SITE-SPECIFIC
SEISMIC RESPONSE ANALYSIS
FINAL REPORT

SC 41 Bridge Replacement
over Wando River
Berkeley County, South Carolina

Prepared For

SCDOT

By

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January 23, 2012

SCDOT File No. 8.158B/10.032102
F&ME Project No. G4067.010

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January 23, 2012

Mr. Chris Gaskins, P.E., P.G.
South Carolina Department of Transportation
955 Park Street
Columbia, South Carolina

Re.: Site-Specific Seismic Response Analysis – Revised Final Report
SC 41 Bridge Replacement over Wando River
Berkeley County, South Carolina
SCDOT File No. 8.158B/10.032102
F&ME Project No. G4067.010

Dear Chris:

Submitted herein is the Site-Specific Seismic Response Analysis – Final Report for the above referenced bridge project. This report has been prepared in accordance with guidelines as defined in the SCDOT Geotechnical Design Manual, Section 21.5.

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

Sincerely,

F&ME CONSULTANTS

Zane W. Abernethy, P.E.
President

Shafiq Rahman
Muhammad Shafiqur Rahman, P.E.
Senior Geotechnical Engineer

attachments

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SC 41 BRIDGE REPLACEMENT OVER WANDO RIVER

SITE-SPECIFIC SEISMIC RESPONSE ANALYSIS

EXECUTIVE SUMMARY

F&ME Consultants has completed a site-specific seismic response analysis for the SC 41 Replacement Bridge over Wando River project located in Berkeley County, South Carolina. The input data and design requirements for our analysis were developed from the following sources:

(a) Subsurface data from ground surface to a depth of approximately elevation -115 feet – F&ME Geotechnical Investigation for the SC 41 Bridge Replacement project;
(b) Subsurface data below a depth of approximately elevation -115 feet to the hypothetical B-C boundary at elevation -480 feet – SCDOT data from nearby bridge projects and USGS, and other published data;
(c) Characteristic Earthquake Motion – SCDOT provided six (6) synthetic earthquakes (ground motions);
(d) Design guidelines for analysis - SCDOT Geotechnical Design Manual, Chapter 12.

Our site-specific horizontal Acceleration Response Spectra (ARS) curves were developed by performing sensitivity analysis on an equivalent-linear one-dimensional soil column model using the computer program ProShake, version 1.1. Our calculated peak shear strain (< 2 percent) validated the use of the equivalent-linear method.

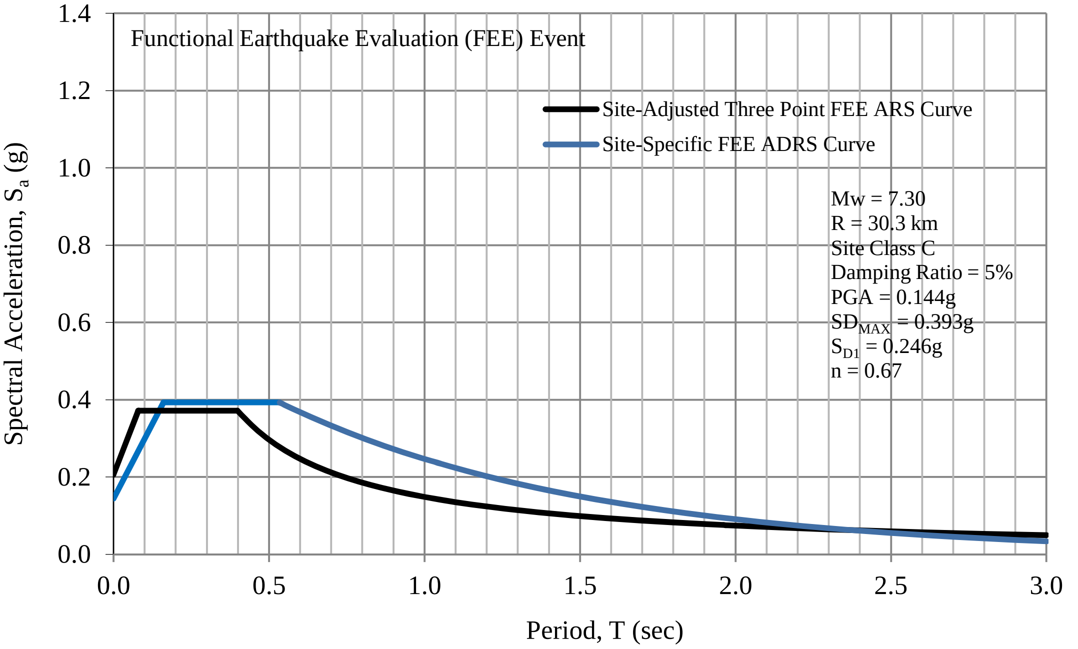
Our recommended Acceleration Design Response Spectrum (ADRS) curves for Site Class C (applicable to interior bents) and Site Class D (applicable to end bents and approach embankments) accompany the summary. The three-point site-adjusted ADRS curves are also superimposed on these curves.

A report of our analysis to include input data, analysis and specific references utilized is attached.

SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102

SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



	T	S_a
	sec	g
	0.00	0.144
	0.05	0.222
	0.10	0.299
T_s	0.16	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
T_s	0.53	0.393
	0.60	0.368
	0.70	0.333
	0.80	0.301
	0.90	0.272
	1.00	0.246
	1.20	0.202
	1.40	0.165
	1.60	0.135
	1.80	0.111
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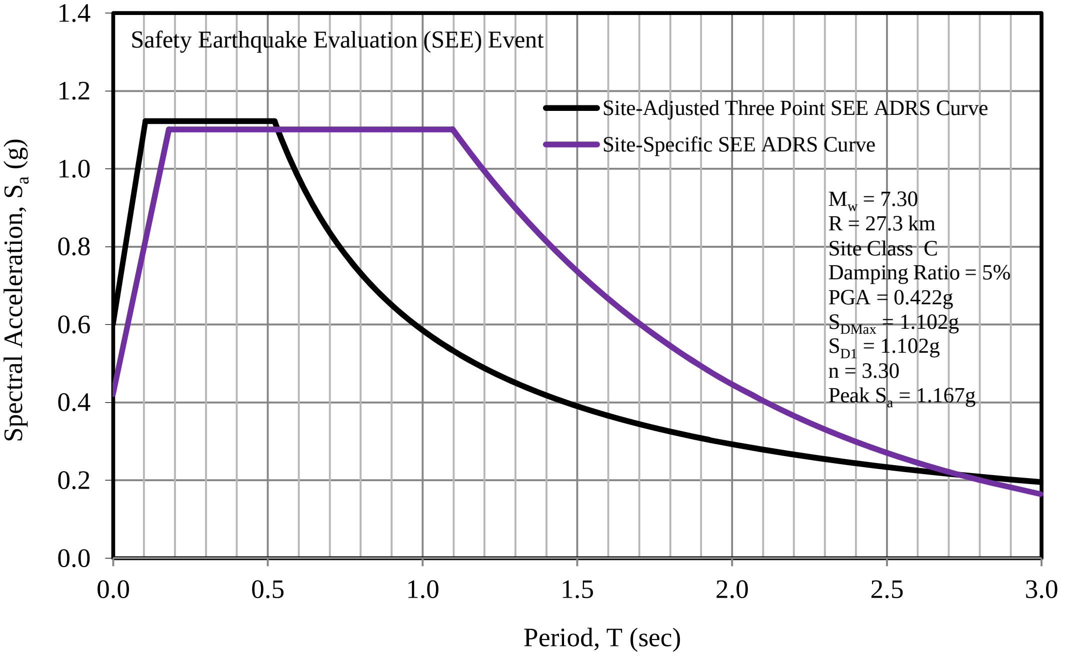

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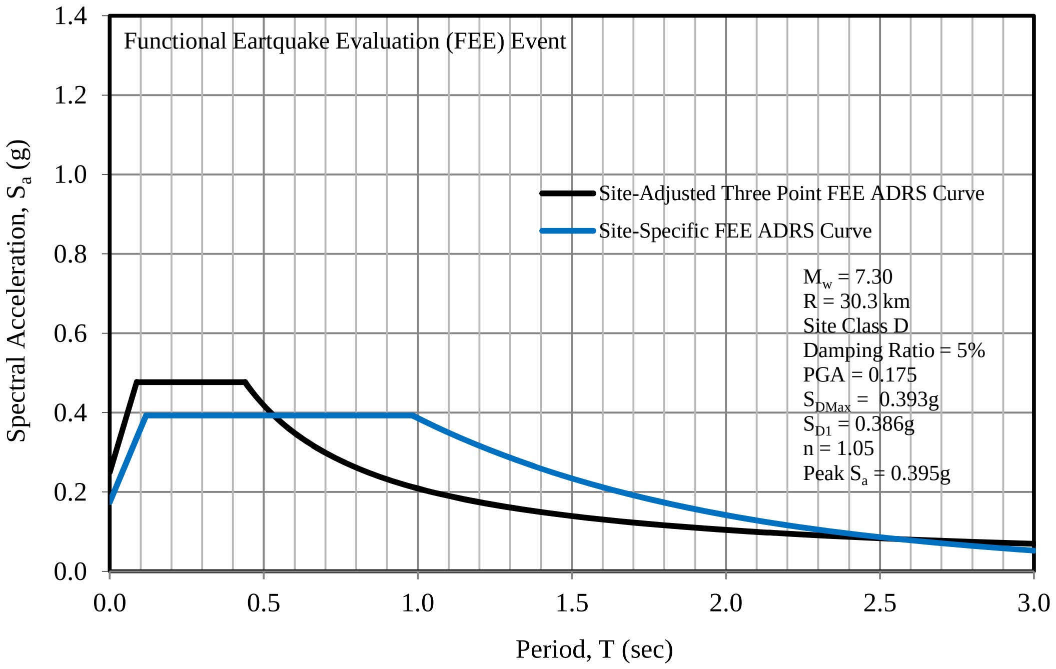
	0.05	0.610
	0.10	0.799
T_s	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102
SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



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T_o	0.12	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
	0.60	0.393
	0.70	0.393
	0.80	0.393
	0.90	0.393
T_s	0.98	0.393
	1.00	0.386
	1.20	0.316
	1.40	0.259
	1.60	0.212
	1.80	0.174
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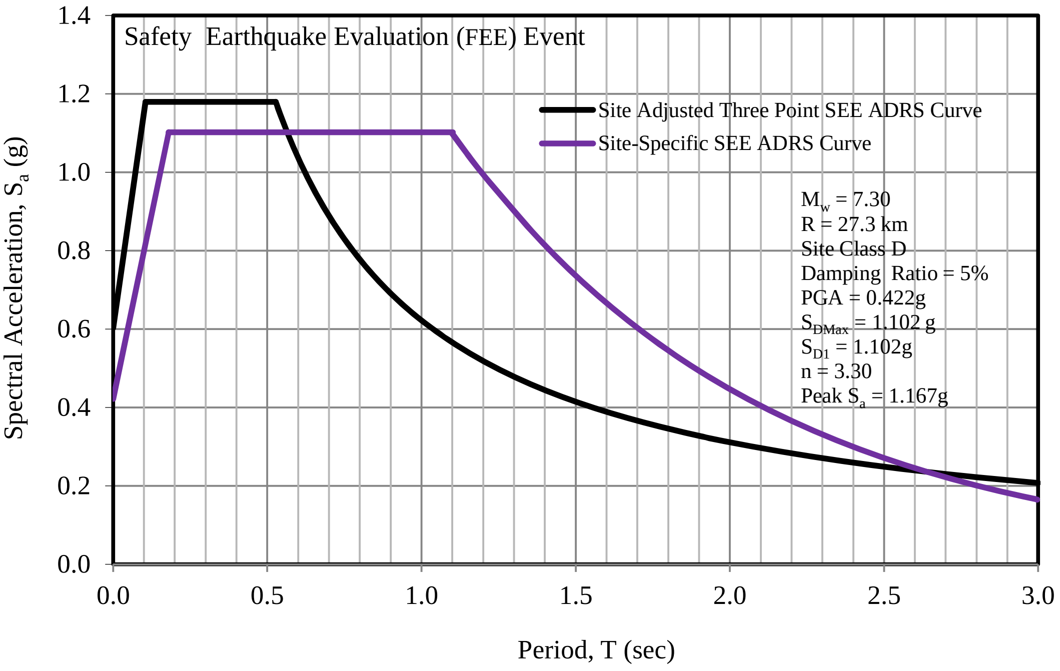
	3.00	0.052



	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_o	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

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SC 41 BRIDGE REPLACEMENT OVER WANDO RIVER

SITE-SPECIFIC SEISMIC RESPONSE ANALYSIS

1.0 OBJECTIVES

Our analysis, as presented within, evaluates the local site effects on the response spectra and develops recommended site-specific Acceleration Response Spectra (ARS) and Acceleration Design Response Spectrum (ADRS) for use in the seismic design of the SC 41 Replacement Bridge over Wando River project located in Berkeley County, South Carolina. The objective of this analysis is to determine the following for the Functional and Safety Earthquake Evaluation (FEE and SEE) design events.

(a) Recommended site-specific response curves;
(b) Smoothed site-specific ADRS curves;
(c) Equations of smoothed ADRS curves;
(d) Table of smoothed ADRS data values (spectral accelerations, S_a for periods, T); and
(e) Table with design spectral response parameters – peak horizontal ground acceleration, *PGA*, maximum design spectral response acceleration, S_{DMax}, design short- and long- period spectral response accelerations, S_{DS} and S_{D1} and period markers T_o and T_s, as determined from the smoothed ADRS Curves.

The following sections of this report present our understandings of the bridge replacement project; summarizes the geology and lithology of the site; outlines our assumptions and analytical methodology; and presents our analyses for development of the recommended site-specific seismic response curves.

2.0 PROJECT DESCRIPTION

The proposed replacement bridge will be located along SC Highway 41 over the Wando River on the Charleston and Berkeley County lines. The new bridge will replace the existing swing span bridge with longer spans and longer overall length (See Figure 1). The new bridge is planned to be aligned on the eastern side of the existing bridge and will be approximately 2000 feet long spanning between Stations 255+92 and 275+28 feet (see Figure 2). The latitude and the longitude of the bridge location are 32.9245° and -79.8250°, respectively (see Appendix B, pp. B-15 and B-16).

Based on the preliminary design by TKA, the new bridge end bents will be supported by steel H-piles and the interior bents will be supported by drilled shafts. In addition, the proposed bridge is detailed with a bascule span on a drilled shaft supported footing.

3.0 GEOLOGY

3.1 SUBSURFACE STRATIGRAPHY

The geologic formations, members, and groups for this site are taken to be the same as specified by the SCDOT Geotechnical Design Section (SCDOT GDS) in their referenced documents by the “Shear Wave Velocity Models to be used in Site-Specific Response Analysis for Charleston, Berkeley, and Dorchester Counties” (see Appendix B, pp. B-1 through B-6). According to these interpretations, the following geologic formations and groups have been selected to represent the soil conditions below the bottom of the river to the hypothetical firm Coastal Plain outcrop equivalent of the B-C boundary.

Elevation (feet, msl)	Geologic Formation and Group
-20 to -283	Ashley Formation (Cooper Group)
-283 to -322	Cross Member of Santee Limestone Formation (Orangeburg Group)
- 322 to -384	Chicaro Member of Williamsburg Formation (Orangeburg Group)
-384 to -440	Lower Bridge Member of Williamsburg Formation (Black Mingo Group)
-440 to -480	Rhems Formation (Black Mingo Group)
~ 480	B-C Boundary

Incorporating the F&ME boring information at the new bridge location, an approximation of the subsurface stratigraphy along the bridge alignment is presented in Figure 2. A layer of calcareous sand within the Cooper Group is found to be present between elevations approximately -71 and -112 feet. The thickness of this layer varies from 16 to 32 feet, with an average of 20 feet. For seismic response analysis, a 20 feet layer of cohesionless silty sand between elevations -80 to -100 feet is assumed.

At the bridge approach locations, a layer comprised of sands and clays overlies the Ashley Formation. This layer is characterized as Pleistocene aged Coastal Plain Sediments and grouped as part of the Wando Formation. The thickness of this layer varies from 22 to 24 feet at the south side of the bridge and approximately 17 feet in each of the borings at the north side of the bridge.

3.2 LITHOLOGY

The lithology of subsurface stratigraphic formations at the project site was developed based on available literatures (see References 2 and 4) and F&ME data from the new bridge site to include boring logs, seismic CPT soundings, and laboratory test results (see Appendix C). The lithographic data is summarized below:

(a) Wando Formation - The lithology of the Wando Formation is variable and includes clayey, fine- to coarse-grained quartz sands, sandy to clayey silts, and sandy to silty clays (see Appendix B, pp. B-7).

Based on the F&ME boring data, the soils within this formation are generally firm to stiff sandy clay (CL) and medium dense clayey or silty sand (SC or SM). The liquid limit in the clay layer ranges from 43 to 55 with plasticity index varying from 21 to 33. The natural moisture content is found to be 25 percent, which is very close to the plastic limit indicating an older formation than the Holocene or Recent deposits.

(b) Ashley Formation (Cooper Group) – The Ashley Formation of the Cooper Group is a stiff, high plasticity calcareous silt or clay and generally classifies as MH or CH material. In addition, very fine to fine-grained glauconite and phosphate sand are present in small amounts throughout the Ashley Formation.

Based on the F&ME laboratory test results, the cohesive soil samples of Cooper Group exhibit a liquid limit ranging from 29 to 89 with a plasticity index varying from 10 to 46. The natural moisture content varies from 25 to 76 percent which is somewhat higher than the plastic limit but much lower than the liquid limit, indicating overconsolidation (see Appendix C, pp. C-33). The historically measured overconsolidation ratio (OCR) ranges from about 3 to 6 (see Appendix B, pp. B-8 and B-13).

Based on the F&ME boring data, the uncorrected SPT *N*-values within the cohesionless layer of the Cooper Group are generally in the range of 13 to 23 blows per foot. There are some variations in values with *N*-values as high as 62 blows per foot. The fines content of the soil ranges between 16 to 38 percent, with a mean value of 23 percent (see Appendix C).

(c) Cross Member of Santee Limestone – The Santee Limestone consists primarily of locally shelly, microfossiliferous limestone (see Appendix B, pp. B-9).

(d) Chicaro Member of Williamsburg Formation – The Chicora is a heterogenous unit consisting of shelly quartz sands, indurated, moldic limestone, and dark, calcareous sandy and silty clays (see Appendix B, pp. B-10).

(e) Lower Bridge Member of Williamsburg Formation – The lower Bridge Member consists of calcareous, silty and sandy clay to very fine sand that has phosphate granules and pebbles at its base (see Appendix B, pp. B-11).

(f) Rhems Formation – The Rhems Formation consists of fine to coarse arenaceous shale and argillaceous sand, and pelecypod-poor to pelecypod-rich clayey sand (see Appendix B, pp. B-12).

4.0 ASSUMPTIONS

The response spectrum describes the maximum response of a structure to a particular input motion as a function of the natural period and damping ratio of the structural system. The following assumptions were made in generating the site-specific response spectra.

(a) Design ground surface is at the bottom of the river (selected elevation is -20 feet, msl);
(b) The depth to motion of the bridge foundation at interior bent locations is 46 feet below the design ground surface at an elevation of -66 feet (see Appendix A, Section 3, pp. A-31A);

(c) The depth of motion of bridge foundations at end bent locations remains below the original ground surface (see Section 6.3);
(d) A layer of cohesionless silty sand of Ashley Formation exists between elevations -80 to -100 feet (see Figure 2);
(e) The depth to the B-C boundary is at elevation -480 feet (see Appendix B, pp. B-1 through B-6);
(f) The overconsolidation ratio of the Cooper Marl varies from 3 to 6 (see Appendix B, pp. B-13);
(g) Soil properties below the Ashley Formation remain unchanged;
(h) The Andrus et al. (2003) correlations for the shear modulus reduction and the equivalent viscous damping ratio curves provide the most accurate representation of the geologic deposits and the soil types encountered at the project site (see GDM, Sections 12.3.8.2 and 12.3.8.3);
(i) If there are no recommended values for Andrus et al. (2003) curves for the soils encountered (such as for the calcareous sand layer of Cooper Group), Vucetic and Dorby (1991) curves are acceptable and most appropriate for non-plastic soils (see Appendix B, pp. 14);
(j) The consequences of the variations in soil properties of the Cooper Marl on the response spectra can be evaluated by utilizing the tentative values of Andrus et al. (2003) curves for plasticity index of 30 and 60;
(k) Equivalent-linear one-dimensional site-specific response analysis method is reliable as long as the calculated peak shear strains do not exceed 2 percent;
(l) The site-specific Acceleration Design Response Spectra (ADRS) curves developed for an equivalent viscous damping ratio of 5 percent is appropriate for the structural behavior of the bridge and the associated approach embankments; and
(m) The site-specific ADRS curves developed for the interior bent locations are applicable to both the end bent locations and the approach embankment locations, provided that the adjustments are made based on their Site Classes (see Section 6.7)

5.0 COMPUTER PROGRAMS USED

Microsoft Excel 2010 was used for various calculations performed by spreadsheet computations. Ground response analysis program, ProShake, version 1.1 was utilized for the equivalent linear one-dimensional site-specific response analysis using six synthetic ground motions generated and provided to us by the SCDOT GDS (included in Appendix A).

6.0 METHOD OF ANALYSIS

6.1 SHEAR MODULUS REDUCTION AND MATERIAL DAMPING RATIO CURVES

The shear modulus reduction and material damping ratio curves for each major geological unit were developed assuming a modified hyperbolic model and using the recommended values of shear modulus and damping coefficients for South Carolina soils by Andrus et al. (2003). The procedures for computing normalized shear modulus, G/G_{max} and the equivalent viscous damping ratio, D, corresponding to shear strain, γ, are described in the latest edition of SCDOT Geotechnical Design Manual (GDM), in Tables 12-16 and 12-18, respectively. The appropriate values for each layer were selected from Tables 12-15 and 12-17 according to the geological unit and plasticity index.

For the non-plastic sand layer of Ashley Formation, there are no recommended values for Andrus et al. (2003) curves. In this case, Vucetic and Dorby (1991) curves were utilized as recommended by Andrus et al. (2003) for soils older than Holocene age with $PI = 0$ (see Appendix B, pp. B-14).

Two sets of curves for G/G_{max} and D for layers from depth to motion to the B-C boundary were computed for plasticity index of 30 and 60 for Cooper Marl Formation. The detailed calculations and the curves are provided in Appendix A, Section 1.

6.2 SITE CHARACTERIZATION

A one-dimensional soil column model is needed to perform the site-specific response analysis. The soil layers in the one-dimensional column are characterized by the total unit weight, shear wave velocity, shear modulus reduction and equivalent viscous damping ratio curves.

Site-specific shear wave velocities, V_s, were measured by two CPT soundings (SCPT-2 and SCPT-3) performed near each end bent location of the bridge. The soundings were taken from ground surface to approximate elevation of -115 feet (see Appendix B, pp. B-5). Below this depth, V_s obtained in four nearby bridge sites located in the same geological area by suspension and downhole testing methods, were utilized (see Appendix B, pp. B-6).

From the ground surface to elevation -115 feet of the soil profile, V_s was obtained from the F&ME SCPT soundings, and from elevations -115 feet to the B-C boundary at elevation -480 feet, the V_s measurements from each of the four nearby bridge sites were individually tabulated. The tabulated values were also plotted as shear wave velocity profiles. The design V_s values were taken as the average of the shear wave velocities within a selected depth interval. The resulting design V_s values were plotted as vertical straight lines in the shear wave velocity profiles. Three such velocity profiles were constructed, one for interior bents and the other two for approach embankments. Tabulated values of measured and design shear wave velocity profiles and their graphical representations are provided in Appendix A, Section 2.

The soil column models were prepared in a tabular form similar to the GDM, Table 12-32. Eight (8) soil column models were developed considering the variations of geological formation, soil type, shear wave velocities at the four additional bridge sites located in this geological area, and the variation of the plasticity index of Cooper Marl Formation. These models are provided in Appendix A, Section 3.

6.3 SEISMIC SITE CLASS DETERMINATION

The seismic Site Class was assigned based on site stiffness, which is a weighted average of the shear wave velocities for the upper 100 feet below the depth-to-motion, Z_{DTM}. Because the different structural components, such as bridge abutments, interior bents, and approach embankments, may have differing Z_{DTM} and due to the spatial variations of the soil profile along the bridge site, Site Classes for each structural component were evaluated.

The end bents and the interior bents will be supported by steel H-piles and concrete drilled shafts, respectively. The Z_{DTM} for all interior bents are anticipated to be located approximately at the same level and is assumed to be at elevation of -66 feet as explained in Appendix A, Section 3, pp. A-31A. The Z_{DTM} for pile foundations at end bent locations are expected at some point below the ground surface. The placement of embankment fill may affect the Z_{DTM} for pile foundations, but it is our assessment that it would remain below the original ground surface. The Z_{DTM} for the approach embankments are assumed to be at the existing ground surface, which is considered as the base of the embankment fill.

The site stiffnesses were computed in accordance with the GDM, Table 12-20 using the design shear wave velocities, V_s, of each layer and utilizing Equation 12-14. The Site Classes were determined in accordance with the GDM, Tables 12-21 and 12-22. The detailed computations are provided in appendix A, Section 4.

6.4 EARTHQUAKE INPUT MOTIONS

The earthquake input motions used to perform the sensitivity analysis for this bridge site were generated by the SCDOT Geotechnical Design Section (GDS) and provided to us. The GDS generated a total of six synthetic ground motions using an earthquake moment magnitude of 7.30 and epicentral distance of 30.3 and 27.3 kilometers for the FEE and SEE events, respectively (see Appendix B, pp. B-15 through B-16). The FEE represents a small ground motion that has a 15 percent probability of occurrence within the design life of the structure, typically assumed to be 75 years when evaluating the design earthquakes, regardless of its actual design life (refer to the GDM, Section 11.9.1). The SEE, on the other hand, represents a large ground motion that has a relatively low probability of occurrence within the life of the structure (3 percent in 75 years). The FEE and the SEE synthetic ground motions are presented graphically in Appendix A, Section 5.

6.5 SENSITIVITY ANALYSIS

The required input to perform the sensitivity analysis includes one-dimensional soil column models, shear modulus reduction curves, material damping ratio curves, and the earthquake motions. An equivalent-linear one-dimensional site-specific response analysis was performed using computer program ProShake, version 1.1. This computer program models a soil column with horizontal layered soil deposits overlying a uniform visco-elastic half space. As a result of the sensitivity analysis performed for each of the synthetic ground motions developed for the project site, a series of site-specific horizontal acceleration response spectra (ARS) curves were generated. All electronic input and output files generated by ProShake are provided in electronic format on a CD included in Appendix A, Section 6.

For each seismic design event earthquake input motion, twenty four (24) ARS curves were generated by ProShake for an equivalent viscous damping ratio of 5 percent. Each output was also checked for the peak shear strains to validate the equivalent-linear response analysis. The calculated peak shear strains at mid-depth of each layer of the soil column models were tabulated for each assumed site condition. The results of all forty eight (48) site-specific response curves at depth of motion were also tabulated and plotted as a function of period. The peak shear strain values, response data and the response spectrum plots are provided in Appendix A, Section 7. The arithmetic mean of the twenty four (24) response curves related to each design earthquake events are also superimposed on each of the graphs.

6.6 RECOMMENDED SITE-SPECIFIC RESPONSE CURVES

The average site-specific ARS curves were compared with the Three-Point Horizontal ADRS curves and 70 percent of their spectral accelerations. The ADRS curves were constructed using the preliminary seismic design information provided to us by the GDS (see Appendix B, pp. B-17) and adjusted for the local site conditions as outlined in the GDM, Tables 12-26 through 12-29. These comparisons are shown graphically in Appendix A, Sections 8 and 9 for Site Classes C and D, respectively.

It is found that some of the spectral accelerations of the average ARS curves are less than the 70 percent of the spectral accelerations of the ADRS curves. Also, the average curves appear to be quite irregular. Therefore, some smoothing was done for the recommended response curves. The smoothing for the recommended site-specific ARS curves for different seismic design events was made utilizing the following methodology:

(a) the values of the average ARS curves unless the corresponding spectral acceleration at that period is less than the 70 percent of those by the Three-Point ADRS curves;
(b) for values of less than the 70 percent spectral acceleration, a minimum of 70 percent of the spectral acceleration of the ADRS curves;
(c) the peak values of the average spectral acceleration curves; and
(d) other values of the average spectral acceleration curves which deemed appropriate in generating the best-fit smooth curve.

The calculations and the graphical representation of the smoothed recommended ARS curves for Site Classes C and D, and their comparison with the Three-Point ADRS and the lowest permitted spectral acceleration curves are provided in Appendix A, Sections 8 and 9, respectively.

6.7 SITE-SPECIFIC HORIZONTAL ADRS CURVES

The recommended site-specific horizontal Acceleration Design Response Spectra (ADRS) were developed using the procedures specified in the GDM, Table 12-33. These smoothed ADRS curves are superimposed over the GDS provided ADRS curves adjusted for the site classes. The procedures for construction of the site-specific ADRS curves for Site Classes C and D are provided in Appendix A, Sections 10 and 11, respectively. The recommended site-specific ADRS curves, thus constructed, are presented at the end of these sections. The site-adjusted Three-Point ADRS curves are also superimposed over the recommended site-specific ADRS curves, and include the project information and design spectral response parameters.

Based upon our limited analysis, the site response curves at end bent locations would not be significantly different from those developed for the interior bent location. Therefore, a separate response analysis for free-field ground surface motion and that at the depth to motion of pile foundations at end bent locations have not been performed.

It is found that the site-specific design ground motion parameters obtained by using the site-adjustment factors provide the higher peak ground acceleration, *PGA*, maximum design spectral acceleration, S_{DMAX} and shorter period range, $T_s - T_o$, when compared to those obtained by using sensitivity analysis. The site-specific ADRS SEE curves for Site Classes C and D are also found to be identical. These points are explained in Appendix A, Section 11, pp. A-78A.

From the design point of view, the following differences are most significant:

(a) The *PGA* is found to be 30 percent less than that obtained by using empirical adjustment factors.
(b) The site-specific ADRS curves have longer period ranges than those of the site-adjusted curves.

The duration difference represents the significant characteristics of eastern U.S. earthquakes when compared to the western U.S. The eastern U.S. earthquakes have longer recurrence periods (or the greater number of cycles) for the same magnitude of western U.S. earthquake-indicating the slower attenuation of ground motions when propagating through the thick layers of soils (see Appendix B, pp. B-18).

These different values of design ground motion parameters signify the importance of site-specific seismic response analysis. In the absence of site-specific response analysis, the calculated earthquake-induced loads on the various foundation systems may not represent the actual loads. Depending upon the component of the foundation system, the loads may be over-estimated or under-estimated.

7.0 CONCLUSIONS

The following conclusions are drawn based on the results of our analysis and the construction of the recommended site-specific smoothed Three-Point ADRS curves.

(a) The maximum value of peak shear strain was found to be 0.21 percent, which does not exceed the peak shear strain of 2 percent. Therefore, equivalent-linear one-dimensional site-specific response analysis method using ProShake is considered valid.
(b) The design spectral response parameters as determined from the smoothed ADRS curves for an equivalent viscous damping ratio of 5 percent for Site Classes C and D are summarized in Figures 3 and 4, respectively. The three-point site-adjusted ADRS curves are also superimposed on these curves.
(c) The site-specific ADRS curves for Site Class C are applicable for the design of interior bent foundation systems, and those for Site Class D are applicable for end bent foundation systems and bridge approach embankments.
(d) The site-specific ADRS curves have longer period ranges than the site-adjusted curves. This represents the significant characteristic difference of eastern U.S. earthquakes when compared to the western U.S. earthquakes.

8.0 LIMITATIONS

This seismic response analysis report is prepared in accordance with generally accepted geotechnical engineering practice for specific application to the referenced bridge project. The conclusions contained herein are based upon the available information and applicable standards at the time this report has been prepared. No other warranty, expressed or implied, is made.

In the event that any changes in nature, design, or location of the structure and/or foundation elements are planned, the conclusions contained in this report will not be valid unless the changes are reviewed and verified in writing.

9.0 REFERENCES

1. Andrus, R. D. (2003), Guide for Estimating the Dynamic Properties of South Carolina soils for Ground Response Analysis, FHWA-SC-03-07, pp. 58.

2. Camp, III, W. M. (2004), Site Characterization and Subsurface Conditions for the Cooper River Bridge, ASCE Geotechnical Special Publication No. 126, Vol. 1, pp. 347-360.

3. ConeTec Inc. (2011), SCPTu Testing, SC 41 Replacement Bridge, Charleston, SC.

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5. EduPro Civil System, ProShake Ground Response Analysis Program, version 1.1, User’s Manual.

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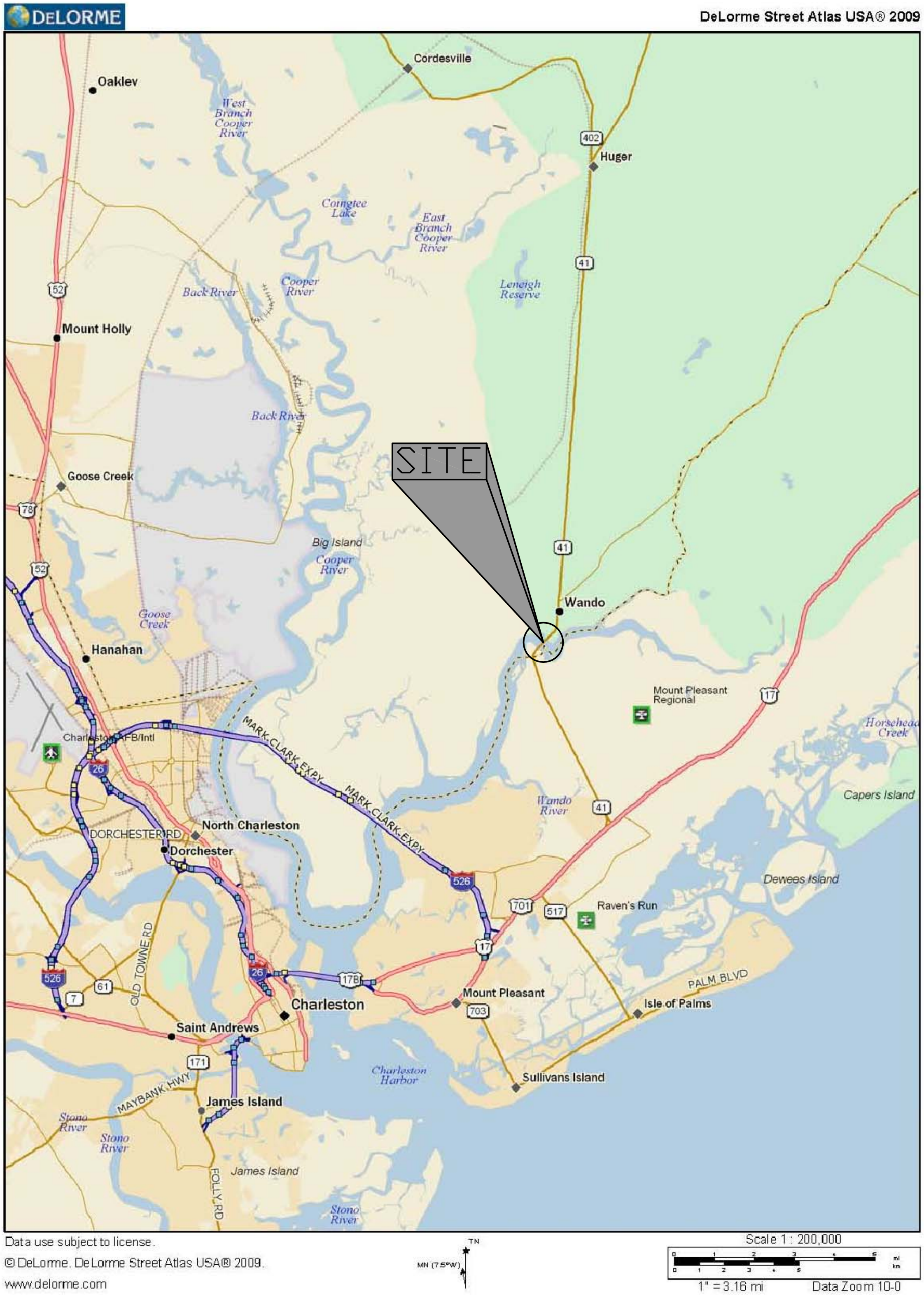
FIGURES



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DRWN. BY: JFH
CHKD. BY: ZWA
APPR. BY: ZWA

NOTES:

ORIGINAL:
12 APRIL 2011
REVISIONS:
1
2
3
4
SCALE:
NONE

F&ME
CONSULTANTS

GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SITE LOCATION PLAN

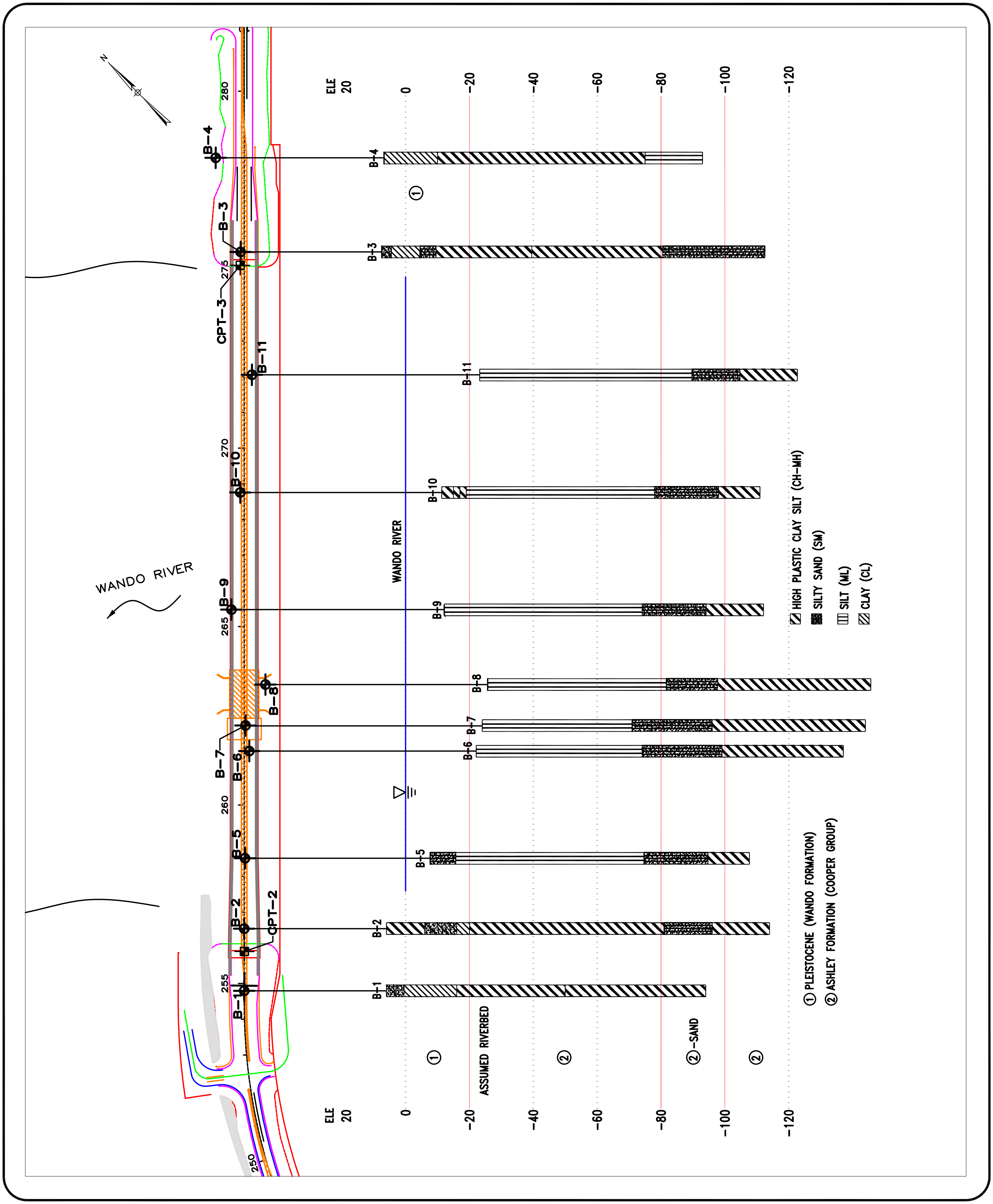
SC 41 BRIDGE REPLACEMENT OVER
WANDO RIVER.

CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE NO.: 8.158B/10.032102

F&ME CONSULTANTS
PROJECT NUMBER:

G4067.01

DRAWING NUMBER:
FIGURE 1



DRWN. BY: JFH
CHKD. BY: MSR
APPR. BY: MSR

NOTES:

ORIGINAL:
4 JANUARY 2011

REVISIONS:
1
2
3
4

SCALE:
NONE

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SOIL TEST LOCATION PLAN
& BORING PROFILES

SC 41 BRIDGE REPLACEMENT OVER
WANDO RIVER.

CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE NO.: 8.158B/10.032102

F&ME CONSULTANTS
PROJECT NUMBER:

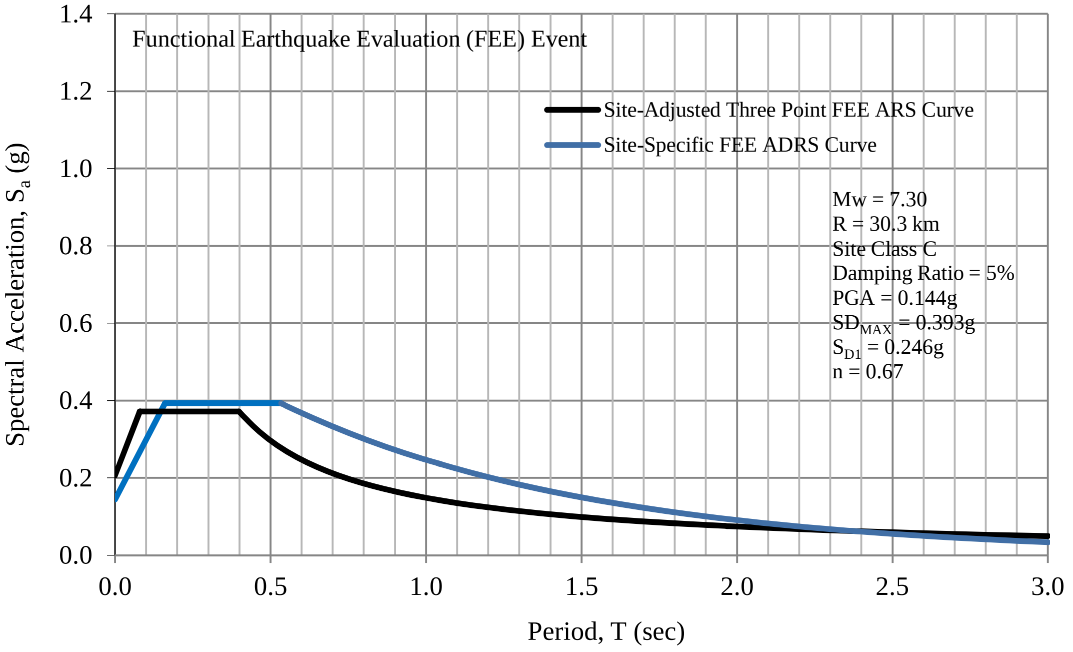
G4067.01

DRAWING NUMBER:
FIGURE 2

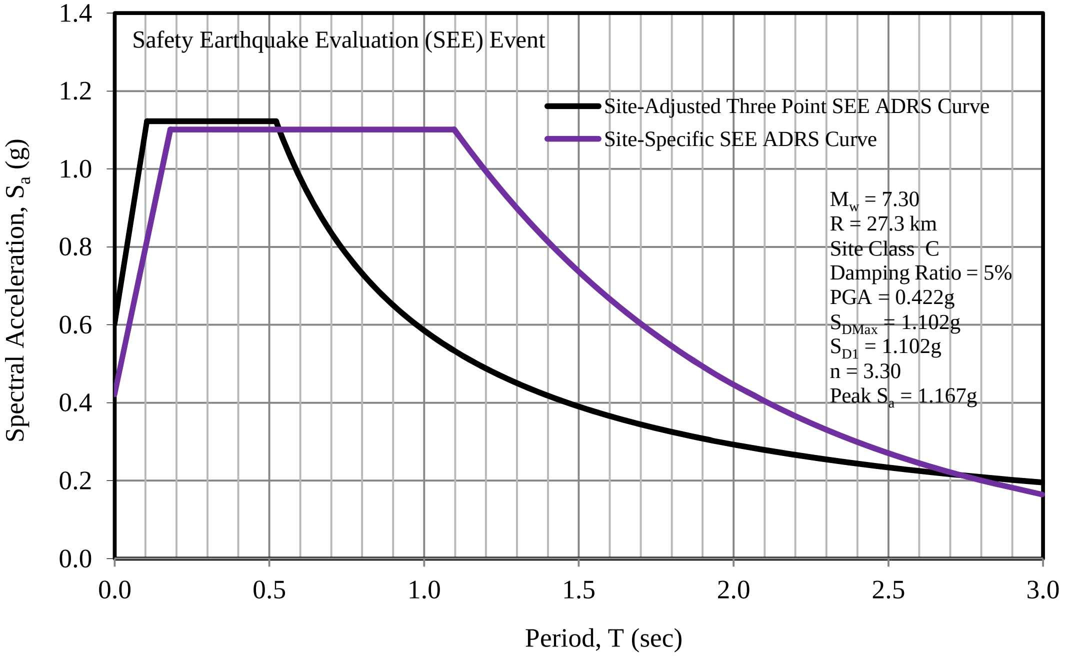
SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102

SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



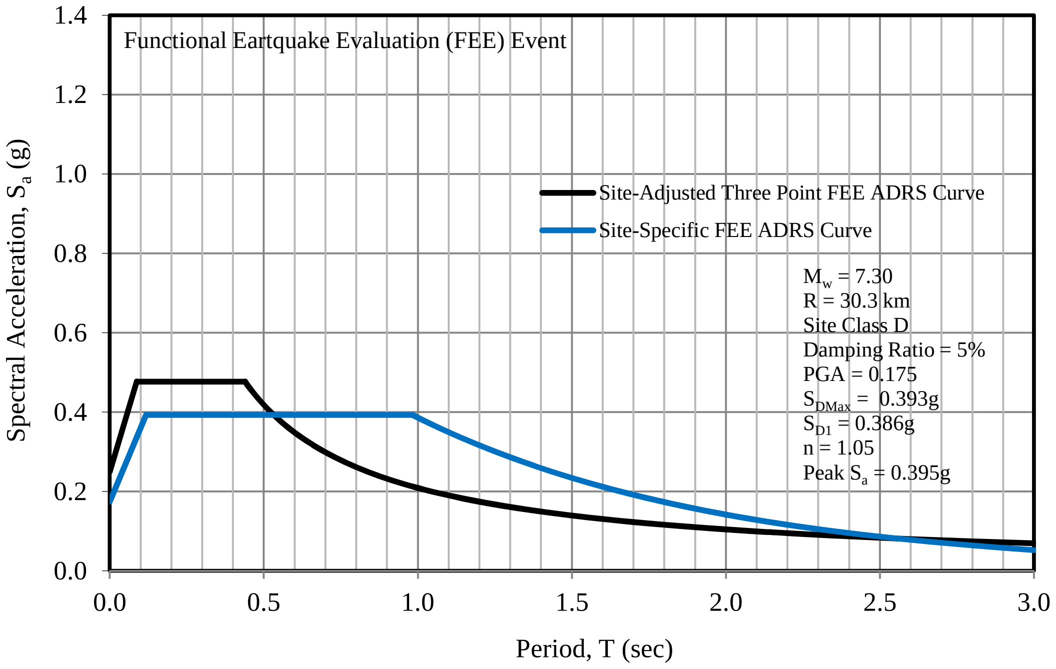
	T	S_a
	sec	g
	0.00	0.144
	0.05	0.222
	0.10	0.299
T_s	0.16	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
T_s	0.53	0.393
	0.60	0.368
	0.70	0.333
	0.80	0.301
	0.90	0.272
	1.00	0.246
	1.20	0.202
	1.40	0.165
	1.60	0.135
	1.80	0.111
	2.00	0.091
	2.20	0.074
	2.40	0.061
	2.60	0.050
	2.80	0.041
	3.00	0.033



	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_s	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102
SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



	T	S_a
	sec	g
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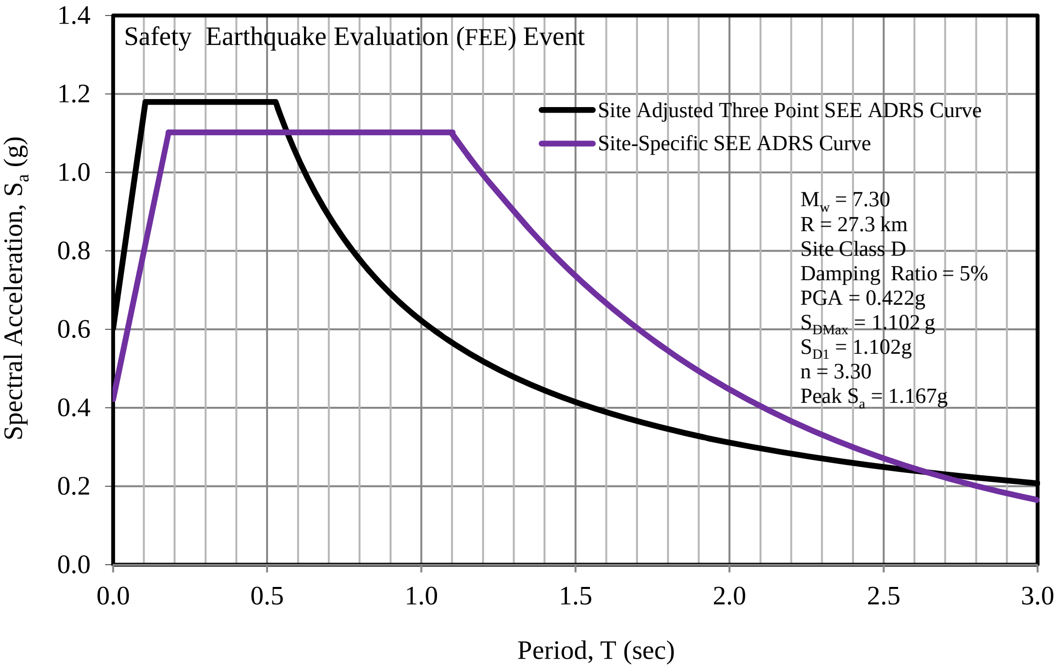
T_o	0.12	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
	0.60	0.393
	0.70	0.393
	0.80	0.393
	0.90	0.393
T_s	0.98	0.393
	1.00	0.386
	1.20	0.316
	1.40	0.259
	1.60	0.212
	1.80	0.174
	2.00	0.142
	2.20	0.116
	2.40	0.095
	2.60	0.078
	2.80	0.064
	3.00	0.052



	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_o	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

APPENDIX A

CALCULATIONS

SC 41 Bridge Replacement over Wando River

Site-Specific Seismic Response Analysis

CONTENTS

SECTION 1

CALCULATION FOR SHEAR MODULUS REDUCTION AND DAMPING CURVES

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 30 for Ashley Formation (Cooper Marl)

Estimation of Mean Confining Pressures

Geologic Formation	Group	Soil Type	E_t	E_b	d	γ_{tw}	γ'	σ'_{vt}	σ'_{vb}	σ'_{vm}	ϕ'	PI	OCR	K'_o	σ'_m
-	-	-	ft	ft	ft	pcf	pcf	ksf	ksf	ksf	deg	dim	dim	dim	ksf
Ashley	Cooper	②	-20	-66	46	125	62.5	0.0	2.9	1.4	-	-	-	-	-
Ashley	Cooper	②	-66	-80	14	125	62.5	2.9	3.8	3.3	0	30	3.0	1.06	3.4
Ashley	Cooper	①	-80	-100	20	130	67.5	3.8	5.1	4.4	33	0	3.0	0.79	3.8
Ashley	Cooper	②	-100	-150	50	130	67.5	5.1	8.5	6.8	0	30	3.0	1.06	7.0
Ashley	Cooper	②	-150	-283	133	130	67.5	8.5	17.5	13.0	0	30	4.0	1.22	14.9
Santee	(a)	③	-283	-322	39	150	87.5	17.5	20.9	19.2	0	0	1.0	1.00	19.2
Williamsburg	(b)	①	-322	-384	62	130	67.5	20.9	25.1	23.0	43	0	3.0	0.55	16.1
Williamsburg	(c)	①	-384	-440	56	130	67.5	25.1	28.8	26.9	43	0	3.0	0.55	18.9
Rhems	(d)	①	-440	-480	40	130	67.5	28.8	31.5	30.2	43	0	3.0	0.55	21.1
Rhems	(e)	①	-480	infinite	-	130	67.5	31.5	-	-	43	0	3.0	0.55	-

Notes:

From river bed to elevation -115 ft, the soil layers are based on the generalized subsurface profile (see Figure 2)

Geologic formations, members, and groups are based on Ref (1)

Ref (1) Shear Wave Velocity Models to be used in Site-Specific Response Analysis as modeled by SCDOT
(a) = Cross Member of Santee Limestone, Orangeburg Group
(b) = Chicaro Member of Williamsburg Formation, Black Mingo Group
(c) = Lower Bridge Member of Williamsburg Formation, Black Mingo Group
(d) = Black Mingo Group
(e) = Black Mingo Group
①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively
E_t, E_b = elevation of top and bottom of the layer
d = thickness of the layer, $d = E_t - E_b$
γ_{tw}, γ' = total and effective unit weight of soil, respectively and $\gamma' = \gamma_t - \gamma_w$, where γ_w is the unit weight of water
σ'_v = vertical effective stress, at top, bottom and mean vertical effective pressure
Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) and is considered at elevation -66 ft
ϕ' = drained friction angle for cohesionless soils and is estimated on the basis of SPT and CPT data
PI = plasticity index of cohesive soils
OCR = overconsolidated ratio of soils
K'_o = coefficient of effective earth pressure at rest (GDM, Table 12-14)
σ'_m = mean confining pressure and $\sigma'_m = \sigma'_v\,[(1 + 2K'_o)/3]$ (GDM, Eq 12-21)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 30 for Ashley Formation (Cooper Marl)

Calculation for Reference Shear Strain

Layer ID	Geologic Unit	Soil Type	z_t	z_b	d	σ'_m	σ'_{min}	σ'_{max}	PI	γ_{r1}	α	k	γ_r
-	-	-	ft	ft	ft	ksf	ksf	ksf	dim	%	dim	dim	dim
	Cooper Marl	②	-20	-66	46	-	-	-	-	-	-	-	-
1	Cooper Marl	②	-66	-80	14	3.4	3.0	3.9	30	0.030	1.10	0.497	0.039
2	Cooper Marl	①	-80	-100	20	3.8	3.2	4.4	0	ǂ	ǂ	ǂ	ǂ
3	Cooper Marl	②	-100	-150	50	7.0	5.3	8.8	30	0.030	1.10	0.497	0.056
4	Cooper Marl	②	-150	-283	133	14.9	9.7	20.0	30	0.030	1.10	0.497	0.081
5	Santee	③	-283	-322	39	19.2	17.5	20.9	0	0.047	1.00	0.313	0.095
6	Black Mingo	①	-322	-480	158	16.1	14.6	22.1	0	0.047	1.00	0.313	0.090
7	Black Mingo	①	-480	infinite	-	-	22.1	-	0	0.047	1.00	0.313	0.100

Notes:

Layers are numbered below the depth-to-motion, Z_{DTM}

①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively

E_t, E_b = elevation of top and bottom of the layer

d = thickness of the layer, $d = E_t - E_b$

σ'_m = mean confining pressure

σ'_{min} = min confining pressure and $\sigma'_{min} = \sigma'_{vt}\,[(1 + 2K'_o)/3]$ and needs to be greater than $0.5\sigma'_m$

σ'_{max} = max confining pressure and $\sigma'_{max} = \sigma'_{vb}\,[(1 + 2K'_o)/3]$ and needs to be less than $1.5\ \sigma'_m$

K'_o = coefficient of effective earth pressure at rest (GDM, Table 12-14)

PI = plasticity index of cohesive soils and is estimated on the basis of available soil test results

γ_{r1} = reference shear strain at 1 tsf (GDM, Table 12-15)

α = curvature coefficient (GDM, Table 12-15)

k = an exponent that varies with geologic formation (GDM, Table 12-15)

γ_r = reference shear strain and $\gamma_r = \gamma_{r1}\,(\sigma'_m/P_a)^k$, where P_a is the reference pressure of 2 ksf (GDM, Eq 12-20)

ǂ Vucetic and Dorby (1991) correlations are used for PI = 0 soils (GDM, §12.3.8.2)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 30 for Ashley Formation (Cooper Marl)

Calculation for Small-Strain Material Damping

Layer ID	Geologic Unit	Soil Type	z_t	z_b	d	σ'_m	σ'_{min}	σ'_{max}	PI	D_{min1}	α	k	D_{min}
-	-	-	ft	ft	ft	ksf	ksf	ksf	dim	%	dim	dim	dim
	Cooper Marl	②	-20	-66	46	-	-	-	-	-	-	-	-
1	Cooper Marl	②	-66	-80	14	3.4	3.0	3.9	30	1.71	1.10	0.497	1.498
2	Cooper Marl	①	-80	-100	20	3.8	3.2	4.4	0	0.56	ǂ	ǂ	ǂ
3	Cooper Marl	②	-100	-150	50	7.0	5.3	8.8	30	1.71	1.10	0.497	1.254
4	Cooper Marl	②	-150	-283	133	14.9	9.7	20.0	30	1.71	1.10	0.497	1.041
5	Santee	③	-283	-322	39	19.2	17.5	20.9	0	0.68	1.00	0.313	0.477
6	Black Mingo	①	-322	-480	158	16.1	14.6	22.1	0	0.68	1.00	0.313	0.491
7	Black Mingo	①	-480	infinite	-	-	22.1	-	0	0.68	1.00	0.313	0.467

Notes:

Layers are numbered below the depth-to-motion, Z_{DTM}

①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively

E_t, E_b = elevation of top and bottom of the layer

d = thickness of the layer, $d = E_t - E_b$

σ'_m = mean confining pressure

$\sigma'_{m(av)}$ = average mean confining pressure for the subdivided geologic unit

PI = plasticity index of cohesive soils

α = curvature coefficient (GDM, Table 12-15)

k = an exponent that varies with geologic formation (GDM, Table 12-15)

D_{min1} = small-strain damping at $\sigma'_m = 2$ ksf (GDM, §12.3.7)

D_{min} = small-scale material damping and $D_{min} = D_{min1} (\sigma'_m/P_a)^{-0.5k}$, where P_a is reference pressure of 2 ksf (GDM, Eq 12-28)

ǂ Vucetic and Dorby (1991) correlations are used for PI = 0 soils (GDM, §12.3.8.2)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 30 for Ashley Formation (Cooper Marl)

Calculation for Shear Modulus Reduction and Equivalent Viscous Damping Ratio Curves[ǂ]

γ	Layer 1		Layer 3		Layer 4		Layer 5		Layer 6		Layer 7	
↓	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D
0.0001	0.999	1.512	0.999	1.263	0.999	1.047	0.999	0.488	0.999	0.502	0.999	0.477
0.0002	0.997	1.528	0.998	1.273	0.999	1.054	0.998	0.498	0.998	0.512	0.998	0.487
0.0004	0.994	1.561	0.996	1.296	0.997	1.070	0.996	0.519	0.996	0.534	0.996	0.506
0.0008	0.986	1.634	0.991	1.345	0.994	1.102	0.992	0.560	0.991	0.578	0.992	0.546
0.001	0.983	1.672	0.988	1.371	0.992	1.119	0.990	0.580	0.989	0.600	0.990	0.565
0.002	0.964	1.872	0.975	1.505	0.983	1.208	0.979	0.684	0.978	0.709	0.980	0.664
0.004	0.925	2.302	0.948	1.795	0.965	1.401	0.960	0.892	0.958	0.929	0.961	0.863
0.008	0.852	3.216	0.895	2.418	0.928	1.815	0.923	1.309	0.919	1.370	0.926	1.262
0.01	0.818	3.682	0.870	2.740	0.909	2.030	0.905	1.518	0.900	1.590	0.909	1.462
0.02	0.677	5.928	0.757	4.361	0.824	3.146	0.827	2.544	0.819	2.670	0.833	2.445
0.04	0.495	9.561	0.592	7.285	0.686	5.326	0.704	4.440	0.693	4.651	0.714	4.274
0.08	0.314	13.970	0.404	11.439	0.504	8.894	0.544	7.489	0.530	7.789	0.555	7.249
0.1	0.263	15.336	0.346	12.878	0.443	10.278	0.488	8.692	0.474	9.012	0.499	8.435
0.2	0.143	18.858	0.198	16.959	0.271	14.673	0.323	12.709	0.311	13.036	0.333	12.441
0.4	0.072	21.092	0.103	19.851	0.148	18.256	0.192	16.347	0.184	16.608	0.199	16.130
0.8	0.035	22.315	0.051	21.541	0.075	20.551	0.106	18.974	0.101	19.149	0.111	18.828
1	0.028	22.563	0.040	21.893	0.059	21.050	0.087	19.593	0.083	19.743	0.091	19.467

Notes:

G/G_{max} = normalized shear modulus and $G/G_{max} = 1/[1 + (\gamma/\gamma_r)^{\alpha}]$, (GDM, Eq 12-19)

D = material damping ratio and $D = D_{min} + 12.2\,[1/\{1 + (\gamma/\gamma_r)^{\alpha}\}]^2 - 34.2\,[1/\{1 + (\gamma/\gamma_r)^{\alpha}\}] + 22.0$ (GDM, Eq 12-30)

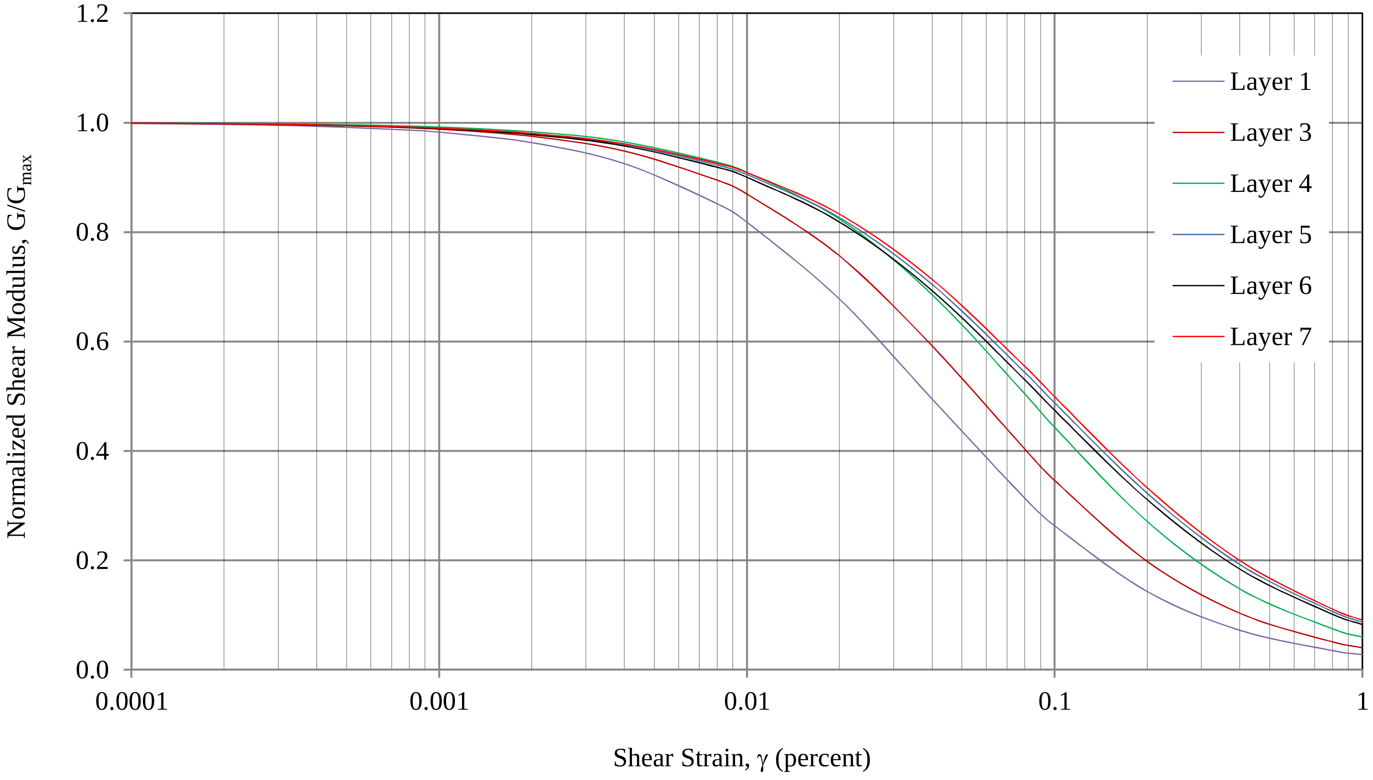
α = curvature coefficient

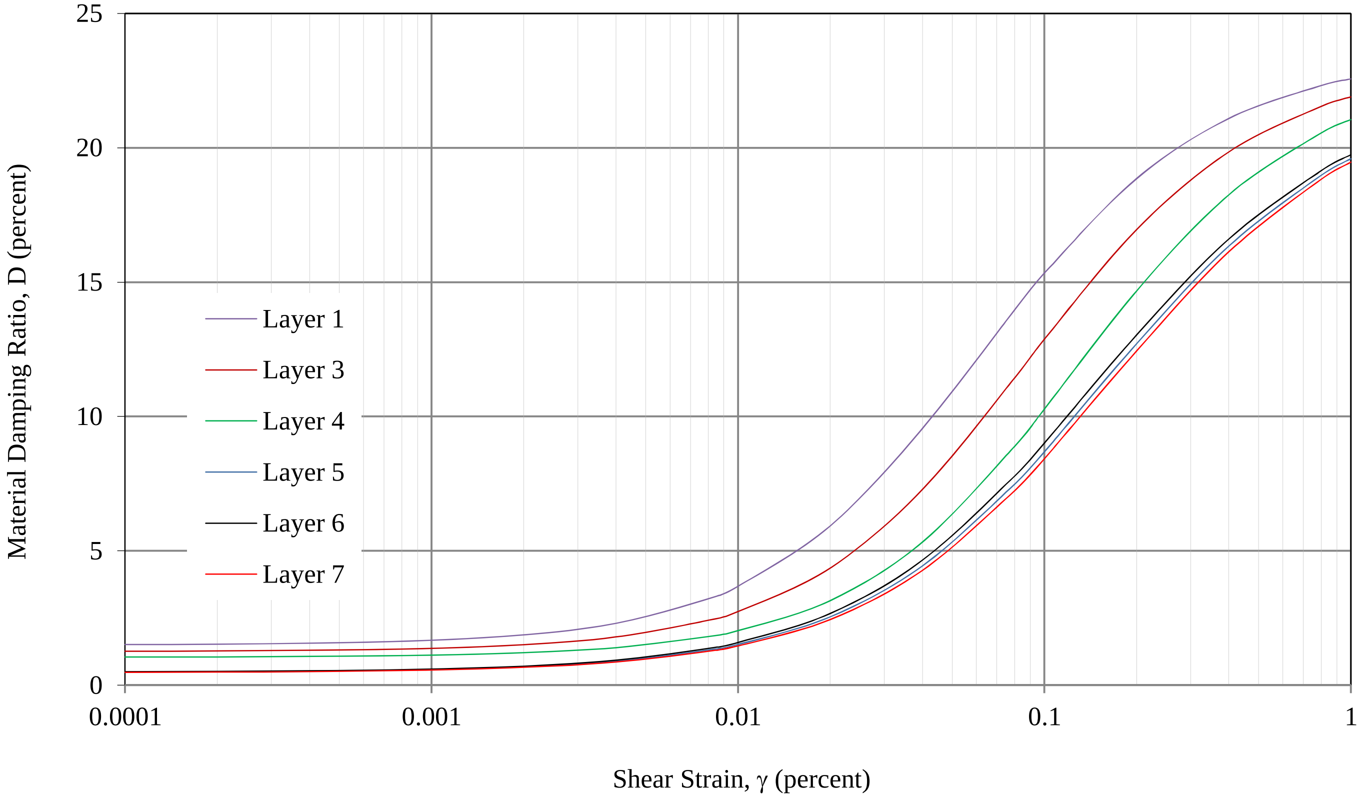
γ_r = reference shear strain

D_{min} = small-scale material damping

ǂ Vucetic and Dorby (1991) correlations are used to represent the soils of Layer 2

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 30 for Ashley Formation (Cooper Marl)





Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 60 for Ashley Formation (Cooper Marl)

Estimation of Mean Confining Pressures

Geologic Formation	Group	Soil Type	E_t	E_b	d	γ_{tw}	γ'	σ'_{vt}	σ'_{vb}	σ'_{vm}	ϕ'	PI	OCR	K'_o	σ'_m
			ft	ft	ft	pcf	pcf	ksf	ksf	ksf	deg	dim	dim	dim	ksf
Ashley	Cooper	②	-20	-66	46	105	42.5	0.0	2.0	1.0	-	-	-	-	-
Ashley	Cooper	②	-66	-80	14	125	62.5	2.0	2.8	2.4	0	60	3.0	1.14	2.6
Ashley	Cooper	①	-80	-100	20	130	67.5	2.8	4.2	3.5	33	0	3.0	0.79	3.0
Ashley	Cooper	②	-100	-150	50	130	67.5	4.2	7.6	5.9	0	60	3.0	1.14	6.4
Ashley	Cooper	②	-150	-283	133	130	67.5	7.6	16.5	12.0	0	60	4.0	1.32	14.6
Santee	(a)	③	-283	-322	39	150	87.5	16.5	19.9	18.2	0	0	1.0	1.00	18.2
Williamsburg	(b)	①	-322	-384	62	130	67.5	19.9	24.1	22.0	43	0	3.0	0.55	15.4
Williamsburg	(c)	①	-384	-440	56	130	67.5	24.1	27.9	26.0	43	0	3.0	0.55	18.2
Rhems	(d)	①	-440	-480	40	130	67.5	27.9	30.6	29.3	43	0	3.0	0.55	20.5
Rhems	(e)	①	-480	infinite	-	130	67.5	30.6	-	-	43	0	3.0	0.55	-

Notes:

From river bed to elevation -115 ft, the soil layers are based on the generalized subsurface profile (see Figure 2)

Geologic formations, members, and groups are based on Ref (1)

Ref (1) Shear Wave Velocity Models to be used in Site Specific Response Analysis as modeled by SCDOT
(a) = Cross Member of Santee Limestone, Orangeburg Group
(b) = Chicaro Member of Williamsburg Formation, Black Mingo Group
(c) = Lower Bridge Member of Williamsburg Formation, Black Mingo Group
(d) = Black Mingo Group
(e) = Black Mingo Group
①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively
E_t, E_b = Elevation of top and bottom of the layer
d = thickness of the layer, $H = E_t - E_b$
γ_{tw}, γ' = total and effective unit weight of soil, respectively and $\gamma' = \gamma_t - \gamma_w$, where γ_w is the unit weight of water
σ'_v = vertical effective stress, at top, bottom and mean vertical effective pressure
Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) and is considered at elevation -66 ft
ϕ' = drained friction angle for cohesionless soils and is estimated on the basis of SPT and CPT data
PI = plasticity index of cohesive soils
OCR = overconsolidated ratio of soils
K'_o = coefficient of effective earth pressure at rest (GDM, Table 12-14)
σ'_m = mean confining pressure and $\sigma'_m = \sigma'_v\,[(1 + 2K'_o)/3]$ (GDM, Eq 12-21)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 60 for Ashley Formation (Cooper Marl)

Calculation for Reference Shear Strain

Layer ID	Geologic Unit	Soil Type	z_t	z_b	d	σ'_m	σ'_{min}	σ'_{max}	PI	γ_{r1}	α	k	γ_r
			ft	ft	ft	ksf	ksf	ksf	dim	%	dim	dim	dim
	Cooper Marl	②	-20	-66	46	-	-	-	-	-	-	-	-
1	Cooper Marl	②	-66	-80	14	2.6	2.1	3.1	60	0.058	1.18	0.436	0.065
2	Cooper Marl	①	-80	-100	20	3.0	2.4	3.6	0	ǂ	ǂ	ǂ	ǂ
3	Cooper Marl	②	-100	-150	50	6.4	4.6	8.3	60	0.058	1.18	0.436	0.096
4	Cooper Marl	②	-150	-283	133	14.6	9.2	20.1	60	0.058	1.18	0.436	0.137
5	Santee	③	-283	-322	39	18.2	16.5	19.9	0	0.047	1.00	0.313	0.094
6	Black Mingo	①	-322	-480	158	15.4	14.0	21.4	0	0.047	1.00	0.313	0.089
7	Black Mingo	①	-480	infinite	-	-	21.4	-	0	0.047	1.00	0.313	0.099

Notes:

Layers are numbered below the depth-to-motion, Z_{DTM}

①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively

E_t, E_b = Elevation of top and bottom of the layer

d = thickness of the layer, $d = E_t - E_b$

σ'_m = mean confining pressure

σ'_{min} = min confining pressure and $\sigma'_{min} = \sigma'_{vt}\,[(1 + 2K'_o)/3]$ and needs to be greater than $0.5\sigma'_m$

σ'_{max} = max confining pressure and $\sigma'_{max} = \sigma'_{vb}\,[(1 + 2K'_o)/3]$ and needs to be less than $1.5\ \sigma'_m$

K'_o = coefficient of effective earth pressure at rest (GDM, Table 12-14)

PI = plasticity index of cohesive soils and is estimated on the basis of available soil test results

γ_{r1} = reference shear strain at 1 tsf (GDM, Table 12-15)

α = curvature coefficient (GDM, Table 12-15)

k = an exponent that varies with geologic formation (GDM, Table 12-15)

γ_r = reference shear strain and $\gamma_r = \gamma_{r1}\,(\sigma'_m/P_a)^k$, where P_a is the reference pressure of 2 ksf (GDM, Eq 12-20)

ǂ Vucetic and Dorby (1991) correlations are used for PI = 0 soils (GDM, §12.3.8.2)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 60 for Ashley Formation (Cooper Marl)

Calculation for Small-Strain Material Damping

Layer ID	Geologic Unit	Soil Type	z_t	z_b	d	σ'_m	σ'_{min}	σ'_{max}	PI	D_{min1}	α	k	D_{min}
			ft	ft	ft	ksf	ksf	ksf	dim	%	dim	dim	dim
	Cooper Marl	②	-20	-66	46	-	-	-	-	-	-	-	-
1	Cooper Marl	②	-66	-80	14	2.6	2.1	3.1	60	1.71	1.18	0.436	1.616
2	Cooper Marl	①	-80	-100	20	3.0	2.4	3.6	0	0.56	ł	ł	ǂ
3	Cooper Marl	②	-100	-150	50	6.4	4.6	8.3	60	1.71	1.18	0.436	1.329
4	Cooper Marl	②	-150	-283	133	14.6	9.2	20.1	60	1.71	1.18	0.436	1.111
5	Santee	③	-283	-322	39	18.2	16.5	19.9	0	0.68	1.00	0.313	0.481
6	Black Mingo	①	-322	-480	158	15.4	14.0	21.4	0	0.68	1.00	0.313	0.494
7	Black Mingo	①	-480	infinite	-	-	21.4	-	0	0.68	1.00	0.313	0.469

Notes:

Layers are numbered below the depth-to-motion, Z_{DTM}

①, ②, ③ = cohesionless and cohesive soil layers, and shelly microfossiliferous limestone, respectively

E_t, E_b = Elevation of top and bottom of the layer

d = thickness of the layer, $d = E_t - E_b$

σ'_m = mean confining pressure

$\sigma'_{m(av)}$ = average mean confining pressure for the subdivided geologic unit

PI = plasticity index of cohesive soils

α = curvature coefficient (GDM, Table 12-15)

k = an exponent that varies with geologic formation (GDM, Table 12-15)

D_{min1} = small-strain damping at $\sigma'_m = 2$ ksf (GDM, §12.3.7)

D_{min} = small-scale material damping and $D_{min} = D_{min1} (\sigma'_m/P_a)^{-0.5k}$, where P_a is reference pressure of 2 ksf (GDM, Eq 12-28)

ł Vucetic and Dorby (1991) correlations are used for PI = 0 soils (GDM, §12.3.8.2)

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 60 for Ashley Formation (Cooper Marl)

Calculation for Shear Modulus Reduction and Equivalent Viscous Damping Ratio Curvesƚ

γ	Layer 1		Layer 3		Layer 4		Layer 5		Layer 6		Layer 7	
↓	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D	G/G_{max}	D
0.0001	1.000	1.621	1.000	1.332	1.000	1.113	0.999	0.492	0.999	0.505	0.999	0.479
0.0002	0.999	1.627	0.999	1.335	1.000	1.115	0.998	0.502	0.998	0.516	0.998	0.489
0.0004	0.997	1.641	0.998	1.344	0.999	1.121	0.996	0.523	0.996	0.538	0.996	0.509
0.0008	0.994	1.672	0.996	1.364	0.998	1.134	0.992	0.565	0.991	0.582	0.992	0.549
0.001	0.993	1.689	0.995	1.374	0.997	1.141	0.989	0.586	0.989	0.604	0.990	0.569
0.002	0.984	1.780	0.990	1.432	0.993	1.179	0.979	0.691	0.978	0.715	0.980	0.668
0.004	0.964	1.989	0.977	1.564	0.985	1.264	0.959	0.902	0.957	0.937	0.961	0.869
0.008	0.921	2.463	0.949	1.862	0.966	1.460	0.921	1.326	0.918	1.384	0.925	1.272
0.01	0.900	2.717	0.935	2.023	0.956	1.565	0.904	1.538	0.899	1.607	0.908	1.473
0.02	0.799	4.072	0.863	2.896	0.906	2.141	0.824	2.579	0.817	2.700	0.832	2.466
0.04	0.638	6.758	0.737	4.758	0.810	3.414	0.701	4.498	0.690	4.701	0.712	4.308
0.08	0.438	10.967	0.553	8.147	0.653	5.972	0.540	7.573	0.527	7.860	0.552	7.298
0.1	0.375	12.502	0.488	9.553	0.592	7.141	0.484	8.781	0.471	9.088	0.497	8.488
0.2	0.210	16.973	0.296	14.265	0.391	11.604	0.319	12.801	0.308	13.112	0.331	12.497
0.4	0.105	20.152	0.157	18.257	0.221	16.141	0.190	16.421	0.182	16.668	0.198	16.176
0.8	0.049	21.953	0.076	20.793	0.112	19.443	0.105	19.024	0.100	19.189	0.110	18.858
1	0.039	22.317	0.060	21.331	0.088	20.189	0.086	19.636	0.082	19.777	0.090	19.494

Notes:

G/G_{max} = normalized shear modulus and $G/G_{max} = 1/[1 + (\gamma/\gamma_r)^{\alpha}]$, (GDM, Eq 12-19)

D = material damping ratio and $D = D_{min} + 12.2\,[1/\{1 + (\gamma/\gamma_r)^{\alpha}\}]^2 - 34.2\,[1/\{1 + (\gamma/\gamma_r)^{\alpha}\}] + 22.0$ (GDM, Eq 12-30)

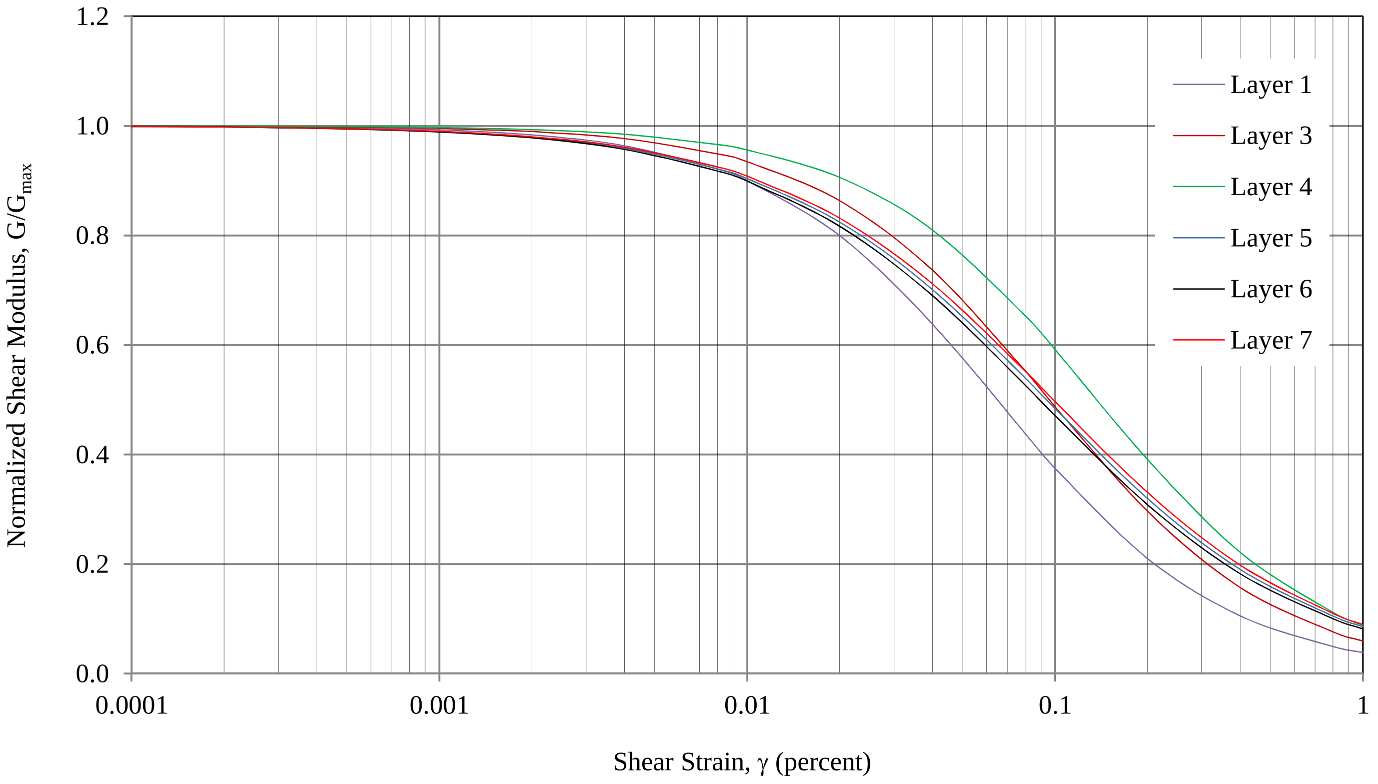
α = curvature coefficient (GDM, Table 12-15)

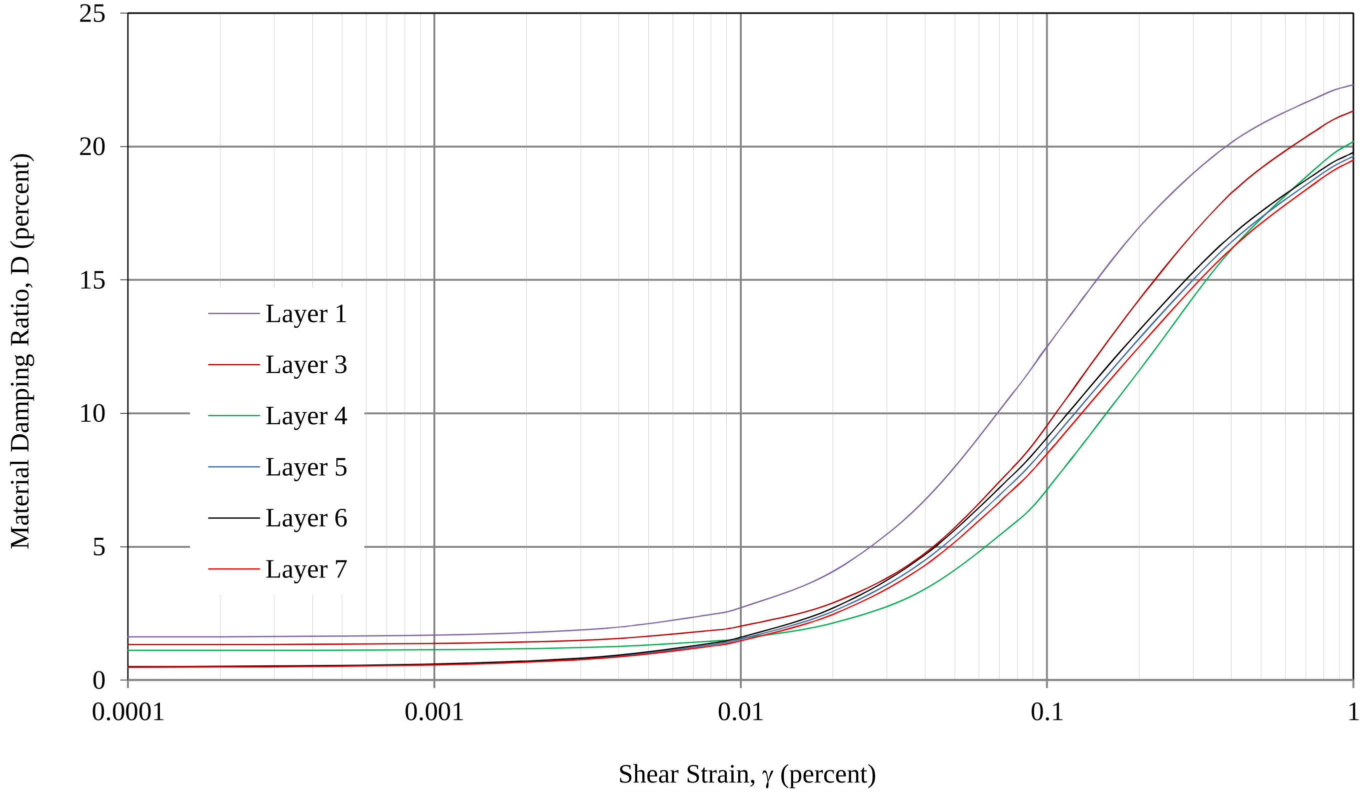
γ_r = reference shear strain

D_{min} = small-scale material damping

ƚ Vucetic and Dorby (1991) correlations are used to represent the soils of Layer 2

Shear Modulus Reduction and Damping Ratio Curves based on Andrus et al. (2003) with PI of 60 for Ashley Formation (Cooper Marl)





SECTION 2

CALCULATION FOR DESIGN WAVE VELOCITY PROFILES

Site-Specific Measured and Design Shear Wave Velocity Profile above Elevation -115 feet

Calculation for Design Shear Wave Velocity using Site-Specific Data

E_z	V_{s2}	E_z	V_{s3}	$V_{s\ (South)}$	V_s	$V_{s\ (North)}$
ft	ft/sec	ft	ft/sec	ft/sec	ft/sec	ft/sec
1.4	464	-0.2	940	510	Depth to Motion ↓	830
-1.9	552	-3.4	757			
-5.1	484	-6.7	917			
-8.4	471	-10.0	705			
-11.7	577	-13.3	1103			1153
-15.0	858	-16.6	1206	858		
-18.3	~~1292~~	-19.9	1149			
-21.5	886	-23.1	779	785	785	785
-24.8	727	-26.4	763			
-28.1	751	-29.7	764			
-31.4	813	-33.0	794			
-34.7	1051	-36.3	1068	1030	1030	1030
-37.9	939	-39.5	870			
-41.2	1030	-42.8	1020			
-44.5	1038	-46.1	957			
-47.8	999	-49.4	975			
-51.1	1100	-52.7	1189			
-54.3	1023	-	-			
-57.6	1059	-59.2	1038			
-60.9	1048	-62.5	992			
-64.2	1101	-65.8	1073			
-67.5	1172	-69.1	1056	1345	1345	1345
-70.7	1265	-72.3	1213			
-74.0	1288	-75.6	1191			
-77.3	1362	-78.9	1213			
-80.6	1483	-82.2	1394			
-83.9	1470	-85.5	1394			
-87.1	1501	-88.7	~~1638~~			
-90.4	1360	-92.0	1236			
-93.7	~~1988~~	-95.3	1394			
-97.0	1198	-98.6	1395			
-100.3	987	-101.9	~~1873~~			
-103.6	985	-105.2	1261	1063	1063	1063
-106.8	1087	-108.4	~~2261~~			
-110.1	1043	-111.7	923			
-113.4	1068	-115.0	1075			

Notes:

E_z = elevation of shear wave velocity measurement

V_{s2}, V_{s3} = measured shear wave velocity from SCPT-2 and SCPT-3 soundings, respectively

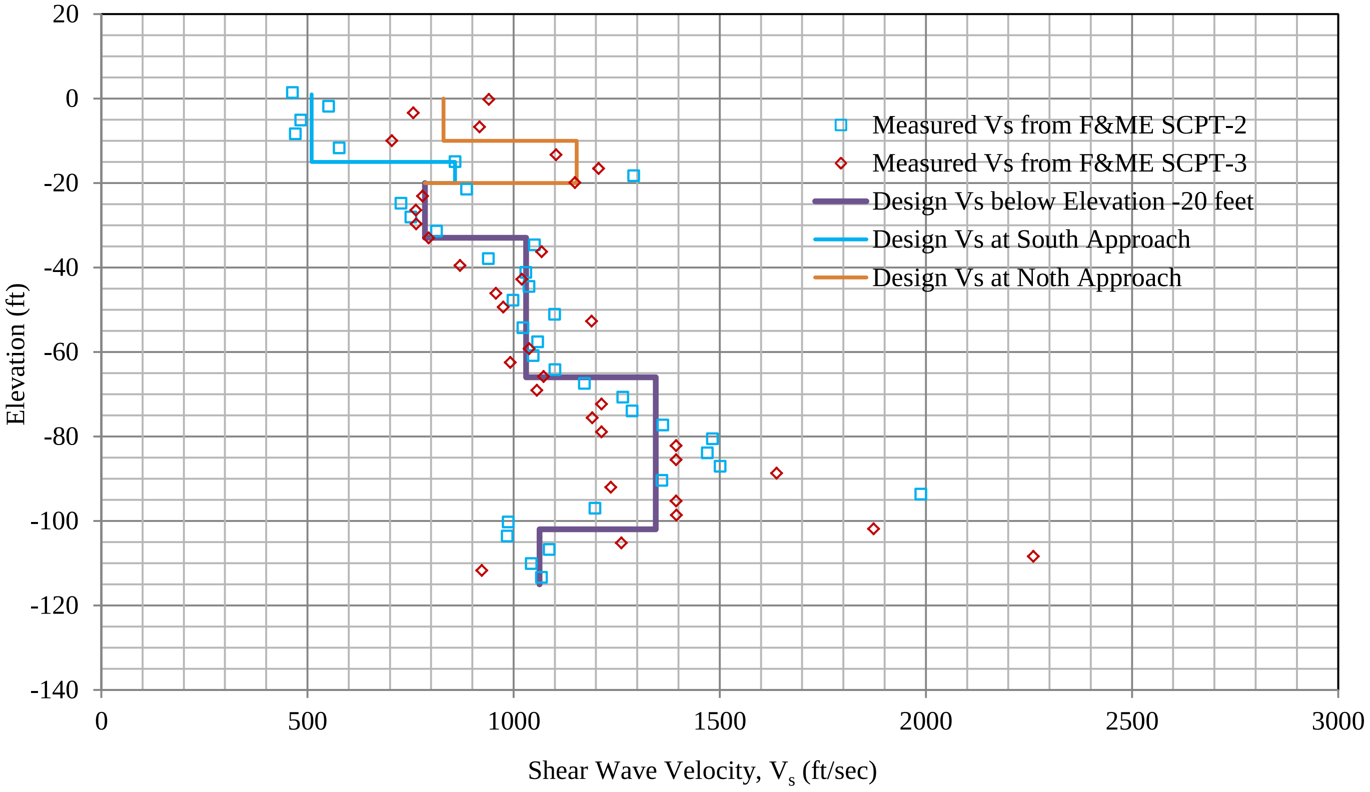
V_s = average shear wave velocity for design analysis for the interior and end bents

$V_{s(S)}$, $V_{s(N)}$ = design shear wave velocity at approach embankments at South and North side, respectively

Strike through values are not considered in calculating the average V_s

The cyan line indicates the river bed elevation

Site-Specific Measured and Design Shear Wave Velocity Profile above Elevation -115 feet



Design Shear Wave Velocity Profiles for Response Analysis

Calculation for Design Shear Wave Velocity

E_t	E_b	V_s	E_t	E_b	V_s	E_t	E_b	V_s	E_t	E_b	V_s
ft	ft	ft/sec	ft	ft	ft/sec	ft/sec	ft/sec	ft/sec			
-20	-33	785	-20	-33	785	-20	-33	785	-20	-33	785
-33	-66	1030	-33	-66	1030	-33	-66	1030	-33	-66	1030
-66	-102	1345	-66	-102	1345	-66	-102	1345	-66	-102	1345
-102	-115	1063	-102	-115	1063	-102	-115	1063	-102	-115	1063
-115	-141	1400	-115	-149	1473	-115	-153	1485	-115	-181	1185
-141	-208	1637	-149	-175	1251	-153	-175	1235	-181	-316	1910
-208	-251	2322	-175	-183	2064	-175	-205	1880	-316	-352	2630
-251	-271	1819	-183	-208	1553	-205	-225	2320	-352	-375	3264
-271	-283	2408	-208	-219	2236	-225	-238	1605	-375	-386	2650
-283	-306	3310	-219	-238	1816	-238	-260	2695	-386	-441	1358
-306	-323	3088	-238	-273	2285	-260	-275	1775	-441	-455	2169
-323	-336	3711	-273	-283	1804	-275	-336	2510	-455	-480	1602
-336	-352	3264	-283	-291	2162	-336	-352	1711	-480	infinite	2500
-352	-375	2650	-291	-306	2408	-352	-375	3264			
-375	-386	1358	-306	-323	3310	-375	-386	2650			
-386	-441	2169	-323	-336	3088	-386	-441	1358			
-441	-455	1602	-336	-352	1711	-441	-455	2169			
-455	-480	2091	-352	-375	3264	-455	-480	1602			
-480	infinite	2500	-375	-386	2650	-480	infinite	2500			
			-386	-441	1358						
			-441	-455	2169						
			-455	-480	1602						
			-480	infinite	2500						
Port Access Road Bridge (B-11 Suspension)			Ravenel Bridge (MP-2 & MP-3 Suspension)			Ravenel Bridge (DS-1 Downhole)			Maybank Bridge (PS-1 Downhole)		

Notes:

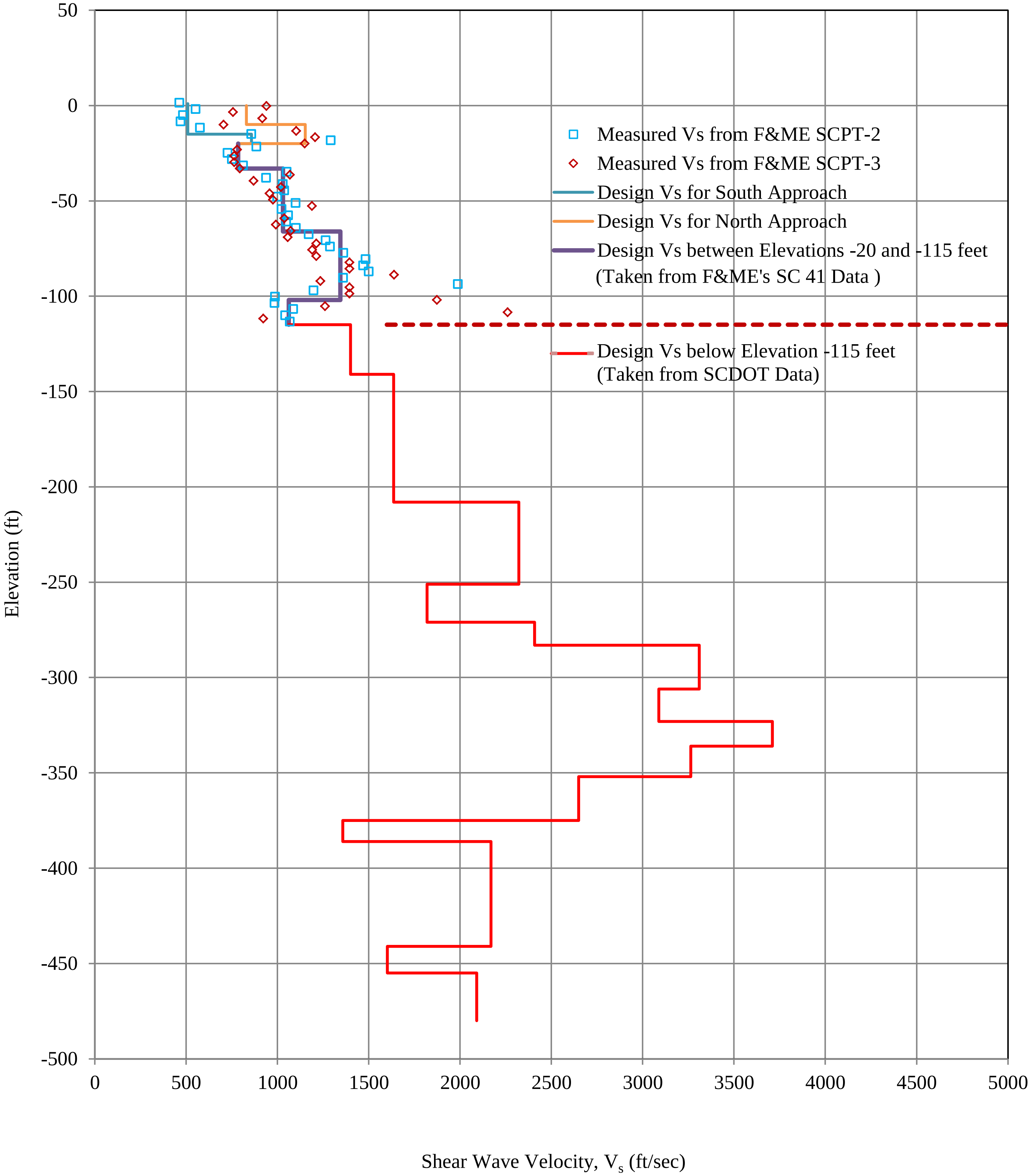
E_t, E_b = top and bottom elevation of the layer of average shear wave velocity

V_s = design shear wave velocity

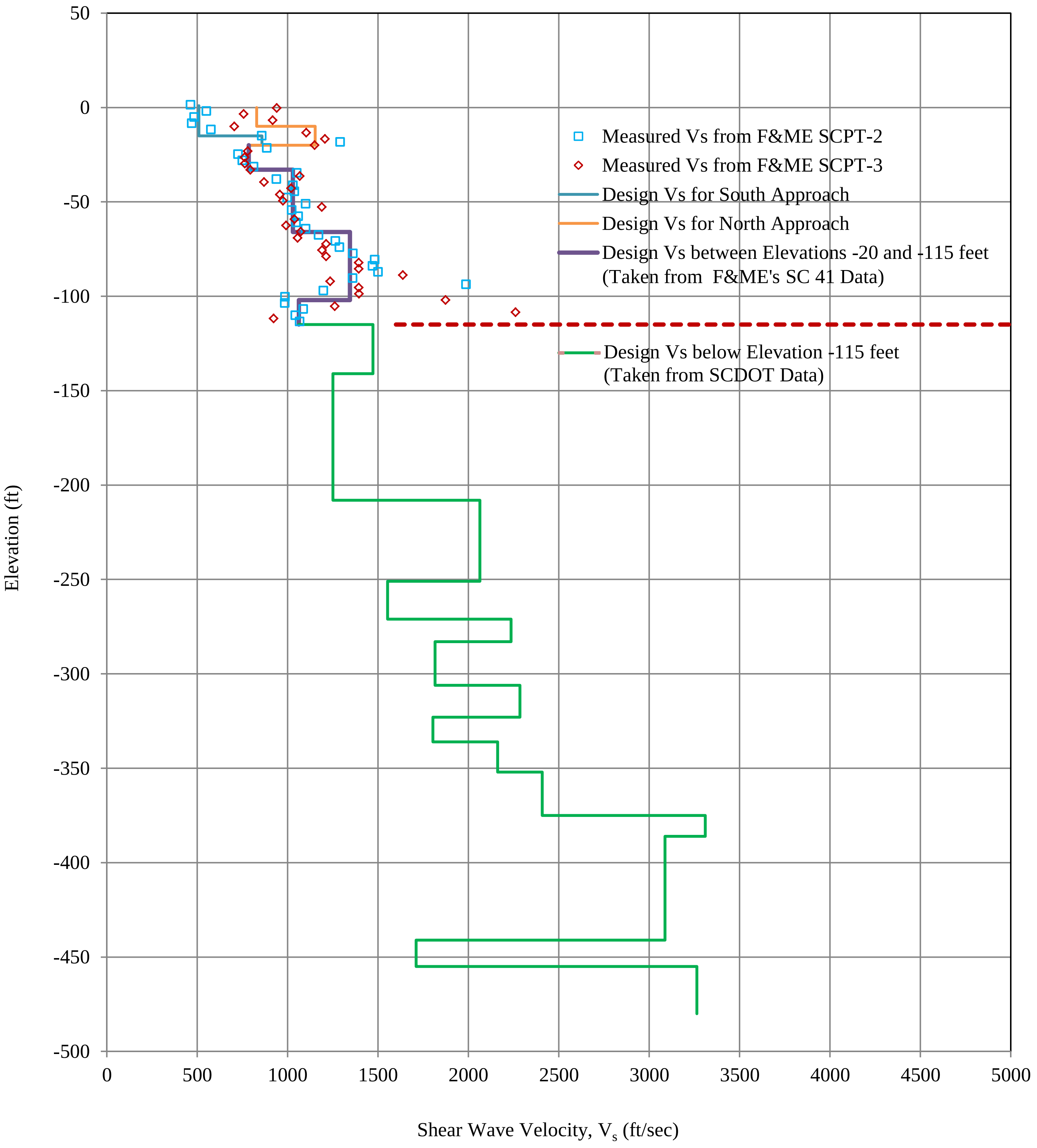
V_s data above the blue lines are the site-specific design shear wave velocities

V_s data below the blue lines are the design shear wave velocities at the bridge site mentioned at the bottom of the table

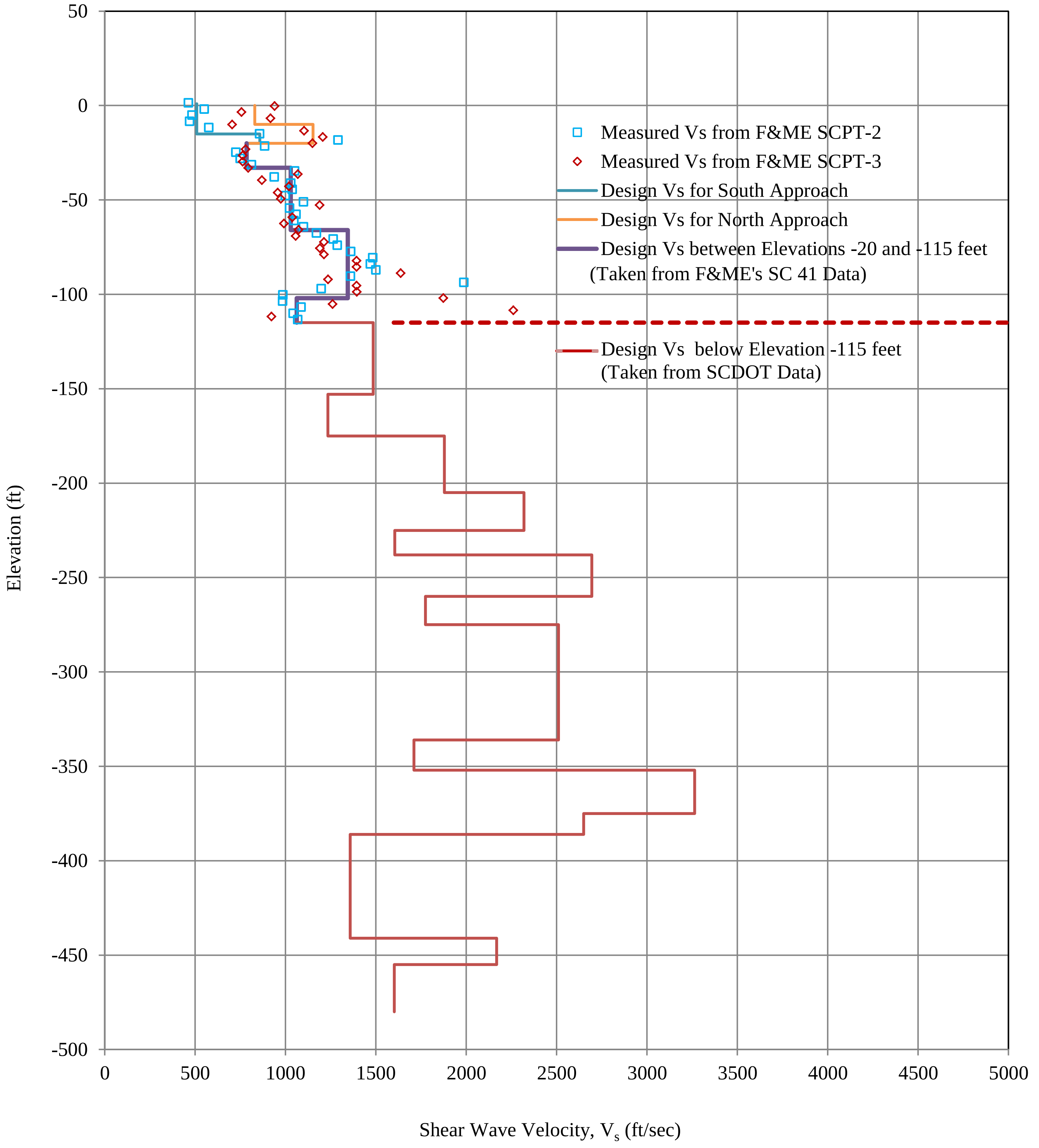
Site-Specific Design Shear Wave Velocity Profile
Using Port Access Road Bridge B-11 (Suspension) Design Shear Wave Velocity Data below -115 feet



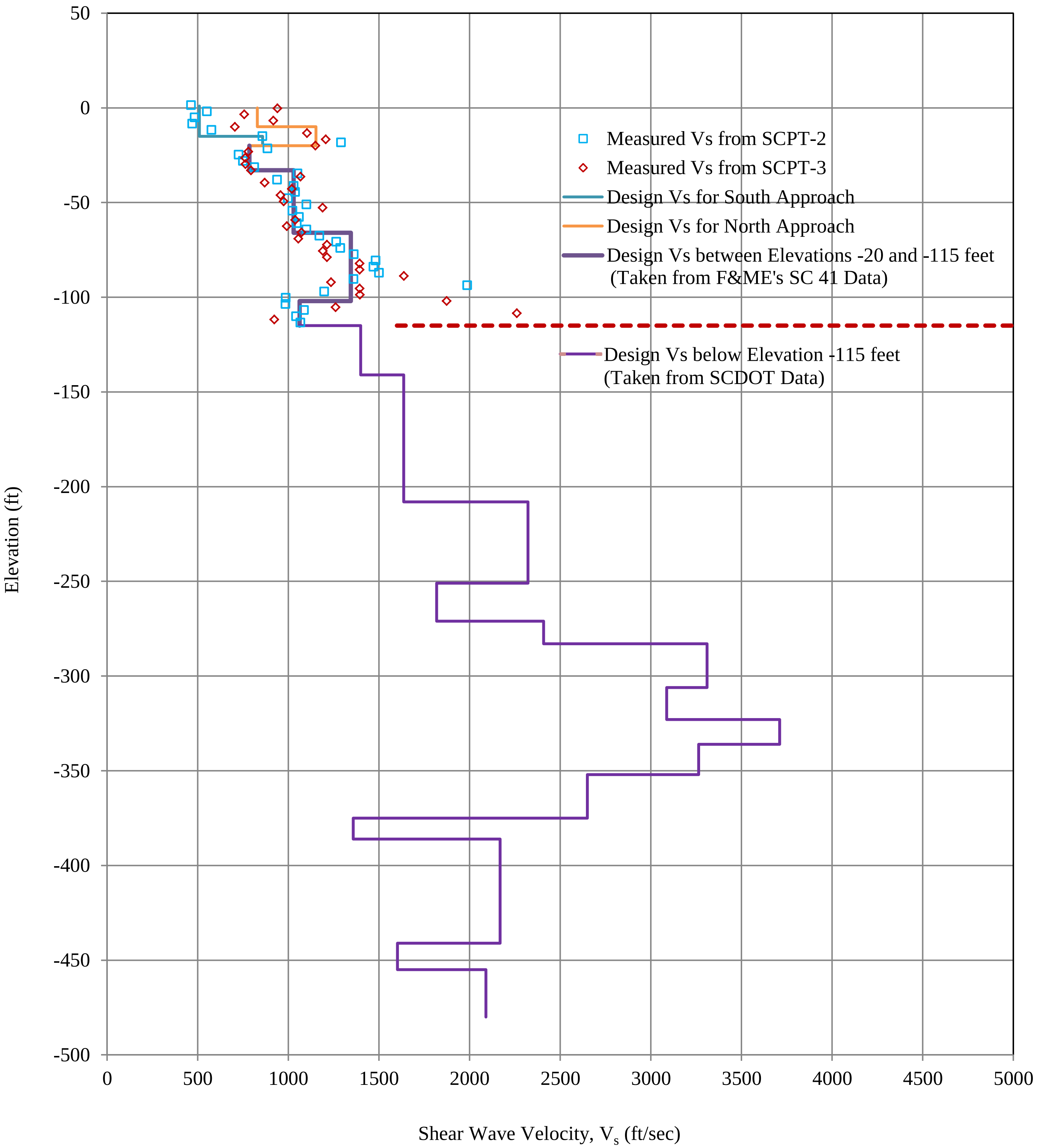
Site-Specific Design Shear Wave Velocity Profile
Using Ravenel Bridge MP-2 and MP-3 (Suspension) Design Shear Wave Velocity Data below -115 feet



Site-Specific Design Shear Wave Velocity Profile
Using Ravenel Bridge DS-1 (Downhole) Design Shear Wave Velocity Data below -115 feet



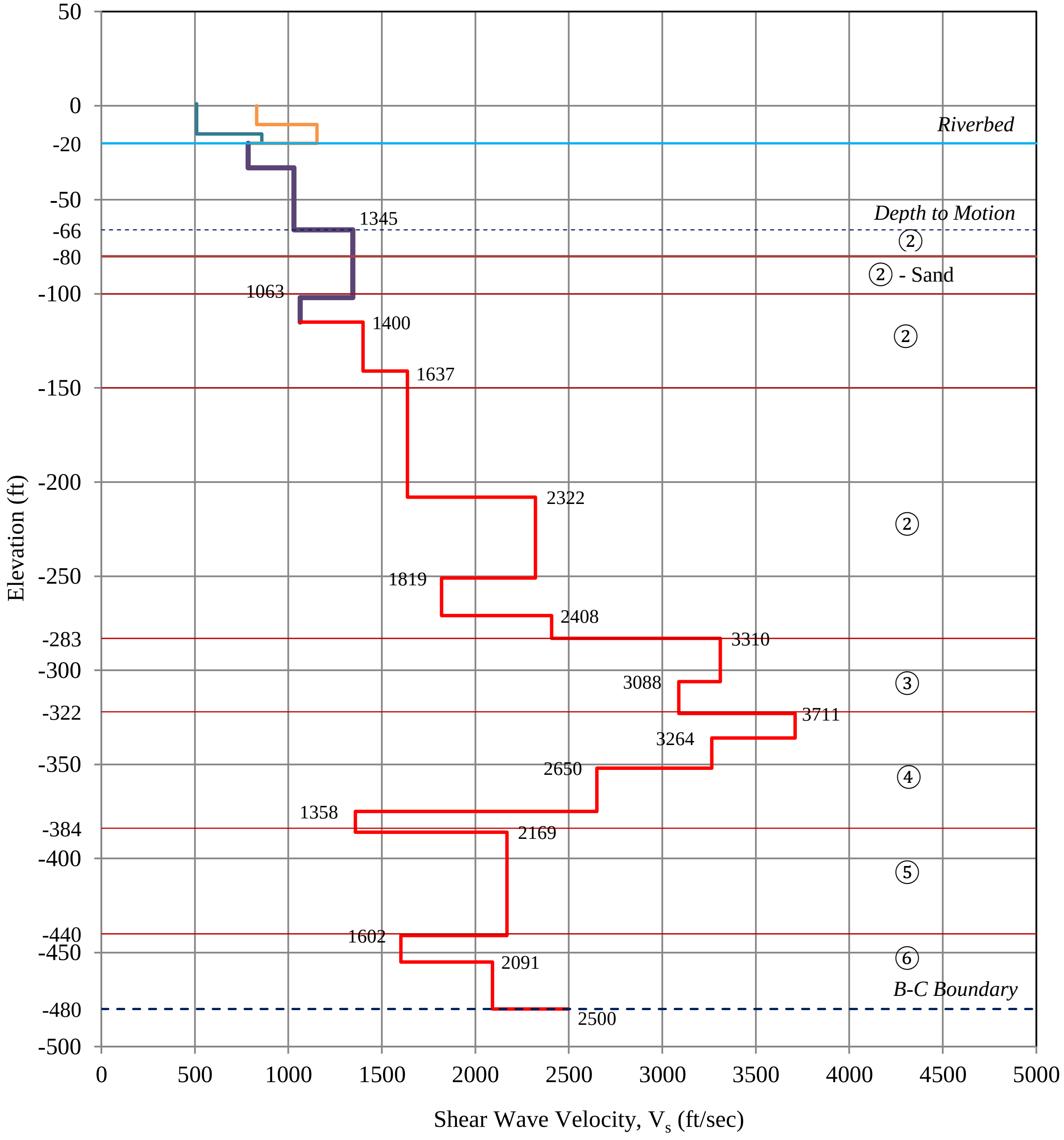
Site-Specific Design Shear Wave Velocity Profile
Using Port Maybank Bridge PS-1 (Downhole) Design Shear Wave Velocity Data below -115 feet



SECTION 3

SITE CHARACTERIZATION

Site-Specific Design Shear Wave Velocity Profile
Using Port Access Road Bridge (B-11 Suspension) Design Shear Wave Velocity Data below -115 feet



Notes:

① = Pleistocene Coastal Deposits (Wando Formation)
② = Ashley Formation (Cooper Group); ② - sand layer represent the cohesionless layer within this formation
③ = Santee Limestone Formation (Orangeburg Group)
④ = Chicaro Member of Williamsburg Formation (Orangeburg Group)
⑤ = Lower Bridge Member of Williamsburg Formation (Black Mingo Group)
⑥ = Rhems Formation (Black Mingo Group)

Site Characterization
with Port Access Road B-11 (Suspension) Shear Wave Velocity Data and PI of 30 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	E_t	E_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age	-	ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	30	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ǂ]	2[ǂ]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	30	-	130	1063	3	3
Tertiary	4	-115	-141	26	Cooper Marl	CH/MH	30	-	130	1400	3	3
Tertiary	5	-141	-150	9	Cooper Marl	CH/MH	30	-	130	1637	3	3
Tertiary	6	-150	-208	58	Cooper Marl	CH/MH	30	-	130	1637	4	4
Tertiary	7	-208	-251	43	Cooper Marl	CH/MH	30	-	130	2322	4	4
Tertiary	8	-251	-271	20	Cooper Marl	CH/MH	30	-	130	1819	4	4
Tertiary	9	-271	-283	12	Cooper Marl	CH/MH	30	-	130	2408	4	4
Tertiary	10	-283	-306	23	Santee	Limestone	0	-	150	3310	5	5
Tertiary	11	-306	-322	16	Santee	Limestone	0	-	150	3088	5	5
Tertiary	12	-322	-336	14	Black Mingo	Sand	0	-	130	3711	6	6
Tertiary	13	-336	-352	16	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	14	-352	-375	23	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	15	-375	-384	9	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	16	-384	-440	56	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	17	-440	-455	15	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	18	-455	-480	25	Black Mingo	Sand	0	-	130	2091	6	6
Tertiary	19	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) is considered at elevation of -66 feet
E_t, E_b = elevation of top and bottom of a layer
d = thickness of the layer, $d = E_t - E_b$
PI = plasticity index of cohesive soils
FC = percent passing No. 200 sieve
γ_{tw} = total unit weight of soil
V_s = shear wave velocity
G/G_{max} Curve = shear modulus reduction curves is based on Andrus et al. (2003), excpt Curve No. 2
D Curve = damping ratio curves is based on Andrus et al. (2003), except Curve No. 2
ǂ Vucetic and Dorby (1991) correlations are used for Curve No. 2

Site Characterization
with Port Access Road B-11 (Suspension) Shear Wave Velocity Data and PI of 60 for Cooper Marl

One-Dimensional Soil Column Model

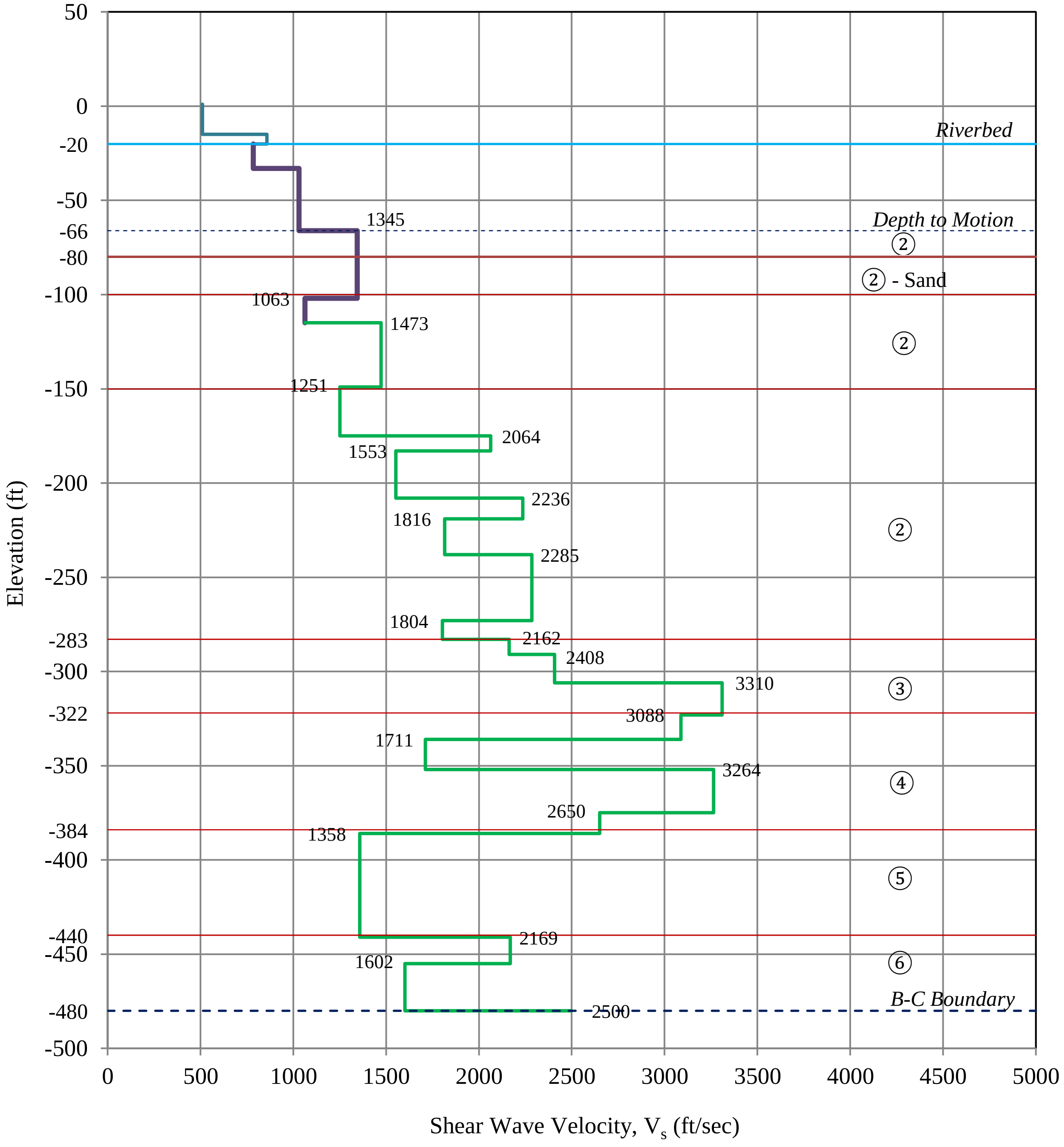
Geologic Time	Layer No.	E_t	E_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age	-	ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	60	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2ɫ	2ɫ
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	60	-	130	1063	3	3
Tertiary	4	-115	-141	26	Cooper Marl	CH/MH	60	-	130	1400	3	3
Tertiary	5	-141	-150	9	Cooper Marl	CH/MH	60	-	130	1637	3	3
Tertiary	6	-150	-208	58	Cooper Marl	CH/MH	60	-	130	1637	4	4
Tertiary	7	-208	-251	43	Cooper Marl	CH/MH	60	-	130	2322	4	4
Tertiary	8	-251	-271	20	Cooper Marl	CH/MH	60	-	130	1819	4	4
Tertiary	9	-271	-283	12	Cooper Marl	CH/MH	60	-	130	2408	4	4
Tertiary	10	-283	-306	23	Santee	Limestone	0	-	150	3310	5	5
Tertiary	11	-306	-322	16	Santee	Limestone	0	-	150	3088	5	5
Tertiary	12	-322	-336	14	Black Mingo	Sand	0	-	130	3711	6	6
Tertiary	13	-336	-352	16	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	14	-352	-375	23	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	15	-375	-384	9	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	16	-384	-440	56	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	17	-440	-455	15	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	18	-455	-480	25	Black Mingo	Sand	0	-	130	2091	6	6
Tertiary	19	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) is considered at elevation of -66 feet
E_t, E_b = elevation of top and bottom of a layer
d = thickness of the layer, $d = E_t - E_b$
PI = plasticity index of cohesive soils
FC = percent passing No. 200 sieve
γ_{tw} = total unit weight of soil
V_s = shear wave velocity
G/G_{max} Curve = shear modulus reduction curves is based on Andrus et al. (2003), excpt Curve No. 2
D Curve = damping ratio curves is based on Andrus et al. (2003), except Curve No. 2
ɫ Vucetic and Dorby (1991) correlations are used for Curve No. 2

