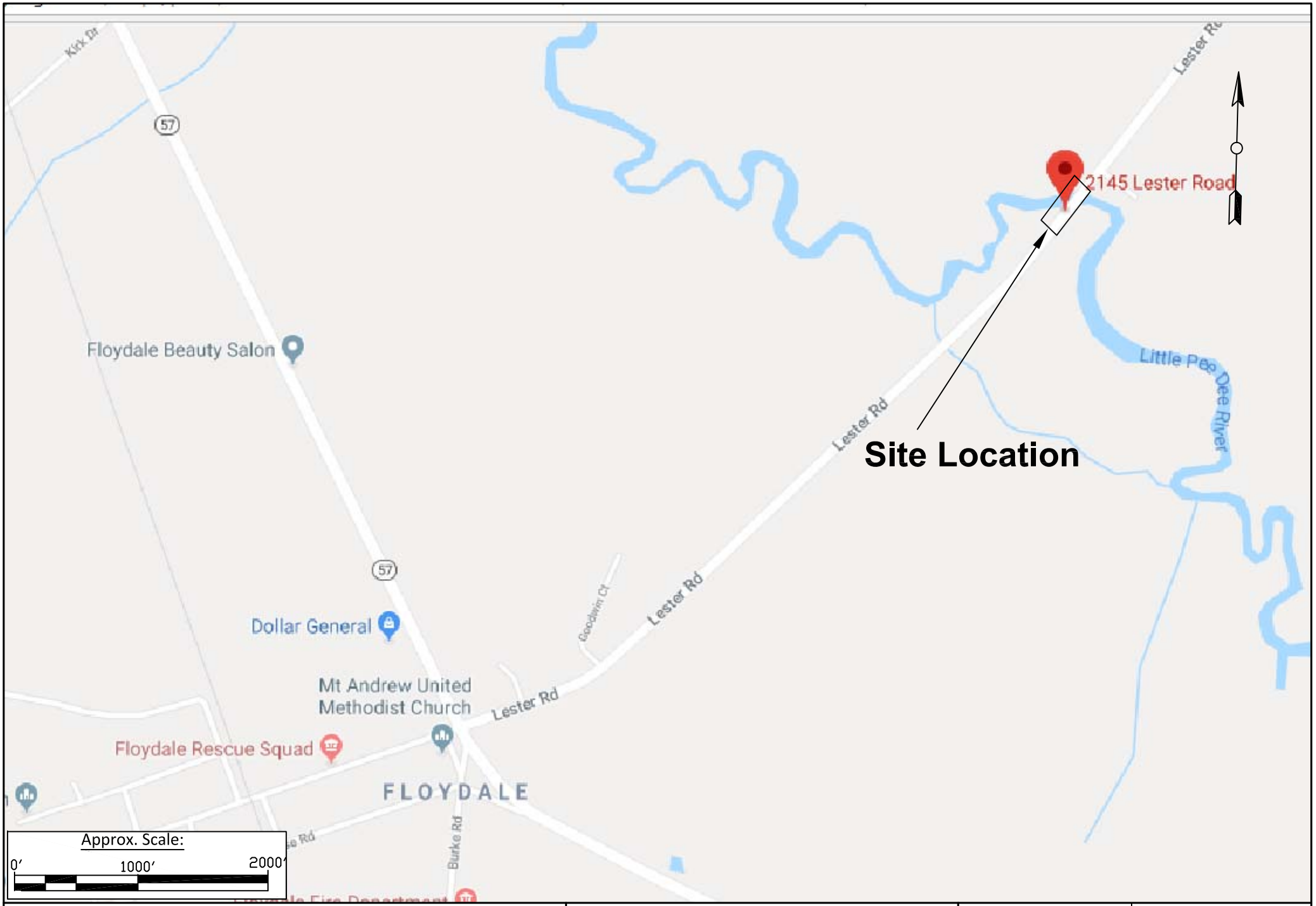
There are important limitations to this and all geotechnical studies. Some of these limitations are discussed in the information prepared by the Geoprofessional Business Association (GBA), which is included in Appendix V. We recommend that you review the GBA information.

This report has been prepared for the exclusive use of South Carolina Department of Transportation – Pee Dee Regional Production Group 2 or their agents, for the specific application to the proposed S-45 (Lester Road) replacement bridges over Little Pee Dee Swamp located in Dillon County, South Carolina, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our exploration is based on site location information furnished to us; and generally accepted geotechnical engineering practice. The subsurface exploration logs included herein, do not reflect variations in subsurface conditions, which could exist intermediate of the boring and sounding locations or in unexplored areas of the site. In areas where variations from the available subsurface data become apparent

during construction, it will be necessary to perform additional subsurface exploration based upon on-site observations of the conditions.

APPENDIX I

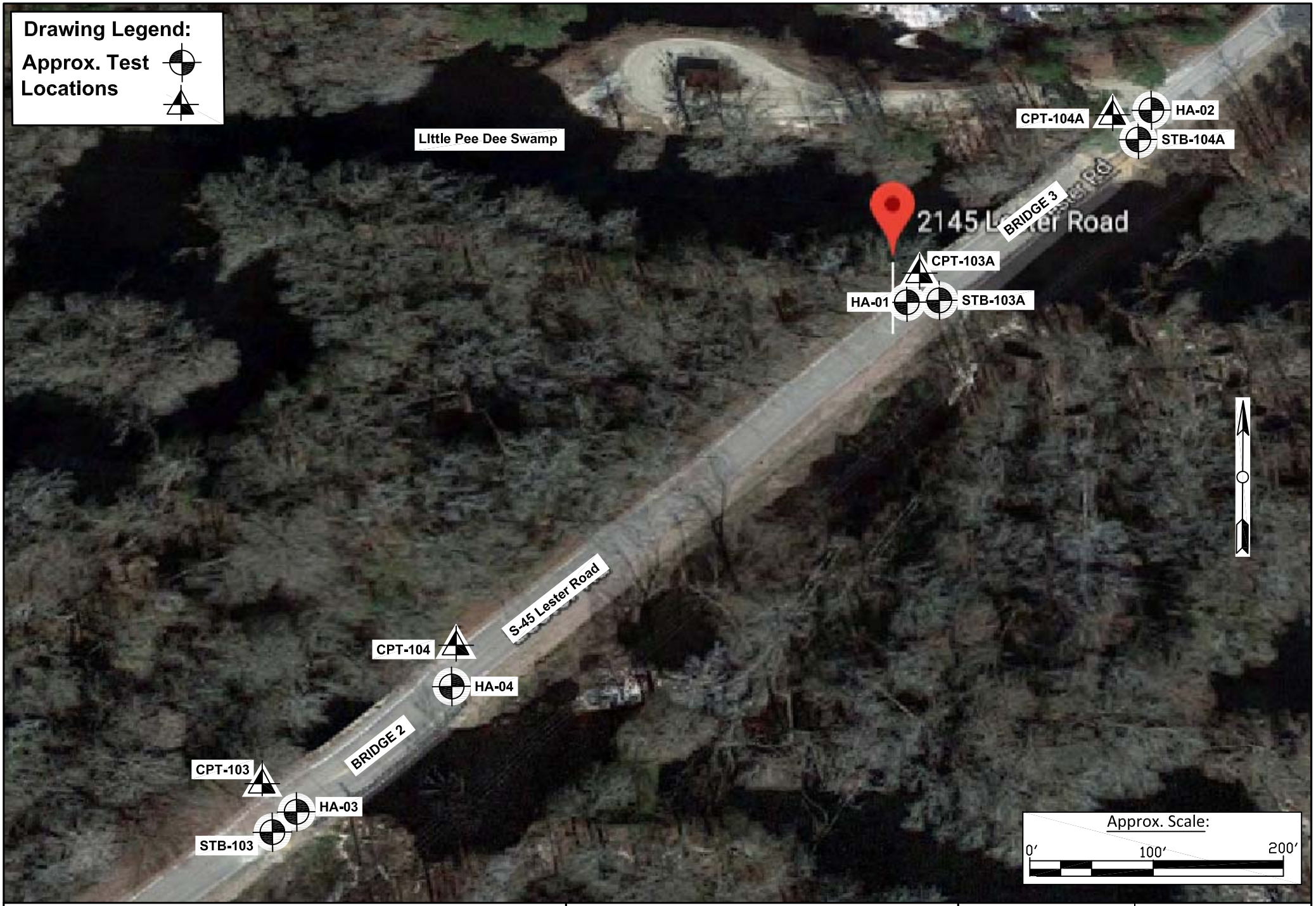
Site Vicinity Map (Figure No. 1)
Test Location Plan (Figure No. 2)
Photographs of Tests Being Performed (Figure Nos. 3A through 3F)



FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
18 Woods Lake Road, Greenville, SC 29607 I USA
T 864.271.2840 I F 864.271.8124

Site Vicinity Map
S-45 (Lester Road) over the Little Pee Dee Swamp;
2 Bridge Replacements
Dillon County, South Carolina

Job No.:	65V-0174	Approx. Scale:	1" = 1000'
Date:	3/6/2018	Drawn By:	R. French
Figure No.:	1	Checked By:	B. Azumah



FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
18 Woods Lake Road, Greenville, SC 29607 I USA
T 864.271.2840 I F 864.271.8124

Test Location Plan
S-45 (Lester Road) over the Little Pee Dee Swamp;
2 Bridge Replacements
Dillon County, South Carolina

Job No.:	65V-0174	Approx. Scale: 1" = 100'
Date:	3/5/2018	Drawn By:	R. French
Figure No.:	2	Checked By:	B. Azumah

Figure No. 3A: Photograph of CPT-103A Being Performed

Figure No. 3B: Photograph of CPT-104A Being Performed

Figure No. 3C: Photograph of STB-103A Being Drilled

Figure No. 3D: Photograph of STB-104A Being Drilled

Figure No. 3E: Photograph of HA-01 Being Drilled

Figure No. 3F: Photograph of HA-02 Being Drilled

APPENDIX II

SCDOT Material Description, Classification, and Logging
Key to Soil Classifications
Soil Classification Chart
Soil Test Boring Logs (STB-103, STB-103A, STB-104A)
Auger Probe Boring Logs (HA-01 through HA-04)
Subsurface Soil Profile (Figure No. 4)

SCDOT Soil Test Boring Log

File No.:	727.615	**Project No. (PIN):**	23546	**County:**	Beaufort/Jasper	**Eng./Geo.:**	A. Bore		
Site Description:	RBO New River					**Route:**	SC 170/46		
Boring No.:	B-722	**Boring Location:**	722+00	**Offset:**	5 ft LT	**Alignment:**	Mainline		
Elev.:	1,500 ft	**Latitude:**	34.3750	**Longitude:**	81.0944	**Date Started:**	07/15/03		
Total Depth:	45 ft	**Soil Depth:**	39 ft	**Core Depth:**	6 ft	**Date Completed:**	07/16/03		
Bore Hole Diameter (in):	4.5	**Sampler Configuration**		**Liner required:**	Y N	**Liner used:**	Y N		
Drill Machine:	CME-750	**Drill Method:**	Wash Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	100%		
Core Size:	NQ Wireline	**Driller:**	I. Core	**Groundwater:**	**TOB**	7.5 ft	**24 hr**	15 ft	

Depth (feet)	Elevation (ft msl)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (feet)	Sample Type / No.	1 st / 2 nd / 3 rd	SPT N-Value	• - SPT N-Value (blows / foot) PL MC LL x-------o-------x ▲ - % fines 10 20 30 40 50 60 70 80 90 100
		Soil Description a , b , c , d , e , f , g h , i , j , Munsell , LL PL , PI , NMC , %#200 Munsell = Munsell Color Chart Designation LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index NMC = Natural Moisture Content %#200 = Percent Passing #200 Sieve						
		Rock Description (as required) Lithologic description: rock type, color, texture, grain size, foliation, weathering and strength with k , l , m , n , o , p , q r , Munsell , RQD , %REC RMR Munsell = Munsell Color Chart Designation RQD = Rock Quality Designation %REC = Percent Recovery RMR = Rock Mass Rating						

Figure 6-10, SCDOT Soil Test Boring Log

SCDOT Soil Test Boring Log Descriptors

a - Relative Density / Consistency Terms

Relative Density[1]

Descriptive Term	Relative Density	SPT Blow Count
Very Loose	0 to 15%	< 4
Loose	16 to 35%	5 to 10
Medium Dense	36 to 65%	11 to 30
Dense	66 to 85%	31 to 50
Very Dense	86to 100%	>51

Consistency[2]

Descriptive Term	Unconfined Compression Strength (q_u) (tsf)	SPT Blow Count
Very Soft	<0.25	<2
Soft	0.26 to 0.50	3 to 4
Firm	0.51 to 1.00	5 to 8
Stiff	1.01 to 2.00	9 to 15
Very Stiff	2.01 to 4.00	16 to 30
Hard	>4.01	> 31

b - Moisture Condition

Descriptive Term	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

c - Color

Describe the sample color while sample is still moist, using Munsell color chart.

d - Angularity[1]

Descriptive Term	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

e - HCl Reaction[3]

Descriptive Term	Criteria
None Reactive	No visible reaction
Weakly Reactive	Some reaction, with bubbles forming slowly
Strongly Reactive	Violent reaction, with bubbles forming immediately

f - Cementation[3]

Descriptive Term	Criteria
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Moderately Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

g - Particle-Size Range[1]

Gravel	mm	Sieve size
Fine	4.76 to 19.1	#4 to ¾ inch
Coarse	19.1 to 76.2	¾ inch to 3 inch

Sand	mm	Sieve size
Fine	0.074 to 0.42	#200 to #40
Medium	0.42 to 2.00	#40 to #10
Coarse	4.00 to 4.76	#10 to #4

h - Primary Soil Type[1, 2]

The primary soil type will be shown in all capital letters

i - USCS Soil Designation

Indicate USCS soil designation as defined in ASTM D-2487 and D-2488

j - AASHTO Soil Designation

Indicate AASHTO soil designation as defined in AASHTO M-145 and ASTM D-3282

[1]Applies to coarse-grained soils (major portion retained on No. 200 sieve)
[2]Appiles to fine-grained soils (major portion passing No. 200 sieve)
[3]Use as required

Figure 6-11, SCDOT Soil Test Boring Log Descriptors - Soil

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

Sands and Gravels

No. of Blows, N	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
Over 50	Very dense

Silts and Clays

No. of Blows, N	Relative Density
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very stiff
31 - 50	Hard
Over 50	Very hard

Particle Size Identification (Unified Classification System)

Boulders:	Diameter exceeds 8 inches
Cobbles:	3 to 8 inches diameter
Gravel:	**Coarse** - 3/4 to 3 inches diameter **Fine** - 4.76 mm to 3/4 inch diameter
Sand:	**Coarse** - 2.0 mm to 4.76 mm diameter **Medium** - 0.42 mm to 2.0 mm diameter **Fine** - 0.074 mm to 0.42 mm diameter
Silt and Clay:	Less than 0.07 mm (particles cannot be seen with naked eye)

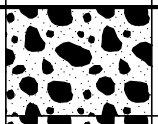
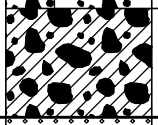
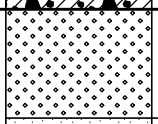
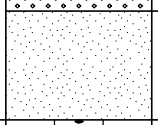
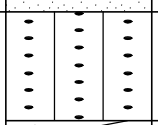
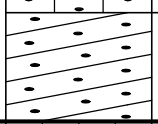
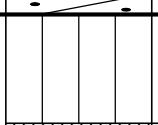
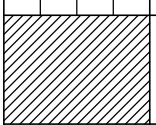
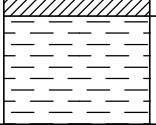
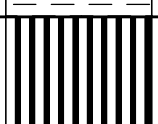
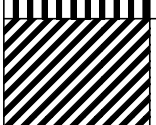
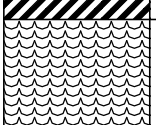
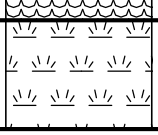
Modifiers

The modifiers provide our estimate of the amount of silt, clay or sand size particles in the soil sample.