Site-Specific Design Shear Wave Velocity Profile
Using Ravenel Bridge (MP-2 and MP-3 Suspension) Design Shear Wave Velocity Data below -115 feet



Notes:

① = Pleistocene Coastal Deposits (Wando Formation)
② = Ashley Formation (Cooper Group); ② - sand layer represent the cohesionless layer within this formation
③ = Santee Limestone Formation (Orangeburg Group)
④ = Chicaro Member of Williamsburg Formation (Orangeburg Group)
⑤ = Lower Bridge Member of Williamsburg Formation (Black Mingo Group)
⑥ = Rhems Formation (Black Mingo Group)

Site Characterization
with Ravenel Bridge MP-2 and MP-5 (Suspension) Shear Wave Velocity Data and PI of 30 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	E_t	E_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age	-	ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	30	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ǂ]	2[ǂ]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	30	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	30	-	130	1473	3	3
Tertiary	5	-150	-175	25	Cooper Marl	CH/MH	30	-	130	1251	4	4
Tertiary	6	-175	-183	8	Cooper Marl	CH/MH	30	-	130	2064	4	4
Tertiary	7	-183	-208	25	Cooper Marl	CH/MH	30	-	130	1553	4	4
Tertiary	8	-208	-219	11	Cooper Marl	CH/MH	30	-	130	2236	4	4
Tertiary	9	-219	-238	19	Cooper Marl	CH/MH	30	-	130	1816	4	4
Tertiary	10	-238	-273	35	Cooper Marl	CH/MH	30	-	130	2285	4	4
Tertiary	11	-273	-283	10	Cooper Marl	CH-MH	30	-	130	1804	4	4
Tertiary	12	-283	-291	8	Santee	Limestone	0	-	150	2162	5	5
Tertiary	13	-291	-306	15	Santee	Limestone	0	-	150	2408	5	5
Tertiary	14	-306	-322	16	Santee	Limestone	0	-	150	3310	5	5
Tertiary	15	-322	-336	14	Black Mingo	Sand	0	-	130	3088	6	6
Tertiary	16	-336	-352	16	Black Mingo	Sand	0	-	130	1711	6	6
Tertiary	17	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	18	-375	-386	11	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	19	-386	-441	55	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	20	-441	-455	14	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	21	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	22	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) is considered at elevation of -66 feet
E_t, E_b = depth of top and bottom of the layer
d = thickness of the layer, $d = E_t - E_b$
PI = plasticity index of cohesive soils
FC = percent passing No. 200 sieve
γ_{tw} = total unit weight of soil
V_s = shear wave velocity
G/G_{max} Curve = shear modulus reduction curves is based on Andrus et al. (2003), excpt Curve No. 2
D Curve = damping ratio curves is based on Andrus et al. (2003), except Curve No. 2

[ǂ] Vucetic and Dorby (1991) correlations are used for Curve No. 2

Site Characterization
with Ravenel Bridge MP-2 and MP-5 (Suspension) Shear Wave Velocity Data and PI of 60 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	E_t	E_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age	-	ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	60	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ǂ]	2[ǂ]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	60	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	60	-	130	1473	3	3
Tertiary	5	-150	-175	25	Cooper Marl	CH/MH	60	-	130	1251	4	4
Tertiary	6	-175	-183	8	Cooper Marl	CH/MH	60	-	130	2064	4	4
Tertiary	7	-183	-208	25	Cooper Marl	CH/MH	60	-	130	1553	4	4
Tertiary	8	-208	-219	11	Cooper Marl	CH/MH	60	-	130	2236	4	4
Tertiary	9	-219	-238	19	Cooper Marl	CH/MH	60	-	130	1816	4	4
Tertiary	10	-238	-273	35	Cooper Marl	CH/MH	60	-	130	2285	4	4
Tertiary	11	-273	-283	10	Cooper Marl	CH-MH	60	-	130	1804	4	4
Tertiary	12	-283	-291	8	Santee	Limestone	0	-	150	2162	5	5
Tertiary	13	-291	-306	15	Santee	Limestone	0	-	150	2408	5	5
Tertiary	14	-306	-322	16	Santee	Limestone	0	-	150	3310	5	5
Tertiary	15	-322	-336	14	Black Mingo	Sand	0	-	130	3088	6	6
Tertiary	16	-336	-352	16	Black Mingo	Sand	0	-	130	1711	6	6
Tertiary	17	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	18	-375	-386	11	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	19	-386	-441	55	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	20	-441	-455	14	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	21	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	22	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

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FC = percent passing No. 200 sieve
γ_{tw} = total unit weight of soil
V_s = shear wave velocity
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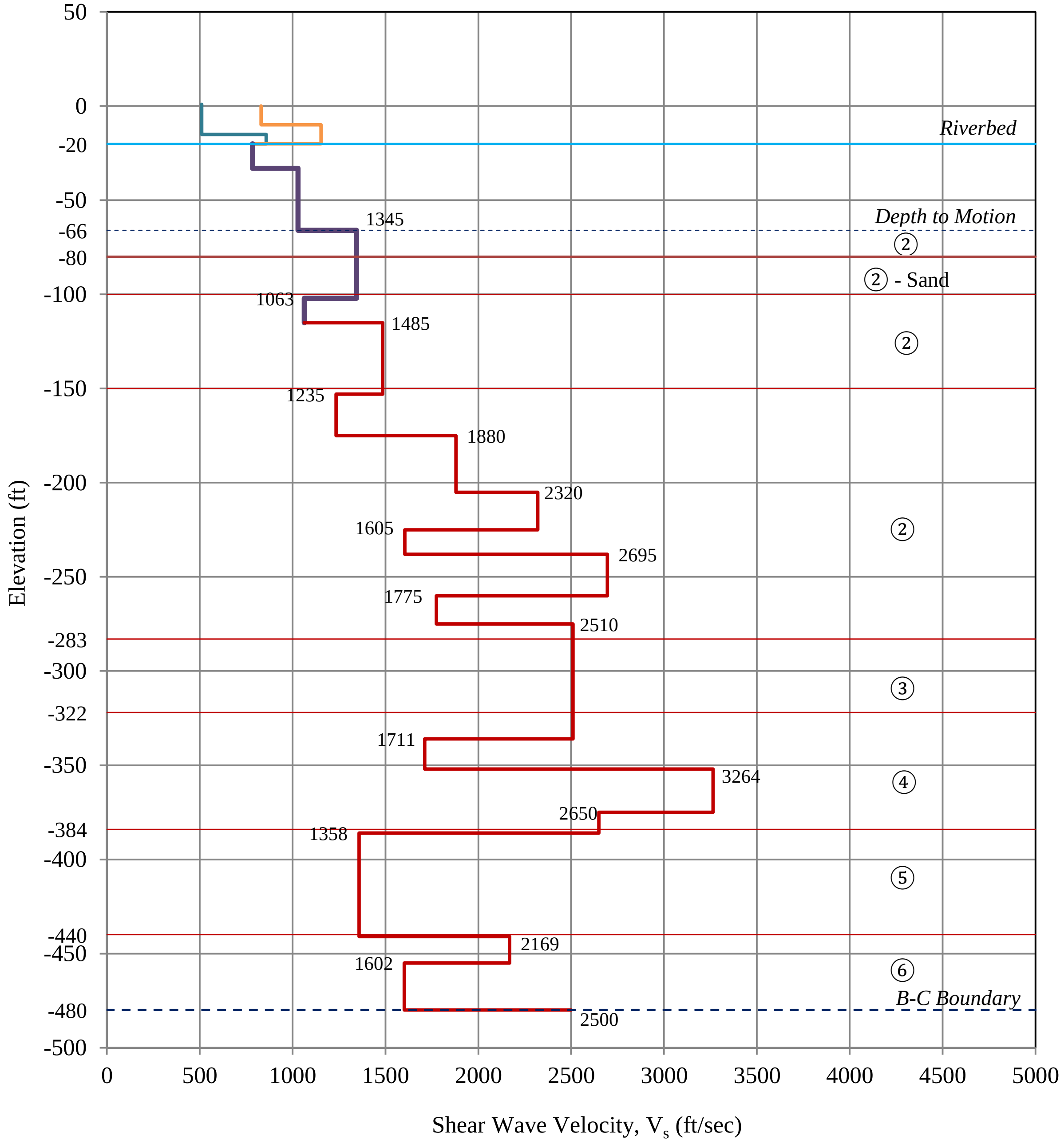
ł Vucetic and Dorby (1991) correlations are used for Curve No. 2

Site-Specific Design Shear Wave Velocity Profile
Using Ravenel Bridge DS-1 (Downhole) Design Shear Wave Velocity Data below -115 feet



Notes:

① = Pleistocene Coastal Deposits (Wando Formation)

② = Ashley Formation (Cooper Group); ② - sand layer represent the cohesionless layer within this formation

③ = Santee Limestone Formation (Orangeburg Group)

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⑤ = Lower Bridge Member of Williamsburg Formation (Black Mingo Group)

⑥ = Rhems Formation (Black Mingo Group)

Site Characterization
with Ravenel Bridge DS-1 (Downhole) Shear Wave Velocity Data and PI of 30 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	E_t	E_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age	-	ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	30	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2ł	2ł
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	30	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	30	-	130	1485	3	3
Tertiary	5	-150	-175	25	Cooper Marl	CH/MH	30	-	130	1235	4	4
Tertiary	6	-175	-205	30	Cooper Marl	CH/MH	30	-	130	1880	4	4
Tertiary	7	-205	-225	20	Cooper Marl	CH/MH	30	-	130	2320	4	4
Tertiary	8	-225	-238	13	Cooper Marl	CH/MH	30	-	130	1605	4	4
Tertiary	9	-238	-260	22	Cooper Marl	CH/MH	30	-	130	2695	4	4
Tertiary	10	-260	-275	15	Cooper Marl	CH/MH	30	-	130	1775	4	4
Tertiary	11	-275	-283	8	Cooper Marl	CH/MH	30	-	130	2510	4	4
Tertiary	12	-283	-322	39	Santee	Limestone	0	-	150	2510	5	5
Tertiary	13	-322	-336	14	Santee	Limestone	0	-	150	2510	5	5
Tertiary	14	-336	-352	16	Santee	Limestone	0	-	150	1711	5	5
Tertiary	15	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	16	-375	-384	9	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	17	-384	-440	56	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	18	-440	-455	15	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	19	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	20	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4) is considered at elevation of -66 feet

E_t, E_b = elevation of top and bottom of the layer

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FC = percent passing No. 200 sieve

γ_{tw} = total unit weight of soil

V_s = shear wave velocity

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Site Characterization
with Ravenel Bridge DS-1 (Downhole) Shear Wave Velocity Data and PI of 60 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	z_t	z_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age		ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	60	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ł]	2[ł]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	60	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	60	-	130	1485	3	3
Tertiary	5	-150	-175	25	Cooper Marl	CH/MH	60	-	130	1235	4	4
Tertiary	6	-175	-205	30	Cooper Marl	CH/MH	60	-	130	1880	4	4
Tertiary	7	-205	-225	20	Cooper Marl	CH/MH	60	-	130	2320	4	4
Tertiary	8	-225	-238	13	Cooper Marl	CH/MH	60	-	130	1605	4	4
Tertiary	9	-238	-260	22	Cooper Marl	CH/MH	60	-	130	2695	4	4
Tertiary	10	-260	-275	15	Cooper Marl	CH/MH	60	-	130	1775	4	4
Tertiary	11	-275	-283	8	Cooper Marl	CH/MH	60	-	130	2510	4	4
Tertiary	12	-283	-322	39	Santee	Limestone	0	-	150	2510	5	5
Tertiary	13	-322	-336	14	Santee	Limestone	0	-	150	2510	5	5
Tertiary	14	-336	-352	16	Santee	Limestone	0	-	150	1711	5	5
Tertiary	15	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	16	-375	-384	9	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	17	-384	-440	56	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	18	-440	-455	15	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	19	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	20	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

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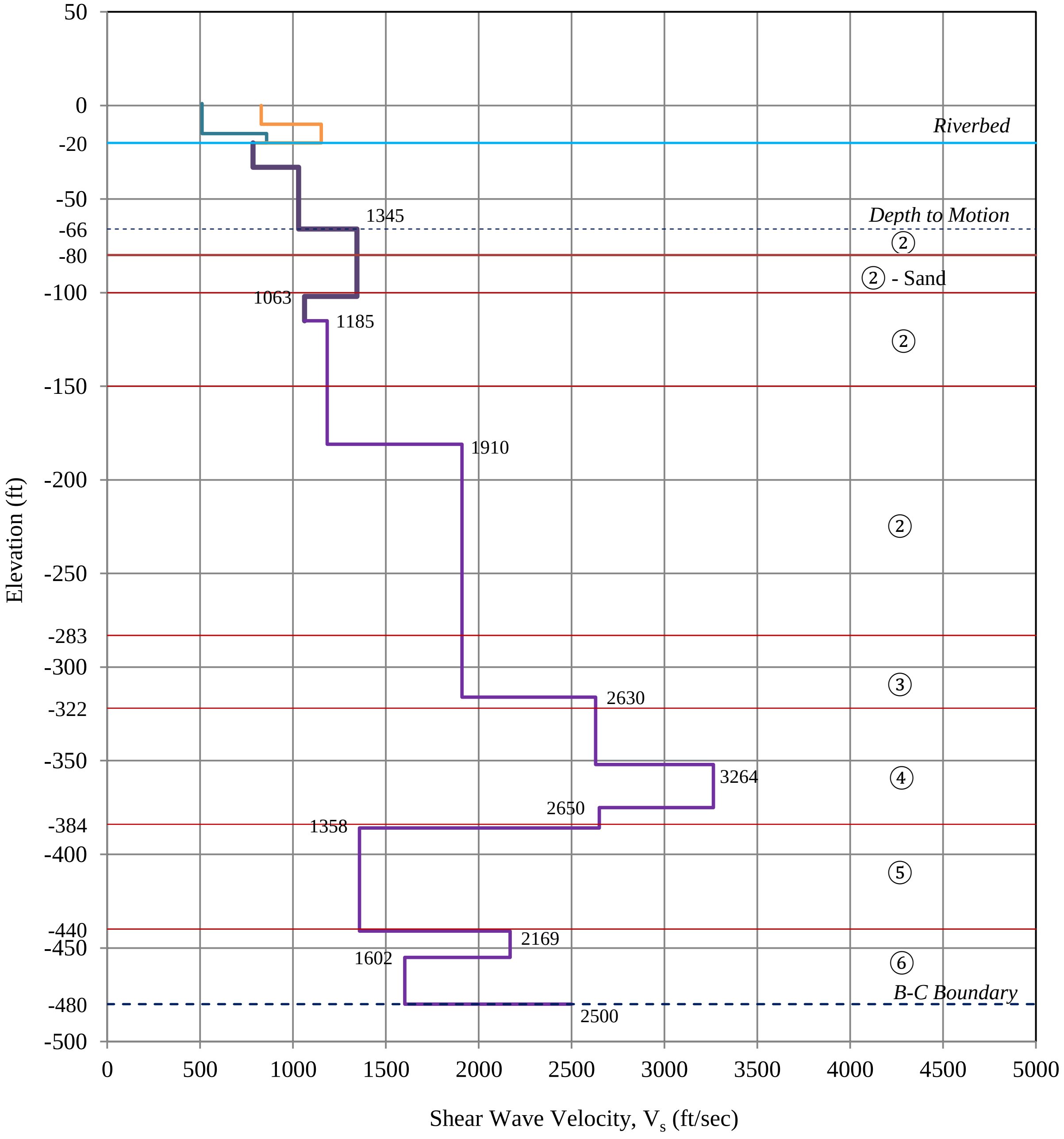
Site-Specific Design Shear Wave Velocity Profile
Using Maybank Bridge PS-1 (Downhole) Design Shear Wave Velocity Data below -115 feet



Notes:
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Site Characterization
with Maybank Bridge PS-1 (Downhole) Shear Wave Velocity Data and PI of 30 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	z_t	z_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age		ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	30	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ǂ]	2[ǂ]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	30	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	30	-	130	1185	3	3
Tertiary	5	-150	-181	31	Cooper Marl	CH/MH	30	-	130	1185	4	4
Tertiary	6	-181	-283	102	Cooper Marl	CH/MH	30	-	130	1910	4	4
Tertiary	7	-283	-316	33	Santee	Limestone	30	-	150	1910	5	5
Tertiary	8	-316	-322	6	Santee	Limestone	30	-	150	2630	5	5
Tertiary	9	-322	-352	30	Black Mingo	Sand	0	-	130	2630	6	6
Tertiary	10	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	11	-375	-386	11	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	12	-386	-440	54	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	13	-440	-455	15	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	14	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	15	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

Layers are numbered below Z_{DTM} and are based on σ'_m, geological time, formation, soil property and Shear Wave Velocity

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Site Characterization
with Maybank Bridge PS-1 (Downhole) Shear Wave Velocity Data and PI of 60 for Cooper Marl

One-Dimensional Soil Column Model

Geologic Time	Layer No.	z_t	z_b	d	Geologic Unit	Soil Description	PI	FC	γ_{tw}	V_s	G/G_{max} Curve	D Curve
age		ft	ft	ft	-	USCS	dim	%	pcf	fps	No.	No.
Tertiary	1	-66	-80	14	Cooper Marl	CH/MH	60	-	125	1345	1	1
Tertiary	2	-80	-100	20	Cooper Marl	SM	0	23	125	1345	2[ǂ]	2[ǂ]
Tertiary	3	-100	-115	15	Cooper Marl	CH/MH	60	-	130	1063	3	3
Tertiary	4	-115	-150	35	Cooper Marl	CH/MH	60	-	130	1185	3	3
Tertiary	5	-150	-181	31	Cooper Marl	CH/MH	60	-	130	1185	4	4
Tertiary	6	-181	-283	102	Cooper Marl	CH/MH	60	-	130	1910	4	4
Tertiary	7	-283	-316	33	Santee	Limestone	60	-	150	1910	5	5
Tertiary	8	-316	-322	6	Santee	Limestone	60	-	150	2630	5	5
Tertiary	9	-322	-352	30	Black Mingo	Sand	0	-	130	2630	6	6
Tertiary	10	-352	-375	23	Black Mingo	Sand	0	-	130	3264	6	6
Tertiary	11	-375	-386	11	Black Mingo	Sand	0	-	130	2650	6	6
Tertiary	12	-386	-440	54	Black Mingo	Sand	0	-	130	1358	6	6
Tertiary	13	-440	-455	15	Black Mingo	Sand	0	-	130	2169	6	6
Tertiary	14	-455	-480	25	Black Mingo	Sand	0	-	130	1602	6	6
Tertiary	15	-480	infinite	-	Black Mingo	Sand	0	-	130	2500	7	7

Notes:

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[ǂ] Vucetic and Dorby (1991) correlations are used for Curve No. 2

Estimation for Depth-to-Motion (Z_{DTM}) for Drilling Shafts at Interior Bent Locations

(a) Depth-to-motion (GDM, §12.4.2 and 12.8.4) is considered at the Point of Fixity (POF).

(b) Point of fixity for the shafts will be governed by the Extreme Event I limit state loading condition (AASHTO, Table 3.4.1-1).

(c) Based on the limitation of center-to-center distance between the shafts (AASHTO, §10.8.1.2) and the structural stability under Extreme Event I loading condition, the number of drilled shafts per interior bent will be either 3 or 4.

(d) The most probable sizes for shaft are assumed to be between 5.5 to 8 ft.

(e) The 100-year scour profile is assumed to be varied between elevation -24 to -30 ft, msl.

(f) Based on Cooper River Bridge Replacement Project Load Test Program Summary Report, the unit side resistance for Cooper Marl generally varies from 3.5 to 4.1 ksf, with an average of 3.8 ksf.

(g) The maximum factored resistance per foot length of shaft are calculated below.
For 5.5 ft diameter shaft: $0.55 \times \pi \times 5.5 \times 4.1 = 39.0$ kip
For 8.0 ft diameter shaft: $0.55 \times \pi \times 8.0 \times 4.1 = 56.7$ kip

(h) The maximum vertical loads per shaft under Strength I loading condition are assumed to be varied from 2200 kip (for the case of 4 shafts per bent) to 3000 kip per shaft (for the case of 3 shafts per bent).

(i) To satisfy the vertical capacity of the foundation, the minimum length of the shaft is found to be:
For 5.5 ft diameter shaft: 2200/39.0 = 56.4 ft
For 8.0 ft diameter shaft: 3000/56.7 = 53.0 ft

(j) The maximum elevation of the bottom of shaft could be -24 -53 = -77 ft, msl.

(k) The load per shaft under Extreme Event I loading condition are assumed to be as follows.
For 5.5 ft diameter shaft:
Lateral load: 180 kip
Vertical load: 1550 kip
Moment arm: 10 ft
For 8.0 ft diameter shaft:
Lateral load: 270 kip
Vertical load: 2100 kip
Moment arm: 10 ft

(l) For no scour condition and with average riverbed at elevation of -20 ft, msl the results of *p-y* analysis are found to be as follows.
For 5.5 ft diameter shaft:
First point of zero deflection: 50 ft
Second point of zero deflection: 80 ft
For 8.0 ft diameter shaft:
First point of zero deflection: 50 ft
Second point of zero deflection: 100 ft
below the top of shaft (The top of shaft elevation is at elevation +4.0 ft, msl)

(m) Based on the *p-y* results, the depth of fixity is assumed to be 70 ft below the top of shaft.

(n) Therefore, the elevation of point of fixity or the depth to motion is +4 - 70 = -66 ft.

SECTION 4

SITE CLASS DETERMINATION

Site Class for Interior Bents

Calculation for Site Stiffness and Determination of Site Class

i	E_t	E_b	d_i	V_{si}	d_i/V_{si}	V_s	σ_n	COV	V'_s	d_c	Site Class
-	ft	ft	ft	ft/sec	sec	ft/sec	ft/sec	dim	ft/sec	ft	-
1	-66	-102	36	1345	0.0268						
2	-102	-115	13	1063	0.0122						
3	-115	-166	51	1185	0.0430						
		d_T =	100	Σ =	0.0820	1219	115	0.09	1219	0	C

Notes:

i = layer number
E_t, E_b = top and bottom elevation of the layer of average shear wave velocity
d_i = thickness of layer i, $d_i = E_t - E_b$
V_{si} = design shear wave velocity of layer i
d_T = total depth, $d_T = \Sigma d_i$ (GDM, Eq 12-14)
V_s = site stiffness, $V_s = d_T/\Sigma V_{si}$ (GDM, Eq 12-14)
σ_n = standard deviation
COV = coefficient of variability, COV = σ_{n-1}/V_s
V'_s = adjusted site stiffness, $V'_s = V_s$ for COV ≤ 0.10 (GDM, Eq 12-31)
d_c = thickness of soft clay layer with PI > 20, w ≥ 40 and s_u < 500 psf (GDM, Table 12-22)
C = Site Class C represents the soil and soft rocks of site stiffness of 1200 ≤ V_s ≥ 2500 ft/sec (GDM, Table 12-22)
V_{si} values above elevation -115 ft are site-specific design shear wave velocities
V_{si} values between elevations -115 and -166 ft are taken as the lowest design shear wave velocities

Site Class for End Bent 1

Calculation for Site Stiffness and Determination of Site Class

i	E_t	E_b	d_i	V_{si}	d_i/V_{si}	V_s	σ_n	COV	V'_s	d_c	Site Class
-	ft	ft	ft	ft/sec	sec	ft/sec	ft/sec	dim	ft/sec	ft	-
1	1	-15	16	510	0.0314						
2	-15	-20	5	858	0.0058						
3	-20	-33	13	785	0.0166						
4	-33	-66	33	1030	0.0320						
5	-66	-99	33	1345	0.0245						
		d_T =	100	Σ =	0.1103	906	276	0.30	630	0	D

Notes:

i = layer number

E_t, E_b = top and bottom elevation of the layer of average shear wave velocity

d_i = thickness of layer i, $d_i = E_t - E_b$

V_{si} = design shear wave velocity of layer i

d_T = total depth, $d_T = \Sigma d_i$ (GDM, Eq 12-14)

V_s = site stiffness, $V_s = d_T/\Sigma V_{si}$ (GDM, Eq 12-14)

σ_{n-1} = standard deviation of the sample

COV = coefficient of variability, COV = σ_{n-1}/V_s

V'_s = adjusted site stiffness, $V'_s = V_s$ (1 - COV) for $0.20 < COV \leq 0.30$ (GDM, Eq 12-31)

d_c = thickness of soft clay layer with PI > 20, w ≥ 40 and $s_u < 500$ psf (GDM, Table 12-22)

D = Site Class D represent the soil of $600 \leq V_s \geq 1200$ ft/sec (GDM, Table 12-22)

V_{si} values above elevation are site-specific design shear wave velocities

Site Class for End Bent 2

Calculation for Site Stiffness and Determination of Site Class

i	E_t	E_b	d_i	V_{si}	d_i/V_{si}	V_s	σ_n	COV	V'_s	d_c	Site Class
-	ft	ft	ft	ft/sec	sec	ft/sec	ft/sec	dim	ft/sec	ft	-
1	1	-15	16	510	0.0314						
2	-15	-20	5	858	0.0058						
3	-20	-33	13	785	0.0166						
4	-33	-66	33	1030	0.0320						
5	-66	-99	33	1345	0.0245						
		d_T =	100	Σ =	0.1103	906	276	0.30	630	0	D

Notes:

i = layer number
E_t, E_b = top and bottom elevation of the layer of average shear wave velocity
d_i = thickness of layer i, $d_i = E_t - E_b$
V_{si} = design shear wave velocity of layer i
d_T = total depth, $d_T = \Sigma d_i$ (GDM, Eq 12-14)
V_s = site stiffness, $V_s = d_T/\Sigma V_{si}$ (GDM, Eq 12-14)
σ_{n-1} = standard deviation of the sample
COV = coefficient of variability, COV = σ_{n-1}/V_s
V'_s = adjusted site stiffness, $V'_s = V_s$ (1 - COV) for 0.20 < COV ≤ 0.30 (GDM, Eq 12-31)
d_c = thickness of soft clay layer with PI > 20, w ≥ 40 and s_u < 500 psf (GDM, Table 12-22)
D = Site Class D represent the soil of 600 ≤ V_s ≥ 1200 ft/sec (GDM, Table 12-22)

V_{si} values above elevation are site-specific design shear wave velocities

Site Class for Approach Embankment of the South Side of the Bridge

Calculation for Site Stiffness and Determination of Site Class

i	E_t	E_b	d_i	V_{si}	d_i/V_{si}	V_s	σ_n	COV	V'_s	d_c	Site Class
-	ft	ft	ft	ft/sec	sec	ft/sec	ft/sec	dim	ft/sec	ft	-
1	1	-15	16	510	0.0314						
2	-15	-20	5	858	0.0058						
3	-20	-33	13	785	0.0166						
4	-33	-66	33	1030	0.0320						
5	-66	-99	33	1345	0.0245						
		d_T =	100	Σ =	0.1103	906	276	0.30	630	0	D

Notes:

i = layer number
E_t, E_b = top and bottom elevation of the layer of average shear wave velocity
d_i = thickness of layer i, $d_i = E_t - E_b$
V_{si} = design shear wave velocity of layer i
d_T = total depth, $d_T = \Sigma d_i$ (GDM, Eq 12-14)
V_s = site stiffness, $V_s = d_T/\Sigma V_{si}$ (GDM, Eq 12-14)
σ_{n-1} = standard deviation of the sample
COV = coefficient of variability, COV = σ_{n-1}/V_s
V'_s = adjusted site stiffness, $V'_s = V_s$ (1 - COV) for 0.20 < COV ≤ 0.30 (GDM, Eq 12-31)
d_c = thickness of soft clay layer with PI > 20, w ≥ 40 and s_u < 500 psf (GDM, Table 12-22)
D = Site Class D represent the soil of 600 ≤ V_s ≥ 1200 ft/sec (GDM, Table 12-22)

V_{si} values above elevation are site-specific design shear wave velocities

Site Class for Approach Embankment of the North Side of the Bridge

Calculation for Site Stiffness and Determination of Site Class

i	E_t	E_b	d_i	V_{si}	d_i/V_{si}	V_s	σ_n	COV	V'_s	d_c	Site Class
-	ft	ft	ft	ft/sec	sec	ft/sec	ft/sec	dim	ft/sec	ft	-
1	0	-10	10	830	0.0120						
2	-10	-20	10	1153	0.0087						
3	-20	-33	13	785	0.0166						
4	-33	-66	33	1030	0.0320						
5	-66	-100	34	1345	0.0253						
		$d_T =$	100	$\Sigma =$	0.0946	1057	207	0.20	846	0	D

Notes:

i = layer number

E_t, E_b = top and bottom elevation of the layer of average shear wave velocity

d_i = thickness of layer i, $d_i = E_t - E_b$

V_{si} = design shear wave velocity of layer i

d_T = total depth, $d_T = \Sigma d_i$ (GDM, Eq 12-14)

V_s = site stiffness, $V_s = d_T/\Sigma V_{si}$ (GDM, Eq 12-14)

σ_n = standard deviation

COV = coefficient of variability, COV = σ_{n-1}/V_s

V'_s = adjusted site stiffness, $V'_s = V_s$ (1 - 0.20) for 0.10 < COV ≤ 0.20 (GDM, Eq 12-31)

d_c = thickness of soft clay layer with PI > 20, w ≥ 40 and s_u < 500 psf (GDM, Table 12-22)

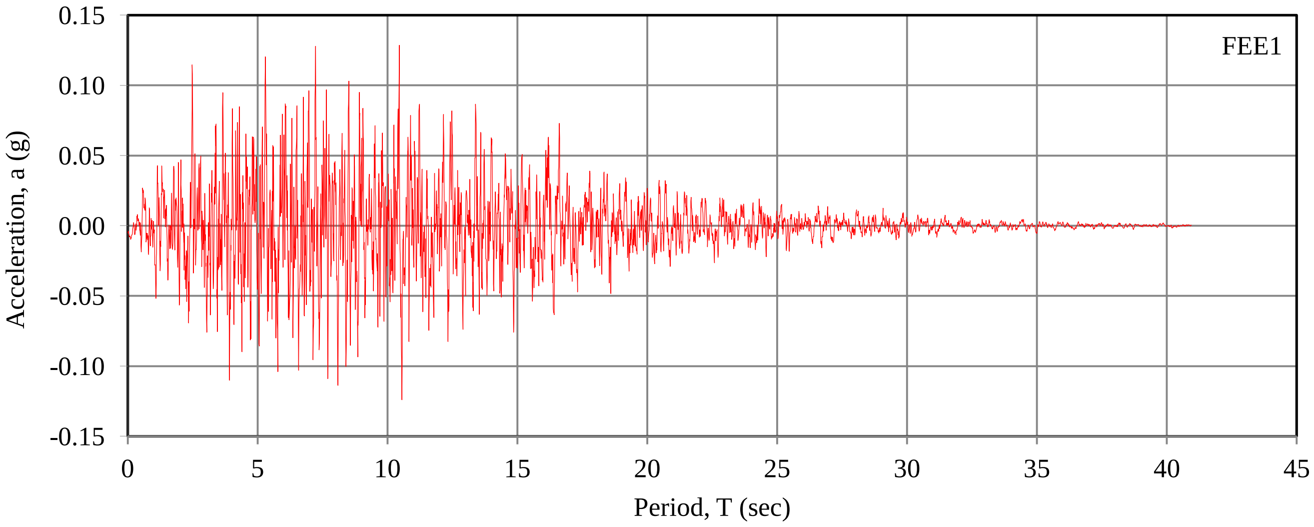
D = Site Class D represent the soil of 600 ≤ V_s ≥ 1200 ft/sec (GDM, Table 12-22)

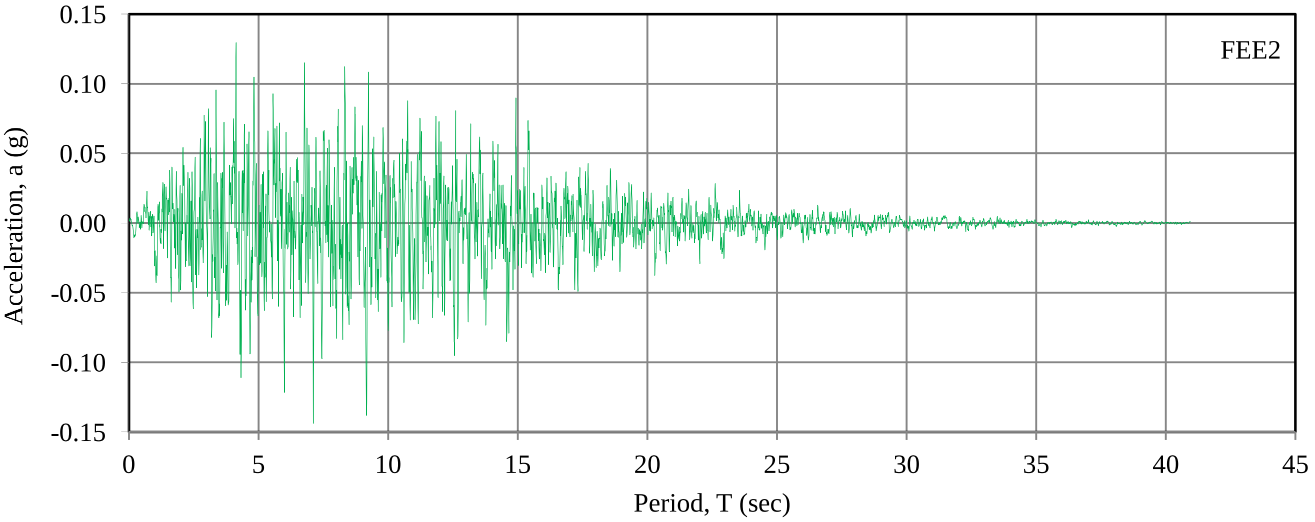
V_{si} values above elevation are site-specific design shear wave velocities

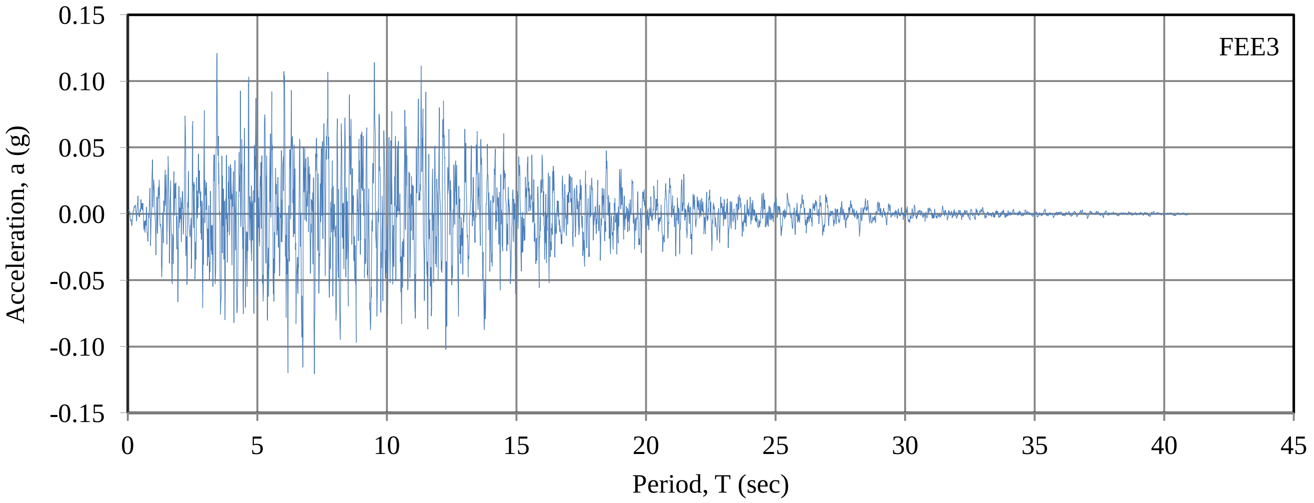
SECTION 5

DESIGN EVENT EARTHQUAKE INPUT MOTION

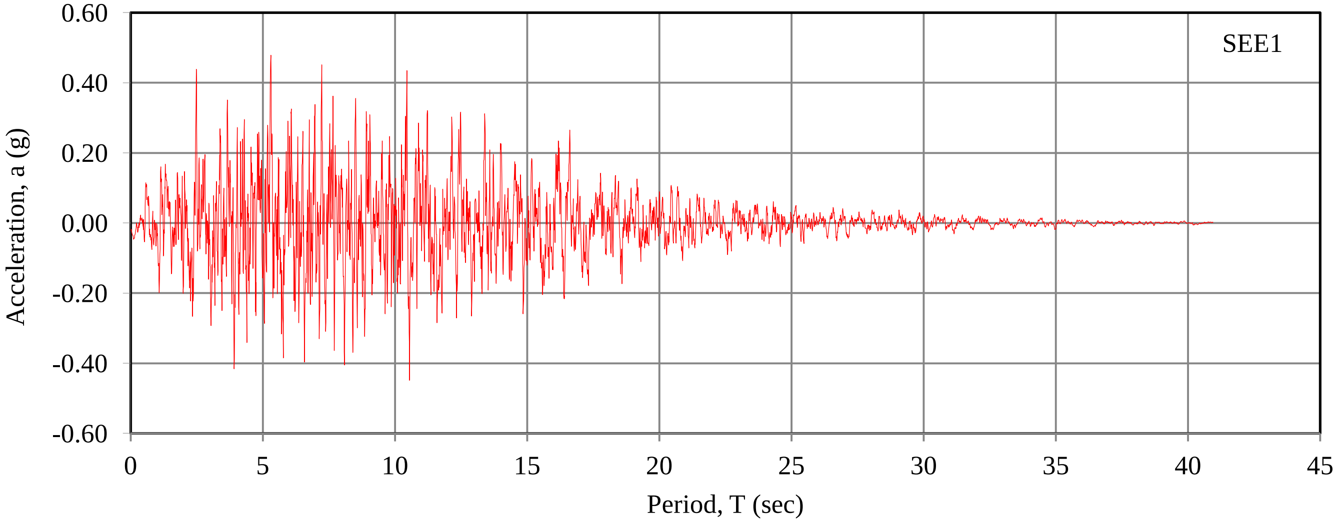
Earthquake Input Motions for Functional Earthquake Evaluation (FEE) Event

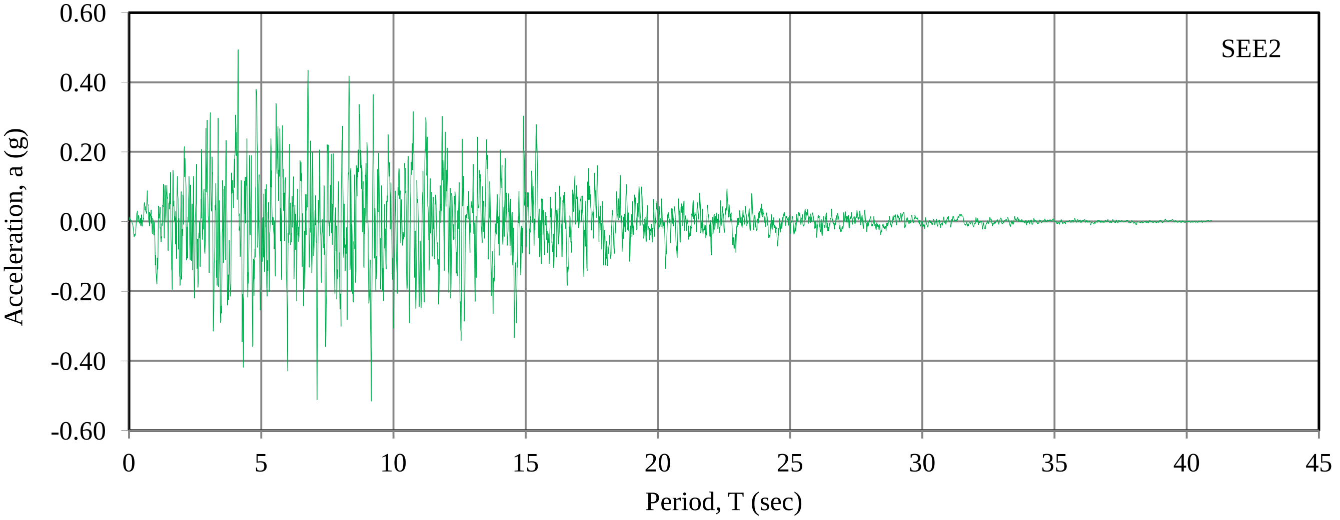


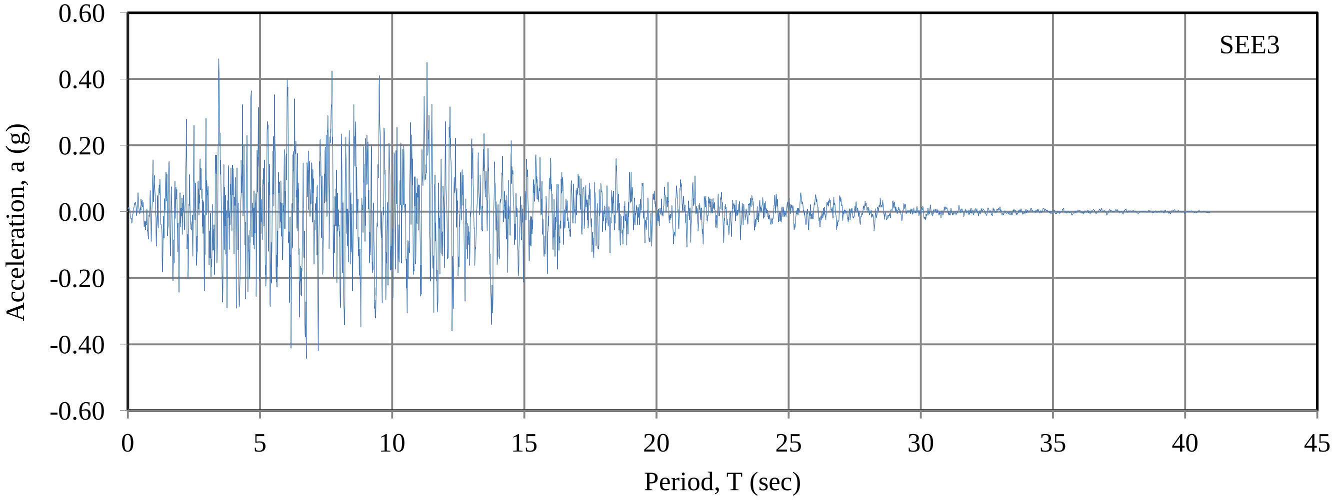




Earthquake Input Motions for Safety Earthquake Evaluation (SEE) Event







SECTION 6

ELECTRONIC INPUT AND OUTPUT FILES FOR RESPONSE ANALYSIS

CONTENTS

Following Folders contains the Proshake Files in the attached CD:
1_Data
2_Motion
3_Layer
4_Output
5_ARS
6_Strain
7_ProShake Files in PDF Format

SECTION 7

RESULTS OF SITE-SPECIFIC RESPONSE ANALYSIS

Results of Peak Shear Strain

Site ID	PI	z	E_m	Geological Group	Peak shear Strain, γ_{peak} (percent)					
	dim	ft	ft	ǂ	FEE1	FEE2	FEE3	SEE1	SEE2	SEE3
①	30	314	-380	Santee	0.019	0.023	0.028	0.140	0.153	0.201
	60	314	-380	Santee	0.020	0.024	0.028	0.129	0.173	0.213
②	30	348	-414	Black Mingo	0.019	0.020	0.021	0.150	0.127	0.173
	60	348	-414	Black Mingo	0.019	0.021	0.022	0.148	0.132	0.161
③	30	346	-412	Black Mingo	0.019	0.020	0.022	0.150	0.129	0.170
	60	346	-412	Black Mingo	0.018	0.021	0.022	0.144	0.138	0.165
④	30	347	-413	Black Mingo	0.021	0.018	0.021	0.141	0.118	0.173
	60	347	-413	Black Mingo	0.021	0.018	0.021	0.158	0.130	0.179

Notes:

Equivalent-linear one-dimensional site-specific response analysis are performed using Proshake, version 1.12 (2003)
From Z_{DTM} to elevation -115 ft, the soil profile is based on the site-specific subsurface information; below elevation -115 ft, the site is characterized with the shear wave velocity measurements from the following bridge location:

① = Port Access Road B-11 (Suspension)
② = Ravenel Bridge MP-2 and MP-5 (Suspension)
③ = Ravenel Bridge DS-1 (Downhole)
④ = Maybank Bridge PS-1 (Downhole)
PI = plasticity index of cohesive soils of Cooper Marl of Ashley Formation
z = depth to the peak shear strain below Z_{DTM}
Z_{DTM} = depth-to-motion is considered at elevation of -66 ft
E_m = elevation of the peak shear strain
ǂ = geological group of the layer where γ_{peak} occurs
γ_{peak} = peak shear strain; maximum peak sherar strain is found to be 0.21 percent
FEE1, 2, 3 = acceleration-time histories for FEE design event
SEE1, 2, 3 = acceleration-time histories for SEE design event

Results of Spectral Acceleration for Functional Evaluation Earthquake (FEE) Event

Time (sec)	Spectral Acceleration (% g)																								
	Using PI for Cooper Marl of 30												Using PI for Cooper Marl of 60												←PI
Site→	①			②			③			④			①			②			③			④			← Site
Motion→	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	FEE1	FEE2	FEE3	mean
0.001	0.147156	0.155652	0.129934	0.148427	0.144220	0.142559	0.153706	0.150199	0.146914	0.132486	0.133574	0.134812	0.142614	0.150613	0.130813	0.154054	0.146635	0.136831	0.156596	0.147251	0.139536	0.136391	0.139959	0.137432	0.143265
0.010	0.146881	0.155426	0.129688	0.148191	0.143955	0.142271	0.153376	0.149915	0.146602	0.132273	0.133241	0.134543	0.142344	0.150411	0.130601	0.153785	0.146380	0.136545	0.156314	0.146985	0.139251	0.136056	0.139652	0.137143	0.142993
0.020	0.146012	0.155745	0.129563	0.149267	0.143669	0.141606	0.155021	0.149819	0.146000	0.132578	0.133349	0.134197	0.142239	0.150643	0.130782	0.152300	0.145946	0.136538	0.155651	0.148175	0.139348	0.135709	0.139631	0.138727	0.143021
0.040	0.184952	0.178783	0.188430	0.190137	0.166480	0.146904	0.180296	0.172067	0.151689	0.176398	0.166824	0.167056	0.194718	0.184787	0.188773	0.173449	0.171614	0.145681	0.179384	0.162870	0.166441	0.172135	0.171583	0.163452	0.172704
0.060	0.306001	0.296214	0.246698	0.218092	0.255269	0.252017	0.255529	0.232260	0.279202	0.220915	0.243553	0.248957	0.293744	0.283513	0.239134	0.230422	0.254361	0.248456	0.254616	0.230305	0.269549	0.210794	0.230260	0.265660	0.252730
0.080	0.276105	0.281263	0.272253	0.273601	0.292517	0.248753	0.252389	0.240708	0.263217	0.273187	0.296694	0.277442	0.264927	0.285033	0.257103	0.269540	0.297616	0.264052	0.252991	0.233630	0.263603	0.270468	0.289632	0.279318	0.269835
0.100	0.292351	0.277526	0.296946	0.330195	0.284170	0.333267	0.319417	0.267079	0.292844	0.292014	0.299242	0.315287	0.294886	0.302180	0.294229	0.356870	0.292327	0.338540	0.358616	0.282854	0.332263	0.288763	0.298588	0.331793	0.307177
0.120	0.399065	0.345392	0.317689	0.380563	0.353014	0.355091	0.400628	0.377961	0.354700	0.285653	0.291066	0.307830	0.394498	0.346973	0.323954	0.393450	0.370561	0.365724	0.417413	0.390221	0.388611	0.329133	0.310197	0.310576	0.354582
0.140	0.348967	0.314629	0.345499	0.406928	0.331783	0.416283	0.383171	0.316776	0.393817	0.371855	0.369314	0.415616	0.349158	0.334591	0.355063	0.404011	0.337516	0.414853	0.376608	0.329580	0.382616	0.385380	0.359157	0.423096	0.369428
0.160	0.392095	0.419077	0.381365	0.366800	0.388822	0.320955	0.352336	0.374416	0.301763	0.278596	0.295612	0.269597	0.394354	0.441322	0.412540	0.384759	0.392808	0.338659	0.358856	0.380956	0.326138	0.280093	0.290973	0.270147	0.350543
0.180	0.505188	0.436643	0.431120	0.435951	0.410935	0.368482	0.432529	0.401538	0.366394	0.317987	0.331550	0.314156	0.509057	0.425600	0.448096	0.471236	0.411407	0.372761	0.471695	0.401382	0.368271	0.328471	0.343446	0.323175	0.401128
0.200	0.402741	0.405092	0.395506	0.428536	0.370814	0.403313	0.411563	0.364869	0.432067	0.426118	0.370696	0.416904	0.392013	0.392877	0.381264	0.400571	0.373886	0.381433	0.388032	0.365017	0.380216	0.446100	0.363259	0.436727	0.397067
0.220	0.344616	0.353767	0.322601	0.315019	0.350593	0.327250	0.316863	0.341588	0.350684	0.367912	0.366469	0.401032	0.339238	0.341391	0.320539	0.312542	0.336953	0.308959	0.314608	0.328374	0.305589	0.365276	0.371237	0.396269	0.341640
0.240	0.369322	0.354606	0.348003	0.271327	0.294970	0.261028	0.275683	0.300232	0.276021	0.306927	0.339434	0.303007	0.374553	0.356655	0.347456	0.268053	0.282637	0.267661	0.279349	0.285770	0.280555	0.279762	0.344470	0.277626	0.306046
0.260	0.354185	0.321840	0.353373	0.259784	0.244831	0.288995	0.269295	0.258871	0.307332	0.250304	0.255221	0.278985	0.358497	0.325467	0.352426	0.263213	0.246993	0.288614	0.278160	0.258749	0.298473	0.250041	0.256150	0.281471	0.287553
0.280	0.368747	0.390918	0.360330	0.262423	0.285828	0.283948	0.270617	0.312650	0.297171	0.247165	0.248813	0.268558	0.378328	0.399073	0.364683	0.266265	0.307155	0.290101	0.281951	0.329948	0.301278	0.259579	0.257709	0.280174	0.304726
0.300	0.426722	0.403474	0.378394	0.291957	0.331859	0.263107	0.319894	0.360846	0.268221	0.238714	0.270692	0.261396	0.439623	0.406230	0.391598	0.312606	0.352179	0.262447	0.349118	0.379498	0.272495	0.254926	0.288558	0.265813	0.324599
0.320	0.410105	0.422663	0.378599	0.356803	0.343832	0.344859	0.383852	0.374983	0.360293	0.283358	0.264484	0.325529	0.410315	0.428128	0.371463	0.374508	0.364619	0.352327	0.408186	0.393369	0.363429	0.315228	0.289157	0.333537	0.360568
0.340	0.413956	0.363809	0.389798	0.394907	0.318674	0.348395	0.418743	0.353599	0.357521	0.328236	0.285312	0.343410	0.417806	0.366381	0.384180	0.407186	0.342128	0.349137	0.429648	0.367033	0.356164	0.360028	0.292810	0.347221	0.364003
0.360	0.389082	0.363141	0.363815	0.399178	0.387094	0.339340	0.404624	0.395636	0.344651	0.366642	0.354101	0.346581	0.383807	0.353785	0.356911	0.396417	0.386680	0.334192	0.408374	0.386646	0.334371	0.387315	0.371120	0.346827	0.370847
0.380	0.364837	0.368452	0.355623	0.423256	0.397157	0.341503	0.417911	0.386791	0.348299	0.421337	0.408184	0.351572	0.347006	0.357444	0.349150	0.409431	0.381956	0.336292	0.398757	0.366348	0.334409	0.438181	0.416375	0.349141	0.377892
0.400	0.335876	0.352400	0.355136	0.366850	0.383192	0.347277	0.356016	0.370219	0.352504	0.388515	0.397826	0.378165	0.326107	0.339072	0.345056	0.349335	0.366754	0.339460	0.334189	0.350188	0.333533	0.391382	0.403081	0.371049	0.359716
0.420	0.274448	0.289291	0.318386	0.293267	0.319967	0.330717	0.279668	0.307363	0.335647	0.332731	0.342263	0.368231	0.265339	0.276578	0.309382	0.275314	0.304401	0.318840	0.265316	0.288423	0.312152	0.326885	0.342822	0.361545	0.309957
0.440	0.285659	0.256041	0.258587	0.269053	0.265403	0.246526	0.253804	0.252580	0.240305	0.328088	0.304962	0.311922	0.276237	0.245055	0.249471	0.252440	0.249579	0.232352	0.244259	0.237158	0.217305	0.308306	0.297362	0.291744	0.265592
0.460	0.269944	0.253398	0.248177	0.254246	0.252164	0.230716	0.246911	0.239106	0.226389	0.304134	0.297883	0.285991	0.259255	0.241397	0.241241	0.245947	0.237241	0.218666	0.238613	0.227048	0.206750	0.286223	0.287923	0.271265	0.252943
0.480	0.254508	0.259372	0.203206	0.244983	0.243648	0.197289	0.236846	0.235680	0.197417	0.293233	0.287030	0.248645	0.243977	0.251345	0.198318	0.236056	0.235961	0.189859	0.226025	0.226596	0.183611	0.276032	0.265899	0.233606	0.236214
0.500	0.231364	0.247152	0.223207	0.215120	0.230224	0.191291	0.209968	0.221457	0.188165	0.257820	0.267451	0.241749	0.226698	0.238706	0.218061	0.210053	0.221711	0.182801	0.207184	0.212843	0.174143	0.242951	0.252222	0.223713	0.222336
0.550	0.212741	0.209933	0.203614	0.197727	0.200880	0.186673	0.193282	0.191741	0.182849	0.215193	0.231787	0.215586	0.206326	0.203102	0.198408	0.192910	0.192145	0.181515	0.187414	0.183300	0.174546	0.211756	0.223988	0.205516	0.200122
0.600	0.195943	0.183583	0.171046	0.193580	0.166357	0.158506	0.189790	0.163114	0.155561	0.205483	0.191866	0.181706	0.191131	0.178918	0.167746	0.190851	0.163714	0.155393	0.186443	0.160203	0.150683	0.197960	0.183599	0.174247	0.177393
0.650	0.183313	0.175341	0.164361	0.185225	0.155318	0.153602	0.180435	0.152301	0.150521	0.194307	0.175427	0.170718	0.178403	0.173134	0.161342	0.181327	0.153145	0.150000	0.175271	0.151481	0.144548	0.192786	0.168846	0.165755	0.168204
0.700	0.169109	0.147322	0.168312	0.165719	0.153286	0.153717	0.159731	0.149951	0.152261	0.183959	0.165561	0.176025	0.164864	0.143992	0.165241	0.161332	0.151261	0.151411	0.154979	0.147567	0.148600	0.178870	0.160104	0.169261	0.160101
0.750	0.129026	0.160401	0.147168	0.129302	0.163087	0.145535	0.127082	0.158420	0.142900	0.136555	0.176060	0.158050	0.127001	0.157864	0.144437	0.127920	0.159896	0.143073	0.125323	0.155028	0.139227	0.133508	0.173045	0.153943	0.146410
0.800	0.126977	0.124957	0.121393	0.132811	0.131584	0.123758	0.127830	0.128751	0.121042	0.146203	0.142256	0.134205	0.124246	0.122965	0.118627	0.128801	0.130070	0.121935	0.126541	0.127302	0.118700	0.143026	0.138372	0.130488	0.128868
0.850	0.134837	0.136075	0.132768	0.146223	0.144855	0.140833	0.143305	0.140901	0.138511	0.153045	0.155671	0.151081	0.132717	0.133758	0.131101	0.144268	0.142585	0.138695	0.140850	0.138403	0.135352	0.151718	0.152777	0.147960	0.142012
0.900	0.119647	0.112228	0.125102	0.132133	0.123253	0.134972	0.127919	0.120797	0.132616	0.140431	0.131615	0.144112	0.118237	0.110826	0.123677	0.129581	0.121309	0.133254	0.125596	0.118715	0.130160	0.138064	0.128721	0.140735	0.127654
0.950	0.106935	0.118410	0.108384	0.119091	0.132510	0.120778	0.117175	0.130336	0.118765	0.127073	0.137654	0.128295	0.106113	0.116912	0.107200	0.118157	0.131535	0.119369	0.116650	0.129082	0.116887	0.124271	0.135767	0.125574	0.121372
1.000	0.109718	0.103283	0.103960	0.121197	0.115929	0.119344	0.119317	0.113028	0.117020	0.127670	0.122209	0.126279	0.108633	0.101514	0.103010	0.120357	0.114115	0.117608	0.118606	0.110909	0.114568	0.125174	0.120211	0.124229	0.115745
1.050	0.102912	0.092208	0.101063	0.114216	0.105854	0.116857	0.112203	0.104014	0.114955	0.119786	0.110640	0.123318	0.101615	0.091414	0.100152	0.113141	0.104884	0.115548	0.111085	0.103245	0.113302	0.117641	0.108966	0.121299	0.109180
1.100	0.082192	0.094494	0.096740	0.094698	0.110895	0.110652	0.093144	0.109226	0.108983	0.098771	0.114975	0.117042	0.081902	0.093812	0.095720	0.093978	0.110022	0.109366	0.092550	0.108332	0.107285	0.096592	0.113492	0.114875	0.102072
1.150	0.078335	0.088564	0.083240	0.089916	0.097530	0.094517	0.088305	0.095188	0.093382	0.093268	0.104683	0.097392	0.077988	0.087338	0.082863	0.088906	0.095891	0.093873	0.087354	0.093518	0.092580	0.092061	0.102517	0.096388	0.091483
1.200	0.088383	0.081999	0.080184	0.101551	0.090126	0.090370	0.100275	0.087725	0.089272	0.104495	0.097162	0.095117	0.087712	0.080807	0.079525	0.100910	0.088545	0.089435	0.099768	0.086233	0.087945	0.103431	0.094931	0.093753	0.091652
1.250	0.076247	0.076240	0.078261	0.089185	0.088247	0.090297	0.087746	0.086812	0.089089	0.092779	0.092054	0.094023	0.075286	0.075375	0.077565	0.088181	0.087202	0.089597	0.086751	0.085739	0.088334	0.091702	0.091064	0.092638	0.086267
1.300	0.063183	0.069985	0.072877	0.071267	0.081587	0.081349	0.069954	0.080193	0.080328	0.074816	0.085628	0.084534	0.062777	0.069246	0.072277	0.070386	0.080659	0.080639	0.069320	0.079240	0.079334	0.073857	0.084301	0.083520	0.075886
1.350	0.065461	0.064066	0.063319	0.074372	0.073249	0.072385	0.073293	0.072391	0.071494	0.078242	0.076333	0.074469	0.064953	0.063692	0.062770	0.073721	0.072707	0.071703	0.072887	0.071914	0.070501	0.076852	0.075224	0.073732	0.071239
1.400	0.061557	0.062071	0.058038	0.071441	0.068098	0.067079	0.070720	0.067511	0.066234	0.073974	0.071401	0.069713	0.061204	0.061765	0.057505	0.071085	0.067833	0.066296	0.070334	0.067394	0.065117	0.072874	0.070172	0.069035	0.067019
1.450	0.058390	0.057074	0.055435	0.065700	0.062496	0.063325	0.065041	0.062005	0.062662	0.067279	0.065144	0.066287	0.058258	0.056731	0.055377	0.065261	0.062293	0.062823	0.064717	0.061840	0.061992	0.066670	0.064045	0.065480	0.062347
1.500	0.057778	0.053290	0.053995	0.064920	0.060892	0.061114	0.064275	0.060762	0.060423	0.066700	0.061455	0.063724	0.057527	0.053115	0.053914	0.064461	0.060893	0.060770	0.063936	0.060661	0.060113	0.066064	0.061017	0.062818	0.060609
1.550	0.055145	0.053974	0.052121	0.062194	0.059391	0.058715	0.061590	0.059038	0.058171	0.064214	0.060135	0.060757	0.054811	0.053804	0.052017	0.061745	0.059123	0.058472	0.061258	0.058827	0.058035	0.063583	0.059937	0.059862	0.058622
1.600	0.052094	0.049528	0.049050	0.059430	0.054829	0.055327	0.058643	0.054349	0.054914	0.061713	0.056299	0.056710	0.051615	0.049268	0.048871	0.058843	0.054502	0.055110	0.057999	0.054064	0.054708	0.060914	0.055897	0.056074	0.055031
1.650	0.050284	0.044880	0.046448	0.056382	0.050235	0.050544	0.055622	0.049934	0.050186	0.058504	0.051346	0.051895	0.050261	0.044567	0.046150	0.055840	0.050045	0.050311	0.055174	0.049770	0.049896	0.057734	0.050884	0.051308	0.051175
1.700	0.047777	0.041903	0.044185	0.052959	0.046620	0.048106	0.052525	0.046066	0.047638	0.054036	0.047785	0.049449	0.047730	0.041695	0.043885	0.052701	0.046278	0.047718	0.052371	0.045731	0.047059	0.053623	0.047349	0.048935	0.048089
1.750	0.043339	0.043936	0.041332	0.048127	0.047814	0.045100	0.047747	0.047511	0.044682	0.049010	0.048555	0.046461	0.043244	0.043763	0.041080	0.047903	0.047625	0.044736	0.047634	0.047346	0.044157	0.048698	0.048268	0.046044	0.046005
1.800	0.041485	0.043716	0.040124	0.045499	0.047963	0.042375	0.045375	0.047663	0.042105	0.045680	0.048833	0.043383	0.041284	0.043512	0.039910	0.045434	0.047755	0.042144	0.045212	0.047456	0.041763	0.045556	0.048538	0.043005	0.044407
1.850	0.039905	0.041609	0.038860	0.044675	0.046069	0.041931	0.044298	0.045722	0.041662	0.045079	0.046992	0.042867	0.039699	0.041438	0.038645	0.044393	0.045838	0.041759	0.043937	0.045483	0.041464	0.045038	0.046669	0.042624	0.043194
1.900	0.034501	0.037621	0.036695	0.039079	0.041940	0.040022	0.038557	0.041565	0.039778	0.039808	0.042851	0.040982	0.034329	0.037463	0.036529	0.038689	0.041700	0.039837	0.038165	0.041322	0.039509	0.039676	0.042505	0.040711	0.039326
1.950	0.030564	0.032890	0.033586	0.033885	0.036861	0.036949	0.033757	0.036542	0.036713	0.034712	0.037654	0.037881	0.030501	0.032727	0.033451	0.033876	0.036649	0.036755	0.033791	0.036342	0.036412	0.034312	0.037335	0.037588	0.035072
2.000	0.028262	0.029585	0.031586	0.031265	0.033075	0.034285	0.031182	0.032830	0.034027	0.031649	0.033706	0.035481	0.028190	0.029472	0.031462	0.031265	0.032917	0.034036	0.031158	0.032692	0.033698	0.031422	0.033461	0.035150	0.032161
2.200	0.029762	0.028748	0.030061	0.032167	0.030850	0.032802	0.031955	0.030684	0.032660	0.032548	0.031376	0.033301	0.029597	0.028620	0.030030	0.032002	0.030737	0.032814	0.031735	0.030572	0.032756	0.032463	0.031185	0.032985	0.031350
2.400	0.023577	0.025049	0.025497	0.025340	0.027516	0.028280	0.025230	0.027345	0.028206	0.025447	0.027863	0.028381	0.023427	0.025040	0.025395	0.025233	0.027387	0.028222	0.025130	0.027202	0.028109	0.025449	0.027787	0.028358	0.026436
2.600	0.020012	0.019317	0.016772	0.021535	0.020421	0.019102	0.021485	0.020327	0.019050	0.021929	0.020534	0.019397	0.019975	0.019275	0.016668	0.021520	0.020355	0.019007	0.021477	0.020300	0.018871	0.021725	0.020456	0.019320	0.019951
2.800	0.016196	0.016796	0.018935	0.016953	0.017866	0.019857	0.017032	0.017822	0.019781	0.017054	0.018194	0.020159	0.016201	0.016755	0.018881	0.017044	0.017855	0.019796	0.017112	0.017809	0.019692	0.016983	0.018064	0.020082	0.018038
3.000	0.015012	0.015826	0.016431	0.015860	0.016365	0.017509	0.015778	0.016404	0.017440	0.015983	0.016323	0.017809	0.015002	0.015830	0.016400	0.015799	0.016419	0.017446	0.015747	0.016451	0.017321	0.015949	0.016316	0.017712	0.016381
3.200	0.013958	0.013560	0.013534	0.014780	0.014457	0.014602	0.014695	0.014388	0.014522	0.014940	0.014551	0.014780	0.013931	0.013529	0.013510	0.014714	0.014391	0.014564	0.014659	0.014305	0.014485	0.014880	0.014533	0.014687	0.014373
3.400	0.013228	0.009963	0.011650	0.013316	0.010302	0.012732	0.013328	0.010316	0.012659	0.013205	0.010414	0.012840	0.013242	0.009937	0.011617	0.013325	0.010294	0.012692	0.013344	0.010285	0.012613	0.013277	0.010363	0.012812	0.011990
3.600	0.012052	0.009909	0.009856	0.012279	0.009984	0.010870	0.012264	0.010039	0.010811	0.012271	0.009750	0.011008	0.012032	0.009905	0.009855	0.012265	0.010023	0.010824	0.012261	0.010062	0.010742	0.012297	0.009810	0.010974	0.010923
3.800	0.010319	0.009686	0.009785	0.010635	0.009867	0.010061	0.010599	0.009898	0.010053	0.010704	0.009716	0.010087	0.010293	0.009670	0.009775	0.010605	0.009882	0.010049	0.010580	0.009897	0.010034	0.010696	0.009768	0.010098	0.010115
4.000	0.008454	0.008991	0.008832	0.008798	0.009240	0.009026	0.008751	0.009248	0.009027	0.008919	0.009162	0.009081	0.008418	0.008965	0.008844	0.008757	0.009234	0.009035	0.008721	0.009230	0.009048	0.008883	0.009200	0.009044	0.008955
4.200	0.007217	0.008019	0.007502	0.007409	0.008302	0.007732	0.007392	0.008294	0.007739	0.007477	0.008278	0.007758	0.007187	0.007990	0.007500	0.007380	0.008284	0.007738	0.007357	0.008262	0.007747	0.007470	0.008299	0.007747	0.007753
4.400	0.006138	0.006940	0.006506	0.006264	0.007229	0.006612	0.006244	0.007213	0.006615	0.006200	0.007238	0.006613	0.006140	0.006907	0.006503	0.006251	0.007206	0.006611	0.006217	0.007176	0.006610	0.006177	0.007255	0.006612	0.006645
4.600	0.005550	0.005874	0.006101	0.005813	0.006157	0.006149	0.005792	0.006133	0.006148	0.005702	0.006187	0.006152	0.005550	0.005844	0.006101	0.005797	0.006129	0.006146	0.005758	0.006094	0.006149	0.005752	0.006192	0.006153	0.005976
4.800	0.005083	0.004896	0.005704	0.005350	0.005162	0.005791	0.005324	0.005136	0.005785	0.005262	0.005201	0.005823	0.005077	0.004867	0.005698	0.005329	0.005132	0.005786	0.005293	0.005099	0.005780	0.005307	0.005205	0.005811	0.005371
5.000	0.005089	0.004900	0.005268	0.005253	0.005101	0.005360	0.005261	0.005076	0.005350	0.005330	0.005169	0.005368	0.005090	0.004891	0.005263	0.005270	0.005084	0.005357	0.005280	0.005056	0.005351	0.005275	0.005145	0.005361	0.005206

Notes:

Equivalent-linear one-dimensional site-specific response analysis are performed using Proshake, version 1.12 (2003)

Earthquake motions FEE1, FEE2, and FEE3 represnt the different acceleration - time histories for FEE events as provided by GDS

From Z_{DTM} to elevation -115 ft, the soil profile is based on the site-specific subsurface information; below elevation -115 ft, the site is characterized with the shear wave velocity measurements from the following bridge location:

① = Port Access Road B-11 (Suspension)
② = Ravenel Bridge MP-2 and MP-5 (Suspension)
③ = Ravenel Bridge DS-1 (Downhole)
④ = Maybank Bridge PS-1 (Downhole)

The recommended site-specific horizontal acceleration response spectra (ARS) curves are based on the arithmatic mean of the ARS curves for the same layer (GDM, §12.8.4)

Results of Spectral Acceleration for Safety Evaluation Earthquake (SEE) Event

Time (sec)	Spectral Acceleration (% g)																								
	Using PI for Cooper Marl of 30												Using PI for Cooper Marl of 60												←PI
Site→	①			②			③			④			①			②			③			④			← Site
Motion→	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	SEE1	SEE2	SEE3	mean
0.001	0.448460	0.393816	0.388469	0.389923	0.340289	0.370354	0.383458	0.336790	0.372478	0.401898	0.394639	0.345475	0.497214	0.449130	0.404598	0.427096	0.410855	0.372607	0.438259	0.382126	0.373612	0.399958	0.376824	0.388293	0.395276
0.010	0.447928	0.393354	0.388050	0.389426	0.339587	0.369981	0.383014	0.336072	0.372136	0.401364	0.394407	0.345170	0.496194	0.448563	0.404132	0.426557	0.410091	0.372219	0.437474	0.381484	0.372908	0.399331	0.376607	0.387860	0.394746
0.020	0.448667	0.394043	0.388172	0.390126	0.340441	0.370536	0.383766	0.336950	0.372923	0.401803	0.394655	0.345255	0.496708	0.449725	0.404134	0.427265	0.410209	0.372455	0.438932	0.382178	0.372907	0.399528	0.376748	0.388508	0.395276
0.040	0.477831	0.425895	0.391274	0.397564	0.357234	0.385254	0.386760	0.348381	0.381735	0.403422	0.412934	0.358698	0.533835	0.483129	0.404475	0.479066	0.439832	0.389075	0.476411	0.394777	0.379515	0.399734	0.410285	0.402599	0.413321
0.060	0.590770	0.530790	0.520056	0.441793	0.390421	0.398531	0.443671	0.389975	0.419689	0.477547	0.415205	0.371532	0.688687	0.567030	0.631052	0.537110	0.459045	0.429456	0.519343	0.444136	0.485924	0.491217	0.420438	0.444234	0.479486
0.080	0.531761	0.505670	0.488708	0.499387	0.553388	0.442829	0.484745	0.577586	0.442733	0.461029	0.468178	0.406364	0.566908	0.667754	0.563865	0.462594	0.671890	0.509234	0.495231	0.614448	0.498695	0.532327	0.584569	0.498230	0.522005
0.100	0.684726	0.574926	0.583076	0.649976	0.489459	0.568439	0.623918	0.474304	0.546929	0.645098	0.490212	0.556358	0.775803	0.627325	0.647590	0.697031	0.595798	0.666023	0.698149	0.560357	0.645023	0.751892	0.626791	0.646076	0.617720
0.120	0.790177	0.676981	0.653677	0.643211	0.652135	0.609739	0.613171	0.591417	0.572342	0.614252	0.627507	0.588334	0.981283	0.842359	0.786709	0.744524	0.724497	0.756946	0.739045	0.721053	0.788837	0.669360	0.668696	0.648071	0.696013
0.140	0.779220	0.724085	0.787253	0.781651	0.765555	0.716552	0.777867	0.799848	0.730769	0.658833	0.496863	0.527746	0.931137	0.790556	0.860684	0.964832	0.979829	0.980138	0.986117	0.940672	0.987571	0.880873	0.797943	0.800972	0.810315
0.160	0.863041	0.879462	0.755765	0.809910	0.856224	0.826377	0.791671	0.847263	0.751961	0.700698	0.689451	0.689083	1.001581	1.131860	0.958374	0.813331	1.044102	0.900873	0.871234	0.985679	0.840473	0.837371	0.792104	0.831161	0.852877
0.180	0.933784	1.137783	0.954856	0.902555	1.014035	0.858880	0.891179	0.969103	0.829729	0.700279	0.726244	0.660160	1.282120	1.365478	1.148647	0.982491	1.134014	1.036108	1.001483	1.118900	0.996470	0.850163	0.935886	0.765606	0.966498
0.200	1.269588	1.153667	1.291378	1.232754	0.930967	1.059594	1.210982	0.935055	1.042100	0.849356	0.644892	0.761120	1.396038	1.253334	1.341478	1.340500	1.093809	1.301307	1.354787	1.073882	1.280961	1.109856	0.905664	0.963964	1.116543
0.220	1.126777	1.173494	1.144299	1.079420	1.044310	1.045997	1.052269	0.997694	1.041949	0.865807	0.807850	0.825806	1.117420	1.227489	1.070110	1.044163	1.105742	1.143049	1.010087	1.076297	1.118024	1.103451	1.109817	1.015319	1.056110
0.240	1.099199	1.171349	1.007155	0.906231	0.877939	0.860963	0.900884	0.889879	0.888827	0.937232	0.881748	0.803241	1.106178	1.156203	1.056698	0.754570	0.993157	0.781653	0.845929	1.022357	0.781248	1.069999	0.995354	0.992725	0.949197
0.260	0.976163	0.946931	1.061370	0.709262	0.665120	0.743816	0.714009	0.690665	0.777663	0.838612	0.824785	0.788990	1.065024	1.012506	1.114502	0.689541	0.767443	0.808526	0.754919	0.793506	0.833335	0.813279	0.765605	0.841753	0.833222
0.280	1.034092	0.946351	1.055155	0.689001	0.609429	0.679035	0.692138	0.620354	0.729832	0.733788	0.728990	0.762560	1.152674	1.151863	1.150441	0.723485	0.721000	0.812645	0.816327	0.759039	0.851228	0.772948	0.638530	0.767461	0.816599
0.300	0.983804	1.064653	0.944378	0.718831	0.683697	0.669576	0.711145	0.692375	0.681985	0.677875	0.663130	0.716171	1.270520	1.306741	1.082219	0.731215	0.843956	0.807955	0.786576	0.877570	0.815229	0.766850	0.735240	0.698453	0.830423
0.320	1.154289	1.075113	1.170399	0.656397	0.662813	0.747782	0.701098	0.677488	0.812150	0.631439	0.653864	0.610686	1.430539	1.348858	1.281910	0.894150	0.798706	0.977298	1.002630	0.857380	1.004056	0.687877	0.706264	0.779051	0.888427
0.340	1.252265	1.004899	1.236878	0.722951	0.684797	0.855506	0.770495	0.734508	0.916638	0.696582	0.619641	0.659865	1.506029	1.194301	1.310273	1.006640	0.954253	1.040586	1.127305	0.998709	1.043581	0.746360	0.757025	0.898302	0.947433
0.360	1.258595	1.241984	1.231895	0.868595	0.868629	0.900352	0.930023	0.933214	0.962000	0.694211	0.683215	0.688183	1.446914	1.341642	1.256939	1.204958	1.184122	1.067544	1.251979	1.228191	1.057486	0.903011	0.967304	0.955604	1.046941
0.380	1.417205	1.437690	1.257728	1.102509	1.033161	0.948337	1.172814	1.107161	1.013838	0.770978	0.785530	0.724592	1.480740	1.444703	1.268067	1.519088	1.394017	1.089531	1.572151	1.434293	1.068483	1.123969	1.157874	1.017431	1.180912
0.400	1.285384	1.404909	1.323962	1.109267	1.044015	1.040779	1.137707	1.125118	1.123815	0.839810	0.804915	0.780774	1.285948	1.397655	1.293414	1.348708	1.395193	1.204394	1.361668	1.405057	1.148923	1.163718	1.150910	1.129697	1.179406
0.420	1.160037	1.192685	1.269948	1.085572	0.966447	1.033725	1.053218	1.011481	1.099888	0.952525	0.778226	0.839684	1.076692	1.155585	1.220460	1.098940	1.184558	1.214471	1.076055	1.177968	1.164386	1.204147	1.087424	1.142557	1.093612
0.440	1.231746	1.096645	1.126077	1.248097	1.102974	1.205133	1.194893	1.047007	1.169031	1.132887	1.013428	0.992365	1.086444	1.005466	0.941205	1.066916	1.040210	0.966452	0.994227	1.009082	0.861594	1.382599	1.229427	1.358487	1.104266
0.460	1.184049	1.125806	1.053473	1.097732	1.116038	1.011677	1.042163	1.060546	0.988159	1.123580	1.086828	0.901142	1.047868	1.003746	0.904195	0.926261	0.998411	0.842033	0.853810	0.956742	0.774401	1.214426	1.232831	1.124339	1.027927
0.480	1.139874	1.120079	0.905649	1.019190	1.123284	0.842771	0.962683	1.054740	0.801905	1.126639	1.165033	1.021094	0.995529	0.972779	0.797539	0.857781	0.887977	0.746733	0.797357	0.842616	0.722865	1.101768	1.223166	0.917747	0.964450
0.500	1.004748	1.066983	0.904872	0.897536	1.061688	0.879919	0.848942	0.987210	0.823210	1.010571	1.143030	1.100073	0.880653	0.925678	0.770919	0.749833	0.804141	0.752517	0.703560	0.756973	0.699005	0.967951	1.151216	0.943447	0.909778
0.550	0.892331	0.932848	0.853677	0.700942	0.797310	0.750338	0.663015	0.762220	0.711337	0.890000	0.914340	0.929159	0.832014	0.826925	0.754236	0.663024	0.713745	0.655105	0.661569	0.671110	0.616207	0.746498	0.847228	0.785605	0.773783
0.600	0.872561	0.792963	0.714894	0.634792	0.701222	0.637421	0.613460	0.661092	0.590151	0.789126	0.912580	0.817006	0.779673	0.704589	0.640522	0.610096	0.608083	0.522281	0.590159	0.565581	0.495383	0.649793	0.722718	0.655808	0.678415
0.650	0.809940	0.750750	0.661639	0.605380	0.643736	0.546810	0.587018	0.611311	0.525664	0.742925	0.835596	0.629022	0.750912	0.684620	0.608864	0.593249	0.562472	0.499038	0.589554	0.526556	0.470906	0.618849	0.665978	0.569592	0.628766
0.700	0.708522	0.656878	0.712168	0.536815	0.548802	0.596422	0.522128	0.526759	0.574593	0.638998	0.670850	0.679408	0.641006	0.608872	0.641927	0.517322	0.528619	0.531599	0.504423	0.516120	0.512544	0.548862	0.567572	0.612843	0.587669
0.750	0.561832	0.721050	0.614309	0.466176	0.618951	0.503123	0.457851	0.589024	0.480368	0.521802	0.752335	0.580333	0.529578	0.663025	0.574171	0.462427	0.581633	0.459308	0.455901	0.559085	0.447834	0.470681	0.636109	0.511065	0.550749
0.800	0.583471	0.561766	0.531348	0.469364	0.504776	0.458092	0.457688	0.484712	0.450691	0.540288	0.592052	0.519111	0.535852	0.518704	0.498843	0.456016	0.466803	0.440607	0.461110	0.460362	0.423726	0.479273	0.518727	0.464786	0.494924
0.850	0.623885	0.633972	0.591633	0.535419	0.568632	0.508768	0.527945	0.555259	0.493561	0.596784	0.670237	0.593903	0.599425	0.592226	0.560336	0.533984	0.549925	0.489031	0.533666	0.525908	0.476801	0.539687	0.577390	0.511387	0.557907
0.900	0.575254	0.553819	0.578205	0.510116	0.551346	0.516103	0.500813	0.536806	0.506558	0.549353	0.614976	0.588645	0.541593	0.528185	0.550012	0.504219	0.526512	0.505355	0.489912	0.510930	0.491261	0.513851	0.562984	0.517410	0.534342
0.950	0.531384	0.590423	0.522489	0.523838	0.588044	0.509233	0.510917	0.568123	0.495115	0.570010	0.674828	0.550680	0.502759	0.561139	0.497205	0.496316	0.553133	0.482836	0.489522	0.536309	0.467494	0.530757	0.593156	0.517008	0.535947
1.000	0.542158	0.521296	0.510178	0.523235	0.510908	0.504612	0.509509	0.493313	0.495884	0.576500	0.587403	0.547683	0.514465	0.490893	0.483840	0.496558	0.479253	0.495117	0.491531	0.465234	0.482283	0.528813	0.517729	0.509202	0.511567
1.050	0.520437	0.459779	0.512831	0.506018	0.491529	0.523950	0.493886	0.479072	0.512350	0.561457	0.559351	0.557690	0.493166	0.439398	0.490308	0.487081	0.472966	0.504598	0.484557	0.460189	0.489321	0.507412	0.494081	0.528854	0.501262
1.100	0.423690	0.486221	0.495655	0.453207	0.529723	0.499651	0.444230	0.517403	0.487132	0.497878	0.584350	0.545523	0.406516	0.467480	0.472822	0.436723	0.511126	0.477358	0.437442	0.498349	0.463485	0.454752	0.534332	0.503699	0.484531
1.150	0.408101	0.464139	0.432617	0.443503	0.480413	0.436808	0.435757	0.468667	0.430637	0.483944	0.537407	0.472848	0.393116	0.435349	0.419864	0.429264	0.459362	0.433424	0.430324	0.443366	0.424516	0.444497	0.488748	0.437954	0.447276
1.200	0.473167	0.435253	0.409508	0.518246	0.449847	0.430853	0.510462	0.434434	0.424419	0.559350	0.510492	0.455257	0.456235	0.406946	0.393233	0.503243	0.418840	0.418445	0.503153	0.412896	0.409159	0.517754	0.455663	0.433364	0.455842
1.250	0.424192	0.426160	0.437282	0.473570	0.473517	0.480628	0.466912	0.462840	0.471386	0.501034	0.508429	0.501211	0.405847	0.409669	0.420920	0.456663	0.457475	0.464715	0.456075	0.446414	0.455409	0.474820	0.478089	0.483233	0.459854
1.300	0.356729	0.389240	0.394133	0.402548	0.441849	0.426310	0.397570	0.431241	0.420607	0.422475	0.482902	0.455794	0.342392	0.371562	0.379843	0.388700	0.423294	0.417152	0.387381	0.415012	0.409370	0.403735	0.445688	0.426461	0.409666
1.350	0.376326	0.373875	0.365412	0.427988	0.427920	0.411427	0.421176	0.422610	0.405969	0.448698	0.448467	0.430757	0.360581	0.362064	0.353508	0.407820	0.416521	0.400375	0.406777	0.407985	0.393058	0.429790	0.429643	0.411858	0.405859
1.400	0.365308	0.359423	0.343365	0.421564	0.408048	0.392882	0.414355	0.401590	0.387421	0.444555	0.430094	0.408124	0.352346	0.347424	0.331084	0.401616	0.391595	0.380077	0.404450	0.383229	0.373448	0.422966	0.410898	0.393823	0.390404
1.450	0.336565	0.332147	0.329612	0.389225	0.384476	0.380136	0.383875	0.379638	0.374536	0.403279	0.400857	0.394256	0.328527	0.323704	0.318900	0.373724	0.376247	0.366666	0.375479	0.372367	0.360425	0.390574	0.383672	0.381273	0.368340
1.500	0.339760	0.323640	0.322245	0.390722	0.378651	0.372954	0.385109	0.374114	0.367084	0.406929	0.391515	0.386917	0.330720	0.318814	0.313381	0.374399	0.370108	0.358963	0.376331	0.366754	0.353190	0.392187	0.380285	0.374071	0.364535
1.550	0.333847	0.319563	0.314406	0.384494	0.367272	0.364488	0.379002	0.362566	0.358272	0.402899	0.387084	0.378723	0.323345	0.314185	0.306838	0.368525	0.360303	0.350381	0.370504	0.357391	0.345550	0.385912	0.367484	0.365331	0.357015
1.600	0.329918	0.292241	0.300437	0.379038	0.340899	0.348932	0.373691	0.335387	0.342719	0.396192	0.355888	0.363374	0.317796	0.285215	0.293350	0.362597	0.329860	0.335822	0.363721	0.326519	0.331819	0.380879	0.341293	0.349660	0.340719
1.650	0.318284	0.286545	0.283289	0.367546	0.336074	0.326067	0.362680	0.331256	0.320170	0.386666	0.354291	0.340100	0.307338	0.280445	0.276052	0.353263	0.327408	0.314792	0.355409	0.324740	0.311277	0.368315	0.335974	0.326548	0.328939
1.700	0.298145	0.264753	0.272804	0.345001	0.304033	0.303110	0.340997	0.300415	0.298578	0.362877	0.320818	0.311935	0.290985	0.260045	0.265783	0.333410	0.297456	0.292202	0.335997	0.295150	0.288676	0.344922	0.303378	0.303626	0.305629
1.750	0.273039	0.279837	0.258626	0.315639	0.315151	0.287412	0.312495	0.312202	0.282831	0.331099	0.327539	0.295914	0.267133	0.275101	0.251923	0.305782	0.309184	0.278542	0.308341	0.307525	0.276415	0.315408	0.314922	0.287619	0.295403
1.800	0.266622	0.281505	0.255392	0.299217	0.317346	0.281141	0.296239	0.314389	0.276894	0.313193	0.330250	0.293632	0.261714	0.276296	0.249950	0.289921	0.311215	0.271634	0.292922	0.309314	0.269351	0.299426	0.317316	0.281366	0.289844
1.850	0.260046	0.271403	0.249818	0.294433	0.307785	0.274519	0.292545	0.304829	0.270682	0.306995	0.319900	0.289107	0.254415	0.266070	0.244514	0.288549	0.301526	0.267407	0.290991	0.299333	0.265519	0.294184	0.307924	0.273912	0.283184
1.900	0.226255	0.248233	0.236585	0.260717	0.283836	0.260765	0.259209	0.280963	0.257786	0.268144	0.294732	0.274455	0.220679	0.243168	0.231690	0.255043	0.277514	0.255553	0.256132	0.275448	0.253512	0.260519	0.283836	0.260192	0.259374
1.950	0.196403	0.219675	0.217648	0.223860	0.253488	0.241065	0.221022	0.250947	0.238546	0.236345	0.262357	0.253188	0.190749	0.215566	0.212960	0.214959	0.247923	0.236565	0.216407	0.246407	0.234385	0.224309	0.253275	0.240469	0.231188
2.000	0.185945	0.198364	0.209195	0.209907	0.229738	0.231365	0.209308	0.227546	0.227883	0.216960	0.236983	0.239078	0.185991	0.195269	0.204269	0.205881	0.224907	0.223758	0.206984	0.223738	0.222012	0.209946	0.229476	0.231540	0.216085
2.200	0.201660	0.192264	0.203197	0.223926	0.213154	0.227917	0.222554	0.211669	0.225538	0.229013	0.218078	0.236079	0.197523	0.189242	0.201053	0.218455	0.209509	0.224562	0.219842	0.208502	0.223680	0.224518	0.213268	0.227616	0.215117
2.400	0.160430	0.175454	0.175935	0.175290	0.193951	0.200070	0.174490	0.193126	0.198644	0.179209	0.199518	0.205514	0.158266	0.173448	0.173860	0.172318	0.192868	0.197615	0.173751	0.192307	0.196225	0.175328	0.193632	0.199307	0.184607
2.600	0.134515	0.135748	0.122228	0.146061	0.148988	0.145578	0.144794	0.148740	0.144472	0.150240	0.150483	0.147679	0.132318	0.135009	0.120146	0.142387	0.148506	0.142016	0.142879	0.148045	0.140923	0.146408	0.148790	0.145422	0.142182
2.800	0.111918	0.118802	0.129495	0.124578	0.132165	0.134466	0.124116	0.131281	0.133637	0.125907	0.134660	0.139166	0.111942	0.117365	0.127999	0.121733	0.129449	0.133261	0.122820	0.129053	0.132773	0.124783	0.132238	0.134266	0.127411
3.000	0.105923	0.110442	0.114545	0.114605	0.116858	0.122240	0.114519	0.116199	0.121820	0.114485	0.118892	0.125590	0.105128	0.110000	0.113181	0.113762	0.115385	0.121440	0.114107	0.115419	0.120899	0.114825	0.116741	0.122045	0.115794
3.200	0.098759	0.094399	0.094717	0.107291	0.100823	0.103994	0.107039	0.100679	0.103602	0.107420	0.101623	0.104885	0.097627	0.093753	0.093675	0.105870	0.100846	0.102863	0.105915	0.100625	0.102317	0.107428	0.100727	0.103970	0.101702
3.400	0.089963	0.072232	0.081686	0.096442	0.075340	0.091464	0.095996	0.075129	0.090945	0.097690	0.076387	0.091450	0.090059	0.072066	0.080794	0.094879	0.074572	0.089924	0.095702	0.074869	0.089429	0.096587	0.075357	0.091422	0.085849
3.600	0.081866	0.068547	0.071049	0.086336	0.071101	0.080609	0.086357	0.071024	0.080035	0.087470	0.072802	0.080764	0.081760	0.068045	0.070877	0.086058	0.071260	0.078936	0.086686	0.071312	0.078706	0.086198	0.071129	0.080613	0.077898
3.800	0.070950	0.064935	0.066113	0.074985	0.067847	0.069620	0.075001	0.067709	0.069369	0.075282	0.067762	0.069718	0.070499	0.065280	0.065994	0.074747	0.067131	0.068917	0.075015	0.067206	0.068942	0.074913	0.067992	0.069730	0.069819
4.000	0.059137	0.060593	0.060511	0.062924	0.063019	0.063710	0.062886	0.062828	0.063399	0.062986	0.063351	0.064022	0.058422	0.060774	0.060386	0.062485	0.062631	0.063012	0.062554	0.062763	0.062905	0.062988	0.063096	0.063730	0.062296
4.200	0.048486	0.054242	0.051765	0.051539	0.056509	0.054967	0.051590	0.056291	0.054654	0.051572	0.057031	0.055803	0.048292	0.054201	0.051563	0.051366	0.056200	0.054344	0.051667	0.056300	0.054273	0.051616	0.056494	0.054882	0.053569
4.400	0.042857	0.046958	0.044941	0.043658	0.049110	0.046751	0.043601	0.048876	0.046682	0.044136	0.049770	0.046832	0.042266	0.046753	0.044847	0.043261	0.048799	0.046511	0.043275	0.048855	0.046506	0.043799	0.049088	0.046725	0.046036
4.600	0.038844	0.039617	0.042489	0.039631	0.041621	0.044060	0.039488	0.041388	0.043996	0.040265	0.042359	0.044337	0.038605	0.039306	0.042455	0.039051	0.041304	0.043853	0.038838	0.041324	0.043865	0.039649	0.041608	0.044011	0.041332
4.800	0.035355	0.032789	0.039366	0.036047	0.034621	0.040635	0.035904	0.034396	0.040545	0.036675	0.035387	0.040949	0.035194	0.032436	0.039210	0.035459	0.034310	0.040346	0.035656	0.034302	0.040295	0.036044	0.034617	0.040621	0.036715
5.000	0.034511	0.032909	0.036353	0.035075	0.034938	0.037337	0.034814	0.034868	0.037284	0.036080	0.034925	0.037424	0.033897	0.032652	0.036257	0.034424	0.034700	0.037161	0.034395	0.034516	0.037133	0.035195	0.034965	0.037326	0.035381

Notes:

Equivalent-linear one-dimensional site-specific response analysis are performed using Proshake, version 1.12 (2003)

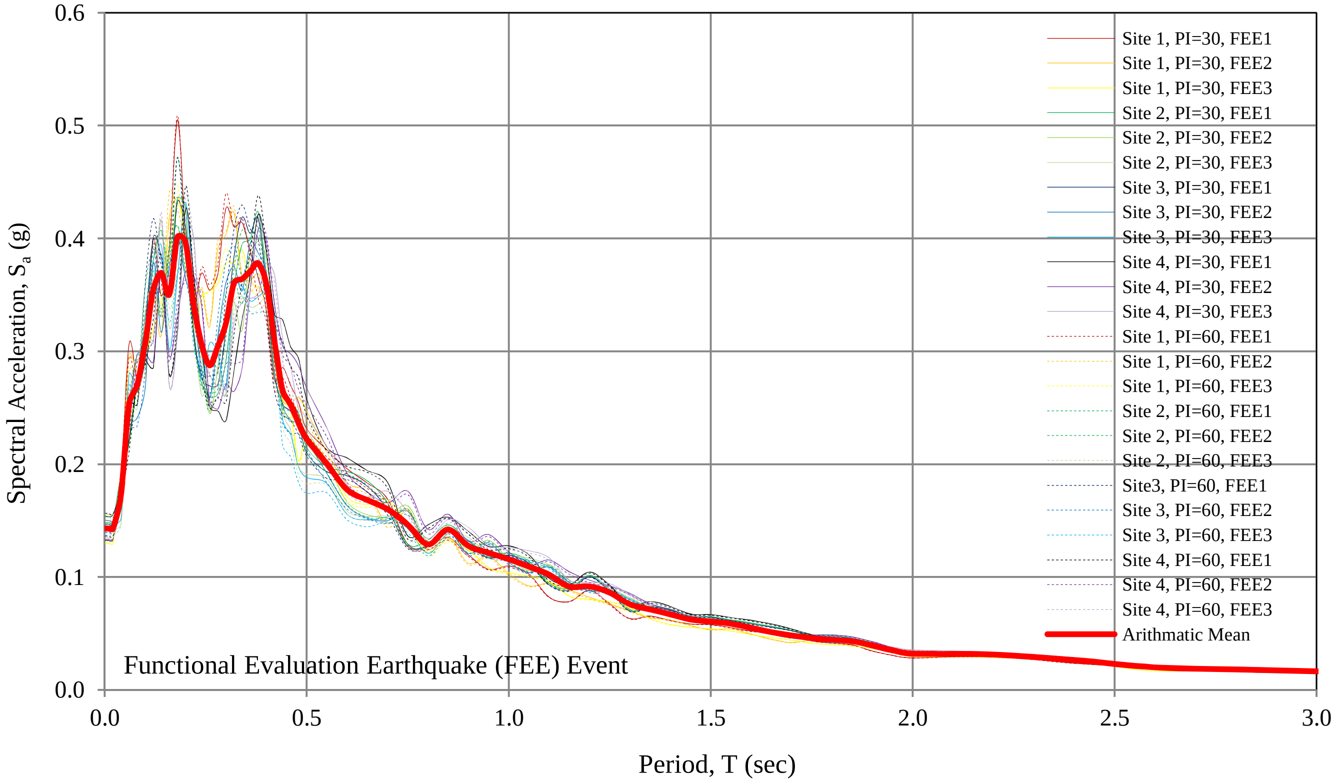
Earthquake motions SEE1, SEE2, and SEE3 represent the different acceleration - time histories for SEE event as provided by GDS

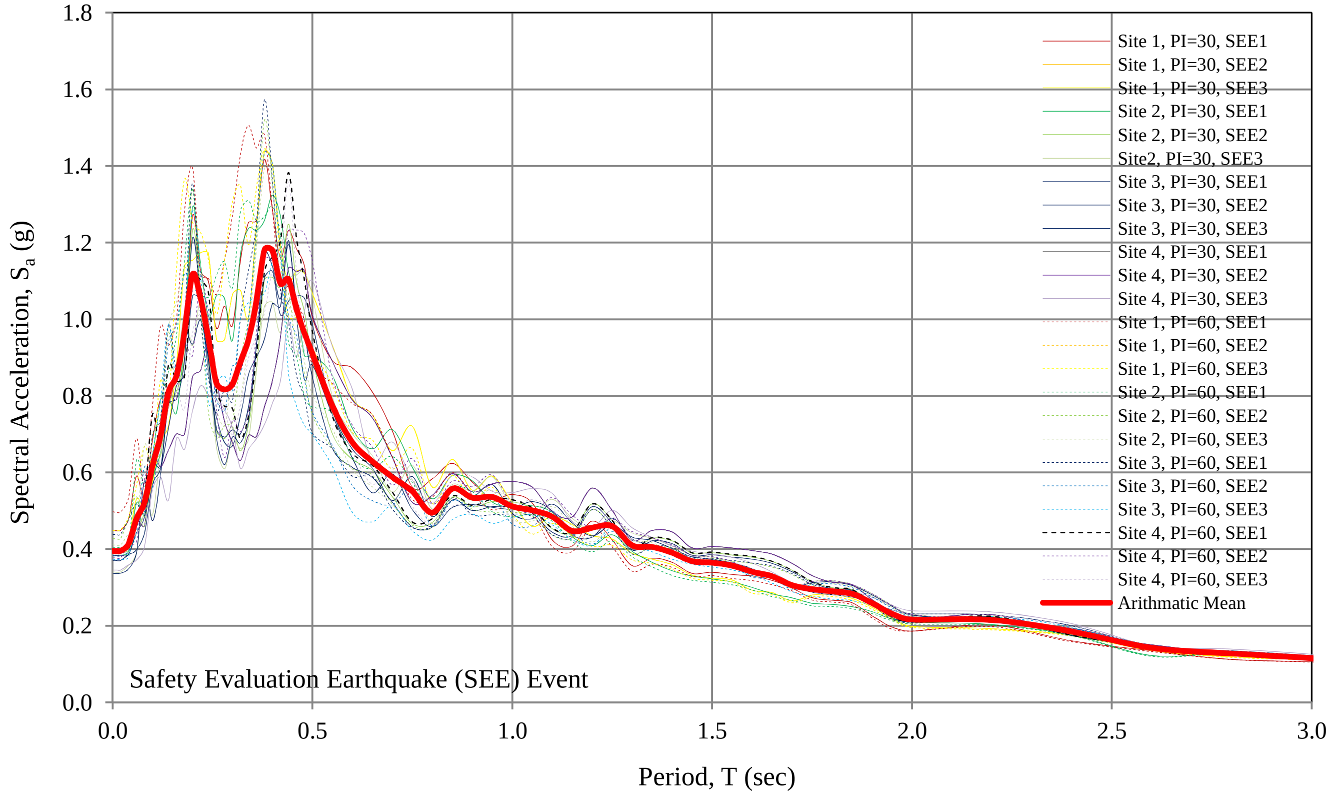
From Z_{DTM} to elevation -115 ft, the soil profile is based on the site-specific subsurface information; below elevation -115 ft, the site is characterized with the shear wave velocity measurements from the following bridge location:

① = Port Access Road B-11 (Suspension)
② = Ravenel Bridge MP-2 and MP-5 (Suspension)
③ = Ravenel Bridge DS-1 (Downhole)
④ = Maybank Bridge PS-1 (Downhole)

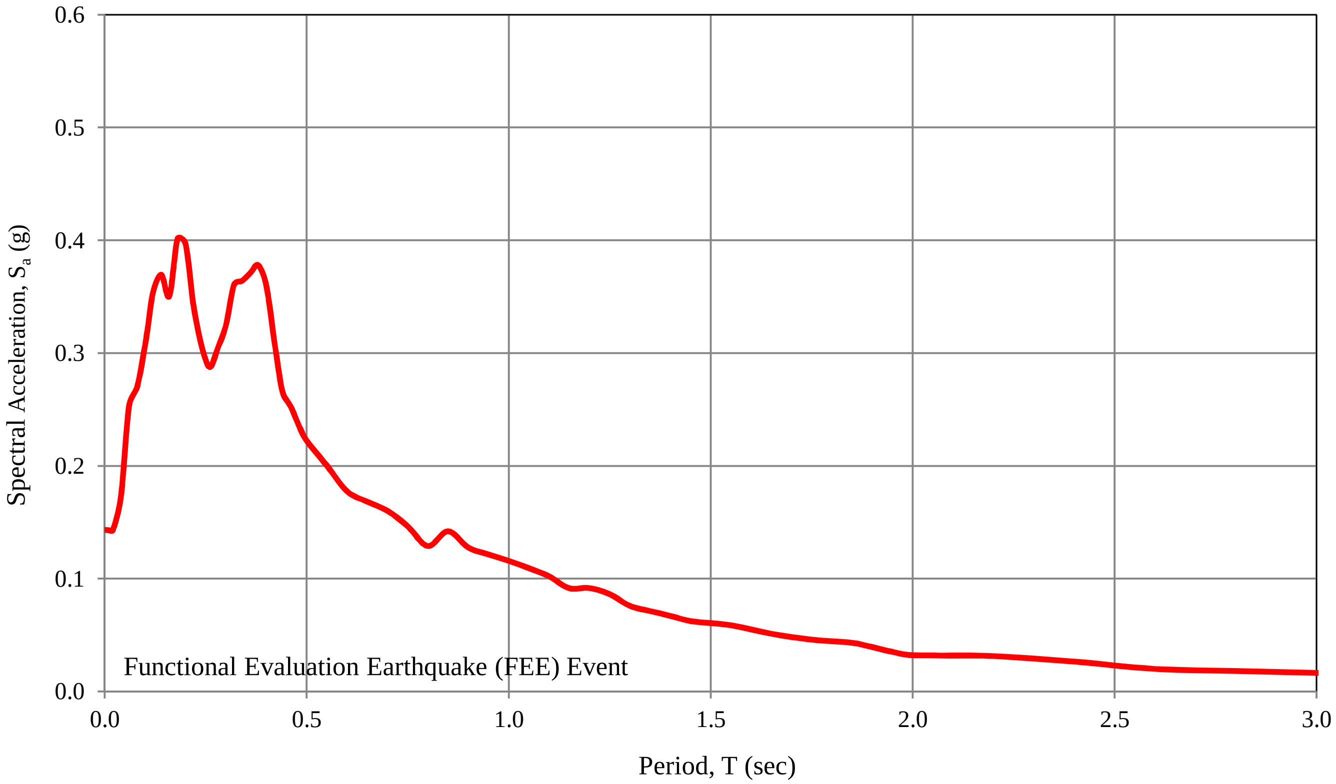
The recommended site-specific horizontal acceleration response spectra (ARS) curves are based on the arithmatic mean of the ARS curves for the same layer (GDM, §12.8.4)

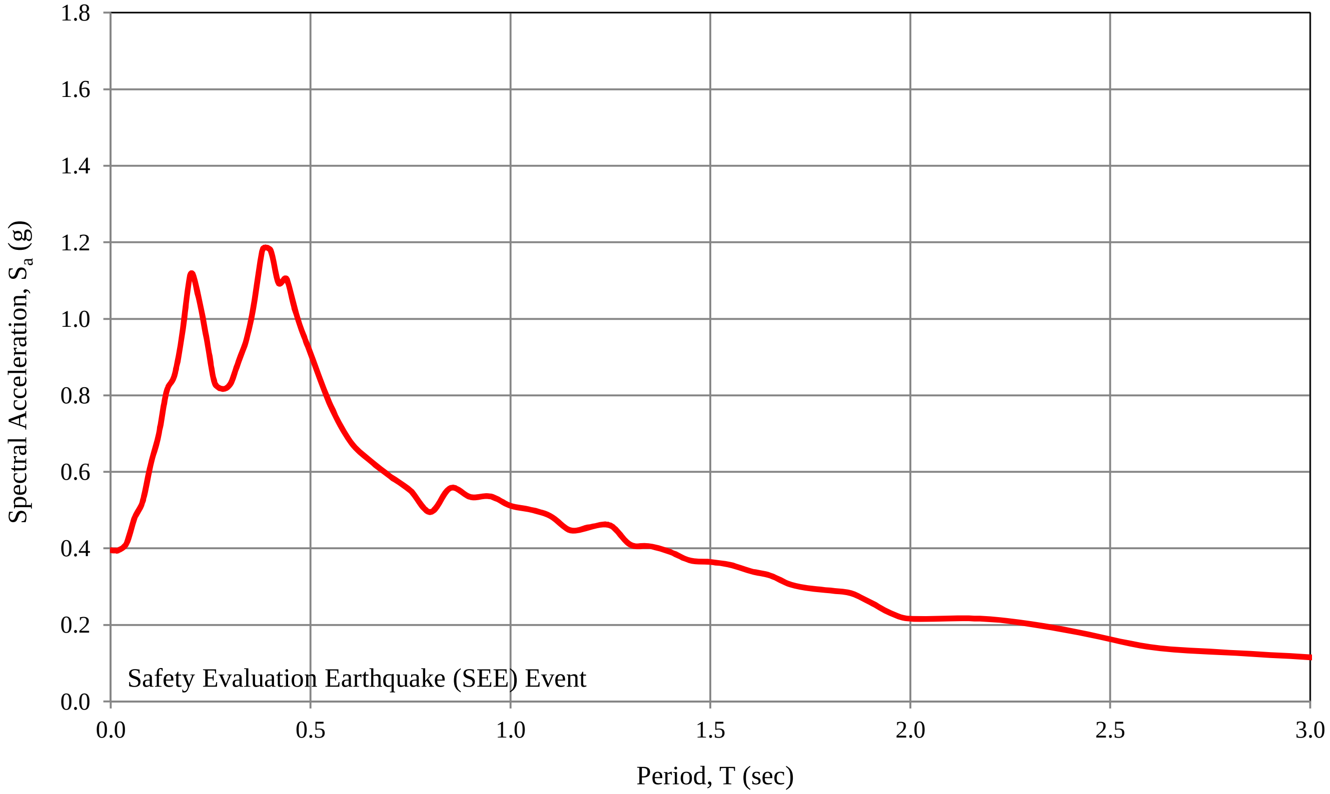
Site-Specific Acceleration Response Spectra (ARS) Curves





Average Site-Specific Acceleration Response Spectra (ARS) Curves





SECTION 8

CALCULATION FOR RECOMMENDED SITE-SPECIFIC RESPONSE CURVES FOR SITE CLASS C

Construction of SC Seismic Hazard Map Three-Point ADRS Curve for Site Class C for Functional Earthquake Evaluation (FEE) Event

Estimation of Spectral Accelerations considering the Local Site Effects

ω	T	$S_{a\,(PSA)}$	T	S_a	$0.7S_a$	$S_{a\,(av)}$	$S_{a\,(Rec)}$	T_a	$S_{a\,(Rec)}$
Hz	sec	g	sec	g	g	g	g	sec	g
-	0.00	0.1714782	0.00	0.205774	0.144042	0.143265	0.144042	0.14	0.369428
13.0	0.08	0.3063957	0.08 $= T_o$	0.371742	0.260219	0.269835	0.269835	0.18	0.401128
6.7	0.15	0.3090329	0.40 $= T_S$	0.371742	0.260219	0.359716	0.359716	0.22	0.341640
5.0	0.20	0.3097848	0.50	0.296350	0.207445	0.222336	0.222336	0.26	0.287553
3.3	0.30	0.2503457	1.00	0.148175	0.103723	0.115745	0.115745	0.38	0.377892
2.0	0.50	0.1689729	2.00	0.074088	0.051861	0.032161	0.051861	0.44	0.265592
1.0	1.00	0.0871619	3.00	0.049392	0.034574	0.016381	0.034574	> 0.44	ł

Notes:

ω, T = frequency and time period, respectively and T = 1/ω
$S_{a\,(PSA)}$ = Pseudo-Spectral Acceleration (PSA) at the B-C boundary as provided by GDS
$PGA_{B\text{-}C}$ = mapped peak ground acceleration at the B-C boundary at T = 0.0 sec (GDM, § 12.7.2)
S_S = mapped spectral acceleration at B-C boundary for short-period (T = 0.2 sec) (GDM, § 12.7.3)
S_1 = mapped spectral acceleration at B-C boundary for long-period (T = 1.0 sec) (GDM, § 12.7.3)
F_{PGA} = site coefficient based on Site Class and mapped $PGA_{B\text{-}C}$ (GDM, Table 12-26)
F_a = site coefficient based on Site Class and S_s (GDM, Table 12-27)
F_v = site coefficient based on Site Class and S_1 (GDM, Table 12-28)
PGA = peak ground acceleration (period, T = 0.0 sec) at $Z_{DTM;}$ PGA = F_{PGA} . $PGA_{B\text{-}C}$ (GDM, Eq 12-35)
Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4)
S_{DS} = design short-period (T = 0.2 sec) spectral response acceleration parameter (GDM, Eq 12-36)
S_{D1} = design long- period (T = 1.0 sec) spectral response acceleration parameter (GDM, Eq 12-37)
T_S, T_o = S_{D1}/S_{DS} (GDM, Eq 12-39), $T_o = 0.20T_s$ (GDM, Eq 12-38)
S_a = design spectral acceleration at Z_{DTM} (GDM, Table 12-29)
$0.7S_a$ = lowest spectral acceleration permitted without an independent third-party review (GDM, §12.8.5)
$S_{a\,(av)}$ = average spectral response acceleration
T_a = periods deemed necessary to generate the recommended response curve
$S_{a\,(Rec)}$ = recommended design spectral response acceleration

Calculations for Design Response Spectrum Parameters:

PGA = F_{PGA} . $PGA_{B\text{-}C}$ = 1.2 x 0.1714782 = 0.2057738
S_{DS} = F_aS_s = 1.2 x 0.3097848 = 0.3717418
S_{D1} = F_vS_1 = 1.7 x 0.0871619 = 0.1481752
T_S = S_{D1}/S_{DS} = 0.1481752/0.3717418 = 0.3986 sec
T_o = $0.20T_S$ = 0.20 x 0.3986 = 0.0797 sec
ł = 0.70 x S_{D1}/T

Construction of SC Seismic Hazard Map Three-Point ADRS Curve for Site Class C for Safety Earthquake Evaluation (SEE) Event

Estimation of Spectral Accelerations considering the Local Site Effects

ω	T	$S_{a\,(PSA)}$	T	S_a	$0.7S_a$	$S_{a\,(av)}$	$S_{a\,(Rec)}$	T_a	$S_{a\,(Rec)}$
Hz	sec	g	sec	g	g	g	g	sec	g
-	0.00	0.602461	0.00	0.602461	0.421723	0.395276	0.421723	0.24	0.949197
13.0	0.08	1.066766	0.10 $= T_o$	1.122372	0.785660	0.617720	0.785660	0.26	0.833222
6.7	0.15	1.120118	0.52 $= T_S$	1.122372	0.785660	0.850666	0.850666	0.28	0.816599
5.0	0.20	1.122372	1.00	0.585579	0.409905	0.511567	0.511567	0.34	0.947433
3.3	0.30	0.970438	2.00	0.292789	0.204953	0.216085	0.216085	0.40	1.179406
2.0	0.50	0.724003	3.00	0.195193	0.136635	0.115794	0.136635	0.44	1.104266
1.0	1.00	0.426269	-	-	-	-	-	0.55	0.773783
0.5	2.00	0.198994	-	-	-	-	-	0.65	0.630623
-	-	-	-	-	-	-	-	0.80	0.512382
-	-	-	-	-	-	-	-	0.85	0.557907
-	-	-	-	-	-	-	-	> 0.85	ł

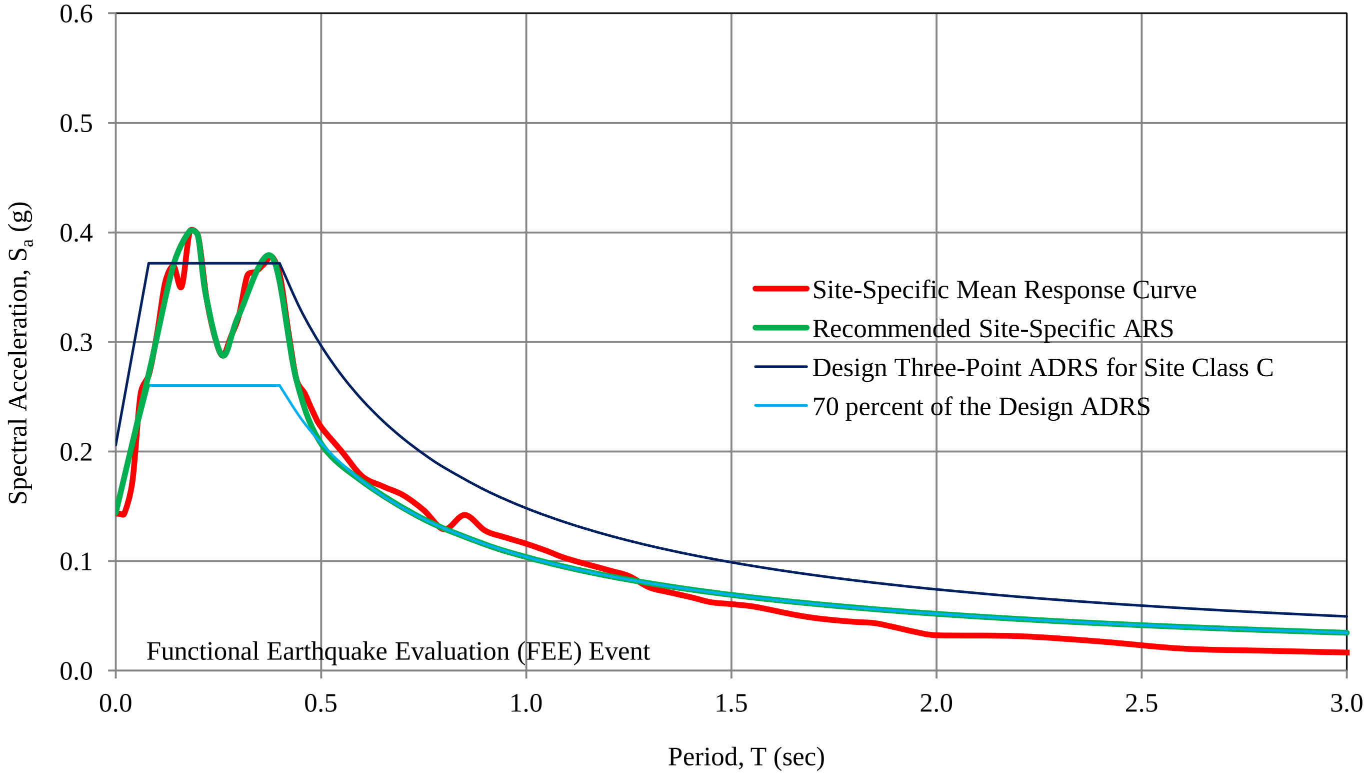
Notes:

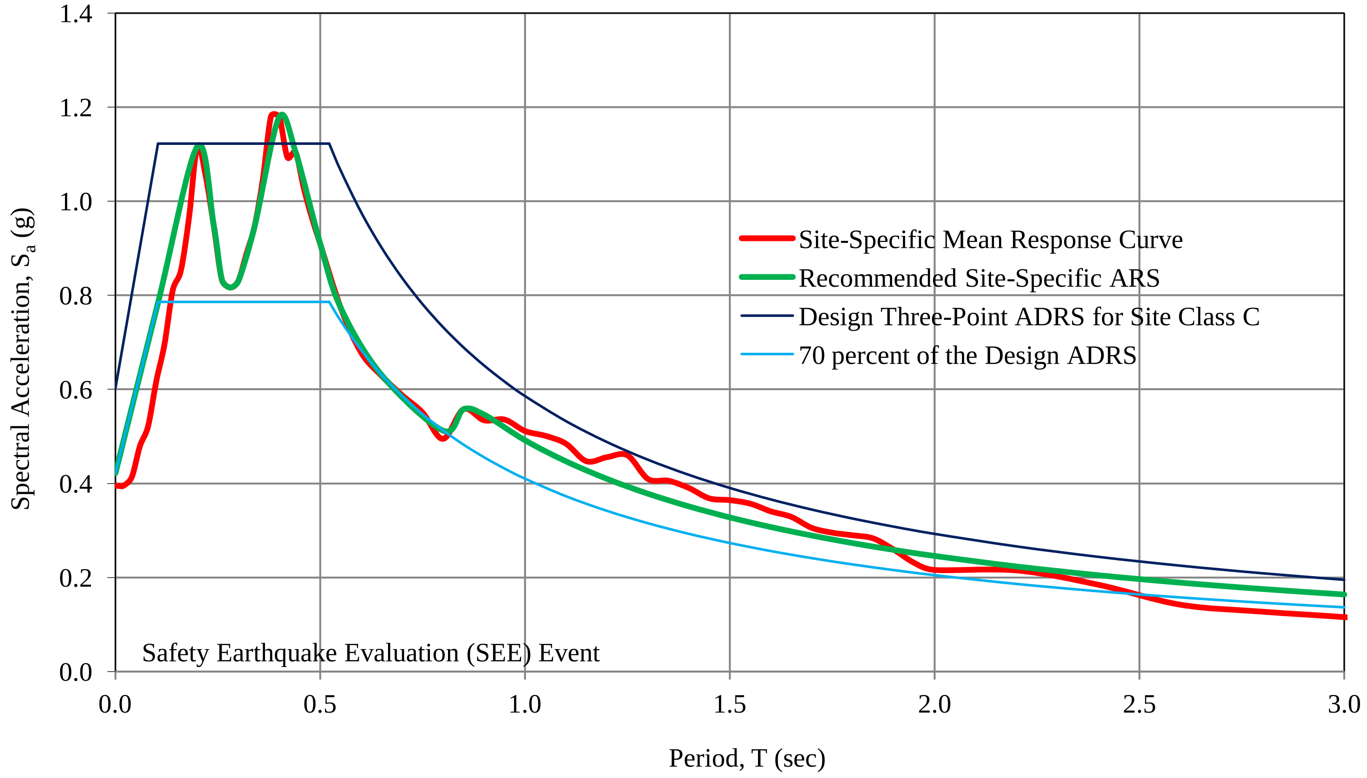
ω, T = frequency and time period, respectively and T = 1/ω
$S_{a\,(PSA)}$ = Pseudo-Spectral Acceleration (PSA) at the B-C boundary as provided by GDS
$PGA_{B\text{-}C}$ = mapped peak ground acceleration at the B-C boundary at T = 0.0 sec (GDM, § 12.7.2)
S_S = mapped spectral acceleration at B-C boundary for short-period (T = 0.2 sec) (GDM, § 12.7.3)
S_1 = mapped spectral acceleration at B-C boundary for long-period (T = 1.0 sec) (GDM, § 12.7.3)
F_{PGA} = site coefficient based on Site Class and mapped $PGA_{B\text{-}C}$ (GDM, Table 12-26)
F_a = site coefficient based on Site Class and S_s (GDM, Table 12-27)
F_v = site coefficient based on Site Class and S_1 (GDM, Table 12-28)
PGA = peak ground acceleration (period, T = 0.0 sec) at $Z_{DTM;}$ PGA = F_{PGA} . $PGA_{B\text{-}C}$ (GDM, Eq 12-35)
Z_{DTM} = depth-to-motion (GDM, §12.4.2 and 12.8.4)
S_{DS} = design short-period (T = 0.2 sec) spectral response acceleration parameter (GDM, Eq 12-36)
S_{D1} = design long- period (T = 1.0 sec) spectral response acceleration parameter (GDM, Eq 12-37)
T_S, T_o = S_{D1}/S_{DS} (GDM, Eq 12-39), $T_o = 0.20T_s$ (GDM, Eq 12-38)
S_a = design spectral acceleration at Z_{DTM} (GDM, Table 12-29)
$0.7S_a$ = lowest spectral acceleration permitted without an independent third-party review (GDM, §12.8.5)
$S_{a\,(av)}$ = average spectral response acceleration
T_a = periods deemed necessary to generate the recommended response curve
$S_{a\,(Rec)}$ = recommended design spectral response acceleration

Calculations for Design Response Spectrum Parameters:

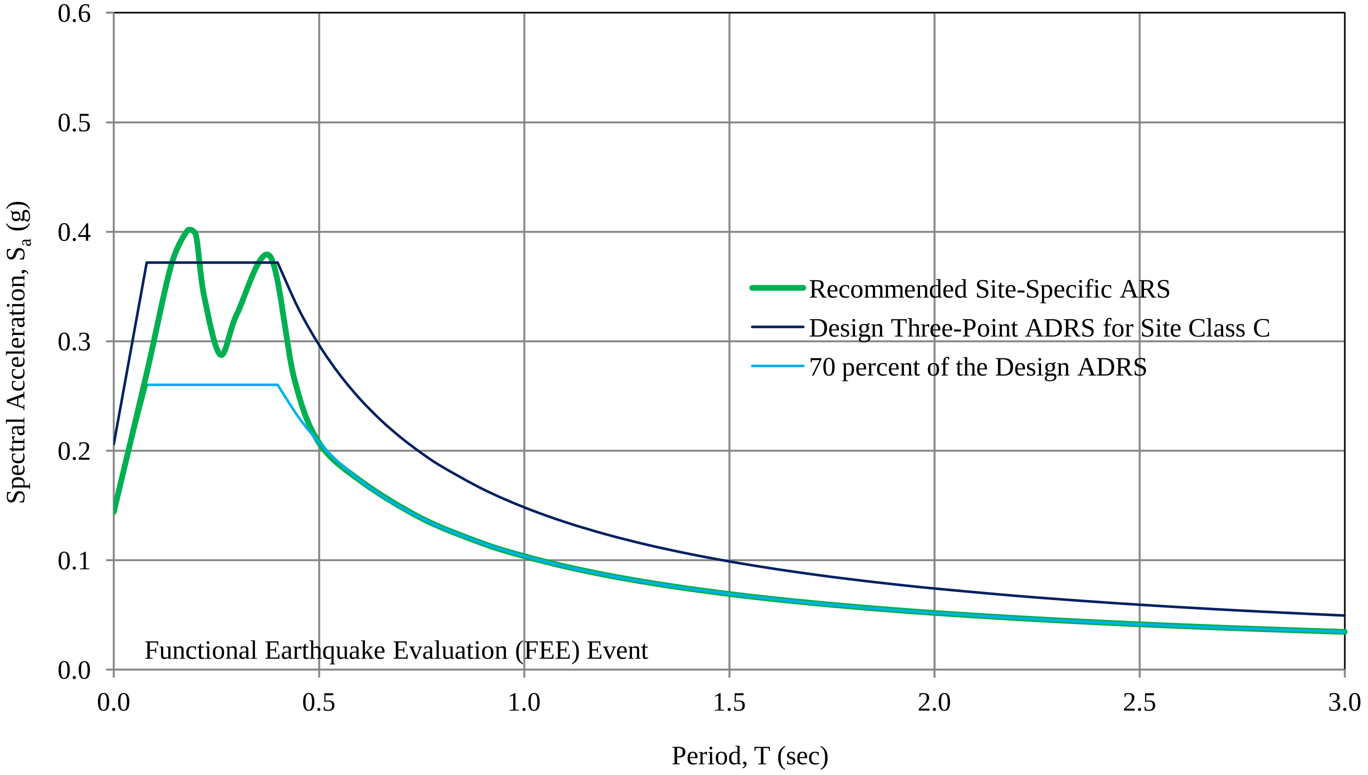
PGA = F_{PGA} . $PGA_{B\text{-}C}$ = 1.0 x 0.602461 = 0.602461
S_{DS} = F_aS_s = 1.0 x 1.122372 = 1.122372
S_{D1} = F_vS_1 = [1.4 + {(1.3 - 1.4)/(0.50 - 0.40)} x (0.426269 - 0.4)}] x 0.426269 = 1.373731 x 0.426269 = 0.58557894
T_S = S_{D1}/S_{DS} = 0.58557894/1.122372 = 0.52173 sec
T_o = $0.20T_S$ = 0.20 x 0.52173 = .104347 sec
ł = 0.84 x S_{D1}/T

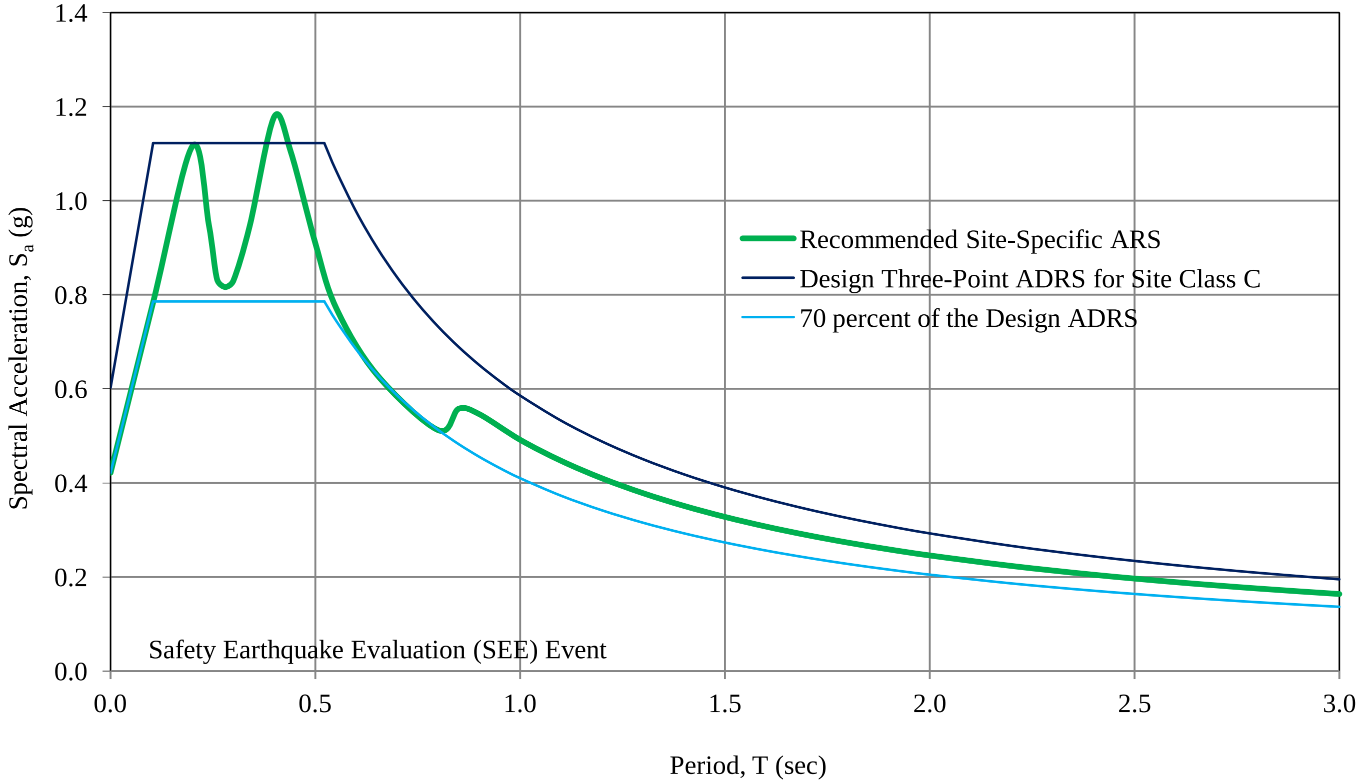
Construction of Recommended Site-Specific Acceleration Response Spectra (ARS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE)



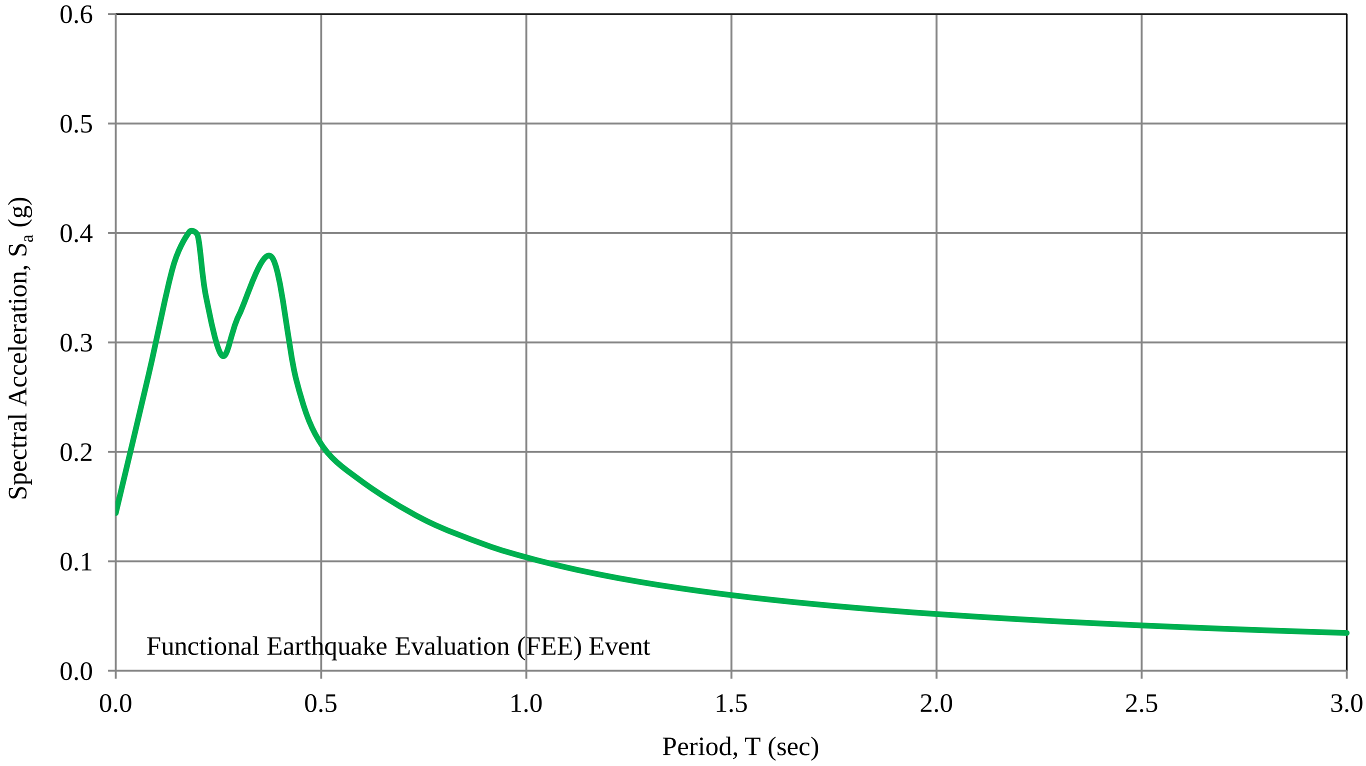


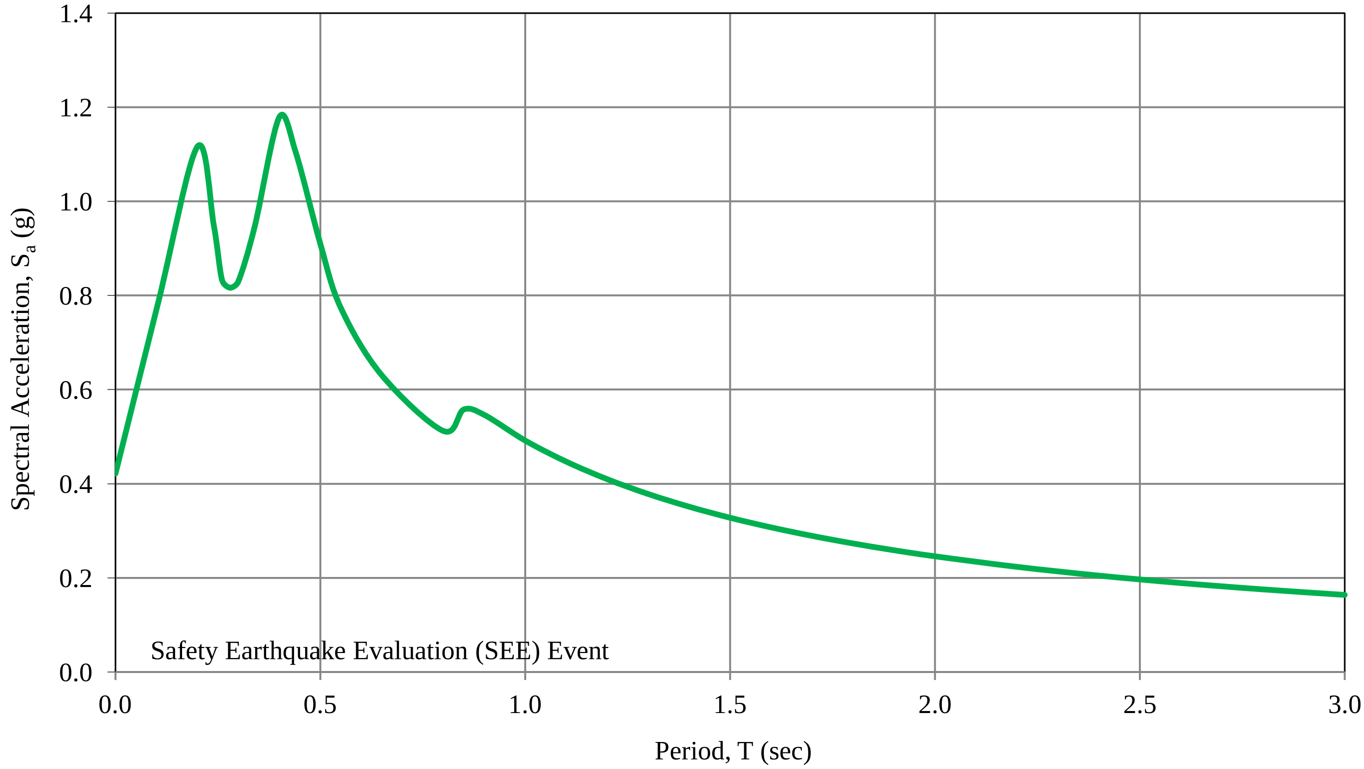
Construction of Recommended Site-Specific Acceleration Response Spectra (ARS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE)





Recommended Site-Specific Acceleration Response Spectra (ARS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE)





SECTION 9

CALCULATION FOR RECOMMENDED SITE-SPECIFIC RESPONSE CURVES FOR SITE CLASS D

Construction of SC Seismic Hazard Map Three-Point ADRS Curve for Site Class D for Functional Earthquake Evaluation (FEE) Event

Estimation of Spectral Accelerations considering the Local Site Effects

ω	T	$S_{a\,(PSA)}$	T	S_a	$0.7S_a$	$S_{a\,(av)}$	$S_{a\,(Rec)}$	T_a	$S_{a\,(Rec)}$
Hz	sec	g	sec	g	g	g	g	sec	g
-	0.00	0.1714782	0.00	0.249851	0.174896	0.143265	0.174896	0.14	0.369428
13.0	0.08	0.3063957	0.09 $= T_o$	0.477135	0.333995	0.298588	0.333995	0.18	0.401128
6.7	0.15	0.3090329	0.44 $= T_S$	0.477135	0.333995	0.265592	0.333995	0.20	0.397067
5.0	0.20	0.3097848	0.50	0.418377	0.292864	0.222336	0.292864	0.22	0.333995
3.3	0.30	0.2503457	1.00	0.209189	0.146432	0.115745	0.146432	0.27	0.333995
2.0	0.50	0.1689729	2.00	0.104594	0.073216	0.032161	0.073216	0.32	0.333995
1.0	1.00	0.0871619	3.00	0.069730	0.048811	0.016381	0.048811	0.34	0.364003
-	-	-	-	-	-	-	-	0.38	0.377892
-	-	-	-	-	-	-	-	> 0.44	‡

Notes:

ω, T = frequency and time period, respectively and $T = 1/\omega$

$S_{a\,(PSA)}$ = Pseudo-Spectral Acceleration (PSA) at the B-C boundary as provided by GDS

$PGA_{B\text{-}C}$ = mapped peak ground acceleration at the B-C boundary at T = 0.0 sec (GDM, § 12.7.2)

S_S, S_1 = mapped spectral acceleration at B-C boundary for short-period (T = 0.2 sec) (GDM, § 12.7.3)

S_1 = mapped spectral acceleration at B-C boundary for long-period (T = 1.0 sec) (GDM, § 12.7.3)

F_{PGA} = site coefficient based on Site Class and mapped $PGA_{B\text{-}C}$ (GDM, Table 12-26)

F_a = site coefficient based on Site Class and S_s (GDM, Table 12-27)

F_v = site coefficient based on Site Class and S_1 (GDM, Table 12-28)

PGA = peak ground acceleration (period, T = 0.0 sec) at $Z_{DTM;}$ $PGA = F_{PGA} \,.\, PGA_{B\text{-}C}$ (GDM, Eq 12-35)

S_{DS} = design short-period (T = 0.2 sec) spectral response acceleration parameter (GDM, Eq 12-36)

S_{D1} = design long- period (T = 1.0 sec) spectral response acceleration parameter (GDM, Eq 12-37)

T_S, T_o = S_{D1}/S_{DS} (GDM, Eq 12-39), $T_o = 0.20T_s$ (GDM, Eq 12-38)

S_a = design spectral acceleration at Z_{DTM}

$0.7S_a$ = lowest spectral acceleration permitted without an independent third-party review (GDM, §12.8.5)

$S_{a\,(av)}$ = average spectral response acceleration (GDM, Table 12-29)

T_a = periods deemed necessary to generate the recommended response curve

$S_{a\,(Rec)}$ = recommended design spectral response acceleration

Calculations for Design Response Spectrum Parameters:

PGA $= F_{PGA} \,.\, PGA_{B\text{-}C} = [1.6 + \{(1.6 - 1.4)/(0.1 - 0.2)\} \text{ x } (0.171478 - 0.1)] \text{ x } PGA_{B\text{-}C} = 1.457044 \text{ x } 0.171478 = 0.249851$

S_{DS} $= F_aS_a = [1.6 + \{(1.6 - 1.4)/(0.25 - 0.50)\} \text{ x } (0.309785 - 0.25)] \text{ x } S_a = 1.540215 \text{ x } 0.309785 = 0.477135$

S_{D1} $= F_vS_1 = 2.4 \text{ x } 0.087162 = 0.209189$

T_S $= S_{D1}/S_{DS} = 0.209189/0.477135 = 0.4384$

T_o $= 0.20T_S = 0.20 \text{ x } 0.219 = 0.0877$

‡ $= 0.70 \text{ x } S_{D1}/T$

Construction of SC Seismic Hazard Map Three-Point ADRS Curve for Site Class D for Safety Earthquake Evaluation (SEE) Event

Estimation of Spectral Accelerations considering the Local Site Effects

ω	T	$S_{a\,(PSA)}$	T	S_a	$0.7S_a$	$S_{a\,(av)}$	$S_{a\,(Rec)}$	T_a	$S_{a\,(Rec)}$
Hz	sec	g	sec	g	g	g	g	sec	g
-	0.00	0.602461	0.00	0.602461	0.421723	0.395276	0.421723	0.20	1.116543
13.0	0.08	1.066766	0.11 = T_o	1.179670	0.825769	0.638859	0.825769	0.24	0.949197
6.7	0.15	1.120118	0.53 = T_S	1.179670	0.825769	0.835797	0.835797	0.26	0.825769
5.0	0.20	1.122372	1.00	0.621920	0.435344	0.511567	0.511567	0.32	0.825769
3.3	0.30	0.970438	2.00	0.310960	0.217672	0.216085	0.217672	0.34	0.947433
2.0	0.50	0.724003	3.00	0.207307	0.145115	0.115794	0.145115	0.40	1.179406
1.0	1.00	0.426269	-	-	-	-	-	0.44	1.104266
0.5	2.00	0.198994	-	-	-	-	-	0.48	0.964450
-	-	-	-	-	-	-	-	> 0.53	*
-	-	-	-	-	-	-	-	> 0.85	ɫ

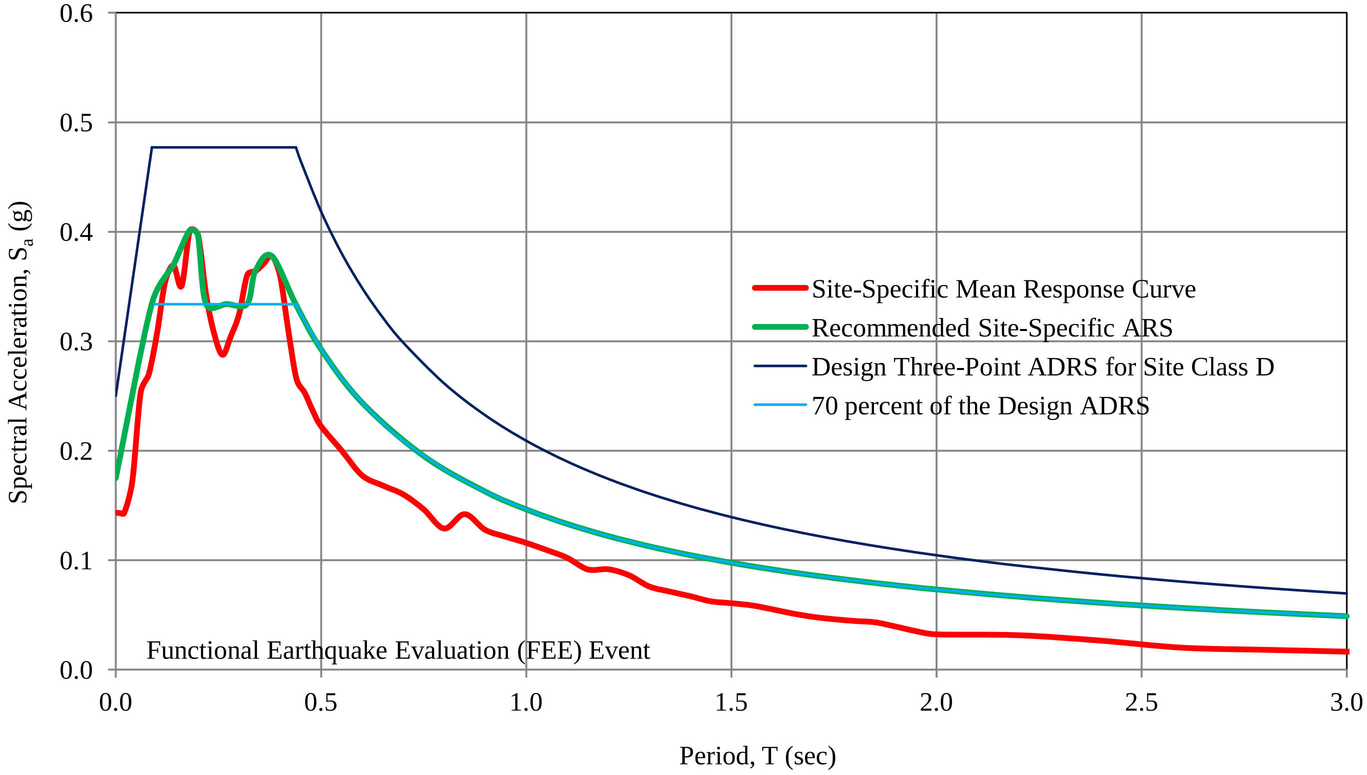
Notes:

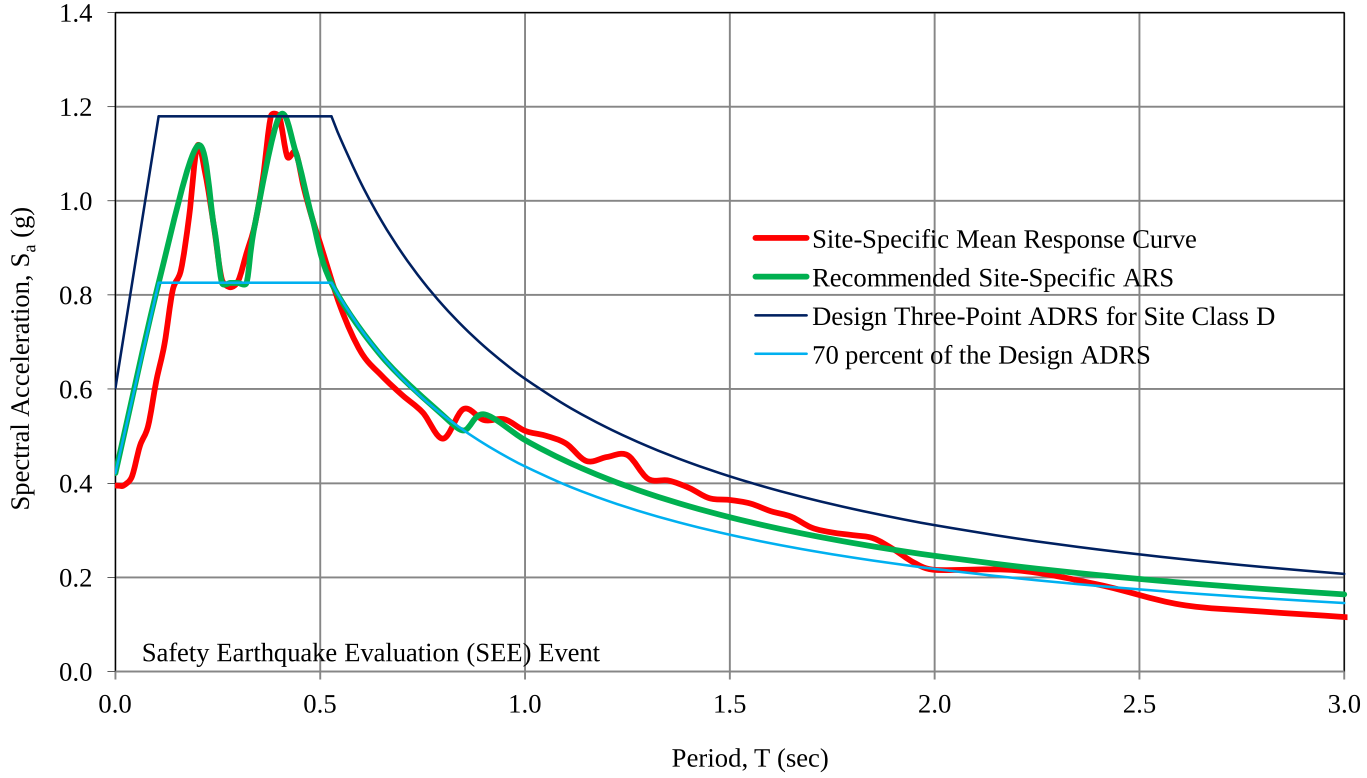
ω, T = frequency and time period, respectively and T = 1/ω
$S_{a\,(PSA)}$ = Pseudo-Spectral Acceleration (PSA) at the B-C boundary as provided by GDS
$PGA_{B\text{-}C}$ = mapped peak ground acceleration at the B-C boundary at T = 0.0 sec (GDM, § 12.7.2)
S_S = mapped spectral acceleration at B-C boundary for short-period (T = 0.2 sec) (GDM, § 12.7.3)
S_1 = mapped spectral acceleration at B-C boundary for long-period (T = 1.0 sec) (GDM, § 12.7.3)
F_{PGA} = site coefficient based on Site Class and mapped $PGA_{B\text{-}C}$ (GDM, Table 12-26)
F_a = site coefficient based on Site Class and S_s (GDM, Table 12-27)
F_v = site coefficient based on Site Class and S_1 (GDM, Table 12-28)
PGA = peak ground acceleration (period, T = 0.0 sec) at $Z_{DTM;}$ PGA = F_{PGA} . $PGA_{B\text{-}C}$ (GDM, Eq 12-35)
S_{DS} = design short-period (T = 0.2 sec) spectral response acceleration parameter (GDM, Eq 12-36)
S_{D1} = design long- period (T = 1.0 sec) spectral response acceleration parameter (GDM, Eq 12-37)
T_S, T_o = S_{D1}/S_{DS} (GDM, Eq 12-39), $T_o = 0.20T_s$ (GDM, Eq 12-38)
S_a = design spectral acceleration at Z_{DTM}
$0.7S_a$ = lowest spectral acceleration permitted without an independent third-party review (GDM, §12.8.5)
$S_{a\,(av)}$ = average spectral response acceleration (GDM, Table 12-29)
T_a = periods deemed necessary to generate the recommended response curve
$S_{a\,(Rec)}$ = recommended design spectral response acceleration

Calculations for Design Response Spectrum Parameters:

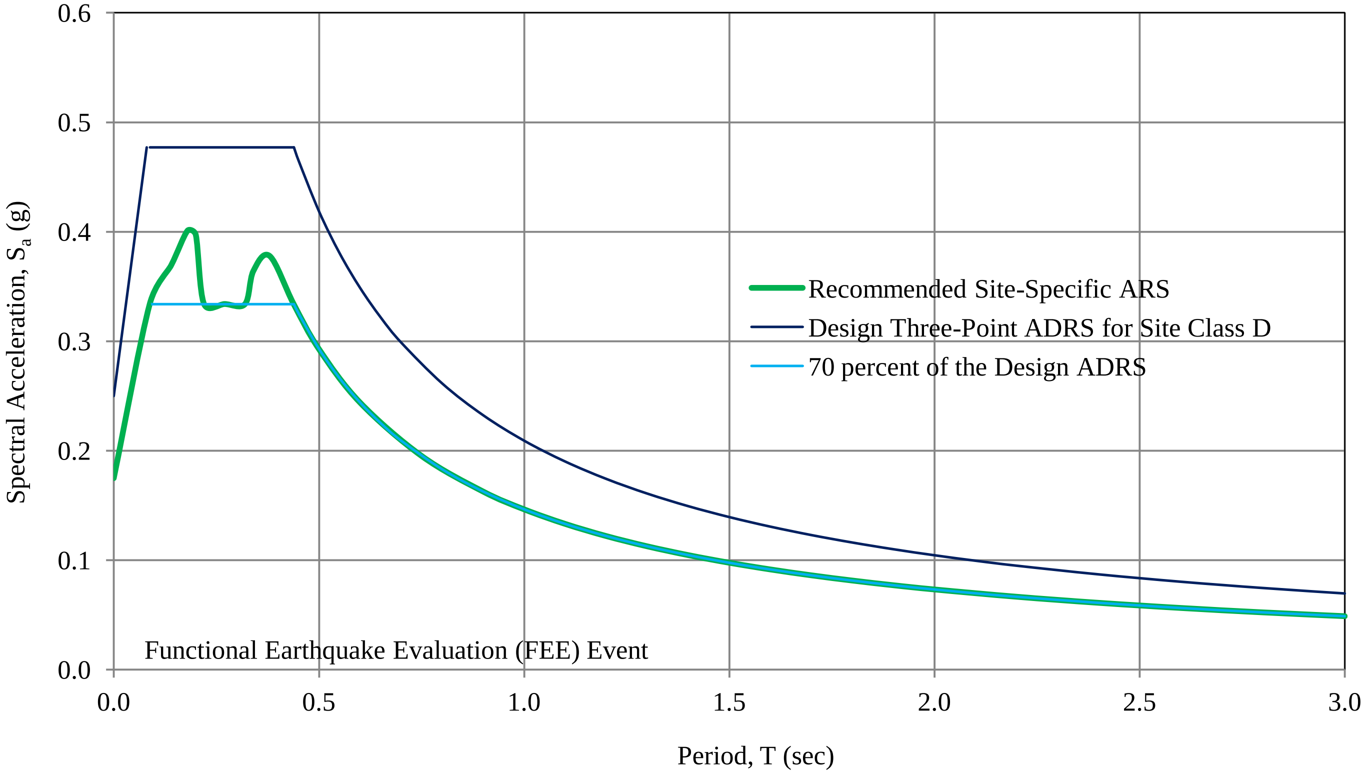
PGA $= F_{PGA} . PGA_{B\text{-}C} = 1.0 \text{ x } 0.602461 = 0.602461$
S_{DS} $= F_aS_s = [1.1 + \{(1.1 - 1.0)/(1.0 - 1.25)\} \text{ x } (1.122372 - 1.0)] \text{ x } 1.122372 = 1.051051 \text{ x}1.122372 = 1.179670$
S_{D1} $= F_vS_1 = [1.6 + \{(1.6 - 1.4)/(0.25 - 0.50)\} \text{ x } (0.426269 - 0.25)] \text{ x } 0.426269 = 1.458985 \text{ x } 0.426269 = 0.621920$
T_S $= S_{D1}/S_{DS} = 0.621920/1.179670 = 0.5272$
T_o $= 0.20T_S = 0.20 \text{ x } 0.52173 = 0.1054$
* $= 0.70 \text{ x } S_{D1}/T$
ɫ $= 0.84 \text{ x } S_{D1}/T$

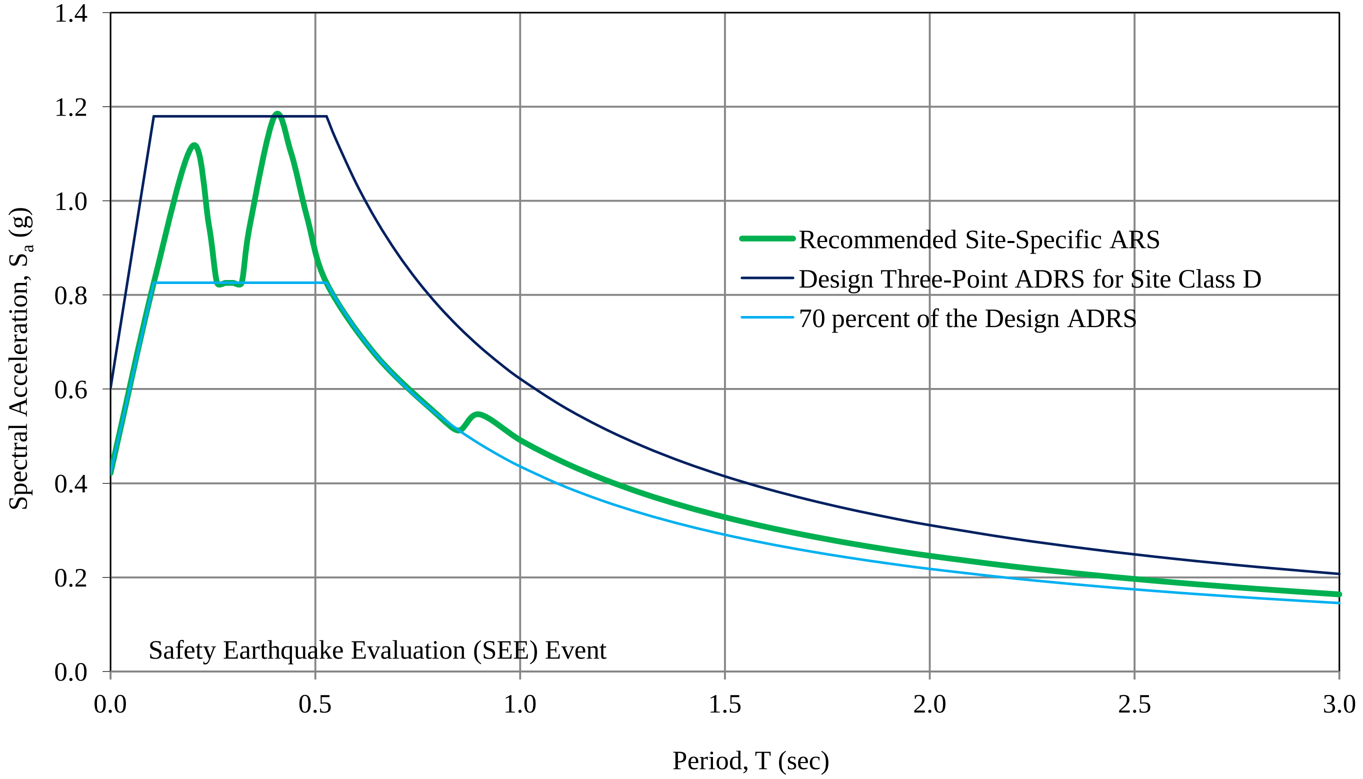
Construction of Recommended Site-Specific Acceleration Response Spectra (ARS) Curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE)



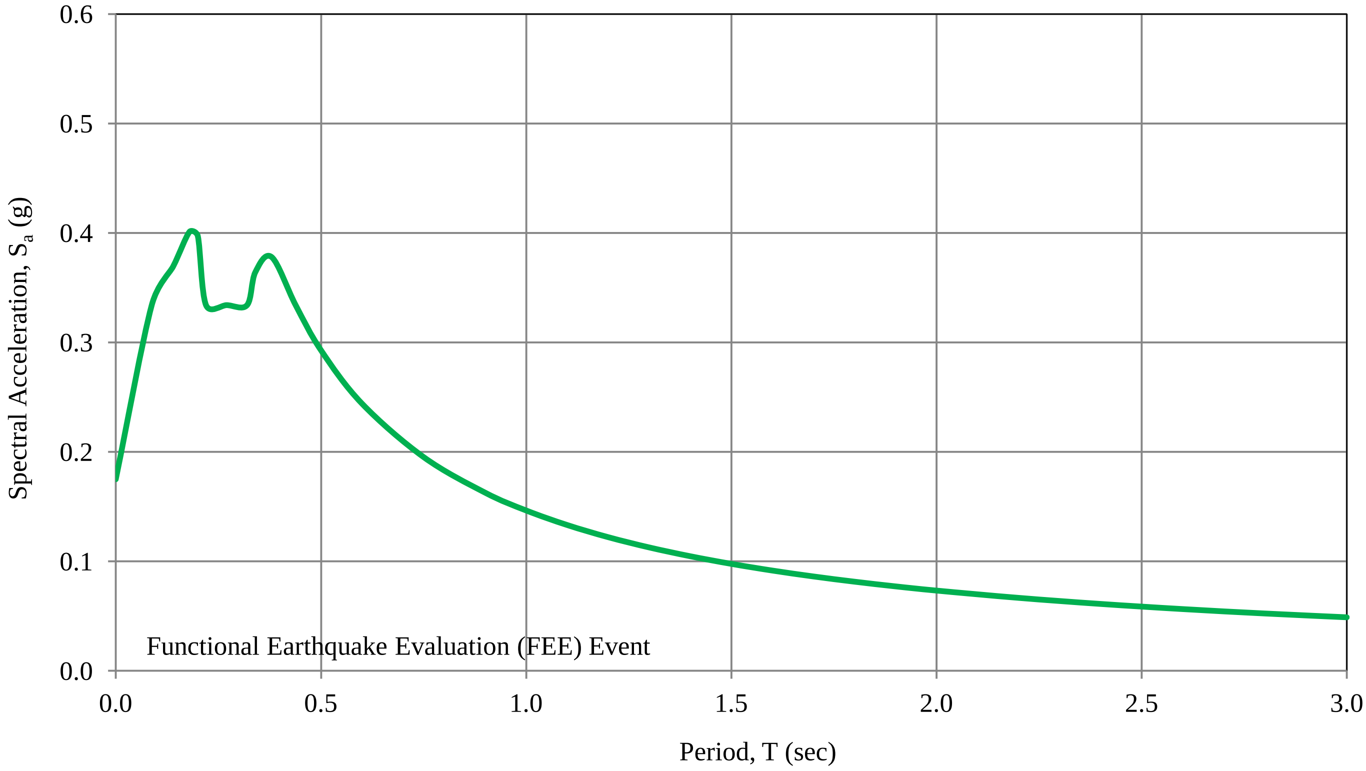


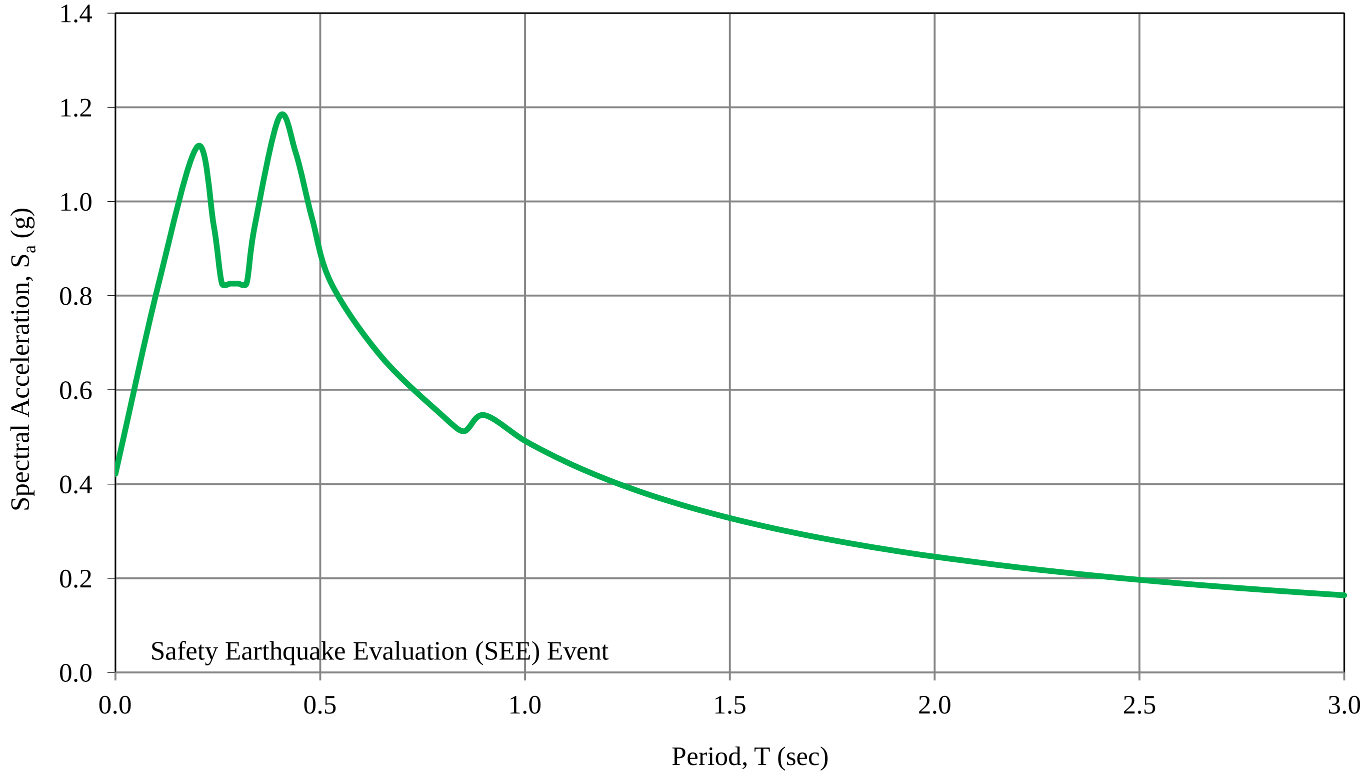
Construction of Recommended Site-Specific Acceleration Response Spectra (ARS) Curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE)





Recommended Site-Specific Acceleration Response Spectra (ARS) curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE)





SECTION 10

CONSTRUCTION OF SITE-SPECIFIC HORIZONTAL ADRS CURVES FOR SITE CLASS C

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curve for Site Class C for Functional Earthquake Evaluation (FEE) Event

Estimation of Spectral Accelerations for Recommended ARS Curves

T	$S_{a\ (rec)}$	0.9 $S_{a\ (rec)}$	T	0.7 $S_{a\ (PSA)}$	Design Parameters	Values	T	S_a
sec	g	g	sec	g	-	-	sec	g
0.00	0.144042	0.129638	0.00	0.144042	PGA, g	0.144042	0.00	0.144042
0.08	0.264218	0.237796	0.08	0.260219	(S_{DMax} - PGA)/T_o	1.550328	0.05	0.221558
0.14	0.364159	0.327743	0.40	0.260219	$S_{a\ (peak)}$, g	0.395333	0.10	0.299074
0.18	0.395333	0.355800	0.50	0.207445	0.9 $S_{a\ (peak)}$, g	0.355800	0.15	0.376591
0.20	0.392737	0.353463	1.00	0.103723	S_{DMax}, g	0.392737	0.16	0.392737
0.22	0.338204	0.304384	2.00	0.051861	n	0.67	0.53	0.392737
0.26	0.285851	0.257266	3.00	0.034574	T_o, sec	0.16	0.60	0.367704
0.30	0.322095	0.289886	-	-	T_s, sec	0.53	0.70	0.332712
0.38	0.374266	0.336839	-	-	-	-	0.80	0.301050
0.44	0.263705	0.237335	-	-	-	-	0.90	0.272402
0.50	0.207445	0.186701	-	-	-	-	1.00	0.246479
1.00	0.103723	0.093350			-	-	1.20	0.201800
2.00	0.054591	0.049132	-	-	-	-	1.40	0.165220
3.00	0.037044	0.033339	-	-	-	-	1.60	0.135271
-	-	-	-	-	-	-	1.80	0.110750
-	-	-	-	-	-	-	2.00	0.090675
-	-	-	-	-	-	-	2.20	0.074238
-	-	-	-	-	-	-	2.40	0.060781
-	-	-	-	-	-	-	2.60	0.049763
-	-	-	-	-	-	-	2.80	0.040743
-	-	-	-	-	-	-	3.00	0.033357

Notes:

ω, T = frequency and time period, respectively and T = 1/ω
$S_{a\ (rec)}$ = recommended site-specific response acceleration
0.9 $S_{a\ (rec)}$ = lowest spectral acceleration permitted that can be used to make the best-fit curve (GDM, Table 12-33)
$S_{a\ (PSA)}$ = Pseudo-Spectral Acceleration (PSA) as provide by the SCDOT Geotechnical Design Section
0.7 $S_{a\ (PSA)}$ = lowest spectral acceleration permitted without an independent third-party review (GDM, Table 12-33)
$S_{a\ (T<To)}$ = design spectral response acceleration for $T < T_o$, $S_a = PGA + T\ (S_{DMax} - PGA)/T_o$ (GDM, Eq 12-45)
$S_{a\ (T>Ts)}$ = design spectral response acceleration for $T > T_s$, $S_a = n/e^T$ (GDM, Eq 12-44)
$S_{a\ (peak)}$ = peak response acceleration at any period from the recommended site-specific ARS (GDM, Table 12-33)
0.9 $S_{a\ (peak)}$ = lowest value of S_{DMax} (GDM, Table 12-33)
S_{DMax} = maximum design spectral response acceleration and maximum of $S_{a\ (rec)}$ at T = 0.2 sec and 0.9 $S_{a\ (peak)}$
PGA = peak ground acceleration (period, T = 0.0 sec)
n = a non-dimensional curve fitting number (GDM, Eq 12-44)
T_o, T_s = short and long period, respectively

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curve for Site Class C for Safety Earthquake Evaluation (SEE) Event

Estimation of Spectral Accelerations for Recommended ARS Curves

T	$S_{a\ (rec)}$	0.9 $S_{a\ (rec)}$	T	0.7 $S_{a\ (PSA)}$	Design Parameter	Value	T	S_a
sec	g	g	sec	g	-	-	sec	g
0.00	0.4217227	0.379550	0.00	0.421723	PGA, g	0.421723	0.00	0.421723
0.10	0.7856604	0.707094	0.10	0.785660	$(S_{DMax}$ - PGA)/T_o	3.773458	0.05	0.610396
0.20	1.1016970	0.991527	0.52	0.785661	$S_{a\ (peak)}$, g	1.167337	0.10	0.799068
0.24	0.9374140	0.843673	1.00	0.409905	0.9 $S_{a\ (peak)}$, g	1.050603	0.15	0.987741
0.26	0.8249870	0.742488	2.00	0.204953	S_{DMax}, g	1.101697	0.18	1.101697
0.28	0.8087620	0.727886	3.00	0.136635	n	3.30	1.10	1.101697
0.30	0.8223130	0.740082	-	-	T_o, sec	0.18	1.20	0.993941
0.34	0.9359270	0.842334	-	-	T_s, sec	1.10	1.40	0.813770
0.40	1.1673370	1.050603	-	-	-	-	1.60	0.666259
0.44	1.0947540	0.985279	-	-	-	-	1.80	0.545486
0.50	0.9037900	0.813411	-	-	-	-	2.00	0.446606
0.55	0.7694020	0.692462	-	-	-	-	2.20	0.365650
0.65	0.6306235	0.567561	-	-	-	-	2.40	0.299369
0.80	0.5123816	0.461143	-	-	-	-	2.60	0.245103
0.85	0.5563660	0.500729	-	-	-	-	2.80	0.200673
1.00	0.4918863	0.442698	-	-	-	-	3.00	0.164297
2.00	0.2459432	0.221349	-	-	-	-	-	-
3.00	0.1639621	0.147566	-	-	-	-	-	-

Notes:

ω, T = frequency and time period, respectively and T = 1/ω

$S_{a\ (rec)}$ = recommended site-specific response acceleration

0.9 $S_{a\ (rec)}$ = lowest spectral acceleration permitted that can be used to make the best-fit curve (GDM, Table 12-33)

$S_{a\ (PSA)}$ = Pseudo-Spectral Acceleration (PSA) as provide by the SCDOT Geotechnical Design Section

0.7 $S_{a\ (PSA)}$ = lowest spectral acceleration permitted without an independent third-party review (GDM, Table 12-33)

$S_{a\ (T<To)}$ = design spectral response acceleration for $T < T_o$, S_a = PGA + T $(S_{DMax}$ - PGA)/T_o (GDM, Eq 12-45)

$S_{a\ (T>Ts)}$ = design spectral response acceleration for $T > T_s$, $S_a = n/e^T$ (GDM, Eq 12-44)

$S_{a\ (peak)}$ = peak response acceleration at any period from the recommended site-specific ARS (GDM, Table 12-33)

0.9 $S_{a\ (peak)}$ = lowest value of S_{DMax} (GDM, Table 12-33)

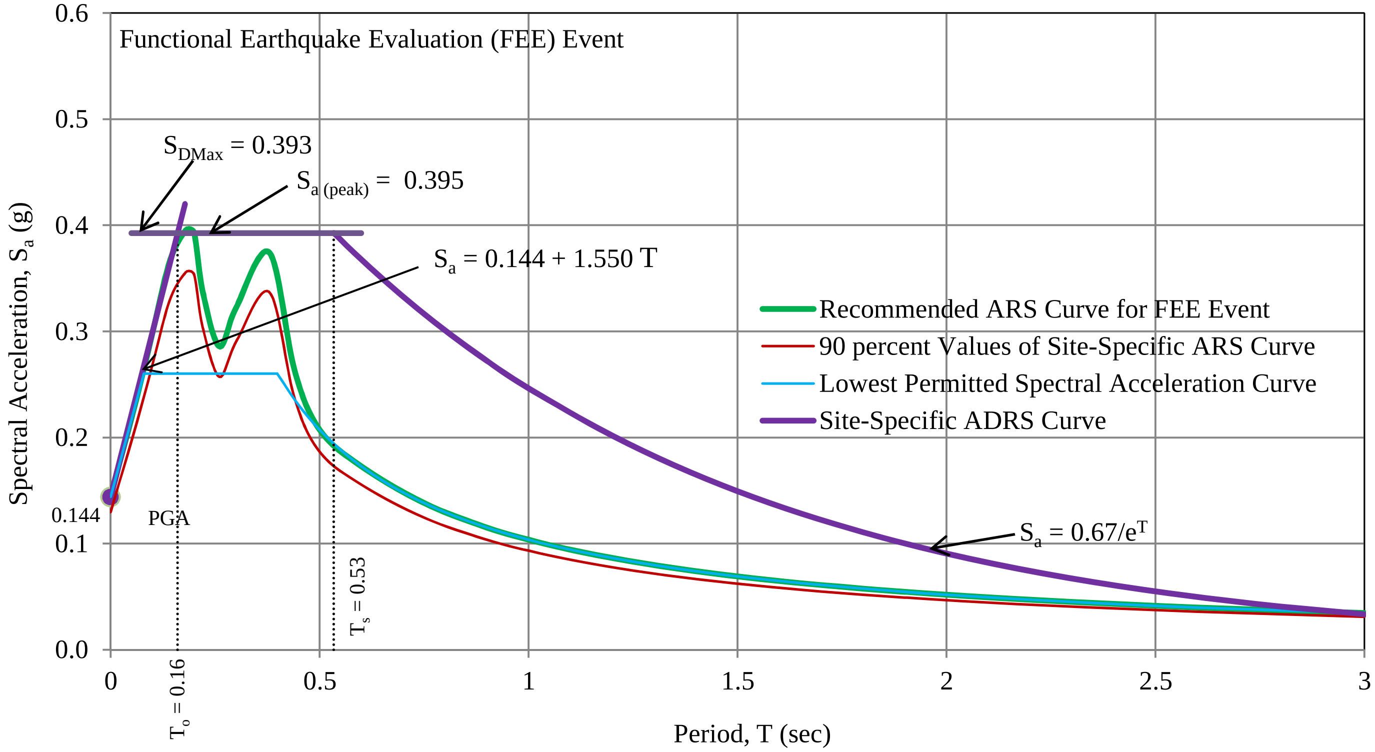
S_{DMax} = maximum design spectral response acceleration and maximum of $S_{a\ (rec)}$ at T = 0.2 sec and 0.9 $S_{a\ (peak)}$

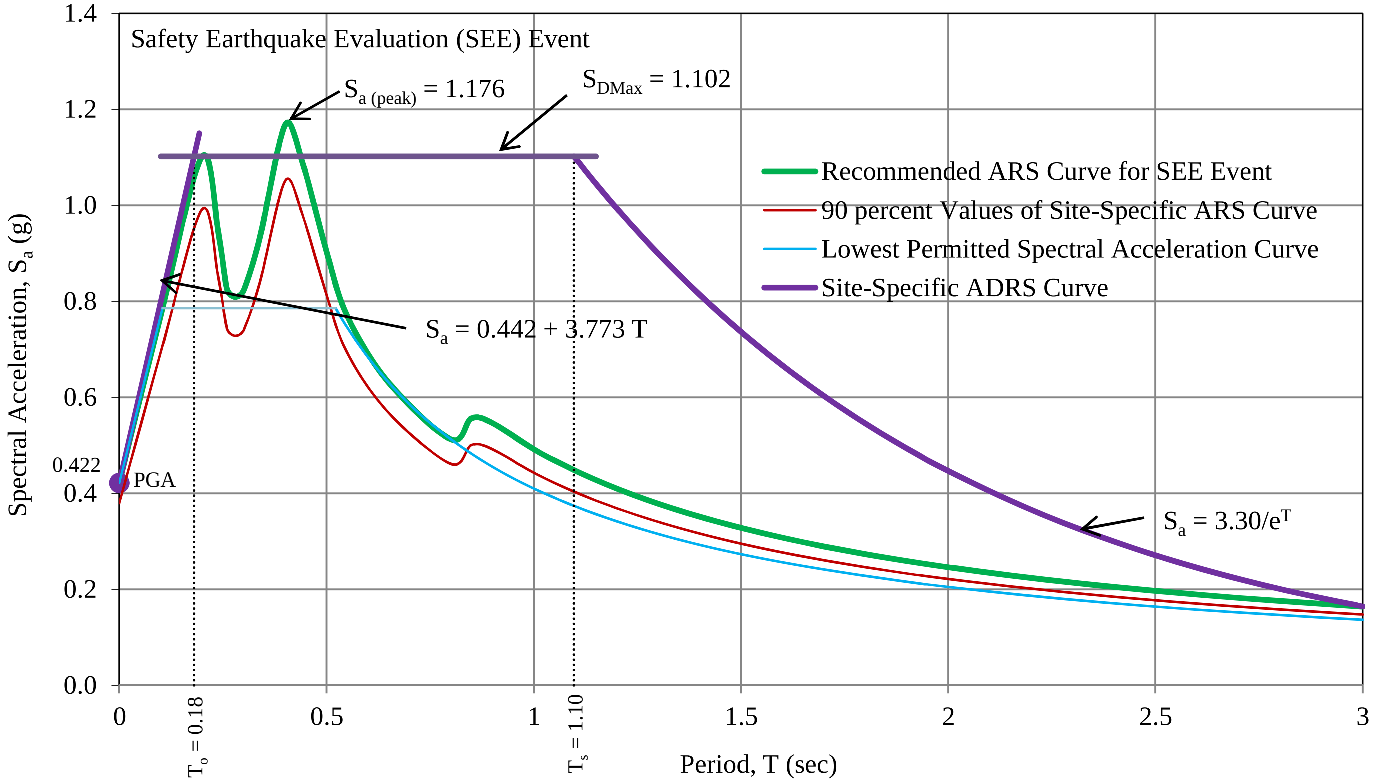
PGA = peak ground acceleration (period, T = 0.0 sec)

n = a non-dimensional curve fitting number (GDM, Eq 12-44)

$T_{o,}$ T_s = short and long period, respectively

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE) Events





Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Class C for Functional and Safety Evaluation Earthquake (FEE and SEE) Events

Calculations for FEE Event

$T < T_o$	S_a	ΔT	S_a-PGA	PGA	S_{DMax}-PGA To	n
0	0.14404	0.178	0.275958	0.144042	1.550328	0.67
0.1780	0.420000					

T	S_{DMax}	S_{DMax}-PGA	S_{DMax}-PGA To	T_o	n/S_{DMax}	T_s
0.05	0.39274	0.2487	1.550328	0.16041	1.70598	0.53414
0.60	0.39274					

T_o	S_{DMax}
0.16041	0
0.16041	0.39274

T_s	S_{DMax}
0.53414	0
0.53414	0.39274

FEE Event	
T	n/e^T
0.53	0.392737
0.60	0.367704
0.70	0.332712
0.80	0.301050
0.90	0.272402
1.00	0.246479
1.20	0.201800
1.40	0.165220
1.60	0.135271
1.80	0.110750
2.00	0.090675
2.20	0.074238
2.40	0.060781
2.60	0.049763
2.80	0.040743
3.00	0.033357

Calculations for SEE Event

$T < T_o$	S_a	ΔT	S_a-PGA	PGA	S_{DMax}-PGA To	n
0	0.42172	0.1930	0.728277	0.421723	3.773458	3.30
0.1930	1.150000					

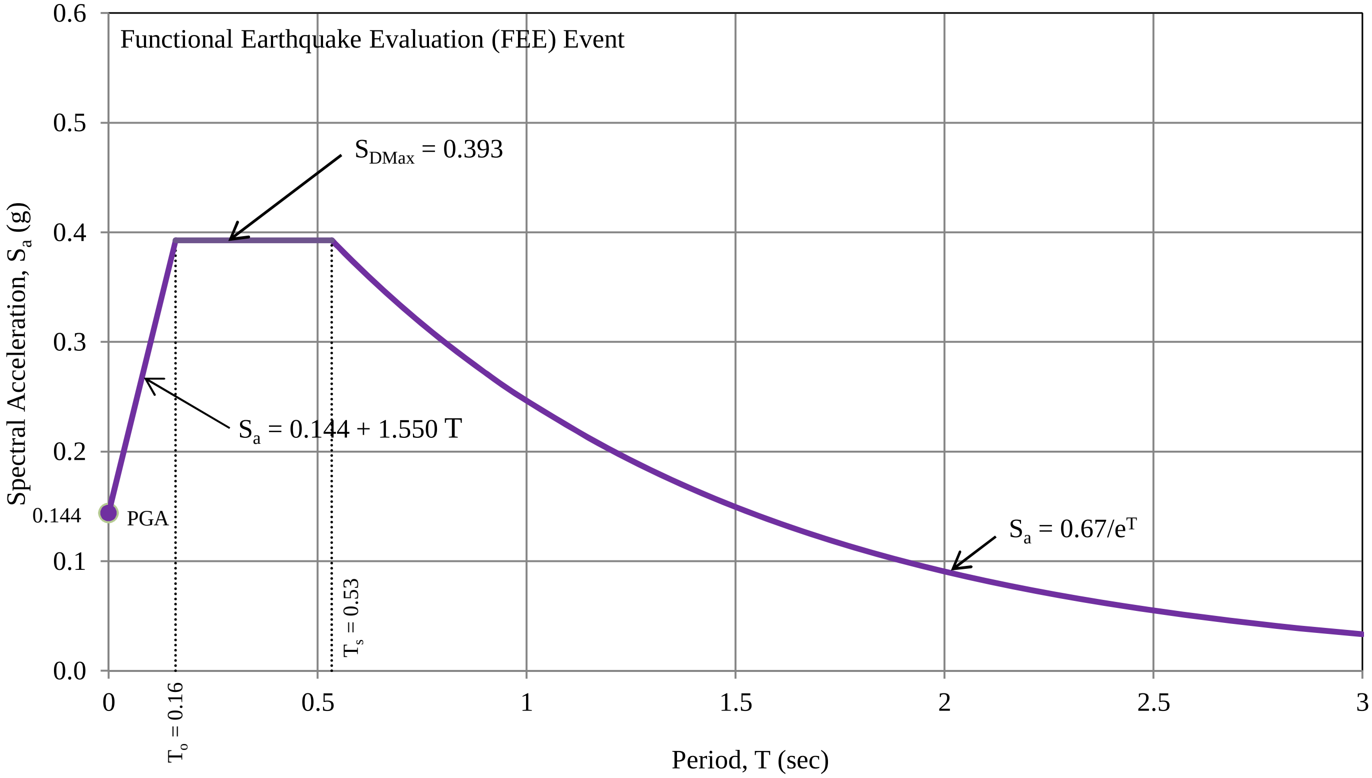
T	S_{DMax}	S_{DMax}-PGA	S_{DMax}-PGA To	T_o	n/S_{DMax}	T_s
0.10	1.1017	0.67997	3.773458	0.1802	2.99538	1.09707
1.15	1.1017					

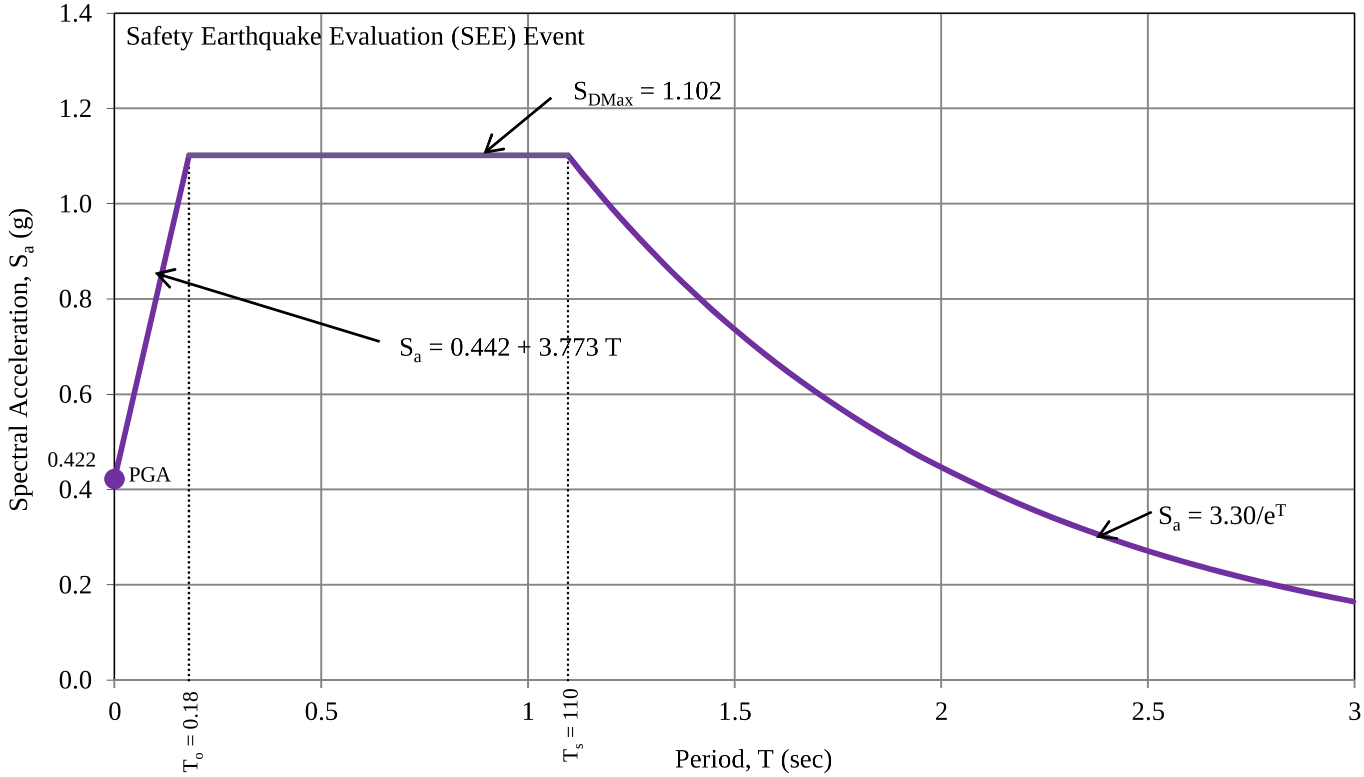
T_o	S_{DMax}
0.1802	0
0.1802	1.1017

T_s	S_{DMax}
1.09707	0
1.09707	1.1017

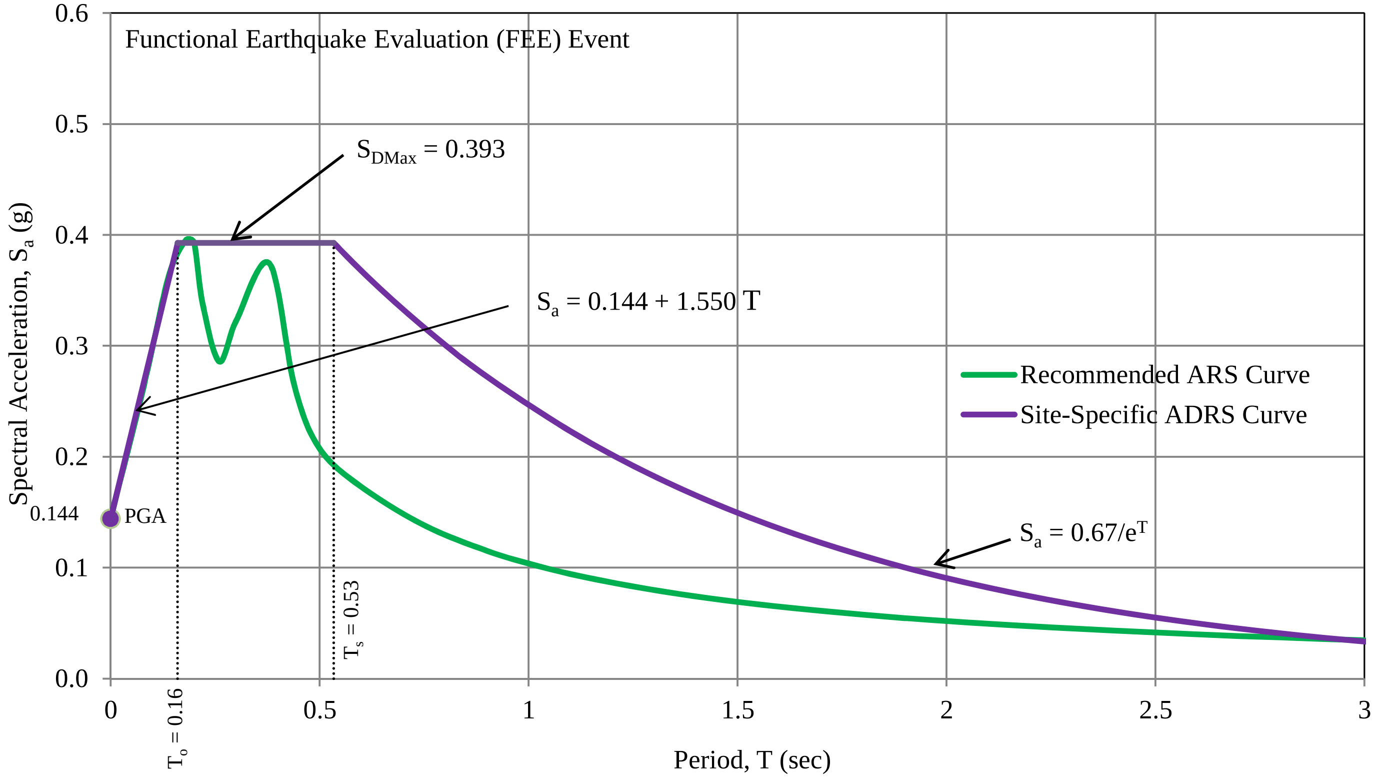
SEE Event	
T	n/e^T
1.10	1.10170
1.15	1.04490
1.20	0.99394
1.30	0.89935
1.40	0.81377
1.50	0.73633
1.60	0.66626
1.70	0.60286
1.80	0.54549
1.90	0.49358
2.00	0.44661
2.20	0.36565
2.40	0.29937
2.60	0.24510
2.80	0.20067
3.00	0.16430

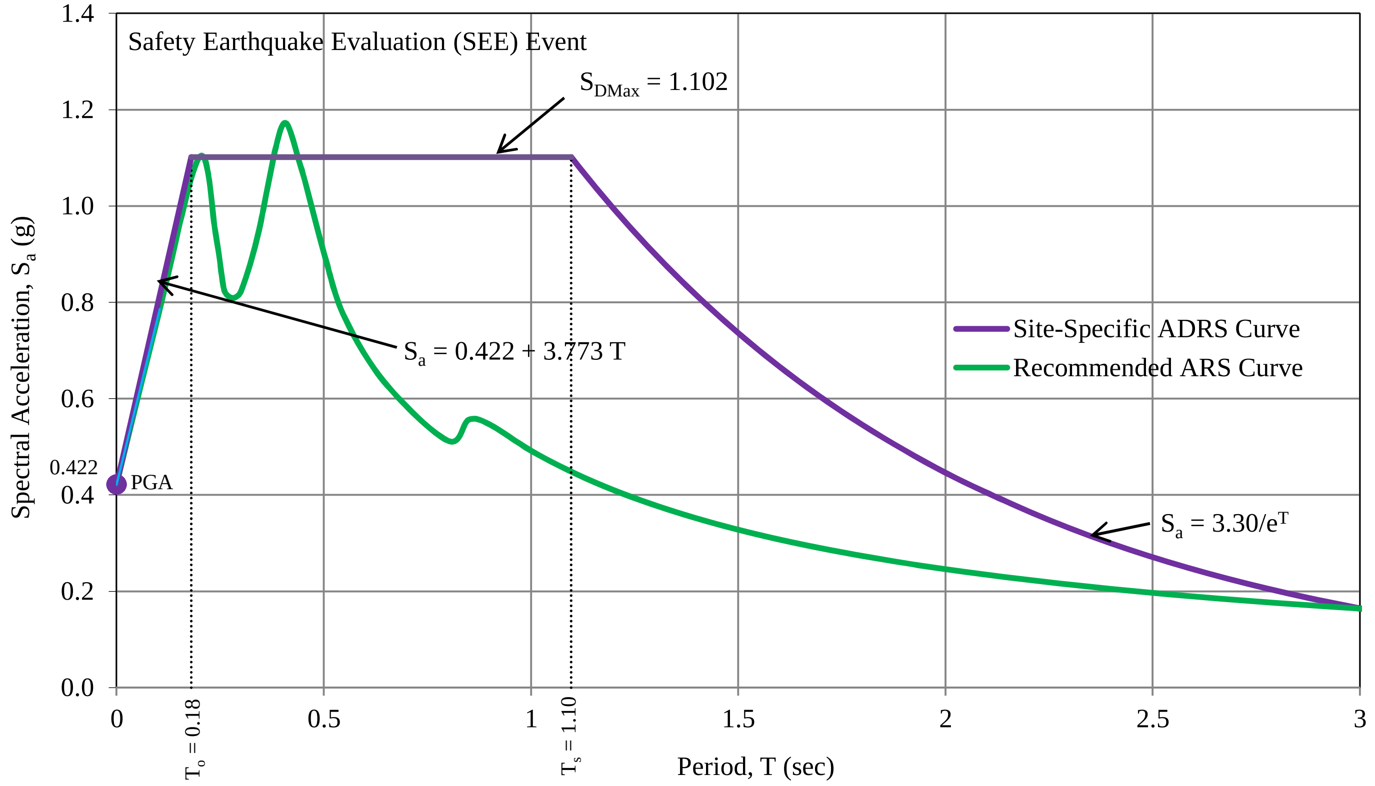
Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE) Events





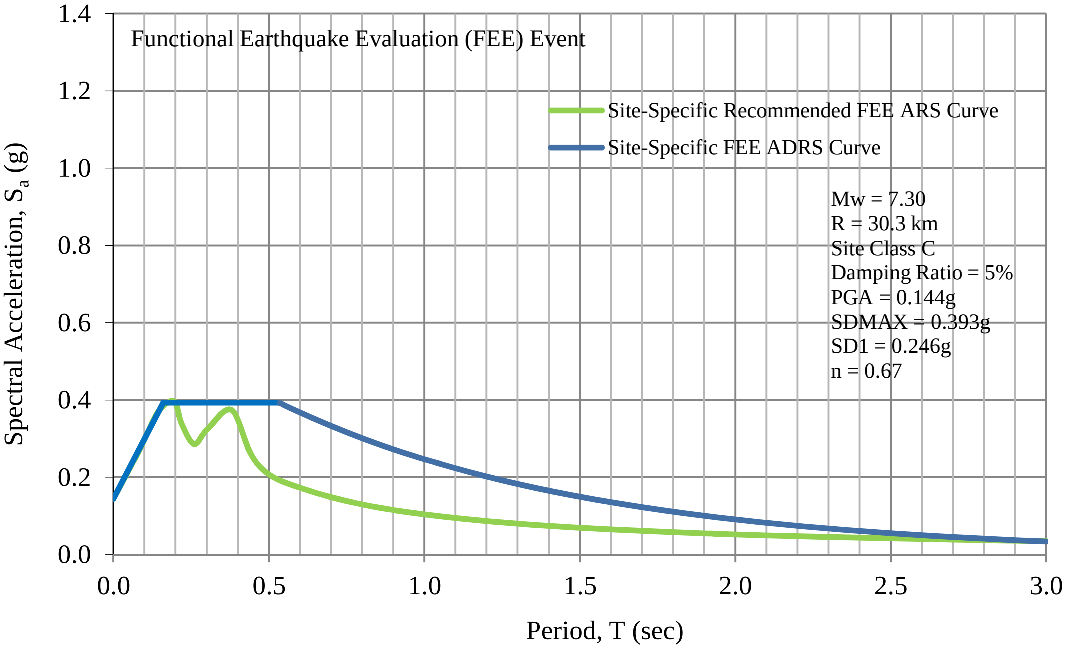
Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C for Functional and Safety Evaluation Earthquake (FEE and SEE) Events



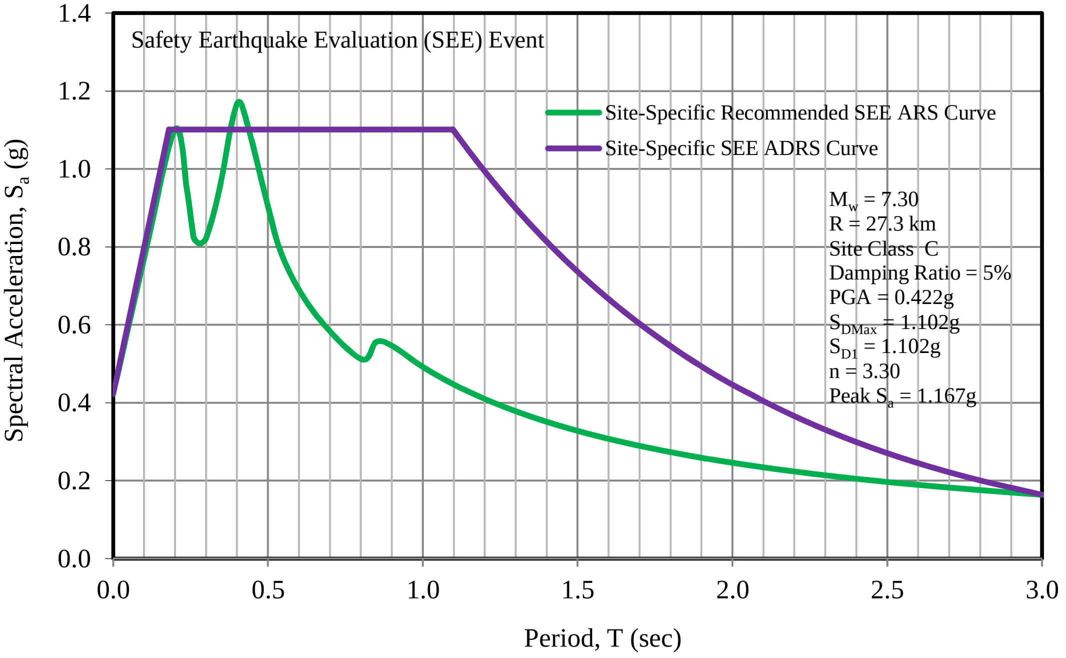


SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102
SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



	T	S_a
	sec	g
	0.00	0.144
	0.05	0.222
	0.10	0.299
T_s	0.16	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
T_s	0.53	0.393
	0.60	0.368
	0.70	0.333
	0.80	0.301
	0.90	0.272
	1.00	0.246
	1.20	0.202
	1.40	0.165
	1.60	0.135
	1.80	0.111
	2.00	0.091
	2.20	0.074
	2.40	0.061
	2.60	0.050
	2.80	0.041
	3.00	0.033

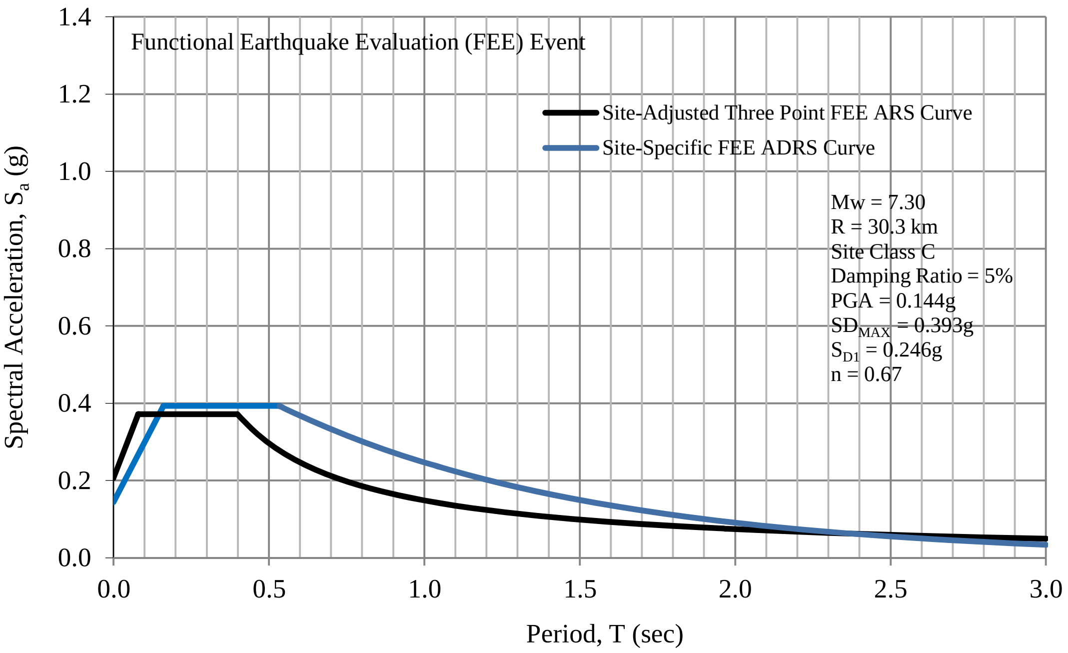


	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_s	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

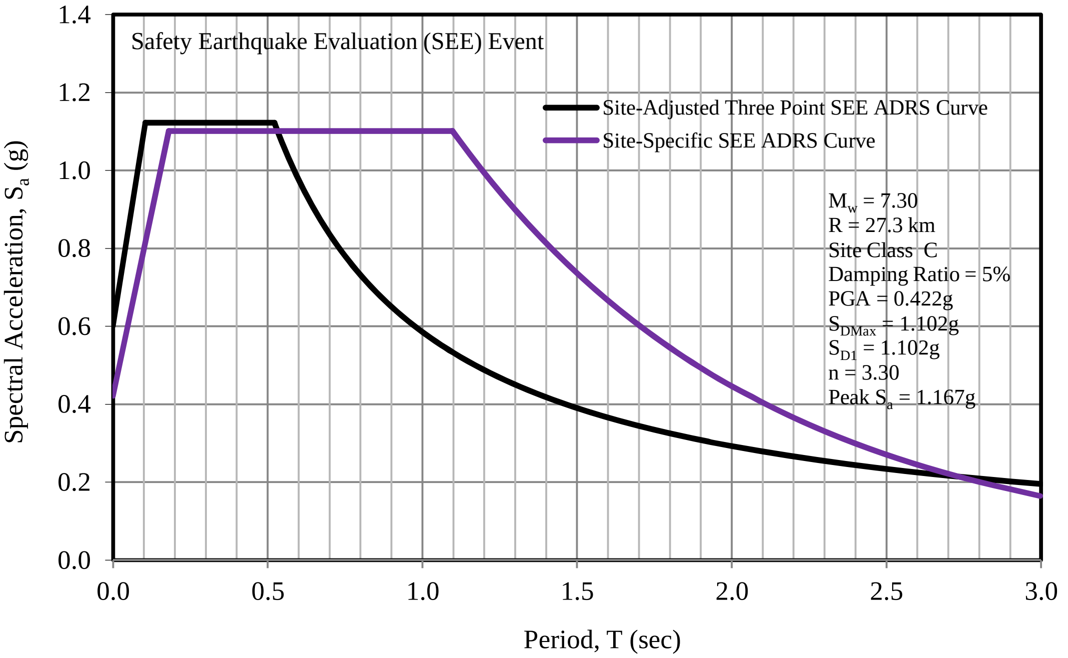
SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class C

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102

SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



	T	S_a
	sec	g
	0.00	0.144
	0.05	0.222
	0.10	0.299
T_s	0.16	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
T_s	0.53	0.393
	0.60	0.368
	0.70	0.333
	0.80	0.301
	0.90	0.272
	1.00	0.246
	1.20	0.202
	1.40	0.165
	1.60	0.135
	1.80	0.111
	2.00	0.091
	2.20	0.074
	2.40	0.061
	2.60	0.050
	2.80	0.041
	3.00	0.033



	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_s	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

SECTION 11

CONSTRUCTION OF SITE-SPECIFIC HORIZONTAL ADRS CURVES FOR SITE CLASS D

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curve for Site Class D for Functional Earthquake Evaluation (FEE) Event

Estimation of Spectral Accelerations for Recommended ARS Curves

T	$S_{a\,(Rec)}$	0.9 $S_{a\,(rec)}$	T	0.7 $S_{a\,(PSA)}$	Design Parameters	Values	T	S_a
sec	g	g	sec	g	-	-	sec	g
0.00	0.174896	0.157406	0.00	0.174896	PGA, g	0.174896	0.00	0.174896
0.09	0.333995	0.300595	0.09	0.333995	$(S_{DMax}$ - PGA$)/T_o$	1.851213	0.05	0.267457
0.14	0.364159	0.327743	0.44	0.333995	$S_{a\,(peak)}$, g	0.395333	0.10	0.360017
0.18	0.395333	0.355800	1.00	0.146432	0.9 $S_{a\,(peak)}$, g	0.355800	0.12	0.392737
0.20	0.392737	0.353463	2.00	0.077069	S_{DMax}, g	0.392737	0.98	0.392737
0.22	0.333995	0.300595	3.00	0.052297	n	1.05	1.00	0.386273
0.27	0.333995	0.300595	-	-	T_o, sec	0.12	1.20	0.316254
0.32	0.333995	0.300595	-	-	T_s, sec	0.98	1.40	0.258927
0.34	0.360578	0.324520	-	-	-	-	1.60	0.211991
0.38	0.374266	0.336839	-	-	-	-	1.80	0.173564
0.44	0.333995	0.300595	-	-	-	-	2.00	0.142102
0.50	0.292864	0.263578			-	-	2.20	0.116343
1.00	0.146432	0.131789	-	-	-	-	2.40	0.095254
2.00	0.077069	0.069363	-	-	-	-	2.60	0.077987
3.00	0.052297	0.047067	-	-	-	-	2.80	0.063851
-	-	-	-	-	-	-	3.00	0.052276

Notes:

ω, T = frequency and time period, respectively and $T = 1/\omega$

$S_{a\,(rec)}$ = recommended site-specific response acceleration

0.9 $S_{a\,(rec)}$ = lowest spectral acceleration permitted that can be used to make the best-fit curve (GDM, Table 12-33)

$S_{a\,(PSA)}$ = Pseudo-Spectral Acceleration (PSA) as provide by the SCDOT Geotechnical Design Section

0.7 $S_{a\,(PSA)}$ = lowest spectral acceleration permitted without an independent third-party review (GDM, Table 12-33)

$S_{a\,(T<To)}$ = design spectral response acceleration for $T < T_o$, $S_a = PGA + T\,(S_{DMax} - PGA)/T_o$ (GDM, Eq 12-45)

$S_{a\,(T>Ts)}$ = design spectral response acceleration for $T > T_s$, $S_a = n/e^T$ (GDM, Eq 12-44)

$S_{a\,(peak)}$ = peak response acceleration at any period from the recommended site-specific ARS (GDM, Table 12-33)

0.9 $S_{a\,(peak)}$ = lowest value of S_{DMax} (GDM, Table 12-33)

S_{DMax} = maximum design spectral response acceleration and maximum of $S_{a\,(rec)}$ at T = 0.2 sec and 0.9 $S_{a\,(peak)}$

PGA = peak ground acceleration (period, T = 0.0 sec)

n = a non-dimensional curve fitting number (GDM, Eq 12-44)

T_o, T_s = short and long period, respectively

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curve for Site Class D for Safety Earthquake Evaluation (SEE) Event

Estimation of Spectral Accelerations for Recommended ARS Curves

T	$S_{a\ (Rec)}$	0.9 $S_{a\ (rec)}$	T	0.7 $S_{a\ (PSA)}$	Design Parameter	Value	T	S_a
sec	g	g	sec	g	-	-	sec	g
0.00	0.4217227	0.379550	0.00	0.421723	PGA, g	0.421723	0.00	0.421723
0.11	0.8257691	0.743192	0.10	0.825769	$(S_{DMax}$ - PGA)/T_o	3.773458	0.05	0.610396
0.20	1.1016970	0.991527	0.52	0.825769	$S_{a\ (peak)}$, g	1.167337	0.10	0.799068
0.24	0.9374140	0.843673	1.00	0.435344	0.9 $S_{a\ (peak)}$, g	1.050603	0.15	0.987741
0.26	0.8257691	0.743192	2.00	0.217672	S_{DMax}, g	1.101697	0.18	1.101697
0.28	0.8257691	0.743192	3.00	0.145115	n	3.30	1.10	1.096612
0.30	0.8257691	0.743192	-	-	T_o, sec	0.18	1.20	0.993941
0.32	0.8257691	0.743192	-	-	T_s, sec	1.10	1.40	0.813770
0.34	0.9359270	0.842334	-	-	-	-	1.60	0.666259
0.40	1.1673370	1.050603	-	-	-	-	1.80	0.545486
0.48	0.9574150	0.861674	-	-	-	-	2.00	0.446606
0.53	0.8257691	0.743192	-	-	-	-	2.20	0.365650
0.65	0.6697601	0.602784	-	-	-	-	2.40	0.299369
0.80	0.5441801	0.489762	-	-	-	-	2.60	0.245103
0.85	0.5121695	0.460953	-	-	-	-	2.80	0.200673
1.00	0.4918863	0.442698	-	-	-	-	3.00	0.164297
2.00	0.2588875	0.232999	-	-	-	-	-	-
3.00	0.1756737	0.158106	-	-	-	-	-	-

Notes:

ω, T = frequency and time period, respectively and T = 1/ω

$S_{a\ (rec)}$ = recommended site-specific response acceleration

0.9 $S_{a\ (rec)}$ = lowest spectral acceleration permitted that can be used to make the best-fit curve (GDM, Table 12-33)

$S_{a\ (PSA)}$ = Pseudo-Spectral Acceleration (PSA) as provide by the SCDOT Geotechnical Design Section

0.7 $S_{a\ (PSA)}$ = lowest spectral acceleration permitted without an independent third-party review (GDM, Table 12-33)

$S_{a\ (T<To)}$ = design spectral response acceleration for $T < T_o$, S_a = PGA + T (S_{DMax} - PGA)/T_o (GDM, Eq 12-45)

$S_{a\ (T>Ts)}$ = design spectral response acceleration for $T > T_s$, $S_a = n/e^T$ (GDM, Eq 12-44)

$S_{a\ (peak)}$ = peak response acceleration at any period from the recommended site-specific ARS (GDM, Table 12-33)

0.9 $S_{a\ (peak)}$ = lowest value of S_{DMax} (GDM, Table 12-33)

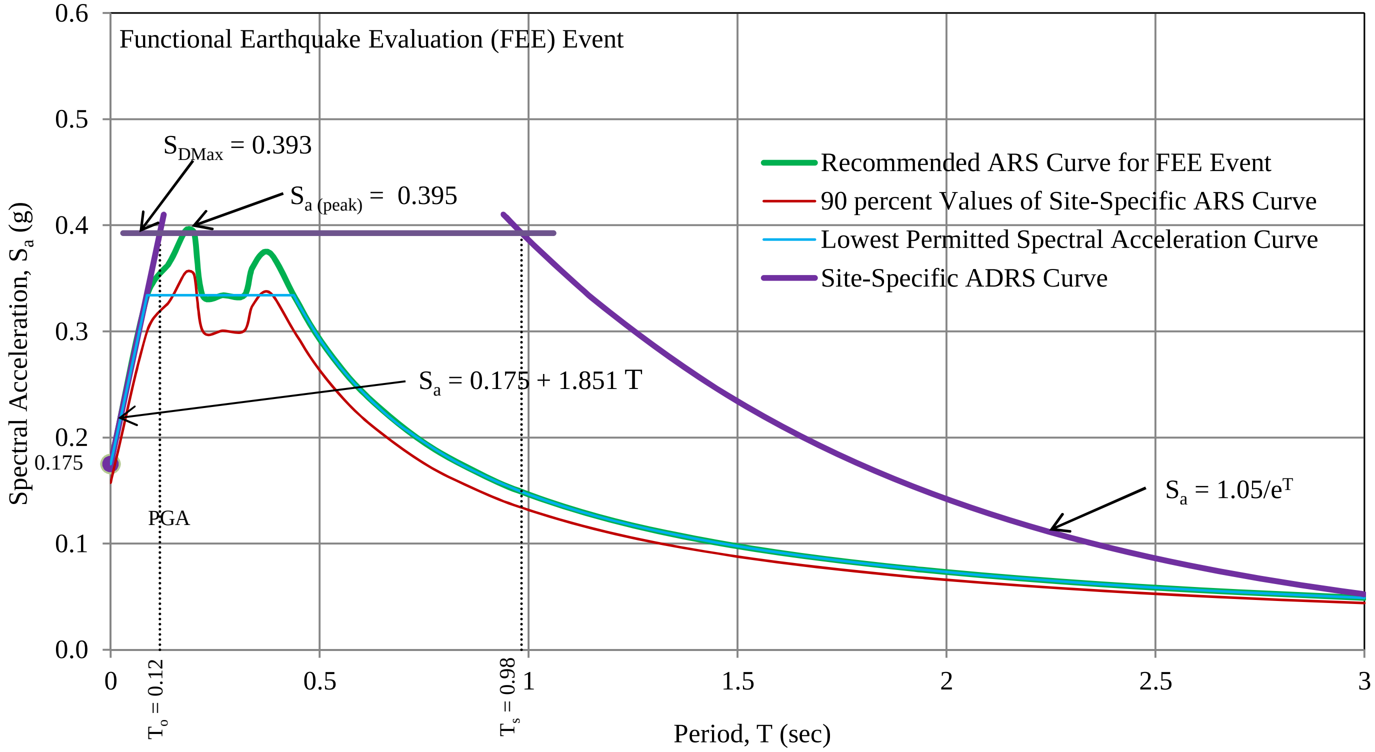
S_{DMax} = maximum design spectral response acceleration and maximum of $S_{a\ (rec)}$ at T = 0.2 sec and 0.9 $S_{a\ (peak)}$

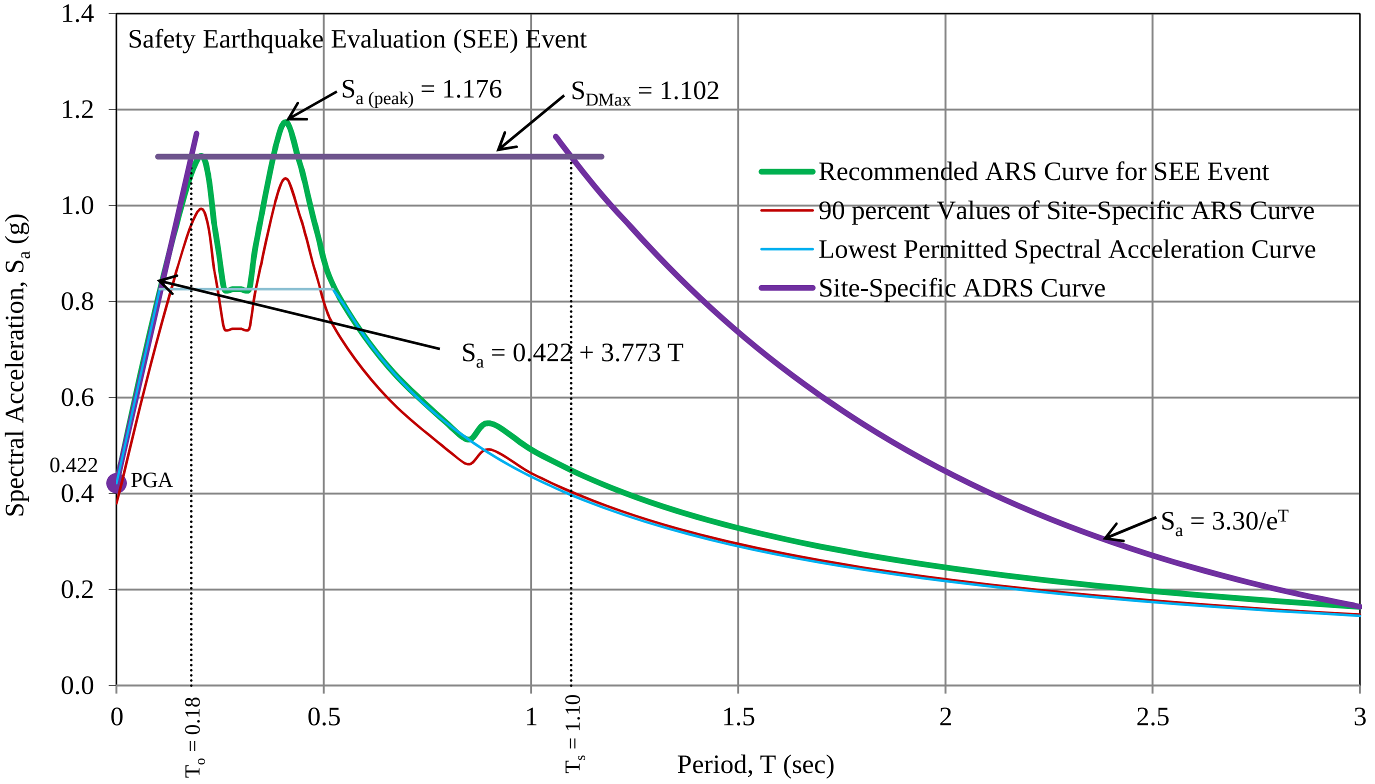
PGA = peak ground acceleration (period, T = 0.0 sec)

n = a non-dimensional curve fitting number (GDM, Eq 12-44)

$T_{o,}$ T_s = short and long period, respectively

Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE) Events





Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Functional and Safety Evaluation Earthquake (FEE and SEE) Events

Calculations for FEE Event

$T < T_o$	S_a	ΔT	S_a-PGA	PGA	$\frac{S_{DMax}\text{-}PGA}{To}$	n
0	0.1749	0.127	0.235104	0.174896	1.851213	1.05
0.1270	0.410000					

T	S_{DMax}	S_{DMax}-PGA	$\frac{S_{DMax}\text{-}PGA}{To}$	T_o	n/S_{DMax}	T_s
0.03	0.39274	0.21784	1.851213	0.11767	2.67354	0.98341
1.06	0.39274					

T_o	S_{DMax}
0.11767	0
0.11767	0.39274

T_s	S_{DMax}
0.98341	0
0.98341	0.39274

FEE Event	
T	n/e^T
0.94	0.410159
0.95	0.406078
1.00	0.386273
1.10	0.349515
1.20	0.316254
1.40	0.258927
1.60	0.211991
1.80	0.173564
2.00	0.142102
2.20	0.116343
2.40	0.095254
2.60	0.077987
2.80	0.063851
3.00	0.052276

Calculations for SEE Event

$T < T_o$	S_a	ΔT	S_a-PGA	PGA	$\frac{S_{DMax}\text{-}PGA}{To}$	n
0	0.42172	0.1930	0.728277	0.421723	3.773458	3.30
0.1930	1.150000					

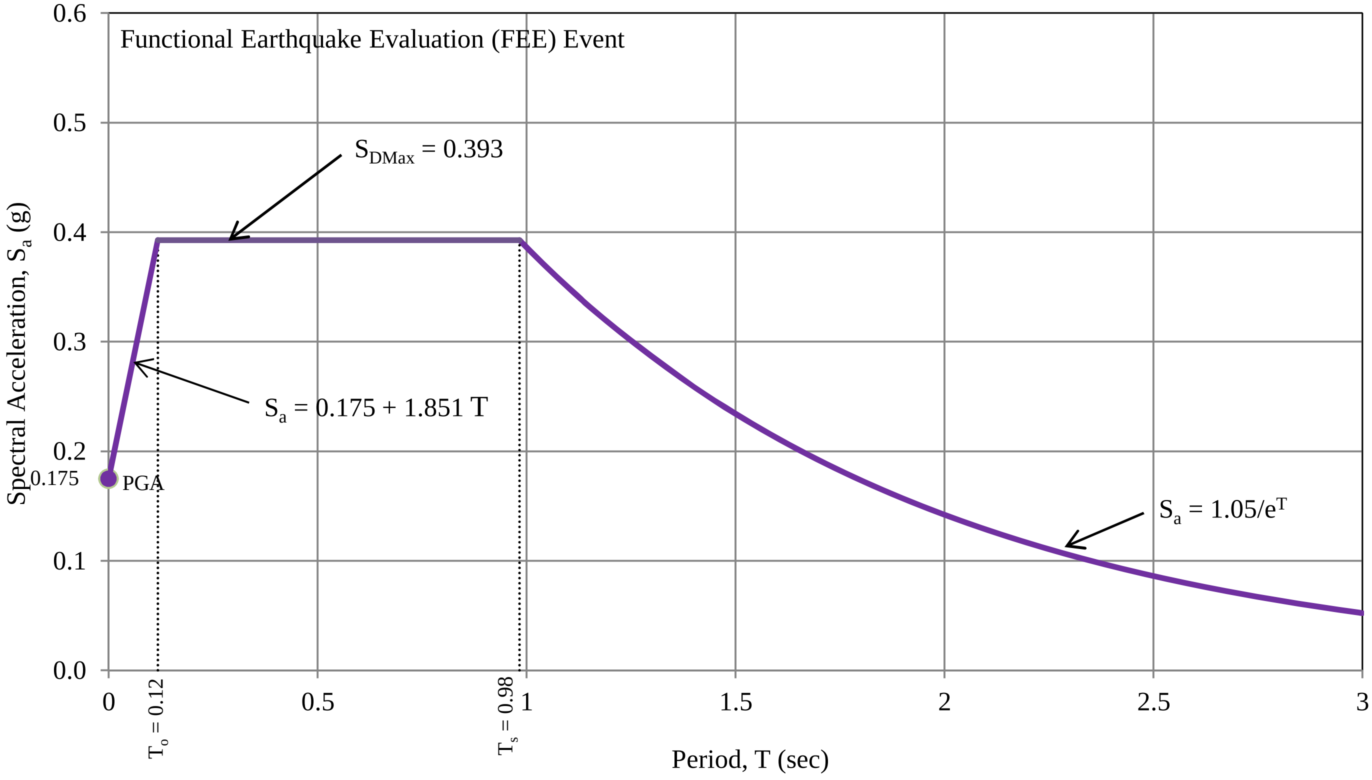
T	S_{DMax}	S_{DMax}-PGA	$\frac{S_{DMax}\text{-}PGA}{To}$	T_o	n/S_{DMax}	T_s
0.10	1.1017	0.67997	3.773458	0.1802	2.99538	1.09707
1.17	1.1017					

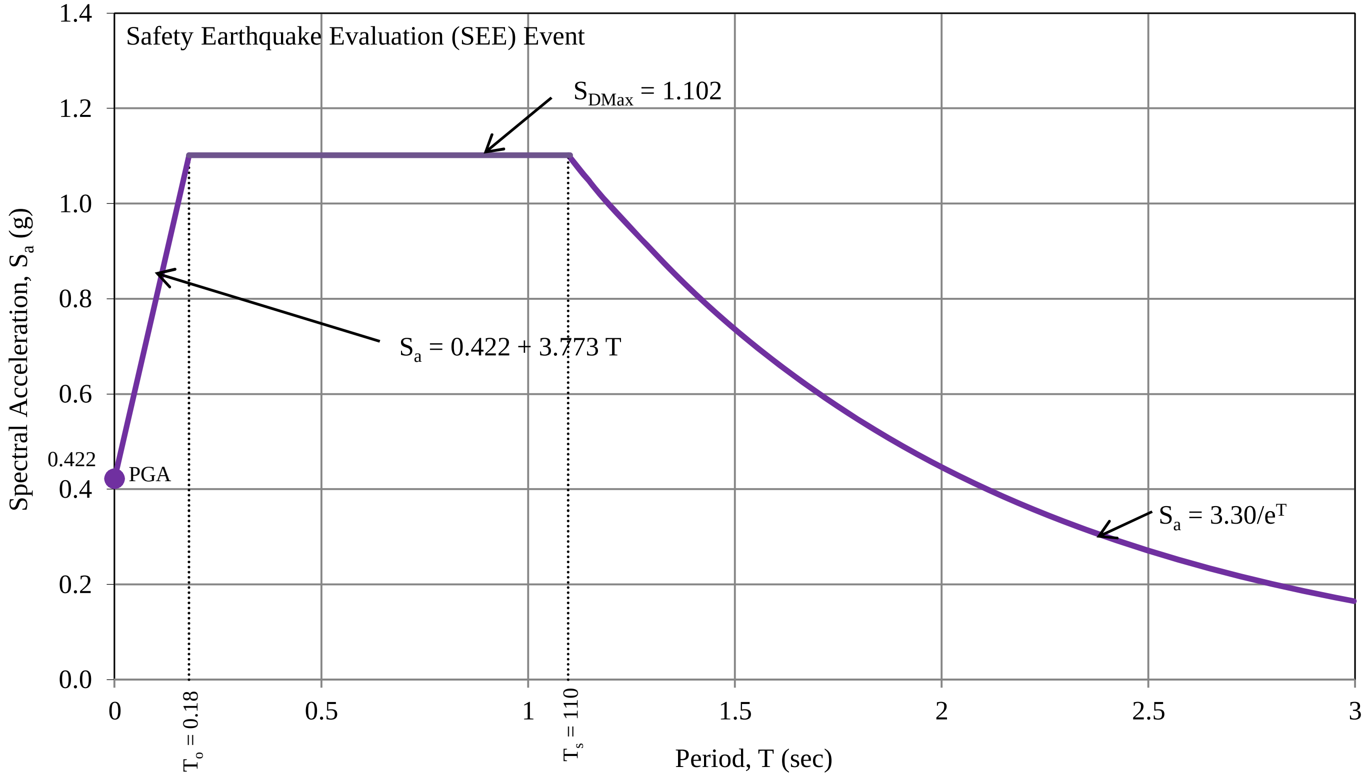
T_o	S_{DMax}
0.1802	0
0.1802	1.1017

T_s	S_{DMax}
1.09707	0
1.09707	1.1017

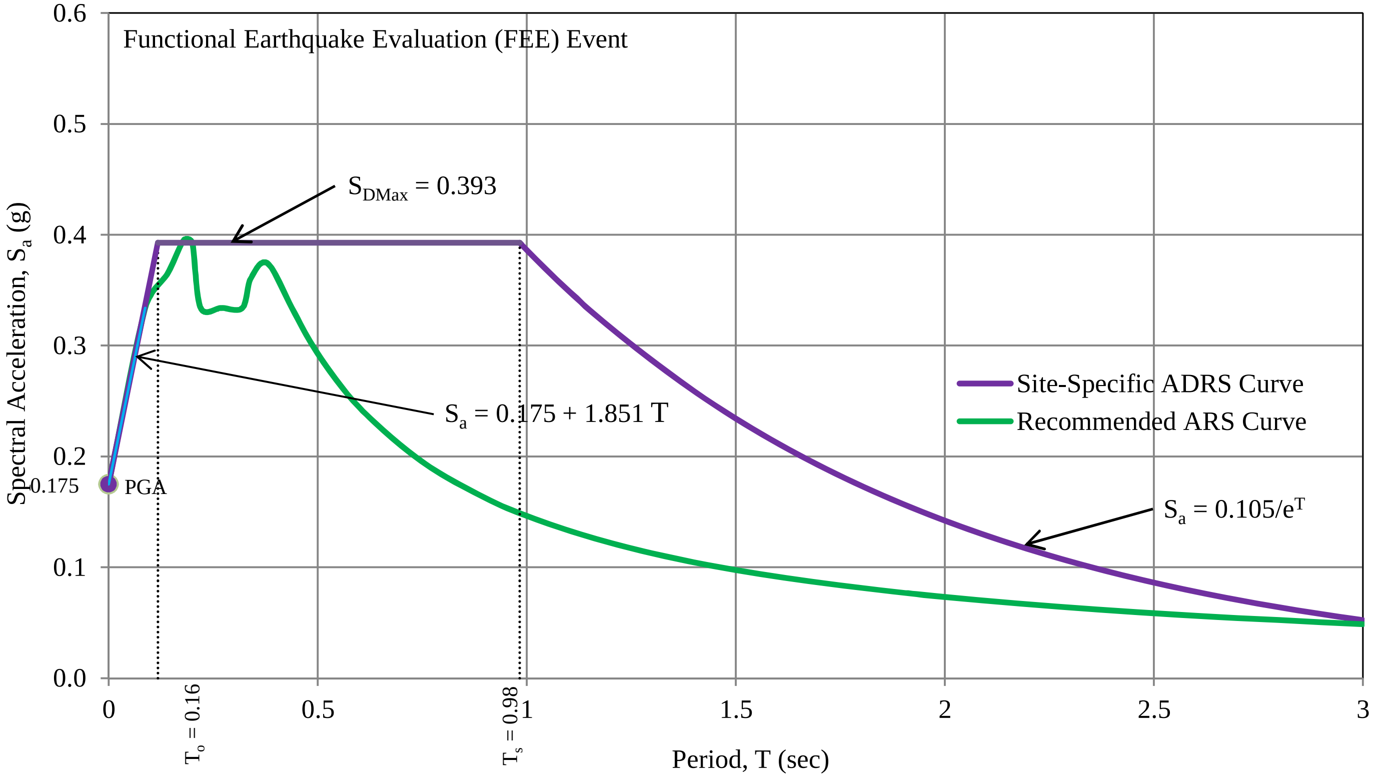
SEE Event	
T	n/e^T
1.06	1.14330
1.10	1.09847
1.20	0.99394
1.40	0.81377
1.60	0.66626
1.80	0.54549
2.00	0.44661
2.20	0.36565
2.40	0.29937
2.60	0.24510
2.80	0.20067
3.00	0.16430

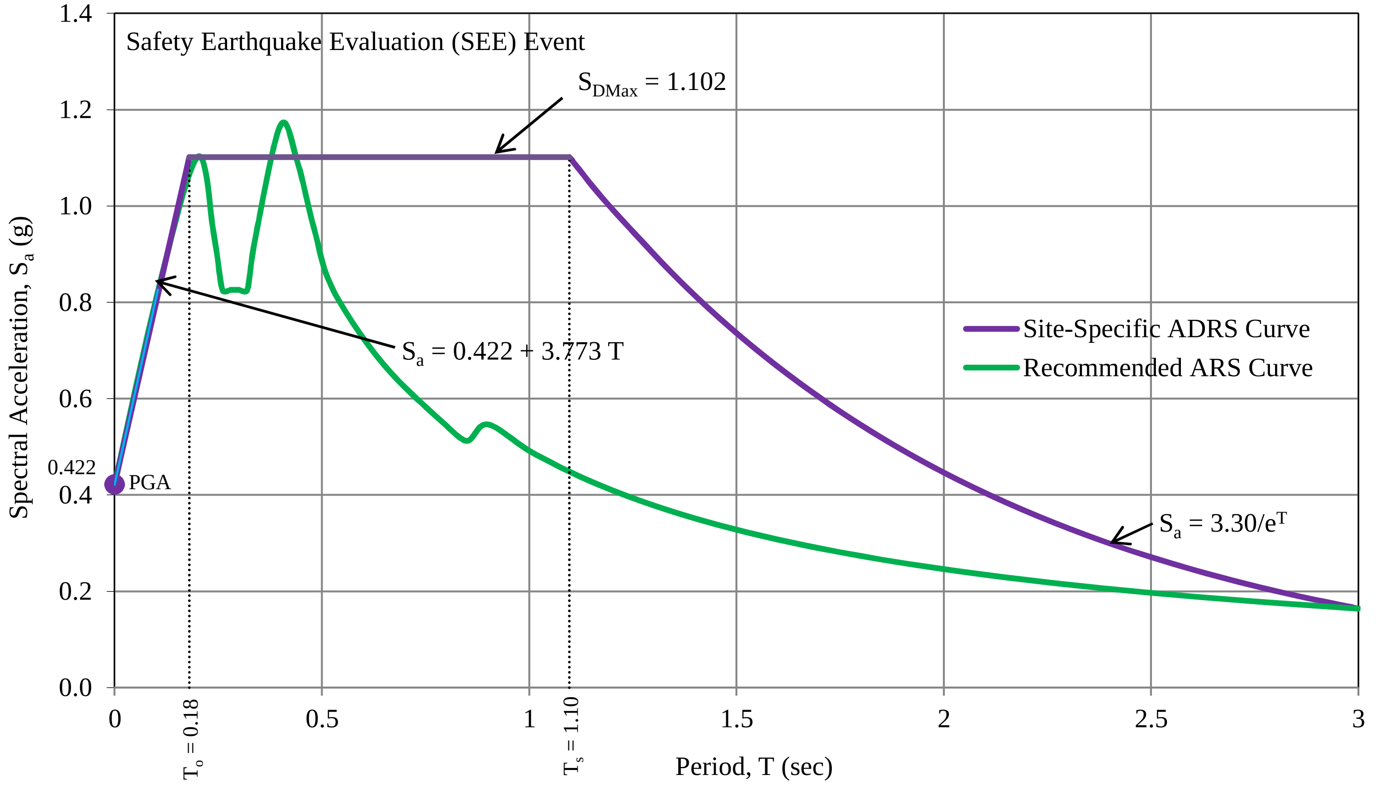
Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE) Events





Construction of Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D for Functional and Safety Evaluation Earthquake (FEE and SEE) Events

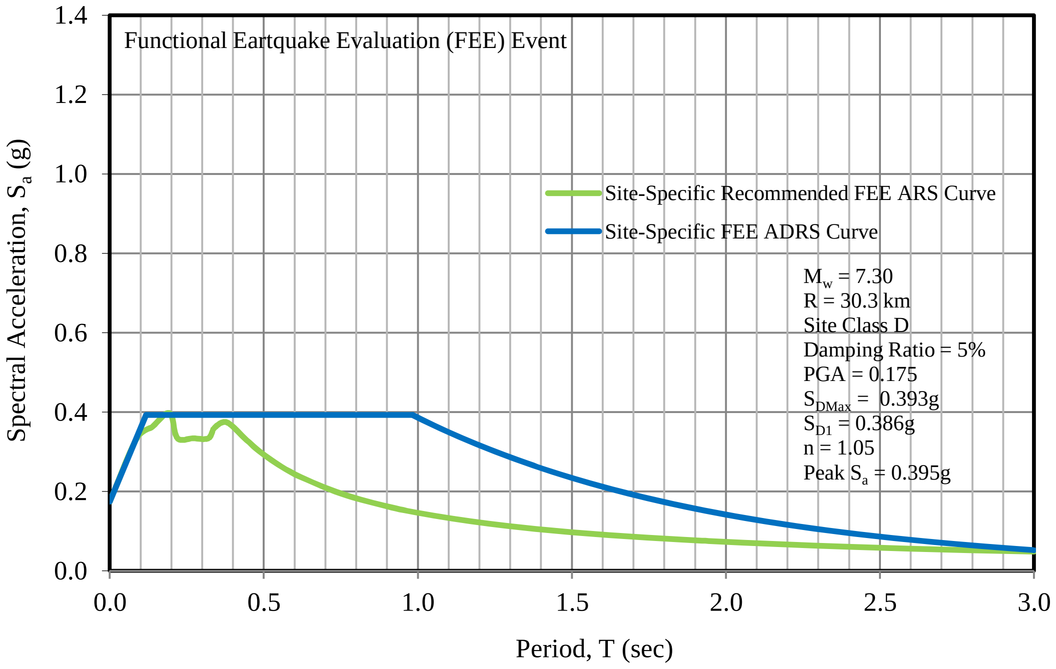




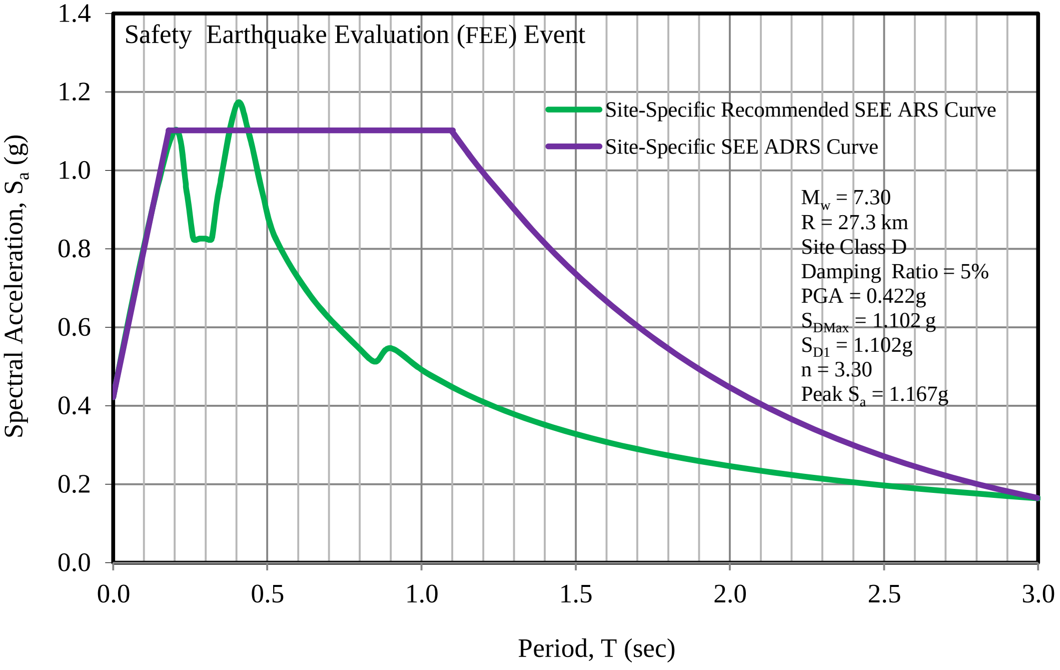
SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102

SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



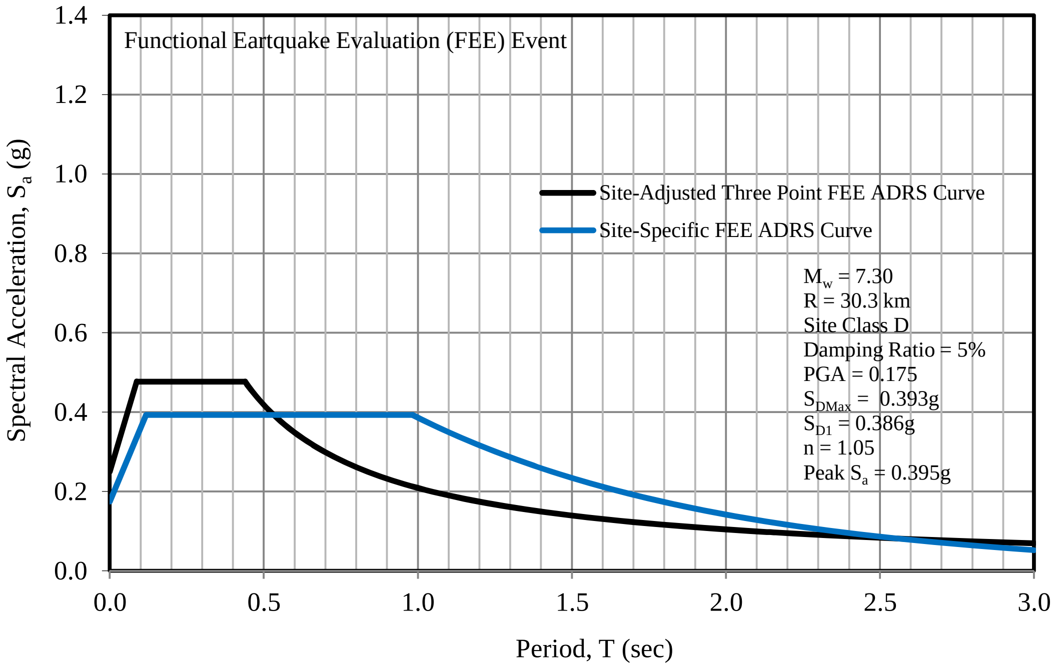
	T	S_a
	sec	g
	0.00	0.175
	0.05	0.267
	0.10	0.360
T_o	0.12	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
	0.60	0.393
	0.70	0.393
	0.80	0.393
	0.90	0.393
T_s	0.98	0.393
	1.00	0.386
	1.20	0.316
	1.40	0.259
	1.60	0.212
	1.80	0.174
	2.00	0.142
	2.20	0.116
	2.40	0.095
	2.60	0.078
	2.80	0.064
	3.00	0.052



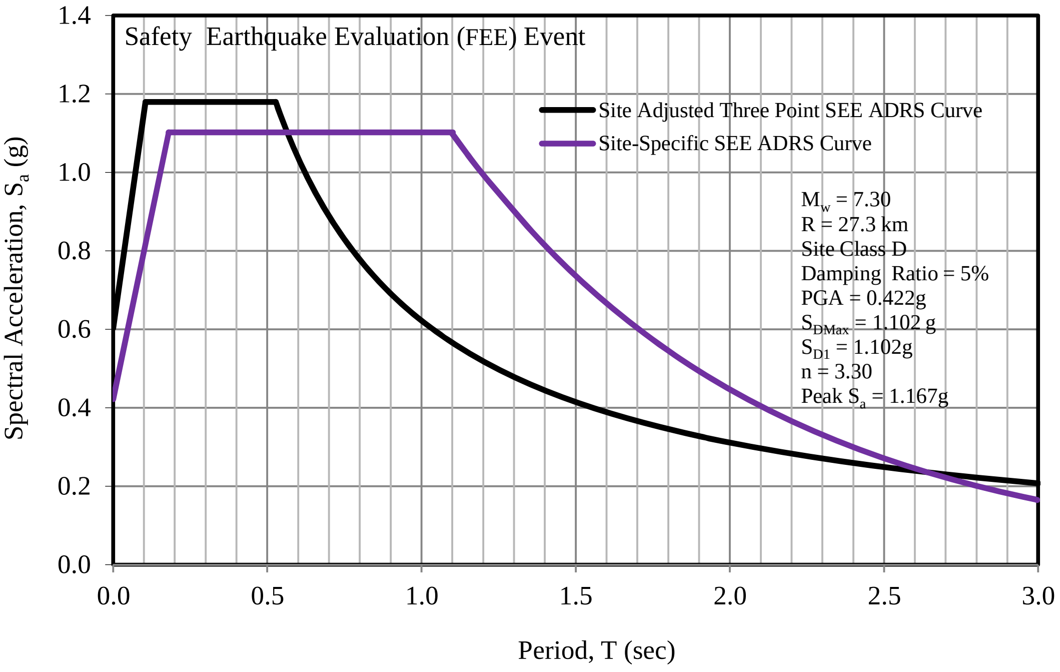
	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_o	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

SC 41 Replacement Bridge over Wando River
Site-Specific Horizontal Acceleration Design Response Spectra (ADRS) Curves for Site Class D

PROJECT IDENTIFICATION File Number: 8.158B/10.032102 Project Number (PIN): 32102
SITE INFORMATION Location - County: Berkeley Route: SC 41 Latitude: 32.9245° Longitude: -79.8250°



	T	S_a
	sec	g
	0.00	0.175
	0.05	0.267
	0.10	0.360
T_o	0.12	0.393
	0.20	0.393
	0.30	0.393
	0.40	0.393
	0.50	0.393
	0.60	0.393
	0.70	0.393
	0.80	0.393
	0.90	0.393
T_s	0.98	0.393
	1.00	0.386
	1.20	0.316
	1.40	0.259
	1.60	0.212
	1.80	0.174
	2.00	0.142
	2.20	0.116
	2.40	0.095
	2.60	0.078
	2.80	0.064
	3.00	0.052



	T	S_a
	sec	g
	0.00	0.422
	0.05	0.610
	0.10	0.799
T_o	0.18	1.102
	0.20	1.102
	0.30	1.102
	0.40	1.102
	0.50	1.102
	0.60	1.102
	0.70	1.102
	0.80	1.102
	0.90	1.102
	1.00	1.102
T_s	1.10	1.102
	1.20	0.994
	1.40	0.814
	1.60	0.666
	1.80	0.545
	2.00	0.447
	2.20	0.366
	2.40	0.299
	2.60	0.245
	2.80	0.201
	3.00	0.164

Comparison between Site-Specific ADRS SEE Curves for Site Class C and Site Class D

(a) Three-Point ADRS curves for Site Class C and Site Class D are generated from Pseudo-Spectral Acceleration values supplied by the SCDOT Geotechnical Design Section (see Appendix B, pp. B-17).