Approximate Content	Modifiers
≤ 5%:	Trace
5% to 12%:	Slightly silty, slightly clayey, slightly sandy
12% to 30%:	Silty, clayey, sandy
30% to 50%:	Very silty, very clayey, very sandy

Field Moisture Description	
Saturated:	Usually liquid; very wet, usually from below the groundwater table
Wet:	Semisolid; requires drying to attain optimum moisture
Moist:	Solid; at or near optimum moisture
Dry:	Requires additional water to attain optimum moisture

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	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 MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	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 MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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

SCDOT Soil Test Log

Project ID:	PO31751	**County:**	Dillon	**Boring No.:**	STB-103		
Site Description:	S-45 Lester Road over Little Pee Dee Swamp			**Route:**	S-45		
Eng./Geo.:	K. Ryan	**Boring Location:**	45+27.49	**Offset:**	5.45 ft RT	**Alignment:**	Existing CL
Elev.:	78.7 ft	**Latitude:**	34.3326565	**Longitude:**	79.3244903	**Date Started:**	2/15/2018
Total Depth:	18 ft	**Soil Depth:**	18 ft	**Core Depth:**	0 ft	**Date Completed:**	2/15/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
	0.0									
	0.5	6 Inches Asphalt		0.0	SS-1	18	14	10	23	24
		FILL: Medium dense, moist, brown, fine to coarse, **CLAYEY SAND (SC/A-2-6)** some fines (7.5YR 5/6)		2.0	SS-2	14	12	15	16	27
	4.0			4.0						
73.7		Loose to very loose, moist, grayish-brown, fine to coarse, **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with little organics and gravel fragments, few fines (7.5YR 5/2)			SS-3	3	4	3	3	7
	6.0			6.0	SS-4	1	1	1	3	2
		ALLUVIUM: Very loose to loose, wet, gray, fine to coarse, **POORLY GRADED SAND (SP/A-3)**, trace fines (7.5YR 4/3)		8.0	SS-5	1	2	3	10	5
68.7				10.0	SS-6	5	4	3	10	7
	12.0			12.0						
		Medium dense, wet, gray, fine to coarse, **POORLY GRADED SAND (SP/A-3)**, trace fines (7.5YR 4/3)			SS-7	6	7	10	12	17
	14.0			14.0						
63.7		Very loose, wet, gray, fine to coarse, **POORLY GRADED SAND (SP/A-3)**, trace fines (7.5YR 4/3)			SS-8	3	3	3	3	6
				16.0	SS-9	8	10	14	4	24
	18.0	Boring terminated at 18 feet due to location conflict. Boring backfilled with drilling spoils and grout.								
58.7										
53.7										

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

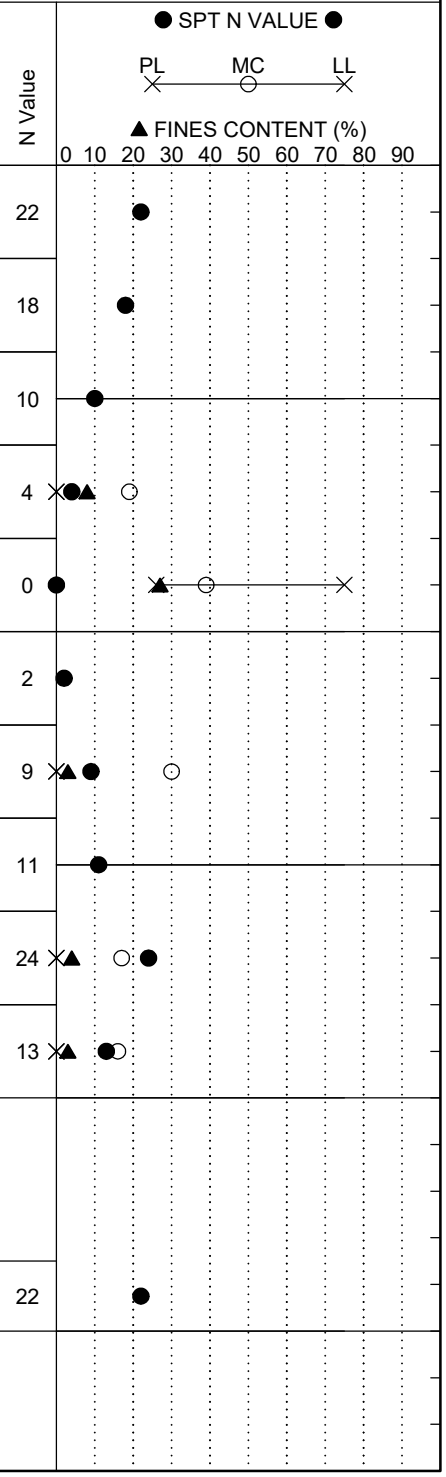
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	STB-103A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	49+64.15	**Offset:**	5.71 ft RT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3335951	**Longitude:**	79.3235879	**Date Started:**	2/15/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/16/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
	0.0		0.0	SS-1	11	11	11	1	22
	0.5	6 Inches Asphalt	2.0	SS-2	5	7	11	14	18
		FILL: Medium dense, moist, brown, fine to coarse, **CLAYEY SAND (SC/A-2-6)** some fines	4.0	SS-3	4	4	6	8	10
	3.0	(7.5YR 5/6)	6.0	SS-4	3	2	2	2	4
73.6		Medium dense to very loose, moist, grayish-brown, fine to coarse, **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, few fines	8.0	SS-5	WOH/24"				0
		(7.5YR 5/2)	10.0	SS-6	1	1	1	2	2
		SS-4: LL=NP, PL=NP,	12.0	SS-7	4	4	5	6	9
	8.0	NMC=18.9%, #200=7.5%	14.0	SS-8	2	5	6	10	11
68.6		Very loose, wet, brown, fine to coarse **CLAYEY SAND (SC/A-2-7)**, with little organics and gravel fragments, little to some fines	16.0	SS-9	7	11	13	15	24
		(7.5YR 5/6)	18.0	SS-10	4	6	7	16	13
	12.0	SS-5: LL=75, PL=27, PI=55, NMC=38.7%, #200=26.7%	23.5	SS-11	5	11	11		22
63.6		**ALLUVIUM:** Loose to medium dense, wet, dark brown, fine to coarse, **POORLY GRADED SAND (SP/A-3)**, with trace to few gravel fragments, trave fines							
		(7.5YR 4/3)							
		SS-7: LL=NP, PL=NP,							
	18.0	NMC=29.7%, #200=2.8%							
58.6		Medium dense, wet, gray, fine to coarse **POORLY GRADED SAND (SP/A-3)**, with little to some gravel fragments, trace fines							
		(7.5YR 6/1)							
		SS-10: LL=NP, PL=NP							
		NMC=15.7%, #200=3.4%							
53.6									
	28.0								



Continued Next Page

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:	PO31751			**County:**	Dillon	**Boring No.:**	STB-103A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	49+64.15	**Offset:**	5.71 ft RT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3335951	**Longitude:**	79.3235879	**Date Started:**	2/15/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/16/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
48.6	0	**PEE DEE FORMATION:** Very stiff, moist, dark gray, **SANDY FAT CLAY (CH/A-7-6)** (GLEY 2 4/5B) SS-12: LL=51, PL=16, PI=35 NMC=41.7%, #200=58.1%		28.5	SS-12	9	12	16		28
	32.5	Dense to very dense, wet, fine to coarse **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with trace gravel fragments, few fines (GLEY 2 4/5B) SS-14: LL=NP, PL=NP NMC=24.5%, #200=6.6%		33.5	SS-13	9	15	18		33
43.6				38.5	SS-14	11	14	18		32
38.6				43.5	SS-15	20	33	35		68
33.6				48.5	SS-16	16	22	39		61
28.6	52.5	Medium dense to very dense, moist, dark gray, **CLAYEY SAND (SC/A-2-7)**, with little gravel fragments, little to some fines (GLEY 2 4/5B) SS-17: LL=82, PL=27, PI=55		53.5	SS-17	7	10	13		23
23.6										

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	STB-103A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	49+64.15	**Offset:**	5.71 ft RT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3335951	**Longitude:**	79.3235879	**Date Started:**	2/15/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/16/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
		NMC=41.8%, #200=24.5%								
				58.5	SS-18	6	9	12		21
18.6										
				63.5	SS-19	15	23	30		53
13.6										
				68.5	SS-20	8	14	15		29
8.6										
				73.5	SS-21	9	11	12		23
3.6										
				78.5	SS-22	6	11	13		24
-1.4										
				83.5						

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

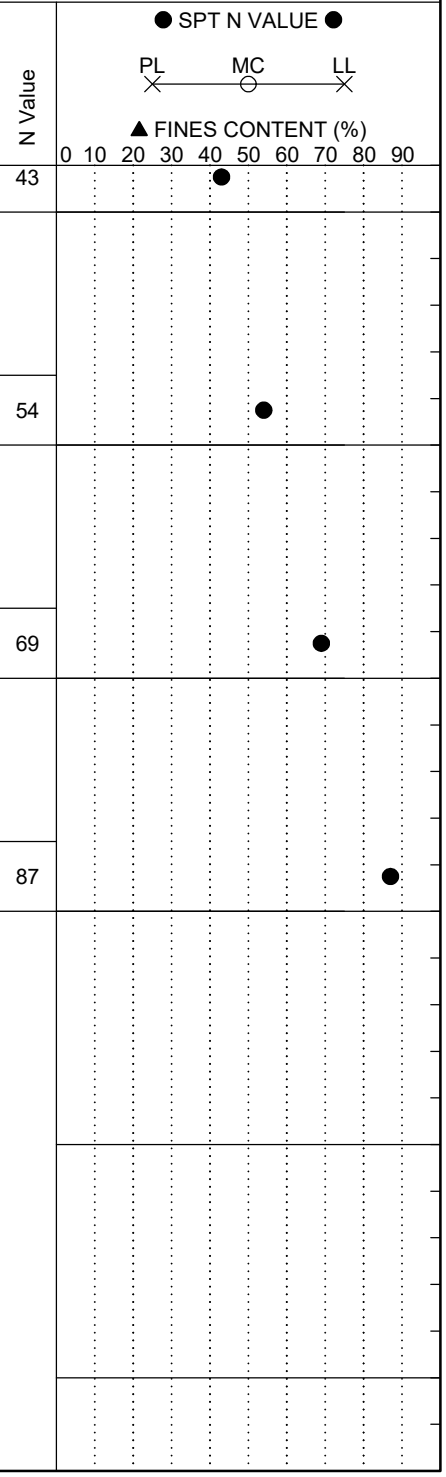
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	STB-103A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	49+64.15	**Offset:**	5.71 ft RT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3335951	**Longitude:**	79.3235879	**Date Started:**	2/15/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/16/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
-6.4					SS-23	13	20	23		43
	87.5	Very dense, moist, fine to medium **CLAYEY SAND (SC/A-2-6)**, little to some fines (GLEY 2 4/5B)		88.5	SS-24	14	18	36		54
-11.4										
				93.5	SS-25	21	32	37		69
-16.4										
				98.5	SS-26	30	42	45		87
-21.4	100.0	Boring terminated at 100 feet. Boring backfilled with drilling spoils and grout after 24-hour water level reading.								
-26.4										
-31.4										



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	

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751	**County:**	Dillon	**Boring No.:**	STB-104A		
Site Description:	S-45 Lester Road over Little Pee Dee Swamp			**Route:**	S-45		
Eng./Geo.:	K. Ryan	**Boring Location:**	51+44.02	**Offset:**	3.09 ft LT	**Alignment:**	Existing CL
Elev.:	78.9 ft	**Latitude:**	34.3339979	**Longitude:**	79.3232412	**Date Started:**	2/19/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/20/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value
	0.0		0.0						
	0.5	6 Inches Asphalt							
		FILL: Medium dense, moist, reddish-brown, fine to coarse **SILTY SAND (SM/A-3)**	2.0	SS-1	11	14	12	7	26
	3.0	(10YR 5/6)							
		Medium dense to loose, moist, brown, fine to coarse **POORLY GRADED SAND (SP/A-3)** with trace organics, trace fines	4.0	SS-2	6	12	12	10	24
73.9		(7.5YR 5/6)		SS-3	2	6	6	5	12
		SS-3: LL=NP, PL=NP, NMC=7.7%, #200=3.3%	6.0	SS-4	3	3	4	4	7
	8.0	▽	8.0						
		Loose to dense, wet, brown, fine to coarse **POORLY GRADED SAND WITH SILT (SP-SM/A-3)** with trace organics, few fines		SS-5	2	3	5	10	8
68.9		(7.5YR 5/6)	10.0	SS-6	11	16	17	16	33
		SS-5: LL=NP, PL=NP, NMC=24.3%, #200=9.1%							
	12.0		12.0						
		ALLUVIUM: Medium dense, wet, brown, fine to coarse **POORLY GRADED SAND (SP/A-3)** with trace organics		SS-7	6	8	8	8	16
		(7.5YR 5/6)	14.0	SS-8	7	10	12	13	22
63.9		SS-7: LL=NP, PL=NP, NMC=15.4%, #200=4.2%							
			16.0	SS-9	11	12	12	12	24
	18.0		18.0						
		Medium dense, wet, brown, fine to coarse **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, mostly wood		SS-10	6	6	5	7	11
58.9		(7.5YR 5/6)							
		SS-10: LL=NP, PL=NP, NMC=33.6%, #200=6%							
	22.5								
		Medium dense, wet, grayish-brown, fine to coarse, **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with some gravel fragments	23.5						
				SS-11	4	12	9		21
53.9		(7.5YR 5/2)							
		SS-11: LL=NP, PL=NP, NMC=17.4%, #200=6.6%							
	28.0								

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

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:	PO31751	**County:**	Dillon	**Boring No.:**	STB-104A		
Site Description:	S-45 Lester Road over Little Pee Dee Swamp			**Route:**	S-45		
Eng./Geo.:	K. Ryan	**Boring Location:**	51+44.02	**Offset:**	3.09 ft LT	**Alignment:**	Existing CL
Elev.:	78.9 ft	**Latitude:**	34.3339979	**Longitude:**	79.3232412	**Date Started:**	2/19/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/20/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
48.9		**PEE DEE FORMATION:** Very dense to dense, wet, dark gray, fine to coarse **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with fat clay pockets (GLEY 2 4/5B) SS-12: LL=NP, PL=NP, NMC=26%, #200=6.2%		28.5	SS-12	25	27	30		57
43.9				33.5	SS-13	16	18	24		42
38.9				38.5	SS-14	10	15	19		34
33.9				43.5	SS-15	21	32	34		66
28.9				48.5	SS-16	14	20	26		46
23.9	52.5	Dense to medium dense, moist, dark gray, **CLAYEY SAND (SC/A-2-4)**, some fines (GLEY 2 4/5B) SS-17: LL=26, PL=17, PI=9, NMC=40.6%, #200=30.9%		53.5	SS-17	12	16	25		41

● SPT N VALUE ●
PL MC LL
▲ FINES CONTENT (%)
0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	STB-104A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	51+44.02	**Offset:**	3.09 ft LT	**Alignment:**	Existing CL
Elev.:	78.9 ft	**Latitude:**	34.3339979	**Longitude:**	79.3232412	**Date Started:**	2/19/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/20/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
				58.5	SS-18	8	11	12		23
18.9										
				63.5	SS-19	10	17	15		32
13.9										
				68.5	SS-20	9	10	12		22
8.9										
	72.5	Dense to medium dense, moist, dark gray, fine to coarse, **CLAYEY SAND (SC/A-2-6)**, little to some fines (GLEY 2 4/5B)		73.5	SS-21	14	16	20		36
3.9										
				78.5	SS-22	10	12	18		30
-1.1										
	82.5	Hard to very hard, moist, dark gray, **SANDY FAT CLAY (CH/A-7-6)**		83.5						

SPT N VALUE ●

PL ⨯ MC ○ LL ⨯

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

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	

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	STB-104A
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	51+44.02	**Offset:**	3.09 ft LT	**Alignment:**	Existing CL
Elev.:	78.9 ft	**Latitude:**	34.3339979	**Longitude:**	79.3232412	**Date Started:**	2/19/2018
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	2/20/2018
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-55	**Drill Method:**	Wash Boring	**Hammer Type:**	Automatic	**Energy Ratio:**	86%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB** 8 ft	**24HR**	7.2 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
-6.1		(GLEY 2 4/5B)			SS-23	12	22	33		55
				88.5						
					SS-24	14	18	21		39
-11.1										
				93.5						
					SS-25	36	43	50/5"		100
-16.1										
				98.5						
					SS-26	25	39	50/5"		99
-21.1	100.0	Boring terminated at 100 feet. Boring backfilled with drilling spoils and grout after 24-hour water level reading.								
-26.1										
-31.1										