(b) The site-adjusted ground motion parameters from Three-Point ADRS curves are provided below (see Appendix A, pp. A-51 and A-57).

Ground Motion Parameters	Site Class C	Site Class D
Peak ground accelerarion, PGA	0.60g	0.60g
Short period spectral response acceleration, S_{DS}	1.12g	1.18g
Long period spectral response acceleration, S_{D1}	0.52g	0.62g

(c) The PGA values for site-specific ADRS SEE curves are controlled by the limitation of the minimum of 70 percent of the site-adjusted Three-Point ADRS curve, which is found to be equal to 0.70 x 0.60g = 0.42g.

(d) The maximum design spectral response acceleration, S_{DMax} are controlled by the maximum of the following.
(1) minimum of 90 percent of the site-specific peak response acceleration at any period; and
(2) the peak site-specific response acceleration at 0.2 second.

(e) The response acceleration from the site-specific response acceleration ARS curves are found to be as follows (see Appendix A, pp. A-47, A-51 and A-57).

Ground Motion Parameters	Site Class C	Site Class D
Peak response acceleration, $S_{a(peak)}$	1.18g	1.18g
Response acceleration at 0.2 sec	1.11g	1.11g

(f) Therefore, S_{DMax} is found to be as follows.
Site Class C: max (0.90 x 1.18g, 1.11g) = max (1.06g, 1.11g) = 1.11g
Site Class D: max (0.90 x 1.18g, 1.11g) = max (1.06g, 1.11g) = 1.11g

(g) Spectral accelerations beyond the period of long period, T_s are generated by a smooth curve based on a non-dimensional curve fitting number, n that best bestfits the ARS curve generated for Site Class C.

(h) The values of n is found to be the same for both the Site Class C and Site Class D and is found to be equal to 3.30 (see Appendix A, pp. A-73 and A-76).

(i) Site-specific design ground parameters found for Class C and Class D are summarized below.

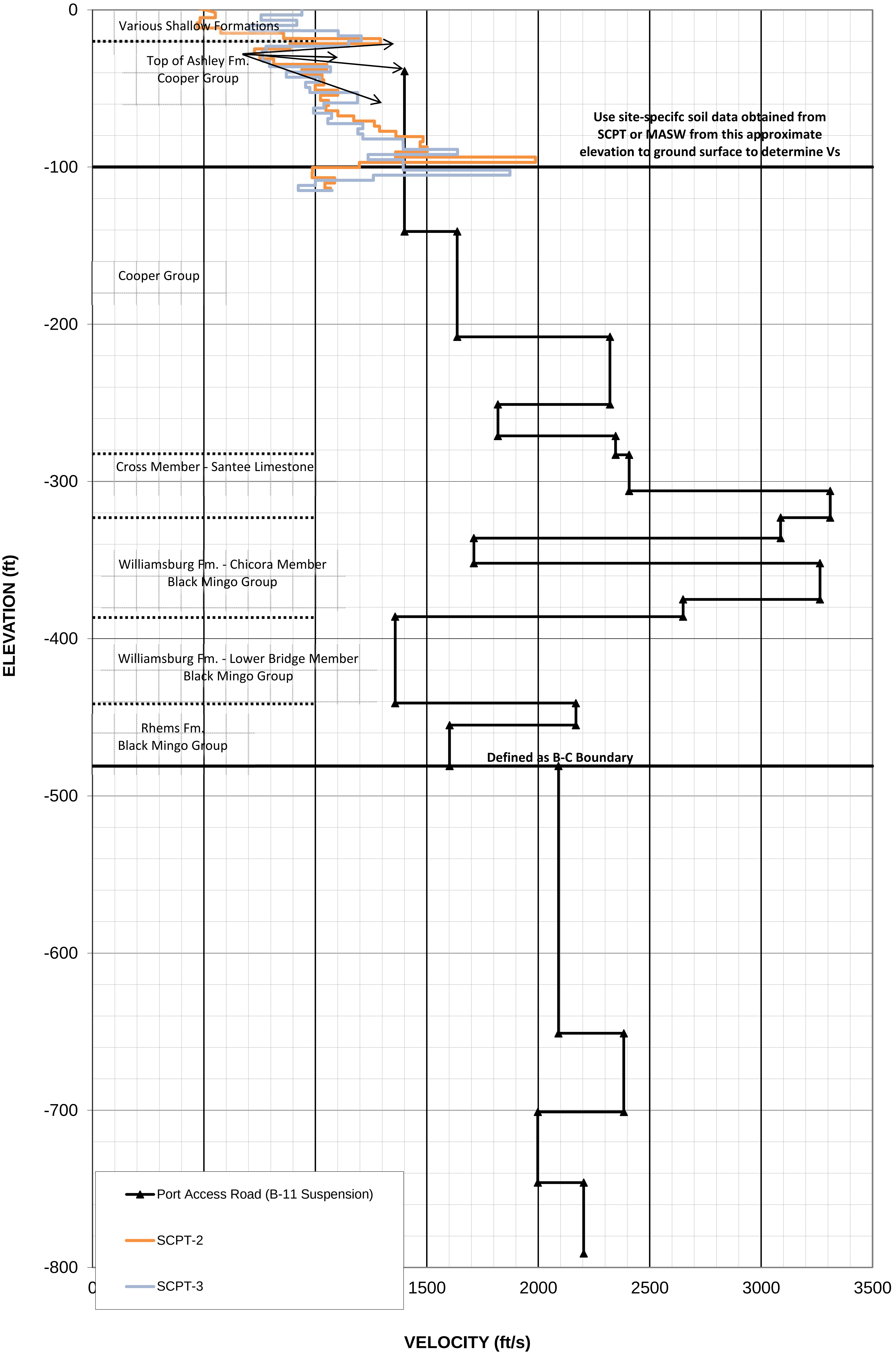
Ground Motion Parameters	Site Class C	Site Class D
Peak ground accelerarion, PGA	0.42g	0.42g
Maximum spectral response acceleration, S_{DMax}	1.11g	1.11g
Curve fitting number, n	3.30	3.30

(j) Therefore, site-specific Horizontal Acceleration Design Response Spectra (ADRS) curves for Site Class C and Site Class D appear to be identical.

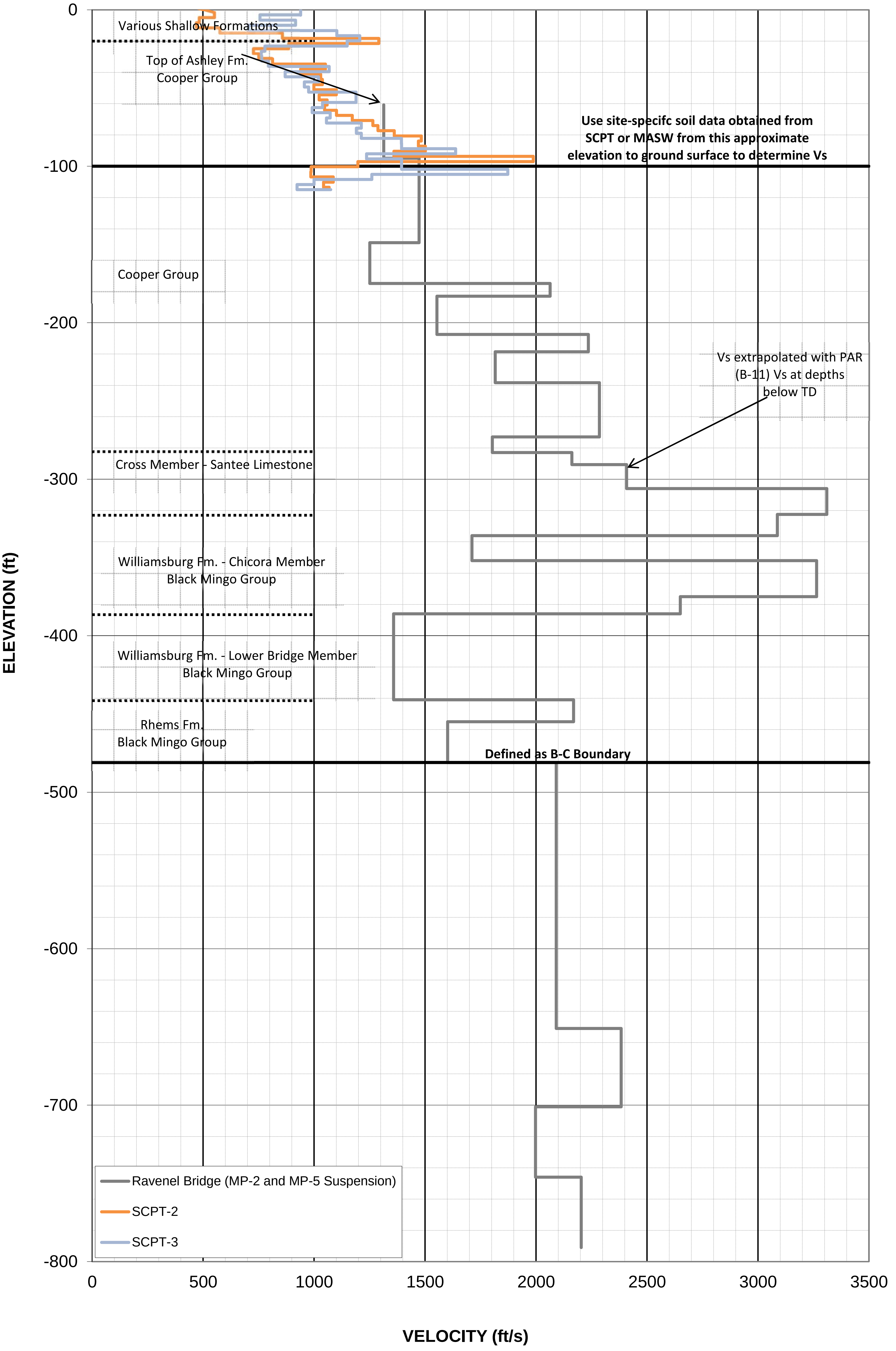
APPENDIX B

REFERENCES

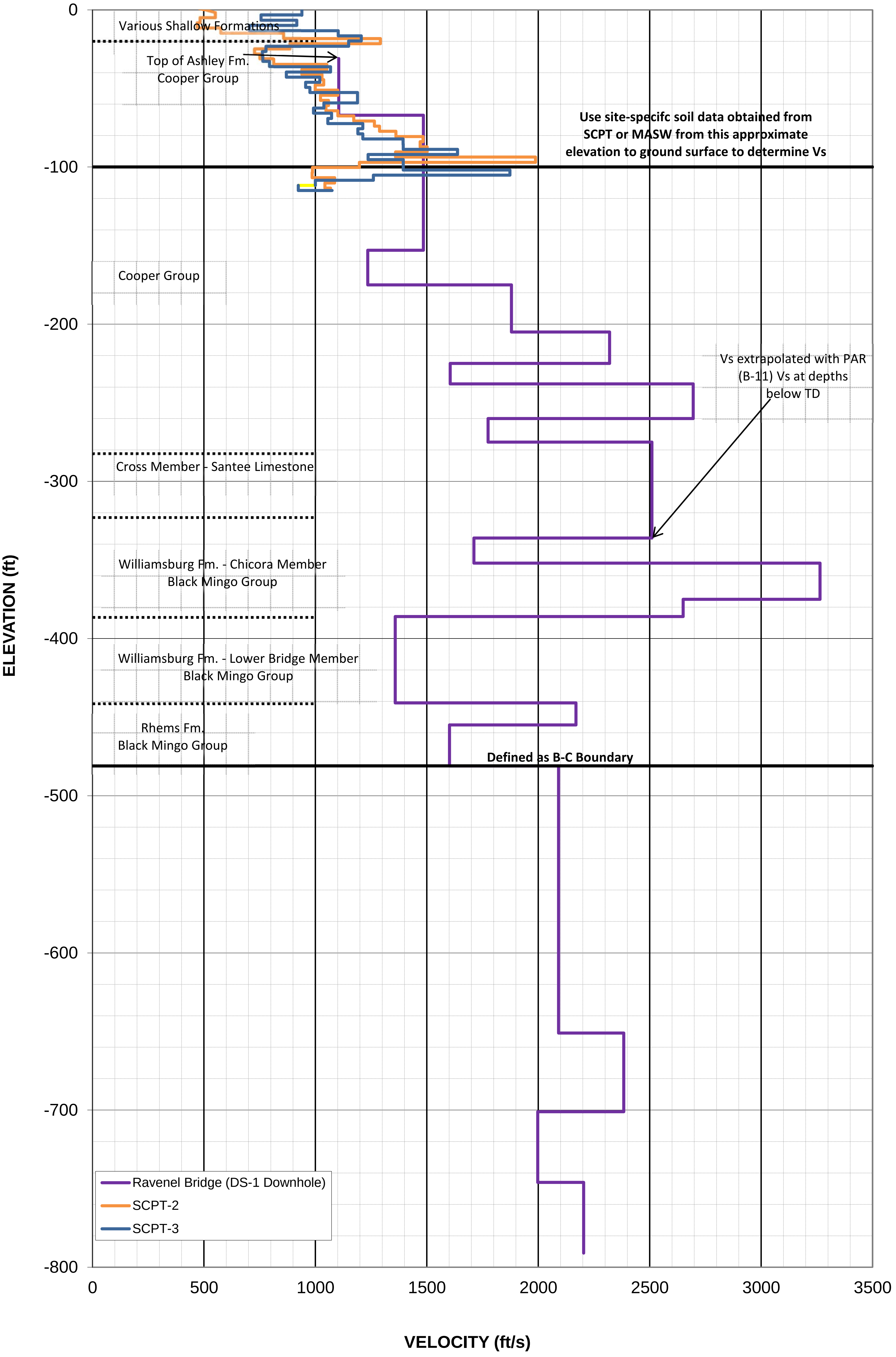
Charleston, Berkely, and Dorchester Counties, SC
Shear Wave Velocity Models To Be Used
In Site Specific Response Analysis



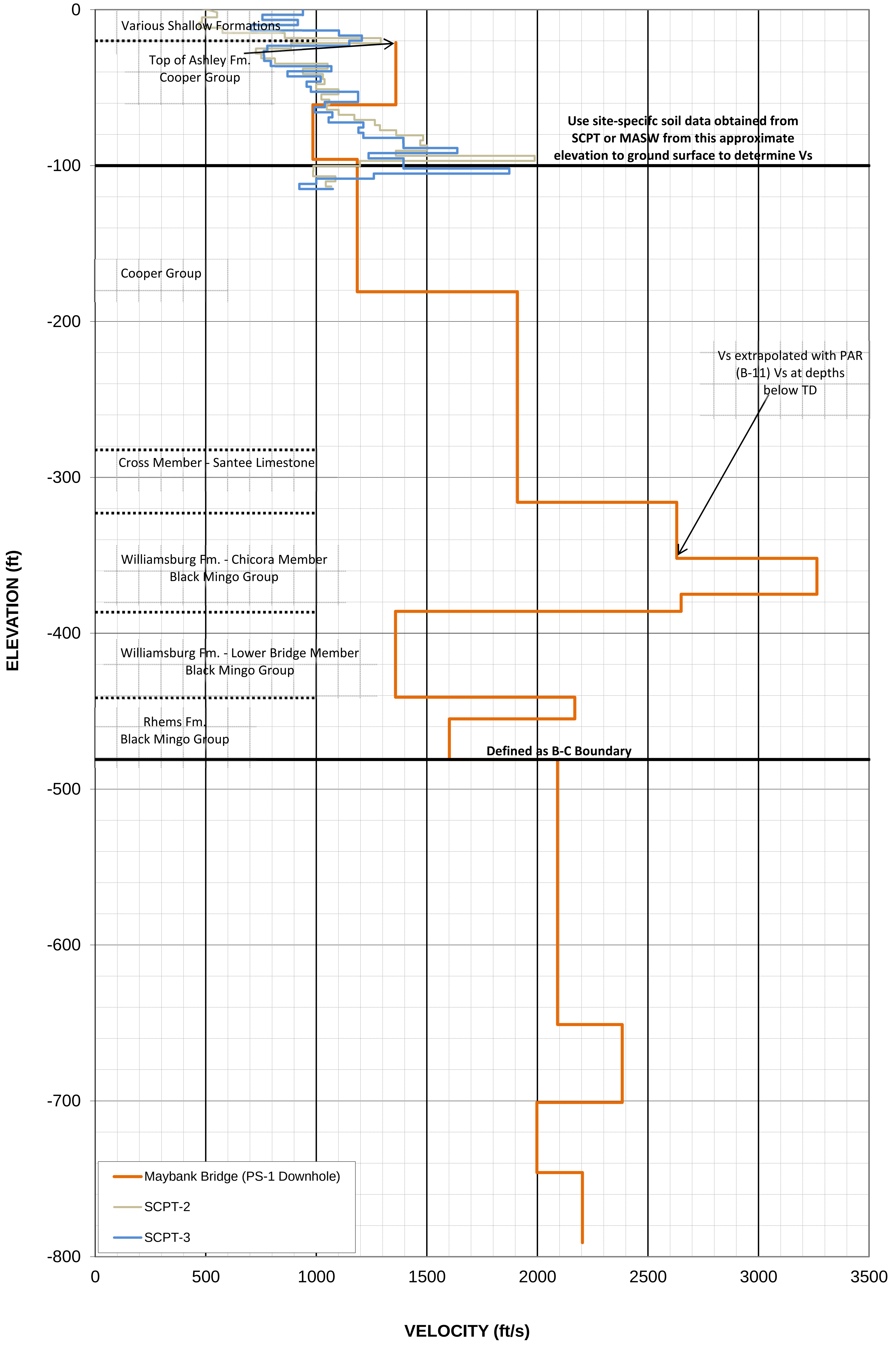
Charleston, Berkely, and Dorchester Counties, SC
Shear Wave Velocity Models To Be Used
In Site Specific Response Analysis



Charleston, Berkely, and Dorchester Counties, SC
Shear Wave Velocity Models To Be Used
In Site Specific Response Analysis



Charleston, Berkely, and Dorchester Counties, SC
Shear Wave Velocity Models To Be Used
In Site Specific Response Analysis



SC 41 over Wando River - SCPT-2				SC 41 over Wando River - SCPT-3			
Elevation	Depth, m	Depth, ft	Velocity, ft/s	Elevation	Depth, m	Depth, ft	Velocity, ft/s
1.44	2	6.56	464.3	-0.16	2	6.56	939.9
-1.84	3	9.84	464.3	-3.44	3	9.84	939.9
-1.84		9.84	552.4	-3.44	3	9.84	756.8
-5.12	4	13.12	552.4	-6.72	4	13.12	756.8
-5.12		13.12	483.7	-6.72	4	13.12	916.6
-8.40	5	16.40	483.7	-10.00	5	16.40	916.6
-8.40		16.40	471.1	-10.00	5	16.40	705.4
-11.69	6	19.69	471.1	-13.29	6	19.69	705.4
-11.69		19.69	576.7	-13.29	6	19.69	1102.9
-14.97	7	22.97	576.7	-16.57	7	22.97	1102.9
-14.97		22.97	857.8	-16.57	7	22.97	1206.3
-18.25	8	26.25	857.8	-19.85	8	26.25	1206.3
-18.25		26.25	1291.7	-19.85	8	26.25	1149.2
-21.53	9	29.53	1291.7	-23.13	9	29.53	1149.2
-21.53		29.53	885.6	-23.13	9	29.53	778.7
-24.81	10	32.81	885.6	-26.41	10	32.81	778.7
-24.81		32.81	727.2	-26.41	10	32.81	762.7
-28.09	11	36.09	727.2	-29.69	11	36.09	762.7
-28.09		36.09	751.1	-29.69	11	36.09	764.4
-31.37	12	39.37	751.1	-32.97	12	39.37	764.4
-31.37		39.37	813.3	-32.97	12	39.37	793.7
-34.65	13	42.65	813.3	-36.25	13	42.65	793.7
-34.65		42.65	1051.3	-36.25	13	42.65	1068.3
-37.93	14	45.93	1051.3	-39.53	14	45.93	1068.3
-37.93		45.93	939.4	-39.53	14	45.93	869.7
-41.21	15	49.21	939.4	-42.81	15	49.21	869.7
-41.21		49.21	1029.6	-42.81	15	49.21	1020
-44.49	16	52.49	1029.6	-46.09	16	52.49	1020
-44.49		52.49	1037.7	-46.09	16	52.49	956.5
-47.77	17	55.77	1037.7	-49.37	17	55.77	956.5
-47.77		55.77	999.3	-49.37	17	55.77	975.4
-51.06	18	59.06	999.3	-52.66	18	59.06	975.4
-51.06		59.06	1100.1	-52.66	18	59.06	1188.8
-54.34	19	62.34	1100.1	-59.22	20	65.62	1188.8
-54.34		62.34	1023.3	-59.22	20	65.62	1038.4
-57.62	20	65.62	1023.3	-62.50	21	68.90	1038.4
-57.62		65.62	1059	-62.50	21	68.90	991.6
-60.90	21	68.90	1059	-65.78	22	72.18	991.6
-60.90		68.90	1047.7	-65.78	22	72.18	1073.1
-64.18	22	72.18	1047.7	-69.06	23	75.46	1073.1
-64.18		72.18	1100.8	-69.06	23	75.46	1056
-67.46	23	75.46	1100.8	-72.34	24	78.74	1056
-67.46		75.46	1172.3	-72.34	24	78.74	1212.7
-70.74	24	78.74	1172.3	-75.62	25	82.02	1212.7
-70.74		78.74	1264.6	-75.62	25	82.02	1190.8
-74.02	25	82.02	1264.6	-78.90	26	85.30	1190.8
-74.02		82.02	1287.7	-78.90	26	85.30	1213
-77.30	26	85.30	1287.7	-82.18	27	88.58	1213.00
-77.30		85.30	1361.6	-82.18	27	88.58	1393.90
-80.58	27	88.58	1361.6	-85.46	28	91.86	1393.90
-80.58		88.58	1482.9	-85.46	28	91.86	1394.00
-83.86	28	91.86	1482.9	-88.74	29	95.14	1394.00
-83.86		91.86	1470	-88.74	29	95.14	1638.20
-87.14	29	95.14	1470	-92.03	30	98.43	1638.20
-87.14		95.14	1501.4	-92.03	30	98.43	1236.40
-90.43	30	98.43	1501.4	-95.31	31	101.71	1236.40
-90.43		98.43	1360.2	-95.31	31	101.71	1394.40
-93.71	31	101.71	1360.2	-98.59	32	104.99	1394.40
-93.71		101.71	1988.1	-98.59	32	104.99	1394.50
-96.99	32	104.99	1988.1	-101.87	33	108.27	1394.50
-96.99		104.99	1197.9	-101.87	33	108.27	1872.70
-100.27	33	108.27	1197.9	-105.15	34	111.55	1872.70
-100.27		108.27	987.2	-105.15	34	111.55	1260.60
-103.55	34	111.55	987.2	-108.43	35	114.83	1260.60
-103.55		111.55	985.2	-108.43	35	114.83	1000.00
-106.83	35	114.83	985.2	-111.71	36	118.11	1000.00
-106.83		114.83	1086.7	-111.71	36	118.11	923.30
-110.11	36	118.11	1086.7	-114.99	37	121.39	923.30
-110.11		118.11	1042.9	-114.99	37	121.39	1185.00
-113.39	37	121.39	1042.9				
-113.39		121.39	1185				

Port Access Road (B-11 Suspension)			**Ravenel Bridge (MP-2 and MP-5 Suspension)**			**Ravenel Bridge (DS-1 Downhole)**			**Maybank Bridge (PS-1 Downhole)**		
Elevation	Depth, ft	Velocity, ft/s	Elevation	Depth, ft	Velocity, ft/s	Elevation	Depth, ft	Velocity, ft/s	Elevation	Depth, ft	Velocity, ft/s
-39	60	1400	-61	61	1314	-31	41	1105			
-141	150	1400	-95	95	1314	-67	77	1105			
-141	150	1637	-95	95	1473	-67	77	1485			
-208	217	1637	-149	149	1473	-153	163	1485			
-208	217	2322	-149	149	1251	-153	163	1235	-113.39	100	1185
-251	260	2322	-175	175	1251	-175	185	1235	-181	185	1185
-251	260	1819	-175	175	2064	-175	185	1880	-181	185	1910
-271	280	1819	-183	183	2064	-205	210	1880	-316	320	1910
-271	280	2347	-183	183	1553	-205	215	2320	-316	320	2630
-283	292	2347	-208	208	1553	-225	235	2320	-352	356	2630
-283	292	2408	-208	208	2236	-225	235	1605	-352	356	3264
-306	315	2408	-219	219	2236	-238	248	1605	-375	379	3264
-306	315	3310	-219	219	1816	-238	248	2695	-375	379	2650
-323	332	3310	-238	238	1816	-260	270	2695	-386	390	2650
-323	332	3088	-238	238	2285	-260	270	1775	-386	390	1358
-336	345	3088	-273	273	2285	-275	285	1775	-441	445	1358
-336	345	1711	-273	273	1804	-275	285	2510	-441	445	2169
-352	361	1711	-283	283	1804	-336	346	2510	-455	459	2169
-352	361	3264	-283	283	2162	-336	346	1711	-455	459	1602
-375	384	3264	-291	291	2162	-352	362	1711	-481	485	1602
-375	384	2650	-291	291	2408	-352	362	3264	-481	485	2091
-386	395	2650	-306	306	2408	-375	385	3264	-651	655	2091
-386	395	1358	-306	306	3310	-375	385	2650	-651	655	2384
-441	450	1358	-323	323	3310	-386	396	2650	-701	705	2384
-441	450	2169	-323	323	3088	-386	396	1358	-701	705	1998
-455	464	2169	-336	336	3088	-441	451	1358	-746	750	1998
-455	464	1602	-336	336	1711	-441	451	2169	-746	750	2204
-481	490	1602	-352	352	1711	-455	465	2169	-791	804	2204
-481	490	2091	-352	352	3264	-455	465	1602			
-651	660	2091	-375	375	3264	-481	491	1602			
-651	660	2384	-375	375	2650	-481	491	2091			
-701	710	2384	-386	386	2650	-651	661	2091			
-701	710	1998	-386	386	1358	-651	661	2384			
-746	755	1998	-441	441	1358	-701	711	2384			
-746	755	2204	-441	441	2169	-701	711	1998			
-791	800	2204	-455	455	2169	-746	756	1998			
			-455	455	1602	-746	756	2204			
			-481	481	1602	-791	801	2204			
			-481	481	2091						
			-651	651	2091						
			-651	651	2384						
			-701	701	2384						
			-701	701	1998						
			-746	746	1998						
			-746	746	2204						
			-791	791	2204						

▨ Extrapolated from PAR B-11

Ground Formations

Various Sgallow Formations	
0.00	-20
1000.00	-20
marl	
0.00	-100
3500.00	-100
Santee	
0	-282.5
1000.00	-282.5
Williamsburg-Chicora	
0	-323
1000	-323
Williamsbur -Lower	
0	-386.5
1000	-386.5
Rhems	
0.00	-441.5
1000.00	-441.5
B-C Boundary	
0.00	-481
3500.00	-481

clayey silts, and sandy to silty clays (estuarine facies). Dominant clay minerals are kaolinite, illite/smectite, and illite in variable proportions. The color is typically medium-light-gray (N6) or dark-yellowish-orange (10YR 6/6), but also sometimes medium-bluish-gray (5B 5/1), greenish-gray (5G 6/1), moderate-reddish-brown (10R 4/6), or moderate red (5R 4/6). The basal contact often is marked by a coarse, quartz gravel lag bed.

Paleontology. -- No stratigraphically useful microfossils have been found in this unit in the Dorchester County area. Terrestrial vertebrate remains have been found in the Summerville area.

Occurrence in studied cores --

- (not present in Pregnall core, DOR-208)
- (not present in St. George core, DOR-211)
- (not present in Clubhouse Crossroads No. 1 core, DOR-037)
- (14 to 0 ft in Summerville water well, DOR-052)
- (10 to 0 ft in DOR-St1 core)
- (13 to 0 in DOR-St2 core)

Wando Formation

Upper Pleistocene

Stratigraphy. -- The Wando Formation, named by McCartan and others (1980) for outcrops near the Wando River, underlies the Pamlico and Princess Anne terraces of Colquhoun (1974). Regionally, it represents a coastal complex of fluvial, estuarine, lagoonal, barrier-island, and shallow- marine shelf deposits, but in the Dorchester County area only fluvial and estuarine deposits are present. Based on U/Th ages of corals in this unit, the age of the Wando Formation is around 130 to 70 ka (Cronin and others, 1981). The unit may be up to 30 ft in thickness. It typically overlies the Ashley Formation, but may overlie the Chandler Bridge, Edisto, or Marks Head formations.

Lithology. -- The lithology of the Wando Formation is variable and includes coarse-grained, poorly sorted, crossbedded sands (fluvial facies) and clayey, fine- to medium-grained quartz sands, sandy to clayey silts, and sandy to silty clays (estuarine facies). Dominant clay minerals are kaolinite, illite/smectite, and illite in variable proportions. Typically grayish-orange (10YR 7/4) and medium-light-gray (N6) in color, the Wando weathers to dark-yellowish-orange (10YR 6/6) and grayish-yellow (5Y 8/4). Its basal contact is often marked by a coarse, quartz gravel lag bed.

Paleontology. -- No stratigraphically useful microfossils have been found in this unit in the Dorchester County area. Numerous terrestrial vertebrate remains have been found in the Giant Cement Quarry near Harleyville (Bentley and others, 1994; Bentley and Knight, 1998).

Occurrence in studied cores --

- (not present in Pregnall core, DOR-208)
- (not present in St. George core, DOR-211)
- (19 to 0 ft in Clubhouse Crossroads No. 1 core, DOR-037)
- (not present Summerville water well, DOR-052)
- (not present in DOR-St1 core)

County. It is typically underlain by the Harleyville or Parkers Ferry Formations of the Cooper Group or the Cross Member of the Santee Limestone and overlain by a wide variety of generally thin Neogene and Quaternary units.

Lithology. -- The Ashley Formation consists of a relatively homogeneous section of calcareous, phosphatic, microfossiliferous, silty and sandy clays. Parts of the section may be sufficiently calcareous to warrant their description as clayey, very fine microfossil calcarenites. The basal contact is a burrowed and unconformable. Very fine to fine-grained glauconite and phosphate sand are present in small amounts throughout the Ashley section, except in the basal 10 feet where the phosphate increases in grain size and abundance. Ashley sediments typically are massive or faintly texture-mottled, suggesting thorough bioturbation.

Paleontology. -- The Ashley Formation is dated as early-late Oligocene and is assigned to calcareous nannofossil Zones NP 24 and 25. Zone NP 24 includes sediments of both early and late Oligocene age (Berggren and others, 1995). In the Clubhouse Crossroads core (DOR-037), the Ashley is placed in Zone NP 24 on the basis of the presence of *Helicosphaera recta* (lowest occurrence in Zone NP 24. The ashley in the Pregnal core (DOR-208) is in Zone NP 24 and possibly Zone NP 25 (based on the absence of *Sphenolithus distentus*, which has its highest occurrence at the top of Zone NP 24). Dinocysts in the Ashley indicate a late Oligocene age and correlation with the Old Church Formation in Virginia. Pollen in Ashley samples is consistent with a late Oligocene age and indicates a tropical to warm-temperate terrestrial climate.

Occurrence in studied cores --

- (85.8 to 30.5 ft in Pregnall core, DOR-208)
- (83 to 30 ft in St. George core, DOR-211)
- (183 to 19 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)
- (108 to 14 ft in Summerville water well, DOR-052)
- (88 to 10 ft in DOR-St1 core)
- (108 to 13 ft in DOR-St2 core)

Chandler Bridge Formation

Upper Oligocene

Stratigraphy. -- The Chandler Bridge Formation was named by Sanders and others (1982). Its type section is at an excavation in southern Dorchester County, and the unit recently has been mapped in Dorchester County by Weems and others (1997). The basal contact of the Chandler Bridge with the underlying Ashley Formation is a burrowed, gently rolling unconformity. The Chandler Bridge is overlain unconformably by various Pleistocene units. The Chandler Bridge occurs only in isolated patches in the southern part of Dorchester County. It may be up to 10 feet thick but usually is much thinner. This formation was not mapped in the present study.

Lithology. -- The Chandler Bridge consists of fine-grained, quartz-phosphate sand and, locally at its base, silty, calcareous clay. The color ranges from greenish-gray (5GY 6/1), dark-greenish-gray (5GY 4/1), and greenish-black (5GY 2/1) to dark-yellowish-brown (10YR 4/2). The dominant clay mineral is illite/smectite with lesser amounts of illite and kaolinite.

and southern Orangeburg Counties, S. C. It is underlain by the Fishburne Formation or the Moultrie Member of the Santee Limestone and overlain by the Harleyville Formation or the Harleyville-Parkers Ferry (undifferentiated) formations of the Cooper Group.

Lithology. -- The Cross Member of the Santee Limestone consists primarily of locally shelly, microfossiliferous limestone. The basal contact is a burrowed unconformity. In the Pregnall core, glauconite- and phosphate-filled burrows extend over a foot into the underlying Moultrie Member from the basal glauconite-phosphate bed of the Cross, and the upper surface of the Moultrie is partially coated with a phosphate crust.

The lower part of the Cross consists of foraminiferal-peloid packstones. Pelecypods, bryozoans, and serpulid worm tubes are present but are typically sparse in this lower part. Pelecypod-serpulid-foraminifer-peloid packstones dominate the middle of the Cross Member. The upper 20 feet of the Cross in the Pregnall core consists of foraminifer-peloid-pelecypod grainstones and packstones. Glauconite and quartz occur only in trace amounts in the Cross, except at the base.

Paleontology. -- The bivalve *Crassatella alta* is commonly found in the Cross Member of the Santee Limestone (Ward and others, 1979). The Cross is dated as both late middle Eocene and late Eocene, representing calcareous nannofossil Zones NP 16, NP 17, and NP 18. In the Clubhouse Crossroads (DOR-037) and DOR-St2 cores, the Cross is in Zone NP 16 on the basis of the presences of *Chiasmolithus bidens/solitus* (highest occurrence defines the top of Zone NP 16), *Cribrocentrum reticulatum* (lowest occurrence in Zone NP 16), and large forms of *Reticulofenestra umbilicus* (lowest occurrence within Zone NP 16) and Zone NP 17 on the basis of the absence of *C. biden/solitus* and the presence of *Helicosphaera compacta* (lowest occurrence near the top of Zone NP 16). In the Pregnall core (DOR-208), the Cross is in Zone NP 17 and NP 18 (lowest occurrence of *Chiasmolithus oamaruensis,* which defines the base of Zone NP 18, is at 123.3 ft). Only the lower part of the Cross was examined in the St. George core (DOR-211), and that is Zone NP 16. Dinocysts also indicate middle and late Eocene ages.

Occurrence in studied cores --

- (189.4 to 90.9 ft in Pregnall core, DOR-208)
- (198 to 90 ft in St. George core, DOR-211)
- (415 to 232 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)
- (560 to 237 ft in Summerville water well, DOR-052)
- (350 to 221 ft in DOR-St1 core)
- (524 to 243 ft in DOR-St2 core)

Harleyville Formation (Cooper Group)

Upper Eocene

Stratigraphy. -- The Harleyville Formation originally was defined as a member of the Cooper Formation by Ward and others (1979) with its type locality at the Giant Portland Cement Company quarry just north of Harleyville in Dorchester County, South Carolina. The Harleyville type section had previously been grouped with the Ashley Formation in an undivided section assigned to the Cooper Marl (Cooke and MacNeil, 1952). Weems and Lemon (1984) raised members of the Cooper Formation defined by Ward and others (1979) to formation status and raised the Cooper Formation to group status. The

- (not present or not recognized in Summerville water well, DOR-052)
- (495 to 446 ft in DOR-St1 core)
- (not penetrated in DOR-St2 core)

Chicora Member of the Williamsburg Formation (Black Mingo Group)

Upper Paleocene

Stratigraphy. -- The Chicora Member of the Williamsburg Formation was named by Van Nieuwenhuise and Colquhoun (1982) for outcrops along the south bank of the Santee River just downstream from Wilsons Landing, Chicora 7.5' quad., Berkeley County, S.C. We anticipate that this member will be raised to formation status in the future.

The Chicora Member of the Williamsburg Formation is underlain by the lower and upper Paleocene Lower Bridge Member of the Williamsburg Formation. The Chicora Member of the Williamsburg Formation is overlain by the middle Eocene Santee Limestone in northern Dorchester County. In southern Dorchester County, the Williamsburg Formation is overlain by the lower Eocene Fishburne Formation (Gohn and others, 1983).

Lithology. -- The Chicora Member of the Williamsburg Formation recovered at Pregnall consists of two contrasting lithologic units, a lower siliciclastic section of terrigenous sand, silt, and clay, and an upper carbonate section of moldic pelecypod limestone. Regionally, the Chicora is a heterogeneous unit consisting of shelly quartz sands, indurated, moldic limestone, and dark, calcareous sndy and silty clays.

Paleontology. -- The Chicora Member of the Williamsburg Formation is dated as late Paleocene and represents the upper part of calcareous nannofossil Zone NP 5 to Zone NP 9. In the Pregnall core (DOR-208), Zone NP 9 and questionably Zone NP 7/8 are present. In the Clubhouse Crossroads core (DOR-037), nannofossil Zones NP 5 (upper part) and NP 9 are present, although the interval between 531 and 454 ft, which contains no diangostic species, probably represents time between upper Zone NP 5 and NP 9. In the St. George core (DOR-211), Zones upper NP 5, NP 8, and NP 9 are present.

The pollen of the Chicora Member of the Williamsburg Formation is in the upper part of the *Caryapollenites prodromus* Interval Zone and the *Carya* Interval Zone.

Occurrence in studied cores --

- (346 to 258 ft in Pregnall core, DOR-208)
- (521 to 268 ft St. George core, DOR-211)
- (546 to 439 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)
- ((?) 658 to 560 ft in Summerville water well, DOR-052)
- (446 to 350 ft in DOR-St1 core)
- (not penetrated in DOR-St2 core)

Fishburne Formation (Black Mingo Group)

Lower Eocene

section in Williamsburg County includes early Paleocene pollen and dinoflagellates.

Occurrence in studied cores --

- (not penetrated in Pregnall core, DOR-208)
- (not present or not recognized in the St. George core, DOR-211)
- (635 to 597 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)
- (not present or not recognized in Summerville water well, DOR-052)
- (526 to 495 ft in DOR-St1 core)
- (not penetrated in DOR-St2 core)

Lower Bridge Member, subunits B and C

Stratigraphy. -- The Lower Bridge Member, subunits B-C, was recovered in only two of the six Dorchester County cores. These subunits were considered to comprise the entire Lower Bridge Member of the Willliamsburg Formation by Bybell and others (1998) and Edwards and others (1999) in two cores in Charleston County, S.C. Subunits B-C are underlain unconformably by subunit A of the Lower Bridge Member of the Williamsburg Formation and overlain unconformably by the Chicora Member of the Williamsburg Formation.

Lithology. -- In Charleston County, S. C. , subunits B and C of the Lower Bridge Member consist of two unconformity-bounded packages. The lower one is a muddy, glauconitic, very fine to fine sand that has phosphate granules and pebbles at its base. This subunit is extensively bioturbated. Common, irregularly distributed calcite-cemented layers typically are about 0.5 ft thick, and two or three usually occur in a given 10-ft interval. The upper subunit consists of a homogeneous section of calcareous, silty and sandy clay that has a muddy, very fine to medium quartz-glauconite-phosphate sand forming a basal lag. Fabrics in these fine-grained deposits vary from laminated to partially bioturbated to completely bioturbated. In Dorchester County, a single subunit (B-C) is recognized; it consists of bioturbated, calcareous, sandy and silty clay above a basal glauconite-phosphate lag deposit.

Paleontology. -- The Lower Bridge Member, subunit B-C, of the Williamsburg Formation is dated as early late Paleocene. This subunit is placed in the lower part of calcareous nannofossil Zone NP 5 on the basis of the presence of *Chiasmolithus bidens/solitus* (lowest occurence near the base of Zone NP 5) and the absence of species that have lowest occurrences in the upper part of Zone NP 5 (*Heliolithus cantabriae*) or Zone NP 6 (*Heliolithus kleinpellii*).

Dinocysts in subunits B-C consist of moderately diverse assemblages that include *Amphorosphaeridium multispinosum, Damassadinium californicum, Deflandrea delineata, Palaeoperidinium pyrophorum*, and *Phelodinium* sp. of Edwards (1989). In the Clubhouse Crossroads core (DOR-037), as in two cores in Charleston County, *D. delineata* has its lowest occurrence and *P. pyrophorum* has its highest occurrence in this subunit of the Lower Bridge. This subunit is in the *Caryapollenites prodromus* pollen interval zone.

Occurrence in studied cores --

- (not penetrated in Pregnall core, DOR-208)
- (not present or not recognized in the St. George core, DOR-211)
- (597 to 546 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)

in the St. George core (DOR-211) was poorly recovered; available core material consists of sparingly shelly, slightly muddy, fine to coarse quartz sand.

Paleontology. -- The Peedee Formation is dated as late Maastrichtian and is assigned to calcareous nannofossil Zones CC 25 and CC 26 of Perch-Nielsen (1985). Subzone CC 25b is recognized in the lowest Peedee sediments because they contain the lowest occurrence of *Lithraphidites quadratus*. This subzone is present throughout Dorchester County. Zone CC 26 is absent in the updip St. George core (DOR-211). This zone, recognized on the basis of the lowest occurrence of *Ceratolithoides kamptneri*, is represented by only 3 ft of sediment in the Clubhouse Crossroads core (DOR-037). Christopher (this volume, chapter D) introduces three pollen zones in the Peedee, two of which are recognized in cores from Dorchester County.

The fauna and flora of the Peedee Formation in South Carolina have been discussed by a number of authors (Habib and Miller, 1989; Gohn 1992; Wingard 1993; Edwards and others, 1999; and Self-Trail, 1999) and include calcareous nannofossils, dinoflagellates, foraminifers, ostracodes, and mollusks.

We infer an upward change from outer neritic deposition to middle neritic deposition from the characteristics of the ostracode assemblages and the lithologic trend.

Occurrence in studied cores --

- (not penetrated in Pregnall core, DOR-208)
- (792 to 558 ft in the St. George core, DOR-211)
- (873 to 800 ft in Clubhouse Crossroads No. 1 core, DOR-037 - log depth)
- (762 to 658 ft in Summerville water well, DOR-052)
- (not penetrated in DOR-St1 core)
- (not penetrated in DOR-St2 core)

Rhems Formation (Black Mingo Group)

Lower Paleocene

Stratigraphy. -- The Rhems was originally described by Sloan (1908) as the Rhems shale, a part of the Upper Black Mingo phase. The unit was abandoned by Cooke (1936) as simply part of the Black Mingo Formation. It was later reinstated as the Rhems Formation by Van Nieuwenhuise and Colquhoun (1982). These authors recognized two members: the Browns Ferry Member and the Perkins Bluff Member, whose type sections are in Georgetown County, S.C. They identified these members in the Clubhouse Crossroads core (DOR-037) in Dorchester County. Muthig and Colquhoun (1988) recognized two additional members of the Rhems Formation, the Sawdust Landing Member and the Lang Syne Member, updip in Calhoun County, S.C. We have not used the members of the Rhems Formation in this report.

In Dorchester County, the Rhems is present as a subsurface unit that unconformably overlies the Peedee Formation and is overlain by the Lower Bridge Member of the Williamsburg Formation. It was not present, or not recognizable as a distinct unit, in the St. George (DOR-211) and DOR –052 cores.

Lithology. -- The Rhems Formation consists of fine to coarse arenaceous shale and argillaceous sand, and pelecypod-poor to pelecypod-rich clayey sand (Van Nieuwenhuise and Colquhoun, 1982). In the

For AASHTO Group II through VI loads, the factors of safety for friction and end bearing were decreased by 25 to 30 percent, consistent with AASHTO overstress allowance for these load combinations. For seismic compression loads (2,500 year earthquake), a factor of safety of 1.1 was applied to friction resistance, and a factor of safety of 1.0 was applied to end bearing, consistent with AASHTO guidelines. For seismic tension loads, a factor of safety of 1.5 was applied to friction resistance.

CONCLUSIONS

The Cooper River Bridge project required unusually deep, high capacity drilled shafts for support of the main piers of the cable-stayed bridge, approach structures and interchange ramps. Embedment requirements for these drilled shafts were determined based on an extensive pre-construction load test program and a supplementary Osterberg load cell test program performed as part of the design-build contract. The construction-stage test program confirmedhigher shaft resistance in the marl below El. -150 (-45.7 m), resulting in a more economical foundation for the main piers. The foundation at each main pier consisted of eleven 10-ft (3,050-mm) diameter drilled shafts with design capacity of approximately 11,000 kips (49 MN). At the west and east main piers, the foundation shafts have design tip elevations of -230 and -233 (-70.1 and -71.0 m), respectively.

ACKNOWLEDGEMENT

The client for the Cooper River Bridge project is the South Carolina Department of Transportation. The design-build team, Palmetto Bridge Constructors, was led by Skanska USA, Inc. and Tidewater Construction Company, in partnership with HBG Constructors, Inc. and Flatiron Structures Company. Design was led by Parsons Brinckerhoff, assisted by Buckland & Taylor, Ltd., Ben C. Gerwick, Inc., and LPA, among others. The Osterberg load cell tests were conducted by LoadTest, Inc. under a subcontract to PBGand under the direction of Parsons Brinckerhoff.

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SITE CHARACTERIZATION AND SUBSURFACE CONDITIONS FOR THE COOPER RIVER BRIDGE

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ABSTRACT: At the expected time of its completion (2005), the new Cooper River Bridge in Charleston, South Carolina will be the longest cable-stayed bridge in the US. The $600+ million structure is supported on drilled shafts, which bear within the soils of the Cooper Group (colloquially known as the Cooper Marl). Geotechnical data necessary for foundation design were primarily obtained during three major site characterization programs performed for the preliminary design phases. The programs included soil test borings, cone penetration testing, shear wave velocity measurements, laboratory index testing, consolidation testing, and triaxial shear testing. The extensive data from these exploration efforts are summarized and evaluated. The Cooper Marl typically classifies as an overconsolidated (OCR of 3 to 6), highly plastic clay or silt with liquid limits often in excess of 100 and plasticity indices of more than 50. The fines content is generally in the range of 75% to 90% but the clay mineral content is small (<10%) and the primary mineral constituent is calcium carbonate (60% to 80%). The calcium carbonate content is mainly in the form of the skeletal remains of microscopic marine organisms (e.g., foraminifera) and the fossiliferous nature of the particles is thought to explain the fact that the effective friction angle is typically in the range of 43 to 46 degrees. The void ratio is relatively high (1 to 2) but the undrained shear strength is also high (140 kPa to 280 kPa) and the shear wave velocity (generally in the range of 400 m/s to 600 m/s) is relatively constant with depth; all of which indicate that the deposit is cemented.

INTRODUCTION

The Cooper River separates Charleston, South Carolina from the growing suburb of Mount Pleasant and its surrounding communities, collectively known as East Cooper. In 1929, a two-lane truss bridge was built over the river, connecting these two areas for the first time. Although the distance between Charleston and Mount Pleasant is only about 2 km by boat, prior to the completion of the bridge, the land trip was more than 130 km each way. Subsequent growth led to the completion of a three-lane

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Greater care should be exercised with using the curves for Pleistocene-age and Tertiary-age soils in the Charleston area, because they were determined using only four test specimens. More data are needed from all areas of the state, particularly from the Lower Coastal Plain area, to further validate the recommended curves.

In general, the Holocene soils exhibited more linearity than the older soils with similar *PI*. The recommended G/G_{max} curve for Holocene soils with $PI = 0$ follows the Seed *et al.* (1986) upper range curve for sand, the Idriss (1990) curve for sand, and the Stokoe *et al.* (1999) curve for sand. On the other hand, the recommended G/G_{max} curves for the older soils with $PI = 0$ generally follow the Seed *et al.* (1986) mean or lower range curve for sand and the Vucetic and Dobry (1991) curve for $PI = 0$ soils. The recommended *D* curve for Holocene soils with $PI = 0$ follows the Seed *et al.* (1986) lower range curve for sand and the Idriss (1990) curve for sand and clay. The recommended *D* curves for the older soils with $PI = 0$ generally follow the Seed *et al.* (1986) mean curve for sand and the Vucetic and Dobry (1991) curve for $PI = 0$ soils.

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THIS FILE CONTAINS THE RESULTS FROM ONE EXECUTION
 OF PROGRAM scenario_pc (Martin Chapman, 2006).

THE NAME OF THE DIRECTORY CONTAINING THIS FILE
 AND ALL ASSOCIATED OUTPUT FILES IS: WandoFEE1


 10% PROBABILITY OF EXCEEDANCE (For 50 year Exposure)
     FOR GEOLOGICALLY REALISTIC SITE CONDITION


 RESULTS OF INTERPOLATION

   Site Location: 32.9245 N 79.8250 W
Nearest Grid Point: 32.8750 N 79.8750 W Distance From Site:   7.21 Km
Thickness of sediments, meters:  740.6

               PSA and PGA as Percentage of g
 0.5Hz    1.0Hz    2.0Hz    3.3Hz    5Hz      6.7Hz    13Hz     PGA
 3.05600  8.71619 16.89729 25.03457 30.97848 30.90329 30.63957 17.14782


        Interpolated results from USGS Deaggregation 2002
Freq. R(mean) km  mag(mean)  eps0(mean) R(modal) km  mag(modal)  eps0(modal)
 PGA     32.7      6.64       -.87       30.4       7.30       -1.56
 5 Hz    36.1      6.74       -.80       30.4       7.30       -1.53
 1 Hz    61.1      6.97       -.98       30.3       7.30       -1.77


TIME SERIES GENERATED BY THIS RUN

The time series defined below is scaled using a
 phase-invariant method to match the entire
 uniform hazard PSA spectrum given above.

Number of points used in time series is:  4096
  Time step used:  .01
Seed used:         -1


SCENARIO EVENT

      Moment magnitude:  7.30
Epicentral distance (km):  30.3  ←

 Motions are based on either a 1 or 2 layer geological structure
 overlying a basement half space.
 The first layer represents a sedimentary layer with
Vs=700 m/s, density 2.0 gm/cc and Q=100.0 The thickness of
```

```
THIS FILE CONTAINS THE RESULTS FROM ONE EXECUTION
 OF PROGRAM scenario_pc (Martin Chapman, 2006).

THE NAME OF THE DIRECTORY CONTAINING THIS FILE
 AND ALL ASSOCIATED OUTPUT FILES IS: WandoSEE1


 2% PROBABILITY OF EXCEEDANCE (For 50 year Exposure)
    FOR GEOLOGICALLY REALISTIC SITE CONDITION


 RESULTS OF INTERPOLATION

    Site Location: 32.9245 N 79.8250 W
Nearest Grid Point: 32.8750 N 79.8750 W Distance From Site:   7.21 Km
Thickness of sediments, meters:   740.6

              PSA and PGA as Percentage of g
  0.5Hz    1.0Hz    2.0Hz    3.3Hz    5Hz      6.7Hz    13Hz     PGA
19.89944  42.62690  72.40032  97.04381 112.23720 112.01180 106.67660  60.24614


         Interpolated results from USGS Deaggregation 2002
Freq. R(mean) km   mag(mean)   eps0(mean) R(modal) km  mag(modal)  eps0(modal)
 PGA       22.4       7.00         .37        25.9       7.30          .43
5 Hz       24.3       7.11         .40        27.2       7.30          .47
1 Hz       27.4       7.22         .34        27.3       7.30          .34


TIME SERIES GENERATED BY THIS RUN

The time series defined below is scaled using a
 phase-invariant method to match the entire
 uniform hazard PSA spectrum given above.

Number of points used in time series is:  4096
  Time step used:  .01
Seed used:          -1


SCENARIO EVENT

     Moment magnitude:  7.30
Epicentral distance (km):  27.3

 Motions are based on either a 1 or 2 layer geological structure
 overlying a basement half space.
 The first layer represents a sedimentary layer with
Vs=700 m/s, density 2.0 gm/cc and Q=100.0 The thickness of
 the first layer is by default that assumed in the hazard
```

Consultant Geotechnical Seismic Response

To:	John F. Hamilton
Consultant:	F&ME Consultants
Date Requested:	04/13/11

PROJECT INFORMATION

File No. 8.158B/10.032102	**Project No. (PIN):** 32102
County: Berkeley	**Route:** SC-41
Description: SC 41 Bridge Replacement over Wando River	
Latitude (4 decimals): 32.9245	**Longitude (4 decimals):** -79.8250

Bridge Category / Seismic OC:	**II**
Type of Seismic Information Requested:	**Preliminary Seismic Design Information**
Seismic Site Class:	**D**

Pseudo-Spectral Acceleration (PSA)

The SCDOT Geotechnical Design Section has generated the required Design Earthquake the pseudo-spectral acceleration (PSA) oscillator response for frequencies 0.5, 1.0, 2.0, 3.3, 5.0, 6.7 and 13 Hz, for 5% critical damping and peak horizontal ground acceleration (PGA) at the **B-C Boundary.**

SEE – 3% Probability of Exceedance in 75 years Geologically Realistic

PSA and PGA as Percentage of g

0.5Hz	**1.0Hz**	**2.0Hz**	**3.3Hz**	**5.0Hz**	**6.7Hz**	**13.0Hz**	**PGA**
19.89944	42.62690	72.40032	97.04381	112.23720	112.01180	106.67660	60.24614

Thickness of sediments: 740.6 meters

FEE – 15% Probability of Exceedance in 75 years Geologically Realistic

PSA and PGA as Percentage of g

0.5Hz	**1.0Hz**	**2.0Hz**	**3.3Hz**	**5.0Hz**	**6.7Hz**	**13.0Hz**	**PGA**
3.05600	8.71619	16.89729	25.03457	30.97848	30.90329	30.63957	17.14782

Thickness of sediments: 797.1 meters

Time Series

Unscaled and Scaled time series were generated for the **B-C Boundary** in Shake91 data format. The Scaled time series are based on the earthquake magnitude (Mw) and Epicentral distance requested.

The Time Series Files are Attached: **Yes** ☒ **No** ☐

Design Response Spectrum

The SCDOT Seismic Design Specifications for Highway Bridges, latest edition, is used to develop the Design Response Spectrum.

The Design Response Spectrum is Attached: **Yes** ☐ **No** ☒

Geotechnical Designer:		**RPG[1]:**	Lowcountry
Date:	04/19/11	**Phone Number:**	(803) 737-1473
Geotechnical Review:		**RPG[1,2]:**	Lowcountry

[1] **RPG – Region Production Group**

Lowcountry - Beaufort, Berkeley, Charleston, Colleton, Dorchester, Hampton, Jasper

Pee Dee – Chesterfield, Clarendon, Darlington, Dillon, Florence, Georgetown, Horry, Kershaw, Lee, Marion, Marlboro, Sumter, Williamsburg

Midlands – Aiken, Allendale, Bamberg, Barnwell, Calhoun, Chester, Fairfield, Lancaster, Lexington, Newberry, Orangeburg, Richland, Union, York

Upstate – Abbeville, Anderson, Cherokee, Edgefield, Greenville, Greenwood, Laurens, McCormick, Oconee, Pickens, Saluda, Spartanburg

[2] **RPG – PreConstruction Support – Geotechnical Design Section (PCS/GDS)**

MDE can be equated to the controlling MCE, as cited in FEMA (2005b). Further PSHA guidance on return-period criteria for significant- and high-hazard-potential dams is anticipated in the future from federal dam safety agencies.

7.7.2 Seismotectonic Modeling

Most seismotectonic studies and publications focus on the western U.S. where there is a relative abundance of data and observations. The seismotectonic modeling of the central and eastern U.S. requires that the differences between the eastern and western U.S. be appreciated. The following characteristics of eastern U.S. earthquakes represent significant differences when compared to the western U.S.

- More than an order of magnitude lower seismicity rates (longer recurrence periods for the same magnitudes).
- General lack of surface faulting, such that it is difficult to define source models
- Slower attenuation of ground motions with distance, which implies larger areas of damage for the same earthquake magnitude.
- Higher high-frequency content of seismic ground motions to larger distances.
- Relatively higher site amplification where soft soil is over rock (considered to be more significant in glaciated areas where the contact with highly competent rock is abrupt; Youd et al., 2001).
- Greater uncertainty in quantitative hazard assessments because the historic seismicity record (300 years) is too short compared to the recurrence periods of major damaging events.
- Few sets of eastern strong-motion data exist. They marginally constrain the attenuation of shaking with distance, as well as the dependence of local ground motion on magnitude, distance and depth of the earthquake.
- Higher frequency content of eastern earthquakes may lead to a greater number of cycles for the same magnitude.

In spite of the differences between eastern and western U.S. seismic events and the limitations of the eastern U.S. database, these factors can be accounted for in a seismic hazard analysis. The high-frequency motions associated with eastern earthquakes are generally limited to near-field rock sites. These motions tend to attenuate rapidly when they propagate through soil, which effectively reduces the amount of energy and the number of pertinent ground motion cycles that could contribute to the hazards of seismically-induced strength loss or ground deformation. Therefore, as noted by Youd et al. (2001), the duration differences between eastern and western soil sites are not likely to be significant when evaluating strength loss and ground deformations.

Compared with a plate boundary environment like California, an intra-plate environment like the central and eastern U.S. is difficult to characterize. Although there have been many recent advances in the understanding of earthquake occurrence based mainly on discoveries of paleoliquefaction phenomena, many gaps still exist in the knowledge of why and how often earthquakes occur in the central and eastern U.S., as summarized by the USGS Geologic Hazards Team (Crone and Wheeler, 2000) that supports the National Earthquake Hazard Reduction Program (NEHRP).

Defining a seismotectonic model for the central and eastern U.S. requires considerable judgment and is a subject of ongoing research. It is anticipated that it will be necessary to review the status of ongoing research whenever new seismic hazard assessments are required. This Manual includes some of the concepts and sources of information suitable for the derivation of seismic hazard at the time of publication, as summarized in the following subsections.

APPENDIX C

BORING LOGS, SHEAR WAVE DATA AND SUMMARY OF LABORATORY TEST RESULTS

SECTION 1

SOIL TEST BORING LOGS

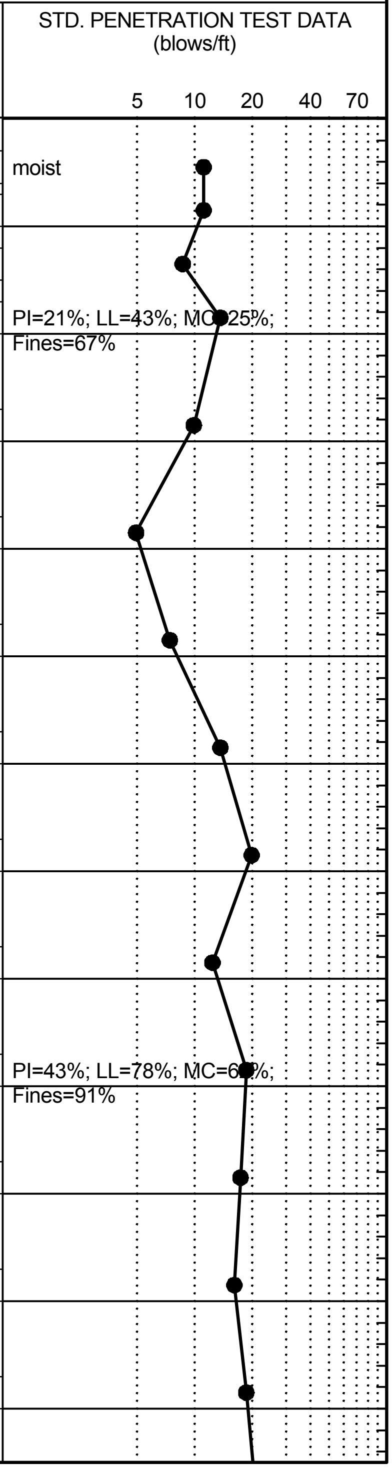
SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

LOG OF BORING No. B-1

Station: 254+80
Offset: CL

Date Drilled: 8/16/04
Supervisor: Ricky Wessinger
Notes: CME-55 Truck Mounted Drill Rig
Casing Length (ft):
Approx. Ground Elevation (ft): 6.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 7.4 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
		Loose; Brown; Fine Clayey SAND (SC)	1.5	SS-1	3	4	5	9	moist
	3.0	Loose; Brown; Fine SAND (SP)	3.5	SS-2	10	4	5	9	
1.0									
	5.5	Stiff to Firm; Brown and Gray; Fine Sandy CLAY ▼(CL)	6.0	SS-3	2	3	4	7	
			8.5	SS-4	2	4	7	11	PI=21%; LL=43%; MC=25%; Fines=67%
-4.0									
			13.5	SS-5	4	3	5	8	
-9.0									
		=> Soft	18.5	SS-6	1	2	2	4	
-14.0									
	22.0	**MARL:-** Firm to Stiff; Brown, Green and Gray; Fine to Medium Sandy Elastic CLAY-SILT (CH-MH); Calcareous	23.5	SS-7	2	2	4	6	
-19.0									
			28.5	SS-8	3	4	7	11	
-24.0									
			33.5	SS-9	4	8	8	16	
-29.0									
			38.5	SS-10	3	4	6	10	
-34.0									
			43.5	SS-11	4	7	8	15	PI=43%; LL=78%; MC=62%; Fines=91%
-39.0									
			48.5	SS-12	3	6	8	14	
-44.0									
			53.5	SS-13	4	5	8	13	
-49.0									
	56.0	Very Stiff; Brown, Green and Gray; Fine to Medium Sandy Elastic CLAY-SILT (CH-MH); Calcareous	58.5	SS-14	4	6	9	15	
-54.0									



LEGEND

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

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

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

LOG OF BORING No. B-1

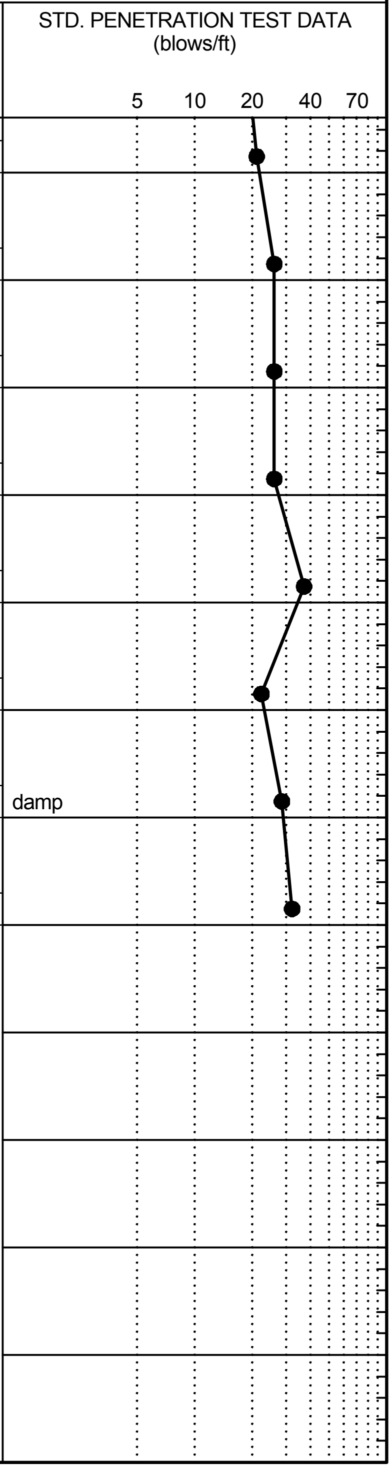
Station: 254+80
Offset: CL

Date Drilled: 8/16/04
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 6.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 7.4 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-55 Truck Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value
-59.0		Very Stiff; Brown, Green and Gray; Fine to Medium Sandy Elastic CLAY-SILT (CH-MH); Calcareous	▨	63.5	SS-15	5	7	10	17
-64.0			▨	68.5	SS-16	5	9	12	21
-69.0			▨	73.5	SS-17	6	9	12	21
-74.0			▨	78.5	SS-18	6	9	12	21
-79.0			▨	83.5	SS-19	7	13	17	30
-84.0			▨	88.5	SS-20	6	8	10	18
-89.0			▨	93.5	SS-21	8	10	13	23
			▨	98.5	SS-22	9	11	15	26
-94.0	100.0	Boring Terminated at 100 Feet							
-99.0									
-104.0									
-109.0									
-114.0									

STD. PENETRATION TEST DATA (blows/ft)



LEGEND

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

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

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

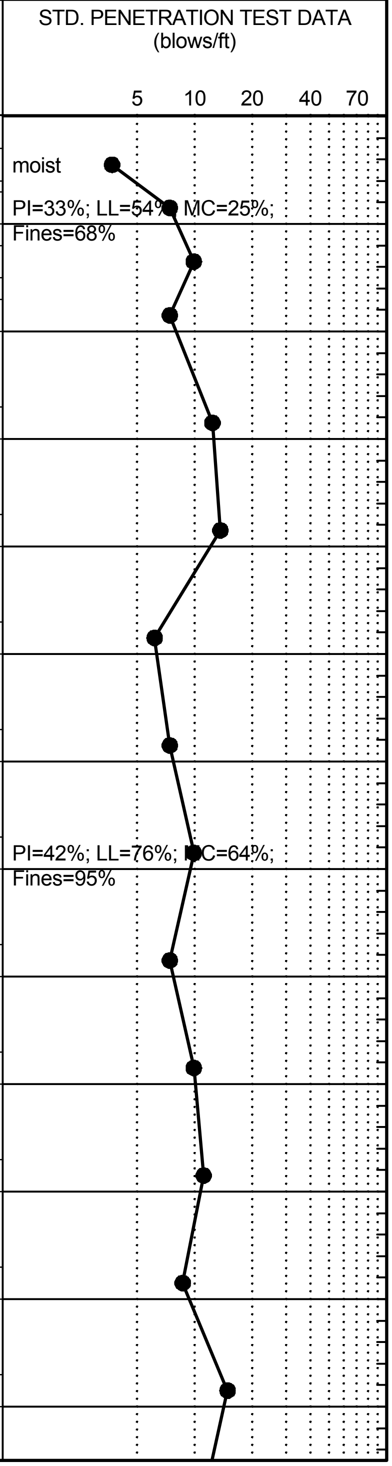
LOG OF BORING No. B-2

Station: 256+55
Offset: CL

Date Drilled: 8/16/04
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 6.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 7.6 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-55 Truck Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
		Soft to Firm; Orange, Tan, Brown and Gray; Fine to Medium Sandy Elastic <u>CLAY</u> (CH)	1.5	SS-1	2	1	2	3	moist
			3.5	SS-2	1	2	4	6	PI=33%; LL=54%; MC=25%; Fines=68%
1.0									
			6.0	SS-3	2	3	5	8	
	▼								
			8.5	SS-4	3	3	3	6	
-4.0									
	12.0	Loose to Firm; Tan and Gray; Clayey Fine to Coarse <u>SAND</u> (SC)							
			13.5	SS-5	3	5	5	10	
-9.0									
		=> with Shell Fragments	18.5	SS-6	4	8	3	11	
-14.0									
	22.0	Firm; Green and Tan; Fine Sandy <u>CLAY</u> (CL)							
			23.5	SS-7	2	2	3	5	
-19.0									
	26.0	**MARL:-** Firm to Stiff; Green and Tan; Elastic <u>CLAY-SILT</u> (CH-MH); Calcareous with Trace Fine Sand							
			28.5	SS-8	1	3	3	6	
-24.0									
			33.5	SS-9	2	3	5	8	PI=42%; LL=76%; MC=64%; Fines=95%
-29.0									
			38.5	SS-10	1	3	3	6	
-34.0									
			43.5	SS-11	2	3	5	8	
-39.0									
			48.5	SS-12	2	4	5	9	
-44.0									
			53.5	SS-13	3	2	5	7	
-49.0									
			58.5	SS-14	2	5	7	12	
-54.0									



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LEGEND

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

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

SOIL_TEST_BORING G4067.GPJ SC_DOT.GDT 4/19/11

F&ME
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SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

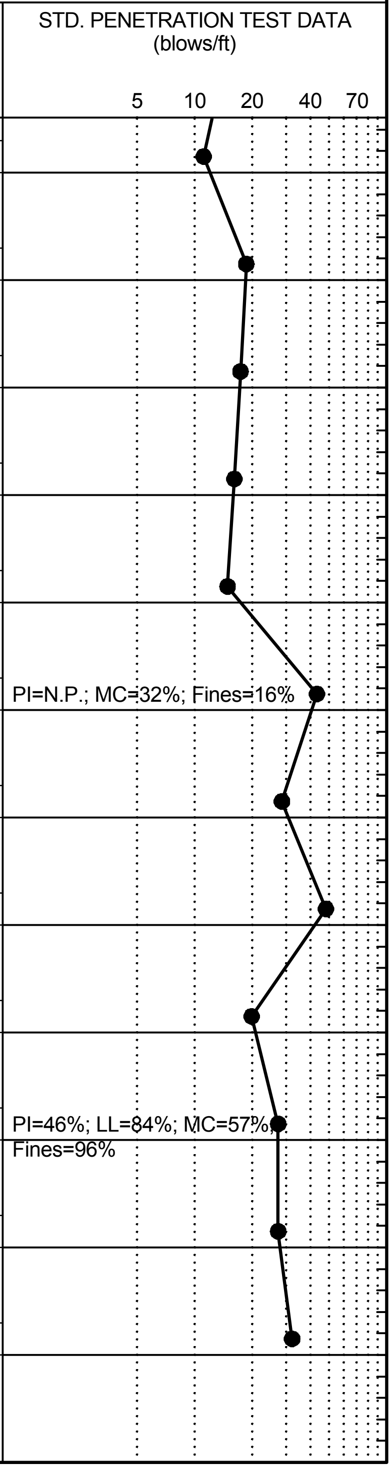
LOG OF BORING No. B-2

Station: 256+55
Offset: CL

Date Drilled: 8/16/04
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 6.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 7.6 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-55 Truck Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
		MARL:- Firm to Stiff; Green and Tan; Elastic CLAY-SILT (CH-MH); Calcareous with Trace Fine Sand		63.5	SS-15	2	3	6	9	
-59.0										
				68.5	SS-16	3	6	9	15	
-64.0										
				73.5	SS-17	3	6	8	14	
-69.0										
				78.5	SS-18	4	4	9	13	
-74.0										
		=> Sandy		83.5	SS-19	5	5	7	12	
-79.0										
	87.0	Very Firm to Dense; Tan and Green; Silty Fine SAND (SM); Calcareous								
				88.5	SS-20	12	16	19	35	PI=N.P.; MC=32%; Fines=16%
-84.0										
				93.5	SS-21	7	9	14	23	
-89.0										
				98.5	SS-22	14	14	25	39	
-94.0										
	102.0	Very Stiff; Green and Gray; Elastic CLAY-SILT (CH-MH); Calcareous with Trace Fine Sand								
				103.5	SS-23	2	4	12	16	
-99.0										
				108.5	SS-24	5	8	14	22	PI=46%; LL=84%; MC=57%; Fines=96%
-104.0										
				113.5	SS-25	6	7	15	22	
-109.0										
				118.5	SS-26	7	10	16	26	
-114.0	120.0	Boring Terminated at 120 Feet								



LEGEND

SAMPLER TYPE

SS	- Split Spoon	NQ	- Rock Core, 1-7/8"
ST	- Shelby Tube	CU	- Cuttings
AWG	- Rock Core, 1-1/8"	CT	- Continuous Tube

DRILLING METHOD

HSA	- Hollow Stem Auger	RW	- Rotary Wash
CFA	- Continuous Flight Augers	RC	- Rock Core
DC	- Driving Casing	PHD	- Percussion Hammer Drill

SOIL_TEST_BORING G4067.GPJ SC_DOT.GDT 4/19/11

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

LOG OF BORING No. B-3

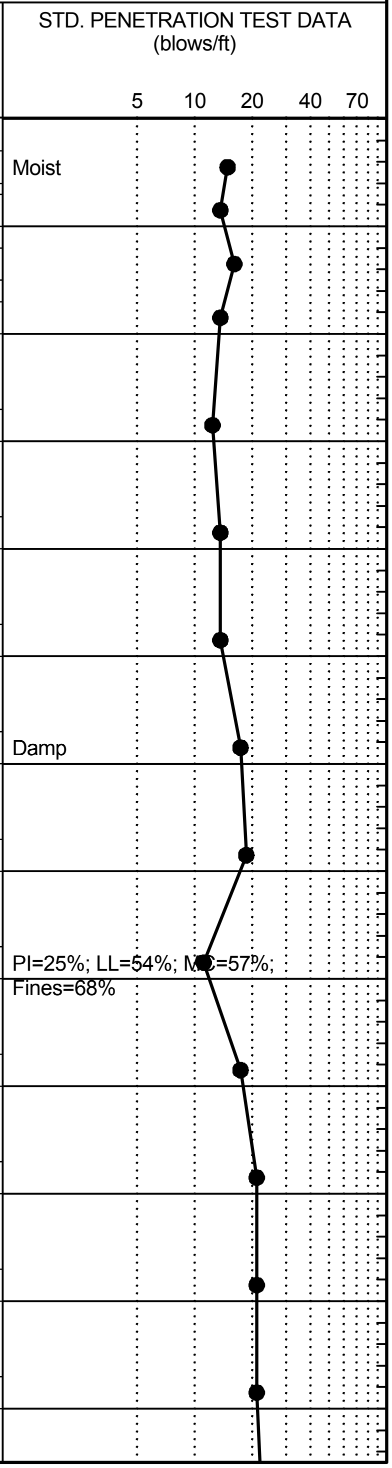
Station: 275+50
Offset: 10' LT of CL

Date Drilled: 9/13/2004
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 7.5
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 5.0 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-550 ATV Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION
		Firm; Light Yellow to Orange; Clayey Fine SAND (SC)
	3.0	Stiff; Gray to Light Yellow; Sandy Silty CLAY (CL)
	▼	
2.5		
-2.5		
	12.0	Loose; Light Yellow to Gray; Silty Fine to Coarse SAND (SM); with some Clay
-7.5		
	17.0	**MARL:-** Stiff; Green and Gray; Elastic CLAY (CH); Calcareous with some Sand
-12.5		
-17.5		
-22.5		
-27.5		
-32.5		
-37.5		
	47.0	Very Stiff; Green and Gray; Elastic CLAY-SILT (CH-MH); Calcareous with some Sand
-42.5		
-47.5		
-52.5		

Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
1.5	SS-1	8	7	5	12	Moist
3.5	SS-2	2	4	7	11	
6.0	SS-3	2	4	9	13	
8.5	SS-4	3	5	6	11	
13.5	SS-5	2	6	4	10	
18.5	SS-6	3	4	7	11	
23.5	SS-7	3	4	7	11	
28.5	SS-8	3	5	9	14	Damp
33.5	SS-9	3	5	10	15	
38.5	SS-10	3	4	5	9	PI=25%; LL=54%; MC=57%; Fines=68%
43.5	SS-11	4	6	8	14	
48.5	SS-12	5	7	10	17	
53.5	SS-13	6	7	10	17	
58.5	SS-14	5	6	11	17	



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LEGEND

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

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

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

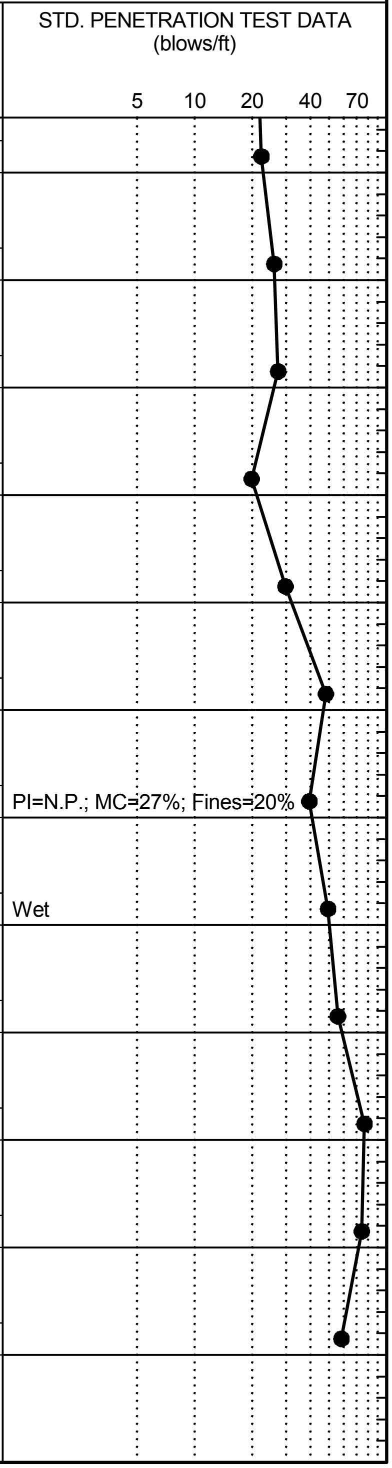
LOG OF BORING No. B-3

Station: 275+50
Offset: 10' LT of CL

Date Drilled: 9/13/2004
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 7.5
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 5.0 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-550 ATV Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
-57.5		Very Stiff; Green and Gray; Elastic CLAY-SILT (CH-MH); Calcareous with some Sand	▨	63.5	SS-15	4	8	10	18	
-62.5			▨	68.5	SS-16	7	9	12	21	
-67.5			▨	73.5	SS-17	6	9	13	22	
-72.5			▨	78.5	SS-18	5	6	10	16	
-77.5			▨	83.5	SS-19	12	12	12	24	
-82.5	88.0	Dense to Very Dense; Green and Gray; Silty Fine SAND (SM); Calcareous	░	88.5	SS-20	10	16	23	39	
-87.5			░	93.5	SS-21	8	12	20	32	PI=N.P.; MC=27%; Fines=20%
-92.5			░	98.5	SS-22	15	20	20	40	Wet
-97.5			░	103.5	SS-23	20	22	25	45	
-102.5			░	108.5	SS-24	25	30	32	62	
-107.5			░	113.5	SS-25	18	27	33	60	
-112.5			░	118.5	SS-26	12	22	25	47	
	120.0	Boring Terminated at 120 Feet								



LEGEND

SAMPLER TYPE

SS - Split Spoon	NQ - Rock Core, 1-7/8"
ST - Shelby Tube	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	PHD - Percussion Hammer Drill

F&ME
CONSULTANTS

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

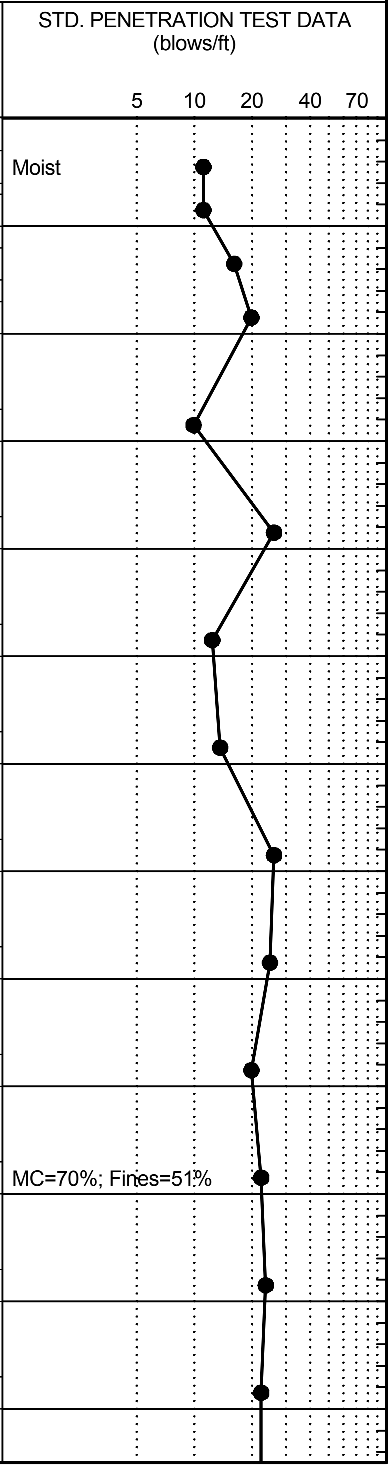
LOG OF BORING No. B-4

Station: 278+13
Offset: 80' LT of CL

Date Drilled: 9/14/2004
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 7.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 5.5 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-550 ATV Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
	0.3	Crushed Stone	1.5	SS-1	6	5	4	9	Moist
2.0		Firm to Very Stiff; Orange and Gray; Fine to Medium Sandy Silty <u>CLAY</u> (CL) ▼	3.5	SS-2	2	4	5	9	
			6.0	SS-3	2	6	7	13	
-3.0			8.5	SS-4	4	7	9	16	
-8.0			13.5	SS-5	1	1	7	8	
-13.0	17.0	**MARL:-** Stiff to Very Stiff, Green and Gray; Elastic <u>CLAY-SILT</u> (CH-MH); Calcareous with some Sand	18.5	SS-6	5	8	13	21	
-18.0			23.5	SS-7	2	4	6	10	
-23.0			28.5	SS-8	4	4	7	11	
-28.0			33.5	SS-9	6	11	10	21	
-33.0			38.5	SS-10	6	10	10	20	
-38.0			43.5	SS-11	4	6	10	16	
-43.0			48.5	SS-12	4	7	11	18	MC=70%; Fines=51%
-48.0			53.5	SS-13	5	9	10	19	
-53.0			58.5	SS-14	5	9	9	18	



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LEGEND

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

F&ME
CONSULTANTS

SC 41 Replacement Bridge over Wando River
Berkeley/Charleston Counties, South Carolina
G4067

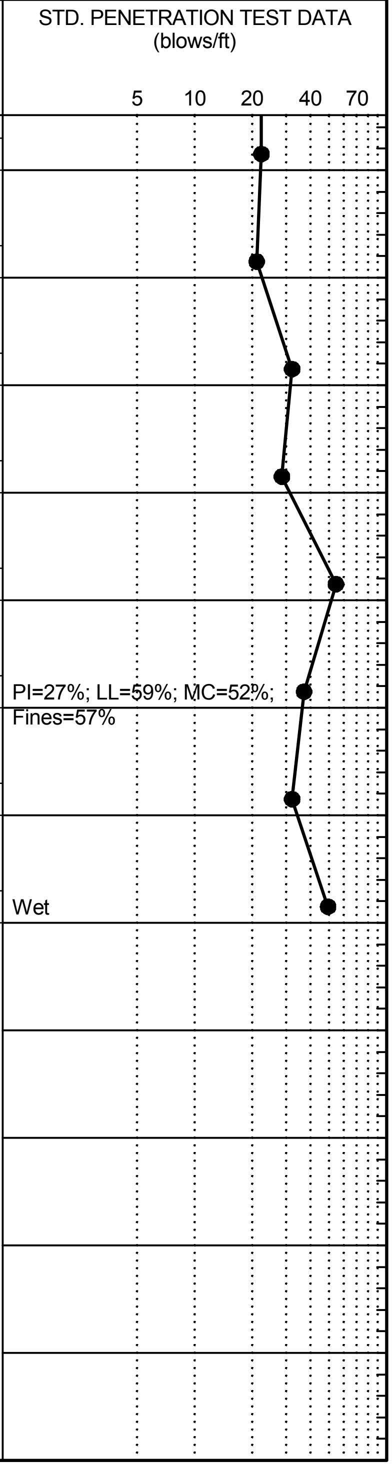
LOG OF BORING No. B-4

Station: 278+13
Offset: 80' LT of CL

Date Drilled: 9/14/2004
Supervisor: Ricky Wessinger
Casing Length (ft):
Approx. Ground Elevation (ft): 7.0
Hammer Type: ☒ Gravity ☐ Automatic ☐ Other:
Water Level: 5.5 Feet at 24 Hours from T.O.B.
Drilling Method: Mud Rotary

Notes:
CME-550 ATV Mounted Drill Rig

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	1st 6"	2nd 6"	3rd 6"	N Value	STD. PENETRATION TEST DATA (blows/ft)
-58.0		**MARL:-** Stiff to Very Stiff, Green and Gray; Elastic <u>CLAY-SILT</u> (CH-MH); Calcareous with some Sand	▨	63.5	SS-15	4	6	12	18	
-63.0			▨	68.5	SS-16	4	5	12	17	
-68.0			▨	73.5	SS-17	6	12	14	26	
-73.0			▨	78.5	SS-18	6	9	14	23	
	82.0	Very Stiff to Hard; Green and Gray; Fine Sandy Elastic <u>SILT</u> (MH); Calcareous	▥							
-78.0			▥	83.5	SS-19	9	17	27	44	
-83.0			▥	88.5	SS-20	9	13	17	30	PI=27%; LL=59%; MC=52%; Fines=57%
-88.0			▥	93.5	SS-21	6	11	15	26	
-93.0	100.0		▥	98.5	SS-22	11	15	25	40	Wet
		Boring Terminated at 100 Feet								
-98.0										
-103.0										
-108.0										
-113.0										



LEGEND

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

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

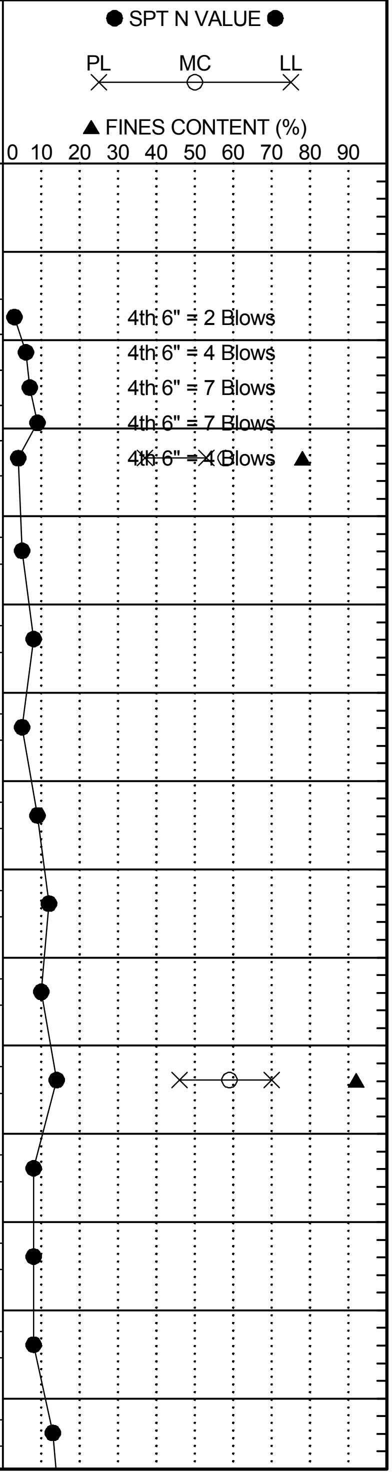
SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin		
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41		
Boring No.:	B-5	**Boring Location:**	258+51	**Offset:**	2.3' RT of CL	**Alignment:**	SC 41		
Elev.:	0.0 ft	**Latitude:**	32.92251806	**Longitude:**	79.82678861	**Date Started:**	4/2/2011		
Total Depth:	107.7 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/2/2011		
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]		
Drill Machine:	CME-458	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%		
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB**	0 ft	**24HR**		

Depth (ft)	MATERIAL DESCRIPTION
0.0	▽Water Surface
7.7	Very Loose to Loose, Wet, Green/Gray/Tan/Light Brown, Fine to Medium SAND (SP-SM), with Silt, Shell Fragments **(COOPER MARL)**
13.7	Loose, Wet, Light Brown, Silty Fine to Medium SAND (SM)
15.7	Soft to Firm, Moist, Gray, Elastic SILT (MH) with Fine Sand
36.2	Firm to Stiff, Moist, Light Brown, Elastic SILT (MH)

Elevation (ft): -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0, -50.0, -55.0, -60.0, -65.0, -70.0

Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
7.7	SS-1	2	1	2	3
9.7	SS-2	4	3	3	6
11.7	SS-3	2	3	4	7
13.7	SS-4	5	5	4	9
15.7	SS-5	3	2	2	4
21.2	SS-6	2	3	2	5
26.2	SS-7	3	4	4	8
31.2	SS-8	3	2	3	5
36.2	SS-9	2	4	5	9
41.2	SS-10	5	6	6	12
46.2	SS-11	4	5	5	10
51.2	SS-12	6	6	8	14
56.2	SS-13	3	3	5	8
61.2	SS-14	3	4	4	8
66.2	SS-16	3	4	4	8
71.2	SS-17	5	6	7	13



LEGEND

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SAMPLER TYPE

SS - Split Spoon	NQ - Rock Core, 1-7/8"
ST - Shelby Tube	CU - Cuttings
AWG - Rock Core, 1-1/8"	CT - Continuous Tube

DRILLING METHOD

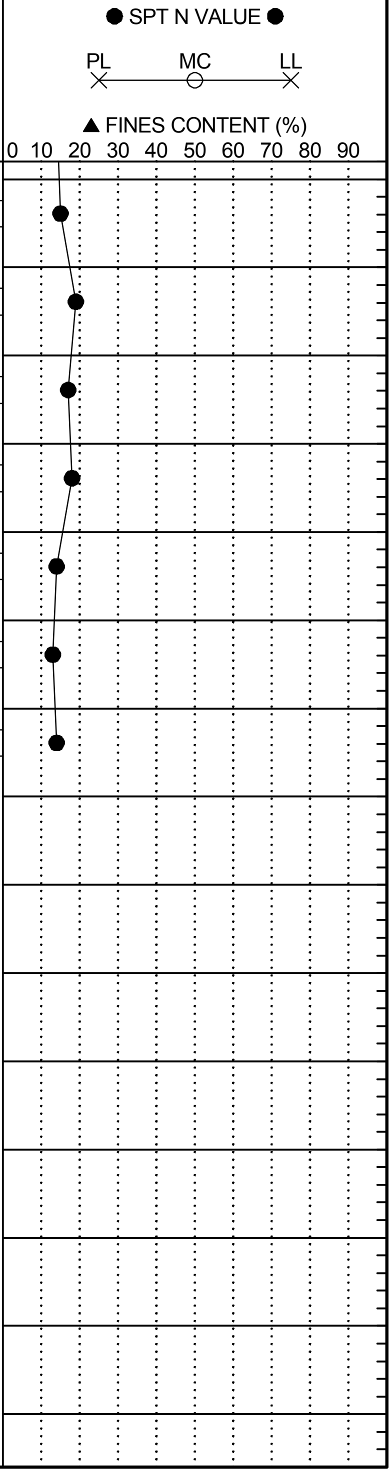
HSA - Hollow Stem Auger	RW - Rotary Wash
CFA - Continuous Flight Augers	RC - Rock Core
DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-5	**Boring Location:**	258+51	**Offset:**	2.3' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92251806	**Longitude:**	79.82678861	**Date Started:**	4/2/2011
Total Depth:	107.7 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/2/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-458	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0	74.7	Medium Dense, Moist to Wet, Tan, Silty Fine SAND (SM), with Black Speckles	76.2	SS-18	5	7	8	15
-80.0			81.2	SS-19	7	9	10	19
-85.0			86.2	SS-20	7	8	9	17
-90.0			91.2	SS-21	6	6	12	18
-95.0	94.7	Stiff, Moist, Light Green, CLAY (CL)	96.2	SS-22	5	6	8	14
-100.0			101.2	SS-23	5	6	7	13
-105.0			106.2	SS-24	5	6	8	14
	107.7	Boring Terminated at 107.7 Feet						
-110.0								
-115.0								
-120.0								
-125.0								
-130.0								
-135.0								
-140.0								
-145.0								



LEGEND

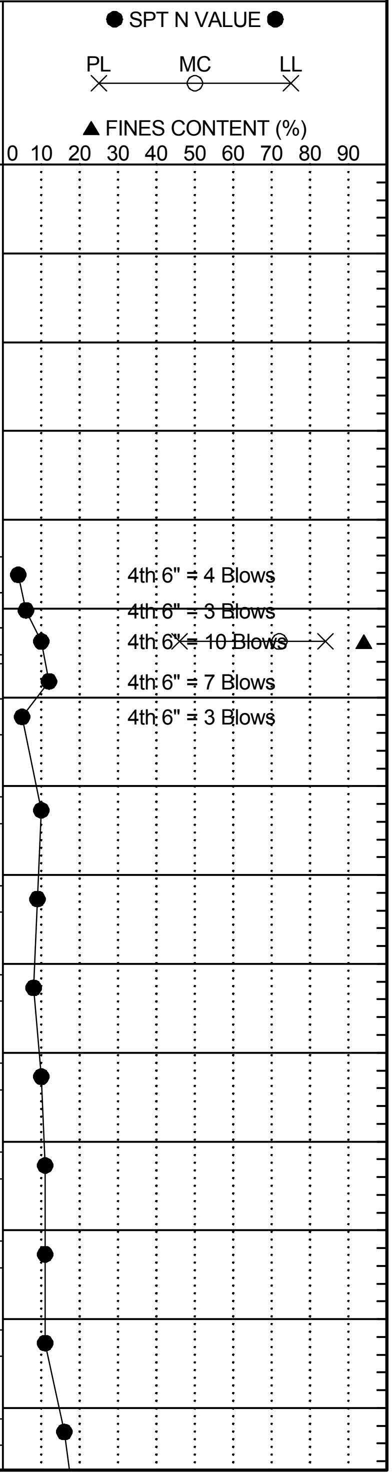
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-6	**Boring Location:**	261+51	**Offset:**	14.2' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92307944	**Longitude:**	79.82607028	**Date Started:**	3/18/2011
Total Depth:	137.1 ft	**Soil Depth:**	115 ft	**Core Depth:**	0 ft	**Date Completed:**	3/21/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
	0.0	▽Water Surface							
	22.1	Soft to Firm, Moist, Green/Brown, Elastic <u>SILT (MH)</u>, with Fine Sand **(COOPER MARL)**	22.1	SS-1	1	2	2	4	4th 6" = 4 Blows
			24.1	SS-2	1	3	3	6	4th 6" = 3 Blows
	26.1	\=> with Shell Fragments	26.1	SS-3	3	4	6	10	4th 6" = 10 Blows
		Firm to Stiff, Moist, Green/Brown, Elastic <u>SILT (MH)</u>	28.1	SS-4	5	6	6	12	4th 6" = 7 Blows
			30.1	SS-5	2	2	3	5	4th 6" = 3 Blows
			35.6	SS-6	3	4	6	10	
			40.6	SS-7	3	4	5	9	
			45.6	SS-8	3	4	4	8	
			50.6	SS-9	4	4	6	10	
			55.6	SS-10	3	5	6	11	
			60.6	SS-11	5	5	6	11	
			65.6	SS-12	4	5	6	11	
-70.0	70.6	Very Stiff, Moist, Green/Brown, Elastic <u>SILT</u> (MH), with Fine Sand	70.6	SS-13	5	8	8	16	



Elevation scale: -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0, -50.0, -55.0, -60.0, -65.0, -70.0

LEGEND

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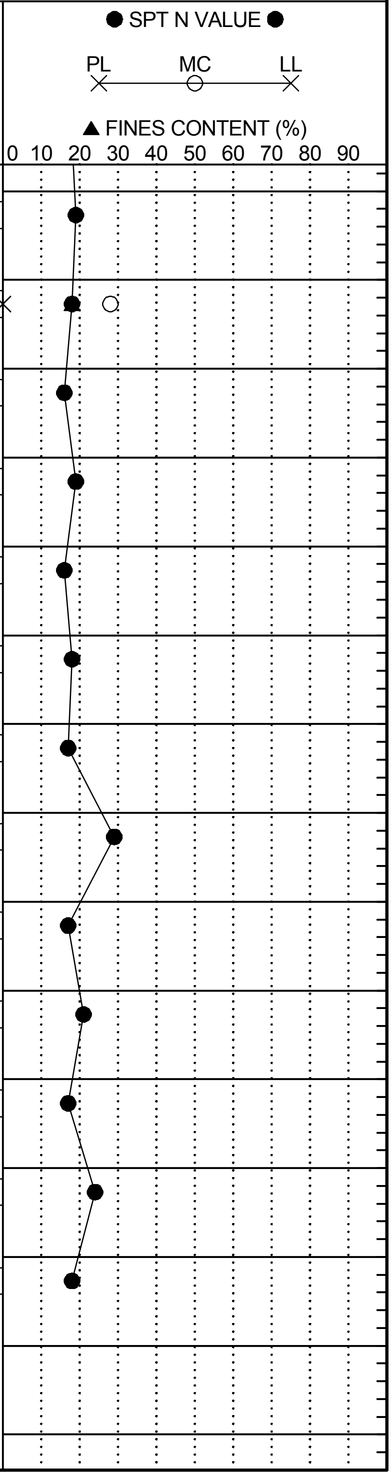
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-6	**Boring Location:**	261+51	**Offset:**	14.2' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92307944	**Longitude:**	79.82607028	**Date Started:**	3/18/2011
Total Depth:	137.1 ft	**Soil Depth:**	115 ft	**Core Depth:**	0 ft	**Date Completed:**	3/21/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0	74.1	Medium Dense, Moist to Wet, Green/Brown, Silty Fine SAND (SM), with Black Speckles		75.6	SS-14	6	9	10	19
-80.0				80.6	SS-15	8	9	9	18
-85.0				85.6	SS-16	9	7	9	16
-90.0				90.6	SS-17	10	9	10	19
-95.0				95.6	SS-18	7	7	9	16
-100.0	99.1	Very Stiff, Moist, Light Green, CLAY (CL)		100.6	SS-19	5	8	10	18
-105.0				105.6	SS-20	6	6	11	17
-110.0				110.6	SS-21	13	13	16	29
-115.0				115.6	SS-22	8	7	10	17
-120.0				120.6	SS-23	8	10	11	21
-125.0				125.6	SS-24	6	7	10	17
-130.0				130.6	SS-25	9	10	14	24
-135.0				135.6	SS-26	5	8	10	18
	137.1	Boring Terminated at 137.1 Feet Due to Caving Sands							
-140.0									
-145.0									



LEGEND

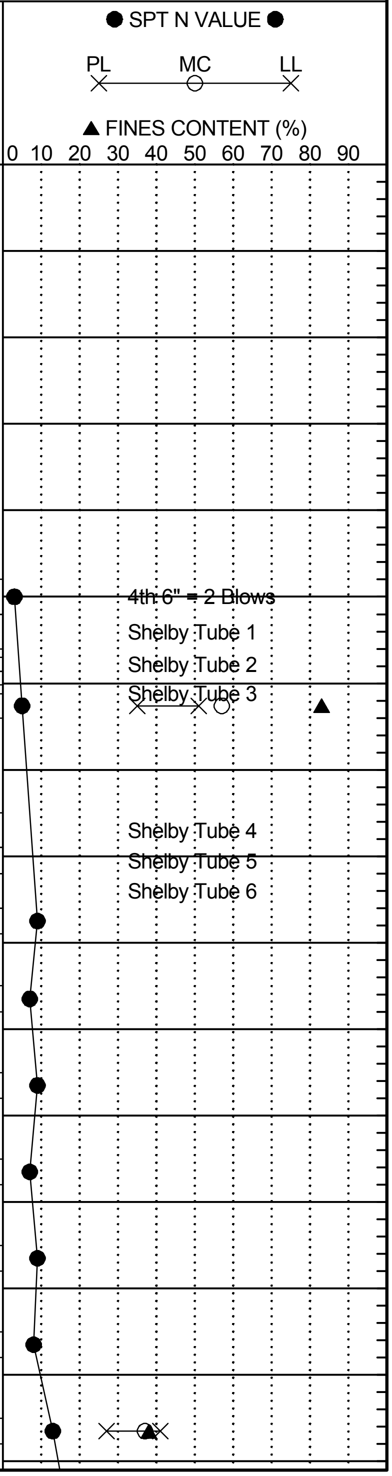
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-7	**Boring Location:**	262+23	**Offset:**	3.6' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92323944	**Longitude:**	79.82593	**Date Started:**	3/16/2011
Total Depth:	144 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/17/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
-5.0									
-10.0									
-15.0									
-20.0									
	24.0	Soft to Firm, Moist, Green/Brown, Elastic SILT (MH) with Fine Sand **(COOPER MARL)**		24.0					
-25.0					SS-1	WOH	1	2	3
				26.0	ST-1				
				28.5	ST-2				
-30.0				29.3	ST-3				
				30.6	SS-2	2	2	3	5
-35.0									
				37.5	ST-4				
-40.0				39.5	ST-5				
				41.0	ST-6				
	43.0	Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH)		43.0	SS-3	3	4	5	9
-45.0									
				47.5	SS-4	2	3	4	7
-50.0									
				52.5	SS-5	3	4	5	9
-55.0									
				57.5	SS-6	3	3	4	7
-60.0									
				62.5	SS-7	3	4	5	9
-65.0									
				67.5	SS-8	3	4	4	8
-70.0	71.0	Loose to Medium Dense, Moist, Green/Brown, Silty Fine to Medium SAND (SM)							
				72.5	SS-9	4	6	7	13
-75.0									



LEGEND

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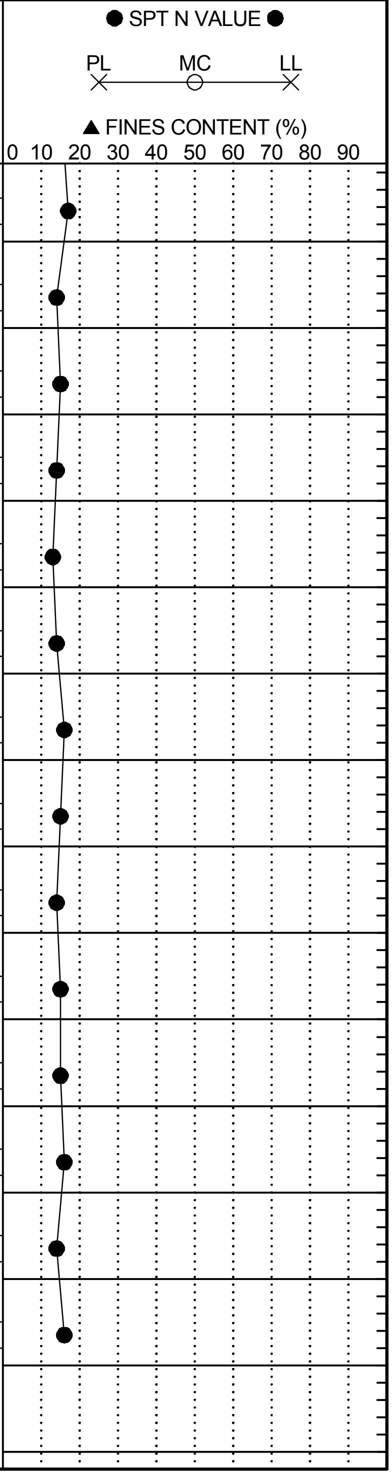
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-7	**Boring Location:**	262+23	**Offset:**	3.6' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92323944	**Longitude:**	79.82593	**Date Started:**	3/16/2011
Total Depth:	144 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/17/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-80.0		Loose to Medium Dense, Moist, Green/Brown, Silty Fine to Medium <u>SAND (SM)</u>		77.5	SS-10	7	8	9	17
-85.0				82.5	SS-11	6	6	8	14
-90.0				87.5	SS-12	6	7	8	15
-95.0	96.0			92.5	SS-13	7	7	7	14
-100.0		Stiff to Very Stiff, Moist, Light Green, <u>CLAY (CL)</u>		97.5	SS-14	4	6	7	13
-105.0				102.5	SS-15	5	6	8	14
-110.0				107.5	SS-16	5	8	8	16
-115.0				112.5	SS-17	5	7	8	15
-120.0				117.5	SS-18	3	7	7	14
-125.0				122.5	SS-19	4	7	8	15
-130.0				127.5	SS-19	4	7	8	15
-135.0				132.5	SS-20	2	7	9	16
-140.0				137.5	SS-21	4	6	8	14
-145.0	144.0	Boring Terminated at 144.0 Feet		142.5	SS-22	6	7	9	16
-150.0									



SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

LEGEND

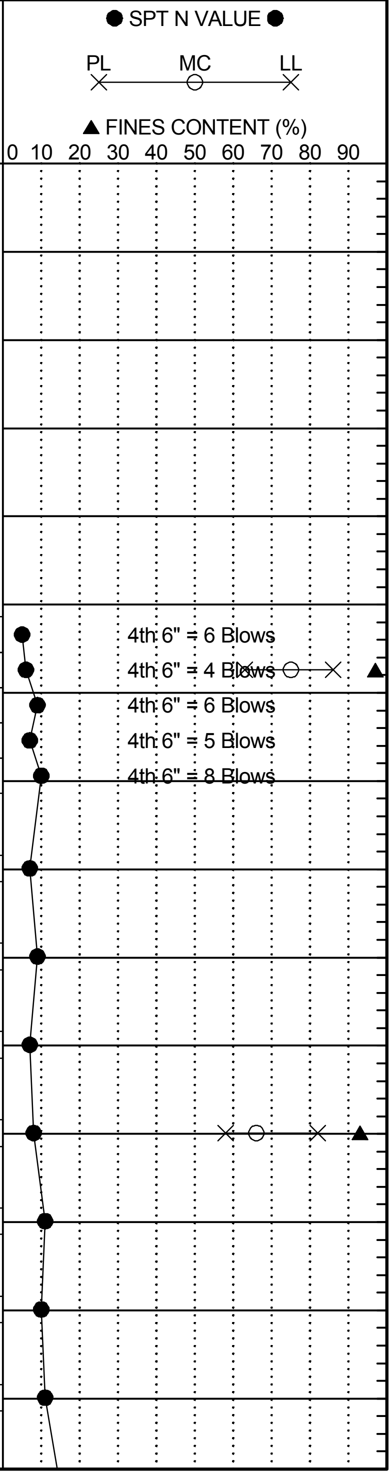
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-8	**Boring Location:**	263+38	**Offset:**	59.5' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92335417	**Longitude:**	79.82553722	**Date Started:**	3/22/2011
Total Depth:	145.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/22/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
	25.7	Firm to Stiff, Moist, Green/Brown, Elastic <u>SILT (MH)</u> **(COOPER MARL)**		25.7	SS-1	2	2	3	5
				27.7	SS-2	2	2	4	6
				29.7	SS-3	3	3	6	9
				31.7	SS-4	2	3	4	7
				33.7	SS-5	3	3	7	10
				39.2	SS-6	2	2	5	7
				44.2	SS-7	3	4	5	9
				49.2	SS-8	3	3	4	7
				54.2	SS-9	3	3	5	8
				59.2	SS-10	4	4	7	11
				64.2	SS-11	3	4	6	10
				69.2	SS-12	3	4	7	11

Elevation (ft): -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0, -50.0, -55.0, -60.0, -65.0, -70.0



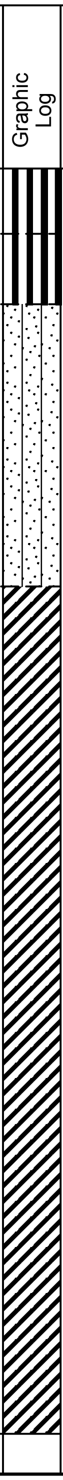
LEGEND *Continued Next Page*

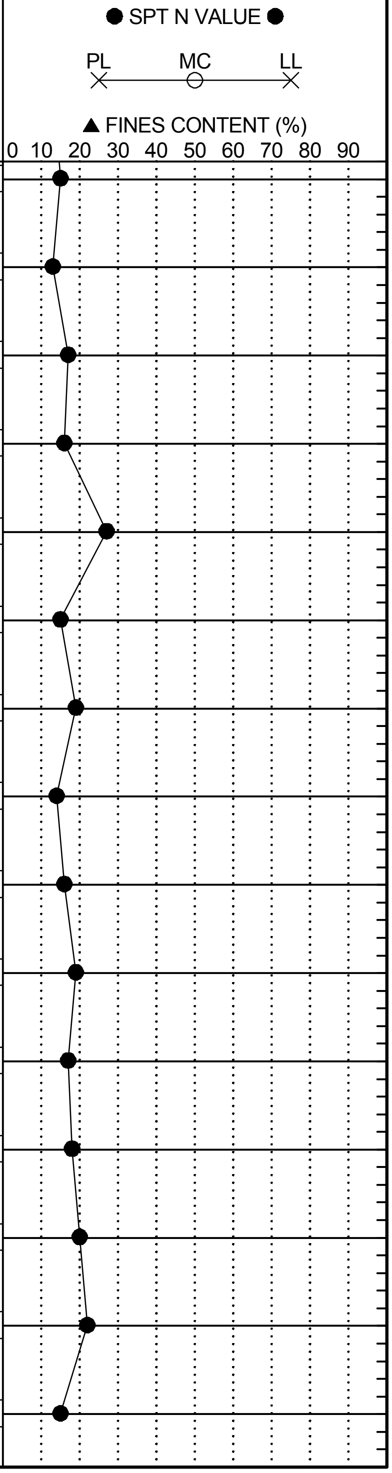
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-8	**Boring Location:**	263+38	**Offset:**	59.5' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92335417	**Longitude:**	79.82553722	**Date Started:**	3/22/2011
Total Depth:	145.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/22/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0		Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH)	74.2	SS-13	5	7	8	15
	77.7	Stiff, Moist, Green/Brown, Fine to Medium Sandy SILT (ML), with Black Speckles						
-80.0			79.2	SS-14	4	5	8	13
	81.7	Medium Dense, Moist to Wet, Green/Brown, Silty Fine to Medium SAND (SM), with Black Speckles						
-85.0			84.2	SS-15	8	9	8	17
-90.0			89.2	SS-16	7	8	8	16
-95.0			94.2	SS-17	8	12	15	27
	97.7	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)						
-100.0			99.2	SS-18	4	6	9	15
-105.0			104.2	SS-19	5	9	10	19
-110.0			109.2	SS-20	6	7	7	14
-115.0			114.2	SS-21	5	8	8	16
-120.0			119.2	SS-22	7	8	11	19
-125.0			124.2	SS-23	7	8	9	17
-130.0			129.2	SS-24	8	7	11	18
-135.0			134.2	SS-25	6	8	12	20
-140.0			139.2	SS-26	8	12	10	22
-145.0	145.7		144.2	SS-27	5	6	9	15
		Boring Terminated at 145.7 Feet						





LEGEND

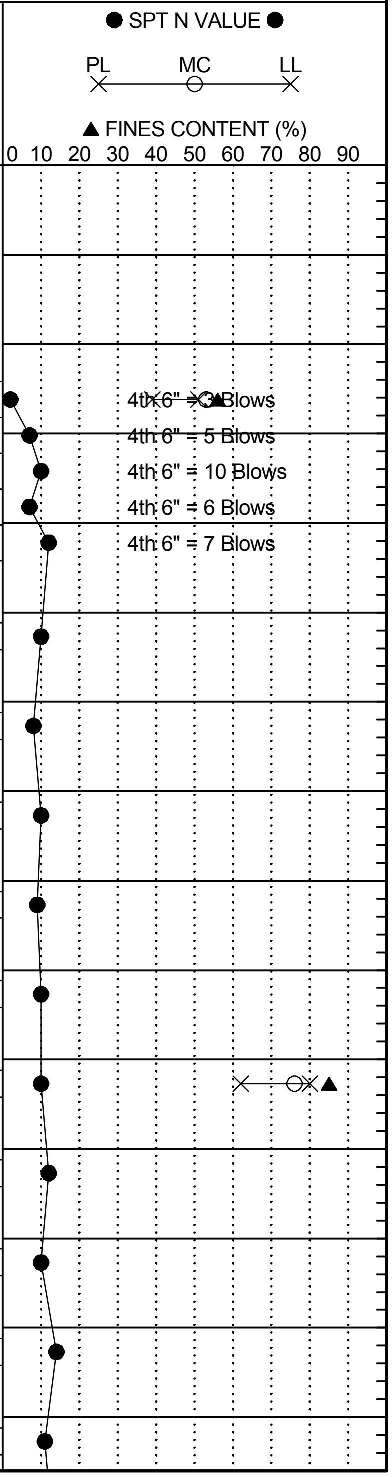
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-9	**Boring Location:**	265+47	**Offset:**	36.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92394833	**Longitude:**	79.82527472	**Date Started:**	3/23/2011
Total Depth:	112.1 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	3/23/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
-5.0									
-10.0									
	12.1	Very Soft, Wet, Gray, Fine to Coarse Sandy Elastic <u>SILT (MH)</u> **(COOPER MARL)**		12.1	SS-1	1	1	1	2
-15.0	14.1	Firm to Stiff, Moist, Green/Brown, Elastic <u>SILT (MH)</u> with Fine Sand		14.1	SS-2	3	3	4	7
				16.1	SS-3	5	5	5	10
				18.1	SS-4	2	3	4	7
-20.0				20.1	SS-5	5	5	7	12
-25.0				25.6	SS-6	3	5	5	10
-30.0				30.6	SS-7	3	3	5	8
-35.0				35.6	SS-8	4	4	6	10
-40.0				40.6	SS-9	4	4	5	9
-45.0				45.6	SS-10	4	4	6	10
-50.0				50.6	SS-11	3	5	5	10
-55.0				55.6	SS-12	4	5	7	12
-60.0				60.6	SS-13	4	5	5	10
-65.0				65.6	SS-14	5	7	7	14
-70.0				70.6	SS-15	3	5	6	11



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LEGEND

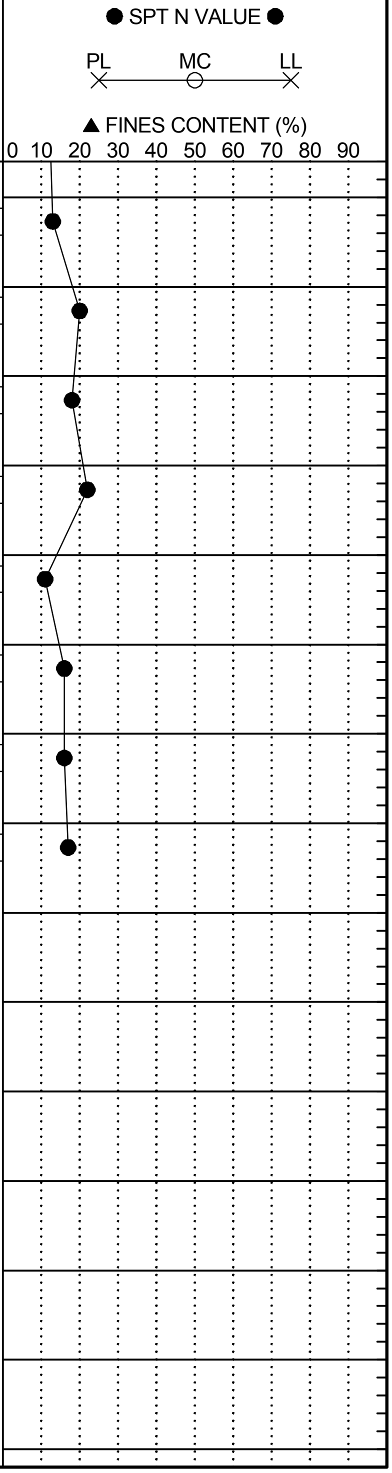
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-9	**Boring Location:**	265+47	**Offset:**	36.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92394833	**Longitude:**	79.82527472	**Date Started:**	3/23/2011
Total Depth:	112.1 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	3/23/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	74.1								
-75.0		Medium Dense, Moist, Green/Brown, Silty Fine to Medium SAND (SM), with Black Speckles		75.6	SS-16	5	6	7	13
	79.1								
-80.0		Medium Dense, Wet, Green/Brown, Fine to Medium SAND (SP-SM), with Silt		80.6	SS-17	8	10	10	20
-85.0				85.6	SS-18	9	9	9	18
-90.0				90.6	SS-19	8	11	11	22
	94.1								
-95.0		Stiff to Very Stiff, Moist, Light Green, CLAY (CL)		95.6	SS-20	4	5	6	11
-100.0				100.6	SS-21	6	7	9	16
-105.0				105.6	SS-22	6	7	9	16
-110.0				110.6	SS-23	6	7	10	17
	112.1	Boring Terminated at 112.1 Feet							
-115.0									
-120.0									
-125.0									
-130.0									
-135.0									
-140.0									
-145.0									



LEGEND

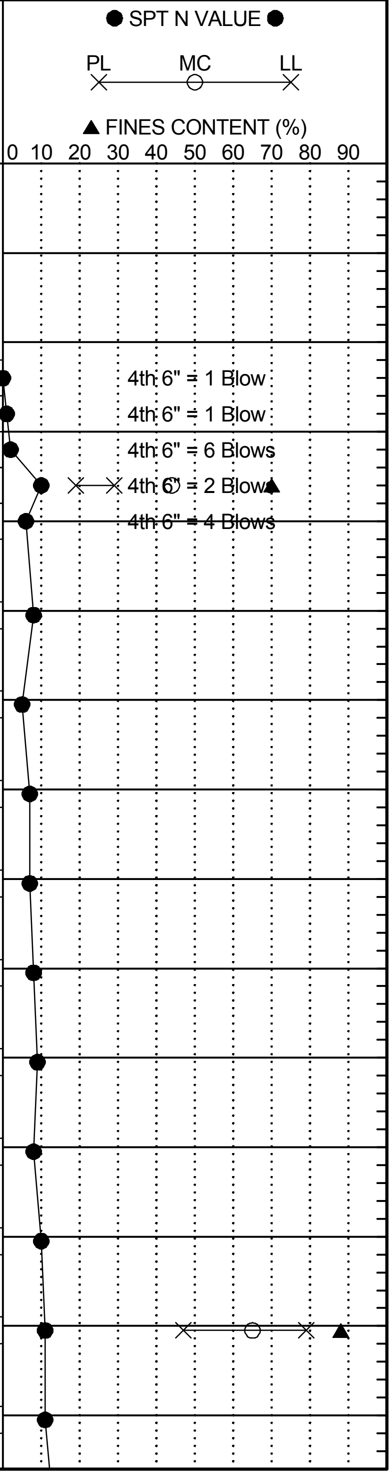
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-10	**Boring Location:**	268+76	**Offset:**	11.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92453889	**Longitude:**	79.82446194	**Date Started:**	4/3/2011
Total Depth:	111 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/3/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface						
-5.0								
-10.0	11.0		11.0	SS-1	WOH			0
	11.3	Very Loose, Wet, Black, Fine SAND (SP) **(COOPER MARL)**	13.0	SS-2	1	1	1	1
-15.0	15.0	Very Soft, Wet, Black, CLAY (CL), with Organics	15.0	SS-3	1	1	1	2
	17.0	Very Soft, Wet, Gray, Lean CLAY (CL) with Fine Sand	17.0	SS-4	14	5	5	10
-20.0	19.0	Stiff, Wet, Gray, Lean CLAY (CL) with Fine Sand	19.0	SS-5	3	3	3	6
-25.0		Firm to Stiff, Moist, Brown/Yellow, SILT (ML), with Sand	24.5	SS-6	2	3	5	8
-30.0			29.5	SS-7	3	2	3	5
-35.0			34.5	SS-8	3	3	4	7
-40.0			39.5	SS-9	3	3	4	7
-45.0			44.5	SS-10	3	4	4	8
-50.0			49.5	SS-11	3	4	5	9
-55.0			54.5	SS-12	3	4	4	8
-60.0			59.5	SS-13	5	4	6	10
-65.0			64.5	SS-14	4	5	6	11
	68.0	Stiff, Moist, Light Brown, Elastic SILT (MH)						
-70.0			69.5	SS-15	4	5	6	11



LEGEND

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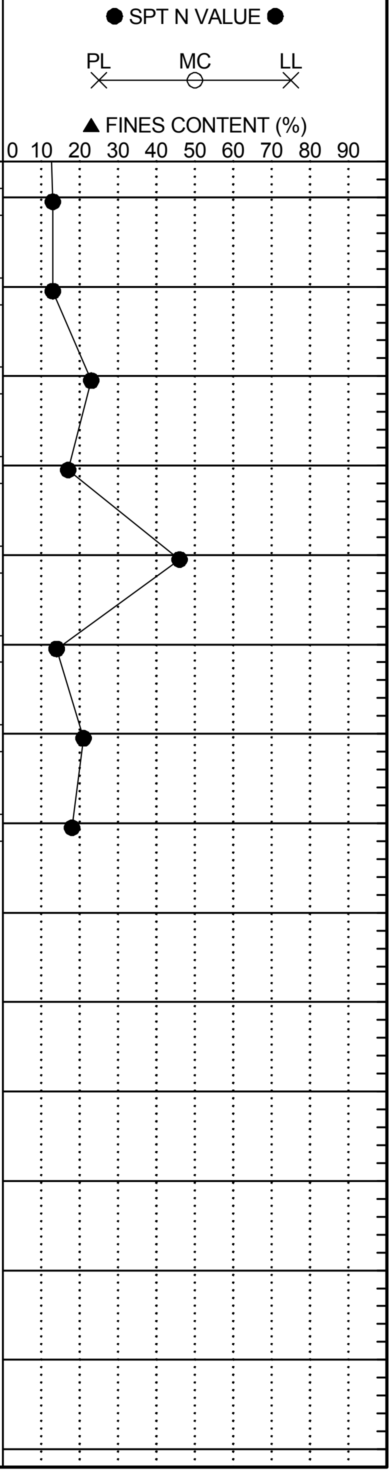
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-10	**Boring Location:**	268+76	**Offset:**	11.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92453889	**Longitude:**	79.82446194	**Date Started:**	4/3/2011
Total Depth:	111 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/3/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0		Stiff, Moist, Light Brown, Elastic SILT (MH)		74.5	SS-16	5	6	7	13
-80.0	78.0	Medium Dense, Wet, Brown/Yellow, Silty Fine to Medium SAND (SM)		79.5	SS-17	4	6	7	13
-85.0	83.0	Medium Dense, Wet, Brown/Yellow, Silty Fine to Medium SAND (SM) Medium Dense to Dense, Wet, Brown/Yellow, Fine to Medium SAND (SP-SM), with Silt		84.5	SS-18	7	10	13	23
-90.0				89.5	SS-19	7	7	10	17
-95.0				94.5	SS-20	12	22	24	46
-100.0	98.0	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)		99.5	SS-21	5	6	8	14
-105.0				104.5	SS-22	7	9	12	21
-110.0	111.0			109.5	SS-23	7	9	9	18
		Boring Terminated at 111.0 Feet							
-115.0									
-120.0									
-125.0									
-130.0									
-135.0									
-140.0									
-145.0									



SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

LEGEND

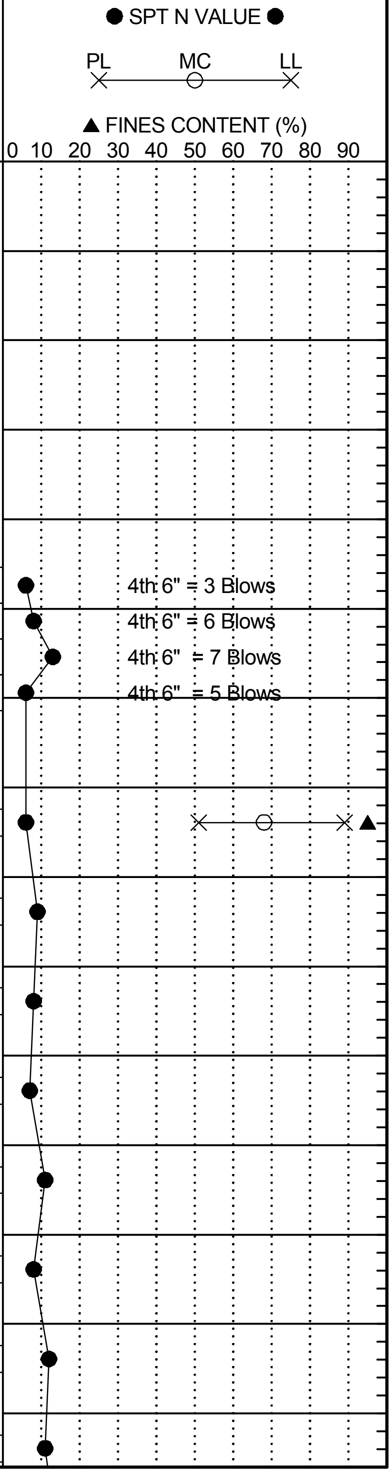
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.: 8.158B/10.032102
Project No. (PIN): 32099
County: Berkeley/Charleston
Eng./Geo.: T. Martin
Site Description: SC 41 Replacement Bridge over Wando River
Route: SC 41
Boring No.: B-11
Boring Location: 272+05
Offset: 21.6' RT of CL
Alignment: SC 41
Elev.: 0.0 ft
Latitude: 32.92511722
Longitude: 79.82362861
Date Started: 4/4/2011
Total Depth: 122.7 ft
Soil Depth: 100 ft
Core Depth: 0 ft
Date Completed: 4/6/2011
Bore Hole Diameter (in): 4
Sampler Configuration
Liner Required: Y [✓ N]
Liner Used: Y [✓ N]
Drill Machine: CME-45B
Drill Method: Rotary Wash
Hammer Type: Automatic
Energy Ratio: 73%
Core Size: N/A
Driller: Mark Brown
Groundwater: **TOB** 0 ft **24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
	0.0	▽Water Surface								
	22.7			22.7						
	23.2	Loose, Moist, Gray/Black, Fine to Coarse SAND (SP), with Shell Fragments **(COOPER MARL)**		24.7	SS-1	1	4	2	6	4th 6" = 3 Blows
		Firm to Stiff, Moist, Light Brown, Elastic SILT (MH)		26.7	SS-2	3	4	4	8	4th 6" = 6 Blows
				28.7	SS-3	7	7	6	13	4th 6" = 7 Blows
					SS-4	2	3	3	6	4th 6" = 5 Blows
				36.2	SS-5	2	3	3	6	
				41.2	SS-6	3	4	5	9	
				46.2	SS-7	4	3	5	8	
	47.7	Firm to Stiff, Moist, Gray, Fine to Medium Sandy SILT (ML)								
				51.2	SS-8	3	3	4	7	
				56.2	SS-9	4	5	6	11	
				61.2	SS-10	3	4	4	8	
				66.2	SS-11	4	6	6	12	
				71.2	SS-12	4	5	6	11	

Elevation scale: -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0, -50.0, -55.0, -60.0, -65.0, -70.0



SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 4/19/11

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LEGEND

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

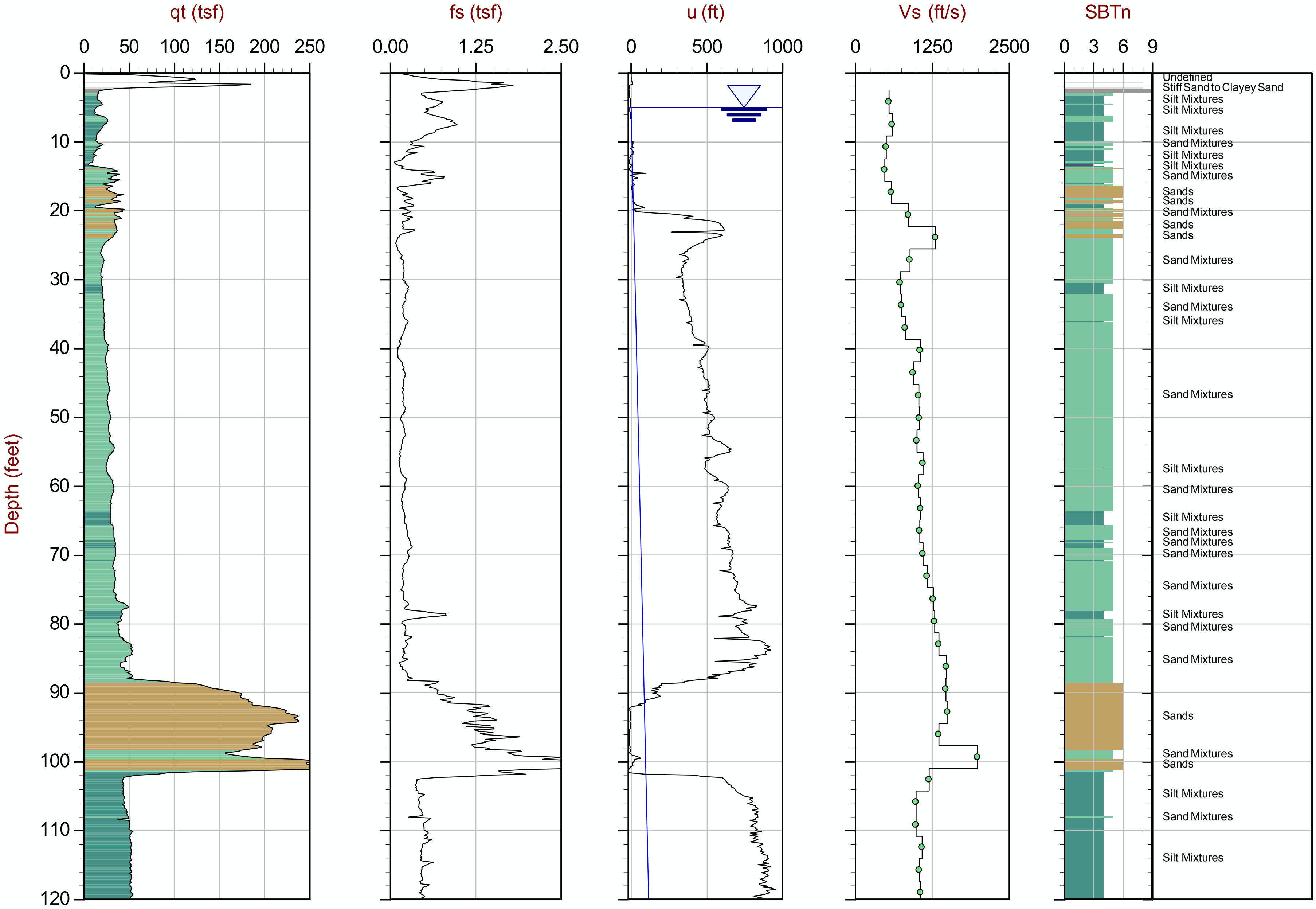
SECTION 2

SHEAR WAVE DATA AND VELOCITY ESTIMATES

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

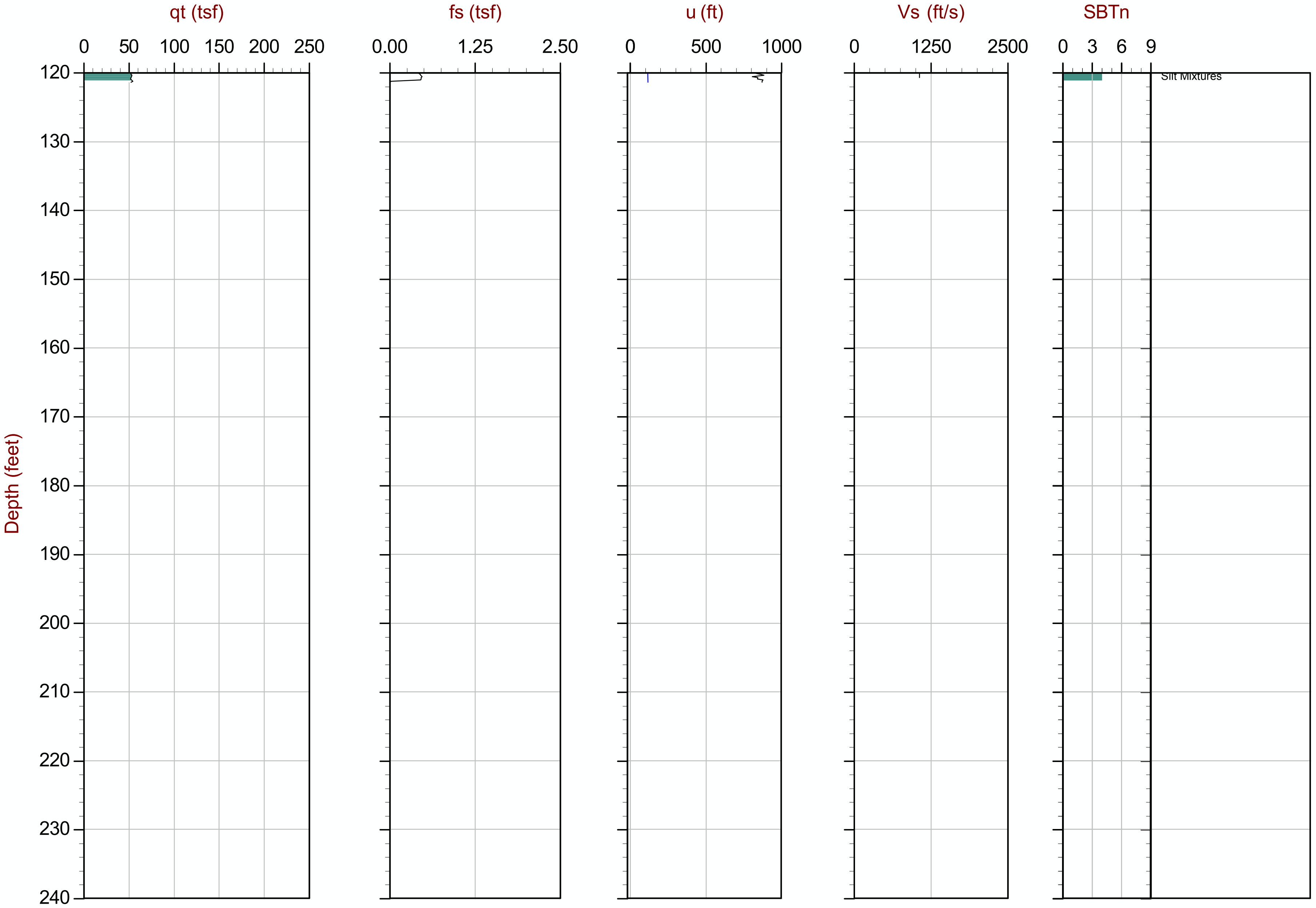
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 1 of 2

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500

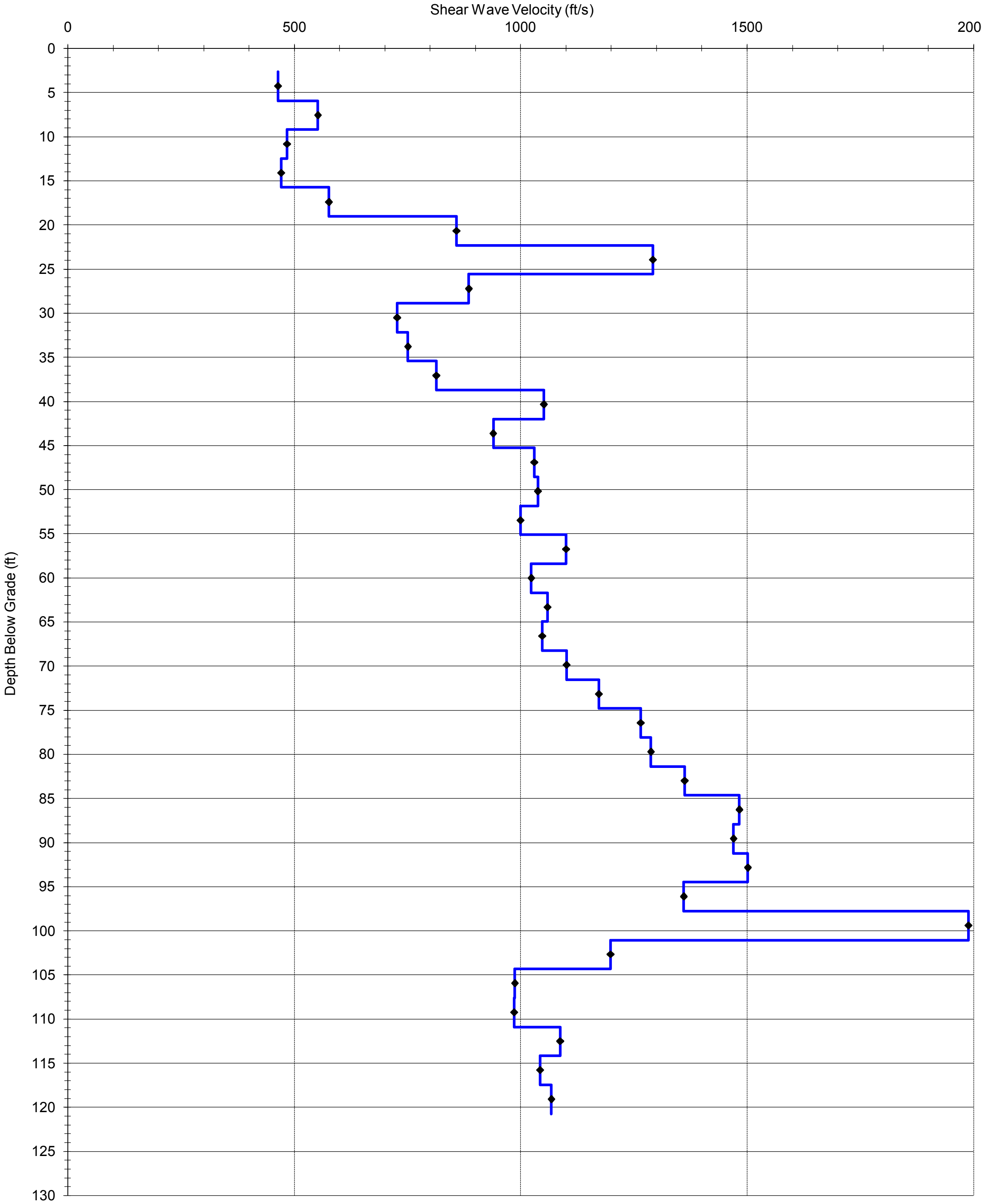


Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 2 of 2

Shear Wave Velocity- CPT-2
SC-41 Replacement Bridge
11-920
March 8 2011



ConeTec Shear Wave Velocity Data Reduction Sheet

Hole:	CPT-2
Location:	SC-41 Replacement Bridge
Cone:	AD214
Date:	8-Mar-11
Source:	Beam
Source Depth	0.00 m
Source Offset	1.45 m

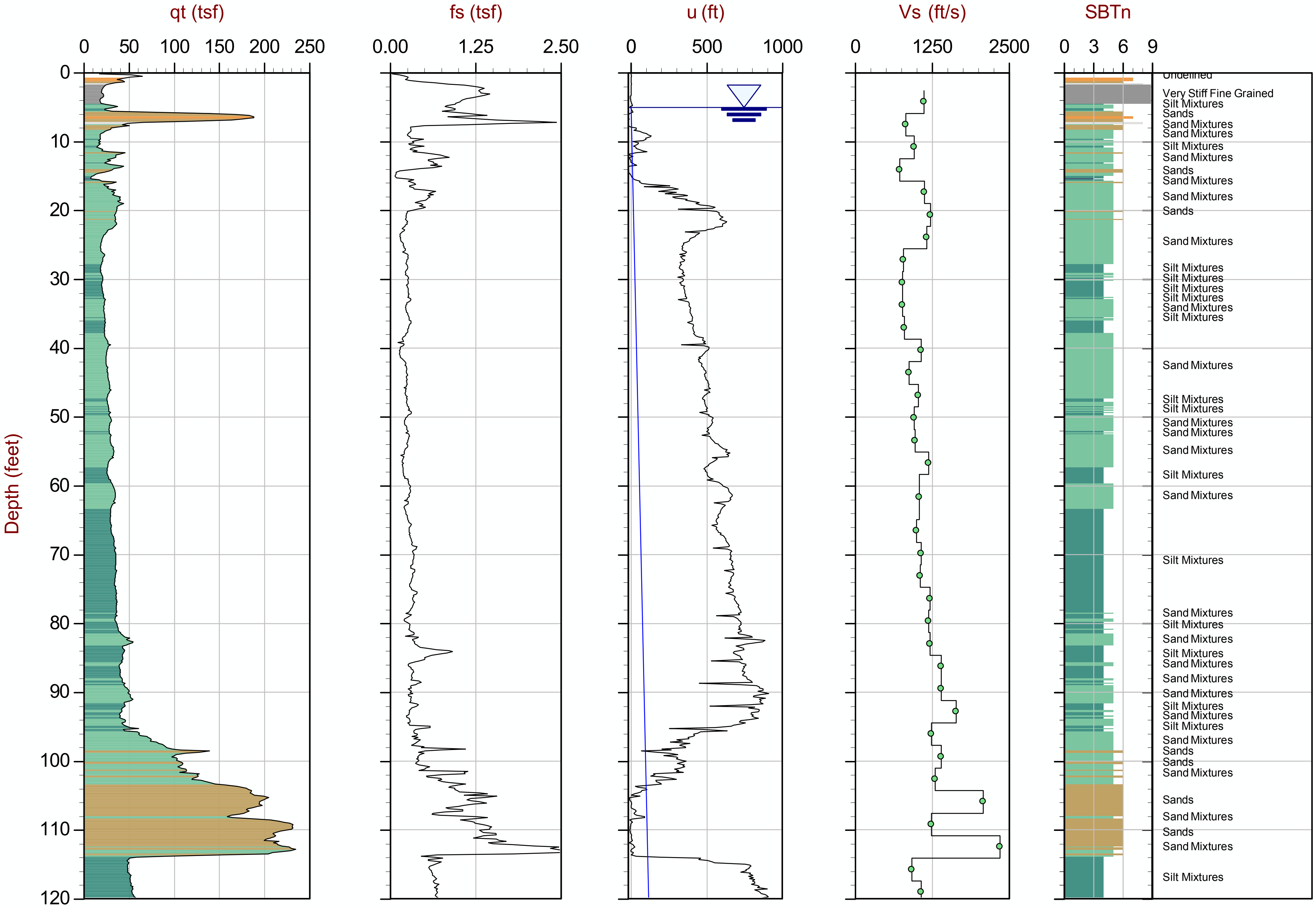
Tip Depth (m)	Geophone Depth(m)	Travel Path (m)	Interval time (ms)	Velocity (m/s)	Velocity (ft/s)	Interval Depth (m)	Interval Depth (ft)
0.00							
1.00	0.80	1.66					
2.00	1.80	2.31	4.63	141.5	464.3	1.30	4.27
3.00	2.80	3.15	5.00	168.4	552.4	2.30	7.55
4.00	3.80	4.07	6.20	147.4	483.7	3.30	10.83
5.00	4.80	5.01	6.60	143.6	471.1	4.30	14.11
6.00	5.80	5.98	5.49	175.8	576.7	5.30	17.39
7.00	6.80	6.95	3.73	261.4	857.8	6.30	20.67
8.00	7.80	7.93	2.49	393.7	1291.7	7.30	23.95
9.00	8.80	8.92	3.65	269.9	885.6	8.30	27.23
10.00	9.80	9.91	4.46	221.6	727.2	9.30	30.51
11.00	10.80	10.90	4.33	228.9	751.1	10.30	33.79
12.00	11.80	11.89	4.00	247.9	813.3	11.30	37.07
13.00	12.80	12.88	3.10	320.4	1051.3	12.30	40.35
14.00	13.80	13.88	3.47	286.3	939.4	13.30	43.63
15.00	14.80	14.87	3.17	313.8	1029.6	14.30	46.92
16.00	15.80	15.87	3.15	316.3	1037.7	15.30	50.20
17.00	16.80	16.86	3.27	304.6	999.3	16.30	53.48
18.00	17.80	17.86	2.97	335.3	1100.1	17.30	56.76
19.00	18.80	18.86	3.20	311.9	1023.3	18.30	60.04
20.00	19.80	19.85	3.09	322.8	1059.0	19.30	63.32
21.00	20.80	20.85	3.12	319.3	1047.7	20.30	66.60
22.00	21.80	21.85	2.97	335.5	1100.8	21.30	69.88
23.00	22.80	22.85	2.79	357.3	1172.3	22.30	73.16
24.00	23.80	23.84	2.59	385.5	1264.6	23.30	76.44
25.00	24.80	24.84	2.54	392.5	1287.7	24.30	79.72
26.00	25.80	25.84	2.41	415.0	1361.6	25.30	83.00
27.00	26.80	26.84	2.21	452.0	1482.9	26.30	86.29
28.00	27.80	27.84	2.23	448.0	1470.0	27.30	89.57
29.00	28.80	28.84	2.18	457.6	1501.4	28.30	92.85
30.00	29.80	29.84	2.41	414.6	1360.2	29.30	96.13
31.00	30.80	30.83	1.65	606.0	1988.1	30.30	99.41
32.00	31.80	31.83	2.74	365.1	1197.9	31.30	102.69
33.00	32.80	32.83	3.32	300.9	987.2	32.30	105.97
34.00	33.80	33.83	3.33	300.3	985.2	33.30	109.25
35.00	34.80	34.83	3.02	331.2	1086.7	34.30	112.53
36.00	35.80	35.83	3.14	317.9	1042.9	35.30	115.81
37.00	36.80	36.83	3.07	325.5	1067.9	36.30	119.09

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 10:56
Site: SC 41 Replacement Bridge

Sounding: CPT-3
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

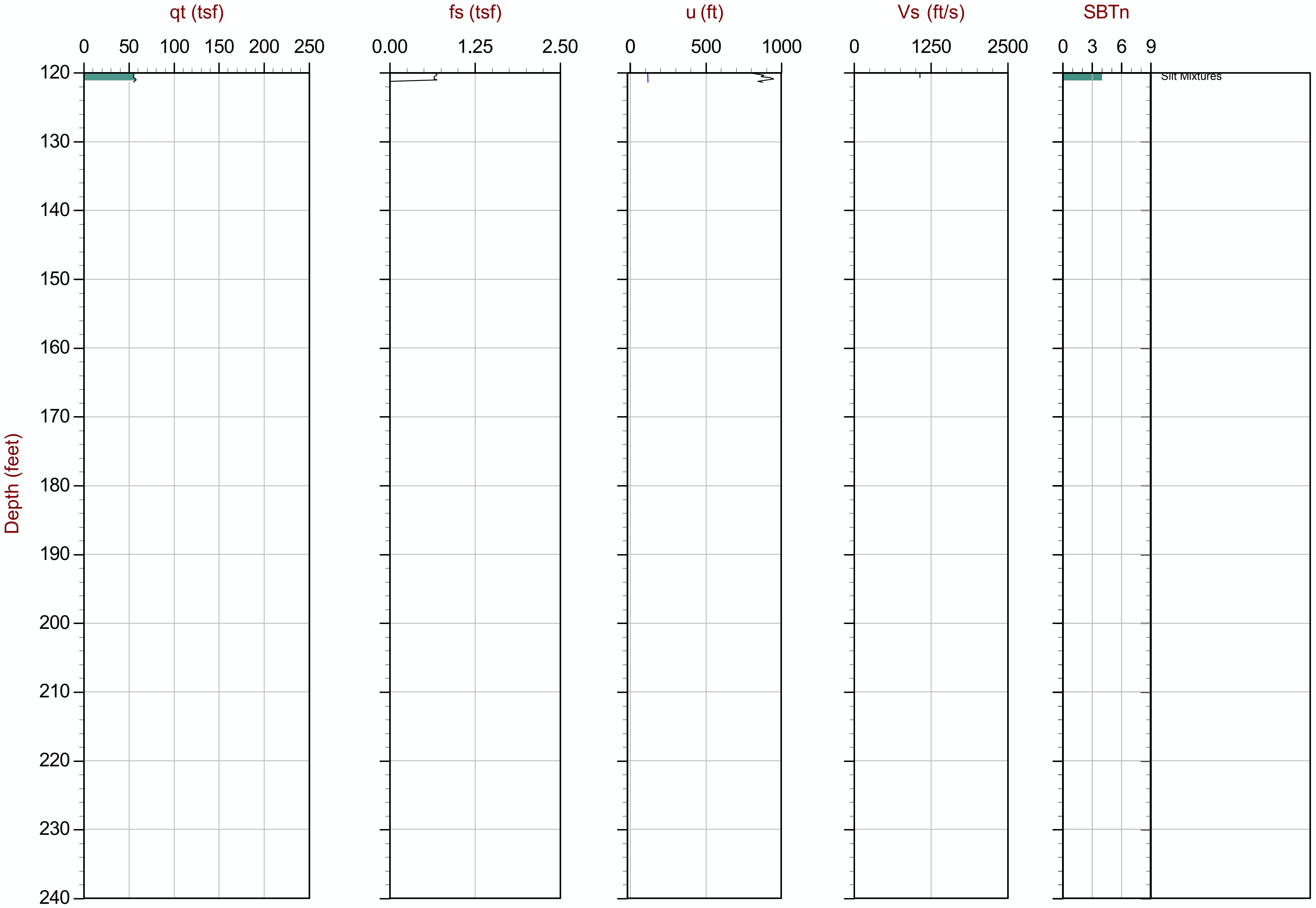
File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 1 of 2

F&ME

Job No: 11-920
Date: 03:08:11 10:56
Site: SC 41 Replacement Bridge

Sounding: CPT-3
Cone: 214:T1500F15U500

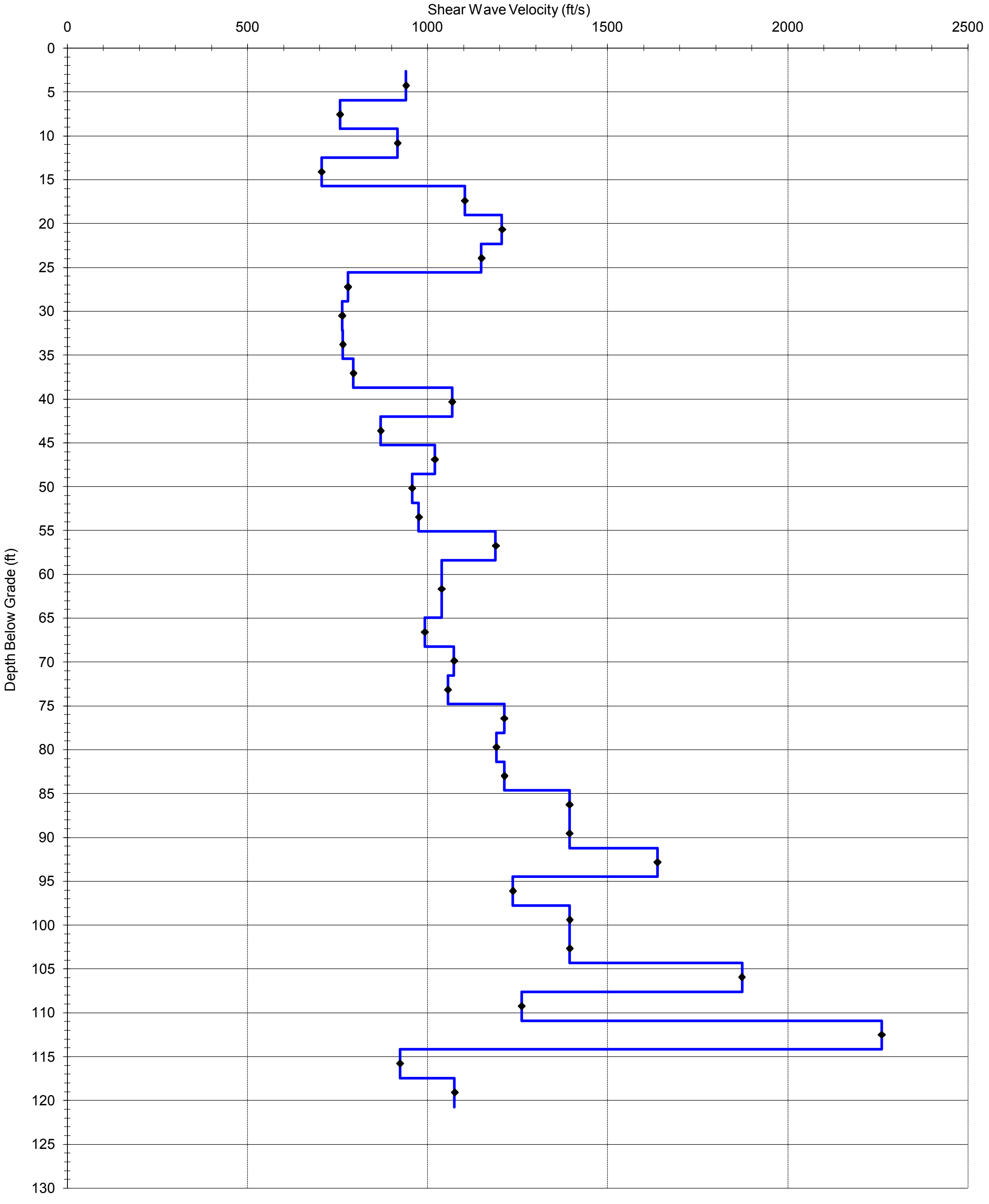


Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 2 of 2

Shear Wave Velocity- CPT-3
SC-41 Replacement Bridge
11-920
March 8 2011



ConeTec Shear Wave Velocity Data Reduction Sheet

Hole:	CPT-3
Location:	SC-41 Replacement Bridge
Cone:	AD214
Date:	8-Mar-11
Source:	Beam

Source Depth	0.00 m
Source Offset	1.45 m

Tip Depth (m)	Geophone Depth(m)	Travel Path (m)	Interval time (ms)	Velocity (m/s)	Velocity (ft/s)	Interval Depth (m)	Interval Depth (ft)
0.00							
1.00	0.80	1.66					
2.00	1.80	2.31	2.29	286.5	939.9	1.30	4.27
3.00	2.80	3.15	3.65	230.7	756.8	2.30	7.55
4.00	3.80	4.07	3.27	279.4	916.6	3.30	10.83
5.00	4.80	5.01	4.40	215.0	705.4	4.30	14.11
6.00	5.80	5.98	2.87	336.2	1102.9	5.30	17.39
7.00	6.80	6.95	2.65	367.7	1206.3	6.30	20.67
8.00	7.80	7.93	2.80	350.3	1149.2	7.30	23.95
9.00	8.80	8.92	4.15	237.4	778.7	8.30	27.23
10.00	9.80	9.91	4.25	232.5	762.7	9.30	30.51
11.00	10.80	10.90	4.25	233.0	764.4	10.30	33.79
12.00	11.80	11.89	4.10	241.9	793.7	11.30	37.07
13.00	12.80	12.88	3.05	325.6	1068.3	12.30	40.35
14.00	13.80	13.88	3.75	265.1	869.7	13.30	43.63
15.00	14.80	14.87	3.20	310.9	1020.0	14.30	46.92
16.00	15.80	15.87	3.41	291.6	956.5	15.30	50.20
17.00	16.80	16.86	3.35	297.3	975.4	16.30	53.48
18.00	17.80	17.86	2.75	362.3	1188.8	17.30	56.76
20.00	19.80	19.85	6.30	316.5	1038.4	18.80	61.68
21.00	20.80	20.85	3.30	302.2	991.6	20.30	66.60
22.00	21.80	21.85	3.05	327.1	1073.1	21.30	69.88
23.00	22.80	22.85	3.10	321.9	1056.0	22.30	73.16
24.00	23.80	23.84	2.70	369.6	1212.7	23.30	76.44
25.00	24.80	24.84	2.75	363.0	1190.8	24.30	79.72
26.00	25.80	25.84	2.70	369.7	1213.0	25.30	83.00
27.00	26.80	26.84	2.35	424.9	1393.9	26.30	86.29
28.00	27.80	27.84	2.35	424.9	1394.0	27.30	89.57
29.00	28.80	28.84	2.00	499.3	1638.2	28.30	92.85
30.00	29.80	29.84	2.65	376.9	1236.4	29.30	96.13
31.00	30.80	30.83	2.35	425.0	1394.4	30.30	99.41
32.00	31.80	31.83	2.35	425.0	1394.5	31.30	102.69
33.00	32.80	32.83	1.75	570.8	1872.7	32.30	105.97
34.00	33.80	33.83	2.60	384.2	1260.6	33.30	109.25
35.00	34.80	34.83	1.45	689.0	2260.5	34.30	112.53
36.00	35.80	35.83	3.55	281.4	923.3	35.30	115.81
37.00	36.80	36.83	3.05	327.6	1074.8	36.30	119.09

SECTION 3

SUMMARY OF LABORATORY TEST RESULTS

SC 41 REPLACEMENT BRIDGE OVER WANDO RIVER
CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE: 8.158B/10.032102 / PIN NO.: 32099
F&ME PROJECT NO.: G4067.01

LABORATORY ANALYSIS SUMMARY

BORING NUMBER	SAMPLE DEPTH	SAMPLE NUMBER	% GRAVEL	% SAND	% FINES	% MOISTURE	LL	PL	PI	USCS
B-1	7.0'-8.5'	--	0.0	32.8	67.2	25.1	43	21	22	CL
	43.5'-45.0'	--	0.0	8.7	91.3	62.1	78	35	43	CH
B-2	3.5'-5.0'	--	0.2	31.4	68.4	24.9	54	20	34	CH
	33.5'-35.0'	--	0.0	5.1	94.9	63.6	76	35	42	CH
	88.5'-90.0'	--	0.0	83.6	16.4	31.5	NP	NP	NP	SM
	108.5'-110.0'	--	0.0	3.7	96.3	56.9	84	38	46	MH
B-3	38.5'-40.0'	--	0.0	32.2	67.8	57.1	54	29	25	CH
	93.5'-95.0'	--	0.0	80.2	19.8	26.8	NP	NP	NP	SM
B-4	48.5'-50.0'	--	19.3	29.5	51.1	69.8	--	--	--	--
	88.8'-90.0'	--	0.0	43.4	56.6	52.5	59	33	27	MH
B-5	15.7'-17.7'	11-0488E	0.0	22.5	77.5	57.9	53	37	16	MH
	36.2'-37.7'	11-0488	--	--	--	--	--	--	--	--
	51.2'-52.7'	11-0488H	0.0	7.6	92.4	58.9	70	46	24	MH
B-6	26.1'-28.1'	11-0429B	0.0	6.5	93.5	71.9	84	46	38	MH
	35.6'-37.1'	11-0429	--	--	--	--	--	--	--	--
	80.6'-82.1'	11-0429E	0.0	82.3	17.7	27.9	NP	NP	NP	SM
B-7	28.5'-29.3'	11-0412E	--	--	--	--	--	--	--	--
	28.5'-29.3'	11-0412D	0.0	11.1	88.9	67.7	86	61	25	MH
	30.6'-32.0'	11-0435B	0.0	17.5	82.5	57.1	51	35	16	MH
	47.5'-49.0'	11-0435	--	--	--	--	--	--	--	--
	72.5'-74.0'	11-0435E	0.0	61.9	38.1	36.8	41	27	14	SM
B-8	27.7'-29.7'	11-0430B	0.0	3.3	96.7	75.3	86	63	24	MH
	54.2'-55.7'	11-0430E	0.0	6.8	93.2	66.0	82	58	24	MH
	59.2'-60.7'	11-0430	--	--	--	--	--	--	--	--
B-9	12.1'-14.1'	11-0431B	5.5	38.3	56.2	52.7	51	39	12	MH
	50.6'-52.1'	11-0431E	0.0	15.5	84.5	76.0	80	62	18	MH
	55.6'-57.1'	11-0431	--	--	--	--	--	--	--	--
B-10	17.0'-19.0'	11-0489E	0.0	29.7	70.3	43.9	29	19	10	CL
	59.5'-61.0'	11-0489	--	--	--	--	--	--	--	--
	64.5'-66.0'	11-0489H	0.1	11.5	88.4	64.7	79	47	32	MH
B-11	36.2'-37.7'	11-0490E	0.0	4.6	95.4	68.2	89	51	38	MH
	81.2'-82.7'	11-0490	--	--	--	--	--	--	--	--
	86.2'-87.7'	11-0490H	0.3	47.2	52.4	46.4	45	31	14	ML

REVISED
GEOTECHNICAL BASELINE REPORT

SC 41 Replacement Bridge over Wando River Charleston/Berkeley County, SC

For

By

F&ME

CONSULTANTS

Geotechnical / Environmental / Materials
3112 Devine Street
Columbia, South Carolina 29205
Tel. (803) 254-4540 • Fax. (803) 254-4542

December 16, 2011

SCDOT File No.: 8.158B/10.032102
F&ME File No.: G4067.01

F&ME
CONSULTANTS

GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

COLUMBIA OFFICE
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Columbia, SC 29205
Phone (803) 254-4540
Fax (803) 254-4542

MYRTLE BEACH OFFICE
1903 Legion Street
Myrtle Beach, SC 29577
Phone (843) 626-9253
Fax (843) 448-0681

December 16, 2011

Mr. Eric Burgess, P.E.
Triplett-King & Associates, Inc.
3014 Southcross Blvd.
Rock Hill, South Carolina 29730

Re.: **REVISED** Geotechnical Base Line Report
SC 41 Replacement Bridge over Wando River
Charleston/Berkeley County, South Carolina
SCDOT File No. 8.158B/10.032102; PIN: 32099
F&ME Project No. G4067.01

Dear Eric:

Submitted herein is the revised base line report and preliminary recommendations/conclusions from the geotechnical investigation for the above referenced bridge project. Revisions to our initial report (report dated August 2, 2011) are from SCDOT review comments (SCDOT comment log dated October 24, 2011). Included is a summary of the field investigations, our analysis of the subsurface findings, and our preliminary recommendations/conclusions for the proposed bridge/roadway system.

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

Sincerely,

F&ME CONSULTANTS

Zane W. Abernethy, P.E.
President

John F. Hamilton, E.I.T.
Staff Engineer

attachments

ZWA:JFH/jfh

No. 6485
ZANE W. ABERNETHY

FOUNDATION & MATERIALS ENGINEERING, INC.
No. C00375

AASHTO R18

AASHTO ACCREDITED LABORATORY

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APPENDIX

GENERAL PROJECT INFORMATION

The proposed bridge project is located along SC 41 over the Wando River on the Charleston and Berkeley County border in South Carolina. A site location plan is presented in the Appendix as Figure 1.

Based on our understanding, the replacement bridge will span between SC 41 Station 255+92 and 275+28. We assume that the end bents will be supported by steel H-piles and the interior bents will be supported by drilled shafts. In addition, the proposed bridge is detailed with a bascule span utilizing an anticipated drilled shaft supported spread foundation.

The bridge geotechnical field investigations were performed in accordance with the 2010 SCDOT Geotechnical Design Manual (GDM). Preliminary bridge foundation analysis and development of preliminary design recommendations were performed in accordance with AASHTO LRFD Specifications for Highway Bridges, 4th Ed., 2007 with the 2008 AASHTO LRFD interim revisions and the GDM.

GENERAL GEOLOGY

The bridge site is located within the Lower Coastal Plain Physiological Province of South Carolina. The Coastal Plain consists of a wedge of sedimentary deposits which overlie basement rocks beginning at the Fall Line and increase in thickness moving seaward. In the Charleston area this sediment wedge is on the order of 2500 feet thick. The surface deposits of this physiological province were formed during the Pleistocene epoch of the Quaternary period and generally consist of sand and clay layers with varying amounts of shells and occasional organics. Underlying the surface deposits is the stiff fine grained soils of the Cooper Marl Formation.

The Cooper Marl Formation varies in composition depending upon depositional environments and was formed in the Upper Cretaceous age. For engineering purposes, Cooper Marl is classified as silt, clay, or silty sand. The formation is over-consolidated with plasticity values ranging from low to high. Properties of Cooper Marl are well documented in the Charleston area with it being the predominant support formation for most major structures.

FIELD INVESTIGATION

(i) Bridge Geotechnical Investigation

On August 16 through September 14, 2004, four (4) soil test borings (designated as B-1 through B-4) were performed for the bridge geotechnical investigation. Two (2) soil test borings were performed near each approach embankment location of the proposed replacement bridge. The soil test borings were advanced utilizing a CME-55 truck mounted drill rig and a CME-550 ATV mounted drill rig. Rotary wash drilling methods were utilized to maintain a stable borehole. The borings were advanced to a depth of 100 feet to 120 feet below existing ground surface. Standard spilt-spoon samples (SPT tests) were obtained at regular intervals throughout the depths of the borings in general accordance with ASTM D-1586 to determine the relative densities and consistencies of the subsurface soils and to collect subsurface soil samples. During standard penetration testing (SPT) of the encountered soils, a gravity hammer type system was used.

On March 8 through April 6, 2011, seven (7) soil test borings (designated as B-5 through B-11) and two (2) cone penetrometer (CPT) soundings (designated as CPT-2 and CPT-3) were performed for the second phase of the bridge geotechnical investigation. The bridge soil test borings for this second phase of the geotechnical investigation were performed within the extents of the Wando River. These soil test borings were advanced utilizing a CME-45B barge mounted drill rig. The soil test borings utilized rotary wash drilling methods to maintain a stable borehole. The borings were advanced to a depth of 100 feet to 120 feet below existing ground surface. Standard spilt-spoon samples (SPT tests) were obtained at regular intervals throughout the depths of the borings in general accordance with ASTM D-1586 to determine the relative densities and consistencies of the subsurface soils and to collect subsurface soil samples. During standard penetration testing (SPT) of the encountered soils, an automatic hammer type system was used.

CPT soundings (designated as CPT-2 and CPT-3) were performed near each end bent location of the proposed replacement bridge. In additional to the typical soil parameters determined from CPT testing, the shear wave velocity of the soil at each embankment was also determined for site specific seismic considerations. The CPT soundings were advanced utilizing a truck mounted drill rig. The CPT soundings were advanced to a depth of approximately 120 feet below existing ground surface. Furthermore, an auger probe boring was performed adjacent to each bridge CPT sounding location (designated as AP-1 and AP-2) to acquire undisturbed soil samples. The auger probe borings were advanced utilizing a CME-45B trailer mounted drill rig. The auger probe borings utilized rotary wash drilling methods to maintain a stable borehole. The borings were advanced to a depth of 12.5 feet to 14 feet below existing ground surface. Standard Shelby tube samples were obtained at the bottom four (4) feet of the auger probe borings in general accordance with ASTM D-1587.

The locations of the borings/soundings performed for the bridge geotechnical investigation are provided in the following table.

Soil Test Location Schedule - Bridge

SC 41 Replacement Bridge over Wando River

Boring I.D.	Station	Offset from CL (ft)	Boring/Sounding Elevation (ft-MSL)	Boring Depth (ft)
B-1	254+80*	CL*	6.0*	100.0
B-2	256+55*	CL*	6.0*	120.0
B-3	275+50*	10-LT*	7.5*	120.0
B-4	278+13*	80-LT*	7.0*	100.0
B-5	258+51	2.3-RT	0.0	107.7
B-6	261+51	14.2-RT	0.0	137.1
B-7	262+23	3.6-RT	0.0	144.0
B-8	263+38	59.5-RT	0.0	145.7
B-9	265+47	36.0-LT	0.0	112.1
B-10	268+76	11.0-LT	0.0	111.0
B-11	272+05	21.6-RT	0.0	122.7
CPT-2	255+90	0.6-RT	8.0	121.4
CPT-3	275+12	11.1-LT	6.4	121.4
AP-1	255+91	0.4-RT	8.1	14.0
AP-2	275+13	10.0-LT	6.3	12.5

* Locations are approximate.

All of the collected soil samples were examined and logged in the field by F&ME personnel, sealed in plastic bags, and transported to our laboratory for further examination and analyses. The soils were visually classified based upon the Unified Soil Classification System. We have provided Test Boring Location Plans in the Appendix as Figure 2 and Figure 3.

(ii) Bridge Geophysical Investigation

F&ME performed a geophysical investigation on November 10, 2004 at select locations within the Wando River to supplement our bridge geotechnical investigation. The geophysical investigation was accomplished through two-dimensional Electrical Resistivity (ER) imaging. The main objective of our geophysical investigation was to provide a continuous indication of subsurface conditions to interpolate between the test borings. The borings and soundings from the bridge geotechnical investigation were used to proof the geophysical data allowing additional refinement and interpretation.

For the ER survey, F&ME utilized the SuperSting Earth Resistivity System manufactured by Advanced Geosciences, Inc. The system consists of the SuperSting 8- channel resistivity meter and a multi-electrode cable with 42 electrodes at nine (9) foot spacing and an automatic switching unit. The eight channels allow for eight resistivity measurements to be taken simultaneously.

The ER survey within the Wando River was performed utilizing a marine electrode cable that was towed behind a boat at two (2) to three (3) knots and the data gathered includes: resistivity, GPS location, temperature, and depth. Due to the current in the river, it was necessary to perform the ER survey at low tide.

Nine (9) survey lines were performed at the site. Three (3) survey lines were located to the southeast of the existing bridge, and they were in the approximate footprint of the proposed replacement bridge location. The other six (6) survey lines extended perpendicular from the existing bridge between the following existing bridge bents (numbered from the north end of the existing bridge): 4 and 5, 8 and 9, 13 and 14, 19 and 20, 25 and 26, and south of the existing swing gate structure.