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	HA-01
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	49+61.88	**Offset:**	5.45 ft LT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3336092	**Longitude:**	79.3236216	**Date Started:**	2/15/2018
Total Depth:	10 ft	**Soil Depth:**	10 ft	**Core Depth:**	0 ft	**Date Completed:**	2/15/2018
Bore Hole Diameter (in):	6	**Sampler Configuration**		**Liner Required:**	Y N	**Liner Used:**	Y N
Drill Machine:	CME-55	**Drill Method:**	3.75" ID HSA	**Hammer Type:**		**Energy Ratio:**	-%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB**		**24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6" / 4th 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	**FILL:** Sampled as moist, brown, fine to coarse, **CLAYEY SAND (SC/A-2-6)** some fines (7.5YR 5/6) BULK SAMPLE: HA-01 Soil Resistivity = 499 ohms-cm Chlorides-S = 44 mg/kg Sulfate-S = 65 mg/kg pH (distilled water) = 4.1 pH (0.01M Calcium Chloride) = 3.9		0.0				
73.6								
68.6	10.0	Boring terminated at 10 feet. Boring backfilled with drilling spoils and grout.						
63.6								
58.6								
53.6								

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	HA-02
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	51+49.00	**Offset:**	3.09 ft LT	**Alignment:**	Existing CL
Elev.:	78.9 ft	**Latitude:**	34.3339979	**Longitude:**	79.3232412	**Date Started:**	2/15/2018
Total Depth:	10 ft	**Soil Depth:**	10 ft	**Core Depth:**	0 ft	**Date Completed:**	2/15/2018
Bore Hole Diameter (in):	6	**Sampler Configuration**		**Liner Required:**	Y N	**Liner Used:**	Y N
Drill Machine:	CME-55	**Drill Method:**	3.75" ID HSA	**Hammer Type:**		**Energy Ratio:**	-%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB**		**24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6" / 4th 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	**FILL** Sampled as moist, brown, fine to coarse **POORLY GRADED SAND (SP/A-3)** with trace organics, trace fines (7.5YR 5/6) BULK SAMPLE: HA-02 Soil Resistivity = 502 ohms-cm Chlorides-S = 37 mg/kg Sulfate-S = 35 mg/kg pH (distilled water) = 4.2 pH (0.01M Calcium Chloride) = 3.9		0.0				qwert
73.9								
68.9	10.0	Boring terminated at 10 feet. Boring backfilled with drilling spoils and grout.						
63.9								
58.9								
53.9								

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	HA-03
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	45+36.34	**Offset:**	0.98 ft LT	**Alignment:**	Existing CL
Elev.:	78.6 ft	**Latitude:**	34.3326865	**Longitude:**	79.3244873	**Date Started:**	2/15/2018
Total Depth:	10 ft	**Soil Depth:**	10 ft	**Core Depth:**	0 ft	**Date Completed:**	2/15/2018
Bore Hole Diameter (in):	6	**Sampler Configuration**		**Liner Required:**	Y N	**Liner Used:**	Y N
Drill Machine:	CME-55	**Drill Method:**	3.75" ID HSA	**Hammer Type:**		**Energy Ratio:**	-%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB**		**24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
	0.0	**FILL** Sampled as moist, grayish-brown, fine to coarse, **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with little organics and gravel fragments, few fines (7.5YR 5/2) BULK SAMPLE: HA-03 Soil Resistivity = 493 ohms-cm Chlorides-S = 100 mg/kg
73.6	6.0	Sulfate-S = 39 mg/kg pH (distilled water) = 4.7 pH (0.01M Calcium Chloride) = 4.0
68.6	10.0	**ALLUVIUM** Sampled as moist, grayish-brown, fine to coarse, **POORLY GRADED SAND WITH SILT (SP-SM/A-3)**, with little organics and gravel fragments, few fines (7.5YR 5/2)
63.6		Boring terminated at 10 feet. Boring backfilled with drilling spoils and grout.
58.6		
53.6		

Graphic Log | Sample Depth (ft) | Sample No./Type | 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | N Value

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18

SCDOT Soil Test Log

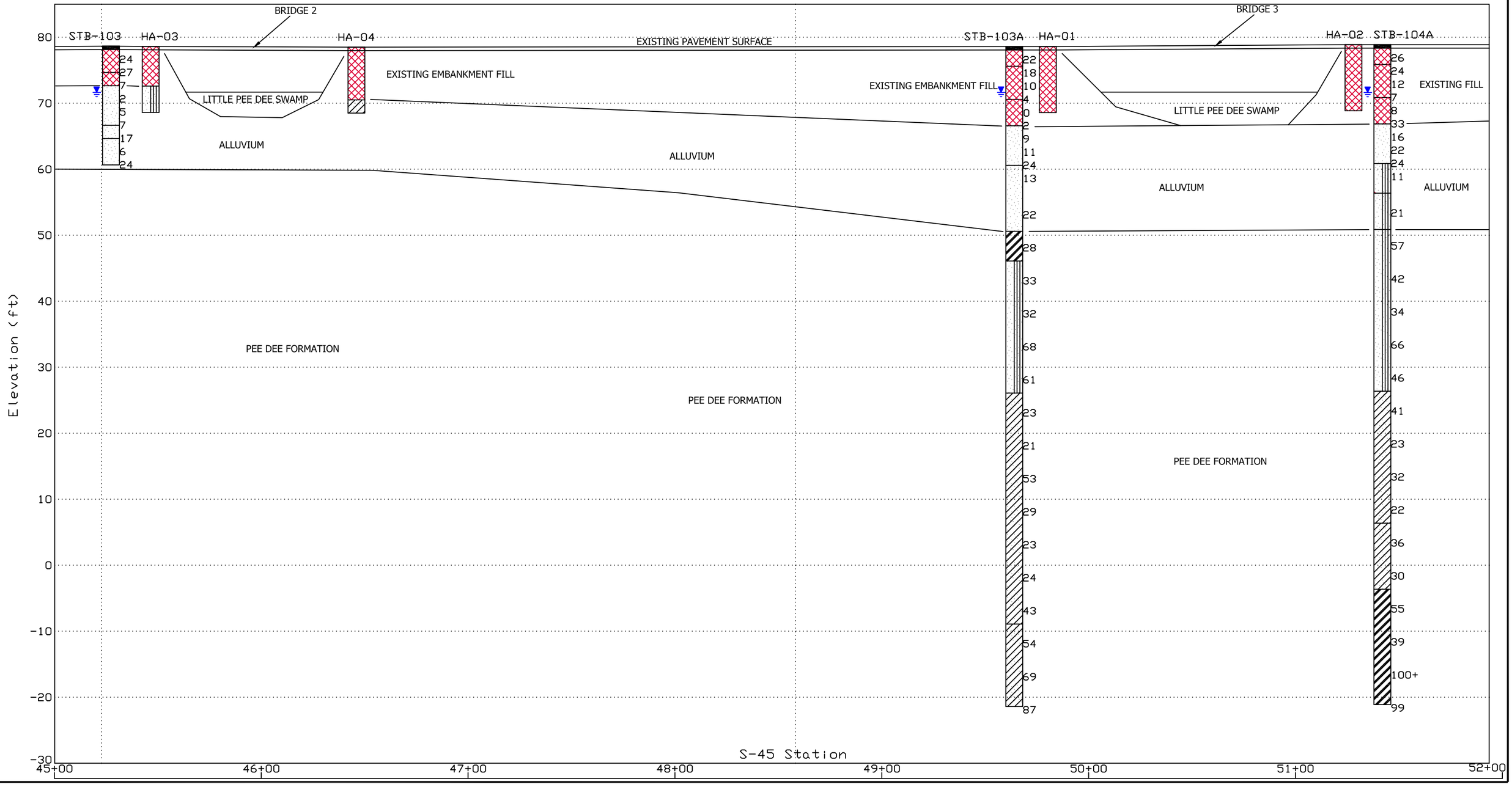
Project ID:	PO31751			**County:**	Dillon	**Boring No.:**	HA-04
Site Description:	S-45 Lester Road over Little Pee Dee Swamp					**Route:**	S-45
Eng./Geo.:	K. Ryan	**Boring Location:**	46+46.90	**Offset:**	0.34 ft LT	**Alignment:**	Existing CL
Elev.:	78.5 ft	**Latitude:**	34.3329215	**Longitude:**	79.3242554	**Date Started:**	2/15/2018
Total Depth:	10 ft	**Soil Depth:**	10 ft	**Core Depth:**	0 ft	**Date Completed:**	2/15/2018
Bore Hole Diameter (in):	6	**Sampler Configuration**		**Liner Required:**	Y N	**Liner Used:**	Y N
Drill Machine:	CME-55	**Drill Method:**	3.75" ID HSA	**Hammer Type:**		**Energy Ratio:**	-%
Core Size:	N/A	**Driller:**	SCI	**Groundwater:**	**TOB**		**24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6" / 4th 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	**FILL** Sampled as moist, grayish-brown, fine to medium, **SILTY SAND (SM/A-2-4)**, little to some fines (7.5YR 5/2) BULK SAMPLE: HA-04 Soil Resistivity = 504 ohms-cm Chlorides-S = 22 mg/kg Sulfate-S = 51 mg/kg pH (distilled water) = 5.1 pH (0.01M Calcium Chloride) = 4.0						
73.5	8.0	**ALLUVIUM** Sampled as moist, dark brown, fine to coarse, **CLAYEY SAND (SC/A-2-7)**, trace root fragments, little organics, gravel fragments, and few fines (7.5YR 5/2)						
68.5	10.0	Boring terminated at 10 feet. Boring backfilled with drilling spoils and grout.						
63.5								
58.5								
53.5								

LEGEND

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

SC_DOT 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/22/18



ELEV_LANDSCAPE_11X17 65V0174 LOGS - FOR FENCE GENERATION.GPJ F&R.GDT 3/20/18

Description of Soil Stratigraphy Symbols

- Fill Soils - Silty Sand (SM), Clayey Sand (SC),
- Fill Soils - Poorly Graded Sand (SP), Poorly Graded Sand with Silt (SP-SM)
- Silty Sand (SM)
- Clayey Sand (SC)
- Poorly Graded Sand (SP)
- Poorly Graded Sand with Silt (SP-SM)
- Sandy Silt (ML)
- Sandy Fat Clay (CH)

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
18 Woods Lake Road, Greenville, SC 29607 I USA
T 864.271.2840 I F 864.271.8124

Drawing Title: Subsurface Soil Profile Along Existing Centerline S-45 Lester Road

Client:	South Carolina Department of Transportation	**Job No.:**	65V-0174
Project:	S-45 (Lester Road) Over Little Pee Dee Swamp Two Bridge Replacements Dillon County, South Carolina	**Date:**	3/20/2018
		Figure No.:	4
		Scale:	As Shown
		Drawn By:	R. French
		Checked By:	B. Azumah

APPENDIX III

Cone Penetration Test Specification Sheet
Cone Penetration Test Results – (CPT-103, CPT-104, CPT-103A, and CPT-104A)

PalmettoINSITU
Geotechnical Exploration

Exploration Findings - Lester Rd (S-45)

Dillon County, South Carolina

Client: FROEHLING & ROBERTSON, Inc.

PILLC No.: 18-018

February 19, 2018

PalmettoINSITU, LLC Provides Specialized Data that which is only to be Interpreted by Qualified Professionals.

TEST METHODS:

PalmettoINSITU, LLC executes exploration projects in general accordance with published American Society for Testing and Material (ASTM) procedures; the United States Department of Transportation (USDOT), Federal Highway Administration (FHA), National Highway Institute (NHI) recommendations; and within generally acceptable industry practices. These include but are not limited to:

⇒ **ASTM D5778:** *Standard Test Method for Performing Electronic Friction Cone and Piezo Cone Penetration Testing of Soils* (CPTu)
⇒ **ASTM D7400:** *Standard Test Methods for Downhole Seismic Testing* (SCPTu)
⇒ **ASTM D6635:** *Standard Test Method for Performing the Flat Plate Dilatometer* (DMT)
⇒ **International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE):** *The Flat Dilatometer Test (DMT) in Soil Investigations: A Report by the ISSMGE Committee TC16*
⇒ **USDOT, FHA and NHI**: *Subsurface Investigation Publication No. FHWA-NHI-05-035*. July 2006.

INSTRUMENTATION :

PalmettoINSITU, LLC Performs Daily Inspections of its Instrumentation as part of its Quality Assurance (QA) Program.

Each Instrument or Critical Measuring Gauge is calibrated as prescribed within one or more of the aforementioned Standards by its manufacturer; an American National Standard Institute (ANSI); or an International Standard (ISO) Laboratory Capable of testing to ISO/IEC 1705:2005 or a laboratory capable of meeting Standard Reference Materials of the National Institute of Standards and Technology (NIST), a non-regulated agency of the United States Department of Commerce.

⇒ **All of PalmettoINSITU's Cone Penetrometer (SCPTu and CPTu) Probes are:**

- Manufactured by Vertek, a division of Applied Research Associates, Inc.(ARA);
- Vertek (VTK) series;
- 1.75 inches (15 cm^2 tip area);
  And, are Capable of:
- Measuring Pore Water Pressure at the U_2 Position;
- Performing Downhole Seismic Testing using Tri-Axial Geophones and;
- Recording the Deviation from Vertical (inclination) about the cone's X and Y-Axis

⇒ **Cone Penetrometer Data Acquisition Systems:**

- Are Manufactured by Vertek, a Division of ARA, Inc. and;
- Are Vertek (VTK) Series.

⇒ **Marchetti Flat Plate Dilatometer (DMT) Tooling**

- Provided by GPE, Inc
- Membranes are H2.5, Unless Otherwise Specified

RIG DESCRIPTION AND GENERALIZED DATA ACQUISITION PROCESS:

The geotechnical exploration program is performed using an S4-Scorpian, Manufactured by Vertek. The S4-Scorpian:

⇒ **Rig Description**:

- Anchors into the soil to achieve a thrust which can exceed 20 tons;
- Using anchors that may range in diameter from 300 to 500 cm;
- Which attach to hydraulically telescoping Anchors
- Uses a Bobcat T770 mini track loader with rubber tracks to convey and for hydraulical power;
- Has a combined weight, including Bobcat T770, and drill string, of approximately 12,000 pounds

⇒ **Generalized Data Acquisition Process:**

The Processes Following Assumes the Instrument has Met its Pre-Test Inspection and Baseline Requirements.

- All tests are pushed to the a target depth, the rigs maximum reaction, equipment failure or maximum lateral support of the push rods.
- The CPT probe or DMT blade is connected to its required control system by pre-stringing a pre-determined length of in-situ rods.
- CPTu data is acquired at a push rate of two centimeters per second. The tip, sleeve friction, pore water pressure and inclination are automatically recorded with relation to depth.
- Downhole Seismic Data is acquired at approximately one meter intervals, unless otherwise specified.
- Dissipation data is acquired at a logarithmic rate with regards to dynamic pore water pressure and depth.
- DMT data is collected at one foot intervals. Delta-A and Delta-B, both pre- and post-sounding are determined. The Z-reading, if necessary, is noted. A-readings and B-Readings are both recorded with respect to depth.

SIGNIFICANT SOFTWARE UTILIZED FOR DATA REDUCTION, LOG AND GRAPH PRODUCTION:

Finalized Output is Routinely Published using RAPIDCPT. However, PalmettoINSITU, LLC may use other Software if Required. The Client will be Notified in Advance if such a Situation Occurs.

⇒ **Bentley Systems, Inc. Supplied:**

- *gINT V8i SS2 Version 08.30.04.285 (gINT V8i Professional)*

⇒ **Vertek Provided:**

- *Coneplot version 2.0.4 (Beta)*
- *CPT Processor version 1.7.19971*

⇒ **Dataforensics, LLC**

- *gINT add-on: RAPIDCPT version 4.2.2.0*

SIGNIFICANT SOFTWARE UTILIZED FOR DATA REDUCTION, LOG AND GRAPH PRODUCTION (CONTINUED) **:**

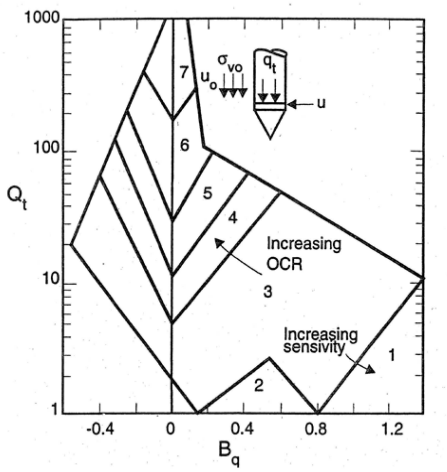
⇒ **Dataforensics, LLC** (Continued):

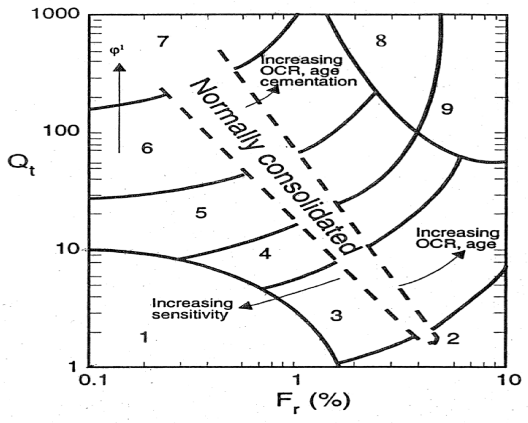
- *The application utilizes the Fuzzy CPT Soil Classification (Zhang & Tumay, 1999) algorithm developed for the classification software created by Louisiana Transportation Research Center (LTRC) under Project No. 98-3GT (Titi & Abu-Farsakh, 1999); its use in this application was developed with the support and assistance under LTRC Project No. 10-2GT, Geotechnical Information Database, Phase 2*

RAPIDCPT DEFAULT VARIABLES:

Min Drained Threshold Zone	5	Dr in M Calc	Dr (1)
Max Drained Threshold Zone	7	Nu	7
Drained Threshold Soil Behavior Type	Qt vs Fr	NkT	15
Phi in K0 Calc	Phi' (1)	Nk	15
OCR in K0 Calc	OCR (1)	Nc	20

NORMALIZED SOIL BEHAVIOR TYPES - ROBERTSON & CAMPANELLA (1990):





SOIL BEHAVIOR TYPE (SBT) MATERIAL LEGEND:

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

Robertson and Campanella: 1990

PalmettoINSITU
Geotechnical Exploration

Lester Rd (S-41) Dillon
Dillon County, SC
Project Number :18-018

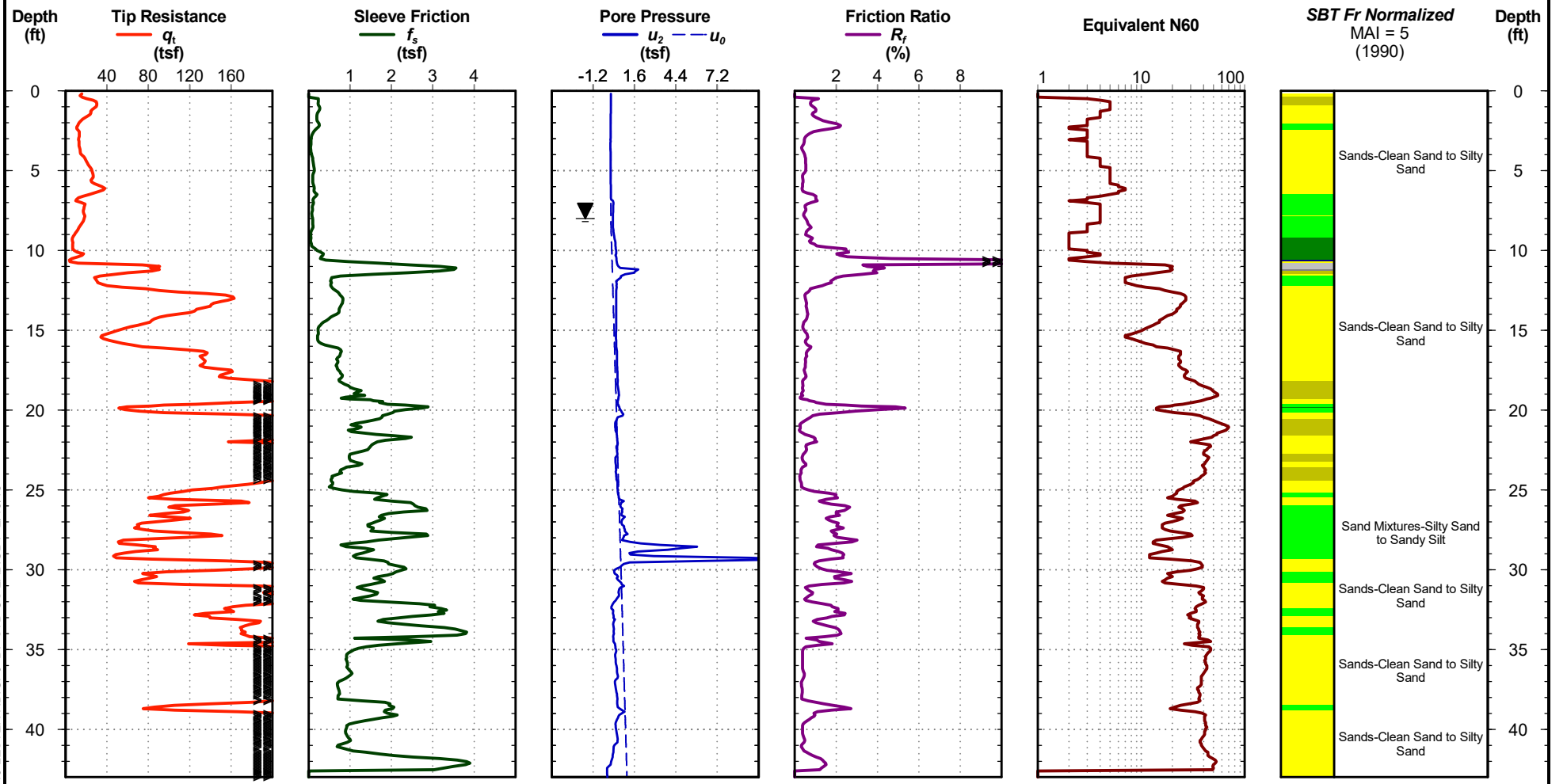
Cone Penetration Test

CPT-103

Date: Feb. 15, 2018
Estimated Water Depth: 8 ft
Rig/Operator: M. Cox | J. Croom

Northing: 913454.9190
Easting: 2505757.9390
Elevation: 78.89 ft

Total Depth: 43.0 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD S-45 LESTER RD.GPJ DF STD US LAB.GDT 2/19/18

CPT-103

Page 1 of 1

Electronic File Name: B15F1804C.DAT

PalmettoINSITU
Geotechnical Exploration

Lester Rd (S-41) Dillon
Dillon County, SC
Project Number :18-018

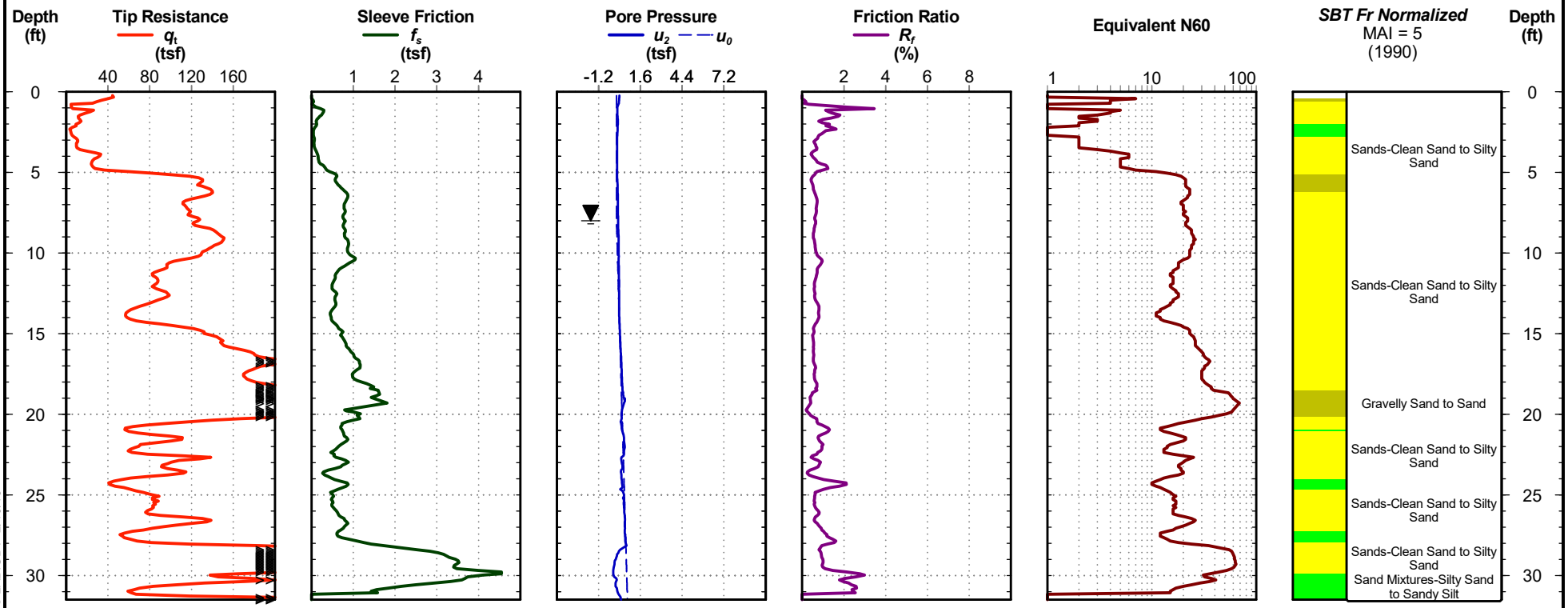
Cone Penetration Test

CPT-104

Date: Feb. 15, 2018
Estimated Water Depth: 8 ft
Rig/Operator: M. Cox | J. Croom

Northing: 913552.9090
Easting: 2505823.3860
Elevation: 78.81 ft

Total Depth: 31.5 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD S-45 LESTER RD.GPJ DF STD US LAB.GDT 2/19/18

CPT-104

Electronic File Name: B15F1803C.DAT

PalmettoINSITU
Geotechnical Exploration

Lester Rd (S-41) Dillon
Dillon County, SC
Project Number :18-018

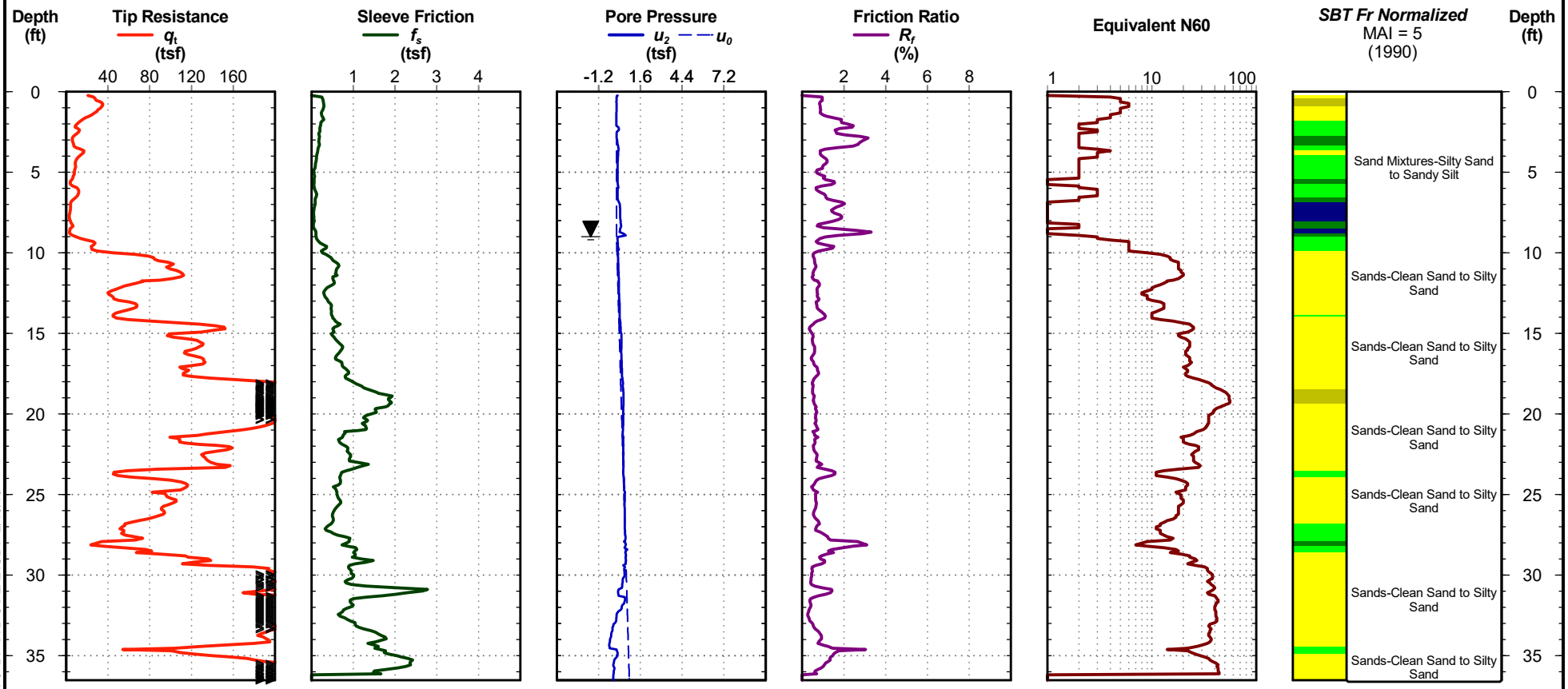
Cone Penetration Test

CPT-103A

Date: Feb. 15, 2018
Estimated Water Depth: 9 ft
Rig/Operator: M. Cox | J. Croom

Northing: 913790.7960
Easting: 2506027.3780
Elevation: 78.59 ft

Total Depth: 36.5 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD S-45 LESTER RD.GPJ DF STD US LAB.GDT 2/19/18