The locations of each ER test and the processed results from each ER test are provided in the Appendix.

(iii) Roadway Geotechnical Investigation

On March 8, 2011, four (4) soil test borings (designated as RW-1 through RW-4) and three (3) CPT soundings (designated as CPT-1, CPT-4, and CPT-5) were performed for the roadway geotechnical investigation. The roadway soil test borings were advanced utilizing a CME-45B track mounted drill rig. The soil test borings utilized rotary wash drilling methods to maintain a stable borehole. The borings were advanced to a depth of 30 feet to 50 feet below existing ground surface. Standard spilt-spoon samples (SPT tests) were obtained at regular intervals throughout the depths of the borings in general accordance with ASTM D-1586 to determine the relative densities and consistencies of the subsurface soils and to collect subsurface soil samples. During standard penetration testing (SPT) of the encountered soils, an automatic hammer type system was used.

The CPT soundings for the preliminary roadway geotechnical investigation were advanced utilizing a truck mounted drill rig. The CPT soundings were advanced to a depth of approximately 32 feet to 53.5 feet below existing ground surface.

The locations of the borings/soundings performed for the roadway geotechnical investigation are provided in the following table.

Soil Test Location Schedule - Roadway				
SC 41 Replacement Bridge over Wando River				
Boring I.D.	Station	Offset from CL (ft)	Boring/Sounding Elevation (ft-MSL)	Boring Depth (ft)
RW-1	248+99	7-LT	6.3	30.0
RW-2	278+53	8.1-LT	6.9	50.0
RW-3	291+28	CL	6.1	30.0
RW-4	12+51	1-RT	5.7	50.0
CPT-1	252+93	4.8-RT	7.2	52.5
CPT-4	280+73	1.2-RT	6.3	52.0
CPT-5	300+66	19.1-RT	9.5	32.8

All of the collected soil samples were examined and logged in the field by F&ME personnel, sealed in plastic bags, and transported to our laboratory for further examination and analyses. The soils were visually classified based upon the Unified Soil Classification System. We have provided Test Boring Location Plans in the Appendix as Figure 2 and Figure 3.

(iv) MSE Wall Geotechnical Investigation

On December 27, 2005, six (6) soil test borings (designated as WB-1 through WB-6) were performed for the MSE wall geotechnical investigation. Test borings WB-1, WB-3, and WB-5, were advanced utilizing a Tiger-tracked mounted drill rig equipped with a gravity hammer system, and test borings WB-2, WB-4, and WB-6, were advanced utilizing a CME-55 truck mounted drill rig equipped with an automatic hammer system. The soil test borings utilized rotary wash drilling methods to maintain a stable borehole. The borings were advanced to a depth of 35 feet below existing ground surface. Standard spilt-spoon samples (SPT tests) were obtained at regular intervals throughout the depths of the borings in general accordance with ASTM D-1586 to determine the relative densities and consistencies of the subsurface soils and to collect subsurface soil samples.

In the absence of hammer energy data for both the gravity and automatic hammers, F&ME has assumed that the gravity hammer system is 55% efficient and the automatic hammer system is 95% efficient, we have normalized the N values to N_{70} (70% energy transfer efficiency). On the soil test boring logs provided in the Appendix, we have shown the blows per 6 inch increment as those recorded in the field. The N-values shown on the logs are the normalized N_{70} values and are the basis for the soil density/consistency descriptions shown on the soil test boring logs and as discussed in subsequent sections of this report.

On January 3, 2005, three (3) soil auger probe borings (designated as WS-3, WS-4, and WS-6) were performed at two (2) to three (3) foot offsets from their respective soil test boring location (i.e. WS-3 offset to WB-3, etc.). The purpose of these auger probe borings was to collect a total of eight (8) Shelby tube samples of soil strata which were identified as representative of relatively ‘soft’ soil consistencies as well as ‘firmer’ consistencies for undisturbed tri-axial shear testing and consolidation tests.

In addition to the test borings, six (6) dilatometer soundings (designated as WD-1 to WD-6) were performed from December 30, 2004 to January 3, 2005. The dilatometers soundings were performed for determination of the soil strength parameters and soil settlement moduli of the existing approach embankment fill material and the existing embankment subgrade soils. The dilatometer tests were performed adjacent to their respective boring location (ie. WD-1 performed adjacent to WB-1, etc.). Dilatometer testing was performed at one (1) foot test depth intervals to a final termination test depth ranging from sixteen (16) to thirty-one (31) feet below existing ground surface.

The locations of the borings/soundings performed for the MSE wall geotechnical investigation are provided in the following table.

Soil Test Location Schedule – MSE Walls				
SC 41 Replacement Bridge over Wando River				
Boring I.D.	Station	Offset from CL (ft)	Boring/Sounding Elevation (ft-MSL)	Testing Depth (ft)
WB-1	251+00*	30-LT*	7.4*	35.0
WD-1				16.0
WB-2	251+60*	40-RT*	7.4*	35.0
WD-2				17.0
WB-3	252+00*	38-LT*	7.4*	35.0
WD-3				31.0
WS-3				22.5
WB-4	252+50*	22-RT*	7.4*	35.0
WD-4				31.0
WS-4				22.5
WB-5	253+02*	37-LT*	7.4*	35.0
WD-5				17.0
WB-6	253+05*	25-RT*	7.4*	35.0
WD-6				31.0
WS-6				17.5

* Locations are approximate.

All of the collected soil samples were examined and logged in the field by F&ME personnel, sealed in plastic bags, and transported to our laboratory for further examination and analyses. The soils were visually classified based upon the Unified Soil Classification System. We have provided Test Boring Location Plans in the Appendix as Figure 2 and Figure 3.

LABORATORY TESTING PROGRAM

Select soil samples recovered from the soil test borings by F&ME were tested in our laboratory to determine the behavioral characteristics of the soils as well as to verify field classifications. Data sheets presenting the results of the laboratory test program are provided in the Appendix. The following table lists the type and quantity of laboratory tests performed.

Laboratory Soil Testing Table

Test Type	Quantity
Grain Size Analysis	34
Atterberg Limits	33
Moisture Content	34
Consolidation	2
Specific Gravity	2
Consolidated-Undrained Tri-axial Shear	2
Corrosion Series	7

SUBSURFACE CONDITIONS

The below soil descriptions, strata depths, and consistencies are generalized and were interpreted by F&ME based on the provided test boring logs. We have included the test boring logs in the Appendix for detailed descriptions of the soil conditions. As with any geologic formation, the depth and thickness of the soil strata will vary across the site. Although the provided test borings designate strata changes at specific depths in the description of the soil stratigraphy on the test boring logs, transitions between soil strata are generally gradual. Therefore, the outlined subsurface profile shown on the test boring logs should only be considered general on-site soil conditions and should not be utilized as an absolute indicator.

(i) Soil Stratigraphy

Soil test borings B-1 through B-4 and cone penetrometer soundings CPT-1 through CPT-4 were performed from existing SC 41 bridge approach embankment areas, and soil test borings B-5 through B-11 were performed from existing ground line within the extent of the Wando River. Borings/soundings B-1 through B-4 and CPT-1 through CPT-4 initially encountered alluvial soils typically described as loose to medium dense clayey SAND (SC) or soft to very stiff sandy CLAY (CL). Standard penetration test values (N-values) in this clayey, sandy material ranged from three (3) to sixteen (16) blows per foot (bpf). This material extended to a depth of seventeen (17) feet to twenty-six (26) feet below existing ground surface.

Soil test borings RW-1 through RW-4 and sounding CPT-5 were performed from existing SC 41 roadway shoulder areas. Test borings RW-1 through RW-4 and sounding CPT-5 initially encountered alluvial soils with varying sand, silt, and clay content. N-values in this alluvial material ranged from 2 to 18 bpf. Alluvial soils extended to a depth of seventeen (17) to twenty-eight (28) feet below existing ground surface.

Below the existing alluvial soils in borings/soundings B-1 through B-4, RW-1 through RW-4, and CPT-1 through CPT-5 and from existing ground surface in borings B-5 through B-11, the Cooper Marl formation was encountered and extended to the boring termination depths. The Cooper Marl was initially sampled as fine sandy lean SILT (ML) with increasing plasticity at greater depths. From approximate elevations -70 ft-MSL to -100 ft-MSL, the Cooper Marl transitions into a silty SAND (SM). Below this sandy layer, the

Cooper Marl returns to a fine-grained soil classified as a lean CLAY (CL). N-values in the Cooper Marl formation ranged from 0 to 62 bpf.

(ii) Groundwater

In the bridge test borings/soundings performed outside the Wando River, groundwater recordings were performed at least 24 hours after completion of the borings and during the soundings. Groundwater was measured ranging from 2.0 to 7.6 feet below present ground surfaces. In the roadway test borings/soundings, groundwater recordings were performed at the time of the borings/soundings, and groundwater was measured ranging from 0.5 to 13.0 feet below present ground surfaces. The Wando River is a tidal river with water surface fluctuations on the order of ten (10) feet. The actual groundwater elevation may fluctuate due to climatic/tidal conditions and/or influence from the Wando River's stage and may be encountered at elevations/depths above or below those listed on the test boring logs.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented in this report are preliminary. The recommendations are based upon the general soil conditions indicated by the soil test borings and CPT soundings, our analyses of the site and subsurface conditions, and our experience on similar projects. The recommendations do not reflect variations in subsurface conditions or the presence of undiscovered obstructions that could exist intermediate of the soil test locations or in unexplored areas of the site.

(i) Seismic Site Class Designation

Seismic CPT soundings (designated as CPT-2 and CPT-3) were performed to determine the shear wave velocity of the soil at this bridge/roadway location. The results from the seismic CPT soundings performed at this site were utilized in conjuncture with the SCDOT provided seismic data at greater depths for site specific seismic determinations. The determined seismic values are presented in our Site Specific Seismic Response Analysis Report (report dated August 11, 2011). Based on the analyses and results from the site specific seismic analyses, a Site Class "D" was determined for bridge approach embankments and roadway design, and a Site Class "C" was determined for replacement bridge end bent and interior bent design. Please refer to our Site Specific Response Analysis Report for specific details regarding the performed seismic analyses.

(ii) Liquefaction Potential

Liquefaction, the loss of a soil's shear strength due to increase in pore water pressure resulting from soil particle contraction induced by seismic vibrations, is a potential concern but usually limited to the South Carolina Coastal Plain. Liquefaction typically occurs in predominantly sandy soils that are non-plastic, saturated, and have been deposited during the Quaternary Period in a loose state.

From the test boring/sounding logs, the subsurface data indicate that potentially liquefiable soils which would impact roadway embankments, bridge approach embankments, and bridge foundation elements are present at the project site. Based on our preliminary analyses utilizing a peak ground acceleration of 0.42g, liquefaction mitigation will not be required at the bridge approach embankments (ie. 150 feet from each bridge end), but may be required within the roadway embankments.

(iii) Bridge Approach Embankments

Based on the fine-grained, river deposited soil material encountered in the soil test borings and CPT soundings as well as the assumed low embankment heights and gradual side slopes, subgrade conditions below the bridge approach embankment are anticipated to be adequate for global slope stability under both static and seismic design events.

The approach embankment subgrade soils are composed of a predominantly soft to stiff clayey material which will experience some immediate and long-term consolidation settlements under any new embankment fill height loadings or any planned approach embankment widening. Surcharging and/or installing wick drains may be desired to expedite primary and secondary consolidation settlement.

(iv) Foundation Corrosion and Deterioration Potential

Per AASHTO LRFD Specifications for Highway Bridges, 4th Ed., 2007, the following soil or site conditions are considered indicative of a potential for steel and/or concrete pile deterioration or corrosion.

1. Resistivity less than 2,000 ohm-cm;
2. pH less than 5.5;
3. pH between 5.5 and 8.5 in soils with high organic content;
4. Sulfate concentrations greater than 1,000 ppm;
5. Landfills and cinder fills;
6. Soils subject to mine or industrial discharge; and,
7. Areas with a mixture of high resistivity soils and low resistivity high alkaline soils.

Per AASHTO LRFD Specifications for Highway Bridges, 4th Ed., 2007, the following water conditions should be considered as indicative of a potential steel and/or concrete pile deterioration or corrosion situation.

1. Chloride content greater than 500 ppm;
2. Sulfate concentration greater than 500 ppm;
3. Mine or industrial runoff;
4. High organic content;
5. pH less than 5.5; and,
6. Piles exposed to wet/dry cycles.

Based on the results from the corrosion series test program, soil resistivity values of the samples tested indicate corrosion values exceeding the AASHTO listed limits. All soil samples tested for sulfate and pH indicate values that conform to the AASHTO listed limits. Two (2) water samples from the Wando River indicate corrosion values that do not conform to the AASHTO listed limits for sulfate and chloride content. The tested soil and water samples indicate that the potential for steel corrosion exists based on the soil resistivity test results and the aqueous sulfate and chloride content results. Precautionary measures should be taken to protect the integrity of any steel foundation elements.

(v) MSE Walls

An MSE wall feasibility study was conducted by F&ME and submitted to TKA on April 22, 2005. This report provided the results from our conceptual analyses of predicted MSE wall performance at the south approach embankment of the proposed replacement bridge as detailed by TKA. The report was performed in accordance with the applicable standards at the time it was completed. Several items, including seismic performance criteria and corrosion potential, were not evaluated in accordance with the GDM. F&ME believes that MSE walls can be constructed at the project site, within reason, to the criteria presented in the GDM, but the referenced MSE wall report is not applicable for this project at this time. If MSE walls are selected to facilitate the replacement bridge design, F&ME recommends that additional investigations and analyses be performed to verify that the walls conform to the GDM performance criteria.

(vi) Bridge Foundations

The proposed bridge foundation system is drilled shafts for interior bents and driven steel H-piles for end bents. In addition, the assumed foundation element for the detailed bascule span is a drilled shaft supported spread foundation. No subsurface conditions which would preclude drilled shafts or H-piles were noted. Both shafts and H-piles will be supported in the Cooper Marl Formation. Load capacity will be developed from skin friction in the marl for the H-piles. The drilled shafts will utilize both skin friction and end bearing.

LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to the referenced bridge project. The conclusions and recommendations contained herein are based upon the provided test borings and testing results contained within, and applicable standards in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

In the event that any changes in nature, design, or location of the structure and/or foundation elements are planned, the recommendations contained in this report will not be considered valid unless the changes are reviewed and verified in writing.

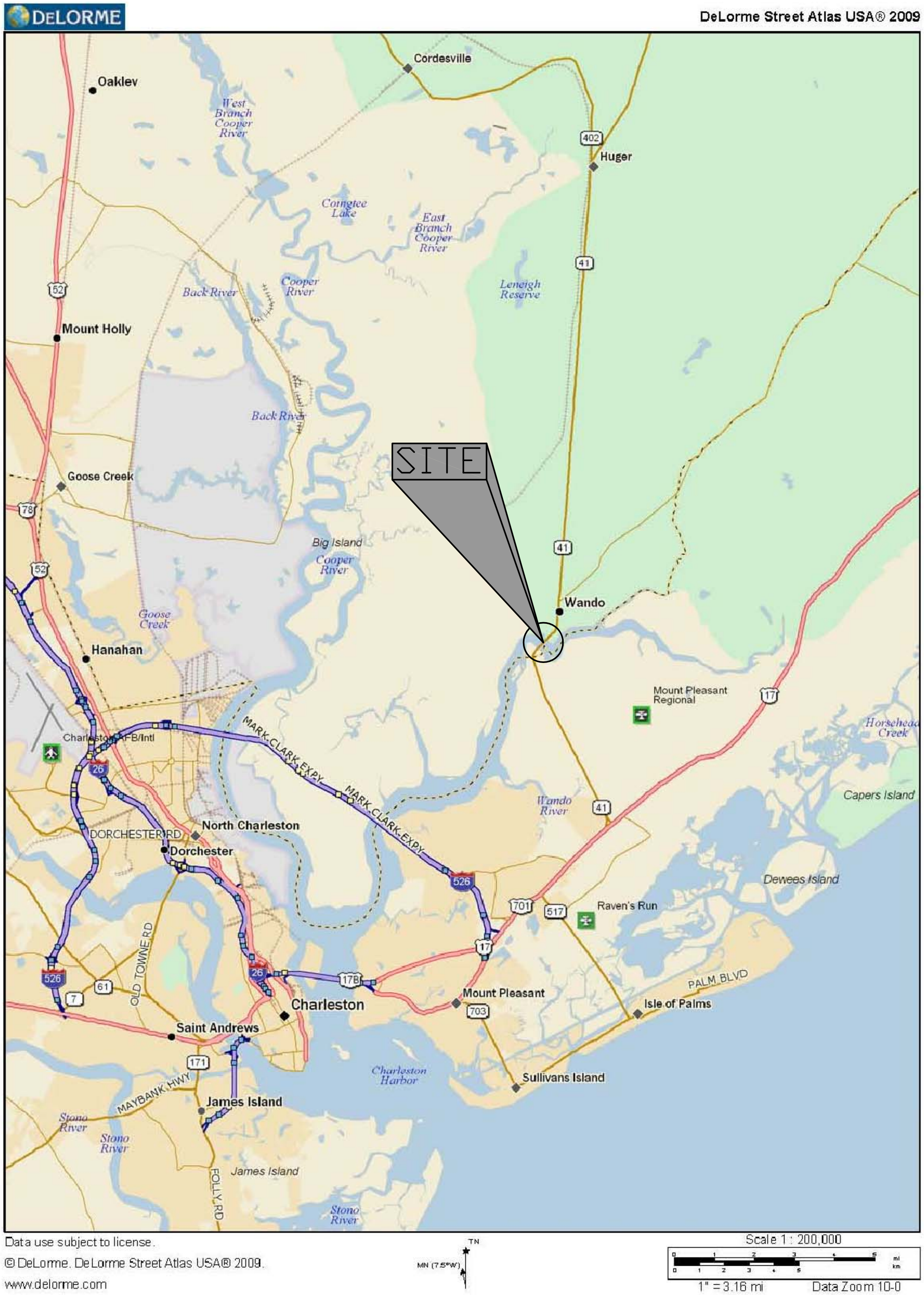
APPENDIX

CONTENTS

APPENDIX

SECTION 1

F&ME SUBSURFACE INVESTIGATION SUMMARY



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www.delorme.com

DRWN. BY: JFH
CHKD. BY: ZWA
APPR. BY: ZWA
NOTES:

ORIGINAL:
12 APRIL 2011
REVISIONS:
1
2
3
4
SCALE:
NONE

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

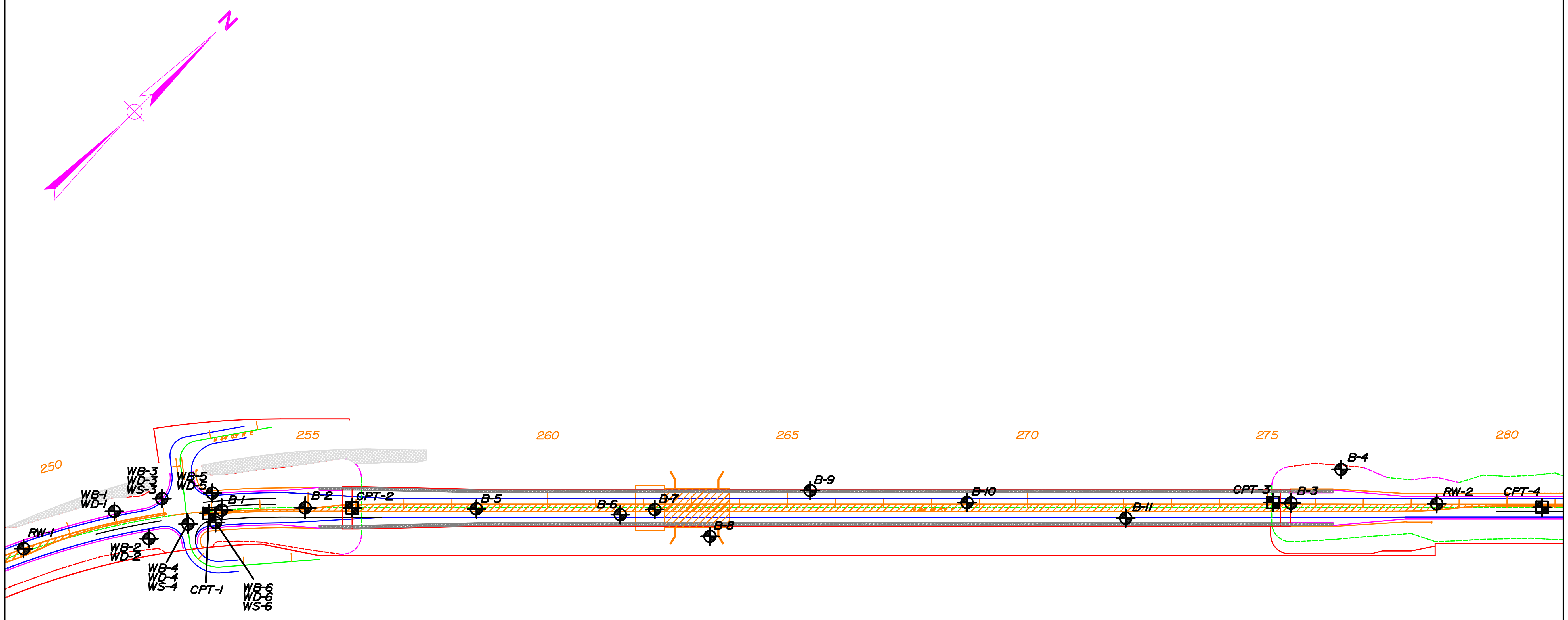
SITE LOCATION PLAN

SC 41 BRIDGE REPLACEMENT OVER
WANDO RIVER.

CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE NO.: 8.158B/10.032102

F&ME CONSULTANTS
PROJECT NUMBER:
G4067.01

DRAWING NUMBER:
FIGURE 1



LEGEND

⊕ SOIL TEST BORING LOCATION

⊞ CPT SOUNDING LOCATION

DRWN. BY: JFH
CHKD. BY: MSM
APPR. BY: MSM
NOTES:

ORIGINAL:
29 NOVEMBER 2011
REVISIONS:
1
2
3
4
SCALE:
NONE

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

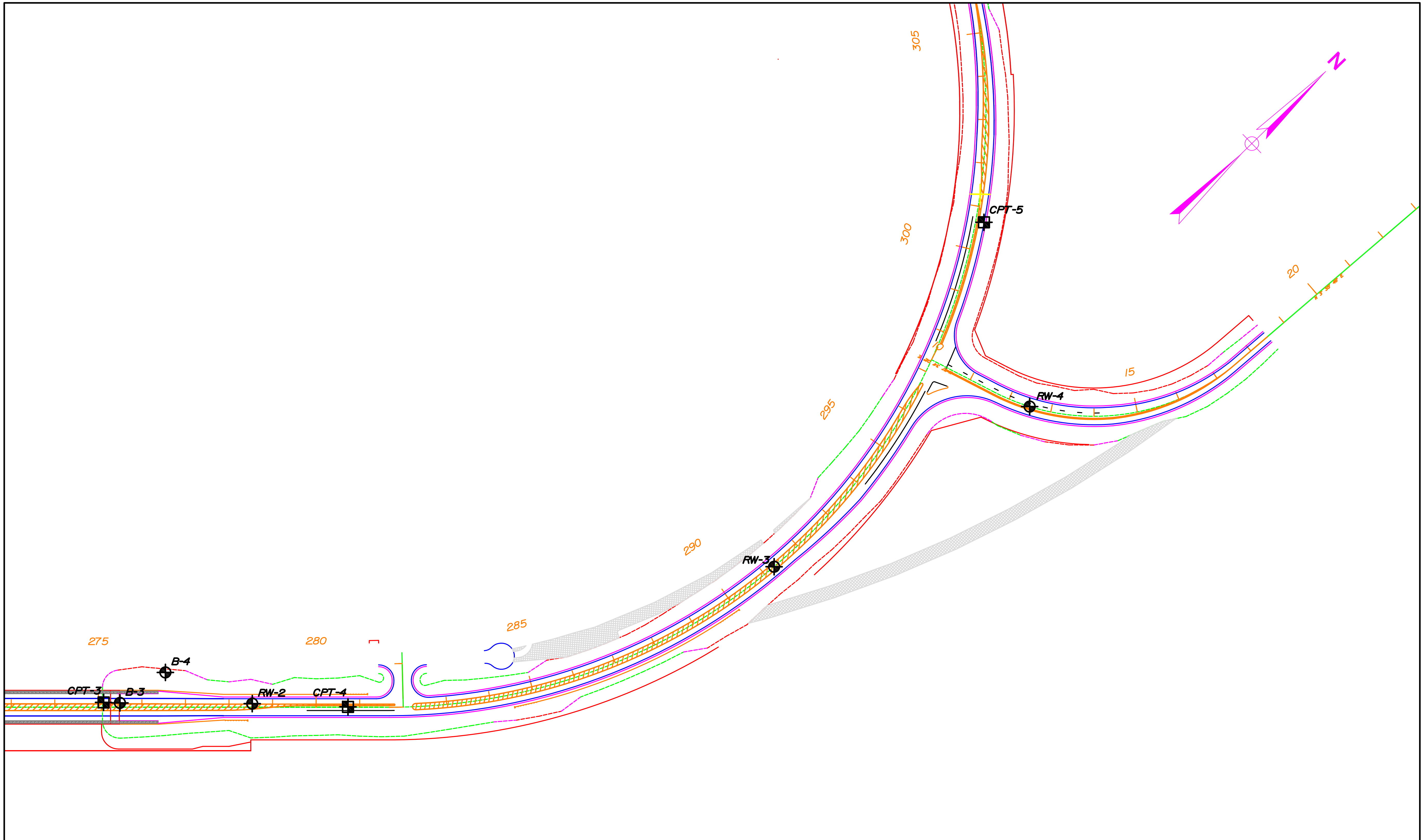
SOIL TEST LOCATION PLAN

SC 41 BRIDGE REPLACEMENT
OVER WANDO RIVER

CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE NO.: 8.158B/10.032102
PIN: 32009

F&ME CONSULTANTS
PROJECT NUMBER:
G4067.01

DRAWING NUMBER:
FIGURE 2



LEGEND

⌖	SOIL TEST BORING LOCATION
⊞	CPT SOUNDING LOCATION

DRWN. BY: JFH
CHKD. BY: MSM
APPR. BY: MSM
NOTES:

ORIGINAL:
29 NOVEMBER 2011
REVISIONS:
1
2
3
4

SCALE:
NONE

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SOIL TEST LOCATION PLAN

SC 41 BRIDGE REPLACEMENT
OVER WANDO RIVER

CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE NO.: 8.158B/10.032102
PIN: 32009

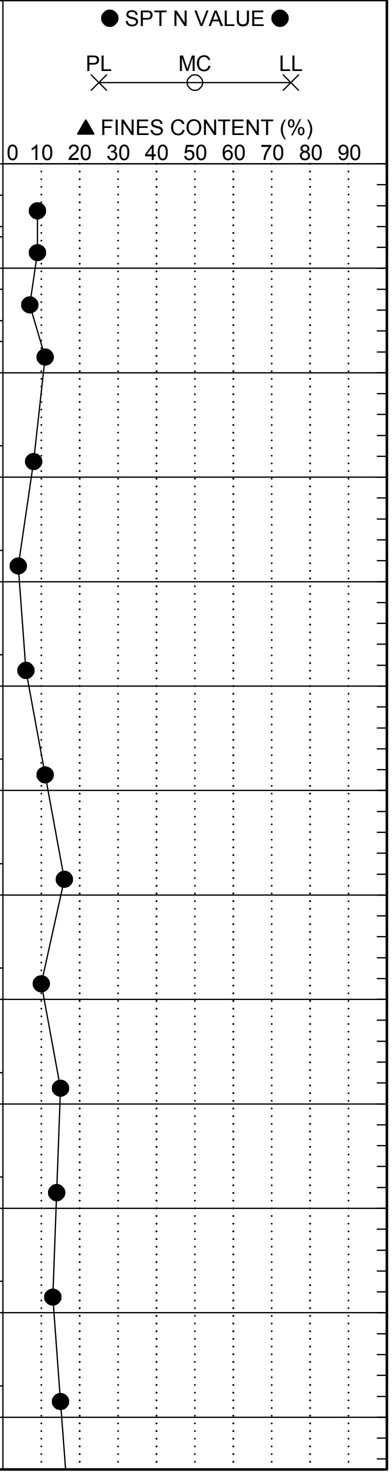
F&ME CONSULTANTS
PROJECT NUMBER:
G4067.01

DRAWING NUMBER:
FIGURE 3

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-1	**Boring Location:**	253+20	**Offset:**	CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92147972	**Longitude:**	79.82800639	**Date Started:**	8/16/2004
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	8/16/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7.4 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
		Loose, Moist, Brown, Clayey Fine <u>SAND</u> <u>(SC)</u>	▨	1.5	SS-1	3	4	5	9
	3.0	Loose, Moist, Brown, Fine <u>SAND (SP)</u>	░	3.5	SS-2	10	4	5	9
2.4	5.5	▼ Stiff to Firm, Moist to Wet, Brown/Gray, Fine Sandy <u>CLAY (CL)</u>	▨	6.0	SS-3	2	3	4	7
		=> LL=43, PL=22, PI=21, NMC=25.1%, %#200=67.2%		8.5	SS-4	2	4	7	11
-2.6									
-7.6				13.5	SS-5	4	3	5	8
-12.6				18.5	SS-6	1	2	2	4
	22.0	Firm to Stiff, Wet, Green/Gray, Fine to Medium Sandy Elastic <u>CLAY-SILT</u> <u>(CH-MH)</u> Calcareous **(COOPER MARL)**	▨	23.5	SS-7	2	2	4	6
-17.6									
-22.6				28.5	SS-8	3	4	7	11
-27.6				33.5	SS-9	4	8	8	16
-32.6				38.5	SS-10	3	4	6	10
-37.6		=> LL=78, PL=35, PI=43, NMC=62.1%, %#200=91.3%		43.5	SS-11	4	7	8	15
-42.6				48.5	SS-12	3	6	8	14
-47.6				53.5	SS-13	4	5	8	13
		=> Very Stiff		58.5	SS-14	4	6	9	15
-52.6									



LEGEND

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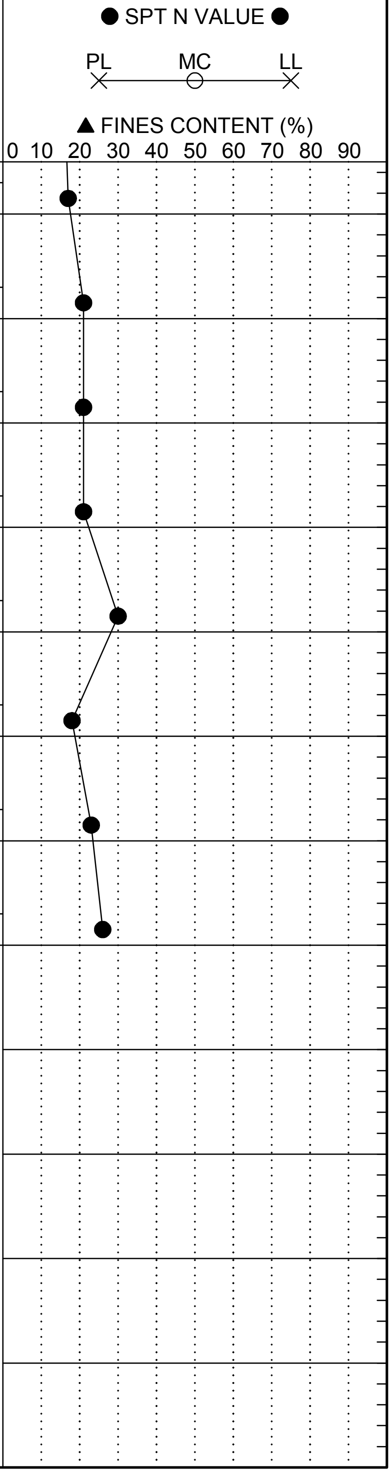
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-1	**Boring Location:**	253+20	**Offset:**	CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92147972	**Longitude:**	79.82800639	**Date Started:**	8/16/2004
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	8/16/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7.4 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-57.6		Very Stiff, Wet, Green/Gray, Fine to Medium Sandy Elastic CLAY-SILT (CH-MH) Calcareous **(COOPER MARL)**	▨	63.5	SS-15	5	7	10	17
-62.6			▨	68.5	SS-16	5	9	12	21
-67.6			▨	73.5	SS-17	6	9	12	21
-72.6			▨	78.5	SS-18	6	9	12	21
-77.6			▨	83.5	SS-19	7	13	17	30
-82.6			▨	88.5	SS-20	6	8	10	18
-87.6			▨	93.5	SS-21	8	10	13	23
-92.6	100.0		▨	98.5	SS-22	9	11	15	26
		Boring Terminated at 100 Feet							
-97.6									
-102.6									
-107.6									
-112.6									



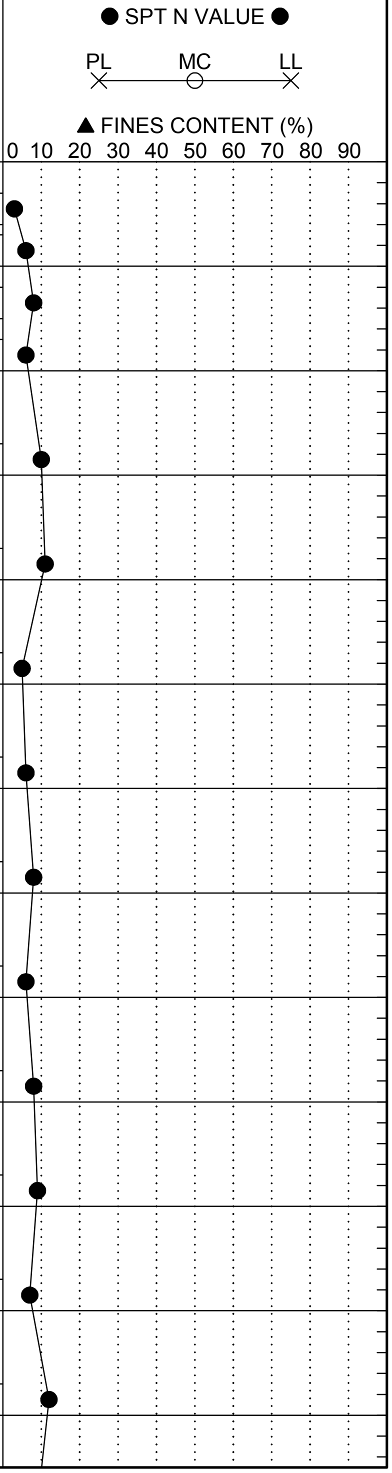
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-2	**Boring Location:**	254+94	**Offset:**	CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92182722	**Longitude:**	79.82761583	**Date Started:**	8/16/2004
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	8/16/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7.6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder						
		Soft to Firm, Moist to Wet, Orange/Brown/Gray, Fine to Medium Sandy Elastic CLAY (CH), PL=54, PL=21, PI=33, NMC=24.9%, %#200=68.4%	1.5	SS-1	2	1	2	3
			3.5	SS-2	1	2	4	6
2.4								
			6.0	SS-3	2	3	5	8
			8.5	SS-4	3	3	3	6
-2.6								
	12.0	Loose to Medium Dense, Wet, Brown/Gray, Clayey Fine to Coarse SAND (SC)						
			13.5	SS-5	3	5	5	10
-7.6								
		=> Shell Fragments	18.5	SS-6	4	8	3	11
-12.6								
	22.0	Firm, Wet, Green/Brown, Fine Sandy CLAY (CL)						
			23.5	SS-7	2	2	3	5
-17.6								
	26.0	Firm to Stiff, Wet, Green/Brown, Elastic CLAY-SILT (CH-MH) Calcareous with Fine Sand **(COOPER MARL)**						
			28.5	SS-8	1	3	3	6
-22.6								
		=> LL=76, PL=34, PI=42, NMC=63.6%, %#200=94.9%	33.5	SS-9	2	3	5	8
-27.6								
			38.5	SS-10	1	3	3	6
-32.6								
			43.5	SS-11	2	3	5	8
-37.6								
			48.5	SS-12	2	4	5	9
-42.6								
			53.5	SS-13	3	2	5	7
-47.6								
			58.5	SS-14	2	5	7	12
-52.6								



LEGEND

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SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

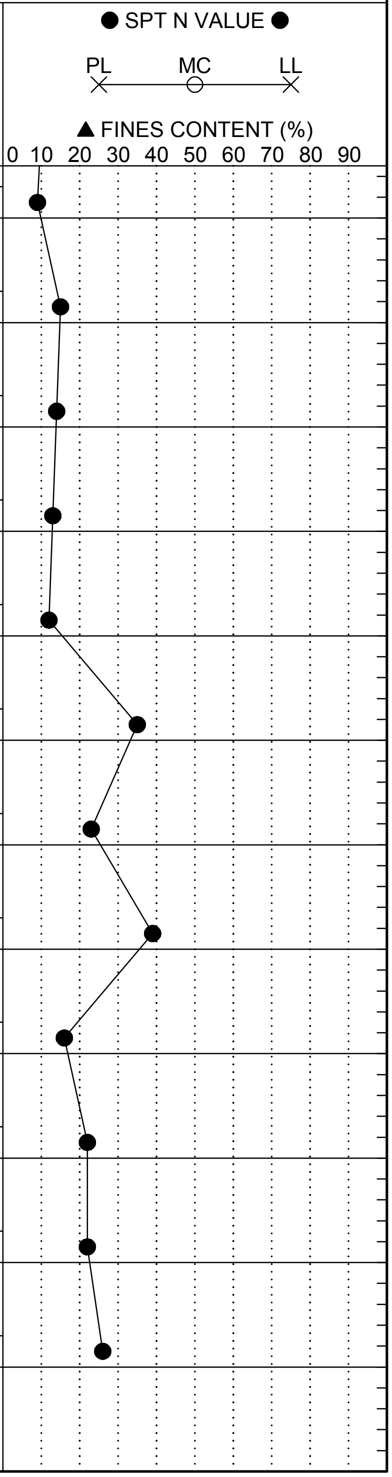
DRILLING METHOD

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-2	**Boring Location:**	254+94	**Offset:**	CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92182722	**Longitude:**	79.82761583	**Date Started:**	8/16/2004
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	8/16/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7.6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-57.6		Very Firm to Dense, Moist, Brown/Green, Silty Fine <u>SAND (SM)</u> Calcareous	▨	63.5	SS-15	2	3	6	9
-62.6				68.5	SS-16	3	6	9	15
-67.6				73.5	SS-17	3	6	8	14
-72.6				78.5	SS-18	4	4	9	13
-77.6				83.5	SS-19	5	5	7	12
-82.6	87.0	Very Firm to Dense, Moist, Brown/Green, Silty Fine <u>SAND (SM)</u> Calcareous, LL=NP, PL=NP, PI=NP, NMC=31.5%, %#200=16.4%	⁚	88.5	SS-20	12	16	19	35
-87.6				93.5	SS-21	7	9	14	23
-92.6				98.5	SS-22	14	14	25	39
-97.6	102.0	Very Stiff, Moist, Green/Gray, Elastic <u>CLAY-SILT (CH-MH)</u> Calcareous with Fine Sand	▨	103.5	SS-23	2	4	12	16
-102.6		=> LL=84, PL=38, PI=46, NMC=56.9%, %#200=96.3%		108.5	SS-24	5	8	14	22
-107.6				113.5	SS-25	6	7	15	22
-112.6	120.0	Boring Terminated at 120 Feet		118.5	SS-26	7	10	16	26



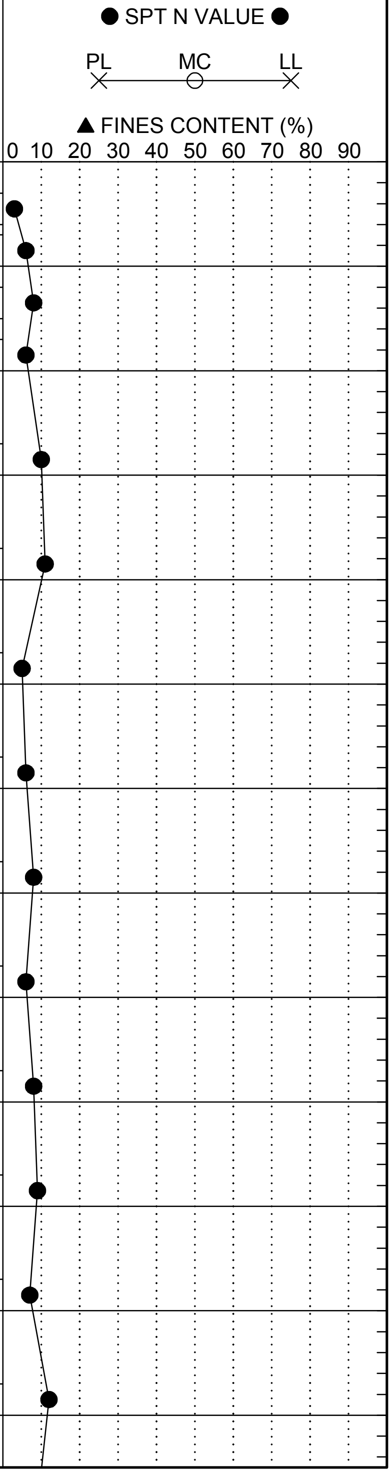
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-3	**Boring Location:**	275+50	**Offset:**	10.0' LT of CL	**Alignment:**	SC 41
Elev.:	7.5 ft	**Latitude:**	32.9258475	**Longitude:**	79.82291047	**Date Started:**	9/13/2004
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	9/13/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-550	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder						
		Firm, Moist, Orange/Yellow, Clayey Fine SAND (SC)	1.5	SS-1	2	1	2	3
2.5	3.0 ▼	Stiff, Moist to Wet, Gray/Yellow, Fine Sandy CLAY (CL)	3.5	SS-2	1	2	4	6
			6.0	SS-3	2	3	5	8
-2.5			8.5	SS-4	3	3	3	6
-7.5	12.0	Loose, Wet, Gray/Yellow, Silty Fine to Coarse SAND (SM) with Clay	13.5	SS-5	3	5	5	10
-12.5	17.0	Stiff, Wet, Green/Gray, Elastic CLAY (CH) Calcareous **(COOPER MARL)**	18.5	SS-6	4	8	3	11
-17.5			23.5	SS-7	2	2	3	5
-22.5			28.5	SS-8	1	3	3	6
-27.5			33.5	SS-9	2	3	5	8
-32.5		=> LL=54, PL=29, PI=25, NMC=57.1%, %#200=67.8%	38.5	SS-10	1	3	3	6
-37.5			43.5	SS-11	2	3	5	8
-42.5			48.5	SS-12	2	4	5	9
-47.5			53.5	SS-13	3	2	5	7
-52.5			58.5	SS-14	2	5	7	12



LEGEND

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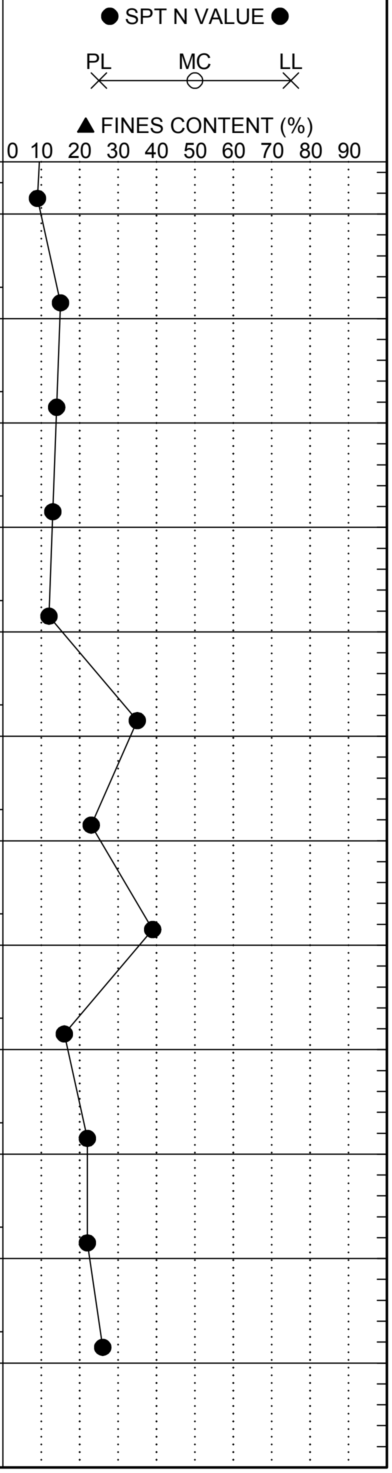
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-3	**Boring Location:**	275+50	**Offset:**	10.0' LT of CL	**Alignment:**	SC 41
Elev.:	7.5 ft	**Latitude:**	32.9258475	**Longitude:**	79.82291047	**Date Started:**	9/13/2004
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	9/13/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-550	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-57.5		Stiff, Wet, Green/Gray, Elastic <u>CLAY (CH)</u> Calcareous **(COOPER MARL)**		63.5	SS-15	2	3	6	9
-62.5				68.5	SS-16	3	6	9	15
-67.5				73.5	SS-17	3	6	8	14
-72.5				78.5	SS-18	4	4	9	13
-77.5				83.5	SS-19	5	5	7	12
-82.5	88.0	Dense to Very Dense, Moist, Green/Gray, Silty Fine <u>SAND (SM)</u> Calcareous		88.5	SS-20	12	16	19	35
-87.5		=> LL=NP, PL=NP, PI=NP, NMC=26.8%, %#200=19.8%		93.5	SS-21	7	9	14	23
-92.5				98.5	SS-22	14	14	25	39
-97.5				103.5	SS-23	2	4	12	16
-102.5				108.5	SS-24	5	8	14	22
-107.5				113.5	SS-25	6	7	15	22
-112.5				118.5	SS-26	7	10	16	26
	120.0	Boring Terminated at 120 Feet							



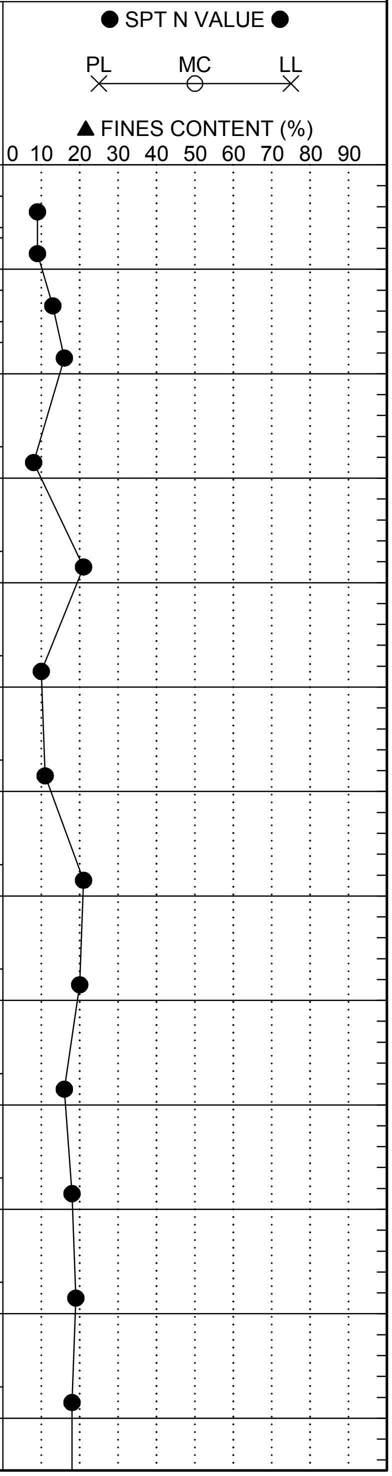
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-4	**Boring Location:**	276+54	**Offset:**	80.0' LT of CL	**Alignment:**	SC 41
Elev.:	7.0 ft	**Latitude:**	32.92618778	**Longitude:**	79.82283083	**Date Started:**	9/14/2004
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	9/14/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-550	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
	0.3	Crushed Stone							
		Firm to Stiff, Moist to Wet, Orange/Gray, Fine to Medium Sandy CLAY (CL)		1.5	SS-1	6	5	4	9
				3.5	SS-2	2	4	5	9
2.0	▼			6.0	SS-3	2	6	7	13
-3.0		=> Very Stiff		8.5	SS-4	4	7	9	16
-8.0				13.5	SS-5	1	1	7	8
	17.0	Stiff to Very Stiff, Wet, Green/Gray, Elastic CLAY-SILT (CH-MH) Calcareous with Sand **(COOPER MARL)**		18.5	SS-6	5	8	13	21
-13.0				23.5	SS-7	2	4	6	10
-18.0				28.5	SS-8	4	4	7	11
-23.0				33.5	SS-9	6	11	10	21
-28.0				38.5	SS-10	6	10	10	20
-33.0				43.5	SS-11	4	6	10	16
-38.0		=> NMC=69.8%, %#200=51.1%		48.5	SS-12	4	7	11	18
-43.0				53.5	SS-13	5	9	10	19
-48.0				58.5	SS-14	5	9	9	18
-53.0									



LEGEND

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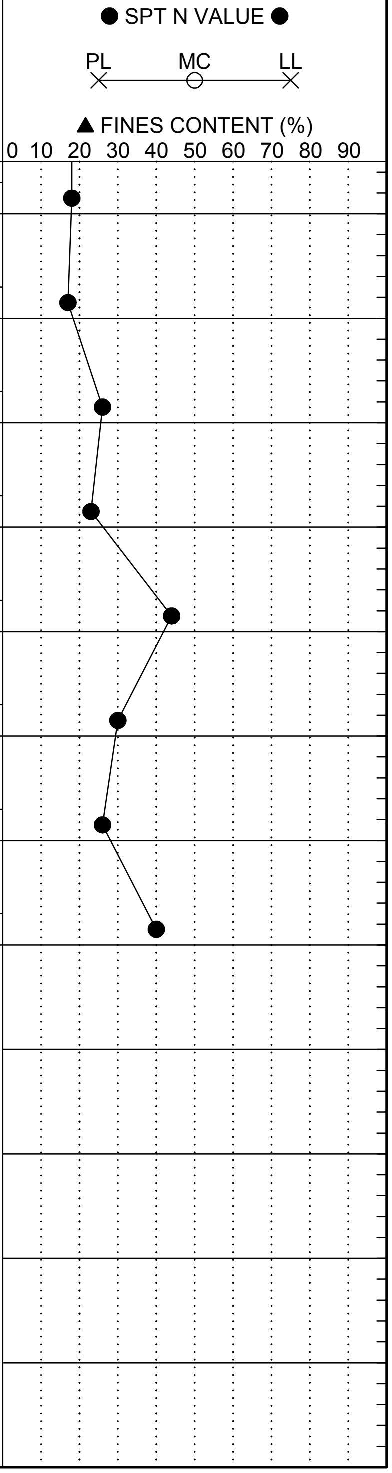
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-4	**Boring Location:**	276+54	**Offset:**	80.0' LT of CL	**Alignment:**	SC 41
Elev.:	7.0 ft	**Latitude:**	32.92618778	**Longitude:**	79.82283083	**Date Started:**	9/14/2004
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	9/14/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-550	**Drill Method:**	Rotary Wash	**Hammer Type:**	Gravity	**Energy Ratio:**	
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-58.0		Stiff to Very Stiff, Wet, Green/Gray, Elastic CLAY-SILT (CH-MH) Calcareous with Sand **(COOPER MARL)**	▨	63.5	SS-15	4	6	12	18
-63.0			▨	68.5	SS-16	4	5	12	17
-68.0			▨	73.5	SS-17	6	12	14	26
-73.0			▨	78.5	SS-18	6	9	14	23
-78.0	82.0	Very Stiff to Hard, Moist, Green/Gray, Fine Sandy Elastic SILT (MH) Calcareous	▥	83.5	SS-19	9	17	27	44
-83.0		=> LL=59, PL=32, PI=27, NMC=52.5%, %#200=56.6%	▥	88.5	SS-20	9	13	17	30
-88.0			▥	93.5	SS-21	6	11	15	26
-93.0	100.0		▥	98.5	SS-22	11	15	25	40
		Boring Terminated at 100 Feet							
-98.0									
-103.0									
-108.0									
-113.0									



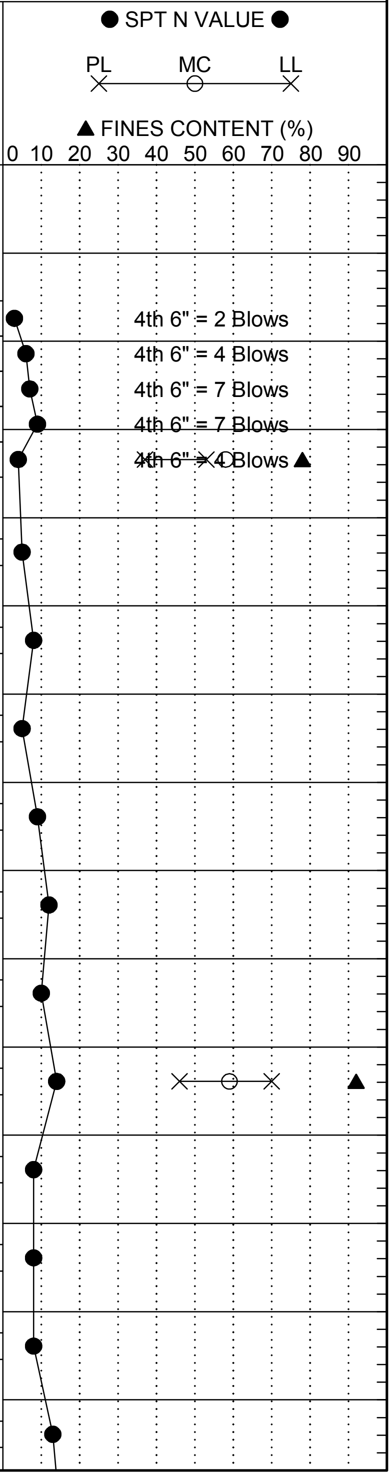
LEGEND

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

SCDOT Soil Test Boring Log

File No.: 8.158B/10.032102 **Project No. (PIN):** 32099 **County:** Berkeley/Charleston **Eng./Geo.:** T. Martin
Site Description: SC 41 Replacement Bridge over Wando River **Route:** SC 41
Boring No.: B-5 **Boring Location:** 258+51 **Offset:** 2.3' RT of CL **Alignment:** SC 41
Elev.: 0.0 ft **Latitude:** 32.92251806 **Longitude:** 79.82678861 **Date Started:** 4/2/2011
Total Depth: 107.7 ft **Soil Depth:** 100 ft **Core Depth:** 0 ft **Date Completed:** 4/2/2011
Bore Hole Diameter (in): 4 **Sampler Configuration** **Liner Required:** Y [✓ N] **Liner Used:** Y [✓ N]
Drill Machine: CME-458 **Drill Method:** Rotary Wash **Hammer Type:** Automatic **Energy Ratio:** 73%
Core Size: N/A **Driller:** Mark Brown **Groundwater:** **TOB** 0 ft **24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
-5.0									
	7.7			7.7					
		Very Loose to Loose, Wet, Green/Gray/Tan/Light Brown, Fine to Medium SAND (SP-SM), with Silt, Shell Fragments **(COOPER MARL)**		9.7	SS-1	2	1	2	3
-10.0				11.7	SS-2	4	3	3	6
	13.7			13.7	SS-3	2	3	4	7
-15.0	15.7	Loose, Wet, Light Brown, Silty Fine to Medium SAND (SM)		15.7	SS-4	5	5	4	9
					SS-5	3	2	2	4
		Soft to Firm, Moist, Gray, Elastic SILT (MH) with Fine Sand => LL=53, PL=37, PI=16, NMC=57.9%, %#200=77.5%							
-20.0									
				21.2	SS-6	2	3	2	5
-25.0									
				26.2	SS-7	3	4	4	8
-30.0									
				31.2	SS-8	3	2	3	5
-35.0									
	36.2			36.2	SS-9	2	4	5	9
		Firm to Stiff, Moist, Light Brown, Elastic SILT (MH)							
-40.0									
				41.2	SS-10	5	6	6	12
-45.0									
				46.2	SS-11	4	5	5	10
-50.0									
		=> LL=70, PL=46, PI=24, NMC=58.9%, %#200=92.4%		51.2	SS-12	6	6	8	14
-55.0									
				56.2	SS-13	3	3	5	8
-60.0									
				61.2	SS-14	3	4	4	8
-65.0									
				66.2	SS-16	3	4	4	8
-70.0									
				71.2	SS-17	5	6	7	13



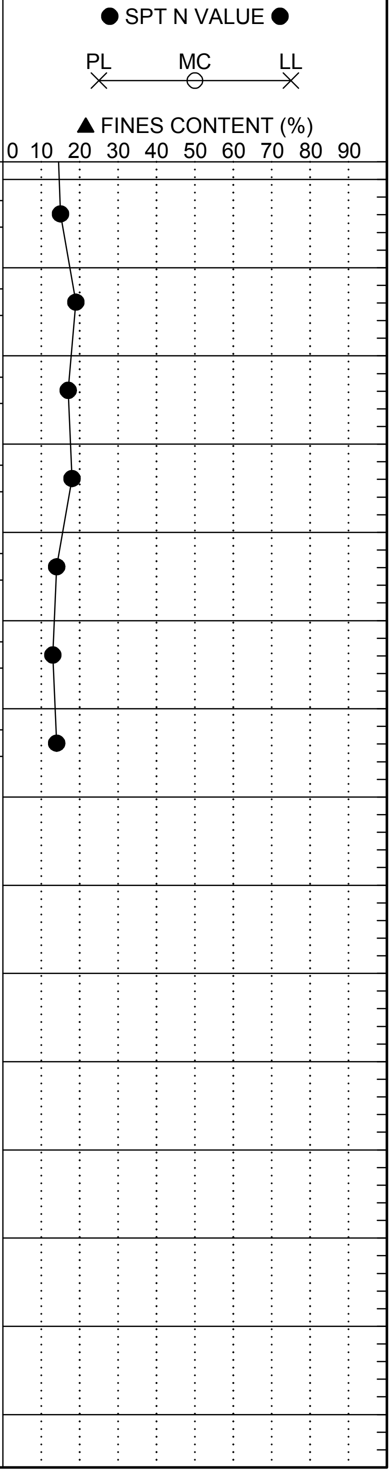
LEGEND *Continued Next Page*

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-5	**Boring Location:**	258+51	**Offset:**	2.3' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92251806	**Longitude:**	79.82678861	**Date Started:**	4/2/2011
Total Depth:	107.7 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/2/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-458	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0	74.7	Medium Dense, Moist to Wet, Tan, Silty Fine SAND (SM), with Black Speckles		76.2	SS-18	5	7	8	15
-80.0				81.2	SS-19	7	9	10	19
-85.0				86.2	SS-20	7	8	9	17
-90.0				91.2	SS-21	6	6	12	18
-95.0	94.7	Stiff, Moist, Light Green, CLAY (CL)		96.2	SS-22	5	6	8	14
-100.0				101.2	SS-23	5	6	7	13
-105.0				106.2	SS-24	5	6	8	14
	107.7	Boring Terminated at 107.7 Feet							
-110.0									
-115.0									
-120.0									
-125.0									
-130.0									
-135.0									
-140.0									
-145.0									



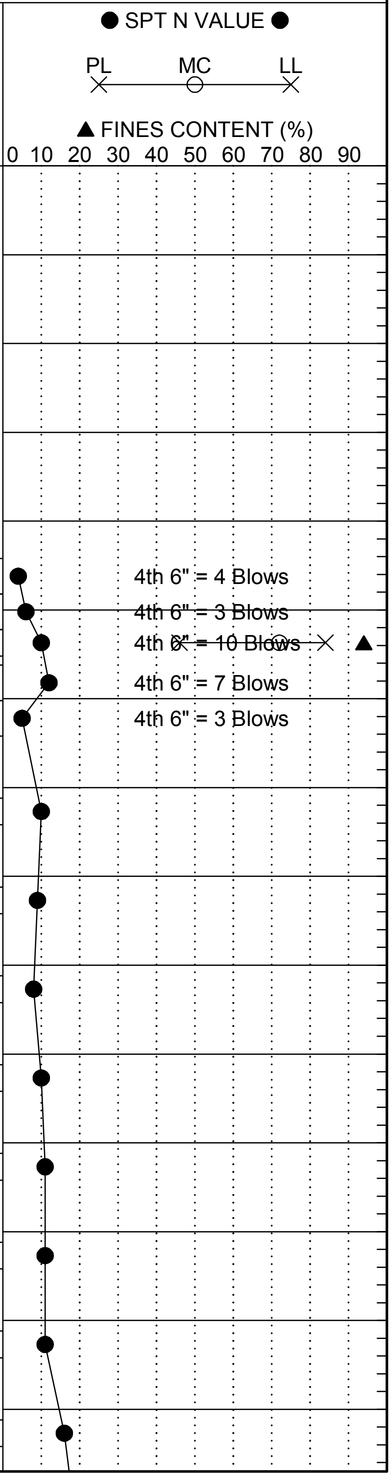
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-6	**Boring Location:**	261+51	**Offset:**	14.2' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92307944	**Longitude:**	79.82607028	**Date Started:**	3/18/2011
Total Depth:	137.1 ft	**Soil Depth:**	115 ft	**Core Depth:**	0 ft	**Date Completed:**	3/21/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	∇Water Surface							
-5.0									
-10.0									
-15.0									
-20.0									
	22.1	Soft to Firm, Moist, Green/Brown, Elastic SILT (MH), with Fine Sand **(COOPER MARL)**		22.1	SS-1	1	2	2	4
-25.0				24.1	SS-2	1	3	3	6
	26.1	=> with Shell Fragments		26.1	SS-3	3	4	6	10
		Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH), LL=84, PL=46, PI=38, NMC=71.9%, %#200=93.5%		28.1	SS-4	5	6	6	12
-30.0				30.1	SS-5	2	2	3	5
-35.0				35.6	SS-6	3	4	6	10
-40.0				40.6	SS-7	3	4	5	9
-45.0				45.6	SS-8	3	4	4	8
-50.0				50.6	SS-9	4	4	6	10
-55.0				55.6	SS-10	3	5	6	11
-60.0				60.6	SS-11	5	5	6	11
-65.0				65.6	SS-12	4	5	6	11
-70.0	70.6	Very Stiff, Moist, Green/Brown, Elastic SILT (MH), with Fine Sand		70.6	SS-13	5	8	8	16



4th 6" = 4 Blows

4th 6" = 3 Blows

4th 6" = 10 Blows

4th 6" = 7 Blows

4th 6" = 3 Blows

LEGEND

Continued Next Page

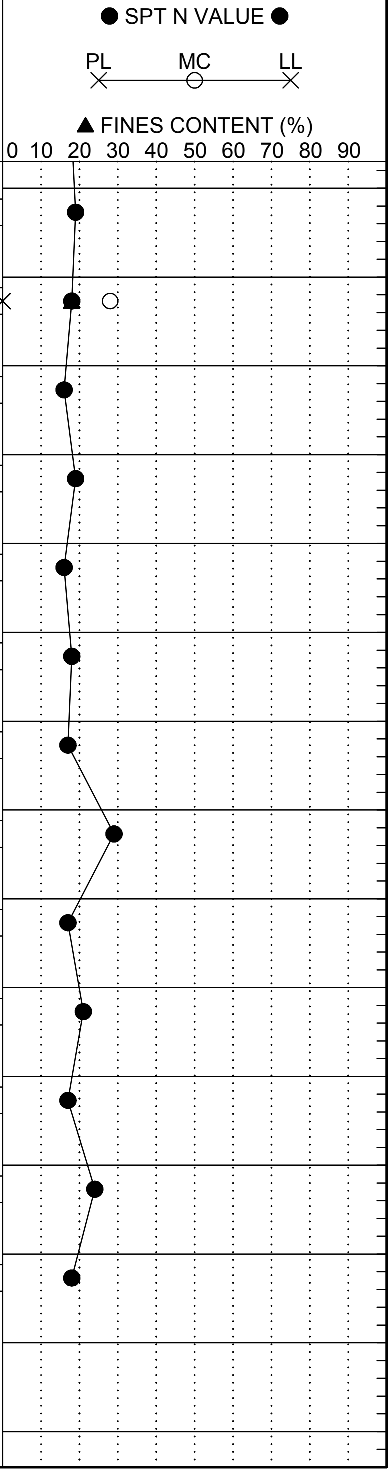
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 11/30/11

Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-6	**Boring Location:**	261+51	**Offset:**	14.2' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92307944	**Longitude:**	79.82607028	**Date Started:**	3/18/2011
Total Depth:	137.1 ft	**Soil Depth:**	115 ft	**Core Depth:**	0 ft	**Date Completed:**	3/21/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	74.1	Medium Dense, Moist to Wet, Green/Brown, Silty Fine SAND (SM), with Black Speckles						
-75.0			75.6	SS-14	6	9	10	19
-80.0		=> LL=NP, PL=NP, PI=NP, NMC=27.9%, %#200=17.7%	80.6	SS-15	8	9	9	18
-85.0			85.6	SS-16	9	7	9	16
-90.0			90.6	SS-17	10	9	10	19
-95.0			95.6	SS-18	7	7	9	16
	99.1	Very Stiff, Moist, Light Green, CLAY (CL)						
-100.0			100.6	SS-19	5	8	10	18
-105.0			105.6	SS-20	6	6	11	17
-110.0			110.6	SS-21	13	13	16	29
-115.0			115.6	SS-22	8	7	10	17
-120.0			120.6	SS-23	8	10	11	21
-125.0			125.6	SS-24	6	7	10	17
-130.0			130.6	SS-25	9	10	14	24
-135.0			135.6	SS-26	5	8	10	18
	137.1	Boring Terminated at 137.1 Feet Due to Caving Sands						
-140.0								
-145.0								



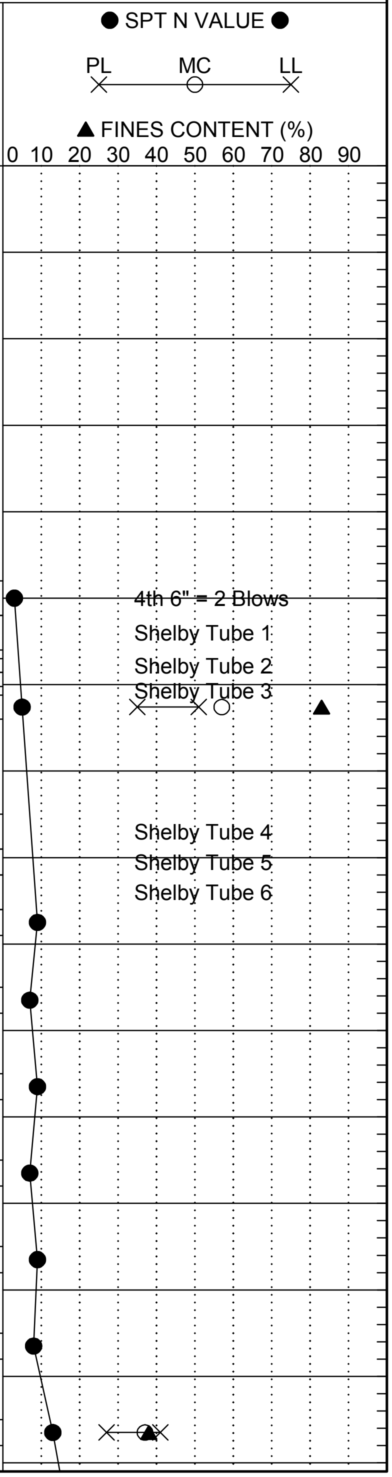
LEGEND

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

Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-7	**Boring Location:**	262+23	**Offset:**	3.6' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92323944	**Longitude:**	79.82593	**Date Started:**	3/16/2011
Total Depth:	144 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/17/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface						
-5.0								
-10.0								
-15.0								
-20.0								
	24.0		24.0					
-25.0		Soft to Firm, Moist, Green/Brown, Elastic <u>SILT (MH)</u> with Fine Sand **(COOPER MARL)**	26.0	SS-1	WOH	1	2	3
				ST-1				
			28.5	ST-2				
-30.0			29.3	ST-3				
			30.6	SS-2	2	2	3	5
		=> LL=51, PL=35, PI=16, NMC=57.1%, %#200=82.5%						
-35.0								
			37.5					
			39.5	ST-4				
-40.0			41.0	ST-5				
	43.0		43.0	ST-6				
		Firm to Stiff, Moist, Green/Brown, Elastic <u>SILT (MH)</u>		SS-3	3	4	5	9
-45.0								
			47.5	SS-4	2	3	4	7
-50.0								
			52.5	SS-5	3	4	5	9
-55.0								
			57.5	SS-6	3	3	4	7
-60.0								
			62.5	SS-7	3	4	5	9
-65.0								
			67.5	SS-8	3	4	4	8
-70.0	71.0							
		Loose to Medium Dense, Moist, Green/Brown, Silty Fine to Medium <u>SAND (SM)</u>	72.5	SS-9	4	6	7	13
-75.0								



LEGEND

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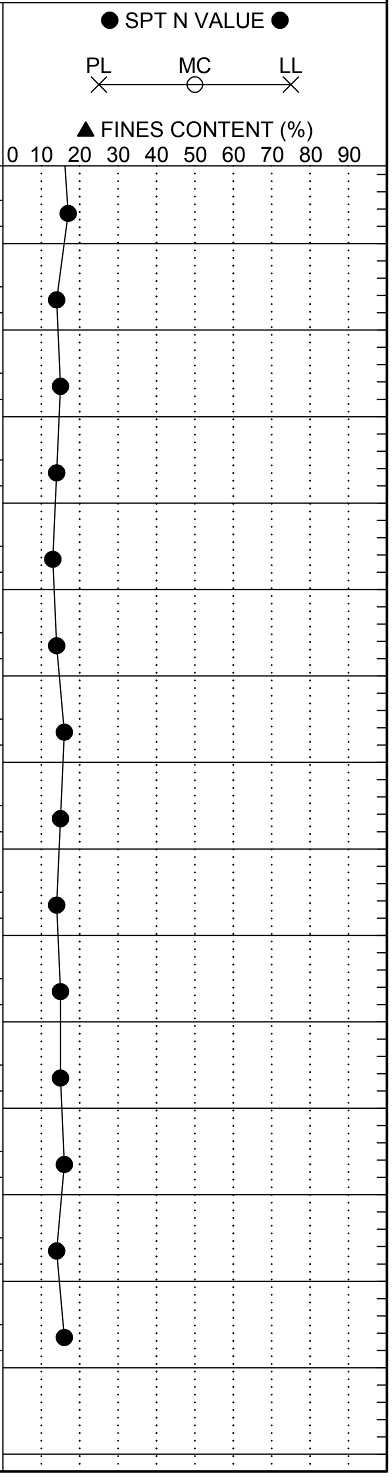
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 11/30/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-7	**Boring Location:**	262+23	**Offset:**	3.6' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92323944	**Longitude:**	79.82593	**Date Started:**	3/16/2011
Total Depth:	144 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/17/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		=> LL=41, PL=27, PI=14, NMC=36.8%, %#200=38.1% Loose to Medium Dense, Moist, Green/Brown, Silty Fine to Medium SAND (SM)	77.5	SS-10	7	8	9	17
-80.0								
			82.5	SS-11	6	6	8	14
-85.0								
			87.5	SS-12	6	7	8	15
-90.0								
			92.5	SS-13	7	7	7	14
-95.0								
	96.0	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)	97.5	SS-14	4	6	7	13
-100.0								
			102.5	SS-15	5	6	8	14
-105.0								
			107.5	SS-16	5	8	8	16
-110.0								
			112.5	SS-17	5	7	8	15
-115.0								
			117.5	SS-18	3	7	7	14
-120.0								
			122.5	SS-19	4	7	8	15
-125.0								
			127.5	SS-19	4	7	8	15
-130.0								
			132.5	SS-20	2	7	9	16
-135.0								
			137.5	SS-21	4	6	8	14
-140.0								
			142.5	SS-22	6	7	9	16
	144.0	Boring Terminated at 144.0 Feet						
-145.0								
-150.0								



LEGEND

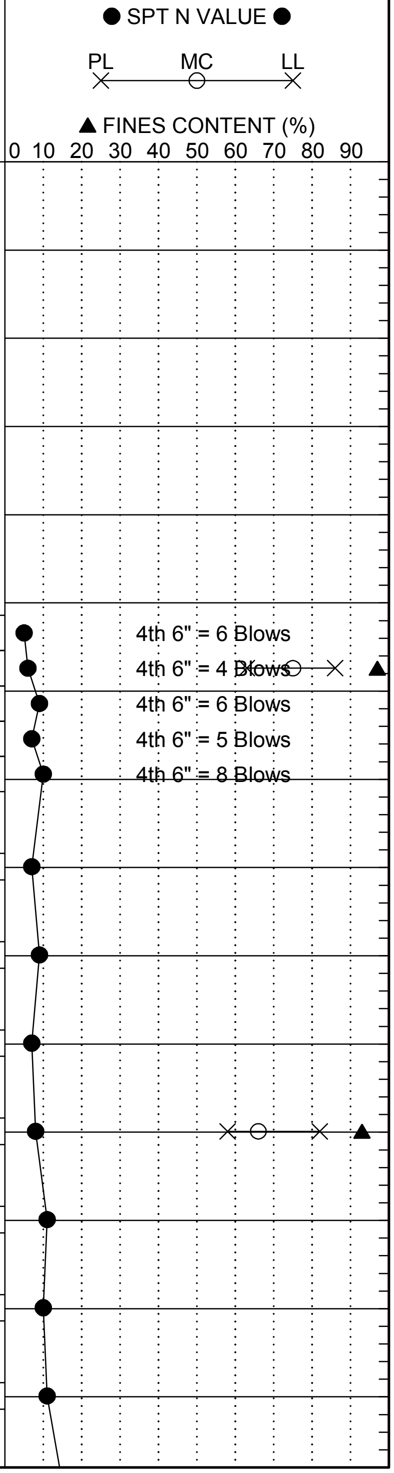
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 11/30/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-8	**Boring Location:**	263+38	**Offset:**	59.5' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92335417	**Longitude:**	79.82553722	**Date Started:**	3/22/2011
Total Depth:	145.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/22/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
-5.0									
-10.0									
-15.0									
-20.0									
-25.0	25.7	Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH) **(COOPER MARL)**		25.7	SS-1	2	2	3	5
				27.7	SS-2	2	2	4	6
-30.0		=> LL=86, PL=63, PI=24, NMC=75.3%, %#200=96.7%		29.7	SS-3	3	3	6	9
				31.7	SS-4	2	3	4	7
-35.0				33.7	SS-5	3	3	7	10
-40.0				39.2	SS-6	2	2	5	7
-45.0				44.2	SS-7	3	4	5	9
-50.0				49.2	SS-8	3	3	4	7
-55.0				54.2	SS-9	3	3	5	8
		=> LL=82, PL=58, PI=24, NMC=66.0%, %#200=93.2%							
-60.0				59.2	SS-10	4	4	7	11
-65.0				64.2	SS-11	3	4	6	10
-70.0				69.2	SS-12	3	4	7	11



LEGEND

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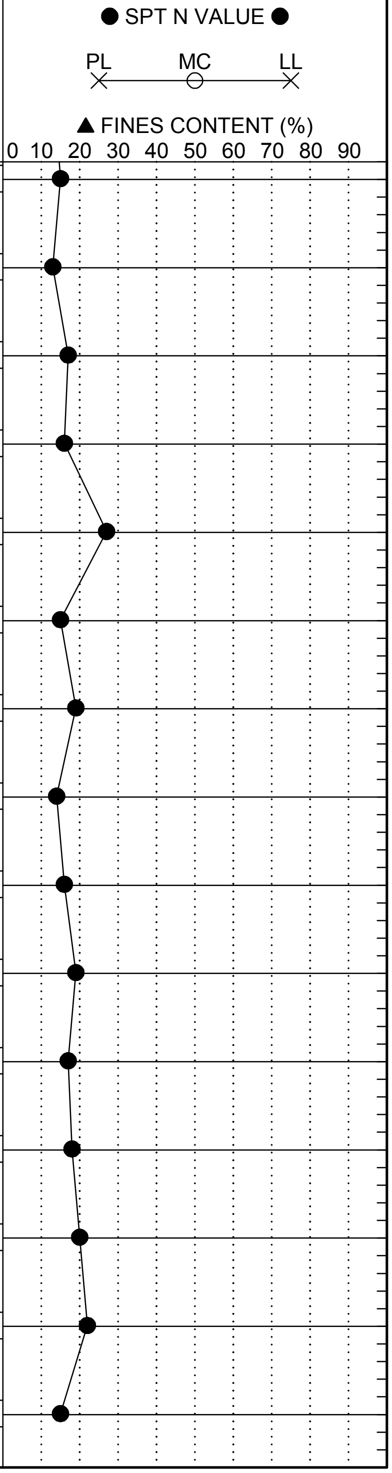
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-8	**Boring Location:**	263+38	**Offset:**	59.5' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92335417	**Longitude:**	79.82553722	**Date Started:**	3/22/2011
Total Depth:	145.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	0 ft	**Date Completed:**	3/22/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0		Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH)		74.2	SS-13	5	7	8	15
	77.7	Stiff, Moist, Green/Brown, Fine to Medium Sandy SILT (ML), with Black Speckles							
-80.0				79.2	SS-14	4	5	8	13
	81.7	Medium Dense, Moist to Wet, Green/Brown, Silty Fine to Medium SAND (SM), with Black Speckles							
-85.0				84.2	SS-15	8	9	8	17
-90.0				89.2	SS-16	7	8	8	16
-95.0				94.2	SS-17	8	12	15	27
	97.7	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)							
-100.0				99.2	SS-18	4	6	9	15
-105.0				104.2	SS-19	5	9	10	19
-110.0				109.2	SS-20	6	7	7	14
-115.0				114.2	SS-21	5	8	8	16
-120.0				119.2	SS-22	7	8	11	19
-125.0				124.2	SS-23	7	8	9	17
-130.0				129.2	SS-24	8	7	11	18
-135.0				134.2	SS-25	6	8	12	20
-140.0				139.2	SS-26	8	12	10	22
-145.0				144.2	SS-27	5	6	9	15
	145.7	Boring Terminated at 145.7 Feet							



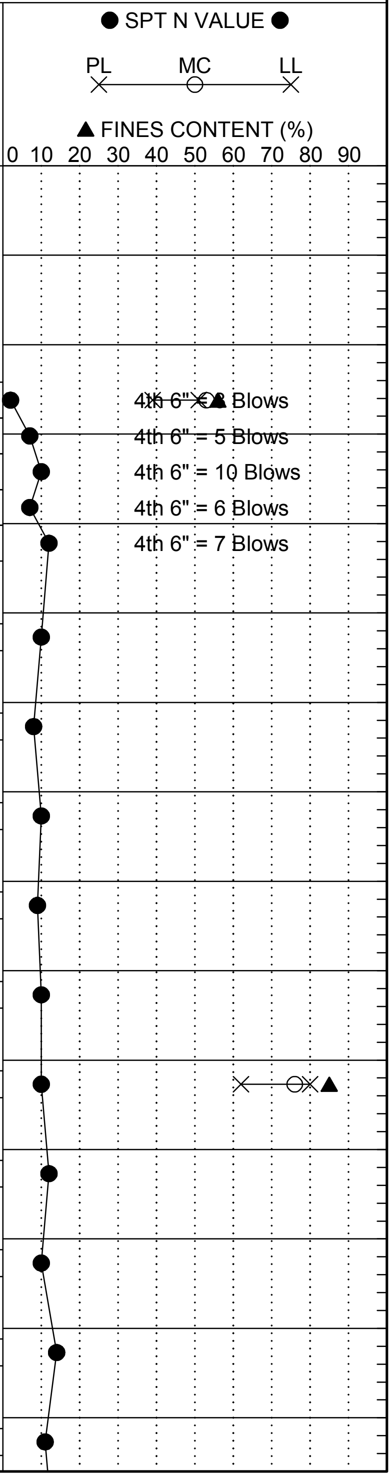
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-9	**Boring Location:**	265+47	**Offset:**	36.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92394833	**Longitude:**	79.82527472	**Date Started:**	3/23/2011
Total Depth:	112.1 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	3/23/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
-5.0									
-10.0									
	12.1	Very Soft, Wet, Gray, Fine to Coarse Sandy Elastic SILT (MH) **(COOPER MARL)**,Sand, LL=51, PL=39, PI=12, NMC=52.7%, %#200=56.2%		12.1	SS-1	1	1	1	2
-15.0	14.1	Firm to Stiff, Moist, Green/Brown, Elastic SILT (MH) with Fine		14.1	SS-2	3	3	4	7
				16.1	SS-3	5	5	5	10
				18.1	SS-4	2	3	4	7
-20.0				20.1	SS-5	5	5	7	12
-25.0				25.6	SS-6	3	5	5	10
-30.0				30.6	SS-7	3	3	5	8
-35.0				35.6	SS-8	4	4	6	10
-40.0				40.6	SS-9	4	4	5	9
-45.0				45.6	SS-10	4	4	6	10
-50.0		=> LL=80, PL=62, PI=18, NMC=76.0%, %#200=84.5%		50.6	SS-11	3	5	5	10
-55.0				55.6	SS-12	4	5	7	12
-60.0				60.6	SS-13	4	5	5	10
-65.0				65.6	SS-14	5	7	7	14
-70.0				70.6	SS-15	3	5	6	11



LEGEND

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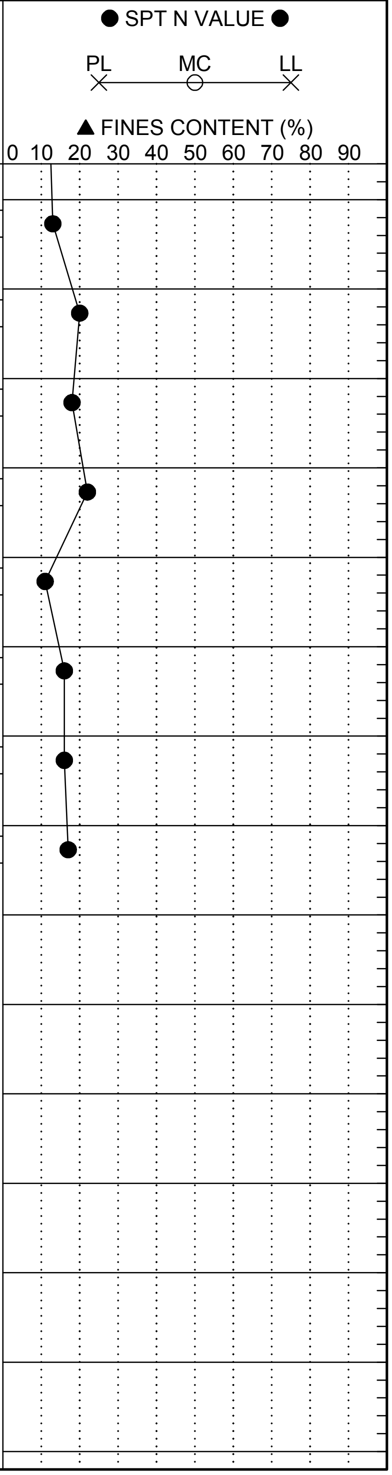
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-9	**Boring Location:**	265+47	**Offset:**	36.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92394833	**Longitude:**	79.82527472	**Date Started:**	3/23/2011
Total Depth:	112.1 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	3/23/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	74.1								
-75.0		Medium Dense, Moist, Green/Brown, Silty Fine to Medium SAND (SM), with Black Speckles		75.6	SS-16	5	6	7	13
	79.1								
-80.0		Medium Dense, Wet, Green/Brown, Fine to Medium SAND (SP-SM), with Silt		80.6	SS-17	8	10	10	20
-85.0				85.6	SS-18	9	9	9	18
-90.0				90.6	SS-19	8	11	11	22
	94.1								
-95.0		Stiff to Very Stiff, Moist, Light Green, CLAY (CL)		95.6	SS-20	4	5	6	11
-100.0				100.6	SS-21	6	7	9	16
-105.0				105.6	SS-22	6	7	9	16
-110.0				110.6	SS-23	6	7	10	17
	112.1	Boring Terminated at 112.1 Feet							
-115.0									
-120.0									
-125.0									
-130.0									
-135.0									
-140.0									
-145.0									



LEGEND

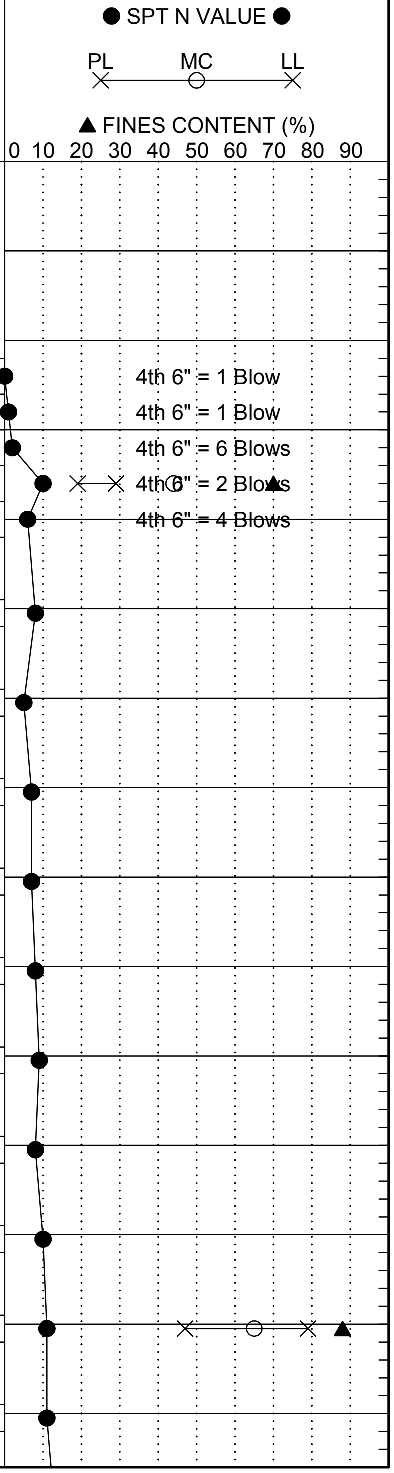
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 11/30/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-10	**Boring Location:**	268+76	**Offset:**	11.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92453889	**Longitude:**	79.82446194	**Date Started:**	4/3/2011
Total Depth:	111 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/3/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
	0.0	▽Water Surface								
-5.0										
-10.0	11.0			11.0						
	11.3	Very Loose, Wet, Black, Fine SAND (SP) **(COOPER MARL)**	▨		SS-1	WOH			0	4th 6" = 1 Blow
			▨	13.0	SS-2	1	1	1	1	4th 6" = 1 Blow
-15.0	15.0	Very Soft, Wet, Black, CLAY (CL), with Organics	▨	15.0	SS-3	1	1	1	2	4th 6" = 6 Blows
	17.0	Very Soft, Wet, Gray, Lean CLAY (CL) with Fine Sand	▨	17.0	SS-4	14	5	5	10	4th 6" = 2 Blows
-20.0	19.0	Stiff, Wet, Gray, Lean CLAY (CL) with Fine Sand, LL=29, PL=19, PI=10, NMC=43.9%, %#200=70.3%	‖	19.0	SS-5	3	3	3	6	4th 6" = 4 Blows
-25.0		Firm to Stiff, Moist, Brown/Yellow, SILT (ML), with Sand	‖	24.5	SS-6	2	3	5	8	
-30.0			‖	29.5	SS-7	3	2	3	5	
-35.0			‖	34.5	SS-8	3	3	4	7	
-40.0			‖	39.5	SS-9	3	3	4	7	
-45.0			‖	44.5	SS-10	3	4	4	8	
-50.0			‖	49.5	SS-11	3	4	5	9	
-55.0			‖	54.5	SS-12	3	4	4	8	
-60.0			‖	59.5	SS-13	5	4	6	10	
-65.0		=> LL=79, PL=47, PI=32, NMC=64.7%, %#200=88.4%	‖	64.5	SS-14	4	5	6	11	
	68.0	Stiff, Moist, Light Brown, Elastic SILT (MH)	‖							
-70.0			‖	69.5	SS-15	4	5	6	11	



LEGEND

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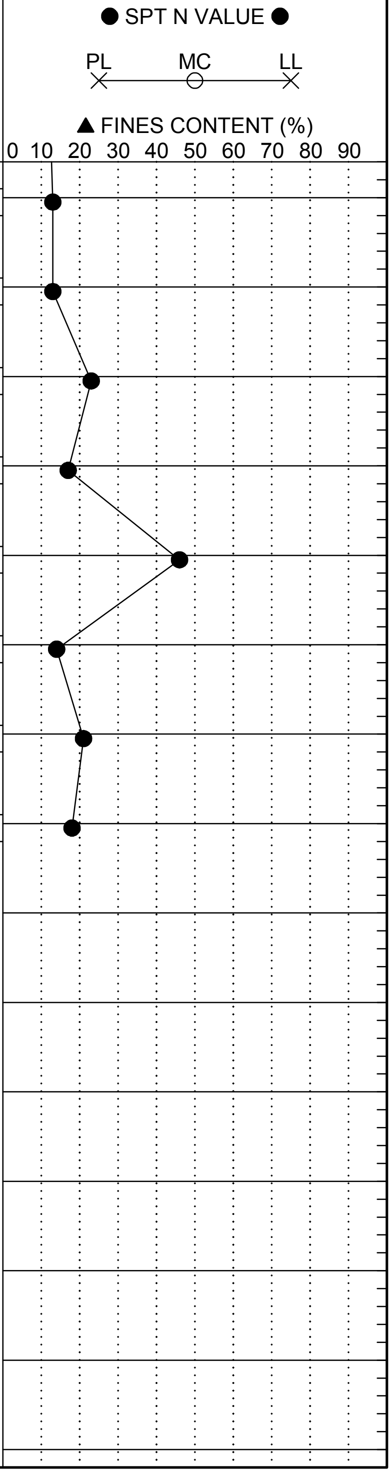
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-10	**Boring Location:**	268+76	**Offset:**	11.0' LT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92453889	**Longitude:**	79.82446194	**Date Started:**	4/3/2011
Total Depth:	111 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/3/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0		Stiff, Moist, Light Brown, Elastic SILT (MH)	74.5	SS-16	5	6	7	13
	78.0	Medium Dense, Wet, Brown/Yellow, Silty Fine to Medium SAND (SM)						
-80.0			79.5	SS-17	4	6	7	13
	83.0	Medium Dense, Wet, Brown/Yellow, Silty Fine to Medium SAND (SM)						
-85.0		Medium Dense to Dense, Wet, Brown/Yellow, Fine to Medium SAND (SP-SM), with Silt	84.5	SS-18	7	10	13	23
-90.0			89.5	SS-19	7	7	10	17
-95.0			94.5	SS-20	12	22	24	46
	98.0	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)						
-100.0			99.5	SS-21	5	6	8	14
-105.0			104.5	SS-22	7	9	12	21
-110.0			109.5	SS-23	7	9	9	18
	111.0	Boring Terminated at 111.0 Feet						
-115.0								
-120.0								
-125.0								
-130.0								
-135.0								
-140.0								
-145.0								



LEGEND

SAMPLER TYPE

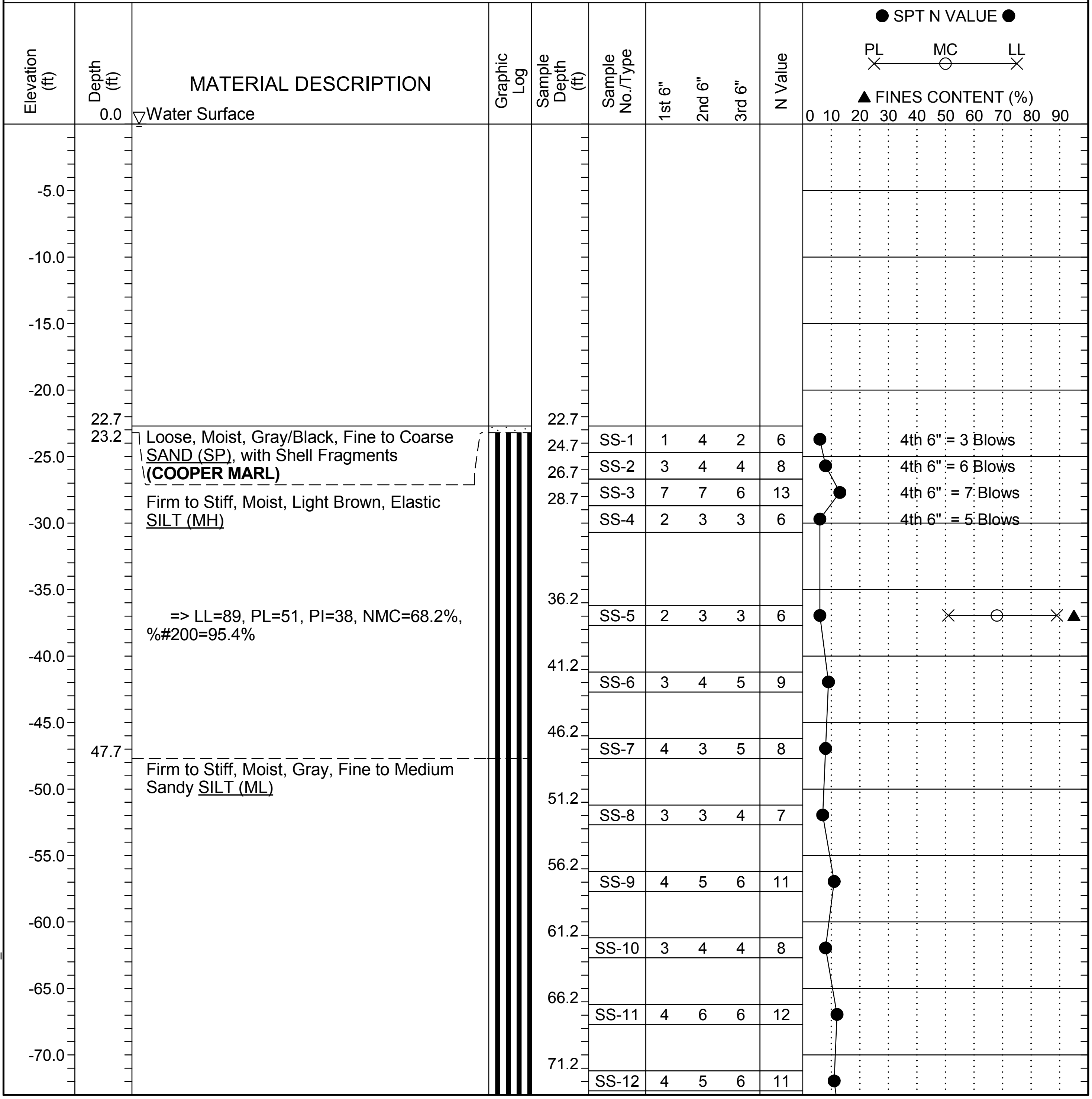
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	B-11	**Boring Location:**	272+05	**Offset:**	21.6' RT of CL	**Alignment:**	SC 41
Elev.:	0.0 ft	**Latitude:**	32.92511722	**Longitude:**	79.82362861	**Date Started:**	4/4/2011
Total Depth:	122.7 ft	**Soil Depth:**	100 ft	**Core Depth:**	0 ft	**Date Completed:**	4/6/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y Ⓝ	**Liner Used:**	Y Ⓝ
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	73%
Core Size:	N/A	**Driller:**	Mark Brown	**Groundwater:**	**TOB** 0 ft	**24HR**	



Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	▽Water Surface							
	22.7			22.7					
	23.2	Loose, Moist, Gray/Black, Fine to Coarse SAND (SP), with Shell Fragments **(COOPER MARL)**		24.7	SS-1	1	4	2	6
				26.7	SS-2	3	4	4	8
		Firm to Stiff, Moist, Light Brown, Elastic SILT (MH)		28.7	SS-3	7	7	6	13
					SS-4	2	3	3	6
		=> LL=89, PL=51, PI=38, NMC=68.2%, %#200=95.4%		36.2	SS-5	2	3	3	6
				41.2	SS-6	3	4	5	9
				46.2	SS-7	4	3	5	8
	47.7	Firm to Stiff, Moist, Gray, Fine to Medium Sandy SILT (ML)		51.2	SS-8	3	3	4	7
				56.2	SS-9	4	5	6	11
				61.2	SS-10	3	4	4	8
				66.2	SS-11	4	6	6	12
				71.2	SS-12	4	5	6	11

LEGEND

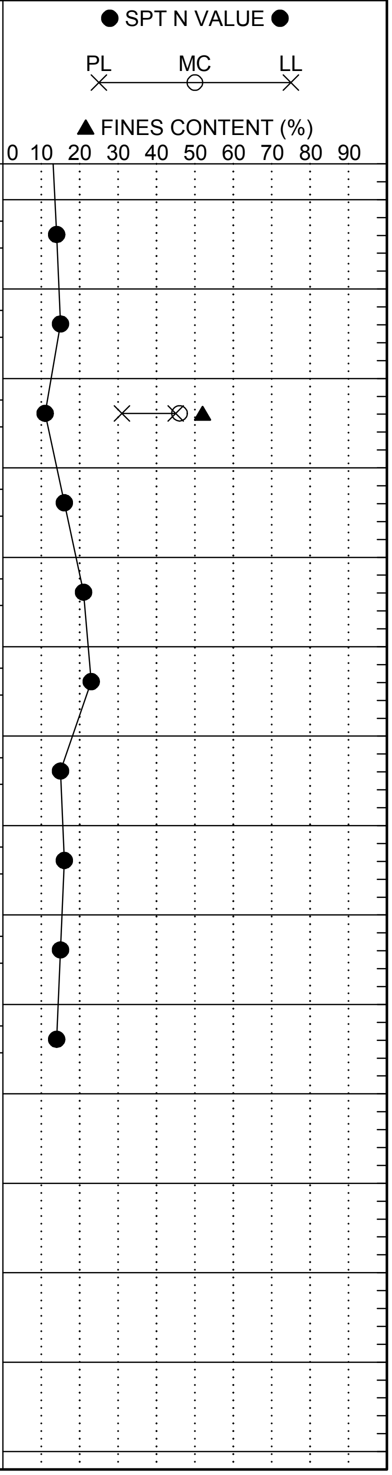
Continued Next Page

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

SCDOT Soil Test Boring Log

File No.: 8.158B/10.032102 **Project No. (PIN):** 32099 **County:** Berkeley/Charleston **Eng./Geo.:** T. Martin
Site Description: SC 41 Replacement Bridge over Wando River **Route:** SC 41
Boring No.: B-11 **Boring Location:** 272+05 **Offset:** 21.6' RT of CL **Alignment:** SC 41
Elev.: 0.0 ft **Latitude:** 32.92511722 **Longitude:** 79.82362861 **Date Started:** 4/4/2011
Total Depth: 122.7 ft **Soil Depth:** 100 ft **Core Depth:** 0 ft **Date Completed:** 4/6/2011
Bore Hole Diameter (in): 4 **Sampler Configuration** **Liner Required:** Y [✓ N] **Liner Used:** Y [✓ N]
Drill Machine: CME-45B **Drill Method:** Rotary Wash **Hammer Type:** Automatic **Energy Ratio:** 73%
Core Size: N/A **Driller:** Mark Brown **Groundwater:** **TOB** 0 ft **24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
-75.0		Firm to Stiff, Moist, Gray, Fine to Medium Sandy SILT (ML)		76.2	SS-13	5	6	8	14
-80.0				81.2	SS-14	5	7	8	15
-85.0		=> LL=45, PL=31, PI=14, NMC=46.4%, %#200=52.4%		86.2	SS-15	4	5	6	11
-90.0	89.7	Medium Dense, Wet, Brown/Yellow, Fine to Medium SAND (SP-SM), with Silt		91.2	SS-16	7	7	9	16
-95.0				96.2	SS-17	9	9	12	21
-100.0				101.2	SS-18	9	12	11	23
-105.0	104.7	Stiff to Very Stiff, Moist, Light Green, CLAY (CL)		106.2	SS-19	6	6	9	15
-110.0				111.2	SS-20	7	7	9	16
-115.0				116.2	SS-21	6	6	9	15
-120.0				121.2	SS-22	6	6	8	14
-125.0	122.7	Boring Terminated at 122.7 Feet							
-130.0									
-135.0									
-140.0									
-145.0									



LEGEND

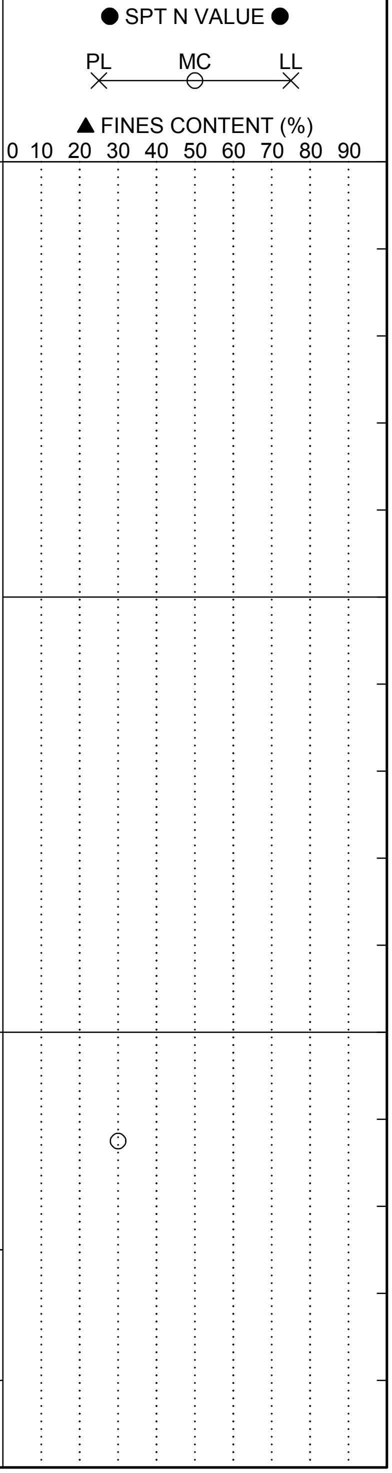
SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	AP-1 (CPT-2)	**Boring Location:**	255+91	**Offset:**	0.4' RT of CL	**Alignment:**	SC 41
Elev.:	8.1 ft	**Latitude:**	32.92201667	**Longitude:**	79.82738944	**Date Started:**	3/8/2011
Total Depth:	14 ft	**Soil Depth:**	14 ft	**Core Depth:**	0 ft	**Date Completed:**	3/8/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	77%
Core Size:	N/A	**Driller:**	Bobby Fowler	**Groundwater:**	**TOB** 2.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
	▽								
3.1									
-1.9	10.0	Wet, Brown/Gray, Fine Sandy CLAY (CL) , A-4(2), LL=31, PL=23, PI=8, NMC=51.5%, %#200=96.7%	▨	10.0	ST-1				
			▨	12.5	ST-2				
	14.0	Boring Terminated at 14.0 Feet							



LEGEND

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

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 11/30/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin	
Site Description:	SC 41 Replacement Bridge over Wando River	**Route:**	SC 41					
Boring No.:	AP-2 (CPT-3)	**Boring Location:**	275+13	**Offset:**	10.0' LT of CL	**Alignment:**	SC 41	
Elev.:	6.3 ft	**Latitude:**	32.9257775	**Longitude:**	79.82299389	**Date Started:**	3/8/2011	
Total Depth:	12.5 ft	**Soil Depth:**	12.5 ft	**Core Depth:**	0 ft	**Date Completed:**	3/8/2011	
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]	
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	77%	
Core Size:	N/A	**Driller:**	Bobby Fowler	**Groundwater:**	**TOB**	2.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Roadway Shoulder								
		∇								
1.3										
	8.5	Wet, Brown/Gray, Fine to Medium Sandy <u>CLAY (CL)</u>, LL=31, PL=22, PI=9, NMC=27.5%, %#200=58.8%	▨	8.5	ST-1					
-3.7			▨	10.5	ST-2					
	12.5	Boring Terminated at 12.5 Feet								

LEGEND

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

SCDOT Soil Test Boring Log

File No.: 8.158B/10.032102 **Project No. (PIN):** 32099 **County:** Berkeley/Charleston **Eng./Geo.:** T. Martin

Site Description: SC 41 Replacement Bridge over Wando River **Route:** SC 41

Boring No.: RW-1 **Boring Location:** 248+99 **Offset:** 7.0' LT of CL **Alignment:** SC 41

Elev.: 6.3 ft **Latitude:** 32.92051972 **Longitude:** 79.82876833 **Date Started:** 3/8/2011

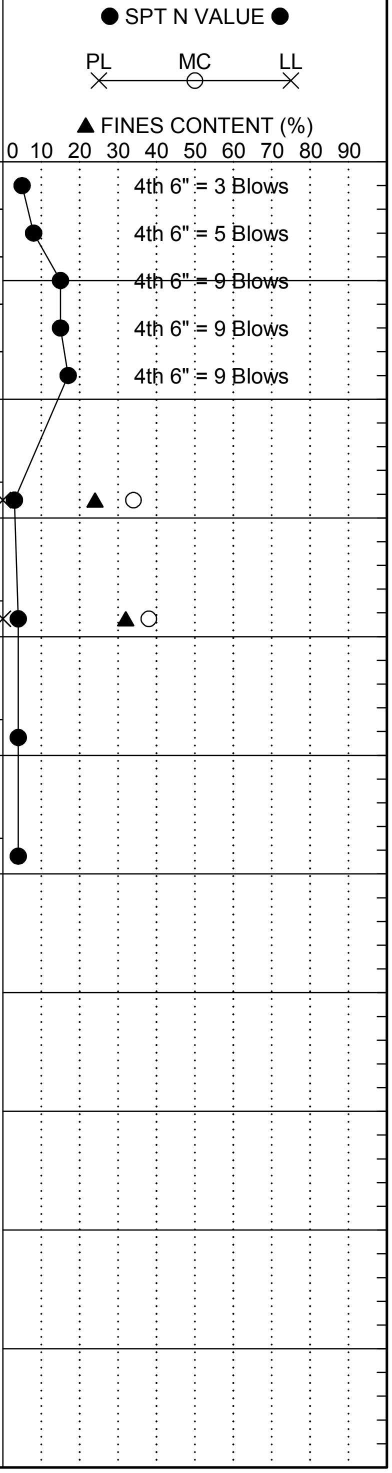
Total Depth: 30 ft **Soil Depth:** 30 ft **Core Depth:** 0 ft **Date Completed:** 3/8/2011

Bore Hole Diameter (in): 4 **Sampler Configuration** **Liner Required:** Y [✓ N] **Liner Used:** Y [✓ N]

Drill Machine: CME-45B **Drill Method:** Rotary Wash **Hammer Type:** Automatic **Energy Ratio:** 77%

Core Size: N/A **Driller:** Bobby Fowler **Groundwater:** **TOB** 12 ft **24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
	1.5	Loose, Moist, Tan, Fine to Medium SAND (SP)		0.0 2.0	SS-1	2	2	3	5
		Firm to Stiff, Moist, Gray/Orange, Fine Sandy CLAY (CL)		4.0	SS-2	2	3	5	8
1.3				6.0	SS-3	5	7	8	15
	8.0			8.0	SS-4	6	7	8	15
		Very Stiff, Moist, Gray/Orange/Green, Fine Sandy CLAY (CL)			SS-5	8	8	9	17
-3.7	11.0								
	13.5	▽Medium Dense, Moist, Gray, Clayey Fine to Medium SAND (SC), with Shell Fragments		13.5					
-8.7		Very Loose, Wet, Gray, Silty Fine to Medium SAND (SM), with Shell Fragments, LL=NP, PL=NP, PI=NP, NMC=33.6%, %#200=24.4%			SS-6	2	1	2	3
	17.0	Very Loose, Moist, Yellow/Tan, Silty Fine SAND (SM) => LL=NP, PL=NP, PI=NP, NMC=38.1%, %#200=32.2%		18.5	SS-7	2	2	2	4
-13.7									
-18.7	26.0	Soft, Moist, Yellow/Tan, CLAY (CL), (Cooper Marl)		23.5	SS-8	2	2	2	4
-23.7	30.0	Boring Terminated at 30.0 feet		28.5	SS-9	2	2	2	4
-28.7									
-33.7									
-38.7									
-43.7									



LEGEND

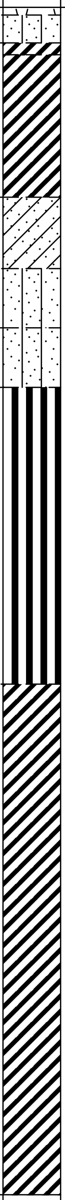
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

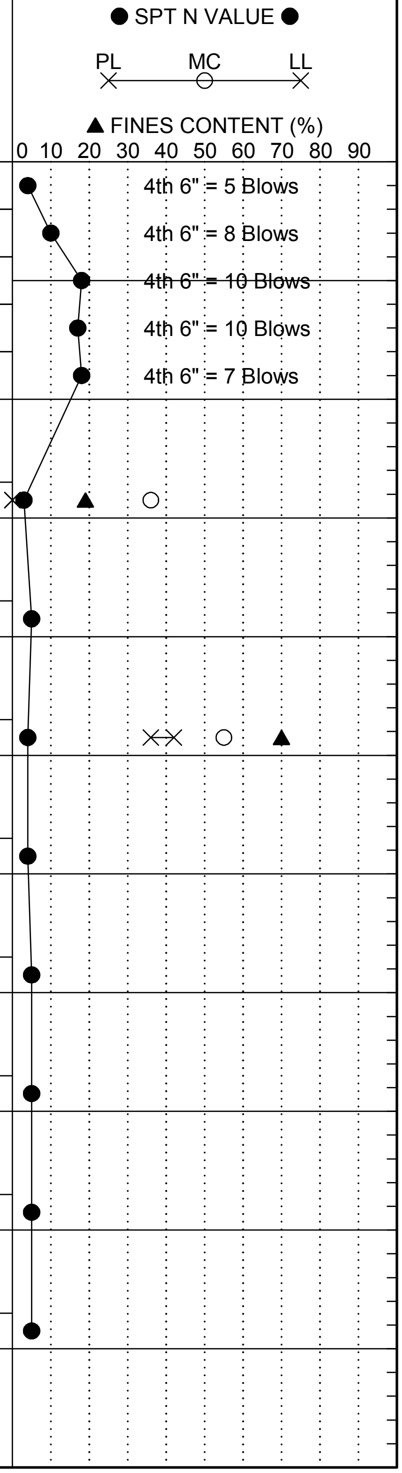
File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	RW-2	**Boring Location:**	278+53	**Offset:**	8.1' LT of CL	**Alignment:**	SC 41
Elev.:	6.9 ft	**Latitude:**	32.926405	**Longitude:**	79.82216861	**Date Started:**	3/8/2011
Total Depth:	50 ft	**Soil Depth:**	50 ft	**Core Depth:**	0 ft	**Date Completed:**	3/8/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	77%
Core Size:	N/A	**Driller:**	Bobby Fowler	**Groundwater:**	**TOB** 13 ft	**24HR**	

Depth (ft)	MATERIAL DESCRIPTION
0.0	Roadway Shoulder
0.3	TOPSOIL
1.5	Very Loose, Moist, Tan/Orange, Silty Fine to Medium SAND (SM)
2.0	Soft, Moist, Tan/Orange, CLAY (CL), with Roots
8.0	Stiff to Very Stiff, Moist, Tan/Orange, CLAY (CL)
11.0	Medium Dense, Moist, Green/Gray, Clayey Fine SAND (SC)
13.5	∇ Medium Dense, Moist, White/Orange/Black, Silty Fine to Coarse SAND (SM)
16.0	Very Loose, Wet, White/Orange/Black, Silty Fine to Coarse SAND (SM), LL=NP, PL=NP, PI=NP, NMC=35.7%, %#200=19.0%
28.5	Soft to Firm, Moist, Tan, Fine Sandy SILT (ML) => LL=42, PL=36, PI=6, NMC=54.6%, %#200=69.8%
50.0	Soft to Firm, Moist, Green/Brown/Yellow, CLAY (CL), (Cooper Marl) => w/ Sand
	Boring Terminated at 50.0 feet

Elevation (ft)
1.9
-3.1
-8.1
-13.1
-18.1
-23.1
-28.1
-33.1
-38.1
-43.1



Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	
0.0	SS-1	2	2	2	4	4th 6" = 5 Blows
2.0	SS-2	3	4	6	10	4th 6" = 8 Blows
4.0	SS-3	7	9	9	18	4th 6" = 10 Blows
6.0	SS-4	6	8	9	17	4th 6" = 10 Blows
8.0	SS-5	9	9	9	18	4th 6" = 7 Blows
13.5	SS-6	1	1	2	3	
18.5	SS-7	2	2	3	5	
23.5	SS-8	2	2	2	4	
28.5	SS-9	2	2	2	4	
33.5	SS-10	2	2	3	5	
38.5	SS-11	2	2	3	5	
43.5	SS-12	2	2	3	5	
48.5	SS-13	2	2	3	5	



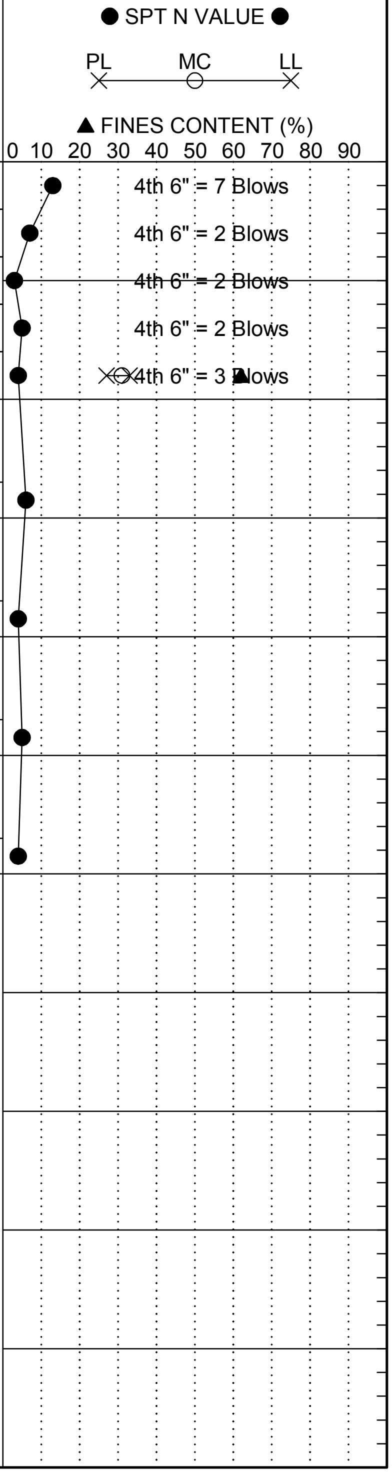
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	RW-3	**Boring Location:**	291+28	**Offset:**	CL	**Alignment:**	SC 41
Elev.:	6.1 ft	**Latitude:**	32.92938083	**Longitude:**	79.82017806	**Date Started:**	3/8/2011
Total Depth:	30 ft	**Soil Depth:**	30 ft	**Core Depth:**	0 ft	**Date Completed:**	3/8/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	77%
Core Size:	N/A	**Driller:**	Bobby Fowler	**Groundwater:**	**TOB** 8 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
		Loose to Medium Dense, Moist, Gray/Yellow, Silty Fine to Medium SAND (SM)		0.0 2.0	SS-1	15	7	6	13
					SS-2	5	4	3	7
	4.0	Soft to Firm, Moist to Wet, Green/Yellow/Gray, Fine to Medium Sandy SILT (ML)		4.0	SS-3	3	2	1	3
1.1				6.0	SS-4	2	2	3	5
	▽			8.0					
-3.9		=> LL=33, PL=27, PI=6, NMC=30.9%, %#200=61.7%			SS-5	3	2	2	4
		=> w/ Shell Fragments		13.5	SS-6	3	2	4	6
-8.9									
	17.0	Soft to Firm, Moist, Yellow/Tan, Fine to Medium Sandy SILT (ML), (Cooper Marl)		18.5	SS-7	2	2	2	4
-13.9									
				23.5	SS-8	2	2	3	5
-18.9									
				28.5	SS-9	2	2	2	4
-23.9	30.0	Boring Terminated at 30.0 feet							
-28.9									
-33.9									
-38.9									
-43.9									



LEGEND

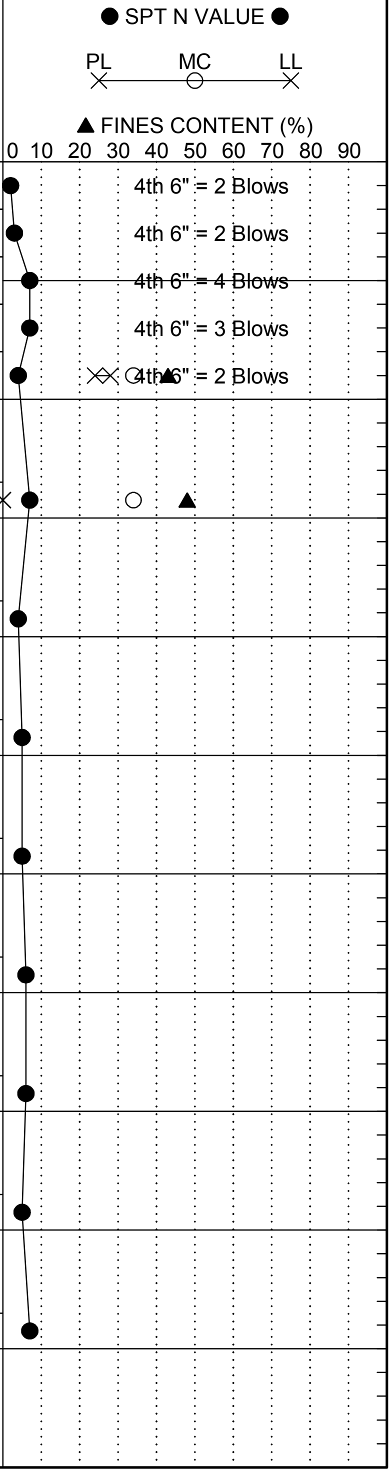
SAMPLER TYPE
- SS - Split Spoon
- ST - Shelby Tube
- AWG - Rock Core, 1-1/8"
- NQ - Rock Core, 1-7/8"
- CU - Cuttings
- CT - Continuous Tube

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	T. Martin
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	RW-4	**Boring Location:**	12+51	**Offset:**	1.0' RT of CL	**Alignment:**	SC 41
Elev.:	5.7 ft	**Latitude:**	32.93123583	**Longitude:**	79.81967056	**Date Started:**	3/8/2011
Total Depth:	50 ft	**Soil Depth:**	50 ft	**Core Depth:**	0 ft	**Date Completed:**	3/8/2011
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-45B	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	77%
Core Size:	N/A	**Driller:**	Bobby Fowler	**Groundwater:**	**TOB** 8 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
		Very Loose to Loose, Moist to Wet, Green/Gray/Orange, Silty Fine to Coarse SAND (SM)		0.0 2.0	SS-1	1	1	1	2
				4.0	SS-2	1	1	2	3
0.7				6.0	SS-3	3	3	4	7
	∇			8.0	SS-4	3	3	4	7
-4.3		=> LL=28, PL=24, PI=4, NMC=33.5%, %#200=42.5%			SS-5	3	2	2	4
-9.3		=> LL=NP, PL=NP, PI=NP, NMC=33.8%, %#200=47.6%		13.5	SS-6	3	4	3	7
	17.0	Soft to Firm, Moist, Yellow/Tan, Fine Sandy CLAY (CL), (Cooper Marl)		18.5	SS-7	2	2	2	4
-14.3				23.5	SS-8	2	2	3	5
-19.3									
-24.3				28.5	SS-9	1	2	3	5
-29.3				33.5	SS-10	2	3	3	6
-34.3				38.5	SS-11	2	3	3	6
-39.3				43.5	SS-12	2	3	2	5
-44.3	50.0			48.5	SS-13	2	3	4	7
		Boring Terminated at 50.0 feet							



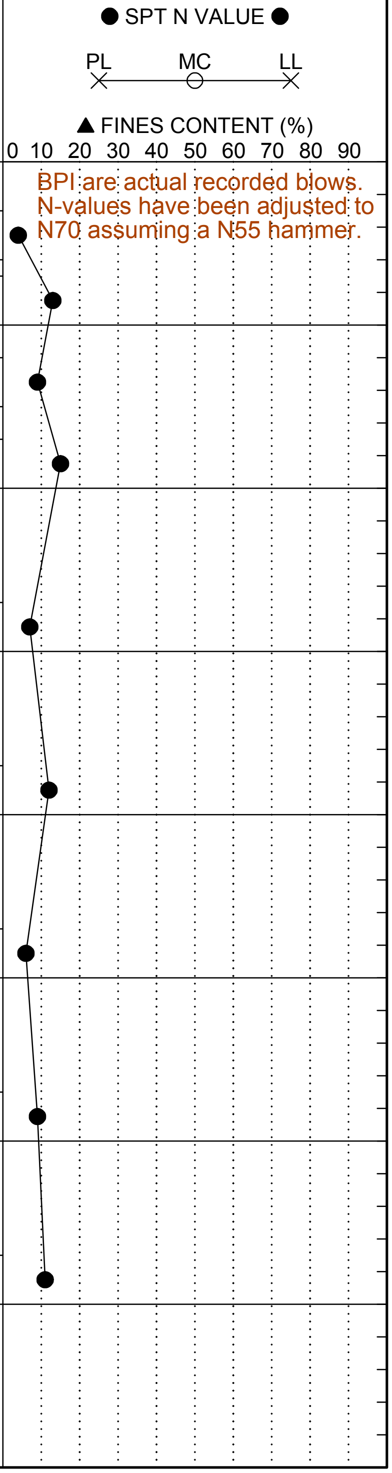
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WB-1	**Boring Location:**	251+00	**Offset:**	30' LT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92103861	**Longitude:**	79.82851278	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	Tiger-track	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	55%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	2 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
	0.3	Grass Rootmat and Topsoil							
		▼ Soft, Moist to Wet, Brown, Sandy Lean CLAY (CL)		1.5	SS-1	1	2	3	4
	3.0	Stiff, Wet, Gray/Orange, Fine to Medium Sandy Lean CLAY (CL)		3.5	SS-2	4	6	10	13
2.4									
				6.0	SS-3	4	6	6	9
				8.5	SS-4	6	7	12	15
-2.6									
	12.0	Firm, Wet, Gray/Brown, Fine Sandy Lean to Elastic CLAY (CL-CH)							
				13.5	SS-5	3	4	5	7
-7.6									
	17.0	Firm to Stiff, Moist, Brown/Green, Fine Sandy SILT (ML) **(COOPER MARL)**							
				18.5	SS-6	3	5	10	12
-12.6									
				23.5	SS-7	2	3	4	6
-17.6									
				28.5	SS-8	3	4	7	9
-22.6									
				33.5	SS-9	5	6	8	11
-27.6	35.0	Boring Terminated at 35.0 Feet							



BPI are actual recorded blows. N-values have been adjusted to N70 assuming a N55 hammer.

LEGEND

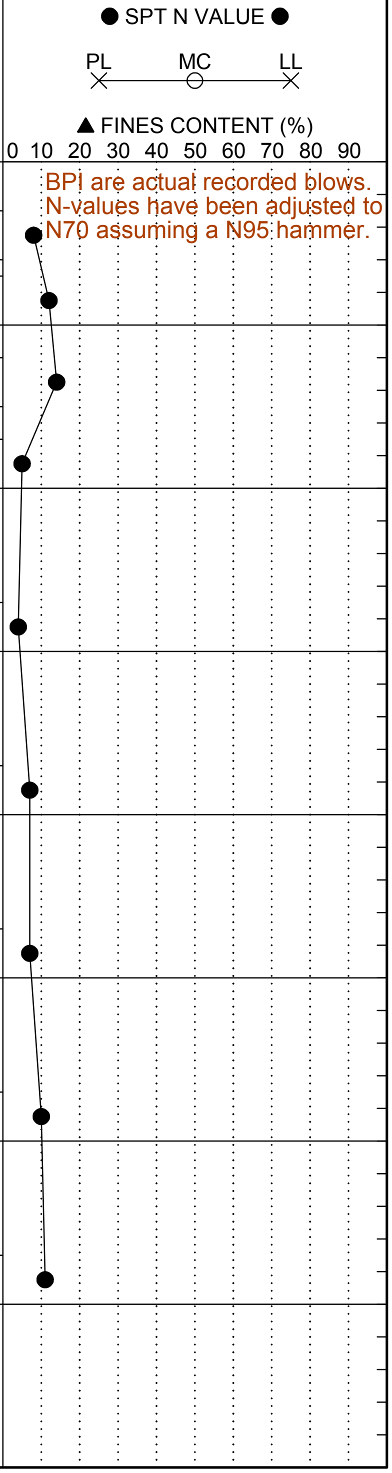
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT G4067.01-RW&BORING.GPJ SC_DOT.GDT 12/1/11

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WB-2	**Boring Location:**	251+60	**Offset:**	40' RT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92106583	**Longitude:**	79.82821583	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	95%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	0.6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Gravel							
	0.3	Grass Rootmat and Topsoil							
	2.0	Firm, Wet, Gray/Brown, Sandy Lean CLAY (CL)	▨	1.5	SS-1	2	3	3	8
		Stiff, Wet, Gray/Orange, Fine to Medium Sandy Lean CLAY (CL)	▨	3.5	SS-2	7	3	6	12
2.4			▨	6.0	SS-3	2	4	6	14
	8.0	Soft to Firm, Wet, Gray/Brown, Fine Sandy Lean to Elastic CLAY (CL-CH)	▨	8.5	SS-4	2	2	2	5
-2.6			▨	13.5	SS-5	1	2	1	4
-7.6			▨						
	17.0	Firm to Stiff, Moist, Brown/Green, Calcareous Fine Sandy SILT (ML) **(COOPER MARL)**		18.5	SS-6	1	2	3	7
-12.6				23.5	SS-7	1	2	3	7
-17.6				28.5	SS-8	1	3	4	10
-22.6				33.5	SS-9	2	3	5	11
-27.6	35.0	Boring Terminated at 35.0 Feet							



BPI are actual recorded blows. N-values have been adjusted to N70 assuming a N95 hammer.

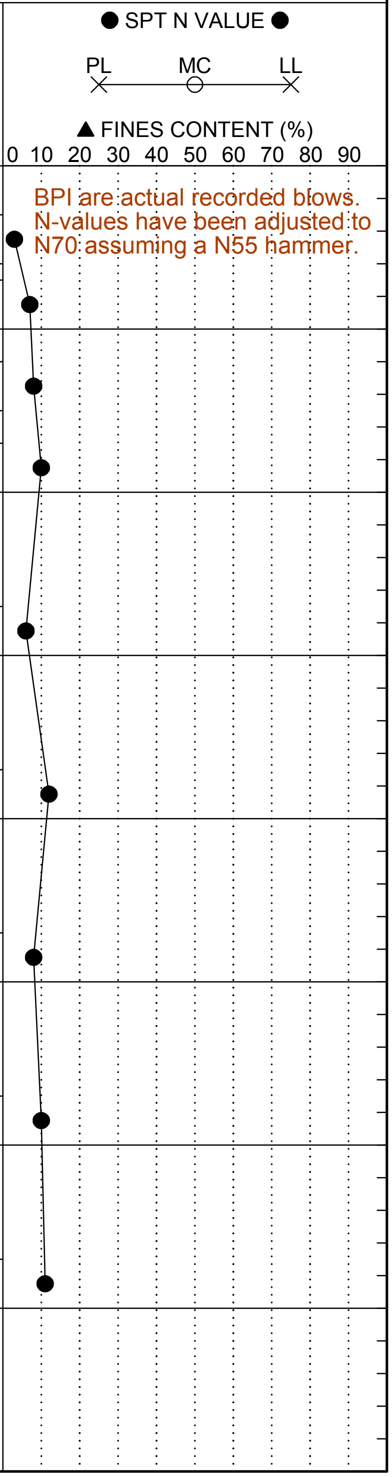
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WB-3	**Boring Location:**	252+00	**Offset:**	38' LT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92128167	**Longitude:**	79.82834667	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	Tiger-track	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	55%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	1.8 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder						
	0.5	Sand Fill						
		▼Soft, Moist to Wet, Brown, Sandy Lean CLAY (CL)	1.5	SS-1	2	2	2	3
	3.0	Firm to Stiff, Wet, Gray/Orange, Fine to Medium Sandy Lean CLAY (CL)	3.5	SS-2	2	4	5	7
2.4			6.0	SS-3	3	4	6	8
			8.5	SS-4	3	5	8	10
-2.6								
	11.0	Firm, Wet, Gray/Brown, Fine to Medium Sandy Lean to Elastic CLAY (CL-CH)						
			13.5	SS-5	2	3	4	6
-7.6								
	18.5	Medium Dense, Moist, Brown/Green, Calcareous Silty Fine SAND (SM) **(COOPER MARL)**	18.5	SS-6	3	6	9	12
-12.6								
	22.0	Firm to Stiff, Moist, Brown/Green, Calcareous Fine Sandy SILT (ML)						
			23.5	SS-7	3	4	6	8
-17.6								
			28.5	SS-8	4	6	7	10
-22.6								
			33.5	SS-9	4	6	8	11
-27.6	35.0	Boring Terminated at 35.0 Feet						



BPI are actual recorded blows. N-values have been adjusted to N70 assuming a N55 hammer.

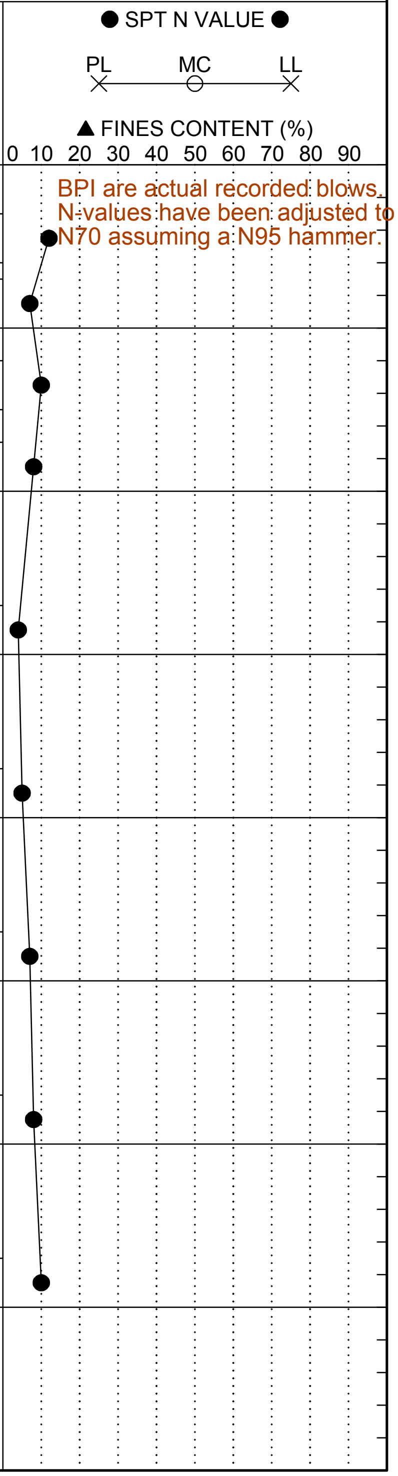
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River	**Route:**	SC 41				
Boring No.:	WB-4	**Boring Location:**	252+50	**Offset:**	22' RT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92128472	**Longitude:**	79.82809889	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	95%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5.6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
		Soft, Moist, Brown, Fine to Medium Sandy Lean CLAY (CL)	▨	1.5	SS-1	1	2	7	12
	2.5	Firm to Stiff, Moist to Wet, Gray/Orange, Fine Sandy Lean CLAY (CL)	▨	3.5	SS-2	1	2	3	7
2.4		▼	▨	6.0	SS-3	1	3	4	10
			▨	8.5	SS-4	2	3	3	8
-2.6			▨						
	12.0	Soft, Wet, Gray/Brown, Fine Sandy Lean to Elastic CLAY (CL-CH)	▨	13.5	SS-5	1	1	2	4
-7.6			▨						
	18.0	Firm to Stiff, Moist, Brown/Green, Calcareous Fine Sandy SILT (ML) with Broken Shell Fragments at Top of Layer **(COOPER MARL)**	⋮	18.5	SS-6	1	2	2	5
-12.6			⋮						
-17.6			⋮	23.5	SS-7	1	2	3	7
			⋮	28.5	SS-8	1	3	3	8
-22.6			⋮						
			⋮	33.5	SS-9	1	3	4	10
-27.6	35.0	Boring Terminated at 35.0 Feet							



BPI are actual recorded blows. N-values have been adjusted to N70 assuming a N95 hammer.

LEGEND

SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
AWG - Rock Core, 1-1/8"
NQ - Rock Core, 1-7/8"
CU - Cuttings
CT - Continuous Tube

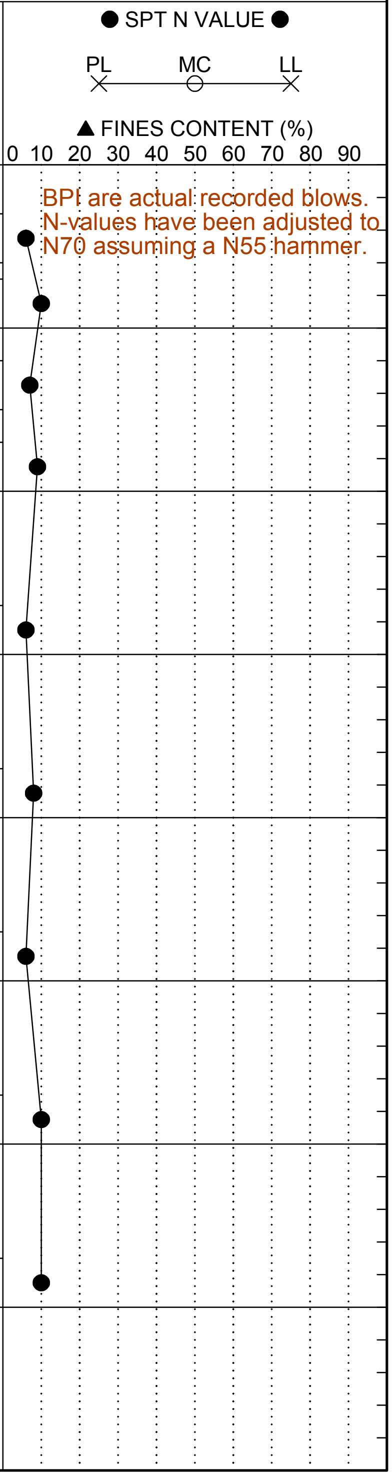
DRILLING METHOD

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WB-5	**Boring Location:**	253+02	**Offset:**	37' LT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92150778	**Longitude:**	79.82813167	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	Tiger-track	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	55%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	1.8 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder						
	0.5	Clayey Sand Fill						
		▼Firm, Moist to Wet, Brown, Fine to Medium Sandy Lean CLAY (CL)	1.5	SS-1	2	4	4	6
	3.0	Firm to Stiff, Wet, Gray/Orange, Fine Sandy Lean CLAY (CL)	3.5	SS-2	3	5	8	10
2.4								
			6.0	SS-3	2	3	6	7
			8.5	SS-4	3	5	7	9
-2.6								
	12.0	Firm, Wet, Gray/Brown, Fine Sandy Lean to Elastic CLAY (CL-CH)	13.5	SS-5	2	3	4	6
-7.6								
	17.0	Firm to Stiff, Moist, Brown/Green, Calcareous Fine Sandy SILT (ML) **(COOPER MARL)**	18.5	SS-6	3	4	6	8
-12.6								
			23.5	SS-7	2	3	4	6
-17.6								
			28.5	SS-8	4	6	7	10
-22.6								
			33.5	SS-9	5	5	8	10
-27.6	35.0	Boring Terminated at 35.0 Feet						



BPf are actual recorded blows. N-values have been adjusted to N70 assuming a N55 hammer.

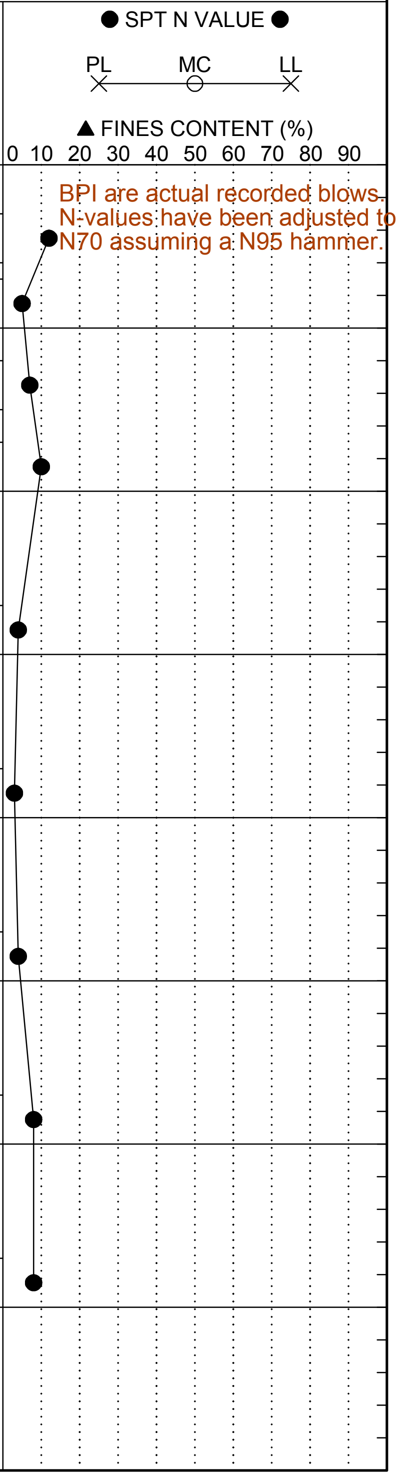
LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WB-6	**Boring Location:**	253+05	**Offset:**	25' RT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92140167	**Longitude:**	79.82797361	**Date Started:**	12/27/2004
Total Depth:	35 ft	**Soil Depth:**	35 ft	**Core Depth:**	0 ft	**Date Completed:**	12/27/2004
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	95%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Shoulder							
		Medium Dense, Moist, Brown, Clayey Fine to Medium SAND (SC)	▨	1.5	SS-1	1	5	4	12
	3.5	Firm to Stiff, Moist to Wet, Gray/Orange, Fine Sandy Lean CLAY (CL)	▨	3.5	SS-2	1	2	2	5
2.4									
				6.0	SS-3	1	2	3	7
		▼							
				8.5	SS-4	2	2	5	10
-2.6									
	13.0	Soft, Wet, Gray/Brown, Fine Sandy Lean to Elastic CLAY (CL-CH)	▨	13.5	SS-5	1	1	2	4
-7.6									
	18.0	Soft to Firm, Moist, Brown/Green, Calcareous Fine Sandy SILT (ML) **(COOPER MARL)**	▥	18.5	SS-6	1	1	1	3
-12.6									
				23.5	SS-7	1	1	2	4
-17.6									
				28.5	SS-8	1	2	4	8
-22.6									
				33.5	SS-9	1	3	3	8
-27.6	35.0	Boring Terminated at 35.0 Feet							



BPI are actual recorded blows. N-values have been adjusted to N70 assuming a N95 hammer.

LEGEND

SAMPLER TYPE

SS	- Split Spoon	NQ	- Rock Core, 1-7/8"
ST	- Shelby Tube	CU	- Cuttings
AWG	- Rock Core, 1-1/8"	CT	- Continuous Tube

DRILLING METHOD

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

Soil Test Boring Log

File No.: 8.158B/10.032102 **Project No. (PIN):** 32099 **County:** Berkeley/Charleston **Eng./Geo.:** R. Wessigner
Site Description: SC 41 Replacement Bridge over Wando River **Route:** SC 41
Boring No.: WS-3 **Boring Location:** 252+00 **Offset:** 38' LT of CL **Alignment:** SC 41
Elev.: 7.4 ft **Latitude:** 32.92128167 **Longitude:** 79.82834667 **Date Started:** 1/3/2005
Total Depth: 22.5 ft **Soil Depth:** 22.5 ft **Core Depth:** 0 ft **Date Completed:** 1/3/2005
Bore Hole Diameter (in): 4 **Sampler Configuration** **Liner Required:** Y [✓ N] **Liner Used:** Y [✓ N]
Drill Machine: CME-55 **Drill Method:** Rotary Wash **Hammer Type:** Automatic **Energy Ratio:** 95%
Core Size: N/A **Driller:** **Groundwater:** **TOB** **24HR** 1.8 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Roadway Shoulder								
	▼	Boring Performed for Shelby Tube Collections. For Soil Stratigraphy, refer to Boring WB-3.								
2.4										
				6.0	ST-1					
				8.0	ST-2					
-2.6										
-7.6										
				18.5	ST-3					
-12.6										
				20.5	ST-4					
	22.5									
-17.6										
-22.6										
-27.6										

LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WS-4	**Boring Location:**	252+50	**Offset:**	22' RT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92128472	**Longitude:**	79.82809889	**Date Started:**	1/3/2005
Total Depth:	22.5 ft	**Soil Depth:**	22.5 ft	**Core Depth:**	0 ft	**Date Completed:**	1/3/2005
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	95%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	5.6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Roadway Shoulder								
		Boring Performed for Shelby Tube Collections. For Soil Stratigraphy, refer to Boring WB-4.								
2.4		▼								
-2.6										
-7.6										
				18.5	ST-1					
-12.6				20.5	ST-2					
	22.5									
-17.6										
-22.6										
-27.6										

LEGEND

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

SCDOT Soil Test Boring Log

File No.:	8.158B/10.032102	**Project No. (PIN):**	32099	**County:**	Berkeley/Charleston	**Eng./Geo.:**	R. Wessigner
Site Description:	SC 41 Replacement Bridge over Wando River					**Route:**	SC 41
Boring No.:	WS-6	**Boring Location:**	253+05	**Offset:**	25' RT of CL	**Alignment:**	SC 41
Elev.:	7.4 ft	**Latitude:**	32.92140167	**Longitude:**	79.82797361	**Date Started:**	1/3/2005
Total Depth:	17.5 ft	**Soil Depth:**	17.5 ft	**Core Depth:**	0 ft	**Date Completed:**	1/3/2005
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y [✓ N]	**Liner Used:**	Y [✓ N]
Drill Machine:	CME-55	**Drill Method:**	Rotary Wash	**Hammer Type:**	Automatic	**Energy Ratio:**	95%
Core Size:	N/A	**Driller:**		**Groundwater:**	**TOB**	**24HR**	7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Roadway Shoulder Boring Performed for Shelby Tube Collections. For Soil Stratigraphy, refer to Boring WB-6.								
2.4										
	▼									
-2.6										
				13.5	ST-1					
-7.6				15.5	ST-2					
	17.5									
-12.6										
-17.6										
-22.6										
-27.6										

LEGEND

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

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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                          SNDG. NO. :WD-1
F&ME Consultants                                                          Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                           FILE NO. : G4067
LOCATION: Off-set to Boring WB-1
SNDG.BY : Ricky Wessinger                                                 SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                                  ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                   LO RANGE  = 11.16 TSF
                                       ROD DIAM.  = 0.69 IN   BL.THICK.  = 0.02 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.00 TSF
                                       FR.RED.DIA. = 0.83 IN   BL.WIDTH   = 0.15 IN    PHI FACTOR = 1
WATER DEPTH =  6.6 FT
                   HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =  2.8 LBF/FT
                                                              DELTA-A    = 0.10 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 =  0.00 TSF
                                       DELTA/PHI   =  0.5     DELTA-B    = 0.55 TSF   M  FACTOR  = 1
MAX SU ID  =  1.0    SU OPTION  =   0    MIN PHI ID  =  1.2     OCR OPTION =   0      K0 FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI   1 M = 3.2808 FT


  Z   ELEV  THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI  ZMCAL  P0    P1    P2    U0   GAMMA  SVP
(FT)  (FT)  (LBF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (PCF)  (TSF)
***** ****** ****** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ****** ****** ******
  1.0   6.4    496  0.73  2.98        0.10  0.55  11.16 0.00  0.05  0.00  0.75  2.42         0.000  106.1 0.054
  2.0   5.4    567  1.10  1.93        0.10  0.55  11.16 0.00  0.05  0.00  1.19  1.38         0.000   93.6 0.103
  3.0   4.4   1160  2.30  4.70        0.10  0.55  11.16 0.00  0.05  0.00  2.32  4.14         0.000  106.1 0.152
  4.0   3.4   1947  3.97  6.84        0.10  0.55  11.16 0.00  0.05  0.00  3.96  6.28         0.000  112.3 0.208
  5.0   2.4   2300  3.60  6.68        0.10  0.55  11.16 0.00  0.05  0.00  3.58  6.13         0.000  112.3 0.263
  6.0   1.4   2020  3.55  5.95        0.10  0.55  11.16 0.00  0.05  0.00  3.57  5.40         0.000  106.1 0.319
  7.0   0.4   2249  5.74  9.81        0.10  0.55  11.16 0.00  0.05  0.00  5.68  9.26         0.014  113.6 0.359
  8.0  -0.6   3554  6.37 10.65        0.10  0.55  11.16 0.00  0.05  0.00  6.30 10.10         0.046  113.6 0.384
  9.0  -1.6   3729  5.48  8.56        0.10  0.55  11.16 0.00  0.05  0.00  5.46  8.01         0.078  113.6 0.408
 10.0  -2.6   3124  4.85  8.09        0.10  0.55  11.16 0.00  0.05  0.00  4.83  7.54         0.111  113.6 0.433
 11.0  -3.6   4150  3.92  8.72        0.10  0.55  11.16 0.00  0.05  0.00  3.81  8.16         0.142  113.6 0.457
 12.0  -4.6   3632  3.65  6.89        0.10  0.55  11.16 0.00  0.05  0.00  3.63  6.34         0.175  113.6 0.482
 13.0  -5.6   4000  5.69  8.51        0.10  0.55  11.16 0.00  0.05  0.00  5.69  7.96         0.207  113.6 0.506
 14.0  -6.6   4143  6.16 10.23        0.10  0.55  11.16 0.00  0.05  0.00  6.10  9.68         0.239  113.6 0.531
 15.0  -7.6   4280  2.98  6.89        0.10  0.55  11.16 0.00  0.05  0.00  2.91  6.34         0.271  107.3 0.554
 16.0  -8.6   5638  3.08 12.74        0.10  0.55  11.16 0.00  0.05  0.00  2.74 12.13         0.304  119.2 0.579
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                      SNDG. NO. : WD-1
F&ME Consultants                                                      Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                       FILE NO. :G4067
LOCATION: Off-set to Boring WB-1
SNDG.BY : Ricky Wessinger                                             SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                              ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                    LO RANGE   = 11.16 TSF
                                      ROD DIAM.   =  0.69 IN    BL.THICK.  =  0.02 IN     SU  FACTOR = 1
SURF.ELEV.  =   7.4 FTLO  GAGE 0 =  0.00 TSF
                                      FR.RED.DIA. =  0.83 IN    BL.WIDTH   =  0.15 IN     PHI FACTOR = 1
WATER DEPTH =   6.6 FT
                    HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =   2.8 LBF/FT
                                                                DELTA-A    =  0.10 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                       DELTA / PHI =   0.5       DELTA - B =  0.55 TSF    M FACTOR = 1
MAX SU ID   =   1.0    SU OPTION  =     0     MIN PHI ID  =   1.2        OCR OPTION =     0       K0 FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV    KD     ID    UD    ED      K0     SU     QD     PHI   SIGFF   PHIO    PC      OCR     M      SOIL TYPE
(FT)  (FT)                  (TSF)         (TSF)  (TSF)  (DEG)  (TSF)  (DEG)  (TSF)          (TSF)
***** ******  ***** ***** ***** ******  *****  *****  *****  *****  ******  *****  *****  *****  ******  ************
  1.0    6.4   13.92 2.20           57    1.32          35.7    47.9     0.09    43.6   0.73   13.4     163  SILTY SAND
  2.0    5.4   11.52 0.16            6    2.01   0.20                                   1.59   15.4      17  MUD
  3.0    4.4   15.16 0.79           64    2.37   0.42                                   3.60   23.6     184  CLAYEY SILT
  4.0    3.4   19.02 0.59           80    2.70   0.76                                   6.99   33.6     251  SILTY CLAY
  5.0    2.4   13.60 0.71           89    2.22   0.64                                   5.24   19.9     246  CLAYEY SILT
  6.0    1.4   11.18 0.51           64    1.97   0.61                                   4.68   14.6     166  SILTY CLAY
  7.0    0.4   15.75 0.63          124    2.42   1.04                                   8.99   25.0     364  CLAYEY SILT
  8.0   -0.6   16.25 0.61          132    2.46   1.16                                  10.10   26.3     390  CLAYEY SILT
  9.0   -1.6   13.18 0.47           89    2.18   0.95                                   7.75   19.0     243  SILTY CLAY
 10.0   -2.6   10.89 0.57           94    1.94   0.79                                   6.10   14.1     242  SILTY CLAY
 11.0   -3.6    8.02  1.19         151    1.60                                          3.99    8.7     345  SILT
 12.0   -4.6    7.16  0.78          94    1.48   0.52                                   3.53    7.3     203  CLAYEY SILT
 13.0   -5.6   10.81 0.41           78    1.93   0.92                                   7.05   13.9     203  SILTY CLAY
 14.0   -6.6   11.01 0.61          124    1.95   0.98                                   7.61   14.3     323  CLAYEY SILT
 15.0   -7.6    4.77  1.29         119                                                                  211  SANDY SILT
 16.0   -8.6    4.20  3.86         326                                                                  569  SAND
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                          SNDG. NO. :WD-2
F&ME Consultants                                                          Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                           FILE NO. : G4067
LOCATION: Off-set to Boring WB-2
SNDG.BY : Ricky Wessinger                                                 SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                                  ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                      LO RANGE   =  9.40 TSF
                                            ROD DIAM.   =  1.75 IN    BL.THICK.  =  0.59 IN     SU  FACTOR = 1
SURF.ELEV.  =   7.4 FTLO  GAGE 0 =  0.00 TSF
                                            FR.RED.DIA. =  2.11 IN    BL.WIDTH   =  3.78 IN     PHI FACTOR = 1
WATER DEPTH =   0.6 FT
                      HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =   4.2 LBF/FT
                                                                      DELTA-A    =  0.16 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 =  0.00 TSF
                                            DELTA/PHI   =  0.5        DELTA-B    =  0.26 TSF    M  FACTOR  = 1
MAX SU ID   =  1.0    SU OPTION  =    0     MIN PHI ID  =  1.2        OCR OPTION =    0         K0 FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV  THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI  ZMCAL  P0    P1    P2    U0    GAMMA  SVP
(FT)   (FT)  (LBF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF)  (PCF)  (TSF)
***** ****** ****** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ****** ****** ******

  1.0    6.4    576  0.42  1.88        0.16  0.26  9.40  0.00  0.05  0.00  0.52  1.62        0.014  107.3  0.054
  2.0    5.4   1486  1.31  2.71        0.16  0.26  9.40  0.00  0.05  0.00  1.41  2.45        0.045  101.1  0.074
  3.0    4.4   1621  2.45  4.38        0.16  0.26  9.40  0.00  0.05  0.00  2.54  4.12        0.077  107.3  0.094
  4.0    3.4   2201  2.56  5.12        0.16  0.26  9.40  0.00  0.05  0.00  2.61  4.85        0.110  107.3  0.116
  5.0    2.4   2871  4.54  8.09        0.16  0.26  9.40  0.00  0.05  0.00  4.54  7.83        0.141  113.6  0.138
  6.0    1.4   2478  4.33  7.10        0.16  0.26  9.40  0.00  0.05  0.00  4.37  6.84        0.174  113.6  0.163
  7.0    0.4   2646  3.97  6.21        0.16  0.26  9.40  0.00  0.05  0.00  4.03  5.95        0.206  107.3  0.186
  8.0   -0.6   3621  7.88 13.15        0.16  0.26  9.40  0.00  0.05  0.00  7.80 12.84        0.238  122.3  0.211
  9.0   -1.6   4178  4.85  6.94        0.16  0.26  9.40  0.00  0.05  0.00  4.93  6.68        0.270  113.6  0.238
 10.0   -2.6   4739  5.38  8.09        0.16  0.26  9.40  0.00  0.05  0.00  5.42  7.83        0.303  113.6  0.263
 11.0   -3.6   4913  4.33  6.73        0.16  0.26  9.40  0.00  0.05  0.00  4.40  6.47        0.334  113.6  0.287
 12.0   -4.6   4498  3.29  5.43        0.16  0.26  9.40  0.00  0.05  0.00  3.36  5.17        0.367  107.3  0.310
 13.0   -5.6   4736  3.34  9.03        0.16  0.26  9.40  0.00  0.05  0.00  3.24  8.77        0.399  119.2  0.334
 14.0   -6.6   5096  3.76  6.11        0.16  0.26  9.40  0.00  0.05  0.00  3.82  5.85        0.431  107.3  0.359
 15.0   -7.6   5299  6.06  9.03        0.16  0.26  9.40  0.00  0.05  0.00  6.09  8.77        0.464  113.6  0.382
 16.0   -8.6   6686  3.76 15.76        0.16  0.26  9.40  0.00  0.05  0.00  3.34 15.45        0.496  119.2  0.408
 17.0   -9.6   8913 10.8614.41        0.16  0.26  9.40  0.00  0.05  0.00 10.8114.09        0.527  119.2  0.435
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                      SNDG. NO. : WD-2
F&ME Consultants                                                      Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                       FILE NO. :G4067
LOCATION: Off-set to Boring WB-2
SNDG.BY : Ricky Wessinger                                             SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                              ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                    LO RANGE  = 9.40 TSF
                                       ROD DIAM.  = 1.75 IN   BL.THICK.  = 0.59 IN   SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.00 TSF
                                       FR.RED.DIA. = 2.11 IN  BL.WIDTH   = 3.78 IN   PHI FACTOR = 1
WATER DEPTH =  0.6 FT
                    HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                          DELTA-A    = 0.16 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                       DELTA / PHI =  0.5     DELTA - B =  0.26 TSF   M FACTOR = 1
MAX SU ID   =  1.0    SU OPTION  =   0     MIN PHI ID  =  1.2      OCR OPTION =   0      KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI   1 M = 3.2808 FT


  Z   ELEV   KD    ID   UD   ED     KO    SU    QD    PHI  SIGFF  PHIO   PC   OCR    M    SOIL TYPE
(FT)  (FT)              (TSF)      (TSF) (TSF) (DEG) (TSF) (DEG) (TSF)      (TSF)
***** ****** ***** ***** ***** ****** ***** ***** ***** ***** ****** ***** ***** ***** ****** ************
 1.0   6.4   9.36 2.16              38   1.16          7.3   42.3   0.09  37.0  0.52   9.7    93  SILTY SAND
 2.0   5.4  18.49 0.76              37   2.66  0.26                             2.37  32.1   112  CLAYEY SILT
 3.0   4.4  26.27 0.65              55   3.24  0.51                             5.20  55.6   188  CLAYEY SILT
 4.0   3.4  21.65 0.90              78   2.91  0.50                             4.74  41.1   252  CLAYEY SILT
 5.0   2.4  31.88 0.75             114   3.61  0.97                            10.37  75.1   410  CLAYEY SILT
 6.0   1.4  25.75 0.59              86   3.20  0.88                             8.78  53.9   290  SILTY CLAY
 7.0   0.4  20.61 0.50              67   2.83  0.75                             7.07  38.1   212  SILTY CLAY
 8.0  -0.6  35.77 0.67             175   3.84  1.71                            19.00  89.9   648  CLAYEY SILT
 9.0  -1.6  19.59 0.38              61   2.75  0.91                             8.35  35.1   191  SILTY CLAY
10.0  -2.6  19.47 0.47              84   2.74  0.99                             9.15  34.8   262  SILTY CLAY
11.0  -3.6  14.14 0.51              72   2.27  0.73                             6.07  21.1   205  SILTY CLAY
12.0  -4.6   9.64 0.60              63   1.80  0.49                             3.61  11.6   155  CLAYEY SILT
13.0  -5.6   8.48 1.95             192   1.04         63.5   42.7   0.56  40.3  2.62   7.8   450  SILTY SAND
14.0  -6.6   9.42 0.60              70   1.77  0.55                             4.03  11.2   171  SILTY CLAY
15.0  -7.6  14.71 0.48              93   2.32  1.02                             8.59  22.5   267  SILTY CLAY
16.0  -8.6   6.96 4.26             421   0.78         94.2   44.3   0.69  42.4  1.86   4.6   919  SAND
17.0  -9.6  23.59 0.32             114   3.05  2.10                            20.46  47.0   378  CLAY
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                        SNDG. NO. :WD-3
F&ME Consultants                                                        Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                         FILE NO. : G4067
LOCATION: Off-set to Boring WB-3
SNDG.BY : Ricky Wessinger                                               SNDG. DATE: January 3, 2005
ANAL.BY : Michael Miller                                                ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                  LO RANGE   =  9.40 TSF
                                      ROD DIAM.   =  1.75 IN    BL.THICK.  =  0.59 IN     SU  FACTOR = 1
SURF.ELEV.  =  24.3 FT
                  LO  GAGE 0 =  0.00 TSF
                                      FR.RED.DIA. =  2.11 IN    BL.WIDTH   =  3.78 IN     PHI FACTOR = 1
WATER DEPTH =   1.8 FT
                  HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =   4.2 LBF/FT
                                                                DELTA-A    =  0.13 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 =  0.00 TSF
                                      DELTA/PHI   =   0.5       DELTA-B    =  0.23 TSF    M  FACTOR  = 1
MAX SU ID   =   1.0   SU OPTION  =    0     MIN PHI ID  =  1.2       OCR OPTION =    0      KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV  THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI  ZMCAL   P0    P1    P2     U0    GAMMA  SVP
(FT)   (FT)  (LBF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF)  (TSF) (TSF) (TSF)  (TSF)  (PCF)  (TSF)
***** ****** ****** ***** ***** ***** ***** ***** ***** ***** ***** *****  ***** ***** *****  ****** ****** ******
  1.0   23.3   1100  1.31  6.58         0.13  0.23  9.40  0.00  0.05  0.00   1.18  6.35         0.000  112.3 0.540
  2.0   22.3   1486  1.72  6.11         0.13  0.23  9.40  0.00  0.05  0.00   1.65  5.88         0.006  113.6 0.589
  3.0   21.3    717  2.35  3.34         0.13  0.23  9.40  0.00  0.05  0.00   2.44  3.11         0.038  101.1 0.610
  4.0   20.3    869  2.09  4.12         0.13  0.23  9.40  0.00  0.05  0.00   2.13  3.89         0.071  107.3 0.631
  5.0   19.3   1297  2.87  5.01         0.13  0.23  9.40  0.00  0.05  0.00   2.90  4.78         0.102  107.3 0.651
  6.0   18.3   1841  3.50  6.06         0.13  0.23  9.40  0.00  0.05  0.00   3.51  5.83         0.135  107.3 0.673
  7.0   17.3   2176  3.13  5.32         0.13  0.23  9.40  0.00  0.05  0.00   3.16  5.09         0.167  107.3 0.694
  8.0   16.3   2690  5.27  9.24         0.13  0.23  9.40  0.00  0.05  0.00   5.22  9.01         0.199  113.6 0.718
  9.0   15.3   3043  7.05 10.96         0.13  0.23  9.40  0.00  0.05  0.00   6.99 10.68         0.231  113.6 0.742
 10.0   14.3   3074  5.90  9.60         0.13  0.23  9.40  0.00  0.05  0.00   5.86  9.32         0.264  113.6 0.767
 11.0   13.3   3724  5.01  7.83         0.13  0.23  9.40  0.00  0.05  0.00   5.01  7.60         0.295  113.6 0.791
 12.0   12.3   3764  3.76  6.16         0.13  0.23  9.40  0.00  0.05  0.00   3.78  5.93         0.328  107.3 0.814
 13.0   11.3   4370  2.24  4.33         0.13  0.23  9.40  0.00  0.05  0.00   2.29  4.10         0.360  107.3 0.835
 14.0   10.3   3903  1.77  5.48         0.13  0.23  9.40  0.00  0.05  0.00   1.73  5.25         0.393  113.6 0.859
 15.0    9.3   4414  0.94  1.31         0.13  0.23  9.40  0.00  0.05  0.00   1.06  1.08         0.424   94.8 0.879
 16.0    8.3   4569  4.38  7.26         0.13  0.23  9.40  0.00  0.05  0.00   4.38  7.03         0.457  113.6 0.899
 17.0    7.3   5285  6.73 10.75         0.13  0.23  9.40  0.00  0.05  0.00   6.68 10.47         0.489  113.6 0.923
 18.0    6.3   8624  6.53  9.40         0.13  0.23  9.40  0.00  0.05  0.00   6.53  9.17         0.521  113.6 0.948
 19.0    5.3   7781  6.11  8.30         0.13  0.23  9.40  0.00  0.05  0.00   6.14  8.07         0.553  113.6 0.972
 20.0    4.3   7014  5.38  7.15         0.13  0.23  9.40  0.00  0.05  0.00   5.43  6.92         0.586  107.3 0.996
 21.0    3.3   6882  3.55  7.78         0.13  0.23  9.40  0.00  0.05  0.00   3.48  7.55         0.617  113.6 1.018
 22.0    2.3   6910  7.99 15.24         0.13  0.23  9.40  0.00  0.05  0.00   7.77 14.96         0.650  122.3 1.046
 23.0    1.3   7175  9.81 15.66         0.13  0.23  9.40  0.00  0.05  0.00   9.62 15.38         0.682  122.3 1.074
 24.0    0.3   7080 10.0213.99          0.13  0.23  9.40  0.00  0.05  0.00   9.92 13.71         0.714  119.2 1.104
 25.0   -0.7   5762 10.4413.68          0.13  0.23  9.40  0.00  0.05  0.00  10.3713.39          0.746  119.2 1.131
 26.0   -1.7   5581 10.6513.89          0.13  0.23  9.40  0.00  0.05  0.00  10.5813.60          0.779  119.2 1.159
 27.0   -2.7   6342 11.5915.76          0.13  0.23  9.40  0.00  0.05  0.00  11.4715.48          0.810  119.2 1.186
 28.0   -3.7   6604 11.0714.82          0.13  0.23  9.40  0.00  0.05  0.00  10.9714.54          0.844  119.2 1.214
 29.0   -4.7   6796 11.2815.03          0.13  0.23  9.40  0.00  0.05  0.00  11.1814.75          0.875  119.2 1.241
 30.0   -5.7   6983 10.8614.82          0.13  0.23  9.40  0.00  0.05  0.00  10.7514.54          0.906  119.2 1.268
 31.0   -6.7   7021 11.2814.62          0.13  0.23  9.40  0.00  0.05  0.00  11.2014.33          0.940  119.2 1.296
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                 SNDG. NO. : WD-3
F&ME Consultants                                                 Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                  FILE NO. :G4067
LOCATION: Off-set to Boring WB-3
SNDG.BY : Ricky Wessinger                                        SNDG. DATE: January 3, 2005
ANAL.BY : Michael Miller                                         ANAL. DATE: January 19, 2005

ANALYSIS PARAMETERS:
                  LO RANGE   = 9.40 TSF
                                   ROD DIAM.  = 1.75 IN    BL.THICK.  = 0.59 IN    SU  FACTOR = 1
SURF.ELEV.  = 24.3 FT
                  LO  GAGE 0 =  0.00 TSF
                                   FR.RED.DIA. = 2.11 IN   BL.WIDTH   = 3.78 IN    PHI FACTOR = 1
WATER DEPTH =   1.8 FT
                  HI  GAGE 0 =  0.05 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                           DELTA-A    = 0.13 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                   DELTA / PHI =  0.5      DELTA - B = 0.23 TSF    M FACTOR = 1
MAX SU ID   =  1.0    SU OPTION  =    0     MIN PHI ID  =  1.2    OCR OPTION =    0     K0 FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV    KD    ID    UD    ED      K0    SU    QD    PHI  SIGFF  PHIO    PC    OCR     M     SOIL TYPE
 (FT)  (FT)               (TSF)        (TSF) (TSF) (DEG) (TSF) (DEG) (TSF)        (TSF)
***** ****** ***** ***** ***** ******  *****  *****  *****  *****  ******  *****  *****  *****  ******  ************

  1.0   23.3  2.19 4.36                180  0.61           14.1   31.2   0.81  28.8   0.95   1.8     212  SAND
  2.0   22.3  2.78 2.58                147  0.65           18.5   32.6   0.91  30.4   1.27   2.2     198  SILTY SAND
  3.0   21.3  3.94 0.28                 23  0.97  0.31                                1.75   2.9      35  CLAY
  4.0   20.3  3.27 0.86                 62  0.84  0.26                                1.36   2.1      84  CLAYEY SILT
  5.0   19.3  4.30 0.67                 65  1.04  0.38                                2.15   3.3     106  CLAYEY SILT
  6.0   18.3  5.02 0.68                 80  1.16  0.47                                2.83   4.2     144  CLAYEY SILT
  7.0   17.3  4.32 0.64                 67  1.04  0.40                                2.31   3.3     110  CLAYEY SILT
  8.0   16.3  6.99 0.76                132  1.46  0.75                                5.05   7.0     281  CLAYEY SILT
  9.0   15.3  9.12 0.54                127  1.74  1.09                                7.91  10.7     307  SILTY CLAY
 10.0   14.3  7.29 0.62                120  1.50  0.85                                5.77   7.5     262  CLAYEY SILT
 11.0   13.3  5.96 0.55                 90  1.31  0.68                                4.35   5.5     176  SILTY CLAY
 12.0   12.3  4.24 0.62                 74  1.03  0.46                                2.63   3.2     121  CLAYEY SILT
 13.0   11.3  2.30 0.95                 63  0.62  0.22                                1.04   1.2      65  SILT
 14.0   10.3  1.56 2.63                122  0.36           57.9   38.5   1.40  37.4   0.65   0.8     103  SILTY SAND
 15.0    9.3  0.73 0.02                  0  0.11  0.05                                0.18   0.2       0  MUD
 16.0    8.3  4.37 0.67                 92  1.05  0.52                                3.04   3.4     151  CLAYEY SILT
 17.0    7.3  6.70 0.61                132  1.42  0.92                                6.10   6.6     276  CLAYEY SILT
 18.0    6.3  6.33 0.44                 92  1.37  0.88                                5.72   6.0     186  SILTY CLAY
 19.0    5.3  5.75 0.35                 67  1.28  0.80                                5.04   5.2     129  CLAY
 20.0    4.3  4.87 0.31                 52  1.14  0.67                                3.99   4.0      91  CLAY
 21.0    3.3  2.81 1.42                141  0.45           98.9   40.5   1.68  39.7   1.35   1.3     179  SANDY SILT
 22.0    2.3  6.81 1.01                250  1.44                                      7.07   6.8     528  SILT
 23.0    1.3  8.31 0.65                200  1.64  1.40                                9.92   9.2     462  CLAYEY SILT
 24.0    0.3  8.34 0.41                132  1.64  1.45                               10.23   9.3     305  SILTY CLAY
 25.0   -0.7  8.51 0.31                105  1.66  1.52                               10.83   9.6     245  CLAY
 26.0   -1.7  8.46 0.31                105  1.65  1.55                               10.98   9.5     244  CLAY
 27.0   -2.7  8.99 0.38                139  1.72  1.71                               12.37  10.4     333  SILTY CLAY
 28.0   -3.7  8.34 0.35                124  1.64  1.59                               11.26   9.3     287  SILTY CLAY
 29.0   -4.7  8.30 0.35                124  1.64  1.62                               11.43   9.2     286  CLAY
 30.0   -5.7  7.76 0.39                132  1.57  1.52                               10.52   8.3     294  SILTY CLAY
 31.0   -6.7  7.92 0.31                109  1.59  1.59                               11.09   8.6     246  CLAY
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                       SNDG. NO. :WD-4
F&ME Consultants                                                       Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                        FILE NO. : G4067
LOCATION: Off-Set to Boring WB-4
SNDG.BY : Ricky Wessinger                                              SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                               ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                    LO RANGE   = 9.40 TSF
                                      ROD DIAM.   = 1.75 IN    BL.THICK.  = 0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.05 TSF
                                      FR.RED.DIA. = 2.11 IN    BL.WIDTH   = 3.78 IN    PHI FACTOR = 1
WATER DEPTH =  5.6 FT
                    HI  GAGE 0 =  0.00 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                               DELTA-A    = 0.16 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 =  0.00 TSF
                                      DELTA/PHI   =  0.5       DELTA-B    = 0.26 TSF   M  FACTOR  = 1
MAX SU ID   =  1.0   SU OPTION  =   0  MIN PHI ID  =  1.2       OCR OPTION =    0       KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV   THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI ZMCAL   P0    P1    P2    U0    GAMMA  SVP
 (FT)  (FT)   (LBF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF)  (PCF)  (TSF)
***** ****** ****** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ****** ****** ******
  1.0   6.4    1484  1.25  2.77         0.16  0.26  9.40  0.05  0.00  0.00  1.31  2.45        0.000  99.8  0.054
  2.0   5.4    1297  1.41  2.40         0.16  0.26  9.40  0.05  0.00  0.00  1.48  2.09        0.000  99.8  0.103
  3.0   4.4    3495  2.87  6.68         0.16  0.26  9.40  0.05  0.00  0.00  2.81  6.37        0.000 106.1  0.153
  4.0   3.4    1469  2.45  3.92         0.16  0.26  9.40  0.05  0.00  0.00  2.51  3.60        0.000 106.1  0.208
  5.0   2.4    1171  2.82  4.54         0.16  0.26  9.40  0.05  0.00  0.00  2.86  4.23        0.000 106.1  0.260
  6.0   1.4    1702  3.60  5.59         0.16  0.26  9.40  0.05  0.00  0.00  3.63  5.27        0.013 107.3  0.302
  7.0   0.4    2355  4.07  8.09         0.16  0.26  9.40  0.05  0.00  0.00  4.00  7.78        0.044 113.6  0.325
  8.0  -0.6    2456  4.33  6.84         0.16  0.26  9.40  0.05  0.00  0.00  4.33  6.53        0.077 113.6  0.350
  9.0  -1.6    2946  6.11  9.03         0.16  0.26  9.40  0.05  0.00  0.00  6.09  8.72        0.109 113.6  0.374
 10.0  -2.6    3751  6.42  9.24         0.16  0.26  9.40  0.05  0.00  0.00  6.41  8.93        0.141 113.6  0.399
 11.0  -3.6    3841  5.85  8.51         0.16  0.26  9.40  0.05  0.00  0.00  5.84  8.20        0.173 113.6  0.423
 12.0  -4.6    4295  5.06  7.10         0.16  0.26  9.40  0.05  0.00  0.00  5.08  6.79        0.206 113.6  0.448
 13.0  -5.6    4212  3.29  5.27         0.16  0.26  9.40  0.05  0.00  0.00  3.32  4.96        0.237 107.3  0.470
 14.0  -6.6    4558  3.18  4.96         0.16  0.26  9.40  0.05  0.00  0.00  3.23  4.65        0.270 107.3  0.492
 15.0  -7.6    4736  2.30  2.77         0.16  0.26  9.40  0.05  0.00  0.00  2.40  2.45        0.302  94.8  0.511
 16.0  -8.6    4002  5.53  8.09         0.16  0.26  9.40  0.05  0.00  0.00  5.53  7.78        0.334 113.6  0.530
 17.0  -9.6    4271  5.32  7.93         0.16  0.26  9.40  0.05  0.00  0.00  5.32  7.62        0.366 113.6  0.554
 18.0 -10.6    4300  6.42  9.03         0.16  0.26  9.40  0.05  0.00  0.00  6.42  8.72        0.399 113.6  0.579
 19.0 -11.6    4322  6.11  8.87         0.16  0.26  9.40  0.05  0.00  0.00  6.10  8.56        0.430 113.6  0.603
 20.0 -12.6    4494  6.00  8.30         0.16  0.26  9.40  0.05  0.00  0.00  6.01  7.99        0.464 113.6  0.628
 21.0 -13.6    4917  5.12  6.73         0.16  0.26  9.40  0.05  0.00  0.00  5.16  6.42        0.495 107.3  0.651
 22.0 -14.6    5239  3.50  6.53         0.16  0.26  9.40  0.05  0.00  0.00  3.48  6.21        0.527 107.3  0.673
 23.0 -15.6    6469  7.73 12.53         0.16  0.26  9.40  0.05  0.00  0.00  7.61 12.27        0.560 122.3  0.698
 24.0 -16.6    6390  8.98 13.15         0.16  0.26  9.40  0.05  0.00  0.00  8.89 12.89        0.592 119.2  0.727
 25.0 -17.6    5689 10.3413.47         0.16  0.26  9.40  0.05  0.00  0.00 10.3613.21        0.623 119.2  0.754
 26.0 -18.6    5804 10.4413.36         0.16  0.26  9.40  0.05  0.00  0.00 10.4713.10        0.657 119.2  0.782
 27.0 -19.6    5665 11.6915.24         0.16  0.26  9.40  0.05  0.00  0.00 11.6914.98        0.688 119.2  0.809
 28.0 -20.6    6613 11.6915.14         0.16  0.26  9.40  0.05  0.00  0.00 11.7014.88        0.720 119.2  0.837
 29.0 -21.6    6851 11.0714.20         0.16  0.26  9.40  0.05  0.00  0.00 11.0913.94        0.753 119.2  0.864
 30.0 -22.6    6732 10.8613.99         0.16  0.26  9.40  0.05  0.00  0.00 10.8813.73        0.784 119.2  0.892
 31.0 -23.6    7135 11.4814.82         0.16  0.26  9.40  0.05  0.00  0.00 11.4914.56        0.816 119.2  0.920
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                     SNDG. NO. : WD-4
F&ME Consultants                                                     Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                      FILE NO. :G4067
LOCATION: Off-Set to Boring WB-4
SNDG.BY : Ricky Wessinger                                            SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                             ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                    LO RANGE  =  9.40 TSF
                                       ROD DIAM.  =  1.75 IN    BL.THICK.  =  0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.05 TSF
                                       FR.RED.DIA. =  2.11 IN    BL.WIDTH   =  3.78 IN    PHI FACTOR = 1
WATER DEPTH =   5.6 FT
                    HI  GAGE 0 =  0.00 TSF LIN.ROD WT. =   4.2 LBF/FT
                                                         DELTA-A    =  0.16 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                        DELTA / PHI =   0.5       DELTA - B =  0.26 TSF    M FACTOR = 1
MAX SU ID   =   1.0    SU OPTION  =     0     MIN PHI ID  =   1.2       OCR OPTION =     0      KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z   ELEV   KD    ID   UD    ED     KO    SU    QD    PHI  SIGFF  PHIO   PC    OCR    M     SOIL TYPE
(FT)  (FT)              (TSF)       (TSF) (TSF) (DEG) (TSF)  (DEG) (TSF)      (TSF)
***** ****** ***** ***** ***** ******  *****  *****  *****  *****  ******  *****  *****  *****  ******  ************
  1.0    6.4  24.13 0.88          40   3.09  0.27                          2.63  48.7     134  CLAYEY SILT
  2.0    5.4  14.40 0.41          21   2.29  0.27                          2.24  21.7      60  SILTY CLAY
  3.0    4.4  18.23 1.27         123   2.19         43.2   43.1    0.26  39.6  5.26  34.2     379  SANDY SILT
  4.0    3.4  12.05 0.44          38   2.06  0.43                          3.42  16.5     102  SILTY CLAY
  5.0    2.4  10.99 0.48          48   1.95  0.48                          3.71  14.3     123  SILTY CLAY
  6.0    1.4  11.98 0.45          57   2.06  0.63                          4.93  16.3     152  SILTY CLAY
  7.0    0.4  12.18 0.96         132   2.08  0.68                          5.44  16.8     353  SILT
  8.0   -0.6  12.18 0.52          76   2.08  0.73                          5.86  16.8     205  SILTY CLAY
  9.0   -1.6  16.01 0.44          91   2.44  1.11                          9.58  25.6     269  SILTY CLAY
 10.0   -2.6  15.72 0.40          88   2.42  1.16                          9.94  24.9     256  SILTY CLAY
 11.0   -3.6  13.41 0.42          81   2.20  1.00                          8.22  19.5     228  SILTY CLAY
 12.0   -4.6  10.91 0.35          58   1.94  0.82                          6.31  14.1     152  CLAY
 13.0   -5.6   6.54 0.53          57   1.40  0.46                          2.99   6.4     118  SILTY CLAY
 14.0   -6.6   6.00 0.48          49   1.32  0.43                          2.72   5.5      98  SILTY CLAY
 15.0   -7.6   4.11 0.03           2   1.01  0.27                          1.57   3.1       3  MUD
 16.0   -8.6   9.80 0.43          78   1.82  0.85                          6.33  11.9     193  SILTY CLAY
 17.0   -9.6   8.93 0.46          80   1.71  0.79                          5.72  10.3     190  SILTY CLAY
 18.0  -10.6  10.38 0.38          80   1.88  1.00                          7.57  13.1     203  SILTY CLAY
 19.0  -11.6   9.38 0.44          86   1.77  0.92                          6.73  11.1     209  SILTY CLAY
 20.0  -12.6   8.83 0.36          69   1.70  0.89                          6.38  10.1     163  SILTY CLAY
 21.0  -13.6   7.16 0.27          44   1.49  0.71                          4.76   7.3      94  CLAY
 22.0  -14.6   4.37 0.93          95   1.05  0.40                          2.28   3.4     159  SILT
 23.0  -15.6  10.10 0.66         162   1.85  1.16                          8.73  12.5     406  CLAYEY SILT
 24.0  -16.6  11.42 0.48         139   2.00  1.41                         11.00  15.1     364  SILTY CLAY
 25.0  -17.6  12.91 0.29          99   2.15  1.70                         13.82  18.3     271  CLAY
 26.0  -18.6  12.55 0.27          91   2.11  1.71                         13.73  17.5     247  CLAY
 27.0  -19.6  13.60 0.30         114   2.22  1.95                         16.10  19.9     318  CLAY
 28.0  -20.6  13.11 0.29         111   2.17  1.93                         15.73  18.8     304  CLAY
 29.0  -21.6  11.95 0.28          99   2.05  1.77                         14.06  16.3     264  CLAY
 30.0  -22.6  11.32 0.28          99   1.99  1.71                         13.32  14.9     259  CLAY
 31.0  -23.6  11.61 0.29         106   2.02  1.83                         14.29  15.5     281  CLAY
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                      SNDG. NO. :WD-5
F&ME Consultants                                                      Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                       FILE NO. : G4067
LOCATION: Off-Set to Boring WB-5
SNDG.BY : Ricky Wessinger                                             SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                              ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                    LO RANGE   =  9.40 TSF
                                        ROD DIAM.   =  1.75 IN   BL.THICK.  =  0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.05 TSF
                                        FR.RED.DIA. =  2.11 IN   BL.WIDTH   =  3.78 IN    PHI FACTOR = 1
WATER DEPTH =  1.8 FT
                    HI  GAGE 0 =  0.00 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                                 DELTA-A    =  0.14 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 =  0.00 TSF
                                        DELTA/PHI   =  0.5       DELTA-B    =  0.26 TSF   M  FACTOR  = 1
MAX SU ID   =  1.0  SU OPTION  =   0    MIN PHI ID  =  1.2       OCR OPTION =    0        KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z    ELEV  THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI  ZMCAL   P0    P1    P2     U0    GAMMA   SVP
(FT)   (FT)  (LBF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF)  (TSF)  (PCF)  (TSF)
***** ****** ****** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ***** ****** ****** ******

  1.0   6.4   1528  1.72  4.91        0.14  0.26  9.40  0.05  0.00  0.00  1.67  4.59         0.000  106.1  0.054