CPT-103A

Page 1 of 1

Electronic File Name: B15F1802C.DAT

PalmettoINSITU
Geotechnical Exploration

Lester Rd (S-41) Dillon
Dillon County, SC
Project Number :18-018

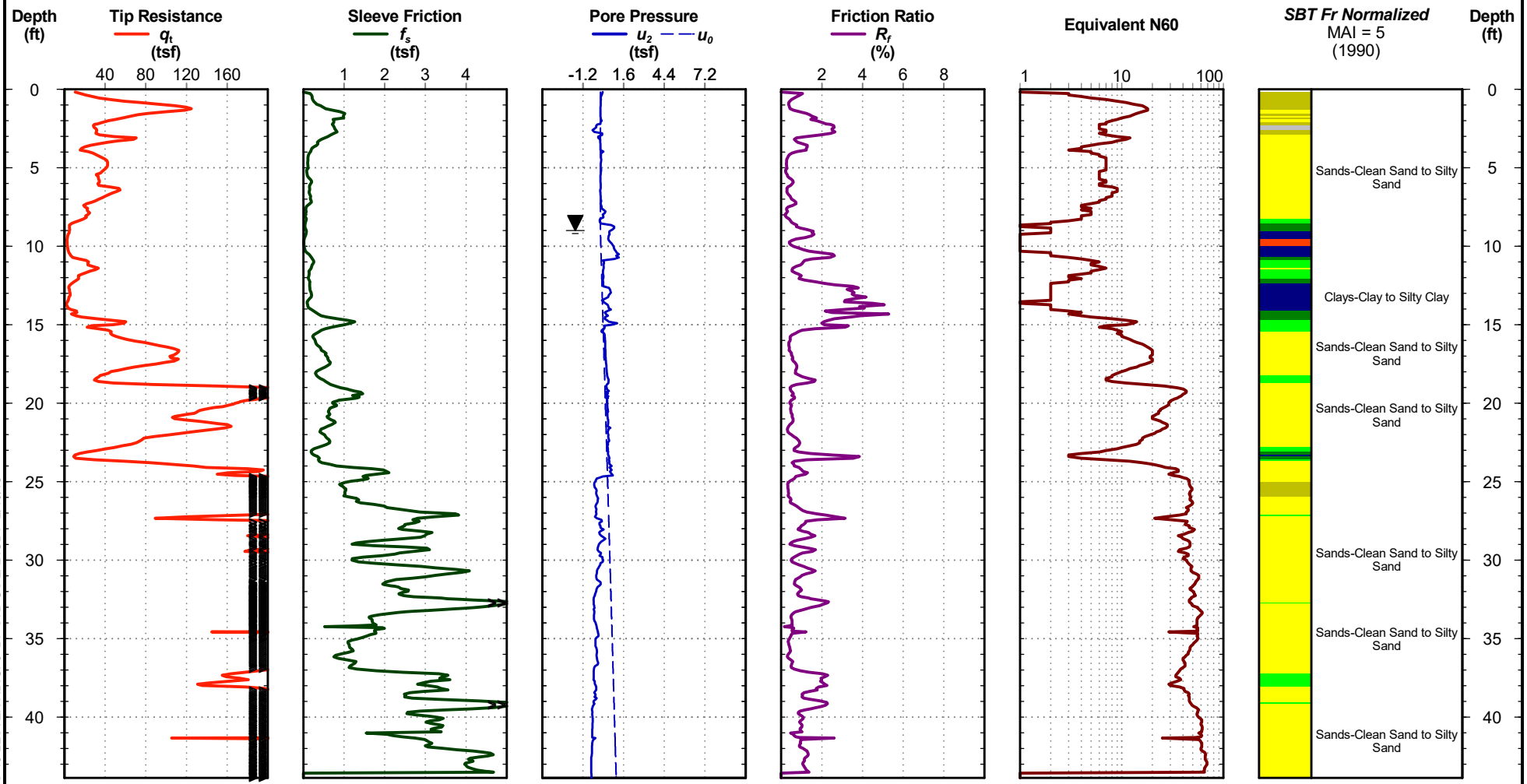
Cone Penetration Test

CPT-104A

Date: Feb. 15, 2018
Estimated Water Depth: 9 ft
Rig/Operator: M. Cox | J. Croom

Northing: 913945.6600
Easting: 2506122.99
Elevation: 78.33 ft

Total Depth: 43.9 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD S-45 LESTER RD.GPJ DF STD US LAB.GDT 2/19/18

CPT-104A

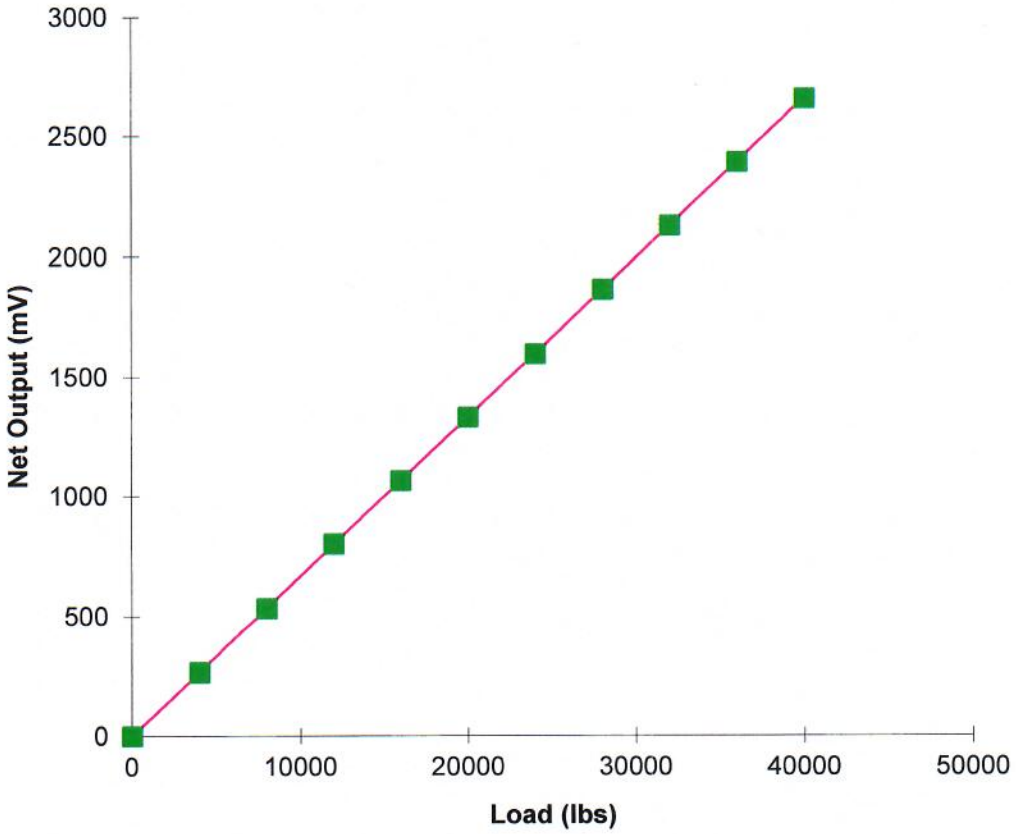
Page 1 of 1

Electronic File Name: B15F1801C.DAT

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Tip

Cone Serial No.:	4444.147	Date:	22-Nov-17
Rated Range:	50000 lbs		
Load Reference:	Ref LC-SN: 390752A	Calibrated By:	M Schaefer
Ref. DVM:	MY47029221		
Ref. Excitation:	9.884 V_{dc}	Approved By:	M McKenna



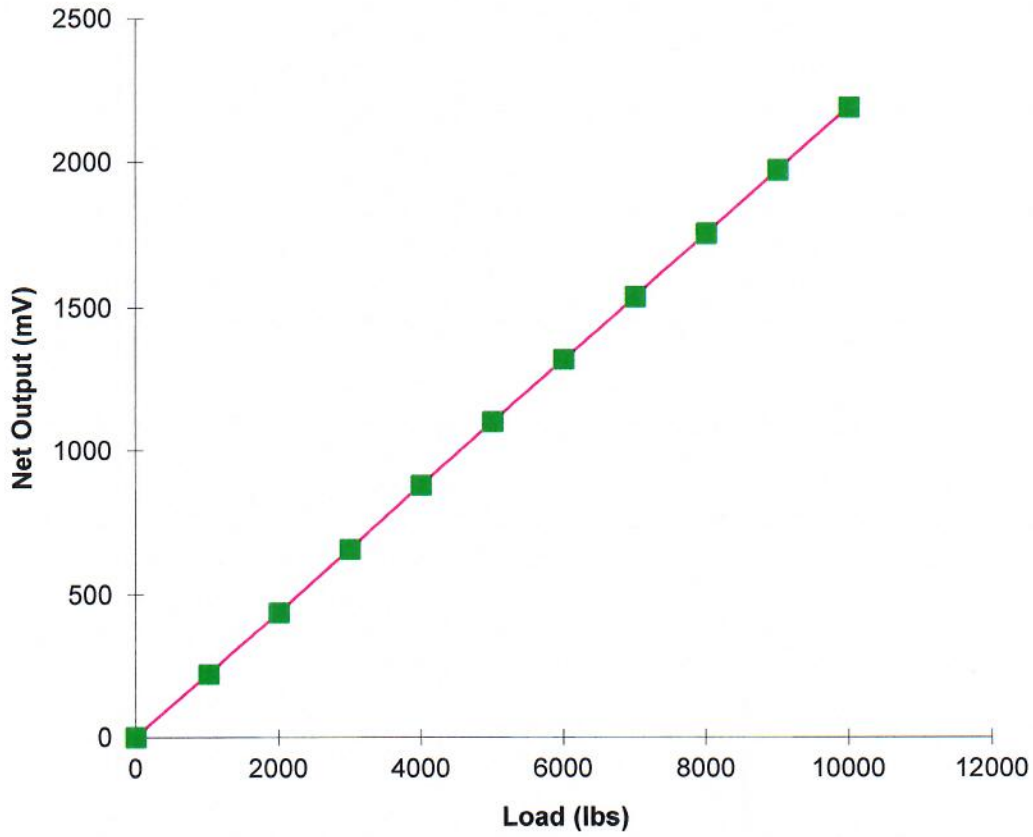
Cal Factor:	**66.399E-3 mV/lbs**	*52.000E-3 nominal*
R^2:	1.00000	
Nonlinearity:	0.13	
Zero Load Output:	261.920E-3 mV	

produced with Cone_Cal v 2003.02.04

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Sleeve

Cone Serial No.:	4444.147	Date:	22-Nov-17
Rated Range:	10000 lbs		
Load Reference:	Ref LC-SN: 390752A	Calibrated By:	M Schaefer
Ref. DVM:	MY47029221		
Ref. Excitation:	9.884 V_{dc}	Approved By:	M McKenna



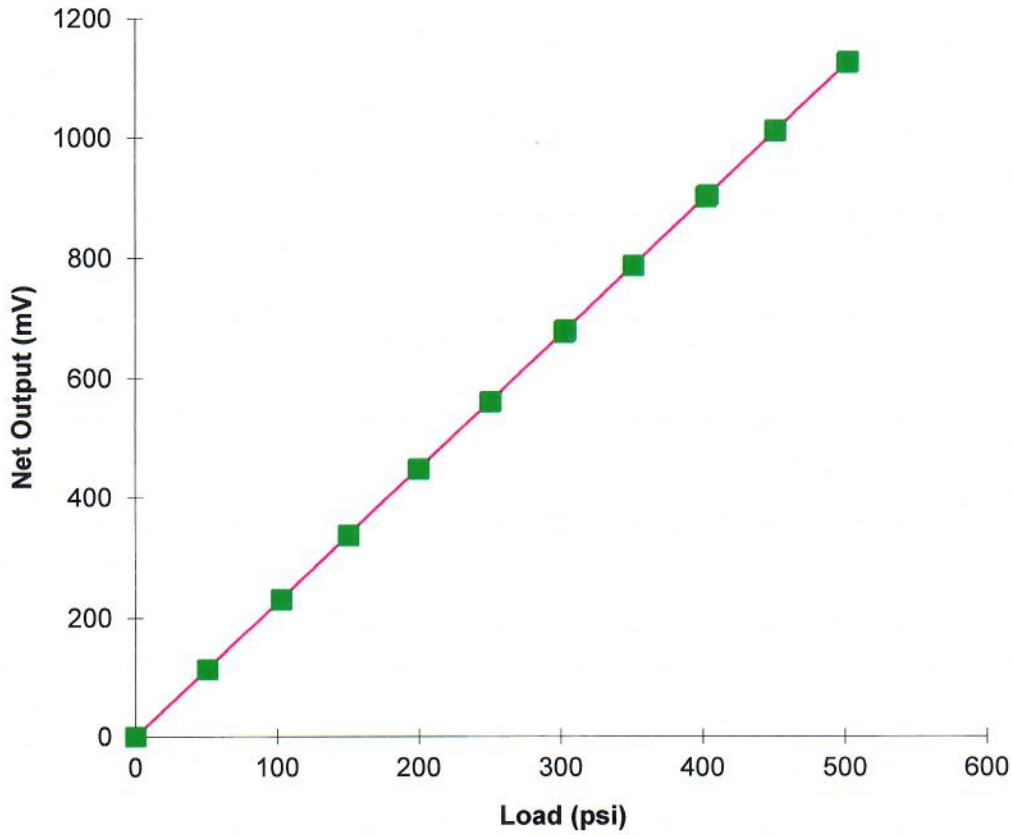
Cal Factor:	**219.289E-3 mV/lbs**	*212.000E-3 nominal*
R^2:	1.00000	
Nonlinearity:	0.09	
Zero Load Output:	237.142E-3 mV	

produced with Cone_Cal v 2003.02.04

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Pore Pressure

Cone Serial No.:	4444.147	Date:	22-Nov-17
Rated Range:	1000 psi		
Load Reference:	Ref PT-13131-01G34P	Calibrated By:	M Schaefer
Ref. DVM:	MY47029221		
Ref. Excitation:	5.034 V_{dc}	Approved By:	M McKenna



Cal Factor:	**2.245E+0 mV/psi**	*2.500E+0 nominal*
R^2:	1.00000	
Nonlinearity:	0.16	
Zero Load Output:	160.611E-3 mV	

produced with Cone_Cal v 2003.02.04

CPT Correlations

References are in parenthesis next to the appropriate equation.

General

p_a=atmospheric pressure (for unit normalization)
q_t=corrected cone tip resistance (tsf)
f_s=friction sleeve resistance (tsf)
$R_f = 100\% \cdot (f_s/q_t)$
u_2=pore pressure behind cone tip (tsf)
u_0=hydrostatic pressure

$B_q = (u_2-u_0)/(q_t-\sigma_{vo})$
$Q_t=(q_t-\sigma_{vo})/\sigma'_{vo}$
$F_r=100\% \cdot f_s/(q_t-\sigma_{vo})$
$I_c = ((3.47-\log Q_t)^2 + (\log F_r+1.22)^2)^{0.5}$ 2
$I_{SBT} = ((3.47-\log(q_c/p_a))^2+(\log F_r+1.22)^2)^{0.5}$ 23

$$I_{c\ J\&D} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q)\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$$ 27

$$I_{c\ J\&B} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q) + 1\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$$ 28

K_o

K_0 (1) $K_o = (1-\sin\varphi)OCR^{\sin\varphi}$
K_0 (2) $K_o = 0.1(Q_t)$ 1

Stress History

$OCR = \sigma_p'/\sigma'_{vo}$
OCR (1) $\sigma_p' = 0.33(q_t - \sigma_{vo})$ - clays 8
OCR (2) $\sigma_p' = 0.53(u_2 - u_o)$ - clays 9
OCR (3) $\sigma_p' = 0.60(q_t - u_2)$ - clays 9
OCR (4) $OCR = 0.25\ Q_t^{1.25}$ – clays 37
OCR (5) $OCR = \left[\frac{0.192*(q_t/p_a)^{0.22}}{(1-\sin(\emptyset')\cdot(\sigma'_{v0}/p_a{}^{0.31})}\right]^{\frac{1}{\sin(\emptyset'-0.27)}}$ – sands 35
OCR (6) $\sigma_p' = .101 \cdot p_a{}^{0.102} \cdot G_{max}{}^{0.478} \cdot \sigma'_{v0}{}^{0.420}$ – all soils 36

N-Value

$N_{60} = (q_t/p_a)/[8.5(1-I_c/4.6)]$ 6

Undrained Shear Strength

S_u (1) $S_u = (u_2 - u_o)/N_u$ where $7 \le N_u \le 9$ 10
S_u (2) $S_u = (q_t - \sigma_{vo})/N_{kT}$ where $15 \le N_{kT} \le 20$ 11
S_u (3) $S_u = 0.091 * ((\sigma'_{vo}{}^{0.2}) * (q_t - \sigma_{vo})^{0.8}$ 21
S_u (4) $S_u = (q_c - \sigma_{vo})/N_k$ where $15 \le N_k \le 20$ 11
S_u (5) $S_u = q_t/N_c$ where $XXX \le N_c \le YYY$
S_u (6) $S_u = q_c/N_c$ where $XXX \le N_c \le YYY$

Effective Cohesion

$c' = 0.02 * \sigma_p'$ 38

Drained Friction Angle

φ′ (1)	$\varphi' = 17.6 + 11.0\text{Log}[q_t/(\sigma_{vo}')^{0.5}]$	1
φ′ (2)	$\varphi' = \arctan[0.1 + 0.38\text{Log}(q_t/\sigma_{vo}')]$	13
φ′ (3)	$\varphi' = 30.8\text{Log}[(f_s/\sigma_{vo}')+1.26]$ (for clays or sands)	14
φ′ (4)	$\varphi' = 29.5\ B_q^{0.121}\ (0.256 + 0.33\ B_q + \text{Log}(Q_t))$	24

Unit Weight

$\rho = \gamma/\gamma_w$

$\rho = 0.8\text{Log}(V_s)$ V_s in m/sec 17

Relative Density and Void Ratio

D_R (1)	$D_R = 100(q_{c1}/305)^{1/2}$	where, $q_{c1} = q_c/(\sigma_{vo}')^{1/2}$	1
D_R (2)	$D_R = -1.292 + 0.268\ln(q_c \cdot (\sigma_{vo}'^{-0.5}))$		18
D_R (3)	$D_R = (1/2.41)\cdot\ln(q_{c1}/15.7)$		3
D_R (4)	$D_R = 1/2.91 * \ln((q_c/(61* \sigma'^{0.71}_{vo}))*100$		20
D_R (5)	$D_R = 100*(0.268*\ln((q_t/p_a)/(\sigma'_{vo}/p_a)\text{^}0.5) – 0.675)$		34

$e_o = 1.099 – 0.204\log(q_{c1})$ 1

$E_D = 5\ q_t$ $I_D = 2.0 – 0.14(R_f)$ $K_D = E_D/(34.7\cdot I_D\cdot \sigma_{vo}')$

Compressibility

$M (1) = R_m\ E_D$ where R_m= function(I_D, K_D) see the following table 22

$I_D <= 0.6$	$R_M = 0.14 + 2.36 \log K_D$
$I_D >= 3$	$R_M = 0.5 + 2 \log K_D$
$0.6 < I_D < 3$	$R_M = R_{M,D} + (2.5 - R_{M,D})\log K_D$
	$R_{M,D} = 0.14 + 0.15(I_D – 0.6)$
$K_D > 10$	$R_M = 0.32 + 2.18 \log K_D$
$R_M < 0.85$	$R_M = 0.85$

M (2)	$M = q_c\cdot 10^{(1.09-0.0075D}R^{)}$ *sands*	1
M (3)	$M = 8.25\ (q_t - \sigma_{vo})$ *clays*	1
M (4)	$M = \alpha \cdot G_{max}$ *where* $0.02 < \alpha < 2$ and G_{max} *is from* Vs	33

Rigidity Index

$I_R = exp\left[\left(\frac{1.5}{M} + 2.925\right)\cdot\left(\frac{q_t-\sigma_{vo}}{q_t-u_2}\right) - 2.925\right]$ where $M = 6\sin\emptyset'/(3-\sin\emptyset')$ 39

Sensitivity

S_t (1)	$S_t = 7.5/R_f$	2
S_t (2)	$S_t = (q_t - \sigma_{vo})/(15\cdot f_s)$	2

Fines Content

$FC = [(3.58-\log(q_t))^2+(1.43+\log(R_f))^2]^{1.8}$ 4

$FC = [5.31(I_{cfs})^{2.31}]+9.61$, where $I_{cfs} = [(1.95-\text{Log}Q_t)^2+(\log F_r+1.78)^2]^{0.5}$

Shear Wave Velocity

$V_s(1) = 277 \cdot q_t^{0.13} \cdot {\sigma'_{vo}}^{0.27}$ (sands) - m/s and MPa 29

$V_s(2) = 1.75 \cdot q_t^{0.627}$ (clays) - m/s and kPa 30

$V_s(3) = (10.1 \cdot \log q_t - 11.4)^{1.67} \cdot (\frac{f_s}{q_t} \cdot 100)^{0.3}$ (all soils) – m/s and kPa 31

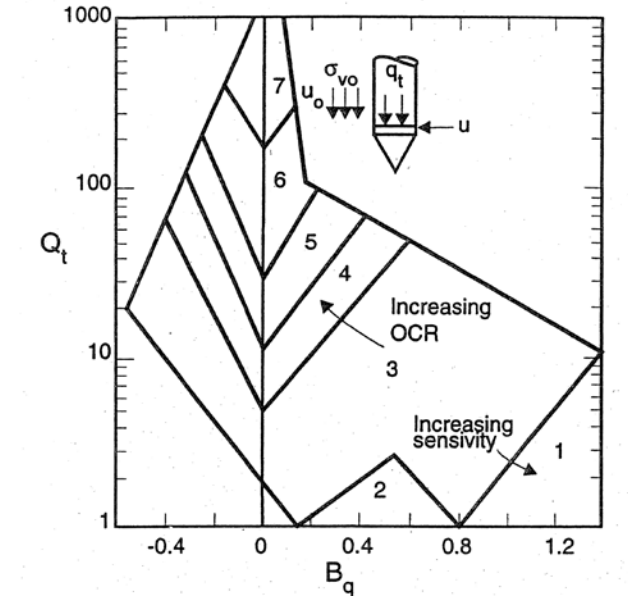
$V_s(4) = 118.8 \cdot \log f_s + 18.5$ (all soils) – m/s and kPa 32

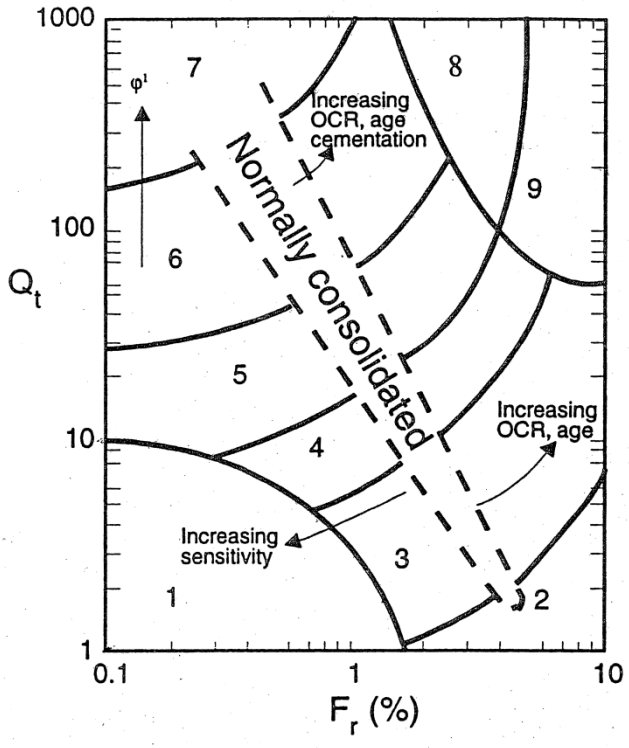
$G_{max} = \rho V_s^2$

Hydraulic Conductivity

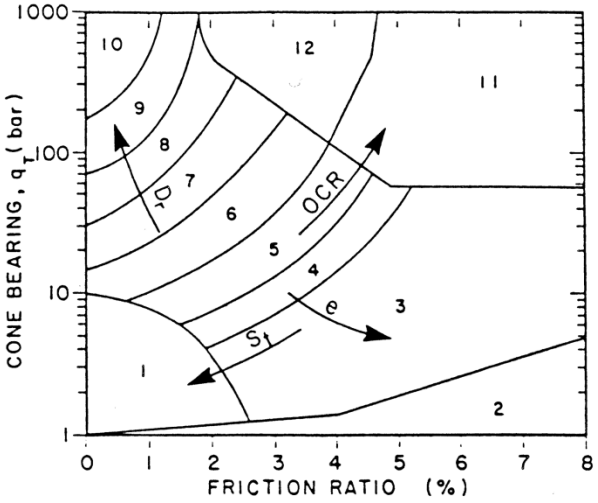
Lookup based on SBT and SBTn (1986 and 1990) 40

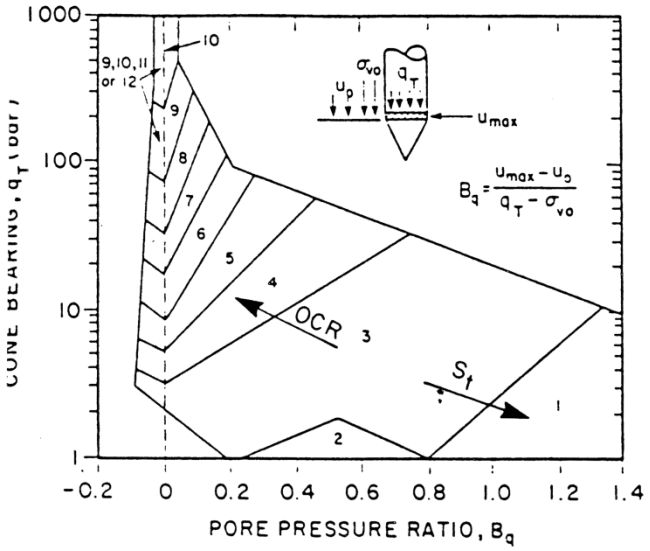
Normalized Soil Behavior Types - Robertson & Campanella (1990)





Non-Normalized Soil Behavior Types – Robertson & Campanella (1986)





References

1. Kulhawy, F. H., and Mayne, P. W., (1990), “Manual for estimating soil properties for foundation design.”, *Report EL-6800,* EPRI, Palo Alto, CA.
2. Lunne, T., Robertson, P.K., and Powell, J.J.M. (1997) Cone Penetration Testing in Geotechnical Practice
3. Baldi, G, Bellotti, R., Ghionna, V., Jamiolkowski, M. and Pasqualini, E. (1986), Interpretation of CPTs and CPTUs; 2nd part: drained penetration of sands, Proceedings of the 4th International Geotechnical Seminar, Singapore.
4. Syms, Frank (2001), Savannah River Site Bechtel Corporation, CPTU Fines Content Determination, Calculation No. K-CIC-G-00065 Revision 0.
5. Marchetti, S. (1980), “In-situ tests by flat dilatometer.”, *Journal of Geotechnical Engineering*, Vol. 107, GT3
6 . Jefferies, M. G. and Davies, M. P., (1993), “Use of CPTu to estimate equivalent SPT N_{60}”, *ASTM Geotechnical Testing Journal*, Vol. 16, No. 4
7. Robertson, P. K., Campanella, R. G., Gillespie, D. and Grieg, J. (1986), “Use of piezometers cone data”. *Proceedings of the ASCE Specialty Conference In Situ ’86: Use of In Situ Tests in Geotechnical Engineering*, Blacksburg, VA
8. Mayne, P. W., (1995), “Profiling yield stresses in clays by in situ tests.”, *Transportation Research Record No. 1479: Engineering Properties and Practice in Overconsolidated Clays*. National Academy Press, Washington, D.C.
9. Chen, B. S. Y., and Mayne, P. W., (1996), “Statistical relationships between piezocone measurements and stress history of clays”, *Canadian Geotechnical Journal*, Vol. 33, No. 3
10. Mayne, P. W. and Holtz, R. D., (1988), “Profiling stress history from piezocone soundings.”, *Soils and Foundations*. Vol 28, No. 1
11. Aas, G., Lacasse, S., Lunne, T. and Höeg, K. (1986), “Use of in situ tests for foundation design on clay”, *Proceedings of the ASCE Specialty Conference In Situ ’86: Use of In Situ Tests in Geotechnical Engineering*, Blacksburg, VA
12. Schmertmann, J. H., (1988) Guidelines for Using the CPT, CPTu, and Marchetti DMT for Geotechnical Design: Volume III – DMT Test Methods and Data Reduction. FHWA-PA-87-024+84-24
13. Robertson, P. K., and Campanella, R. G., (1983), “Interpretation of cone penetrometer test: Part I: Sand”. *Canadian Geotechnical Journal*, 20(4)
14. Masood & Mitchell (1993)
15. Robertson, P. K., and Campanella, R. G., (1991), “Use and interpretation of research Dilatometer”. *Canadian Geotechnical Journal*, 28(1)
16. Marchetti, S. (1997), “The flat Dilatometer design applications”, Third Geotechnical Engineering Conference, Cairo University
17. Mayne (1999) Course Notes
18. Jamiolkowski et al (1985)
19. Reyna & Chameau (1991)
20. Lunne & Christofferson (1983)
21. Wright, S. G, and Duncan, J. M. (2006), Notes for the Short Course “Shear Strength & Slope Stability”

22. Mayne, P.W. “Equivalent CPT Method for Calculating Shallow Foundation Settlements in the Piedmont Residual Soils Based on the DMT Constrained Modulus Approach.” http://geosystems.ce.gatech.edu/Faculty/Mayne/papers/

23. Robertson, P.K. (2010) “Soil behavior type from the CPT: an update” 2nd International Symposium on Cone Penetration Testing, Huntington Beach California

24. Mayne, P.W. and Campanella, R.G., “Versatile Site Characterization by Seismic Piezocone,” *Proceedings, 16th International Conference on Soil Mechanics and Geotechnical Engineering*, Vol. 2 (Osaka), Millpress, Rotterdam, The Netherlands, 2005, pp. 721–724.

25. Zhang Z. and Tumay, M. (1999) “Statistical to Fuzzy Approach Toward CPT Classification” *Journal of Geotechnical Engineering*, Vol. 125, No 3

26. Schneider et al. (2008) “Analysis of Factors Influencing Soil Classification Using Normalized Piezocone Tip Resistance and Pore Pressure Parameters” *Journal of Geotechnical Engineering*, November 2008

27. Jefferies, M.G. and M.P. Davies, “Use of CPTu to Estimate Equivalent SPT N60,” *Geotechnical Testing Journal*, Vol. 16, No. 4, Dec. 1993, pp. 458–468.

28. Jefferies, M. and Been, K. 2006. *Soil Liquefaction: A Critical State Approach*, Taylor and Francis Group, London: 480 p.

29. Baldi, G., R. Bellotti, V.N. Ghionna, M. Jamiolkowski, and D.C.F. LoPresti, “Modulus of Sands from CPTs and DMTs,” *Proceedings, 12th International Conference on Soil Mechanics and Foundation Engineering*, Vol. 1, Rio de Janeiro, Brazil, 1989, Balkema, Rotterdam, The Netherlands, pp. 165–170.

30. Mayne, P.W. and G.J. Rix, “Correlations Between Shear Wave Velocity and Cone Tip Resistance in Clays,” *Soils & Foundations*, Vol. 35, No. 2, 1995, pp. 107–110.

31. Hegazy, Y.A. and P.W. Mayne, “Statistical Correlations Between *Vs* and CPT Data for Different Soil Types,” *Proceedings, Symposium on Cone Penetration Testing*, Vol. 2, Swedish Geotechnical Society, Linköping, Sweden, 1995, pp. 173–178.

32. Mayne, P.W., “The 2nd James K. Mitchell Lecture: Undisturbed Sand Strength from Seismic Cone Tests,” *Geomechanics and Geoengineering*, Vol. 1, No. 4, 2006, pp. 239–247.

33. Burns, S.E. and P.W. Mayne, “Interpretation of Seismic Piezocone Results for the Evaluation of Hydraulic Conductivity in Clays,” *Geotechnical Testing Journal*, Vol. 25, No. 3, 2002b, pp. 333–340.

34. Jamiolkowski, M., D.C.F. LoPresti, and M. Manassero, “Evaluation of Relative Density and Shear Strength of Sands from Cone Penetration Test and Flat Dilatometer Test,” *Soil Behavior and Soft Ground Construction* (GSP 119), American Society of Civil Engineers, Reston, Va., 2001, pp. 201–238.

35. Mayne, P.W., “Integrated Ground Behavior: In-Situ and Lab Tests,” *Deformation Characteristics of Geomaterials*, Vol. 2 (Proc. Lyon, France), Taylor & Francis, London, United Kingdom, 2005, pp. 155–177.

36. Mayne, P.W. and D.A. Brown, “Site Characterization of Piedmont Residuum of North America,” *Characterization and Engineering Properties of Natural Soils*, Vol. 2, Swets and Zeitlinger, Lisse, The Netherlands, 2003, pp. 1323–1339.

37. Robertson, P.K. (2009) “Performance based earthquake deisng using the CPT”, Keynote lecture, IS-Tokyo

38. Mayne, P.W. and H.E. Stewart, “Pore Pressure Response of *K*0 Consolidated Clays,” *Journal of Geotechnical Engineering*, Vol. 114, No. 11, 1988, pp. 1340–1346.

39. Mayne, P.W., “Stress-Strain-Strength-Flow Parameters from Enhanced In-Situ Tests,” *Proceedings, International Conference on In-Situ Measurement of Soil Properties and Case Histories*, Bali, Indonesia, 2001, pp. 27–48.

40. Robertson, P.K. and Cabal, K.L. “Guide to Cone Penetration Testing for Geotechnical Engineering” Gregg Drilling & Testing, Inc. 2009 pp 41-42.

APPENDIX IV

Soil Laboratory Test Assignment Sheet
Summary of Laboratory Test Results
Laboratory Test Data Sheets (STB-103A and STB-104A)
- Atterberg Limits, Index Properties versus Depth

Laboratory Test Data Sheets (HA-01 through HA-04)
- Electrochemical Test Results

Project ID:	**P031751**	**Date Prep.:**	**2/23/2018**
County:	**Dillon**	**Prepared By:**	**NC - BA**
Project Nam	**SC -45 Lester Road**	**Org:**	**F&R, Inc.**

South Carolina Department of Transportation

Soil Test Location	Sample Type/ID	Sample Depth (ft)	Atterberg Limits ASTM-D4318	Moisture Content ASTM-D2216	Wash #200 ASTM D1140	Corrosion Series Testing (pH, Chloride, Sulfate, and Resistivity)	Remarks
STB-103	SS-4	6 – 8	X	X	X	-	
STB-103	SS-5	8 – 10	X	X	X	-	
STB-103	SS-7	12 – 14	X	X	X	-	
STB-103	SS-9	16 – 18	X	X	X	-	
STB-103	SS-10	18 – 20	X	X	X	-	
STB-103	SS-12	28.5 – 30	X	X	X	-	
STB-103	SS-14	38.5 – 40	X	X	X	-	
STB-103	SS-17	53.5 – 55	X	X	X	-	
STB-104	SS-3	4 – 6	X	X	X	-	
STB-104	SS-5	8 – 10	X	X	X	-	
STB-104	SS-7	12 – 14	X	X	X	-	
STB-104	SS-10	18 – 20	X	X	X	-	
STB-104	SS-11	23.5 – 25	X	X	X	-	
STB-104	SS-12	28.5 – 30	X	X	X	-	
STB-104	SS-17	53.5 – 55	X	X	X	-	
HA-01	Bulk / HA-01	0 – 10	-	-	-	X	(AASHTO T289, T291, T290, and ASTM G187)
HA-02	Bulk / HA-02	0 – 10	-	-	-	X	(AASHTO T289, T291, T290, and ASTM G187)
HA-03	Bulk / HA-03	0 – 10	-	-	-	X	(AASHTO T289, T291, T290, and ASTM G187)
HA-04	Bulk / HA-04	0 – 10	-	-	-	X	(AASHTO T289, T291, T290, and ASTM G187)

SUMMARY OF LABORATORY RESULTS

PROJECT ID PO31751 **PROJECT NAME** S-45 Lester Road over Little Pee Dee Swamp

PROJECT COUNTY Dillon

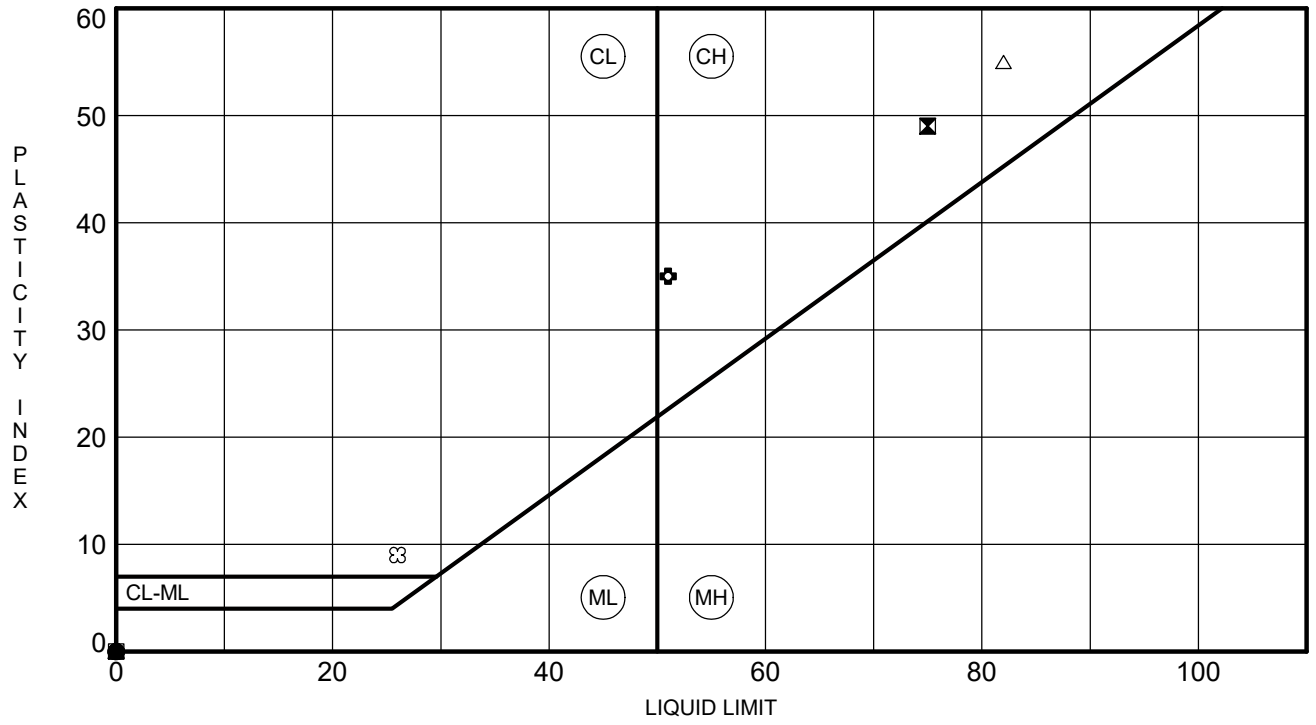
Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Corrosion Series Resistivity (ohms-cm), Chloride (mg/kg), Sulfate (mg/kg) & pH		
HA-01	0.0	NP	NP	NP					499, 44, 65, 4.1/3.9		
HA-02	0.0	NP	NP	NP					502, 37, 35, 4.2/3.9		
HA-03	0.0	NP	NP	NP					493, 100, 39, 4.7/4.0		
HA-04	0.0	NP	NP	NP					504, 22, 51, 5.1/4.0		
STB-103A	6.0	NP	NP	NP	4.75	8	SP-SM	18.9			
STB-103A	8.0	75	26	49	4.75	27	SC	38.7			
STB-103A	12.0	NP	NP	NP	4.75	3	SP	29.7			
STB-103A	16.0	NP	NP	NP	4.75	4	SP	17.3			
STB-103A	18.0	NP	NP	NP	4.75	3	SP	15.7			
STB-103A	28.5	51	16	35	4.75	58	CH	41.7			
STB-103A	38.5	NP	NP	NP	4.75	7	SP-SM	24.5			
STB-103A	53.5	82	27	55	4.75	25	SC	41.8			
STB-104A	4.0	NP	NP	NP	4.75	3	SP	7.7			
STB-104A	8.0	NP	NP	NP	4.75	9	SP-SM	24.3			
STB-104A	12.0	NP	NP	NP	4.75	4	SP	15.4			
STB-104A	18.0	NP	NP	NP	4.75	6	SP-SM	33.6			
STB-104A	23.5	NP	NP	NP	4.75	7	SP-SM	17.4			
STB-104A	28.5	NP	NP	NP	4.75	6	SP-SM	26.0			
STB-104A	53.5	26	17	9	4.75	31	SC	40.6			

LAB SUMMARY 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/19/18

ATTERBERG LIMITS' RESULTS

PROJECT ID PO31751 **PROJECT NAME** S-45 Lester Road over Little Pee Dee Swamp

PROJECT COUNTY Dillon



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**STB-103A**	**6.0**	**NP**	**NP**	**NP**	**8**	**POORLY GRADED SAND WITH SILT (SP-SM)**
⊠	**STB-103A**	**8.0**	**75**	**26**	**49**	**27**	**CLAYEY SAND(SC)**
▲	**STB-103A**	**12.0**	**NP**	**NP**	**NP**	**3**	**POORLY GRADED SAND (SP)**
★	**STB-103A**	**16.0**	**NP**	**NP**	**NP**	**4**	**POORLY GRADED SAND (SP)**
⊙	**STB-103A**	**18.0**	**NP**	**NP**	**NP**	**3**	**POORLY GRADED SAND (SP)**
✿	**STB-103A**	**28.5**	**51**	**16**	**35**	**58**	**SANDY FAT CLAY(CH)**
○	**STB-103A**	**38.5**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND WITH SILT (SP-SM)**
△	**STB-103A**	**53.5**	**82**	**27**	**55**	**25**	**CLAYEY SAND(SC)**
⊗	**STB-104A**	**4.0**	**NP**	**NP**	**NP**	**3**	**POORLY GRADED SAND (SP)**
⊕	**STB-104A**	**8.0**	**NP**	**NP**	**NP**	**9**	**POORLY GRADED SAND WITH SILT (SP-SM)**
□	**STB-104A**	**12.0**	**NP**	**NP**	**NP**	**4**	**POORLY GRADED SAND (SP)**
⊛	**STB-104A**	**18.0**	**NP**	**NP**	**NP**	**6**	**POORLY GRADED SAND WITH SILT (SP-SM)**
◕	**STB-104A**	**23.5**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND WITH SILT (SP-SM)**
☆	**STB-104A**	**28.5**	**NP**	**NP**	**NP**	**6**	**POORLY GRADED SAND WITH SILT (SP-SM)**
⊠	**STB-104A**	**53.5**	**26**	**17**	**9**	**31**	**CLAYEY SAND(SC)**

ATTERBERG LIMITS 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/19/18

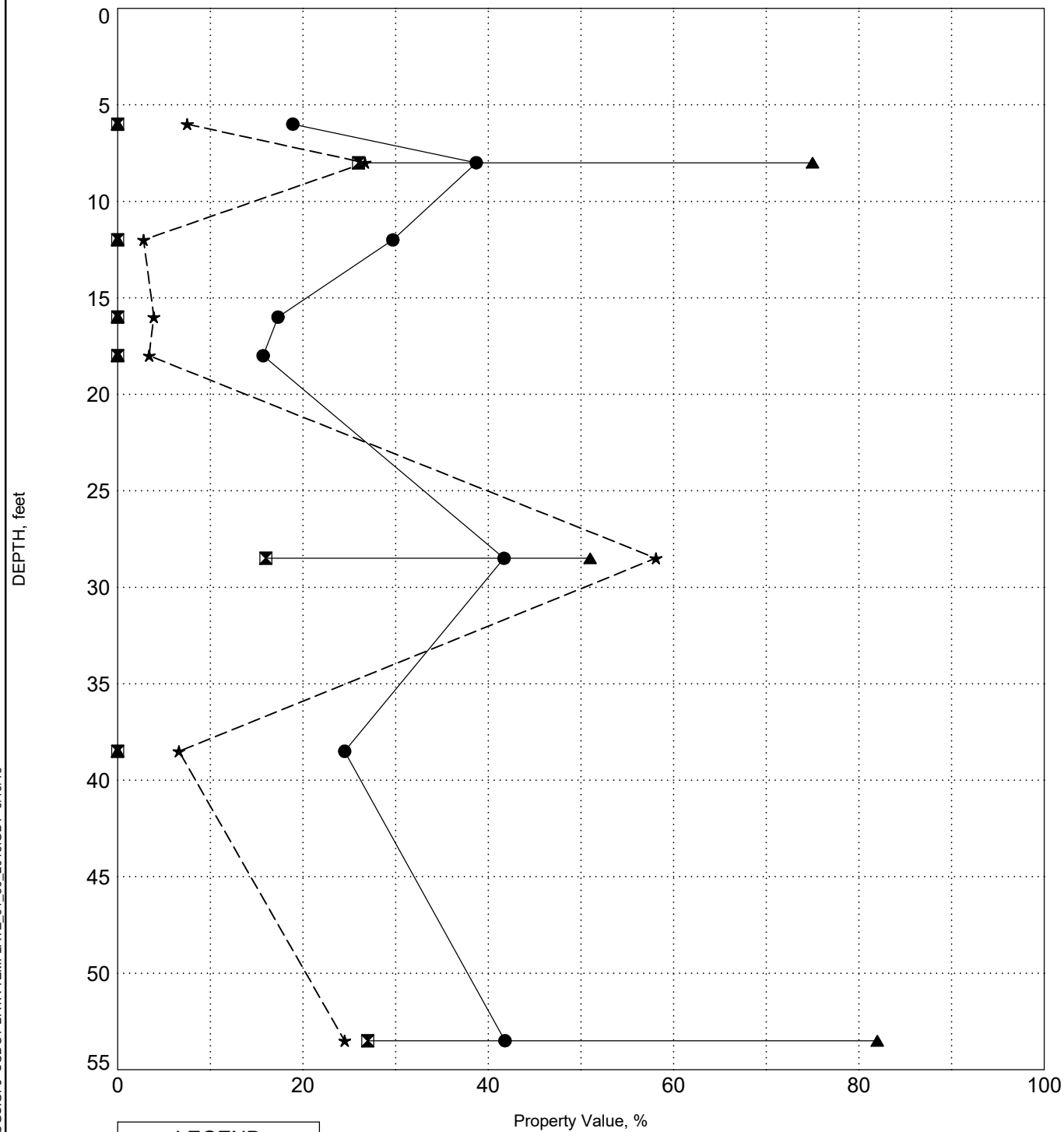
INDEX PROPERTIES VERSUS DEPTH

PROJECT ID PO31751 **PROJECT NAME** S-45 Lester Road over Little Pee Dee Swamp

PROJECT COUNTY Dillon

BORING STB-103A

SURFACE ELEVATION: 78.6



INDEX PROPS 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/19/18

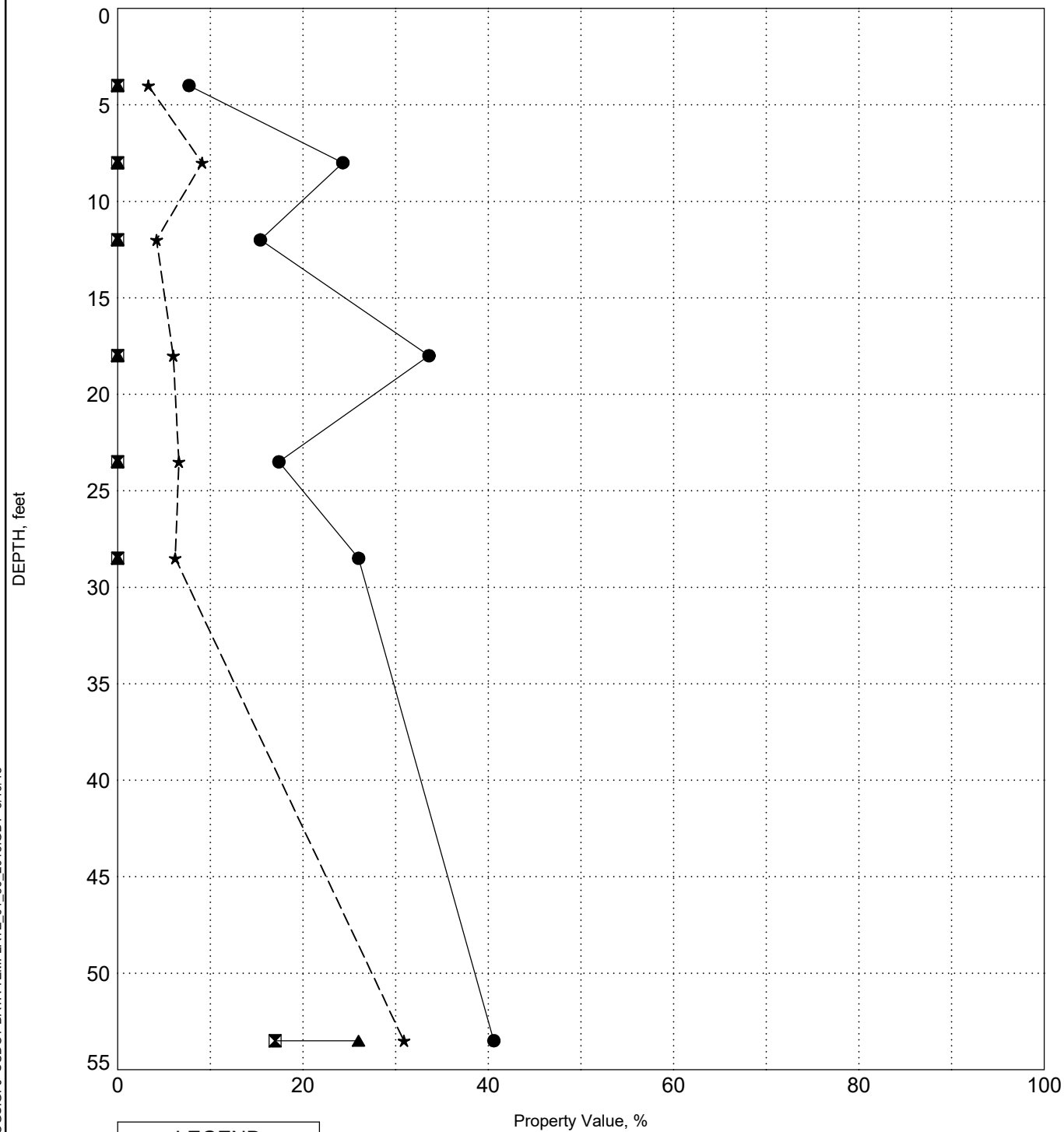
INDEX PROPERTIES VERSUS DEPTH

PROJECT ID PO31751 **PROJECT NAME** S-45 Lester Road over Little Pee Dee Swamp

PROJECT COUNTY Dillon

BORING STB-104A

SURFACE ELEVATION: 78.9



INDEX PROPS 65V0174 LOGS.GPJ SCDOT DATA TEMPLATE_01_30_2015.GDT 3/19/18

SOIL CONSULTANTS, INC.

Construction Materials | Non Destructive | Geotechnical | Environmental

ENGINEERS AND GEOLOGISTS

SINCE 1951

P.O. Drawer 698 • CHARLESTON, SC 29402 • (843) 723-4539 • Fax (843) 723-3648

www.soilconsultantsinc.com

Acct. No: FR012 **Project No: 180019** **Date Sampled: 02/26/2018**
Report Date: 03/07/2018 **Sampled By:** Client
Project: S-45 Bridges, Little Pee Dee Swamp, Dillon, SC - F&R Project 65V0174-00003 **By Order Of:** Client
Location: Boring Samples **Order Number: 65V0174-00003**

Client: FROEHLING & ROBERTSON, INC.

REPORT: Geotechnical Index Testing **LAB NO:** 50685-1

TEST RESULTS **Report No:** 50685-1

Boring	Sample	Top of Interval, ft	Bottom of Interval, ft	Moisture Content, %	Finer than No. 200 Sieve, %	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	USCS Symbol
STB-103	SS-4	6.0	8.0	18.9	7.5	NP	NP	NP	SM
STB-103	SS-5	8.0	10.0	38.7	26.7	75	26	49	SC
STB-103	SS-7	12.0	14.0	29.7	2.8	NP	NP	NP	SM
STB-103	SS-9	16.0	18.0	17.3	3.9	NP	NP	NP	SM
STB-103	SS-10	18.0	20.0	15.7	3.4	NP	NP	NP	SM
STB-103	SS-12	28.5	30.0	41.7	58.1	51	16	35	CH
STB-103	SS-14	38.5	40.0	24.5	6.6	NP	NP	NP	SM
STB-103	SS-17	53.5	55.0	41.8	24.5	82	27	55	SC
STB-104	SS-3	4.0	6.0	7.7	3.3	NP	NP	NP	SM
STB-104	SS-5	8.0	10.0	24.3	9.1	NP	NP	NP	SM
STB-104	SS-7	12.0	14.0	15.4	4.2	NP	NP	NP	SM
STB-104	SS-10	18.0	20.0	33.6	6.0	NP	NP	NP	SM
STB-104	SS-11	23.5	25.0	17.4	6.6	NP	NP	NP	SM
STB-104	SS-12	28.5	30.0	26.0	6.2	NP	NP	NP	SM
STB-104	SS-17	53.5	55.0	40.6	30.9	26	17	9	SC
Comments									

Test Method (As Applicable): ASTM D2216, ASTM D1140, ASTM D4318, ASTM D2487

Orig: FROEHLING & ROBERTSON, INC.
Attn: Mr. Steven A. Charlton
E-Mail: SCharlton@FandR.com (1-ec copy)

Respectfully Submitted,
SOIL CONSULTANTS, INC.

AASHTO ACCREDITED

David J. Hale
P.E., Project Engineer

THIS REPORT APPLIES ONLY TO THE STANDARDS OR PROCEDURES INDICATED AND TO THE SAMPLE(S) TESTED AND/OR OBSERVED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS OR PROCEDURES, NOR DO THEY REPRESENT AN ONGOING QUALITY ASSURANCE PROGRAM UNLESS SO NOTED. THESE REPORTS ARE FOR THE EXCLUSIVE USE OF THE ADDRESSED CLIENT AND ARE NOT TO BE REPRODUCED WITHOUT WRITTEN PERMISSION.

Materials Testing Report	Soil Consultants, Inc. P.O. Drawer 698, Charleston, S.C. 29402	Tabulated Data Sheet
Client: Froehling & Robertson, Inc.		**SCI Project No.:** 50685
Project: S-45 Bridges,Little Pee Dee Swamp,Dillon,SC		**Date:** 03/07/18

Results of Soil Resistivity Test

(ASTM G57)

Sample	Soil Resistivity ohms-cm
HA-1	499
HA-2	502
HA-3	493
HA-4	504

Respectfully Submitted:

Soil Consultants, Inc.

TRIDENT LABS SERVICES, INC.
ANALYTICAL LABORATORY
Soil, Water, Wastewater & Industrial Chemical Analysis
9104 Canvas Lane △ Ladson, South Carolina 29456
Telephone (843) 871-4999 △ Fax (843) 875-2266
e-mail: tls@tridentlabs.com

REPORT OF ANALYSIS

Soil Consultants, Inc.
P. O. Drawer 698
Charleston, SC 29402

Report Date: 03/05/18

Sampled: 03/01/18
Collected By: AC
Sample Matrix: SS
1 of 4

Received: 03/01/18 15:30
Received By: GHS

Sample Id: 0180773
Sample Number(s): 217518
Project Name: Soil Consultants
Location: HA-01

ANALYSIS	METHOD	RESULT	UNITS	DATE/TIME	ANALYST
Sample Type: Grab					
Chloride-S	EPA 300.0	44	mg/kg	03/02/18 12:43	MBL
Sulfate-S	EPA 300.0	65	mg/kg	03/02/18 12:43	MBL

LABORATORY I.D. NO. 10122, FIELD SERVICES I.D. NO 08566
REPORT APPROVED BY:

TRIDENT LABS SERVICES, INC.
ANALYTICAL LABORATORY
Soil, Water, Wastewater & Industrial Chemical Analysis
9104 Canvas Lane △ Ladson, South Carolina 29456
Telephone (843) 871-4999 △ Fax (843) 875-2266
e-mail: tls@tridentlabs.com

REPORT OF ANALYSIS

Soil Consultants, Inc.
P. O. Drawer 698
Charleston, SC 29402

Report Date: 03/05/18

Sampled: 03/01/18
Collected By: AC
Sample Matrix: SS
2 of 4

Received: 03/01/18 15:30
Received By: GHS

Sample Id: 0180773
Sample Number(s): 217519
Project Name: Soil Consultants
Location: HA-02

ANALYSIS	METHOD	RESULT	UNITS	DATE/TIME	ANALYST
Sample Type: Grab					
Chloride-S	EPA 300.0	37	mg/kg	03/02/18 13:33	MBL
Sulfate-S	EPA 300.0	35	mg/kg	03/02/18 13:33	MBL

LABORATORY I.D. NO. 10122, FIELD SERVICES I.D. NO 08566
REPORT APPROVED BY:

TRIDENT LABS SERVICES, INC.
ANALYTICAL LABORATORY
Soil, Water, Wastewater & Industrial Chemical Analysis
9104 Canvas Lane △ Ladson, South Carolina 29456
Telephone (843) 871-4999 △ Fax (843) 875-2266
e-mail: tls@tridentlabs.com

REPORT OF ANALYSIS

Soil Consultants, Inc.
P. O. Drawer 698
Charleston, SC 29402

Report Date: 03/05/18

Sampled: 03/01/18
Collected By: AC
Sample Matrix: SS
3 of 4

Received: 03/01/18 15:30
Received By: GHS

Sample Id: 0180773
Sample Number(s): 217520
Project Name: Soil Consultants
Location: HA-03

ANALYSIS	METHOD	RESULT	UNITS	DATE/TIME	ANALYST
Sample Type: Grab					
Chloride-S	EPA 300.0	100	mg/kg	03/02/18 14:23	MBL
Sulfate-S	EPA 300.0	39	mg/kg	03/02/18 14:23	MBL

LABORATORY I.D. NO. 10122, FIELD SERVICES I.D. NO 08566
REPORT APPROVED BY:

TRIDENT LABS SERVICES, INC.
ANALYTICAL LABORATORY
Soil, Water, Wastewater & Industrial Chemical Analysis
9104 Canvas Lane △ Ladson, South Carolina 29456
Telephone (843) 871-4999 △ Fax (843) 875-2266
e-mail: tls@tridentlabs.com

REPORT OF ANALYSIS

Soil Consultants, Inc.
P. O. Drawer 698
Charleston, SC 29402

Report Date: 03/05/18

Sampled: 03/01/18
Collected By: AC
Sample Matrix: SS
4 of 4

Received: 03/01/18 15:30
Received By: GHS

Sample Id: 0180773
Sample Number(s): 217521
Project Name: Soil Consultants
Location: HA-04

ANALYSIS	METHOD	RESULT	UNITS	DATE/TIME	ANALYST
Sample Type: Grab					
Chloride-S	EPA 300.0	22	mg/kg	03/02/18 15:13	MBL
Sulfate-S	EPA 300.0	51	mg/kg	03/02/18 15:13	MBL

LABORATORY I.D. NO. 10122, FIELD SERVICES I.D. NO 08566
REPORT APPROVED BY:

SOIL CONSULTANTS, INC.

Construction Materials
Non Destructive
Geotechnical
Environmental

ENGINEERS AND GEOLOGISTS

SINCE 1951

P.O. Drawer 698 • CHARLESTON, SC 29402 • (843) 723-4539 • Fax (843) 723-3648

www.soilconsultantsinc.com

Acct. No: FR012 **Project No: 180019** **Date Sampled: 02/26/2018**
Report Date: 03/07/2018 **Sampled By:** Client
Project: S-45 Bridges, Little Pee Dee Swamp, Dillon, SC - F&R Project 65V0174-00003 **By Order Of:** Client
Location: Bucket Samples **Order Number: 65V0174-00003**

Client: FROEHLING & ROBERTSON, INC.

REPORT: pH and Resistivity of Soils **LAB NO:** 50685-2

TEST RESULTS **Report No:** 50685-2
Page 1 of 1

Date Sampled: **Date Tested:**
Date Received: **Received From:**

Sample No.	Visual Description	pH Distilled Water	pH 0.01M Calcium Chloride
HA-1	Gray clayey fine to medium sand	4.1	3.9
HA-2	Gray fine to medium sand	4.2	3.9
HA-3	Dark gray fine to medium sand	4.7	4.0
HA-4	Brown clayey fine to medium sand	5.1	4.0

Test Method: AASHTO T289
Notes:

Orig: FROEHLING & ROBERTSON, INC.
Attn: Mr. Steven A. Charlton
E-Mail: SCharlton@FandR.com (1-ec copy)

Respectfully Submitted,
SOIL CONSULTANTS, INC.

AASHTO ACCREDITED

David J. Hale
P.E., Project Engineer

THIS REPORT APPLIES ONLY TO THE STANDARDS OR PROCEDURES INDICATED AND TO THE SAMPLE(S) TESTED AND/OR OBSERVED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS OR PROCEDURES, NOR DO THEY REPRESENT AN ONGOING QUALITY ASSURANCE PROGRAM UNLESS SO NOTED. THESE REPORTS ARE FOR THE EXCLUSIVE USE OF THE ADDRESSED CLIENT AND ARE NOT TO BE REPRODUCED WITHOUT WRITTEN PERMISSION.

APPENDIX V

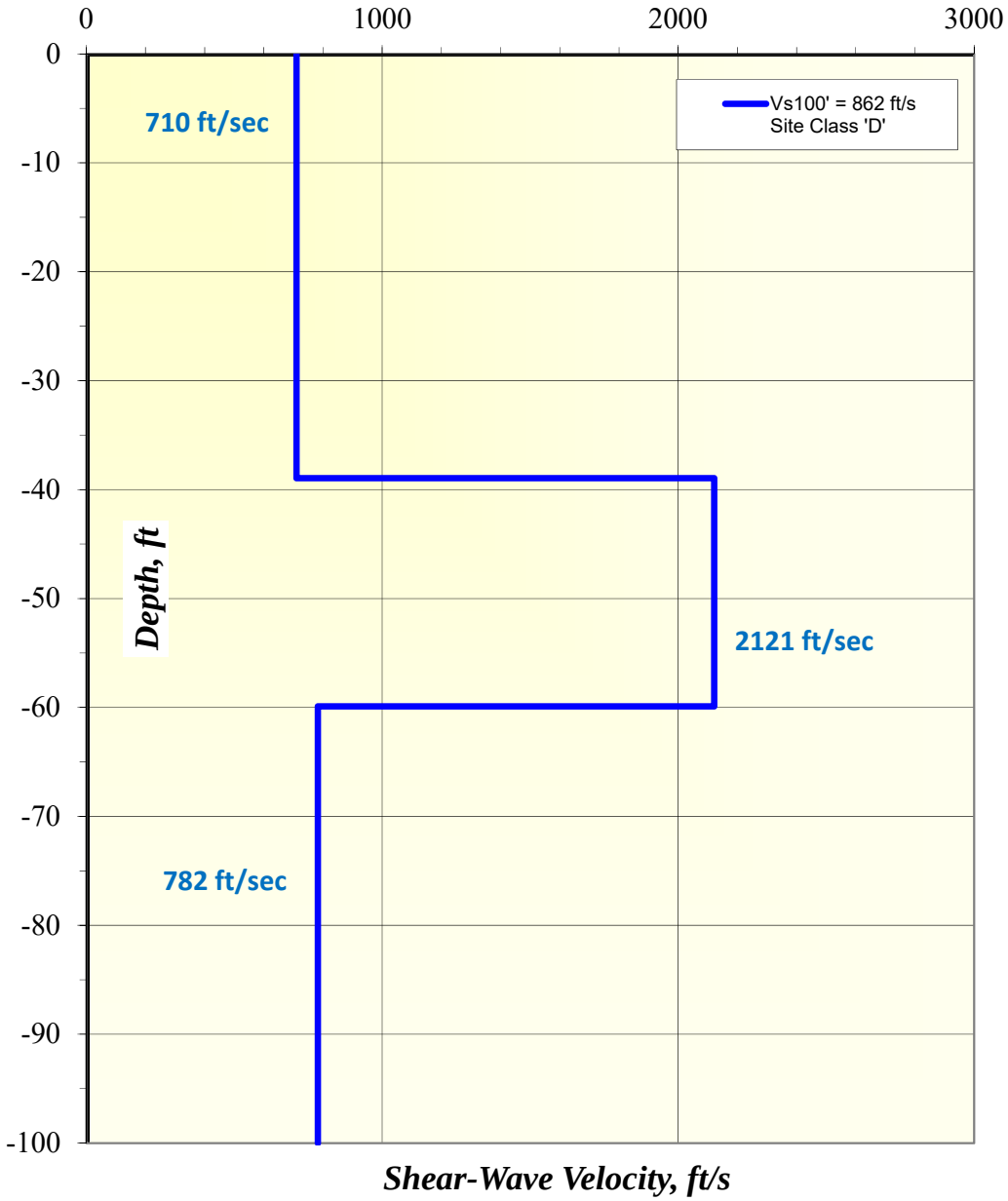
Geophysical Testing Result at S-45 – Refraction Microtremor (ReMi)

FROEHLING & ROBERTSON, INC.

Refraction Microtremor (REMI) Results

Project: S-45 Lester Road Over Little Pee Dee Swamp
Client: SCDOT Pee Dee RPG-2
Test Date: 3/8/2018
Report Date: 3/20/18
Record No.: 65V-0174

Vs Model



APPENDIX VI

Geoprofessional Business Association (GBA) Document

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2016 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document or its wording as a complement to or as an element of a report of any kind. Any other firm, individual, or other entity that so uses this document without being a GBA member could be committing negligent

HQ: 3015 DUMBARTON ROAD RICHMOND, VIRGINIA 23228 T 804.264.2701 F 804.264.1202 www.fandr.com

VIRGINIA • NORTH CAROLINA • SOUTH CAROLINA • MARYLAND • DISTRICT OF COLUMBIA