  2.0   5.4   1618  1.41  4.65        0.14  0.26  9.40  0.05  0.00  0.00  1.35  4.33         0.006  113.6  0.101
  3.0   4.4   1034  1.83  3.08        0.14  0.26  9.40  0.05  0.00  0.00  1.87  2.77         0.038  101.1  0.123
  4.0   3.4   1171  2.56  3.65        0.14  0.26  9.40  0.05  0.00  0.00  2.61  3.34         0.071  101.1  0.142
  5.0   2.4   1751  4.23  6.32        0.14  0.26  9.40  0.05  0.00  0.00  4.23  6.00         0.102  107.3  0.161
  6.0   1.4   1943  3.03  4.54        0.14  0.26  9.40  0.05  0.00  0.00  3.06  4.23         0.135  107.3  0.183
  7.0   0.4   1793  4.49  8.20        0.14  0.26  9.40  0.05  0.00  0.00  4.41  7.88         0.167  113.6  0.206
  8.0  -0.6   2335  5.90  9.60        0.14  0.26  9.40  0.05  0.00  0.00  5.82  9.34         0.199  113.6  0.231
  9.0  -1.6   2514  5.74  8.77        0.14  0.26  9.40  0.05  0.00  0.00  5.69  8.46         0.231  113.6  0.255
 10.0  -2.6   2849  5.59  8.30        0.14  0.26  9.40  0.05  0.00  0.00  5.55  7.99         0.264  113.6  0.280
 11.0  -3.6   3292  5.01  7.78        0.14  0.26  9.40  0.05  0.00  0.00  4.98  7.46         0.295  113.6  0.304
 12.0  -4.6   3793  4.18  6.73        0.14  0.26  9.40  0.05  0.00  0.00  4.16  6.42         0.328  113.6  0.329
 13.0  -5.6   4145  4.85 10.02        0.14  0.26  9.40  0.05  0.00  0.00  4.70  9.76         0.360  113.6  0.353
 14.0  -6.6   4573  5.74  8.56        0.14  0.26  9.40  0.05  0.00  0.00  5.70  8.25         0.393  113.6  0.378
 15.0  -7.6   4236  7.05 10.23        0.14  0.26  9.40  0.05  0.00  0.00  6.98  9.97         0.424  113.6  0.402
 16.0  -8.6   4328  6.21  8.82        0.14  0.26  9.40  0.05  0.00  0.00  6.18  8.51         0.457  113.6  0.427
 17.0  -9.6   8652  8.35 20.88        0.14  0.26  9.40  0.05  0.00  0.00  7.83 20.62         0.489  122.3  0.453
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                         SNDG. NO. : WD-5
F&ME Consultants                                                         Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                          FILE NO. :G4067
LOCATION: Off-Set to Boring WB-5
SNDG.BY : Ricky Wessinger                                                SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                                 ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                   LO RANGE  =  9.40 TSF
                                       ROD DIAM.  =  1.75 IN    BL.THICK.  =  0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.05 TSF
                                       FR.RED.DIA. =  2.11 IN   BL.WIDTH   =  3.78 IN    PHI FACTOR = 1
WATER DEPTH =   1.8 FT
                   HI  GAGE 0 =  0.00 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                             DELTA-A    =  0.14 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                        DELTA / PHI =  0.5       DELTA - B =  0.26 TSF   M FACTOR = 1
MAX SU ID   =   1.0    SU OPTION  =    0     MIN PHI ID  =  1.2       OCR OPTION =    0      KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI    1 M = 3.2808 FT


  Z   ELEV    KD    ID    UD    ED     KO     SU     QD     PHI   SIGFF   PHIO    PC    OCR     M     SOIL TYPE
(FT)  (FT)               (TSF)        (TSF)  (TSF)  (DEG)  (TSF)  (DEG)  (TSF)         (TSF)
***** ****** ***** ***** ***** ****** ***** ***** ***** ***** ****** ***** ***** ***** ****** ************
  1.0   6.4  30.88 1.76         101                                                          362  SANDY SILT
  2.0   5.4  13.22 2.22         103   1.62          20.1   42.6    0.17   38.3   1.90   18.7   286  SILTY SAND
  3.0   4.4  14.90 0.49          31   2.34   0.33                                2.82   22.9    90  SILTY CLAY
  4.0   3.4  17.92 0.29          25   2.61   0.48                                4.33   30.6    78  CLAY
  5.0   2.4  25.59 0.43          62   3.19   0.86                                8.59   53.3   209  SILTY CLAY
  6.0   1.4  15.96 0.40          41   2.44   0.54                                4.67   25.5   120  SILTY CLAY
  7.0   0.4  20.62 0.82         120   2.83   0.84                                7.83   38.1   384  CLAYEY SILT
  8.0  -0.6  24.35 0.63         122   3.11   1.16                               11.38   49.3   409  CLAYEY SILT
  9.0  -1.6  21.44 0.51          96   2.89   1.09                               10.31   40.5   309  SILTY CLAY
 10.0  -2.6  18.91 0.46          85   2.69   1.02                                9.30   33.3   262  SILTY CLAY
 11.0  -3.6  15.40 0.53          87   2.39   0.86                                7.34   24.2   252  SILTY CLAY
 12.0  -4.6  11.63 0.59          78   2.02   0.66                                5.13   15.6   208  SILTY CLAY
 13.0  -5.6  12.29 1.17         175   2.09                                       5.99   17.0   474  SILT
 14.0  -6.6  14.05 0.48          89   2.26   0.95                                7.91   20.9   250  SILTY CLAY
 15.0  -7.6  16.33 0.45         103   2.47   1.22                               10.64   26.5   307  SILTY CLAY
 16.0  -8.6  13.41 0.41          80   2.20   1.01                                8.31   19.5   224  SILTY CLAY
 17.0  -9.6  16.18 1.74         444   2.00         105.9   41.9    0.75   39.9  12.92   28.5  1312  SANDY SILT
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                        SNDG. NO. :WD-6
F&ME Consultants                                                        Page 1a
JOB FILE: SC-41 over Wando River-MSE Wall Study                         FILE NO. : G4067
LOCATION: Off-Set to Boring WB-6
SNDG.BY : Ricky Wessinger                                               SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                                ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                    LO RANGE  = 9.40 TSF
                                        ROD DIAM.  = 1.75 IN    BL.THICK.  = 0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 = 0.05 TSF
                                        FR.RED.DIA. = 2.11 IN   BL.WIDTH   = 3.78 IN    PHI FACTOR = 1
WATER DEPTH =  7.0 FT
                    HI  GAGE 0 = 0.00 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                                DELTA-A    = 0.13 TSF   OCR FACTOR = 1
SP.GR.WATER = 1.030 CAL GAGE 0 = 0.00 TSF
                                        DELTA/PHI  =  0.5       DELTA-B    = 0.23 TSF   M  FACTOR  = 1
MAX SU ID   =  1.0  SU OPTION  =   0    MIN PHI ID =  1.2       OCR OPTION =   0        K0 FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI   1 M = 3.2808 FT


  Z    ELEV  THRUST   A     B     C     DA    DB   ZMRNG ZMLO  ZMHI ZMCAL   P0    P1    P2     U0   GAMMA  SVP
 (FT)  (FT)  (LBF)  (TSF) (TSF) (TSF)  (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF) (TSF)  (TSF) (PCF)  (TSF)
***** ******  ******  ***** ***** *****  ***** *****  ***** ***** ***** *****  ***** ***** *****  ****** ****** ******

  1.0   6.4   1087  1.20  2.45        0.13  0.23  9.40  0.05  0.00  0.00  1.23  2.17         0.000  99.8  0.054
  2.0   5.4   2031  2.77  7.57        0.13  0.23  9.40  0.05  0.00  0.00  2.62  7.29         0.000 112.3  0.106
  3.0   4.4   2631  1.31  2.82        0.13  0.23  9.40  0.05  0.00  0.00  1.32  2.54         0.000  99.8  0.159
  4.0   3.4    895  1.46  2.56        0.13  0.23  9.40  0.05  0.00  0.00  1.49  2.28         0.000  99.8  0.209
  5.0   2.4   1155  1.83  3.18        0.13  0.23  9.40  0.05  0.00  0.00  1.85  2.90         0.000  99.8  0.259
  6.0   1.4   1574  2.51  4.75        0.13  0.23  9.40  0.05  0.00  0.00  2.48  4.47         0.000 106.1  0.311
  7.0   0.4   2889  1.20  5.38        0.13  0.23  9.40  0.05  0.00  0.00  1.09  5.09         0.000 112.3  0.364
  8.0  -0.6   2467  2.66  5.32        0.13  0.23  9.40  0.05  0.00  0.00  2.62  5.04         0.032 107.3  0.387
  9.0  -1.6   1885  3.39  6.37        0.13  0.23  9.40  0.05  0.00  0.00  3.33  6.09         0.065 107.3  0.409
 10.0  -2.6   3087  3.92  6.58        0.13  0.23  9.40  0.05  0.00  0.00  3.87  6.30         0.097 113.6  0.432
 11.0  -3.6   3740  3.55  6.32        0.13  0.23  9.40  0.05  0.00  0.00  3.50  6.03         0.128 107.3  0.455
 12.0  -4.6   3947  3.18  5.59        0.13  0.23  9.40  0.05  0.00  0.00  3.15  5.30         0.162 107.3  0.477
 13.0  -5.6   4304  2.71  5.01        0.13  0.23  9.40  0.05  0.00  0.00  2.69  4.73         0.193 107.3  0.498
 14.0  -6.6   5173  2.40  4.02        0.13  0.23  9.40  0.05  0.00  0.00  2.41  3.74         0.226 107.3  0.520
 15.0  -7.6   6042  1.31  3.65        0.13  0.23  9.40  0.05  0.00  0.00  1.27  3.37         0.258 107.3  0.541
 16.0  -8.6   5519  7.26  9.03        0.13  0.23  9.40  0.05  0.00  0.00  7.26  8.75         0.290 113.6  0.565
 17.0  -9.6   5722  6.47  9.19        0.13  0.23  9.40  0.05  0.00  0.00  6.43  8.91         0.322 113.6  0.589
 18.0 -10.6   5504  6.89 10.23        0.13  0.23  9.40  0.05  0.00  0.00  6.81 10.00         0.355 113.6  0.614
 19.0 -11.6   6112  7.62 10.96        0.13  0.23  9.40  0.05  0.00  0.00  7.54 10.73         0.386 113.6  0.638
 20.0 -12.6   5376  6.79  9.81        0.13  0.23  9.40  0.05  0.00  0.00  6.72  9.58         0.419 113.6  0.663
 21.0 -13.6   5978  6.53  8.77        0.13  0.23  9.40  0.05  0.00  0.00  6.50  8.49         0.451 113.6  0.687
 22.0 -14.6   5290  5.59  7.73        0.13  0.23  9.40  0.05  0.00  0.00  5.56  7.44         0.483 113.6  0.712
 23.0 -15.6   5815  5.22  7.26        0.13  0.23  9.40  0.05  0.00  0.00  5.21  6.97         0.515 113.6  0.736
 24.0 -16.6   6031  5.32  7.10        0.13  0.23  9.40  0.05  0.00  0.00  5.32  6.82         0.548 107.3  0.759
 25.0 -17.6   6408  5.43  7.20        0.13  0.23  9.40  0.05  0.00  0.00  5.43  6.92         0.579 113.6  0.782
 26.0 -18.6   5486  2.71  4.23        0.13  0.23  9.40  0.05  0.00  0.00  2.72  3.95         0.612 107.3  0.805
 27.0 -19.6   6551  5.38  7.99        0.13  0.23  9.40  0.05  0.00  0.00  5.33  7.70         0.644 113.6  0.828
 28.0 -20.6   7318 10.6513.99        0.13  0.23  9.40  0.05  0.00  0.00 10.6313.76         0.677 119.2  0.854
 29.0 -21.6   7704 10.4413.78        0.13  0.23  9.40  0.05  0.00  0.00 10.4213.55         0.708 119.2  0.881
 30.0 -22.6   8405 10.5413.99        0.13  0.23  9.40  0.05  0.00  0.00 10.5113.76         0.740 119.2  0.909
 31.0 -23.6   8496 10.6513.99        0.13  0.23  9.40  0.05  0.00  0.00 10.6313.76         0.773 119.2  0.936
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DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
                                                                               SNDG. NO. : WD-6
F&ME Consultants                                                               Page 2
JOB FILE: SC-41 over Wando River-MSE Wall Study                                FILE NO. :G4067
LOCATION: Off-Set to Boring WB-6
SNDG.BY : Ricky Wessinger                                                      SNDG. DATE: December 30, 2004
ANAL.BY : Michael Miller                                                       ANAL. DATE: January 26, 2005

ANALYSIS PARAMETERS:
                    LO RANGE  = 9.40 TSF
                                            ROD DIAM.  = 1.75 IN   BL.THICK.  = 0.59 IN    SU  FACTOR = 1
SURF.ELEV.  =  7.4 FTLO  GAGE 0 =  0.05 TSF
                                            FR.RED.DIA. = 2.11 IN   BL.WIDTH   = 3.78 IN    PHI FACTOR = 1
WATER DEPTH =  7.0 FT
                    HI  GAGE 0 =  0.00 TSF LIN.ROD WT. =  4.2 LBF/FT
                                                                   DELTA-A    = 0.13 TSF    OCR FACTOR = 1
SP.GR.WATER = 1.030  CAL GAGE 0 =  0.00 TSF;
                                            DELTA / PHI =  0.5     DELTA - B = 0.23 TSF    M FACTOR = 1
MAX SU ID   =  1.0    SU OPTION  =    0     MIN PHI ID  =  1.2      OCR OPTION =    0      KO FACTOR  = 1
UNIT CONVERSIONS:  1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI   1 M = 3.2808 FT


  Z   ELEV   KD    ID   UD    ED     KO    SU    QD    PHI  SIGFF  PHIO   PC    OCR     M    SOIL TYPE
(FT)  (FT)             (TSF)        (TSF) (TSF) (DEG) (TSF)  (DEG) (TSF)       (TSF)
***** ****** ***** ***** ***** ****** ***** ***** ***** ***** ****** ***** ***** ***** ****** ************
  1.0    6.4  22.77 0.77          32   2.99  0.25                              2.40   44.4    108  CLAYEY SILT
  2.0    5.4  24.64 1.78         162   3.07        21.3   40.5   0.18   36.0  7.28   68.5    544  SANDY SILT
  3.0    4.4   8.33 0.92          42   1.64  0.21                              1.47    9.3     98  SILT
  4.0    3.4   7.16 0.52          27   1.48  0.23                              1.52    7.3     58  SILTY CLAY
  5.0    2.4   7.16 0.57          37   1.48  0.28                              1.89    7.3     78  SILTY CLAY
  6.0    1.4   7.99 0.80          69   1.60  0.39                              2.69    8.7    157  CLAYEY SILT
  7.0    0.4   2.97 3.71         139   0.42        42.3   41.7   0.61   39.4  0.45    1.2    201  SAND
  8.0   -0.6   6.67 0.94          85   1.42  0.39                              2.54    6.5    176  SILT
  9.0   -1.6   8.00 0.84          95   1.60  0.51                              3.55    8.7    217  CLAYEY SILT
 10.0   -2.6   8.73 0.64          85   1.69  0.61                              4.31   10.0    198  CLAYEY SILT
 11.0   -3.6   7.41 0.75          88   1.52  0.51                              3.52    7.7    193  CLAYEY SILT
 12.0   -4.6   6.28 0.72          74   1.36  0.44                              2.84    6.0    151  CLAYEY SILT
 13.0   -5.6   5.01 0.82          71   1.16  0.34                              2.09    4.2    127  CLAYEY SILT
 14.0   -6.6   4.20 0.61          46   1.02  0.29                              1.66    3.2     74  CLAYEY SILT
 15.0   -7.6   1.89 2.05          73   0.11        93.1   45.2   0.93   43.7  0.06    0.1     69  SILTY SAND
 16.0   -8.6  12.35 0.21          52   2.09  1.21                              9.66   17.1    140  CLAY
 17.0   -9.6  10.38 0.41          86   1.88  1.01                              7.67   13.0    218  SILTY CLAY
 18.0  -10.6  10.53 0.49         111   1.90  1.08                              8.18   13.3    282  SILTY CLAY
 19.0  -11.6  11.22 0.45         111   1.98  1.21                              9.40   14.7    289  SILTY CLAY
 20.0  -12.6   9.51 0.45          99   1.78  1.02                              7.55   11.4    243  SILTY CLAY
 21.0  -13.6   8.81 0.33          69   1.70  0.96                              6.94   10.1    163  CLAY
 22.0  -14.6   7.15 0.37          65   1.48  0.77                              5.19    7.3    140  SILTY CLAY
 23.0  -15.6   6.38 0.38          62   1.37  0.69                              4.49    6.1    125  SILTY CLAY
 24.0  -16.6   6.29 0.31          52   1.36  0.70                              4.54    6.0    104  CLAY
 25.0  -17.6   6.20 0.31          52   1.35  0.71                              4.57    5.8    104  CLAY
 26.0  -18.6   2.63 0.57          42   0.70  0.25                              1.23    1.5     48  SILTY CLAY
 27.0  -19.6   5.67 0.50          82   1.27  0.67                              4.21    5.1    158  SILTY CLAY
 28.0  -20.6  11.64 0.32         109   2.02  1.70                             13.34   15.6    288  CLAY
 29.0  -21.6  11.01 0.32         109   1.95  1.64                             12.62   14.3    282  CLAY
 30.0  -22.6  10.76 0.33         113   1.92  1.64                             12.54   13.8    289  CLAY
 31.0  -23.6  10.52 0.32         109   1.90  1.64                             12.48   13.3    277  CLAY
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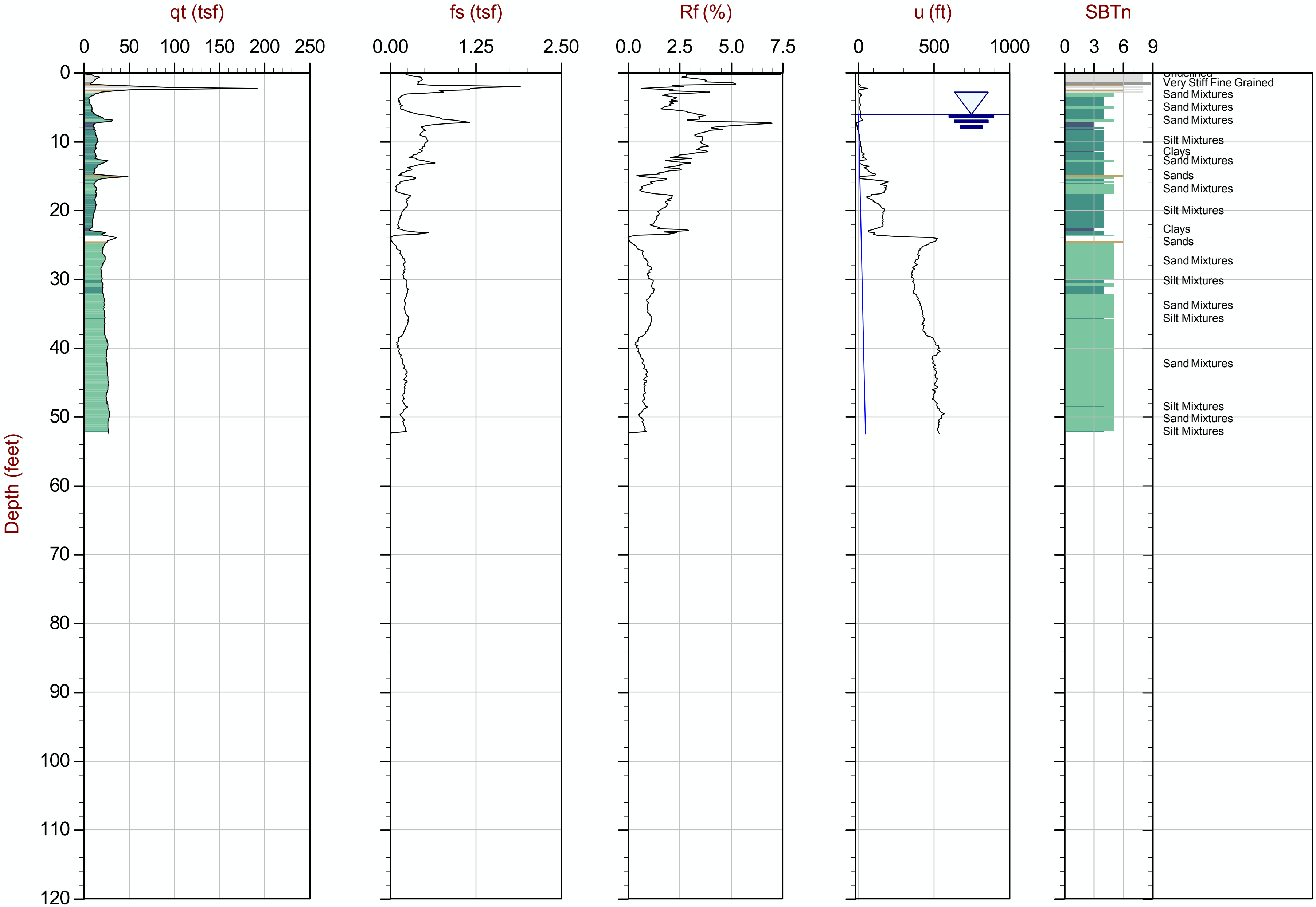
CPTu Plots

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 16:18
Site: SC 41 Replacement Bridge

Sounding: CPT-1
Cone: 214:T1500F15U500



Max Depth: 16.000 m / 52.49 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP01.COR
Unit Wt: SBT Chart Soil Zones

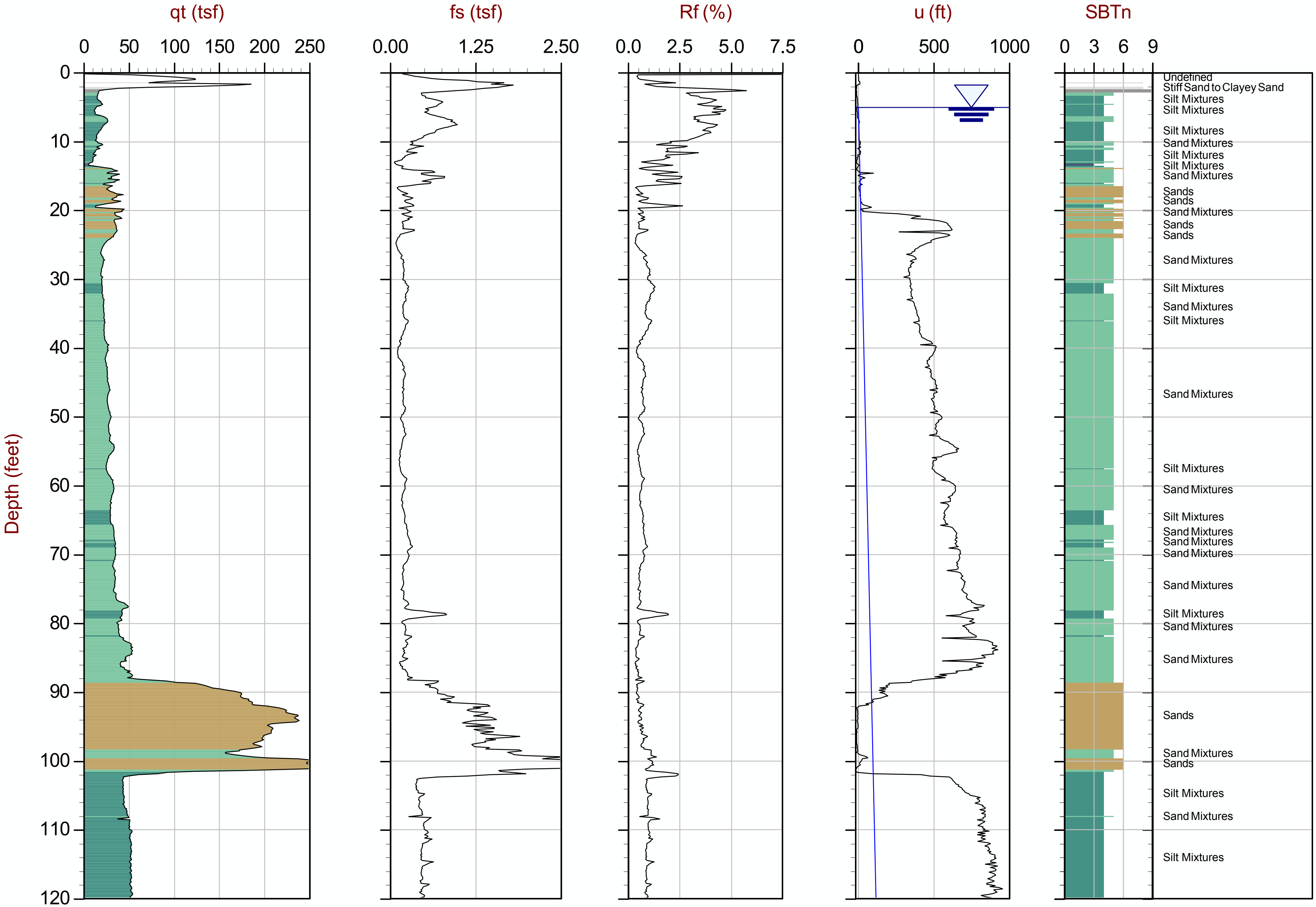
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92143 Long: -79.82807
Page No: 1 of 1

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

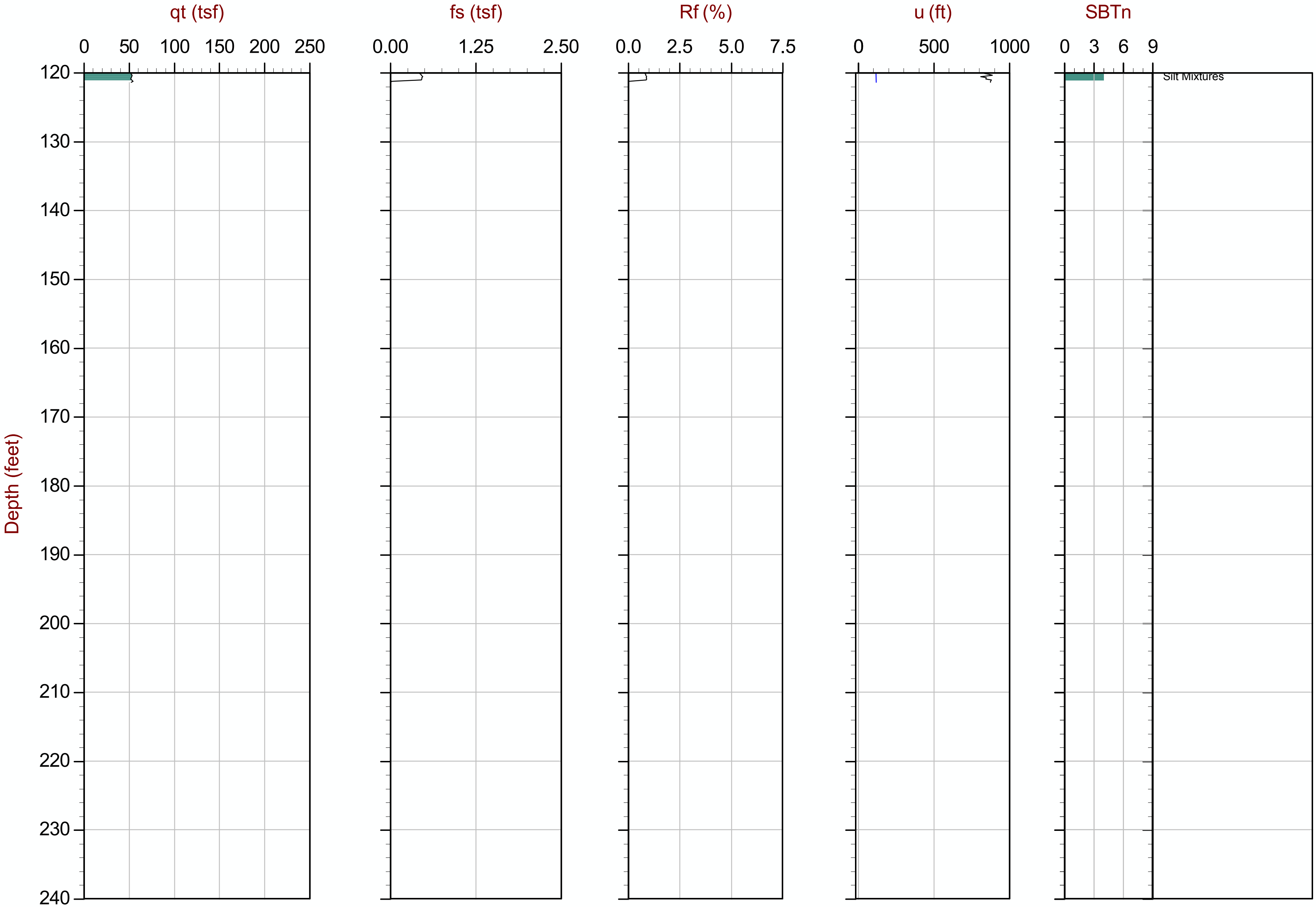
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 1 of 2

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

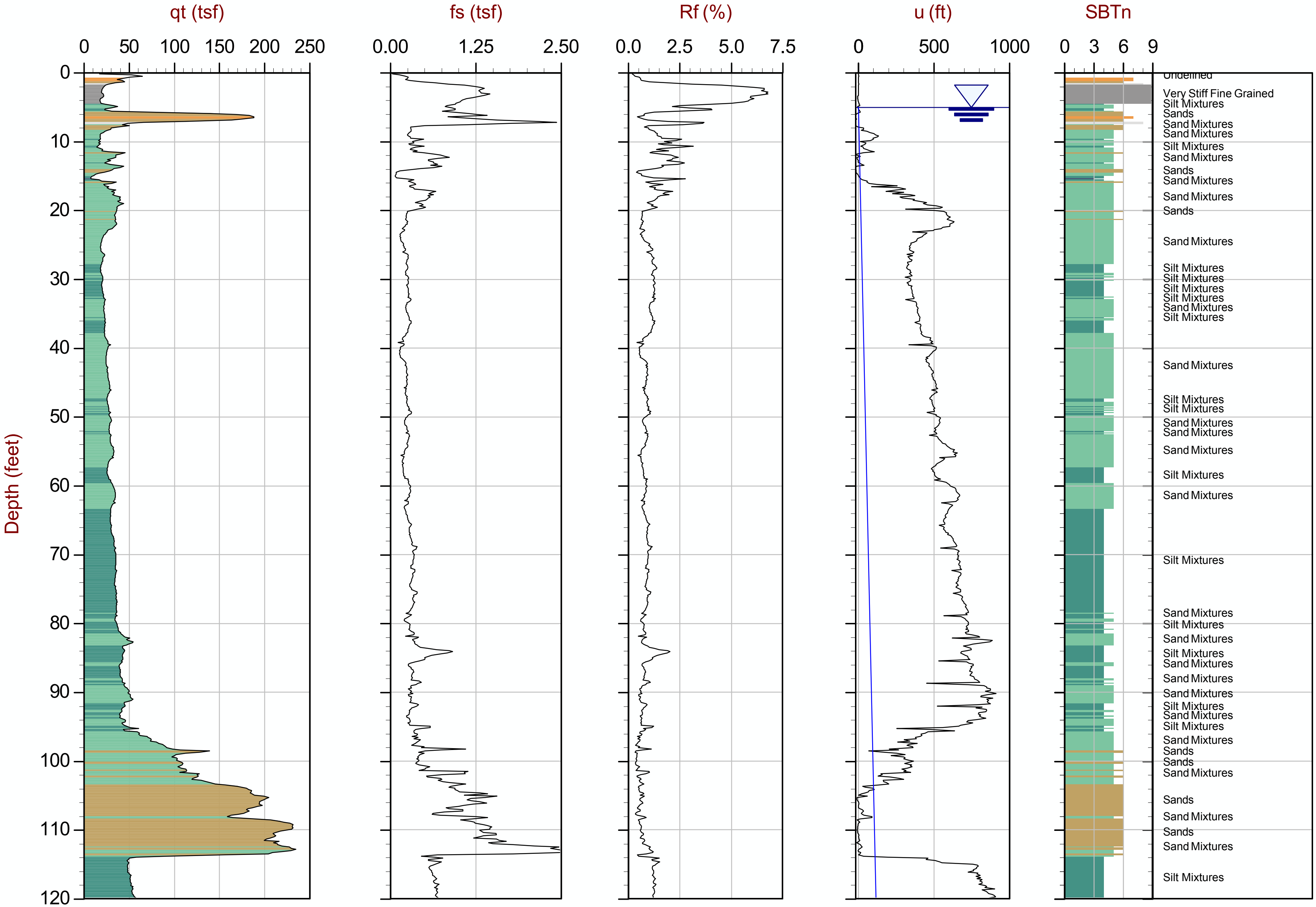
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 2 of 2

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 10:56
Site: SC 41 Replacement Bridge

Sounding: CPT-3
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

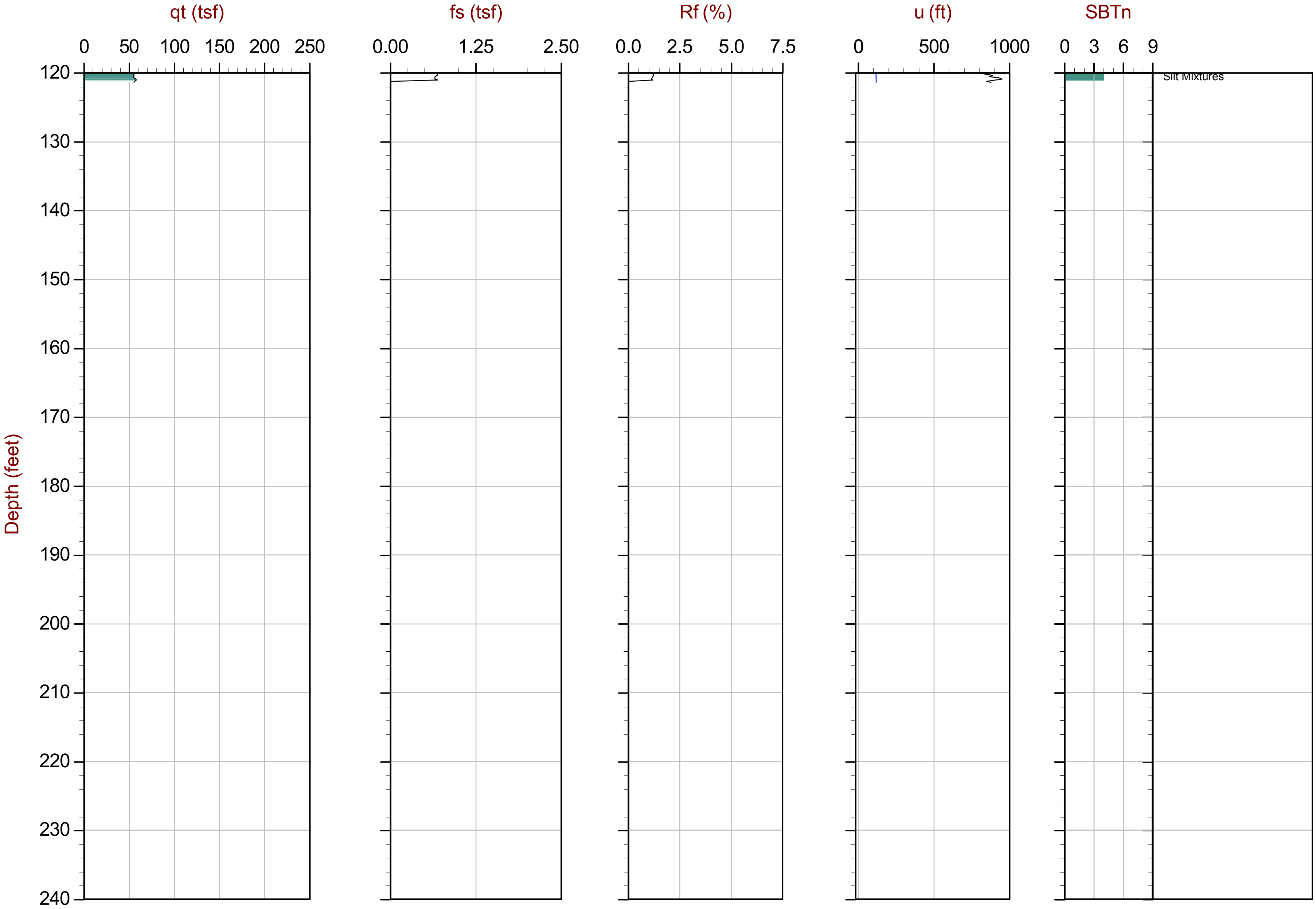
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 1 of 2

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 10:56
Site: SC 41 Replacement Bridge

Sounding: CPT-3
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

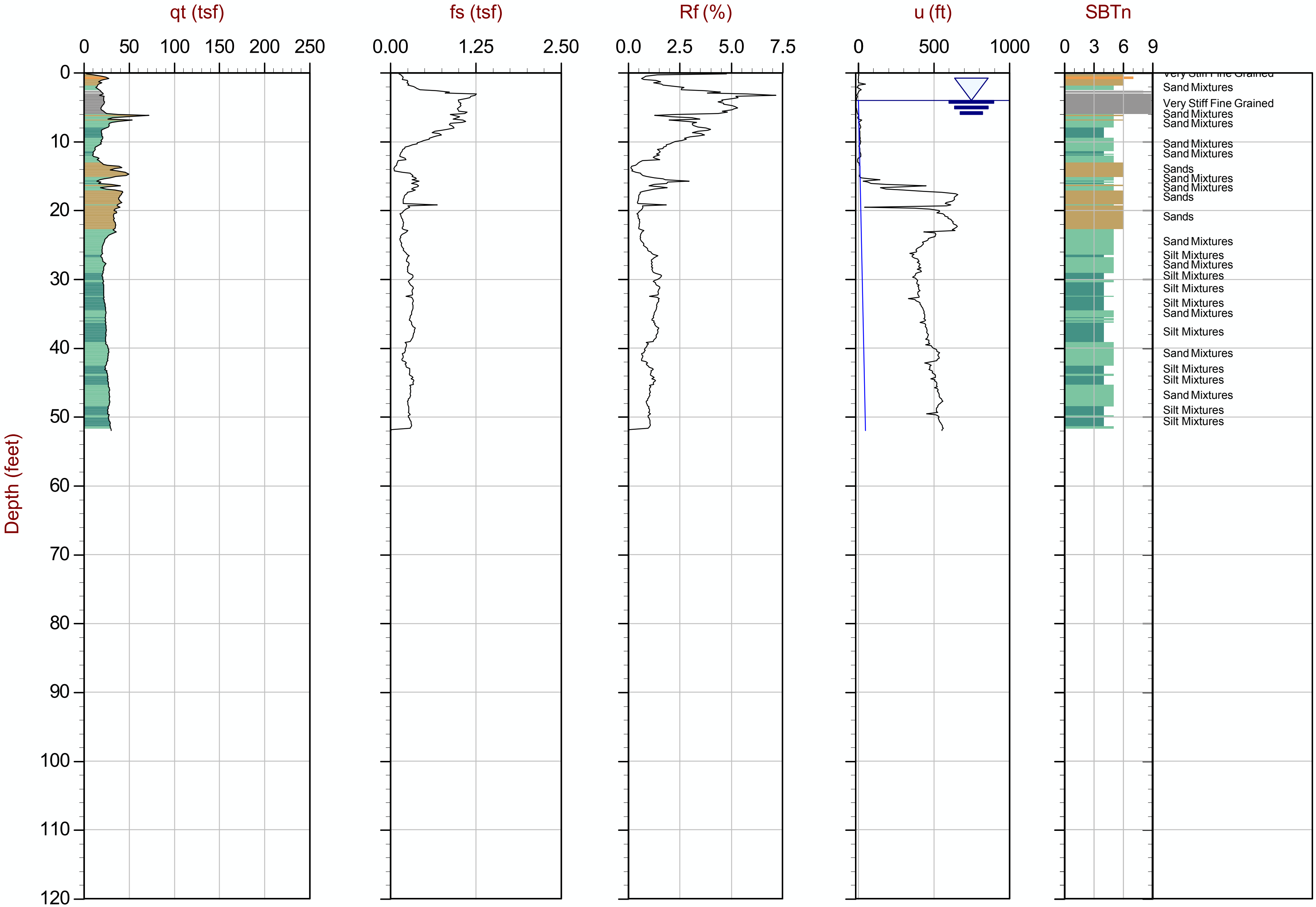
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 2 of 2

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 09:20
Site: SC-41 Bridge Replacement

Sounding: CPT-4
Cone: 184:T1500F15U500



Max Depth: 15.850 m / 52.00 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

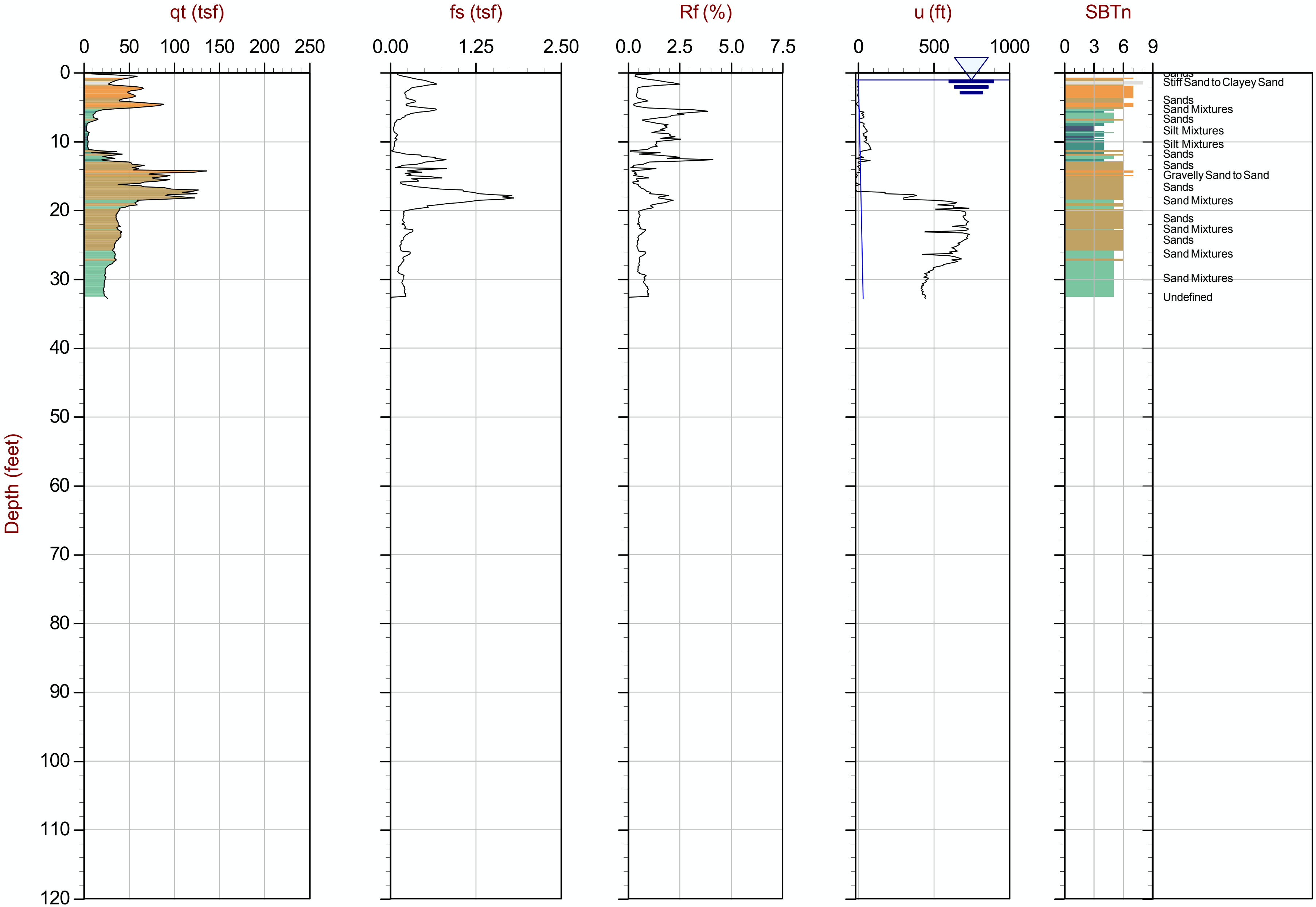
File: 920CP04.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 32.927 E: -79.822
Page No: 1 of 1

F&ME

Job No: 11-920
Date: 03:08:11 12:08
Site: SC-41 Bridge Replacement

Sounding: CPT-5
Cone: 184:T1500F15U500



Max Depth: 10.000 m / 32.81 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP05.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.93186 Long: -79.82088
Page No: 1 of 1

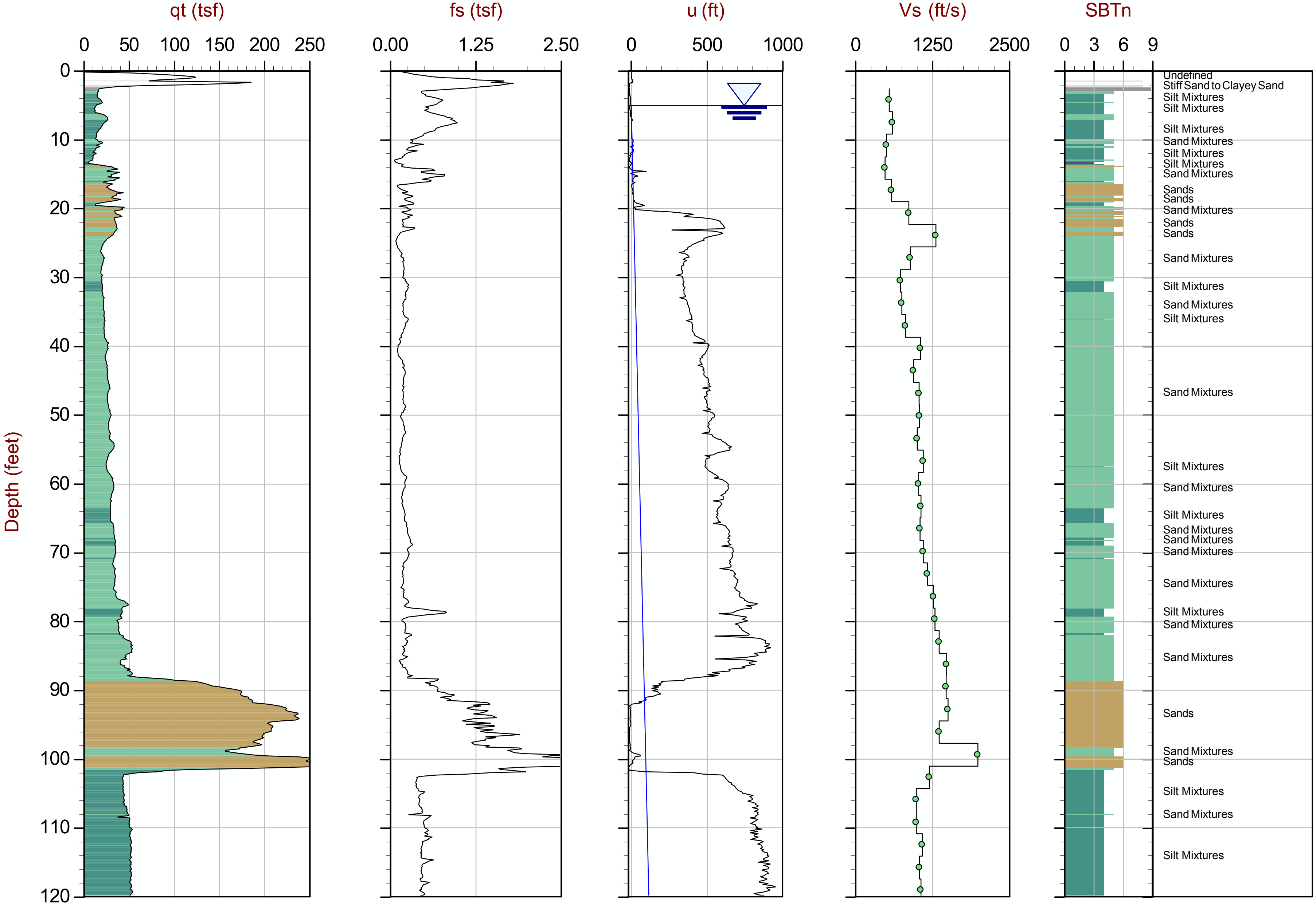
Shear Wave Data and Velocity Estimates

CONETEC

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500



Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

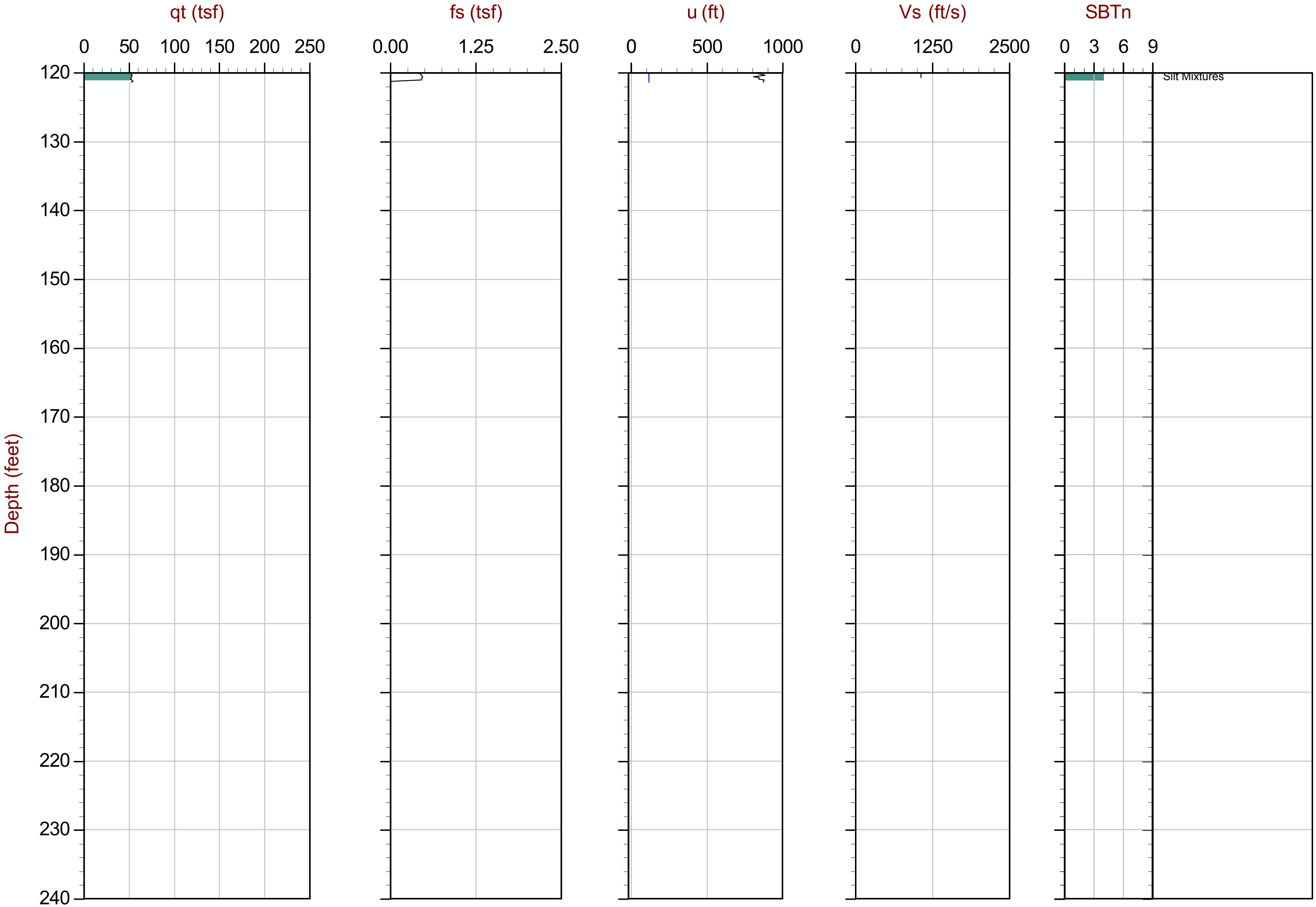
File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 1 of 2

F&ME

Job No: 11-920
Date: 03:08:11 13:54
Site: SC 41 Replacement Bridge

Sounding: CPT-2
Cone: 214:T1500F15U500

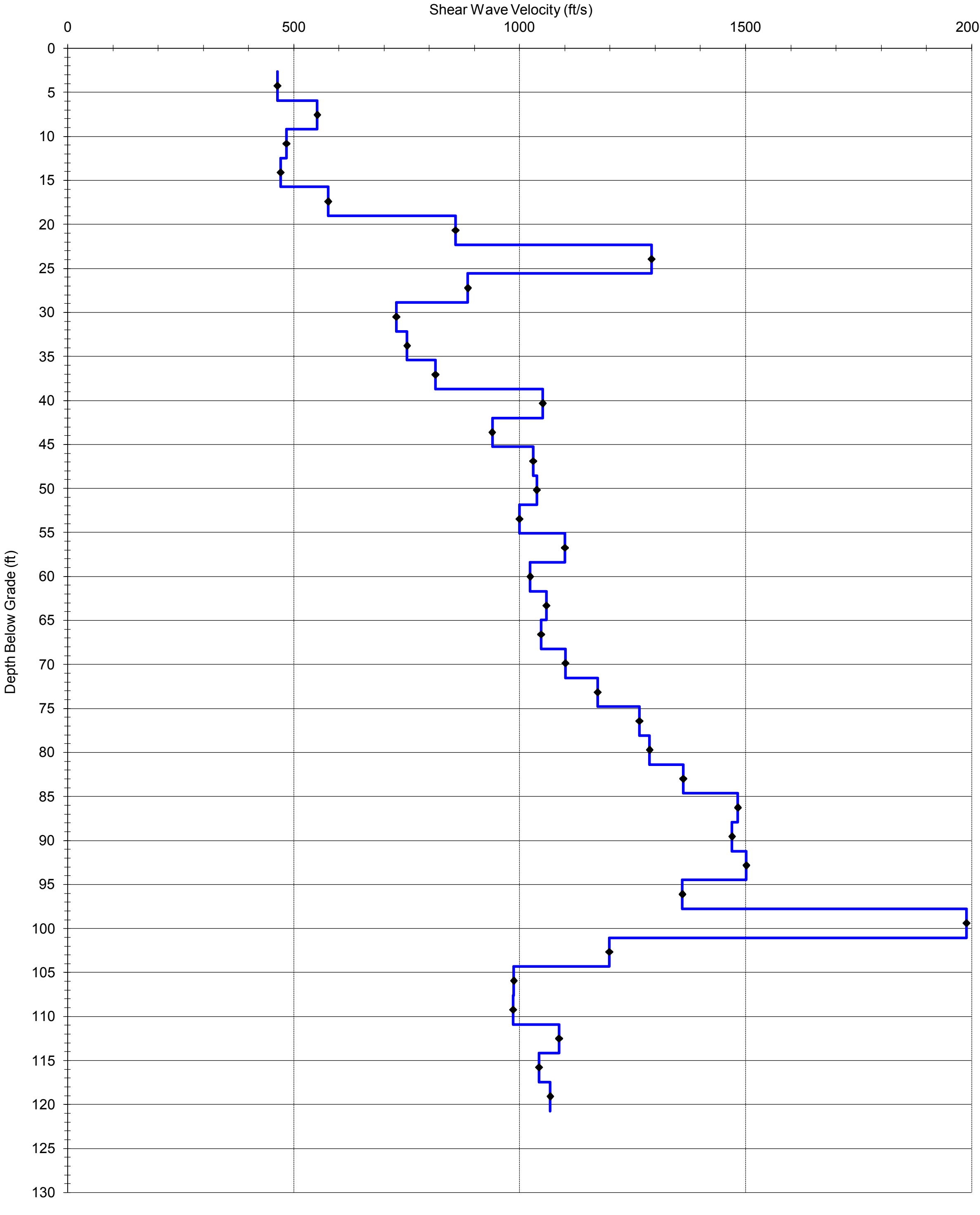


Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92202 Long: -79.82738
Page No: 2 of 2

Shear Wave Velocity- CPT-2
SC-41 Replacement Bridge
11-920
March 8 2011



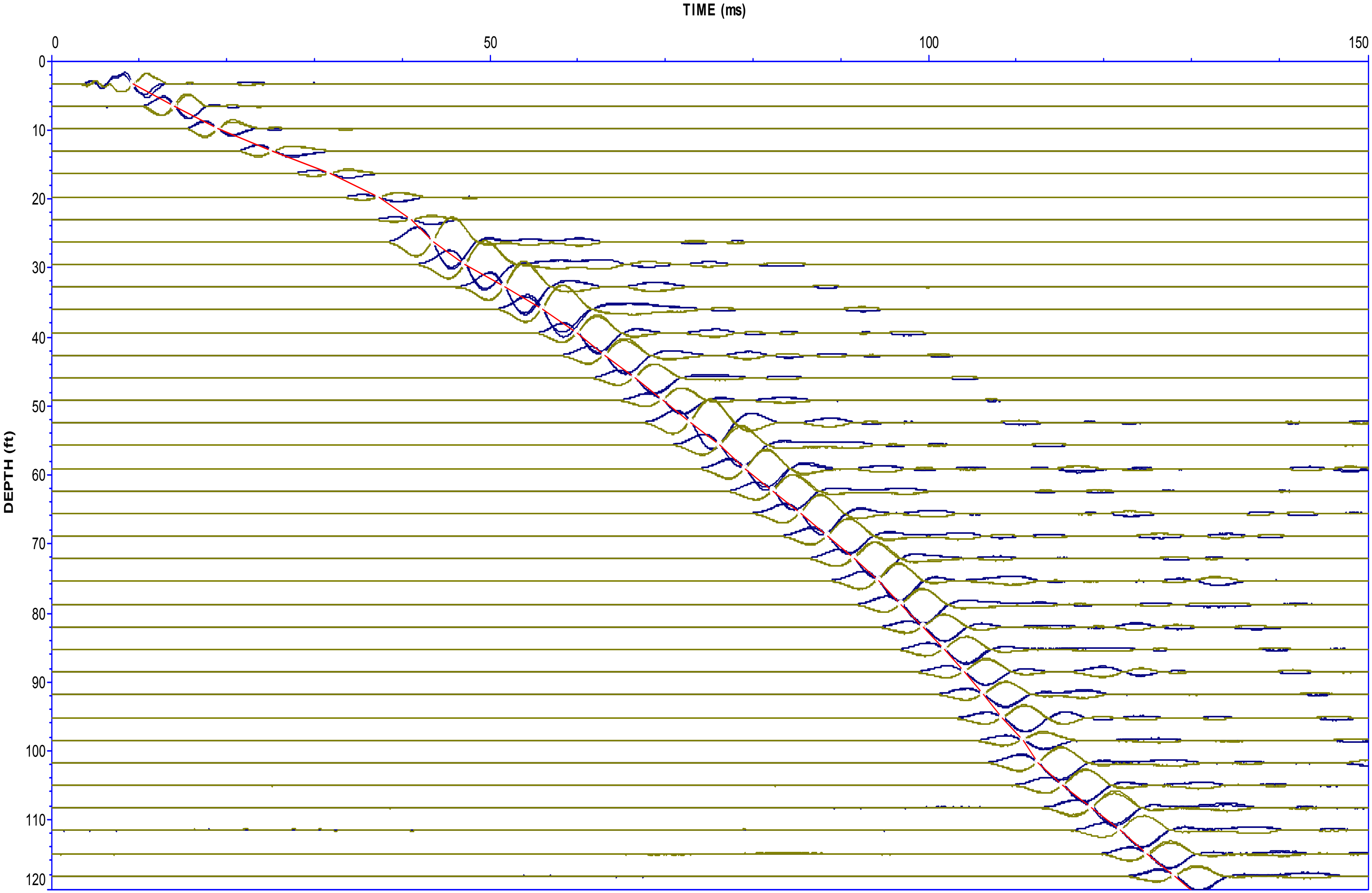
ConeTec Shear Wave Velocity Data Reduction Sheet

Hole: CPT-2
Location: SC-41 Replacement Bridge
Cone: AD214
Date: 8-Mar-11
Source: Beam

Source Depth 0.00 m
Source Offset 1.45 m

Tip Depth (m)	Geophone Depth(m)	Travel Path (m)	Interval time (ms)	Velocity (m/s)	Velocity (ft/s)	Interval Depth (m)	Interval Depth (ft)
0.00							
1.00	0.80	1.66					
2.00	1.80	2.31	4.63	141.5	464.3	1.30	4.27
3.00	2.80	3.15	5.00	168.4	552.4	2.30	7.55
4.00	3.80	4.07	6.20	147.4	483.7	3.30	10.83
5.00	4.80	5.01	6.60	143.6	471.1	4.30	14.11
6.00	5.80	5.98	5.49	175.8	576.7	5.30	17.39
7.00	6.80	6.95	3.73	261.4	857.8	6.30	20.67
8.00	7.80	7.93	2.49	393.7	1291.7	7.30	23.95
9.00	8.80	8.92	3.65	269.9	885.6	8.30	27.23
10.00	9.80	9.91	4.46	221.6	727.2	9.30	30.51
11.00	10.80	10.90	4.33	228.9	751.1	10.30	33.79
12.00	11.80	11.89	4.00	247.9	813.3	11.30	37.07
13.00	12.80	12.88	3.10	320.4	1051.3	12.30	40.35
14.00	13.80	13.88	3.47	286.3	939.4	13.30	43.63
15.00	14.80	14.87	3.17	313.8	1029.6	14.30	46.92
16.00	15.80	15.87	3.15	316.3	1037.7	15.30	50.20
17.00	16.80	16.86	3.27	304.6	999.3	16.30	53.48
18.00	17.80	17.86	2.97	335.3	1100.1	17.30	56.76
19.00	18.80	18.86	3.20	311.9	1023.3	18.30	60.04
20.00	19.80	19.85	3.09	322.8	1059.0	19.30	63.32
21.00	20.80	20.85	3.12	319.3	1047.7	20.30	66.60
22.00	21.80	21.85	2.97	335.5	1100.8	21.30	69.88
23.00	22.80	22.85	2.79	357.3	1172.3	22.30	73.16
24.00	23.80	23.84	2.59	385.5	1264.6	23.30	76.44
25.00	24.80	24.84	2.54	392.5	1287.7	24.30	79.72
26.00	25.80	25.84	2.41	415.0	1361.6	25.30	83.00
27.00	26.80	26.84	2.21	452.0	1482.9	26.30	86.29
28.00	27.80	27.84	2.23	448.0	1470.0	27.30	89.57
29.00	28.80	28.84	2.18	457.6	1501.4	28.30	92.85
30.00	29.80	29.84	2.41	414.6	1360.2	29.30	96.13
31.00	30.80	30.83	1.65	606.0	1988.1	30.30	99.41
32.00	31.80	31.83	2.74	365.1	1197.9	31.30	102.69
33.00	32.80	32.83	3.32	300.9	987.2	32.30	105.97
34.00	33.80	33.83	3.33	300.3	985.2	33.30	109.25
35.00	34.80	34.83	3.02	331.2	1086.7	34.30	112.53
36.00	35.80	35.83	3.14	317.9	1042.9	35.30	115.81
37.00	36.80	36.83	3.07	325.5	1067.9	36.30	119.09

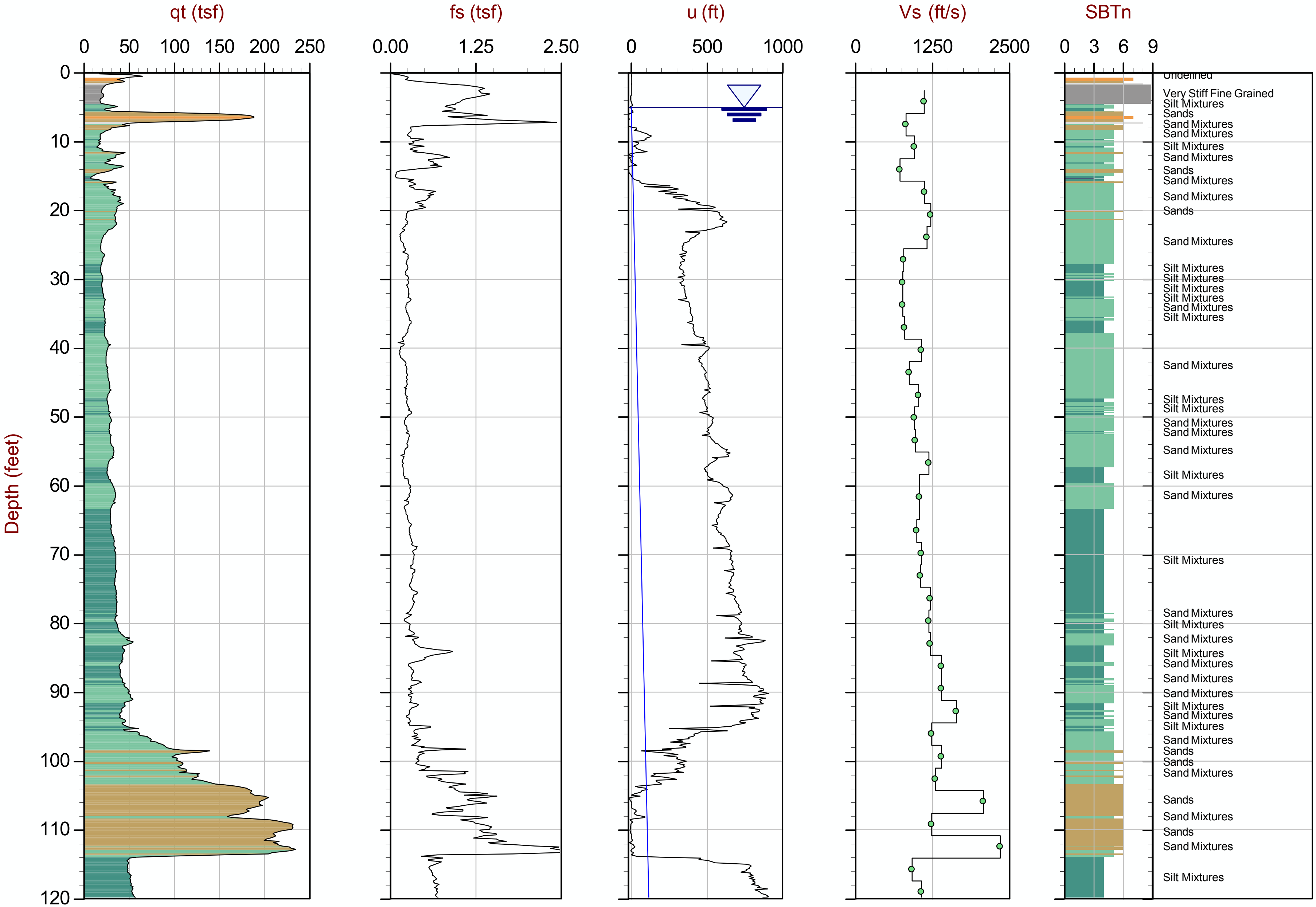
Job No: 11-920 Client: F&ME Project Title: SC-41 Replacement Bridge Operator: AS-RH Hole: CPT-2 Site: SC 41 Replaceme Date: 03:08:11 13:54
Oversite: 214:T1500F15U500



F&ME

Job No: 11-920
Date: 03:08:11 10:56
Site: SC 41 Replacement Bridge

Sounding: CPT-3
Cone: 214:T1500F15U500

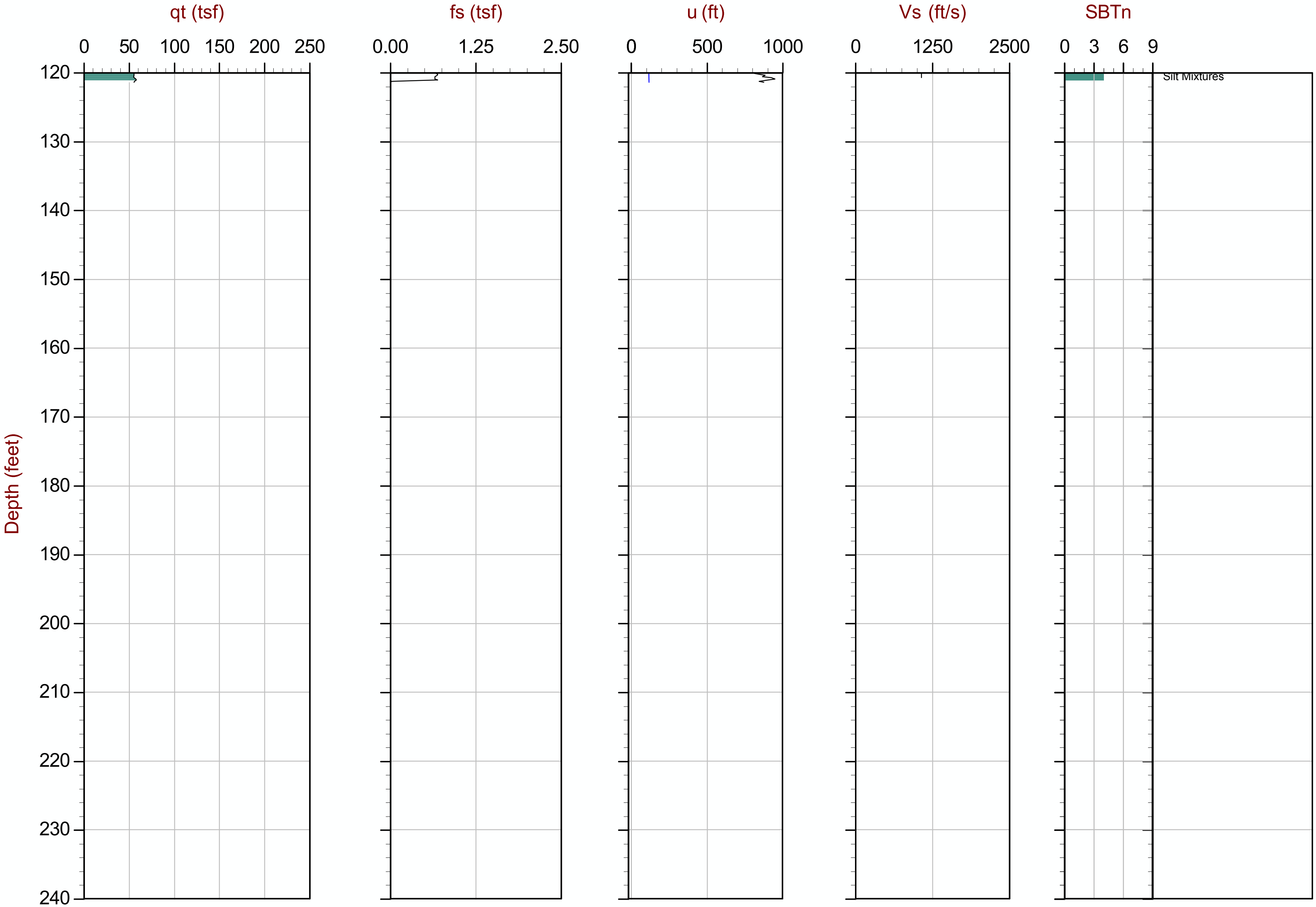


Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 1 of 2

F&ME	Job No: 11-920	Sounding: CPT-3
	Date: 03:08:11 10:56	Cone: 214:T1500F15U500
	Site: SC 41 Replacement Bridge	

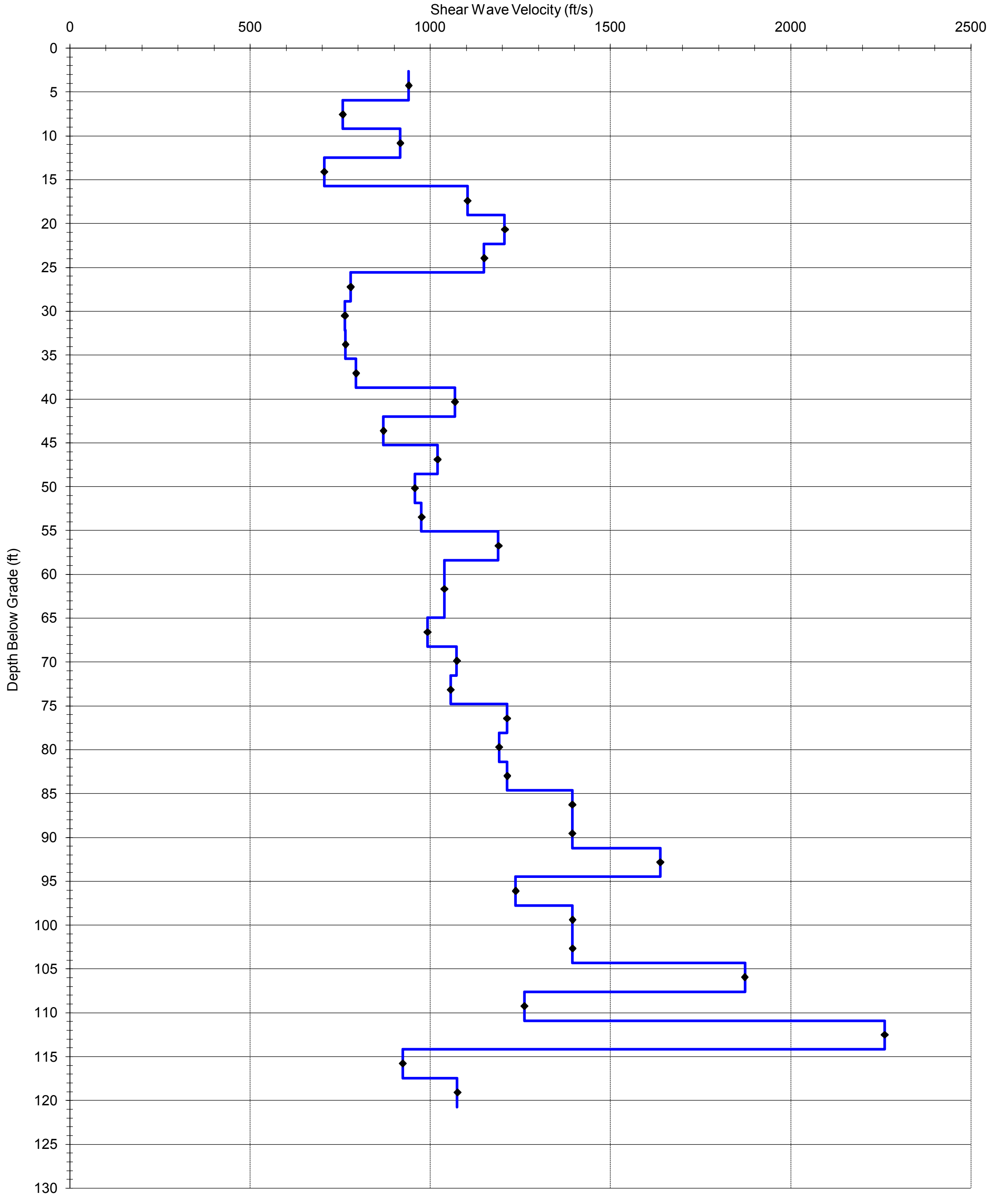


Max Depth: 37.000 m / 121.39 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 920CP03.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 32.92577 Long: -79.82300
Page No: 2 of 2

Shear Wave Velocity- CPT-3
SC-41 Replacement Bridge
11-920
March 8 2011



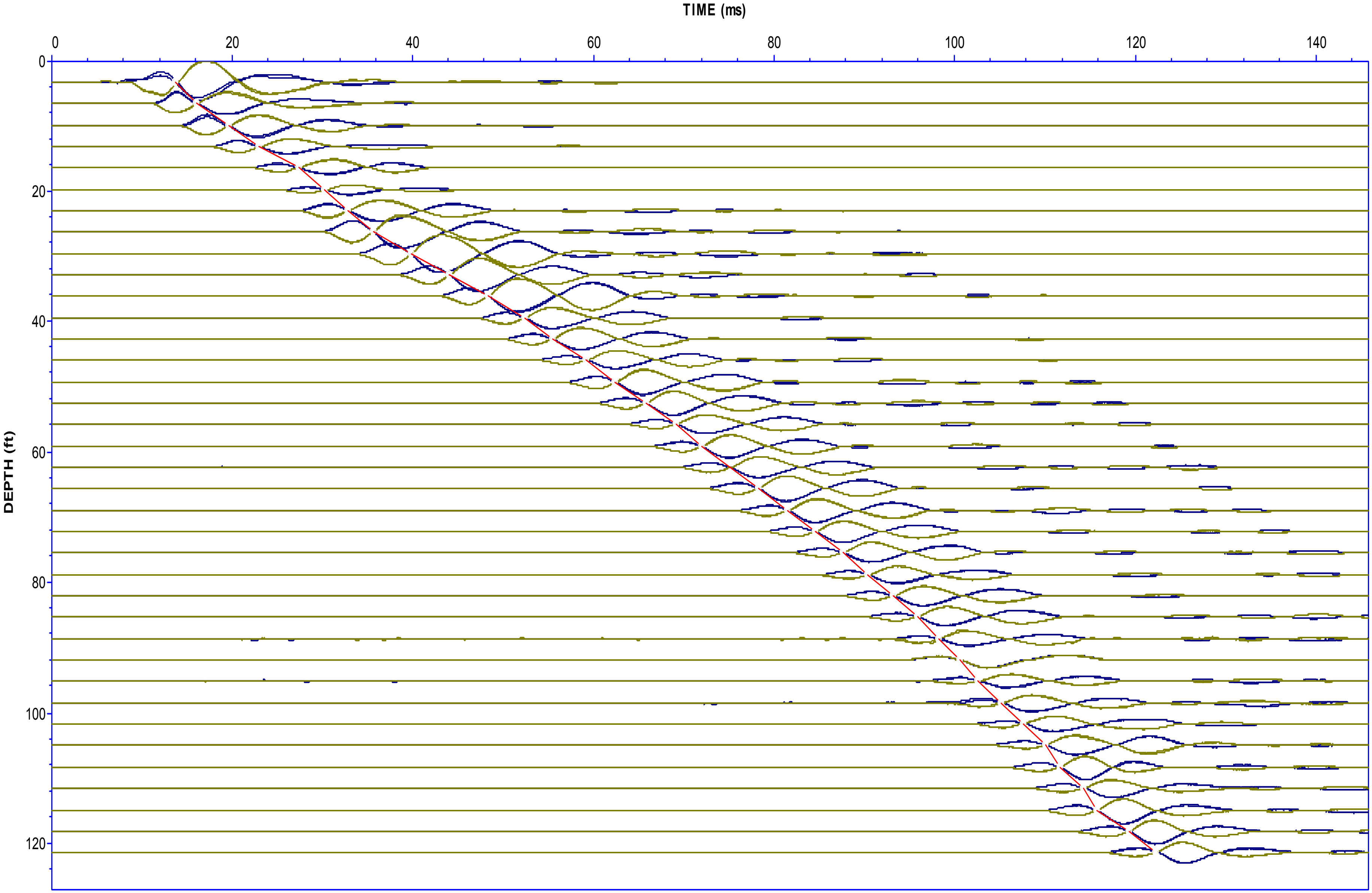
ConeTec Shear Wave Velocity Data Reduction Sheet

Hole:	CPT-3
Location:	SC-41 Replacement Bridge
Cone:	AD214
Date:	8-Mar-11
Source:	Beam

Source Depth	0.00	m
Source Offset	1.45	m

Tip Depth (m)	Geophone Depth(m)	Travel Path (m)	Interval time (ms)	Velocity (m/s)	Velocity (ft/s)	Interval Depth (m)	Interval Depth (ft)
0.00							
1.00	0.80	1.66					
2.00	1.80	2.31	2.29	286.5	939.9	1.30	4.27
3.00	2.80	3.15	3.65	230.7	756.8	2.30	7.55
4.00	3.80	4.07	3.27	279.4	916.6	3.30	10.83
5.00	4.80	5.01	4.40	215.0	705.4	4.30	14.11
6.00	5.80	5.98	2.87	336.2	1102.9	5.30	17.39
7.00	6.80	6.95	2.65	367.7	1206.3	6.30	20.67
8.00	7.80	7.93	2.80	350.3	1149.2	7.30	23.95
9.00	8.80	8.92	4.15	237.4	778.7	8.30	27.23
10.00	9.80	9.91	4.25	232.5	762.7	9.30	30.51
11.00	10.80	10.90	4.25	233.0	764.4	10.30	33.79
12.00	11.80	11.89	4.10	241.9	793.7	11.30	37.07
13.00	12.80	12.88	3.05	325.6	1068.3	12.30	40.35
14.00	13.80	13.88	3.75	265.1	869.7	13.30	43.63
15.00	14.80	14.87	3.20	310.9	1020.0	14.30	46.92
16.00	15.80	15.87	3.41	291.6	956.5	15.30	50.20
17.00	16.80	16.86	3.35	297.3	975.4	16.30	53.48
18.00	17.80	17.86	2.75	362.3	1188.8	17.30	56.76
20.00	19.80	19.85	6.30	316.5	1038.4	18.80	61.68
21.00	20.80	20.85	3.30	302.2	991.6	20.30	66.60
22.00	21.80	21.85	3.05	327.1	1073.1	21.30	69.88
23.00	22.80	22.85	3.10	321.9	1056.0	22.30	73.16
24.00	23.80	23.84	2.70	369.6	1212.7	23.30	76.44
25.00	24.80	24.84	2.75	363.0	1190.8	24.30	79.72
26.00	25.80	25.84	2.70	369.7	1213.0	25.30	83.00
27.00	26.80	26.84	2.35	424.9	1393.9	26.30	86.29
28.00	27.80	27.84	2.35	424.9	1394.0	27.30	89.57
29.00	28.80	28.84	2.00	499.3	1638.2	28.30	92.85
30.00	29.80	29.84	2.65	376.9	1236.4	29.30	96.13
31.00	30.80	30.83	2.35	425.0	1394.4	30.30	99.41
32.00	31.80	31.83	2.35	425.0	1394.5	31.30	102.69
33.00	32.80	32.83	1.75	570.8	1872.7	32.30	105.97
34.00	33.80	33.83	2.60	384.2	1260.6	33.30	109.25
35.00	34.80	34.83	1.45	689.0	2260.5	34.30	112.53
36.00	35.80	35.83	3.55	281.4	923.3	35.30	115.81
37.00	36.80	36.83	3.05	327.6	1074.8	36.30	119.09

Job No: 11-920 Client: F&ME Project Title: SC-41 Replacement Bridge Operator: AS-RH Hole: CPT-3 Site: SC 41 Replaceme Date: 03:08:11 10:56
Oversite: 214:T1500F15U500



Interpretation Methods

CONETEC INTERPRETATION METHODS

A Detailed Description of the Methods Used in ConeTec's CPT Interpretation and Plotting Software

Revision SZW-Rev 02
March 12, 2008

Prepared by Jim Greig

ConeTec Interpretations as of March 12, 2008

ConeTec's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and does not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1\text{-}a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.80 for ConeTec cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2. The Bq classification charts are not reproduced in this document but can be reviewed in Lunne, Robertson and Powell (1997) or Robertson (1990).

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". In some cases the value 0 will be used. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).
2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).
3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.
4. Where pre-requisite or intermediate interpretation calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are provided in Microsoft Excel XLS format. The ConeTec software has several options for output depending on the number or types of interpreted parameters desired. Each output file will be named using the original COR file basename followed by a three or four letter indicator of the interpretation set selected (e.g. BSC, TBL, NLI or IFI) and possibly followed by an operator selected suffix identifying the characteristics of the particular interpretation run.

Table 1
CPT Interpretation Methods

Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1 - a) \bullet u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{qt}$	$AvgRf = 100\% \bullet \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5

Interpreted Parameter	Description	Equation	Ref
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_v	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ *where* γ_i is layer unit weight h_i is layer thickness	
E. Stress σ_v'	Effective vertical overburden stress at Mid Layer Depth	*Estress = Tstress -* u_{eq}	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \bullet (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_v')^{-0.5}$ where σ_v' *is in tsf* $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \bullet N_{60}$	4
$N_{60}I_c$	SPT N_{60} values based on the Ic parameter	$(qt/pa)/ N_{60} = 8.5 (1 – Ic/4.6)$	5
$(N_1)_{60}Ic$	SPT N_{60} value corrected for overburden pressure (using N_{60} $I_{c).}$ User has 2 options.	1) $(N_1)_{60}Ic = Cn \bullet (N_{60} Ic)$ 2) $q_{c1n}/ (N_1)_{60}Ic = 8.5 (1 – Ic/4.6)$	4 5
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}$Ic. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}Ic)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}Ic)$ 3) $q_{c1ncs})/ (N_1)_{60cs}Ic = 8.5 (1 – Ic/4.6)$ FC ≤ 5%: $\alpha = 0$, $\beta=1.0$ FC ≥ 35% $\alpha = 5.0$, $\beta=1.2$ 5% < FC < 35% $\alpha = \exp[1.76 – (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ *where:* $\Delta u = u - u_{eq}$ *and u = dynamic pore pressure* u_{eq} *= equilibrium pore pressure*	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma_v'}$	2, 5

Interpreted Parameter	Description	Equation	Ref
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \bullet \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5
SBT-BQ	Non-normalized soil behavior type based on the Bq parameter	See Figure 5.7 (reference 5)	2, 5
SBT-BQn	Normalized Soil Behavior base on the Bq parameter	See Figure 5.8 (reference 5) or Figure 3 (reference 2)	2, 5
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ *Where:* $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ *And* *Fr is in percent* P_a *= atmospheric pressure* P_{a2} *= atmospheric pressure* *n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting* I_c	3, 8
FC	Apparent fines content (%)	$FC=1.75(Ic^{3.25}) - 3.7$ $FC=100$ *for* $Ic > 3.5$ $FC=0$ *for* $Ic < 1.26$ $FC = 5\%$ *if* $1.64 < Ic < 2.6$ *AND* $F_r<0.5$	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu d) Kulhawy and Mayne	See reference	5 5 5 11
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5
OCR	Over Consolidation Ratio	a) Based on Schmertmann's method involving a plot of S_u/σ_v' /($S_u/\sigma_v')_{NC}$ and OCR where the Su/p' ratio for NC clay is user selectable	9
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	8, 6, 5
Es/qt	Intermediate parameter for calculating Young's Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5

Interpreted Parameter	Description	Equation	Ref
Young's Modulus E	Young's Modulus based on the work done in Italy. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in the Es/qt chart.	Mean normal stress is evaluated from: $\sigma'_m = \frac{1}{3} \bullet \left(\sigma'_v + \sigma'_h + \sigma'_h\right)^3$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress and $\sigma_h = K_o * \sigma_v'$ with Ko assumed to be 0.5	5
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in Mpa	3
q_{c1n}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1n} = (q_{c1} / Pa)(Pa/\sigma_v')$ where: Pa = atm. Pressure and n ranges from 0.5 to 0.75 based on Ic.	3
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) * (FC - 5))$	10
K_{CPT}	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference)	10
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	3
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833\ [(q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93\ [(q_{c1ncs}/1000]^3 + 0.08$	10
CSR	Cyclic Stress Ratio	$CSR = (\tau_{av}/\sigma_v') = 0.65\ (a_{max} / g)\ (\sigma_v/ \sigma_v')\ r_d$ $r_d = 1.0 - 0.00765\ z$ $z \leq 9.15m$ $r_d = 1.174 - 0.0267\ z$ $9.15 < z \leq 23m$ $r_d = 0.744 - 0.008\ z$ $23 < z \leq 30m$ $r_d = 0.50$ $z > 30m$	10
MSF	Magnitude Scaling Factor	See Reference	10
FofS	Factor of Safety against Liquefaction	$FS = (CRR_{7.5} / CSR)\ MSF$	10
Liquefaction Status	Statement indicating possible liquefaction	Takes into account FofS and limitations based I_c and q_{c1ncs}.	10

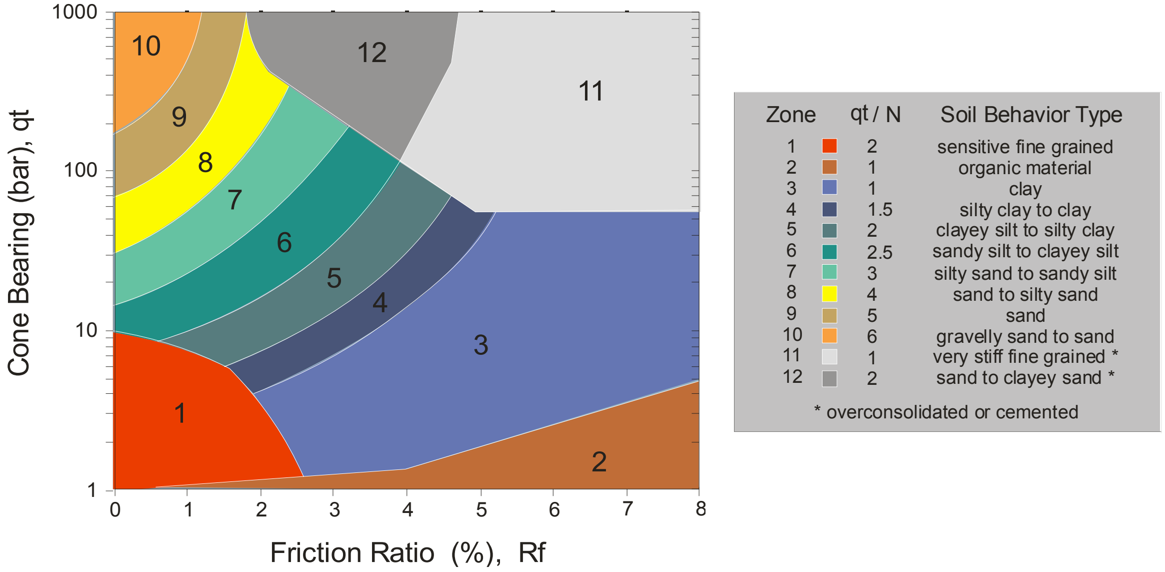


Figure 1 Non-Normalized Behavior Type Classification Chart

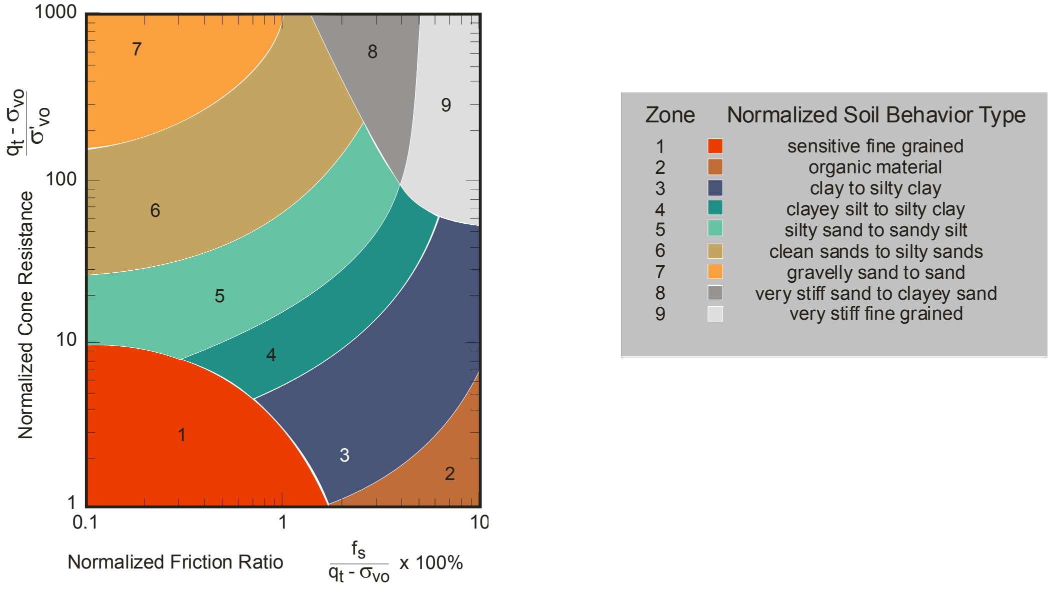
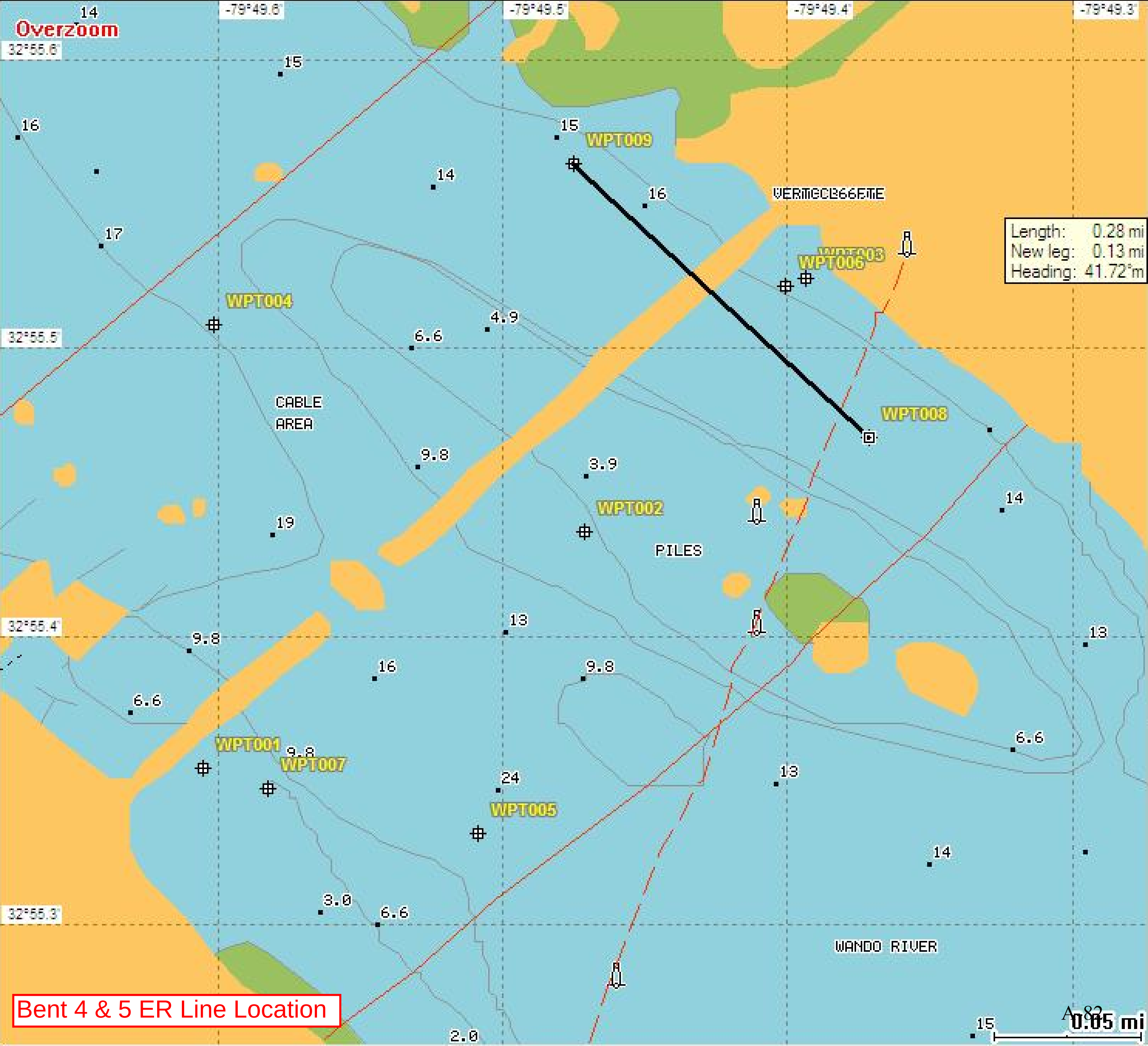


Figure 2 Normalized Behavior Type Classification Chart

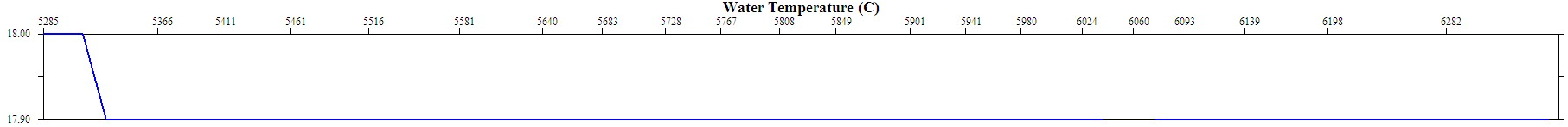
Table 2 References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, “Use of Piezometer Cone Data”, Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, “Soil Classification Using the Cone Penetration Test”, Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, “Evaluating cyclic liquefaction potential using the cone penetration test”, Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, “Cyclic Liquefaction and its Evaluation Based on SPT and CPT”, NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, “ Cone Penetration Testing in Geotechnical Practice,” Blackie Academic and Professional.
6	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, “CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility”, 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
7	Jefferies, M.G. and Davies, M.P., 1993. “Use of CPTu to Estimate equivalent N_{60}”, Geotechnical Testing Journal, 16(4): 458-467.
8	Been, K. and Jefferies, M.P., 1985, “A state parameter for sands”, Geotechnique, 35(2), 99-112.
9	Schmertmann, 1977, “Guidelines for Cone Penetration Test Performance and Design”, Federal Highway Administration Report FHWA-TS-78-209, U.S. Department of Transportation
10	Proceedings of theNCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt LakeCity, 1996. Chaired by Leslie Youd. 11
11	Kulhawy, F.H. and Mayne, P.W. ,1990, Manual on Estimating Soil Properties for Foundation Design, *Report No. EL-6800*, Electric Power Research Institute, Palo Alto, CA, August 1990, 306 p.



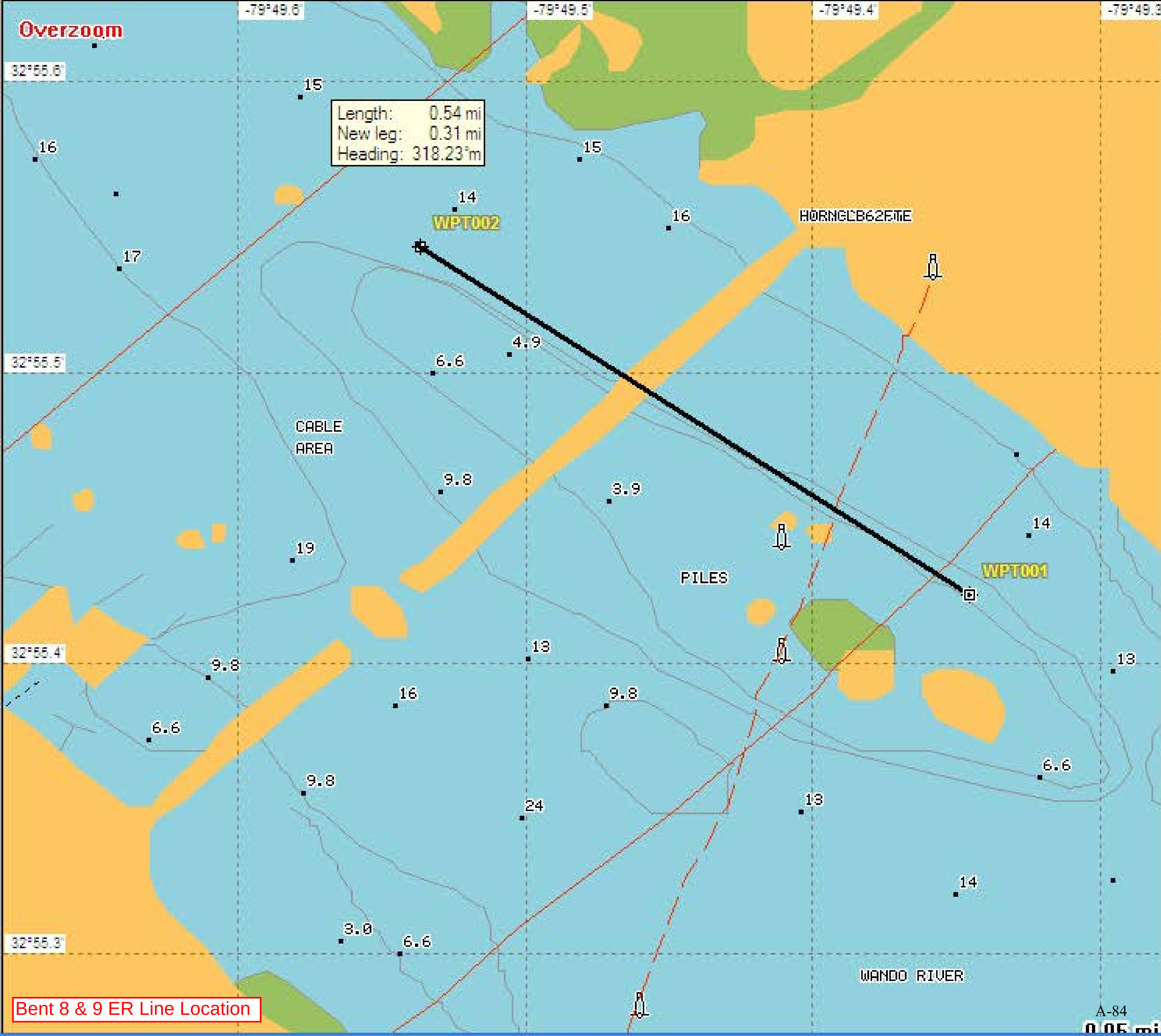
Bent 4 & 5 ER Line Location

Complete Inverted Resistivity Section



Water Temperature (C)

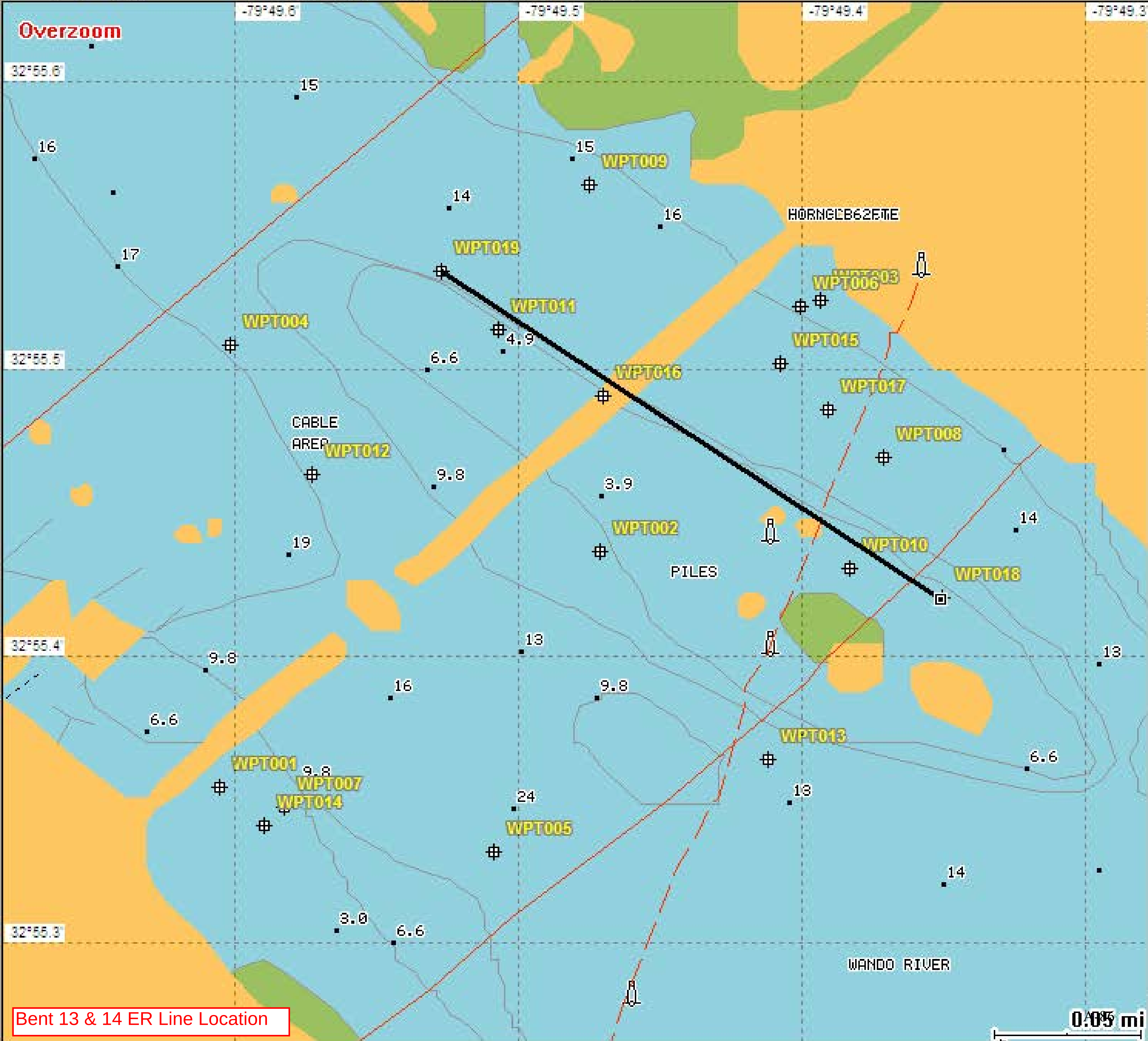
Bent 4 & 5 ER Profile



Length: 0.54 mi
New leg: 0.31 mi
Heading: 318.23°m

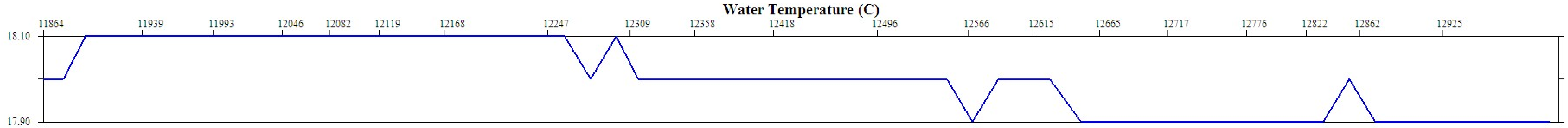
Bent 8 & 9 ER Line Location

Bent 8 & 9 ER Profile



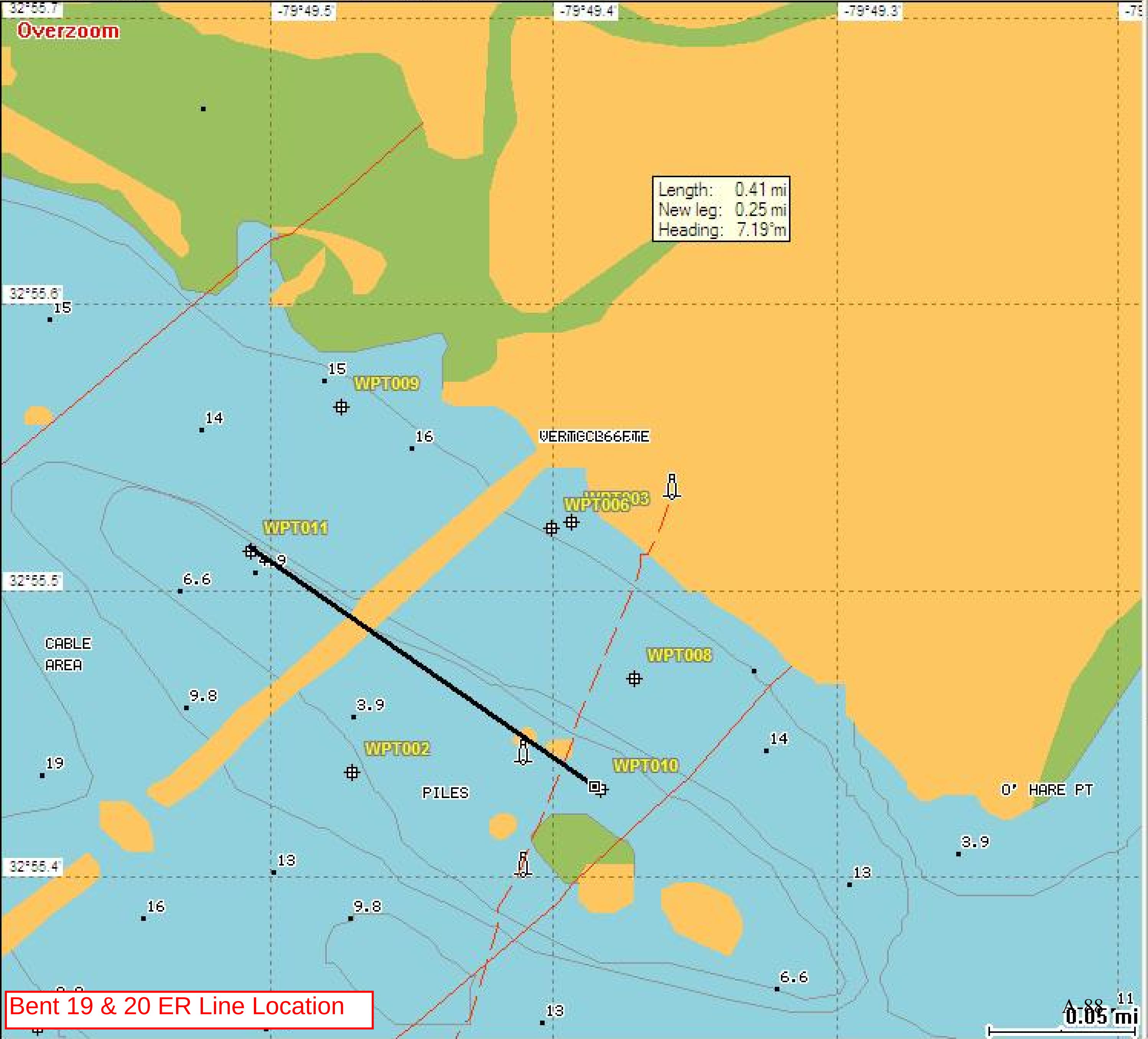
Bent 13 & 14 ER Line Location

Complete Inverted Resistivity Section



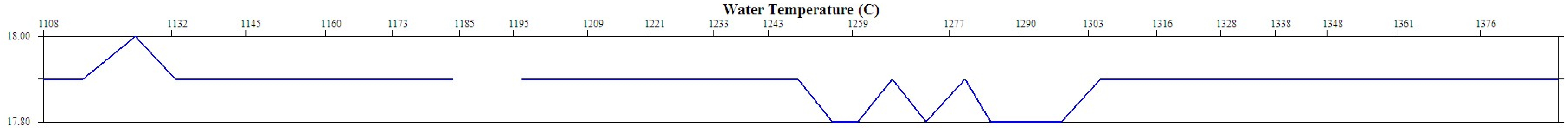
Water Temperature (C)

Bent 13 & 14 ER Profile

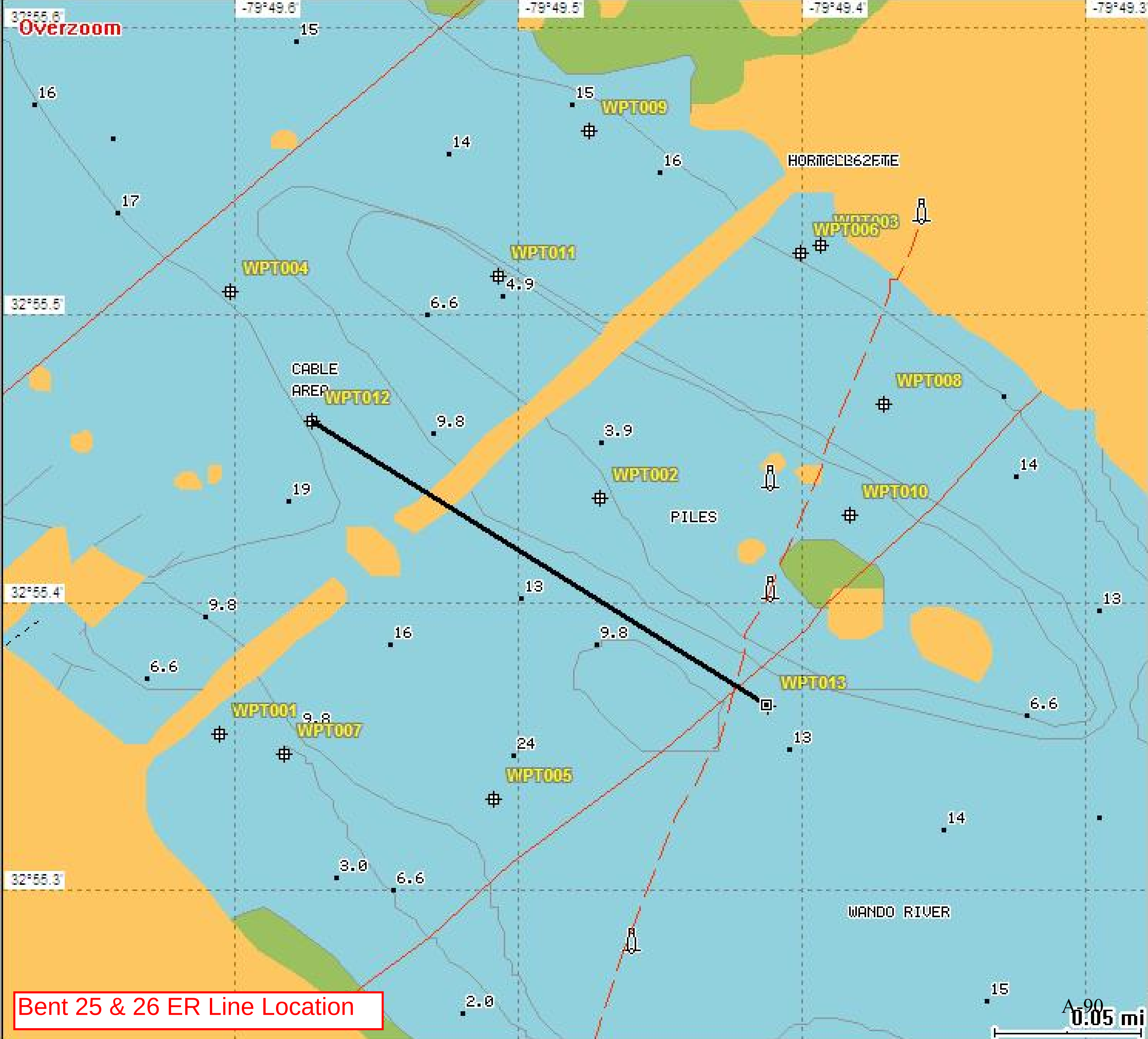


Bent 19 & 20 ER Line Location


Complete Inverted Resistivity Section


Water Temperature (C)

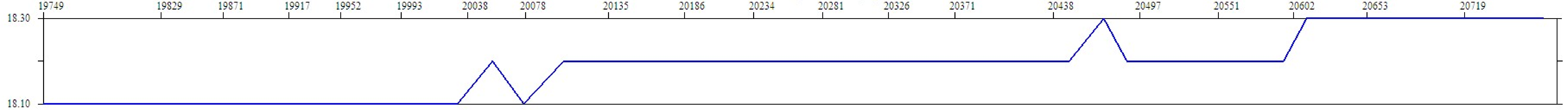
Bent 19 & 20 ER Profile



Bent 25 & 26 ER Line Location

Complete Inverted Resistivity Section

Water Temperature (C)



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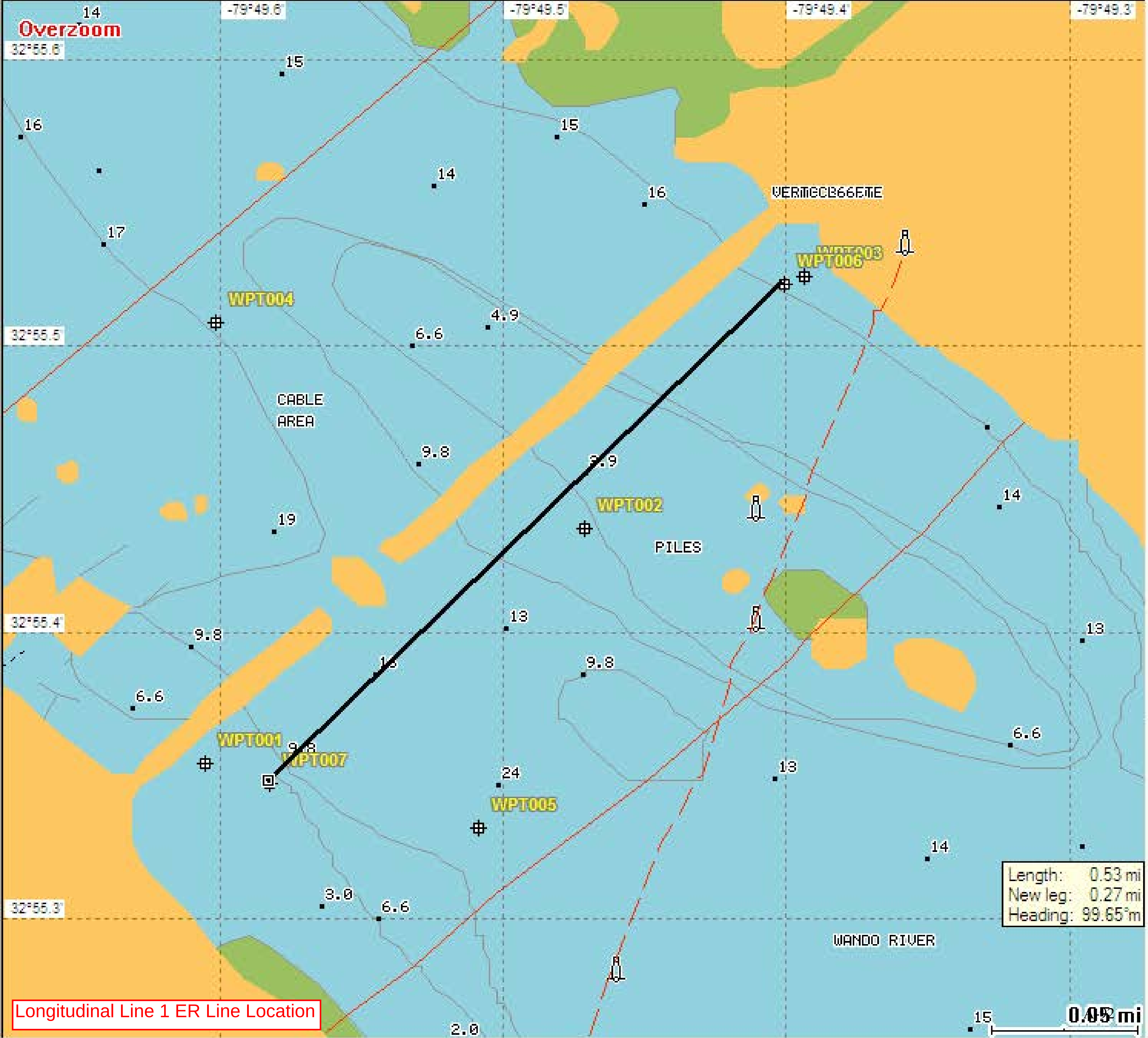
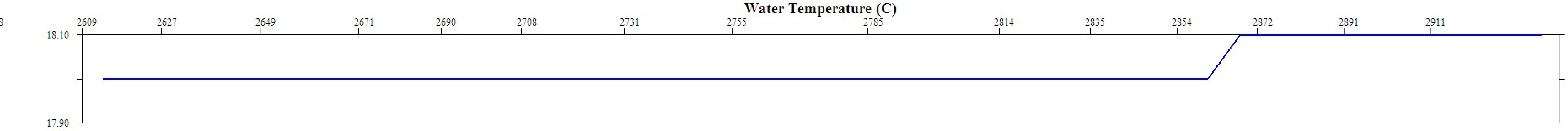


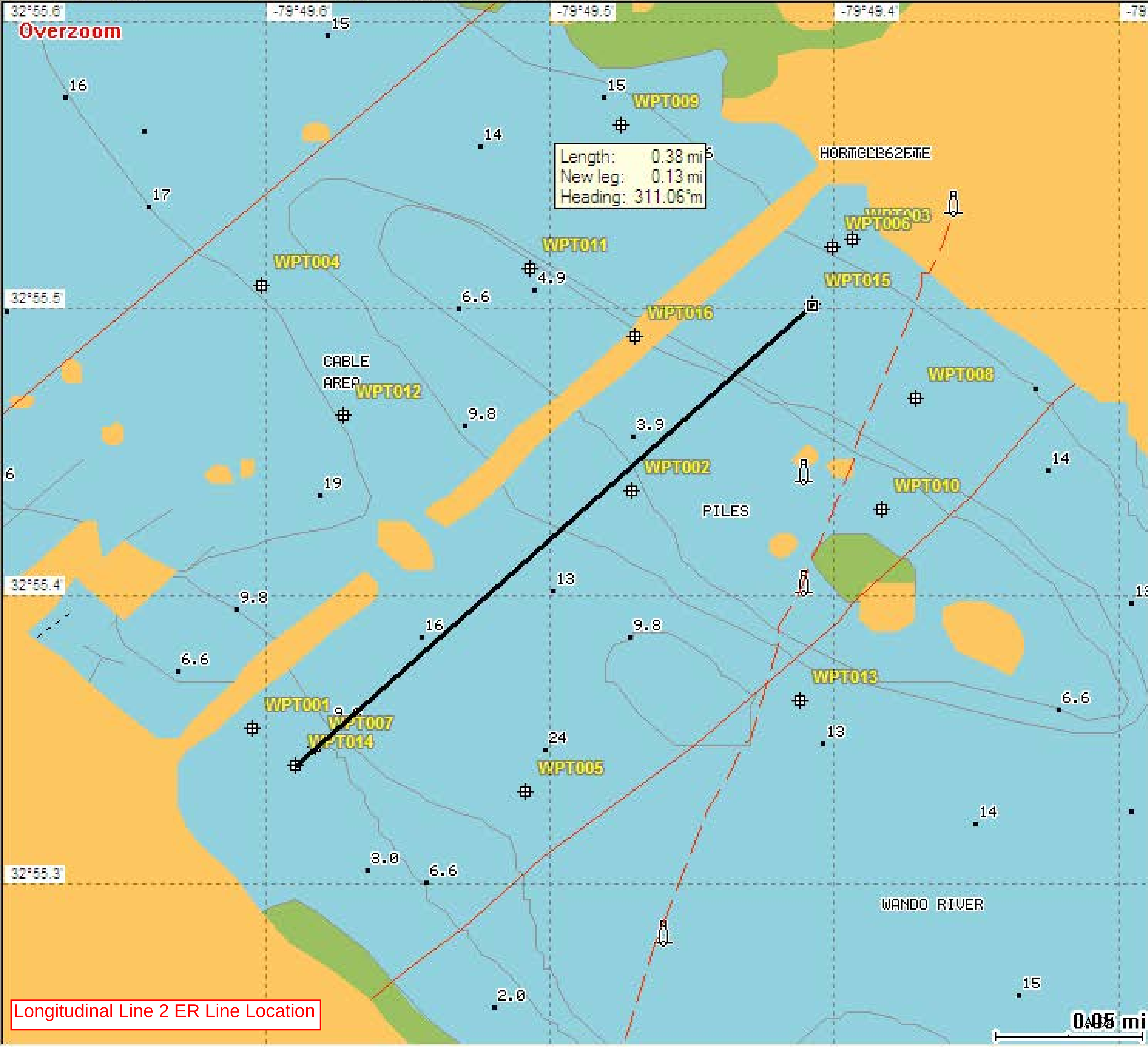
Longitudinal Line 1 ER Line Location

Complete Inverted Resistivity Section



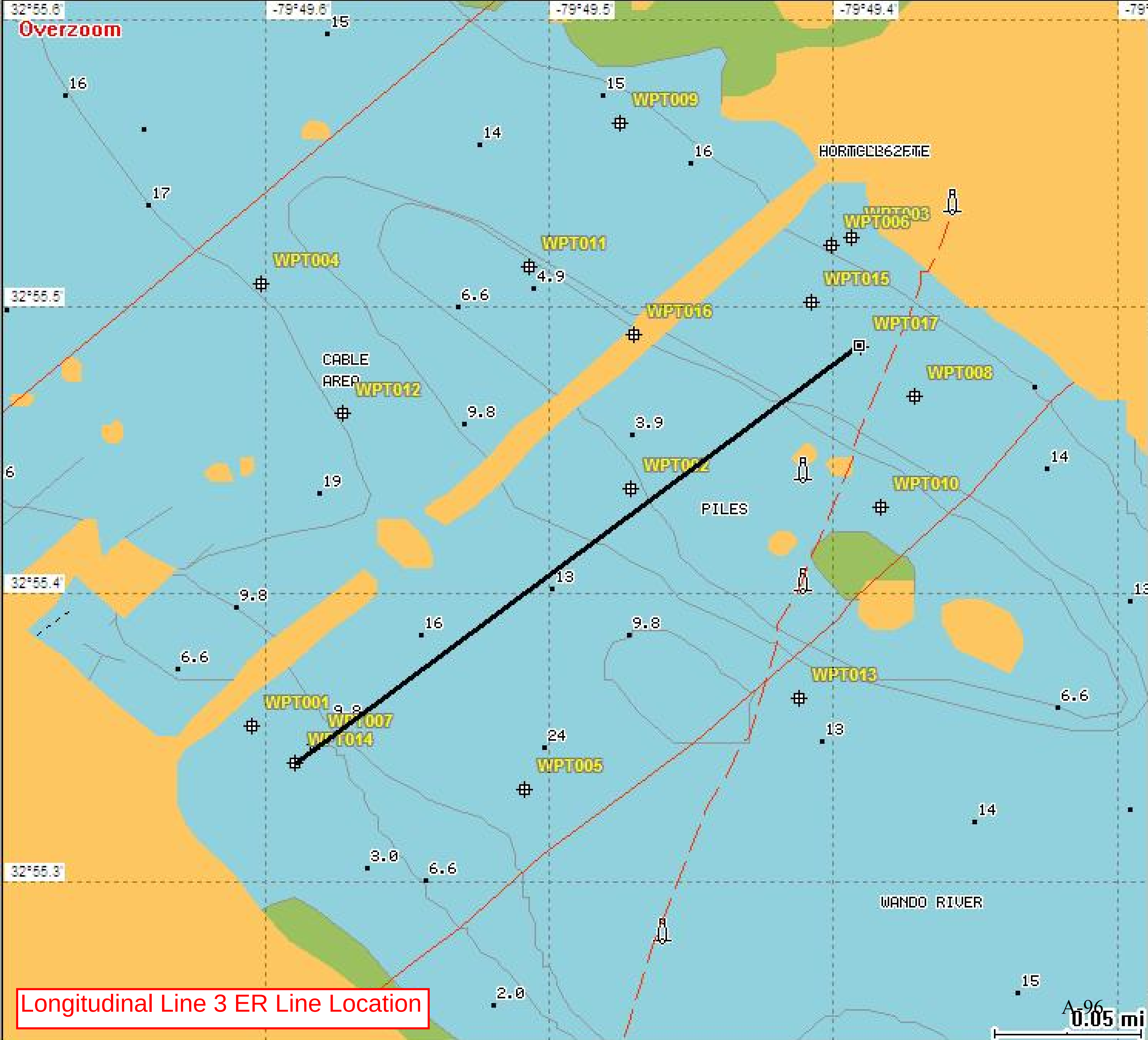
Water Temperature (C)

Longitudinal Line 1 ER Profile

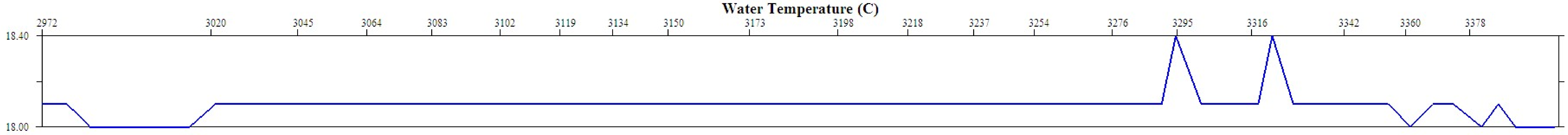


Longitudinal Line 2 ER Line Location

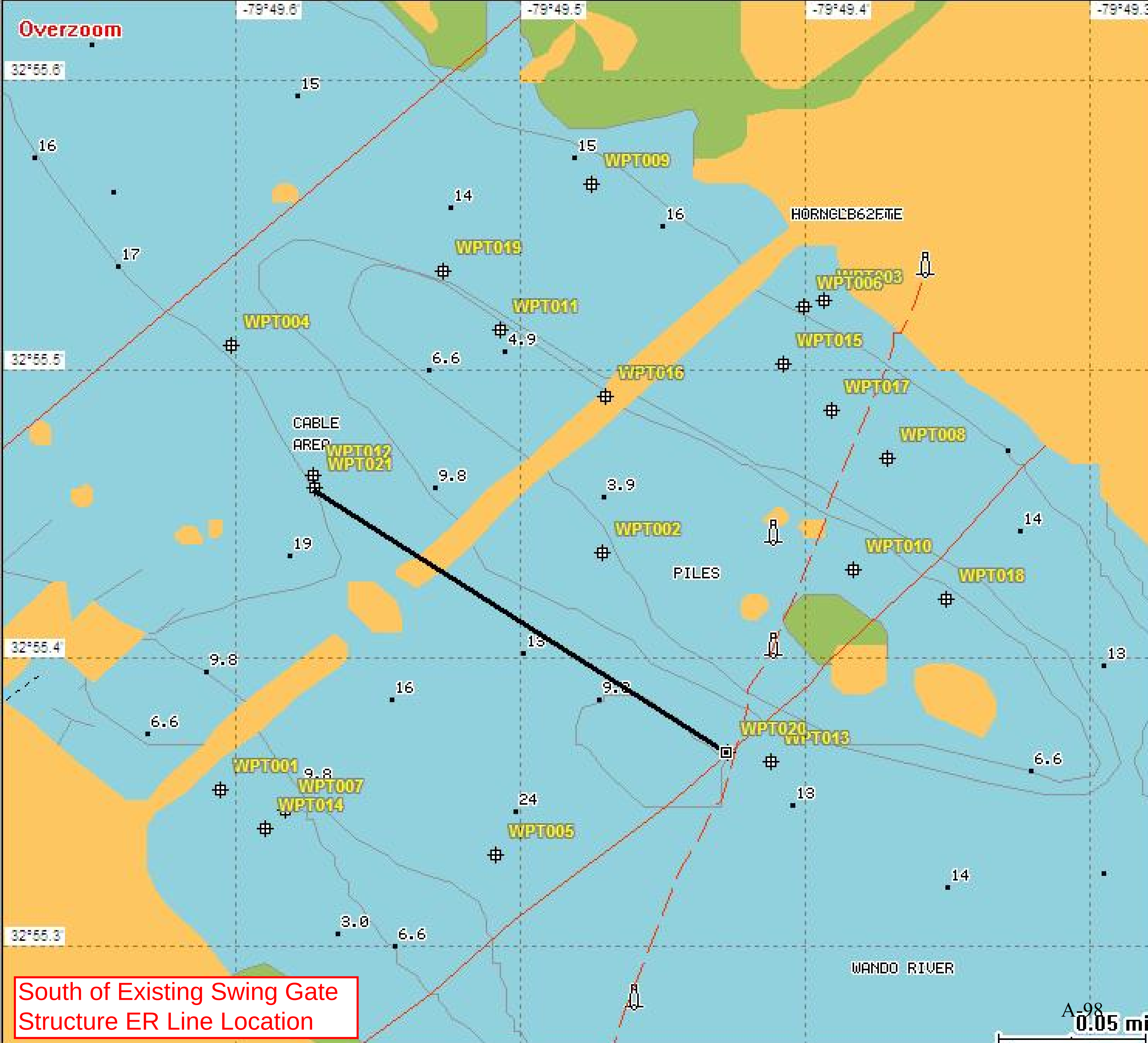
Longitudinal Line 2 ER Profile



Longitudinal Line 3 ER Line Location



Longitudinal Line 3 ER Profile



South of Existing Swing Gate Structure ER Line Location


Complete Inverted Resistivity Section

Water Temperature (C)

South of Existing Swing Gate Structure ER Profile

APPENDIX

SECTION 2

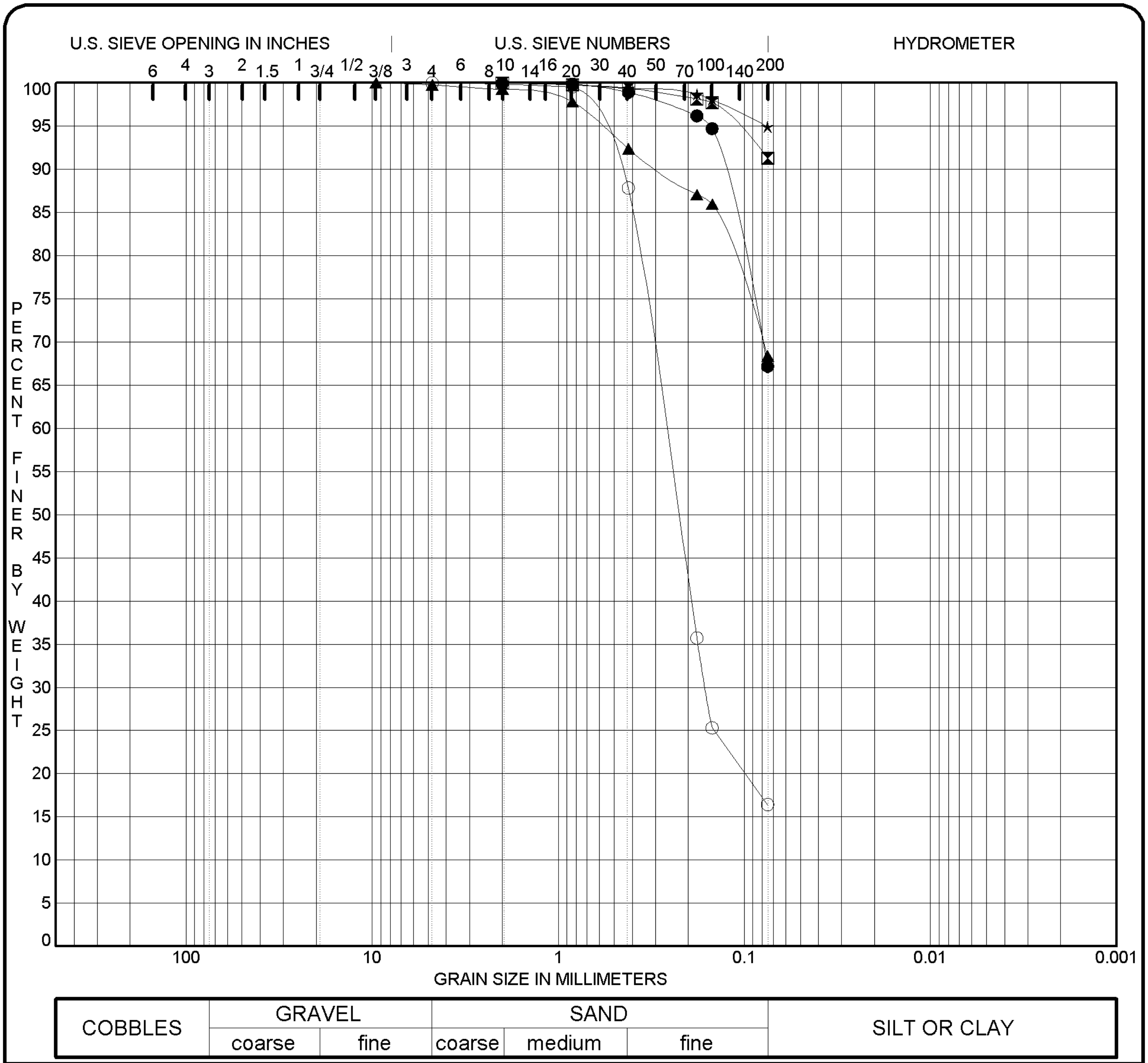
LABORATORY TEST RESULTS

SC 41 REPLACEMENT BRIDGE OVER WANDO RIVER
CHARLESTON/BERKELEY COUNTY, SOUTH CAROLINA
SCDOT FILE: 8.158B/10.032102 / PIN NO.: 32099
F&ME PROJECT NO.: G4067.01

LABORATORY ANALYSIS SUMMARY

BORING NUMBER	SAMPLE DEPTH	SAMPLE NUMBER	% GRAVEL	% SAND	% FINES (SILT/CLAY)	% MOISTURE	LL	PL	PI	USCS	AASHTO CLASS	TRIAXIAL TESTS				SPECIFIC GRAVITY	COMPRESSION INDEX, C_c	pH	RESISTIVITY		SOLUBLE CHLORIDE	SOLUBLE SULFATE (mg/kg)
												Φ (DEGREES)	C (PSF)	Φ' (DEGREES)	C' (PSF)				% MC	@15.5c (ohm-cm)		
B-1	7.0'-8.5'	--	0.0	32.8	67.2	25.1	43	21	22	CL	--	--	--	--	--	--	--	--	--	--	--	--
	43.5'-45.0'	--	0.0	8.7	91.3	62.1	78	35	43	CH	--	--	--	--	--	--	--	--	--	--	--	--
B-2	3.5'-5.0'	--	0.2	31.4	68.4	24.9	54	20	34	CH	--	--	--	--	--	--	--	--	--	--	--	--
	33.5'-35.0'	--	0.0	5.1	94.9	63.6	76	35	42	CH	--	--	--	--	--	--	--	--	--	--	--	--
	88.5'-90.0'	--	0.0	83.6	16.4	31.5	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
	108.5'-110.0'	--	0.0	3.7	96.3	56.9	84	38	46	MH	--	--	--	--	--	--	--	--	--	--	--	--
B-3	38.5'-40.0'	--	0.0	32.2	67.8	57.1	54	29	25	CH	--	--	--	--	--	--	--	--	--	--	--	--
	93.5'-95.0'	--	0.0	80.2	19.8	26.8	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
B-4	48.5'-50.0'	--	19.3	29.5	51.1	69.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	88.8'-90.0'	--	0.0	43.4	56.6	52.5	59	33	27	MH	--	--	--	--	--	--	--	--	--	--	--	--
B-5	15.7'-17.7'	11-0488E	0.0	22.5	77.5	57.9	53	37	16	MH	--	--	--	--	--	--	--	--	--	--	--	--
	36.2'-37.7'	11-0488	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.99	44.5	679	930	460
	51.2'-52.7'	11-0488H	0.0	7.6	92.4	58.9	70	46	24	MH	--	--	--	--	--	--	--	--	--	--	--	--
B-6	26.1'-28.1'	11-0429B	0.0	6.5	93.5	71.9	84	46	38	MH	--	--	--	--	--	--	--	--	--	--	--	--
	35.6'-37.1'	11-0429	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.09	39.4	127	6300	BRL
	80.6'-82.1'	11-0429E	0.0	82.3	17.7	27.9	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
B-7	28.5'-29.3'	11-0412E	--	--	--	--	--	--	--	--	--	--	--	--	--	2.54	--	--	--	--	--	--
	28.5'-29.3'	11-0412D	0.0	11.1	88.9	67.7	86	61	25	MH	--	--	--	--	--	--	0.55	--	--	--	--	--
	30.6'-32.0'	11-0435B	0.0	17.5	82.5	57.1	51	35	16	MH	--	--	--	--	--	--	--	--	--	--	--	--
	47.5'-49.0'	11-0435	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.11	39.9	272	2700	BRL
	72.5'-74.0'	11-0435E	0.0	61.9	38.1	36.8	41	27	14	SM	--	--	--	--	--	--	--	--	--	--	--	--
B-8	27.7'-29.7'	11-0430B	0.0	3.3	96.7	75.3	86	63	24	MH	--	--	--	--	--	--	--	--	--	--	--	--
	54.2'-55.7'	11-0430E	0.0	6.8	93.2	66.0	82	58	24	MH	--	--	--	--	--	--	--	--	--	--	--	--
	59.2'-60.7'	11-0430	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.30	39.5	355	2500	BRL
B-9	12.1'-14.1'	11-0431B	5.5	38.3	56.2	52.7	51	39	12	MH	--	--	--	--	--	--	--	--	--	--	--	--
	50.6'-52.1'	11-0431E	0.0	15.5	84.5	76.0	80	62	18	MH	--	--	--	--	--	--	--	--	--	--	--	--
	55.6'-57.1'	11-0431	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.36	39.0	304	2800	BRL
B-10	17.0'-19.0'	11-0489E	0.0	29.7	70.3	43.9	29	19	10	CL	--	--	--	--	--	--	--	--	--	--	--	--
	59.5'-61.0'	11-0489	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.33	37.4	382	1700	440
	64.5'-66.0'	11-0489H	0.1	11.5	88.4	64.7	79	47	32	MH	--	--	--	--	--	--	--	--	--	--	--	--
B-11	36.2'-37.7'	11-0490E	0.0	4.6	95.4	68.2	89	51	38	MH	--	--	--	--	--	--	--	--	--	--	--	--
	81.2'-82.7'	11-0490	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.29	64.1	504	1900	930
	86.2'-87.7'	11-0490H	0.3	47.2	52.4	46.4	45	31	14	ML	--	--	--	--	--	--	--	--	--	--	--	--
RW-1	13.5'-15.0'	11-0456B	0.2	75.3	24.4	33.6	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
	18.5'-20.0'	11-0456E	0.9	66.9	32.2	38.1	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
RW-2	13.5'-15.0'	11-0457B	3.9	77.1	19.0	35.7	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
	23.5'-25.0'	11-0457E	0.1	30.1	69.8	54.6	42	36	6	ML	--	--	--	--	--	--	--	--	--	--	--	--
RW-3	8.0'-10.0'	11-0458B	0.0	38.3	61.7	30.9	33	27	6	ML	--	--	--	--	--	--	--	--	--	--	--	--
RW-4	8.0'-10.0'	11-0459B	8.6	48.9	42.5	33.5	28	24	4	ML	--	--	--	--	--	--	--	--	--	--	--	--
	13.5'-15.0'	11-0459E	13.1	39.2	47.6	33.8	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
AP-1 (CPT-2)	10.0'-12.5'	11-0329A	0.0	48.5	51.5	29.8	31	23	8	CL	--	--	--	--	--	--	--	--	--	--	--	--
		11-0329E	--	--	--	--	--	--	--	--	--	--	--	--	--	2.61	--	--	--	--	--	--
		11-0329F	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.24	--	--	--	--	--
		11-0329C	--	--	--	--	--	--	--	--	--	17	570	28	380	--	--	--	--	--	--	--
AP-2 (CPT-3)	8.5'-10.5'	11-0330A	0.0	41.2	58.8	27.5	31	22	9	CL	--	--	--	--	--	--	--	--	--	--	--	--
		11-0330C	--	--	--	--	--	--	--	--	--	21	540	27	580	--	--	--	--	--	--	--
WB-3	6.0'-7.5'	--	0.0	37.5	62.5	29.0	41	20	21	CL	--	--	--	--	--	--	--	--	--	--	--	--
	18.5'-20.0'	--	0.0	55.3	44.7	47.1	NP	NP	NP	SM	--	--	--	--	--	--	--	--	--	--	--	--
WB-4	18.5'-20.0'	--	2.3	46.2	51.5	45.9	NP	NP	NP	ML	--	--	--	--	--	--	--	--	--	--	--	--
WB-6	13.5'-15.0'	--	0.0	27.0	73.0	45.7	50	23	27	CL-CH	--	--	--	--	--	--	--	--	--	--	--	--
WS-3	7.1'-7.6'	--	0.0	37.0	63.0	--	51	19	32	--	A-7-6(18)	--	--	--	--	--	--	--	--	--	--	--
WS-3	21.5'-22.0'	--	0.0	47.0	53.0	--	NP	NP	NP	--	A-4(0)	--	--	--	--	--	--	--	--	--	--	--
WS-4	22.0'-22.5'	--	0.0	51.0	49.0	--	NP	NP	NP	--	A-4(0)	--	--	--	--	--	--	--	--	--	--	--
WS-6	13.5'-14.3'	--	0.0	40.0	60.0	--	26	23	3	--	A-4(0)	--	--	--	--	--	--	--	--	--	--	--
WS-3	7.0'-10.0'	--	--	--	--	--	51	19	32	CL-CH	--	23.0	350	--	--	--	--	--	--	--	--	--
WS-3	20.5'-22.5'	--	--	--	--	--	NP	NP	NP	ML	--	15.7	180	--	--	--	--	--	--	--	--	--
WS-4	20.5'-22.5'	--	--	--	--	--	NP	NP	NP	SM	--	30.7	950	--	--	--	--	--	--	--	--	--
WS-6	13.5'-17.5'	--	--	--	--	--	26	23	3	ML	--	4.7	1000	--	--	--	--	--	--	--	--	--

[1] BRL - Below Reporting Limit



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-1**	**8.5**	**Lt. Tan F-M Sandy Lean CLAY (CL)**	**25.1**	**43**	**21**	**21**		
⧗	**B-1a**	**45.0**	**Lt. Tan Fat CLAY (CH)**	**62.1**	**78**	**35**	**43**		
▲	**B-2**	**5.0**	**Gray/Orange F-M Sandy Fat CLAY (CH)**	**24.9**	**54**	**20**	**33**		
★	**B-2a**	**35.0**	**Lt. Tan Fat CLAY (CH)**	**63.6**	**76**	**35**	**42**		
○	**B-2b**	**90.0**	**Dk Gray Silty F-M SAND (SM)**	**31.5**	**NP**	**NP**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**8.5**	**2.00**				**0.0**	**32.8**	**67.2**	
⧗	**B-1a**	**45.0**	**2.00**				**0.0**	**8.7**	**91.3**	
▲	**B-2**	**5.0**	**9.52**				**0.2**	**31.4**	**68.4**	
★	**B-2a**	**35.0**	**2.00**				**0.0**	**5.1**	**94.9**	
○	**B-2b**	**90.0**	**4.76**	**0.27**	**0.162**		**0.0**	**83.6**	**16.4**	

PROJECT **SC-41 Bridge Replacement Over Wando River**
LOCATION **Berkeley/Charleston Counties, South Carolina**
JOB NO. **G4067**
DATE **11/24/04**

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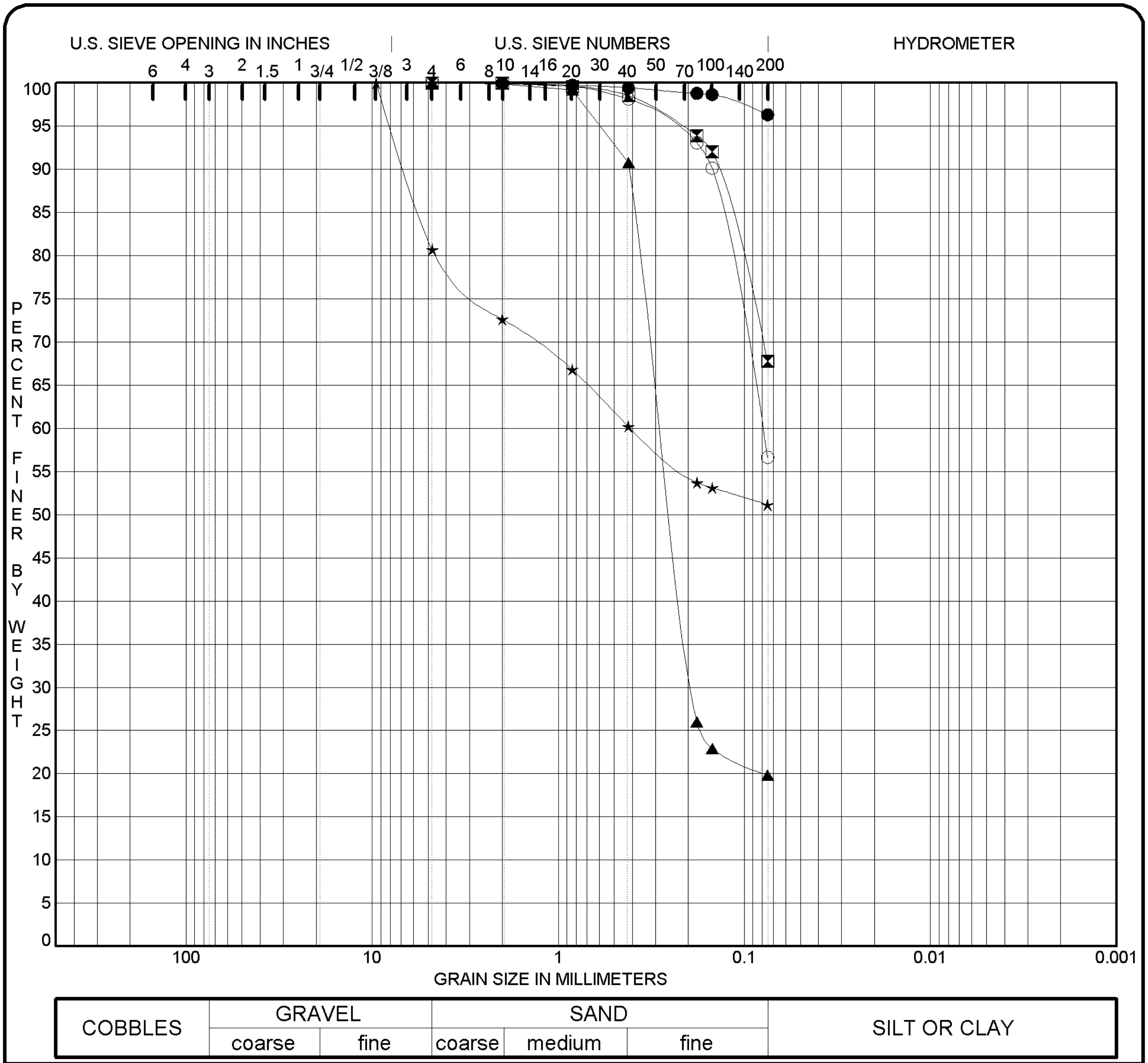
GRADATION CURVES



Specimen Identification			Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-2c**	**110.0**	**Lt. Tan Elastic SILT (MH)**	**56.9**	**84**	**38**	**46**		
⧗	**B-3**	**40.0**	**Grayish Tan F-M Sandy Fat CLAY (CH)**	**57.1**	**54**	**29**	**25**		
▲	**B-3a**	**95.0**	**Gray Tan Silty F-M SAND (SM)**	**26.8**	**NP**	**NP**	**NP**		
★	**B-4**	**50.0**	**Grayish-Tan Silty CLAY**	**69.8**					
○	**B-4a**	**90.0**	**Grayish Tan F-M Sandy Elastic SILT (MH)**	**52.5**	**59**	**33**	**27**		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2c**	**110.0**	**2.00**				**0.0**	**3.7**	**96.3**	
⧗	**B-3**	**40.0**	**4.76**				**0.0**	**32.2**	**67.8**	
▲	**B-3a**	**95.0**	**4.76**	**0.28**	**0.190**		**0.0**	**80.2**	**19.8**	
★	**B-4**	**50.0**	**9.52**	**0.41**			**19.3**	**29.5**	**51.1**	
○	**B-4a**	**90.0**	**4.76**	**0.08**			**0.0**	**43.4**	**56.6**	

PROJECT **SC-41 Bridge Replacement Over Wando River**
LOCATION **Berkeley/Charleston Counties, South Carolina**
JOB NO. **G4067**
DATE **11/24/04**

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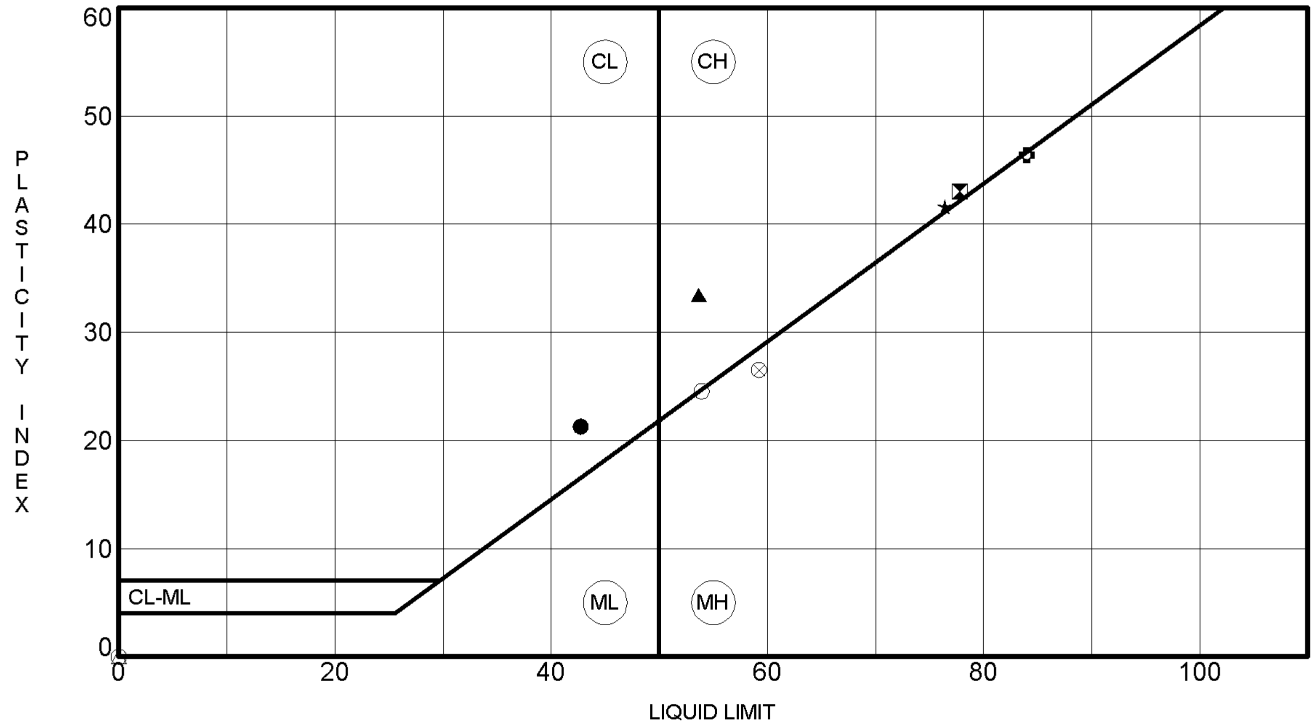
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**8.5**	**43**	**21**	**22**	**67**	**Lt. Tan F-M Sandy Lean CLAY (CL)**
⧗	**B-1a**	**45.0**	**78**	**35**	**43**	**91**	**Lt. Tan Fat CLAY (CH)**
▲	**B-2**	**5.0**	**54**	**20**	**34**	**68**	**Gray/Orange F-M Sandy Fat CLAY (CH)**
★	**B-2a**	**35.0**	**76**	**35**	**41**	**95**	**Lt. Tan Fat CLAY (CH)**
○	**B-2b**	**90.0**	**NP**	**NP**	**NP**	**16**	**Dk Gray Silty F-M SAND (SM)**
✜	**B-2c**	**110.0**	**84**	**38**	**46**	**96**	**Lt. Tan Elastic SILT (MH)**
○	**B-3**	**40.0**	**54**	**29**	**25**	**68**	**Grayish Tan F-M Sandy Fat CLAY (CH)**
△	**B-3a**	**95.0**	**NP**	**NP**	**NP**	**20**	**Gray Tan Silty F-M SAND (SM)**
⊗	**B-4a**	**90.0**	**59**	**33**	**26**	**57**	**Grayish Tan F-M Sandy Elastic SILT (MH)**

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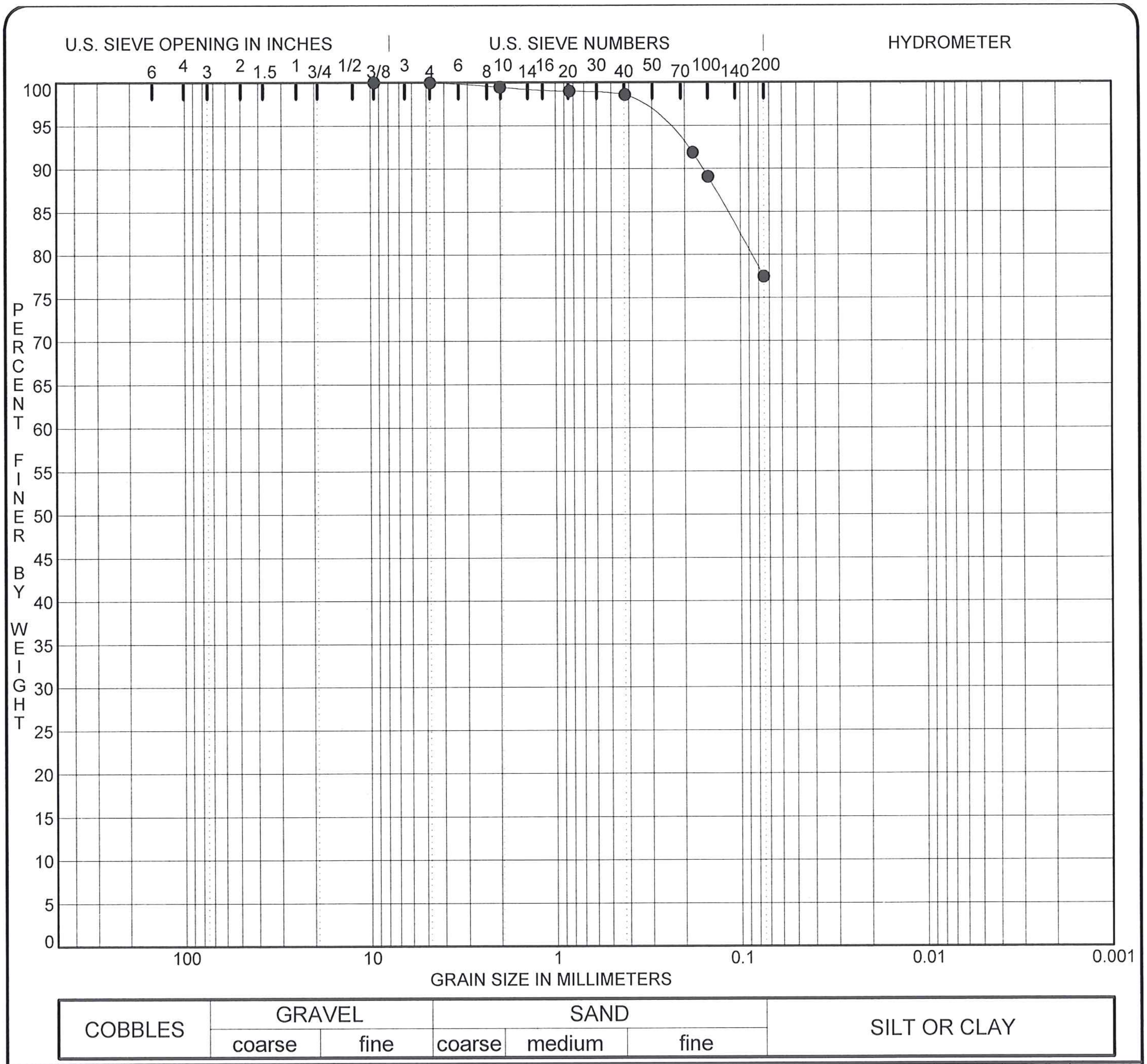
ATTERBERG LIMITS' RESULTS

Project: SC-41 Bridge Replacement Over Wando River

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067

US ATTERBERG LIMITS G4067LAB.GPJ US LAB.GDT 11/24/04



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-5 (0488E) 10.0**	**Gray Elastic SILT (MH), w/Fine SAND**	**57.9**					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5 (0488E) 10.0**	**9.52**				**0.0**	**22.5**	**77.5**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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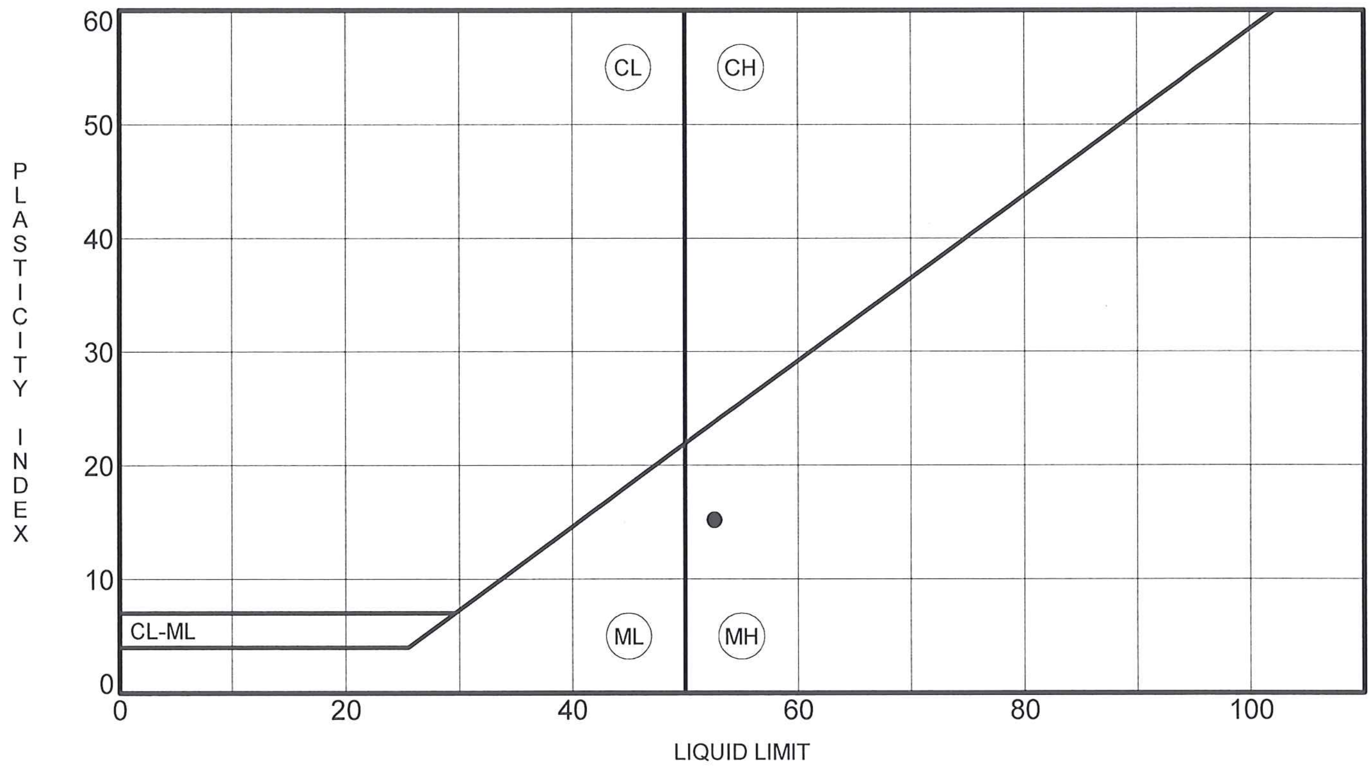
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-5 (0488F)**	**10.0**	**53**	**37**	**16**		**Gray Elastic SILT (MH), w/Fine SAND**

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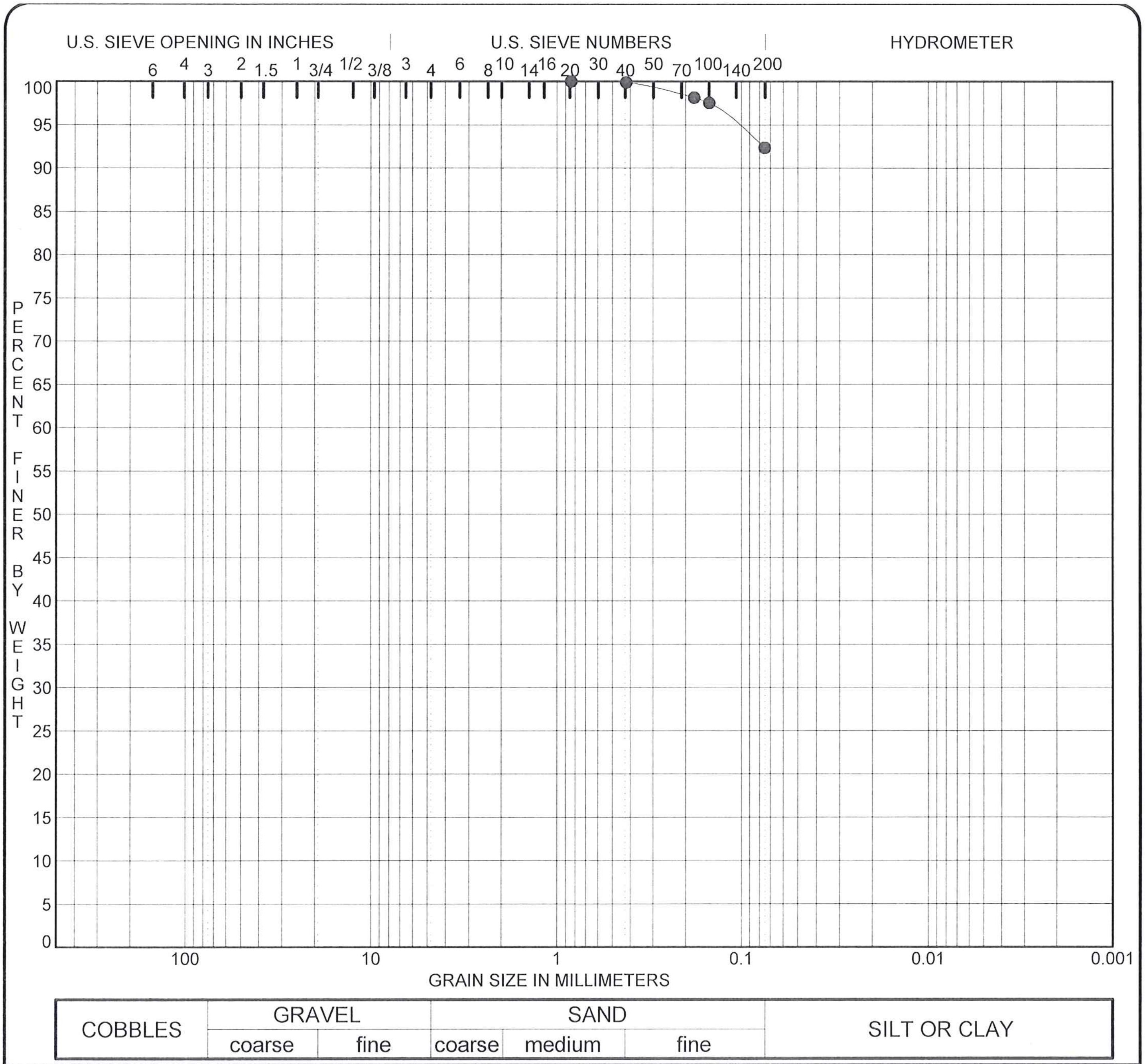
ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-5 (0488H) 45.0**	**Tan Elastic SILT (MH)**	**58.9**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5 (0488H) 45.0**	**0.84**				**0.0**	**7.6**	**92.4**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/11/11**

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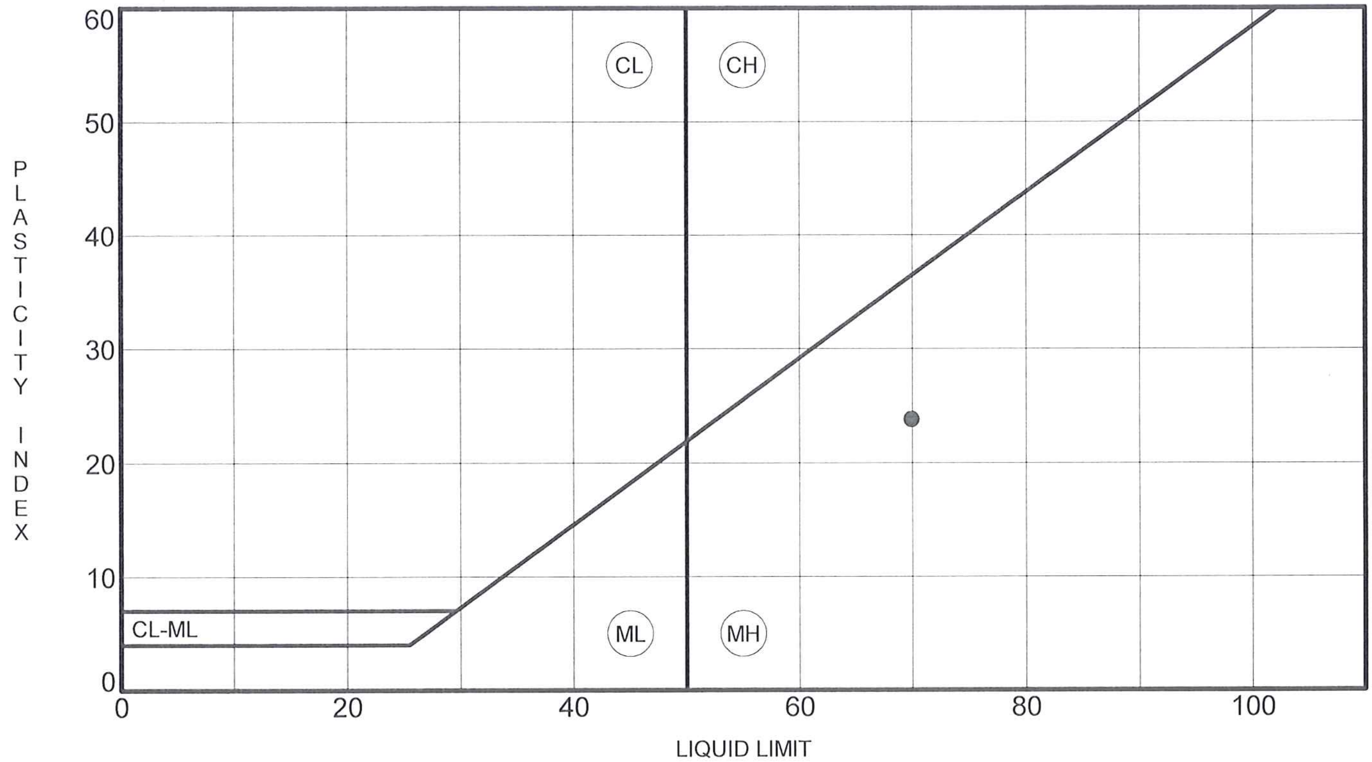
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-5 (0488I)**	**45.0**	**70**	**46**	**24**		**Tan Elastic SILT (MH)**

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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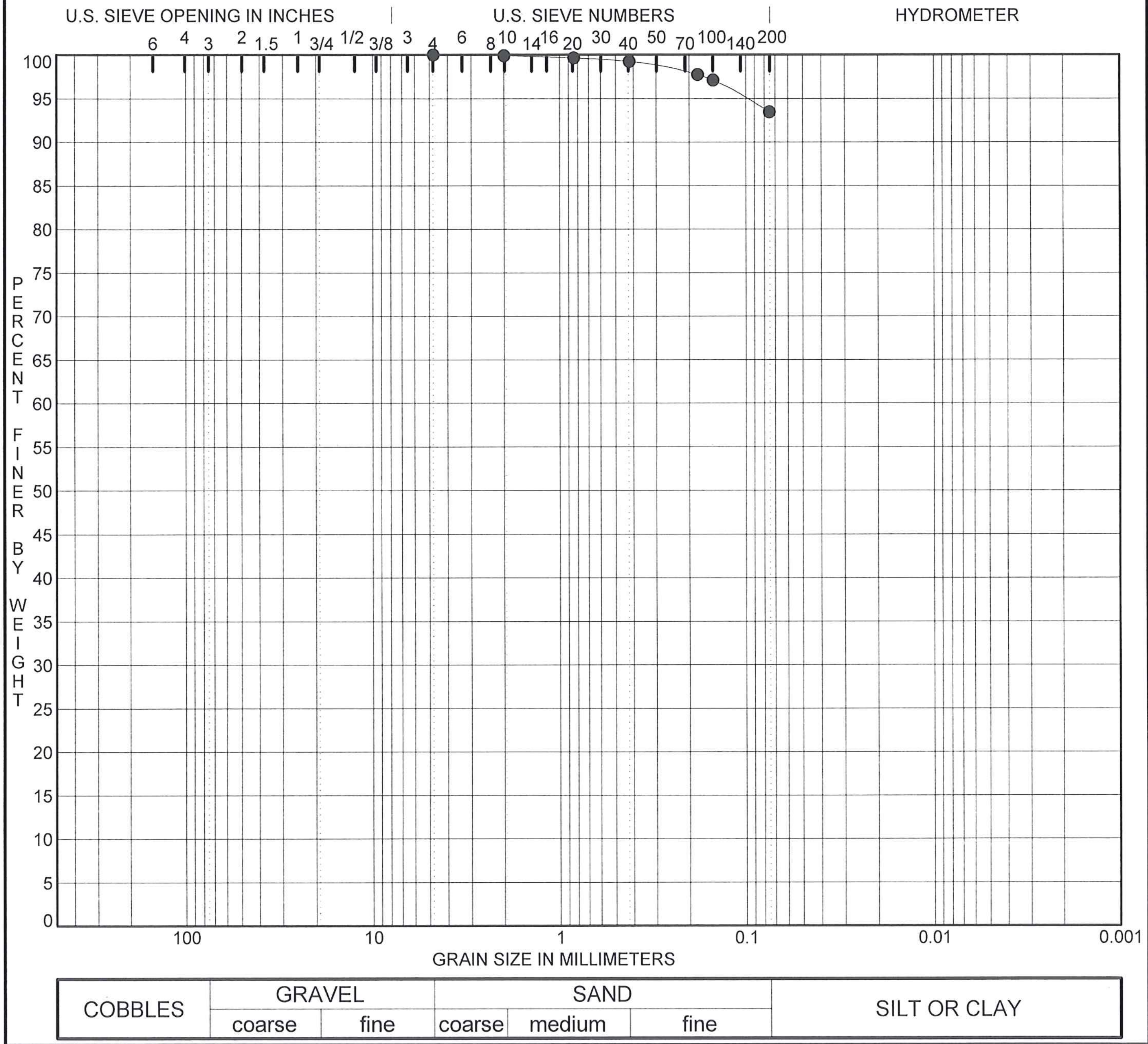

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-6 (0429B)**	**6.0**	**Green/Brown Elastic SILT (MH)**	**71.9**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6 (0429B)**	**6.0**	**4.76**				**0.0**	**6.5**	**93.5**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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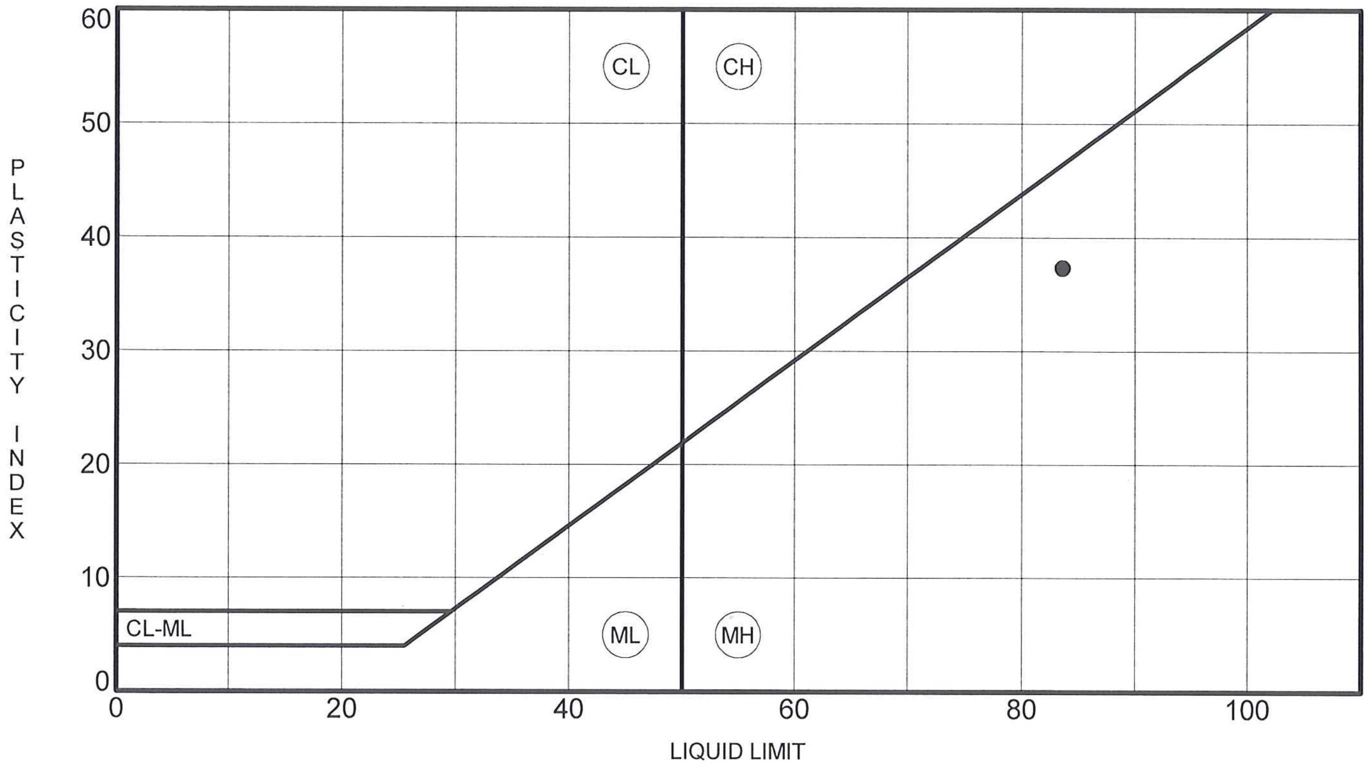
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-6 (0429C)**	**6.0**	**84**	**46**	**38**		**Green/Brown Elastic SILT (MH)**

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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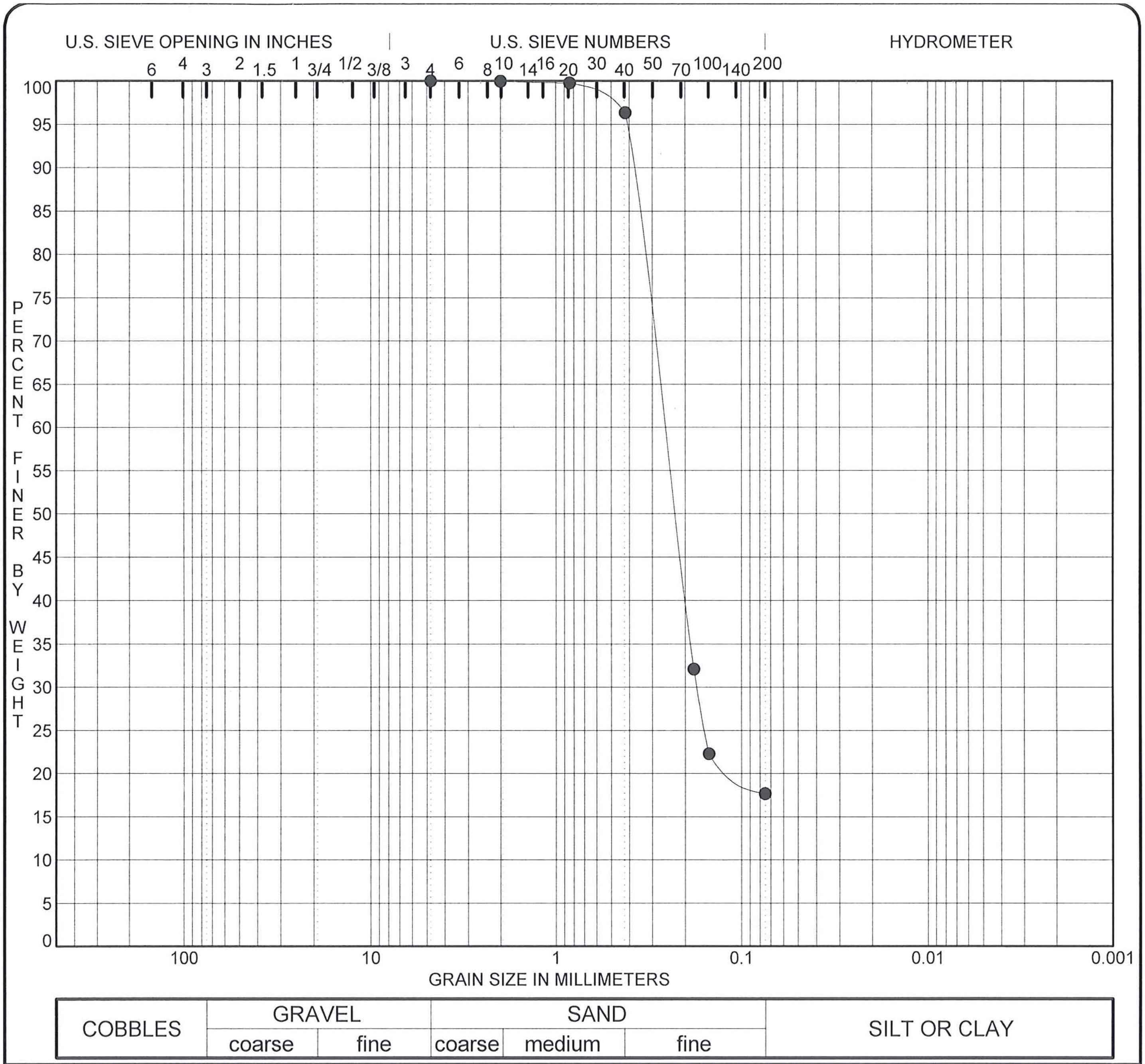

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-6 (0429E) 60.0**	**Green/Brown Silty Fine SAND (SM)**	**27.9**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6 (0429E) 60.0**	**4.76**	**0.26**	**0.173**		**0.0**	**82.3**	**17.7**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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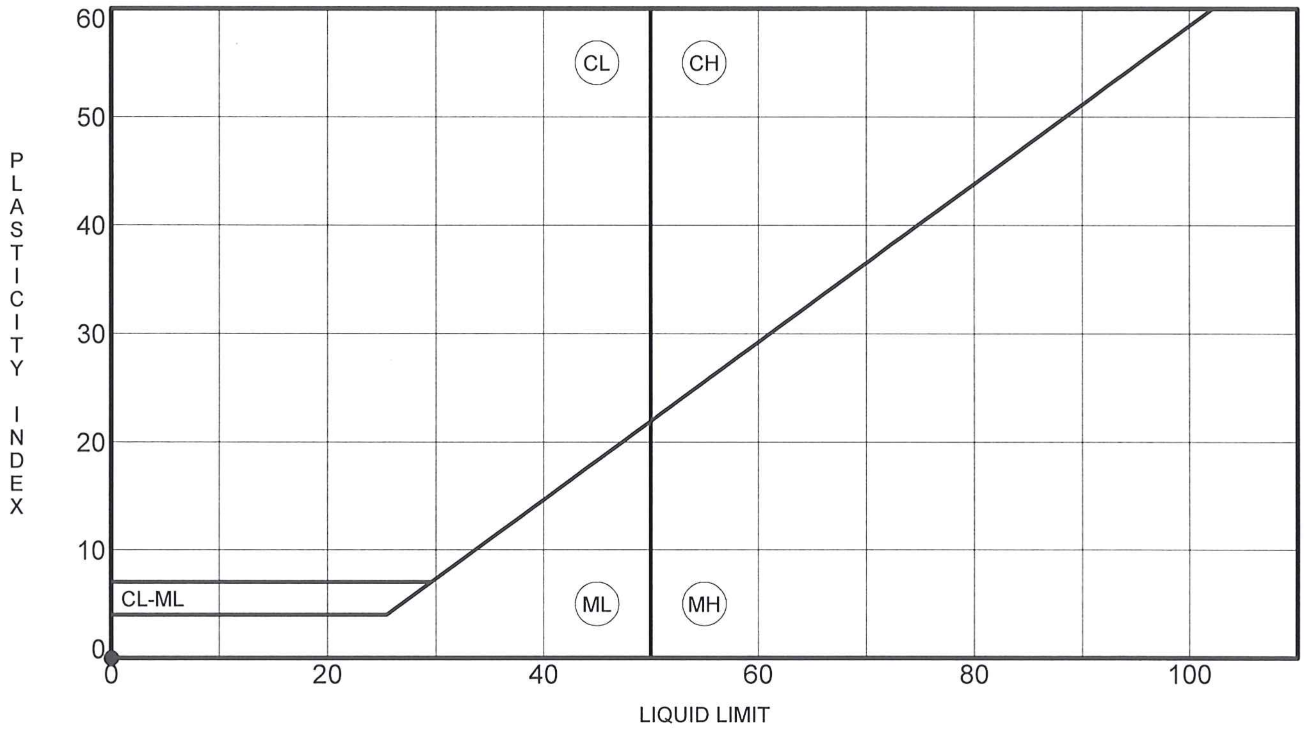
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-6 (0429F)**	**60.0**	**NP**	**NP**	**NP**		**Green/Brown Silty Fine SAND (SM)**

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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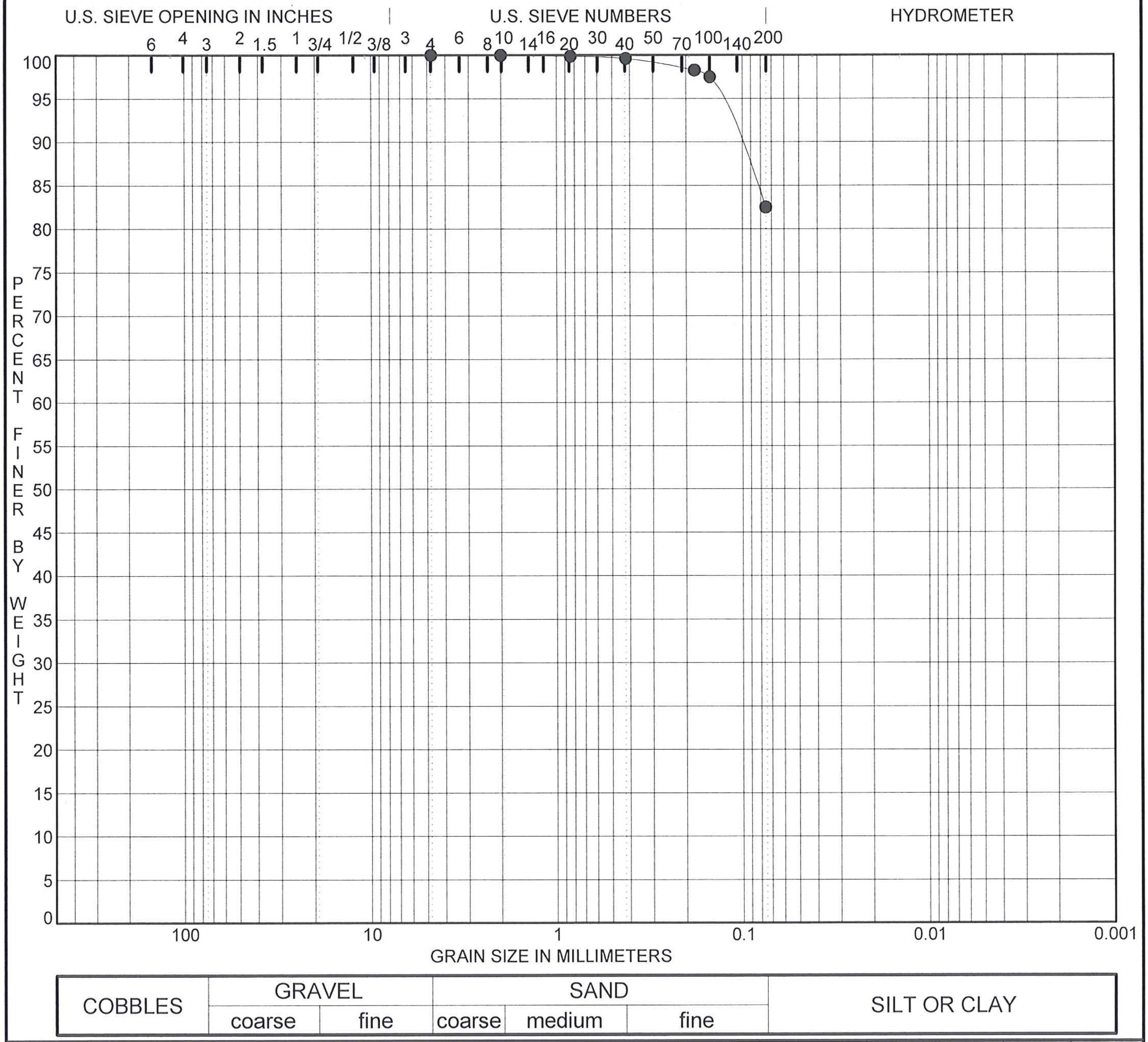

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	B-7 (0435B) 8.0	Green/Brown Elastic SILT (MH), w/Fine Sand	57.1					

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-7 (0435B) 8.0	4.76				0.0	17.5	82.5	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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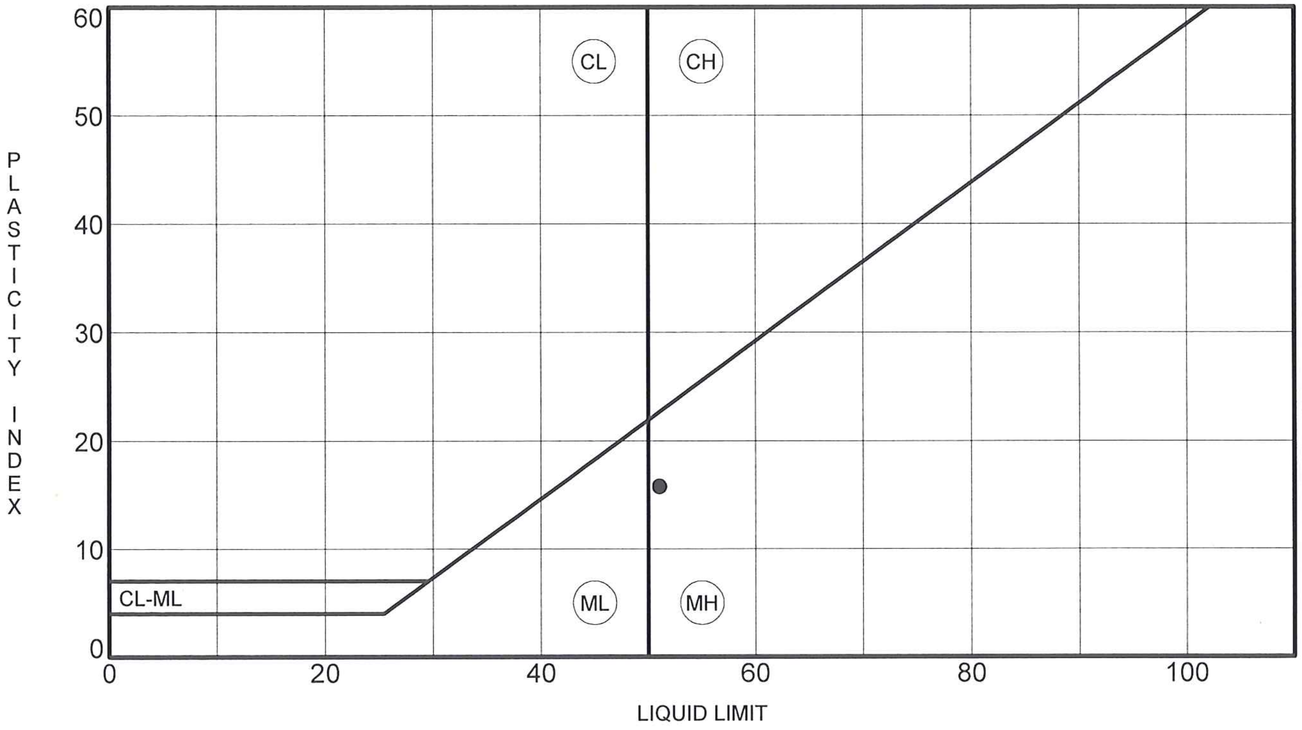
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-7 (0435C)**	**8.0**	**51**	**35**	**16**		**Green/Brown Elastic SILT (MH), w/ Fine Sand**

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11

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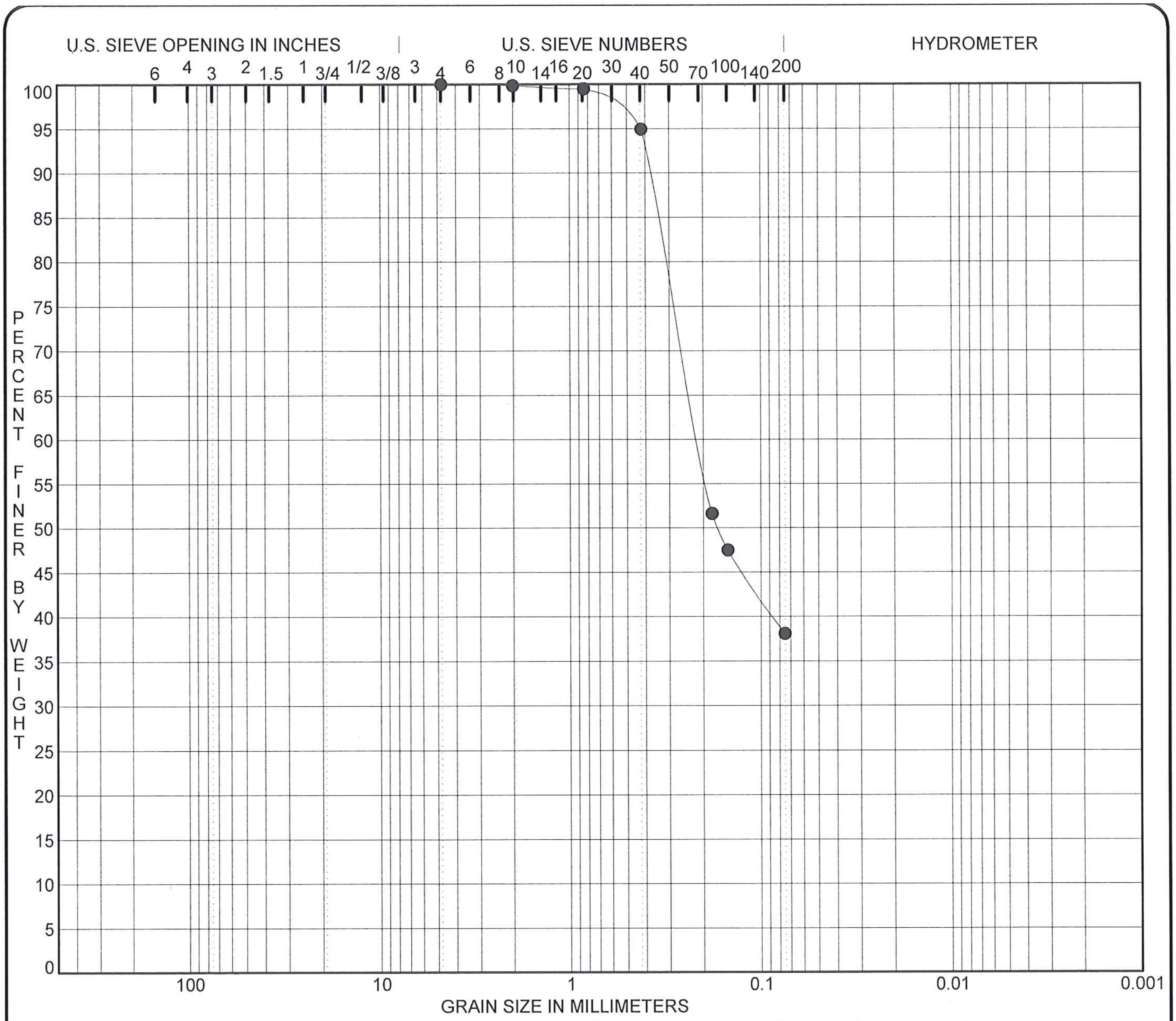
ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-7 (0435E) 50.0**	**Green/Brown Silty F/M SAND (SM)**	**36.8**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-7 (0435E) 50.0**	**4.76**	**0.21**			**0.0**	**61.9**	**38.1**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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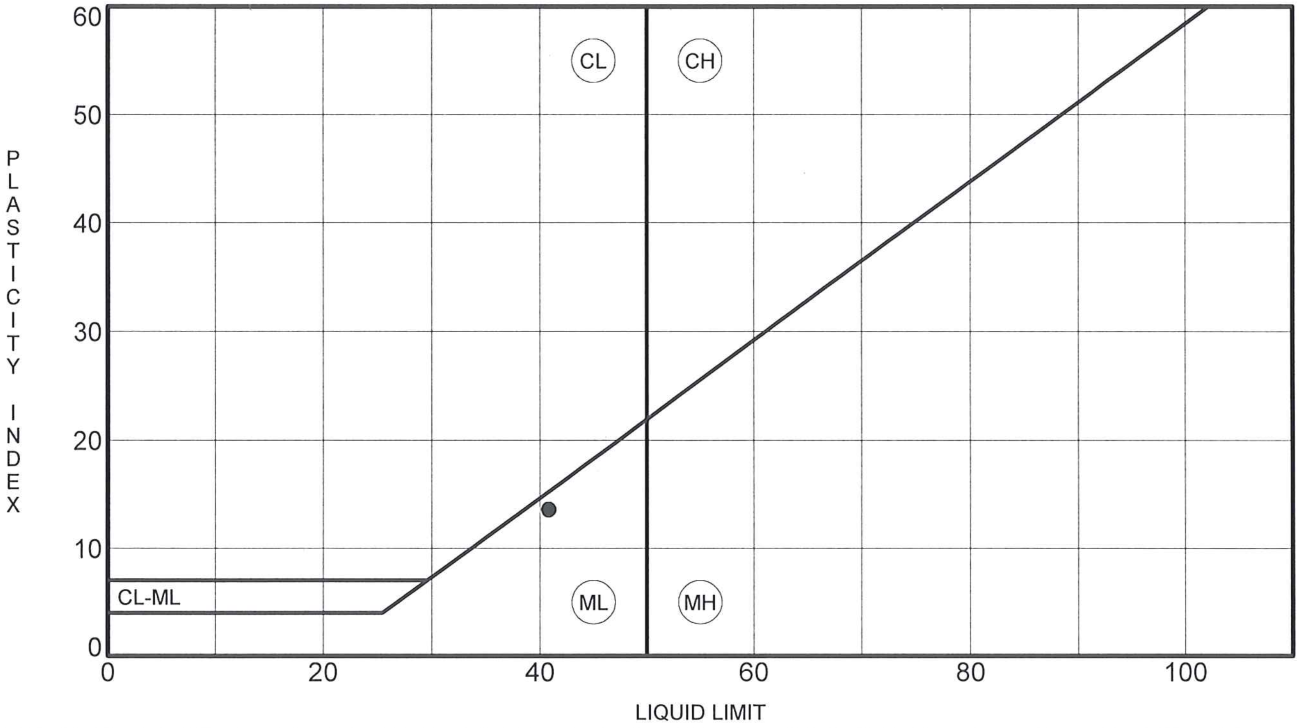
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-7 (0435F)**	**50.0**	**41**	**27**	**14**		**Green/Brown Silty F/M SAND (SM)**

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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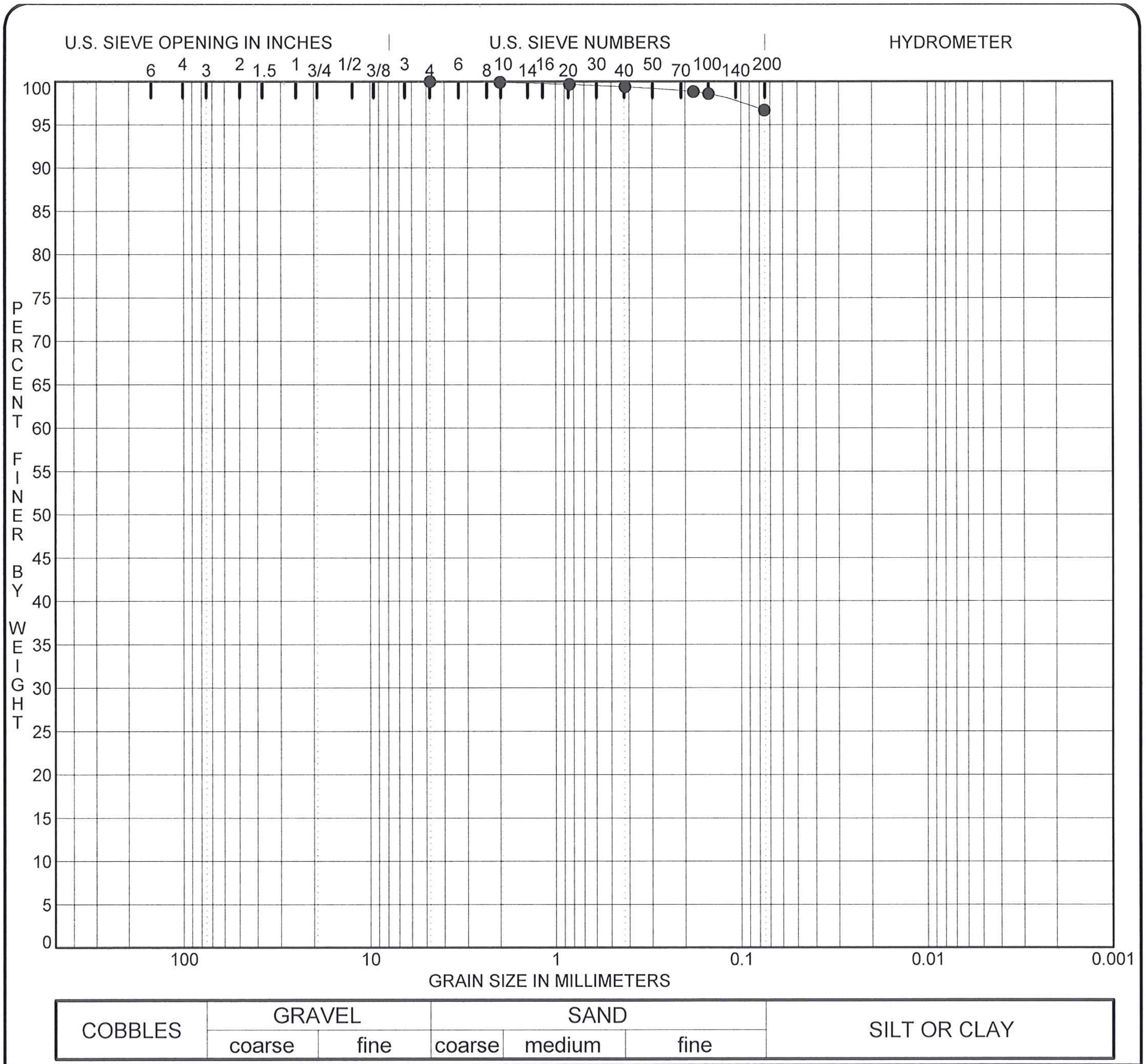

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-8 (0430B) 4.0**	**Green/Brown Elastic SILT (MH)**	**75.3**					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-8 (0430B) 4.0**	**4.76**				**0.0**	**3.3**	**96.7**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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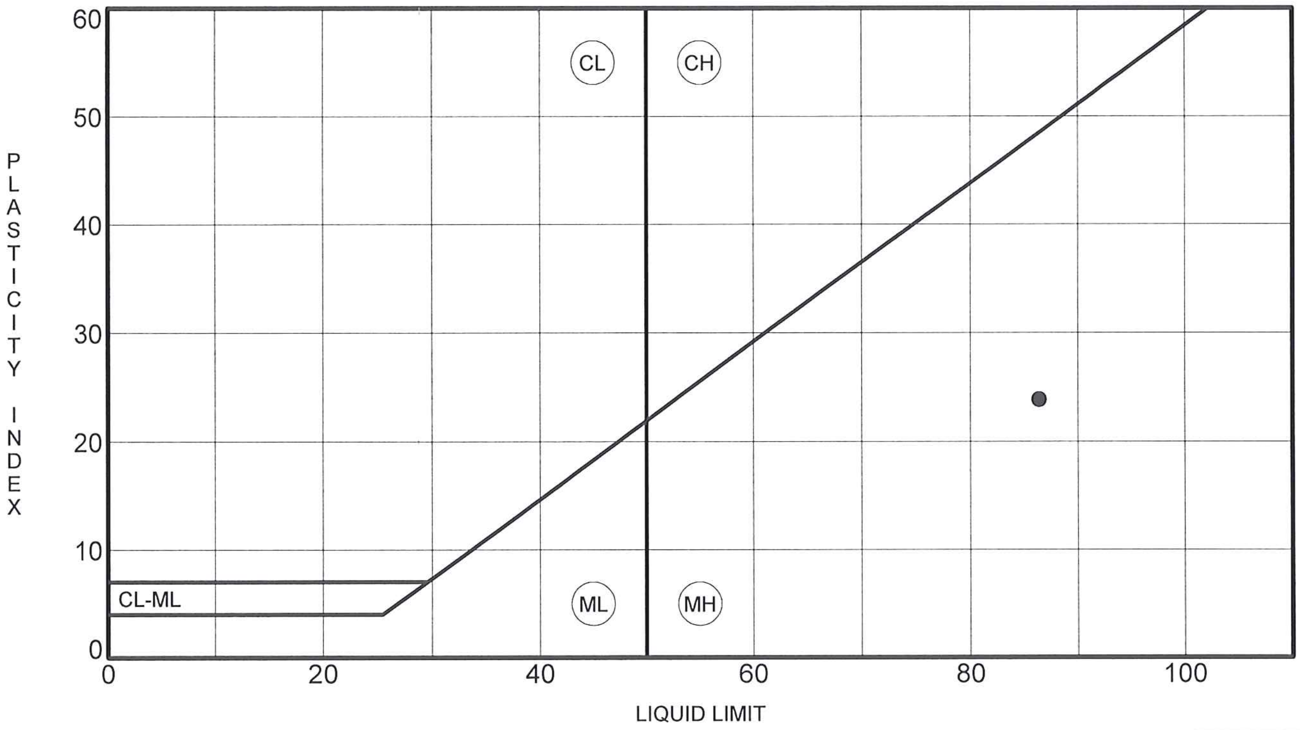
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-8 (0430C)**	**4.0**	**86**	**63**	**24**		**Green/Brown Elastic SILT (MH)**

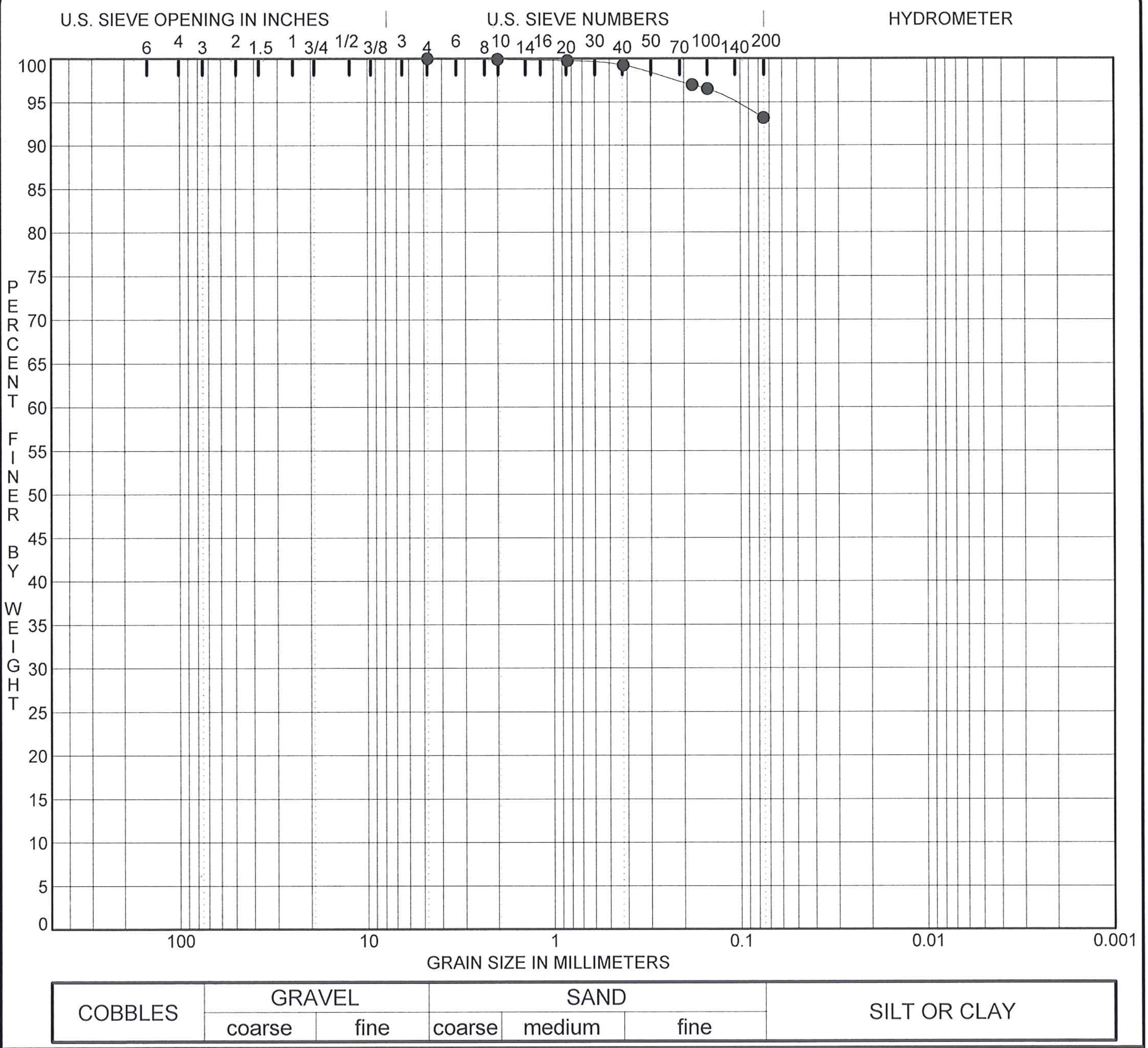
ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-8 (0430E) 30.0**	**Green/Brown Elastic SILT (MH)**	**66.0**					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-8 (0430E) 30.0**	**4.76**				**0.0**	**6.8**	**93.2**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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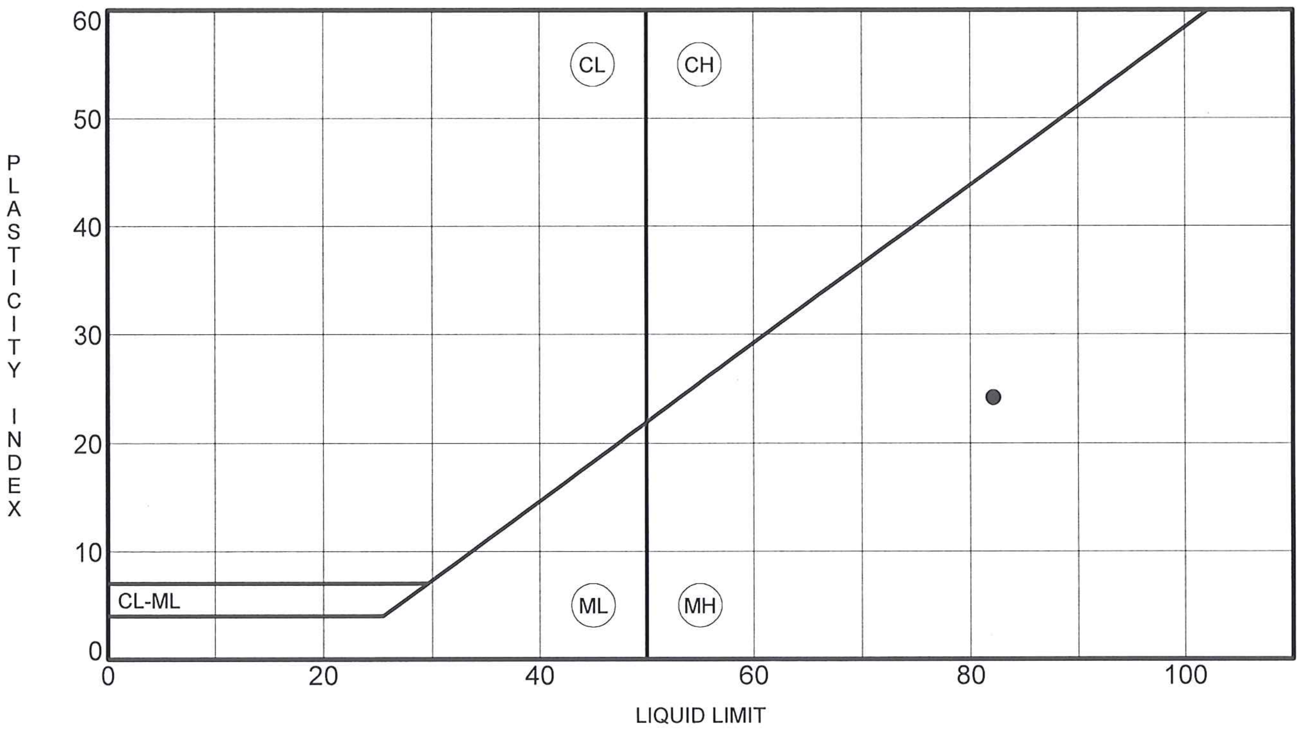
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-8 (0430F)**	**30.0**	**82**	**58**	**24**		**Green/Brown Elastic SILT (MH)**

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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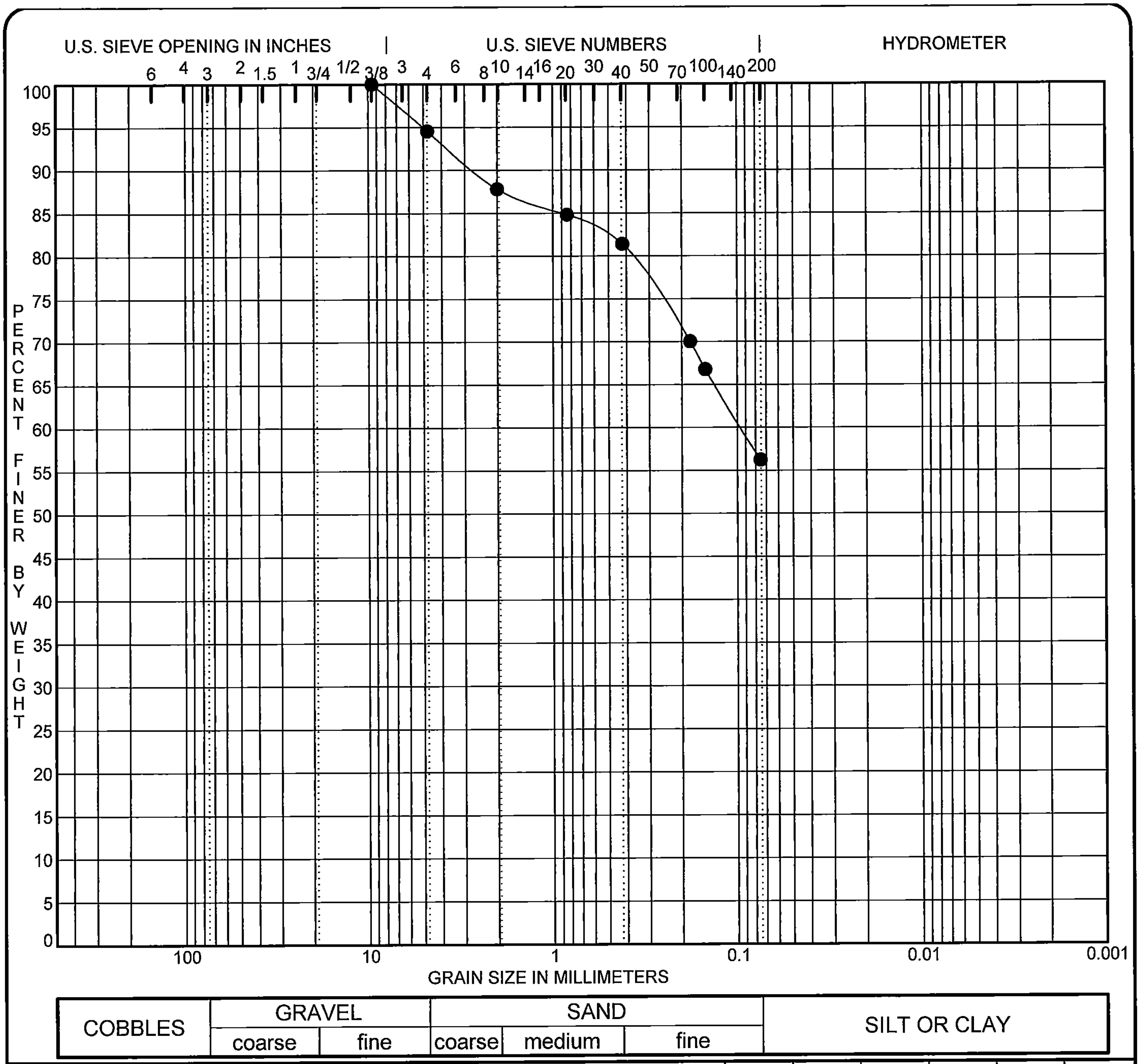

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-9 (0431B) 14.1**	**Gray F/C Sandy Elastic SILT (MH)**	**52.7**	**51**	**39**	**12**		

Specimen Identification	D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-9 (0431B) 14.1**	**9.52**				**5.5**	**38.3**	**56.2**	

PROJECT **SC-41 Over Wando**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **11/30/11**

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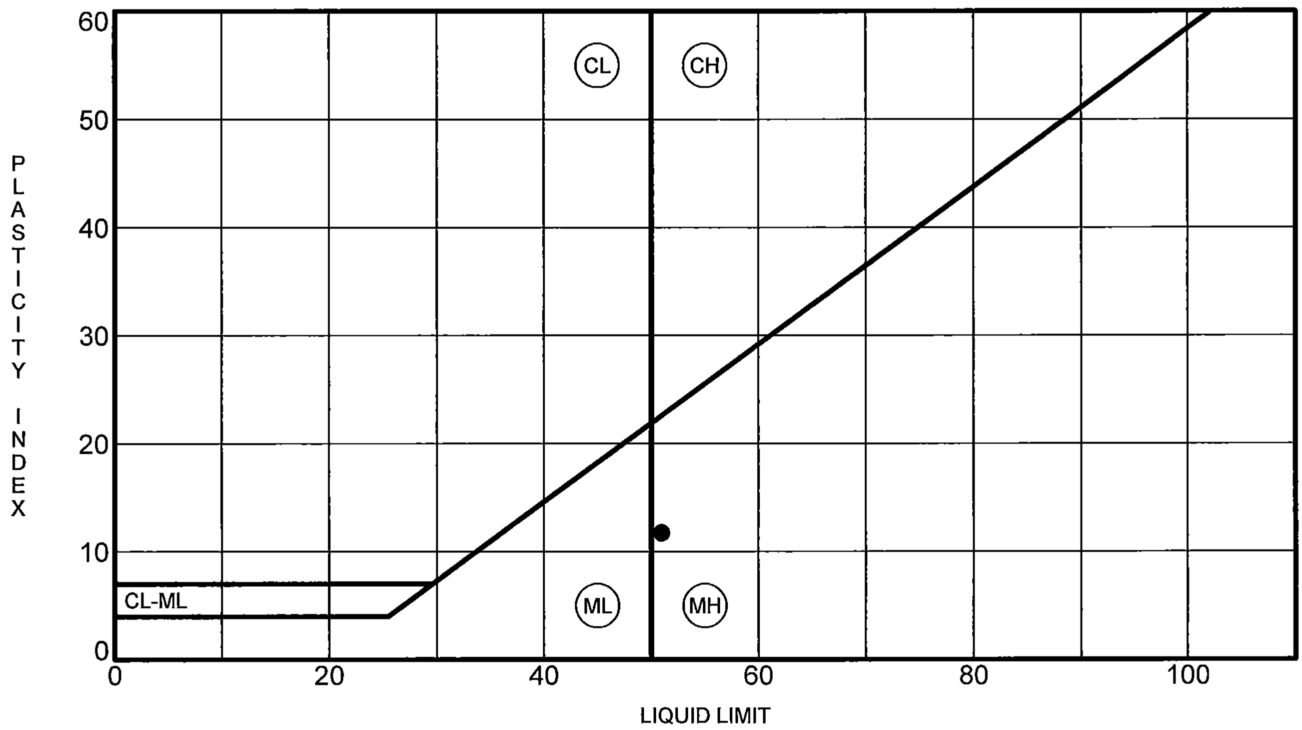
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-9 (0431C)**	**14.1**	**51**	**39**	**12**		**Gray F/C Sandy Elastic SILT (MH)**

ATTERBERG LIMITS' RESULTS

Project: SC-41 Over Wando

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

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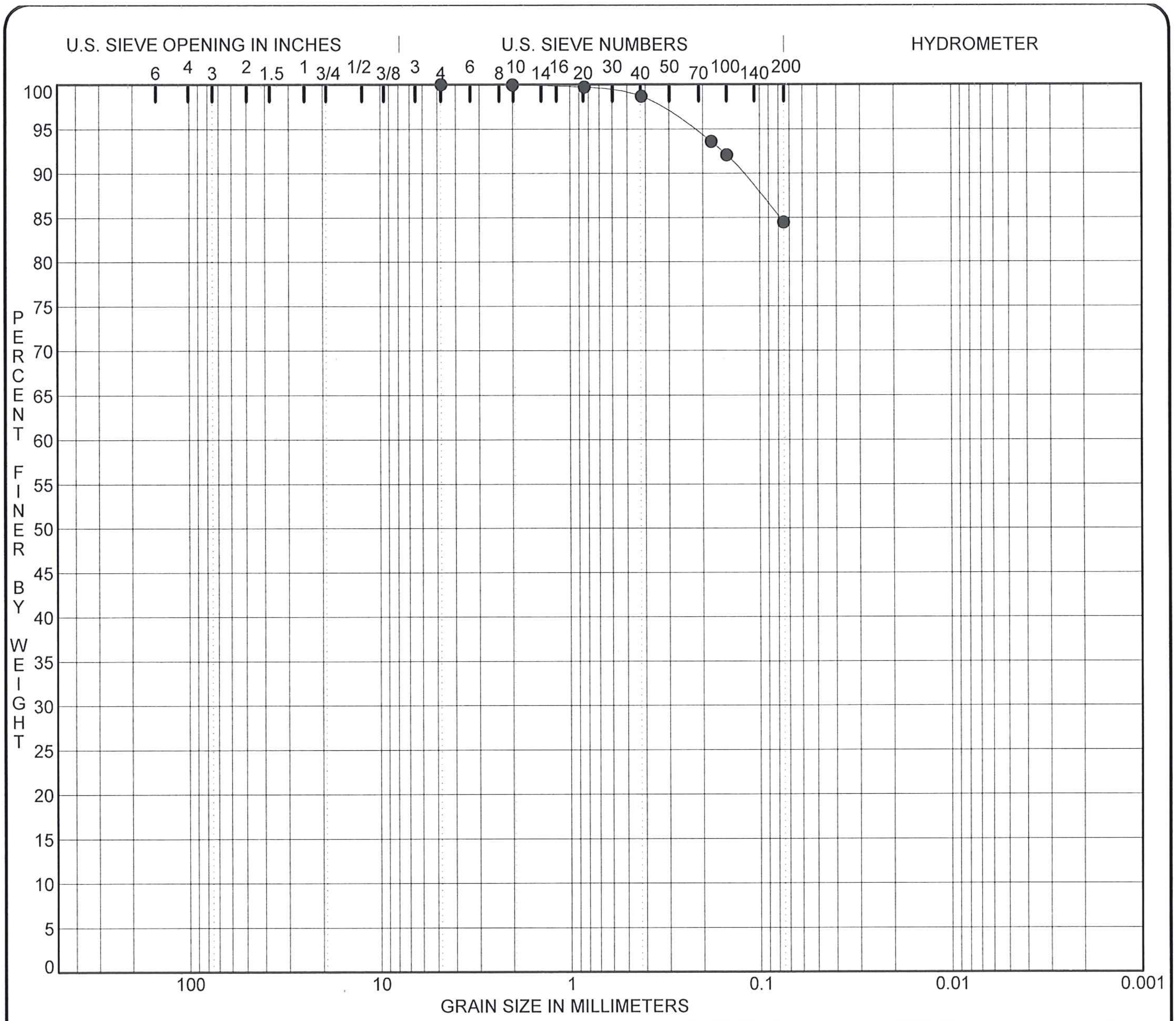
US_ATTERBERG_LIMITS G4067.01LAB.GPJ US_LAB.GDT 11/30/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-9 (0431E) 40.0**	**Green/Brown Elastic SILT (MH), w/Fine Sand**	**76.0**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-9 (0431E) 40.0**	**4.76**				**0.0**	**15.5**	**84.5**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

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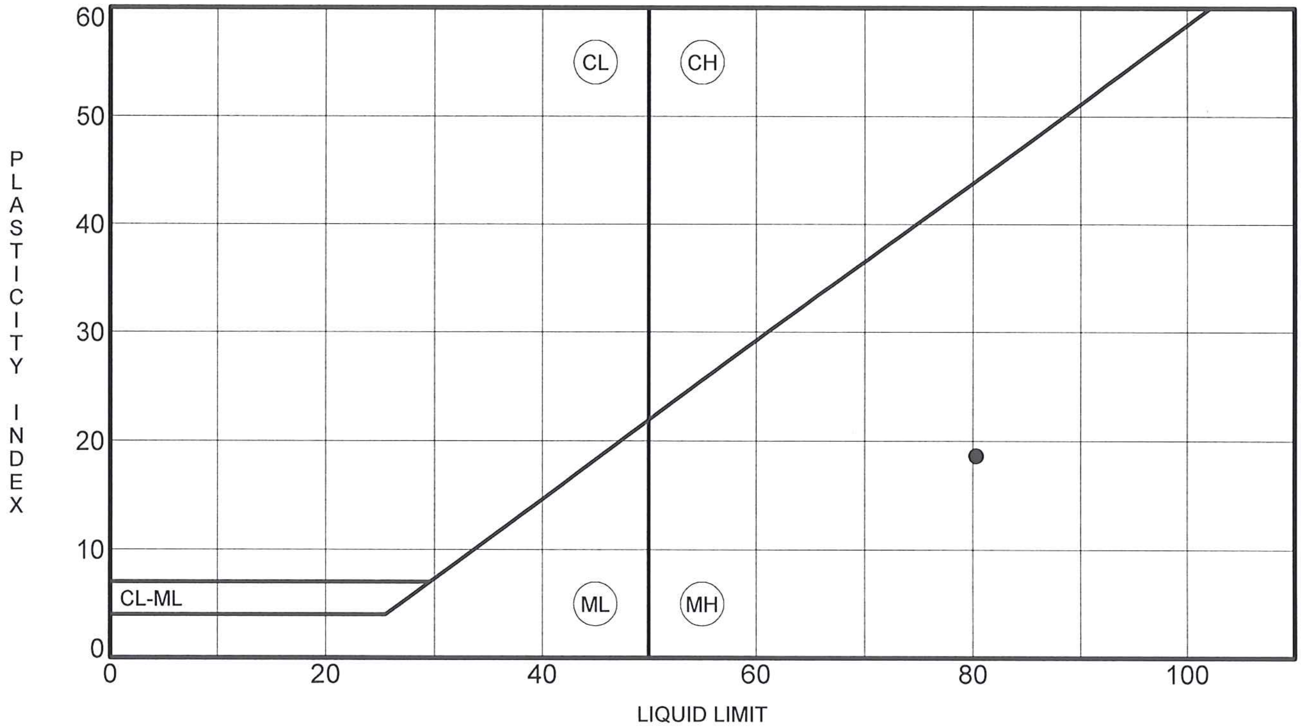
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-9 (0431F)**	**40.0**	**80**	**62**	**18**		**Green/Brown Elastic SILT (MH), w/Fine Sand**

US_ATTERBERG_LIMITS_G4067.01LAB.GPJ_US_LAB.GDT_4/13/11

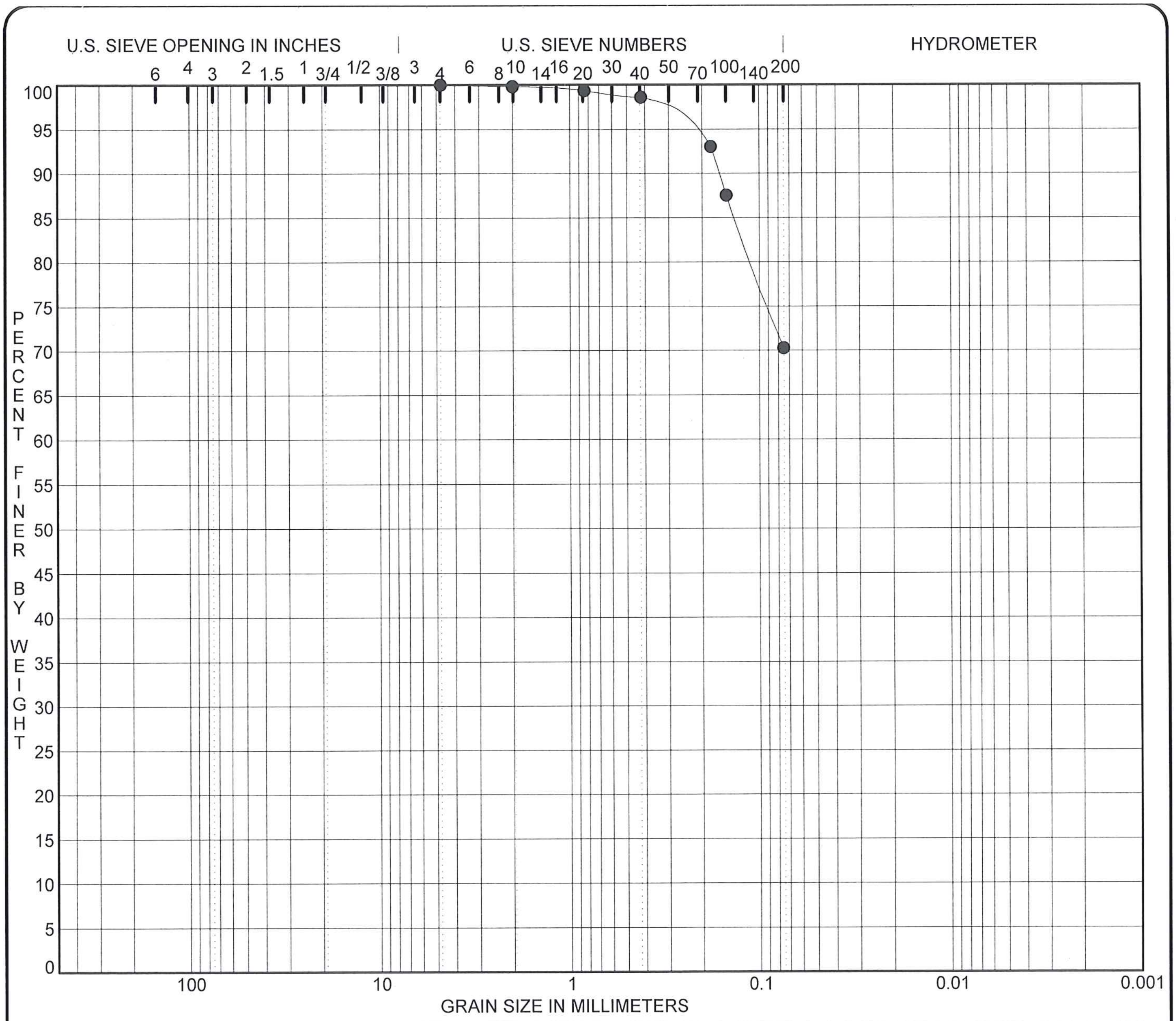
F&ME CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-10 (0489E) 8.0**	**Gray Lean CLAY (CL), w/Fine SAND**	**43.9**					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-10 (0489E) 8.0**	**4.76**				**0.0**	**29.7**	**70.3**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

F&ME
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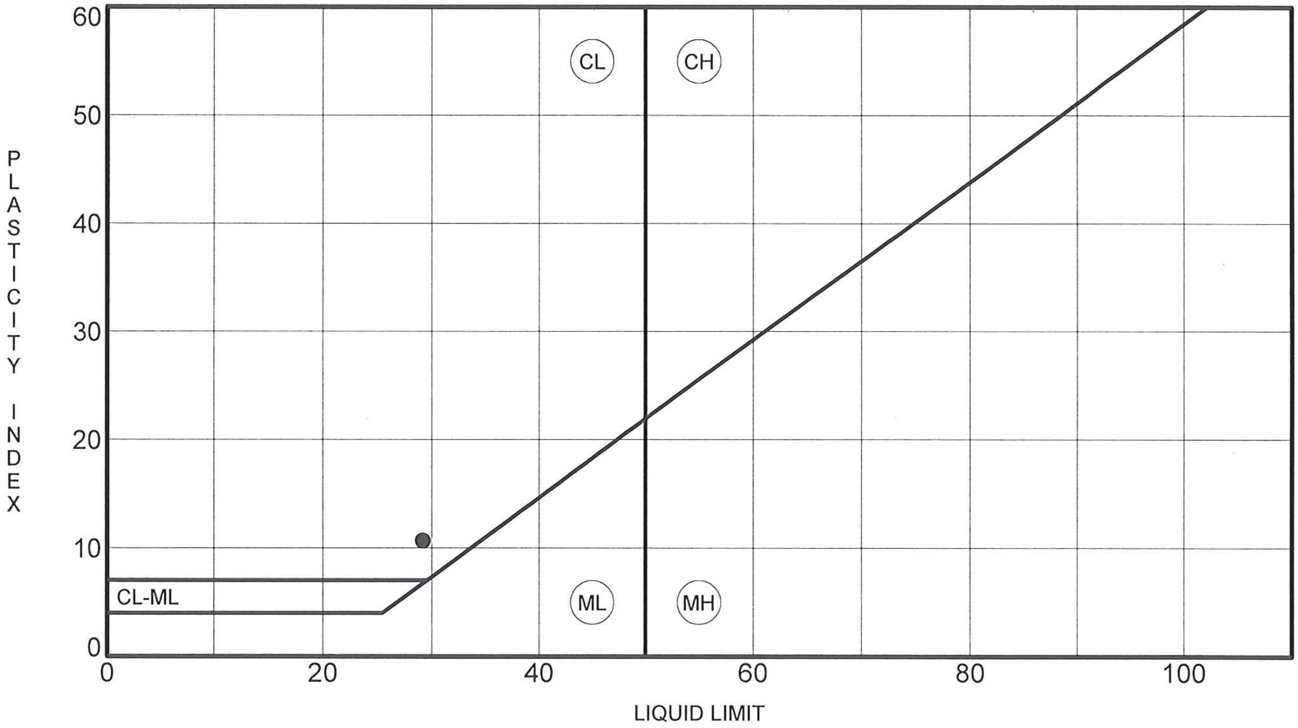
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-10 (0489F)**	**8.0**	**29**	**19**	**10**		**Gray Lean CLAY (CL), w/Fine Sand**

ATTERBERG LIMITS' RESULTS

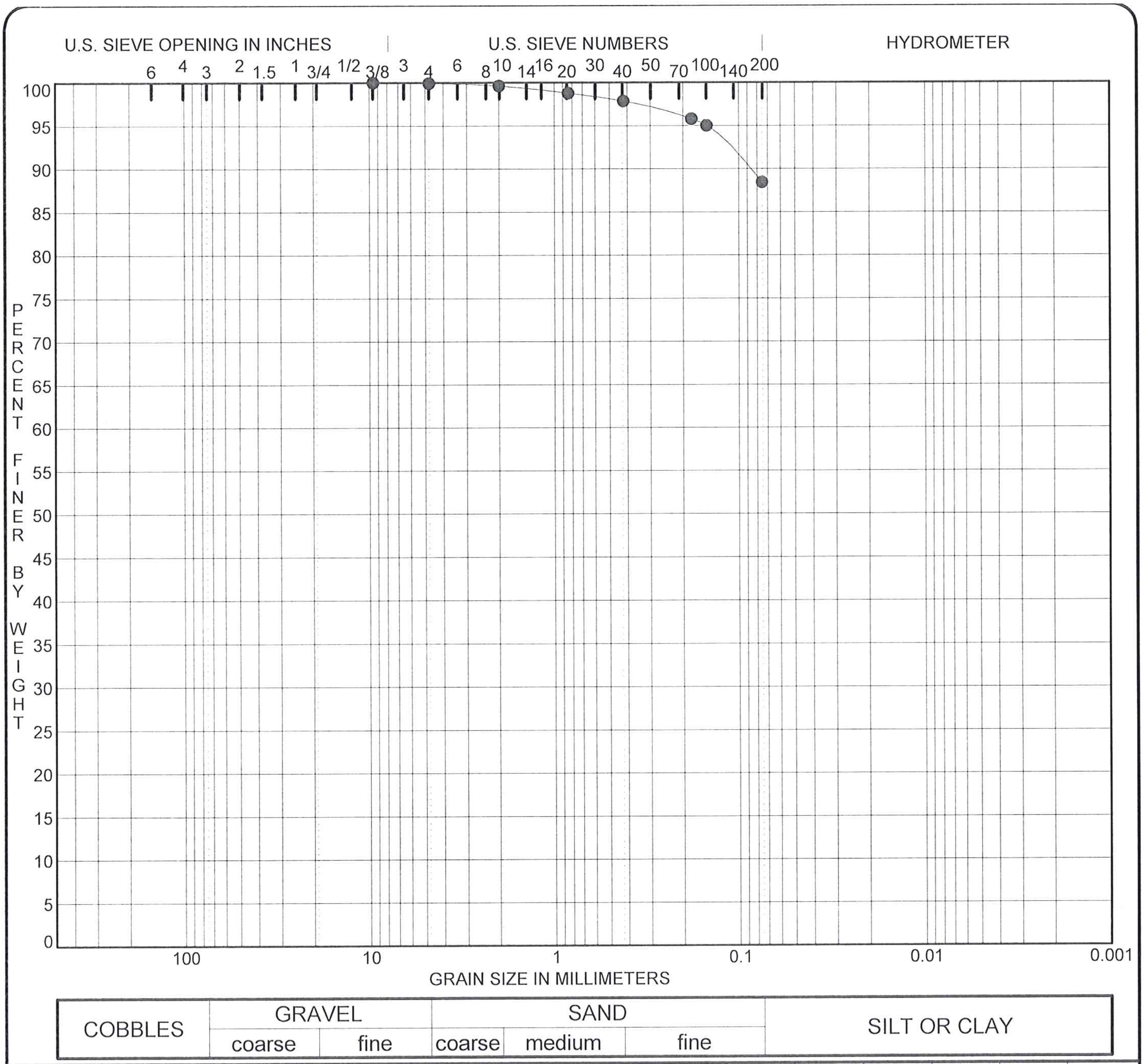
Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-10 (0489H) 55.0**	**Tan Elastic SILT (MH)**	**64.7**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-10 (0489H) 55.0**	**9.52**				**0.1**	**11.5**	**88.4**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/11/11**

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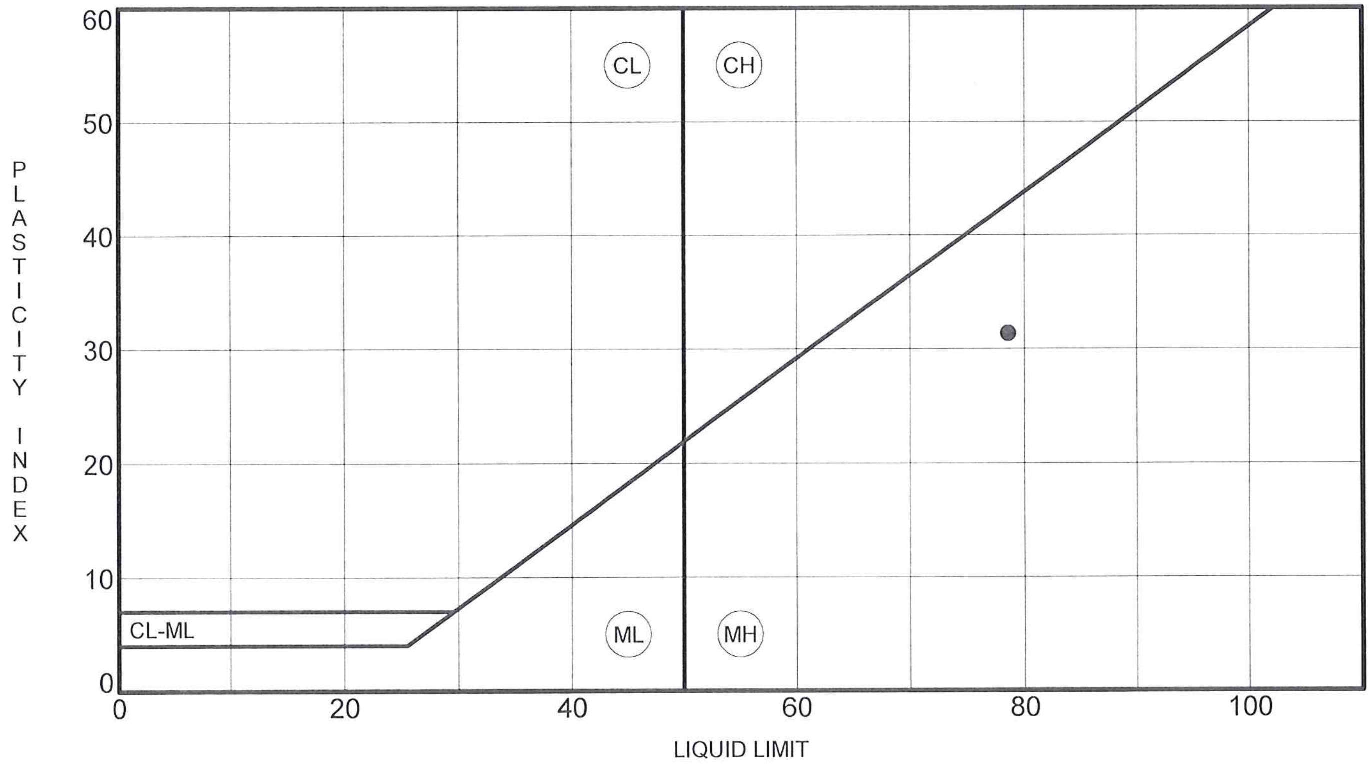
GRADATION CURVES



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**B-10 (0489I) 55.0**	**79**	**47**	**32**		**Tan Elastic SILT (MH)**

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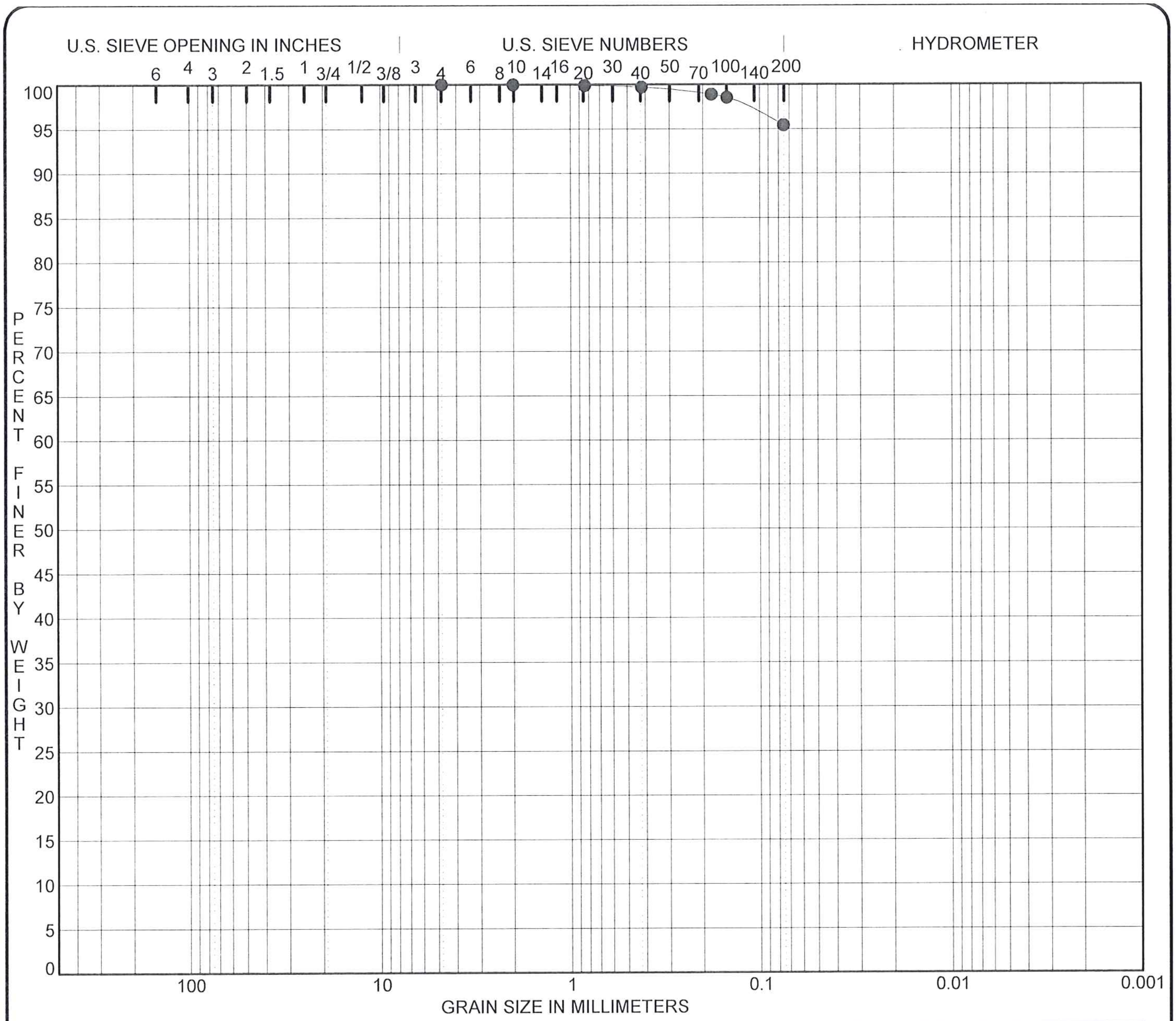
CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-11 (0490E) 15.0**	**Tan Elastic SILT (MH)**	**68.2**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-11 (0490E) 15.0**	**4.76**				**0.0**	**4.6**	**95.4**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/11/11**

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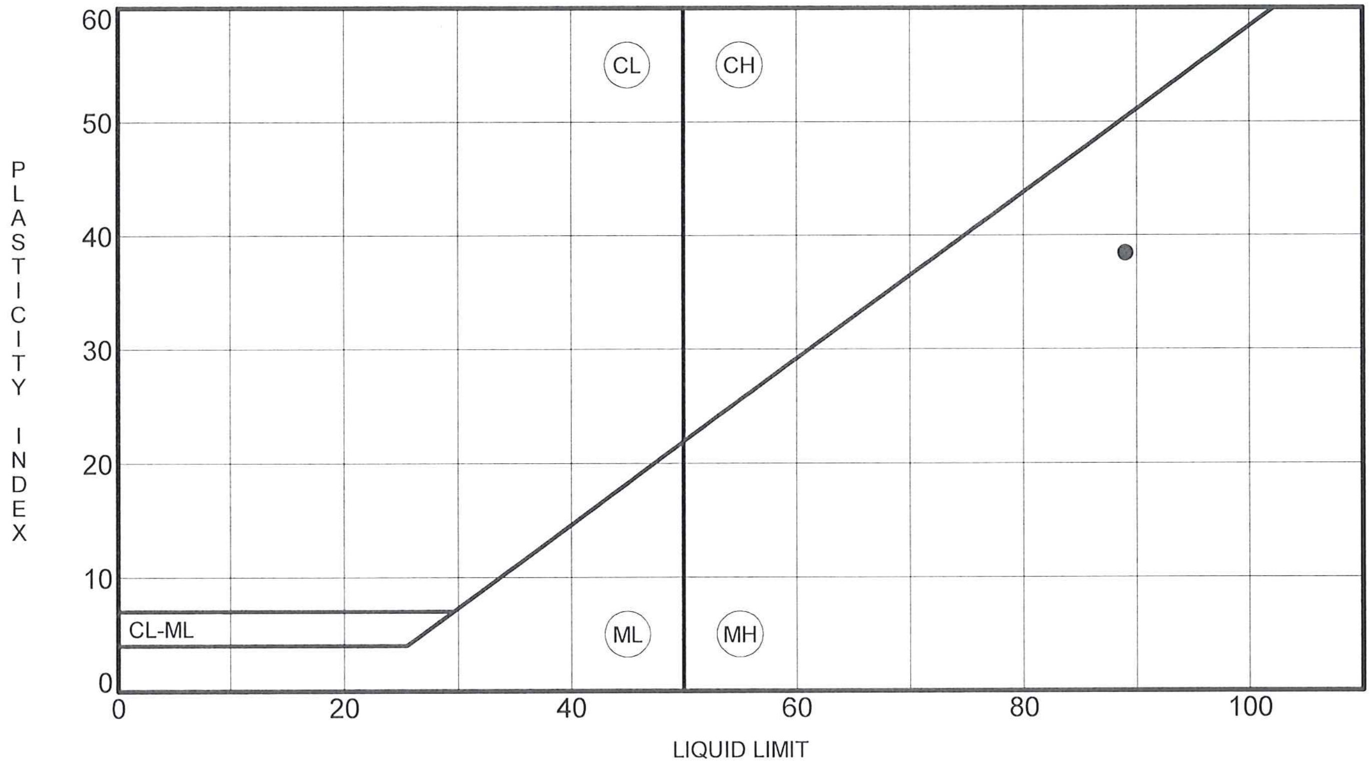
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-11 (0490F)**	**15.0**	**89**	**51**	**38**		**Tan Elastic SILT (MH)**

ATTERBERG LIMITS' RESULTS

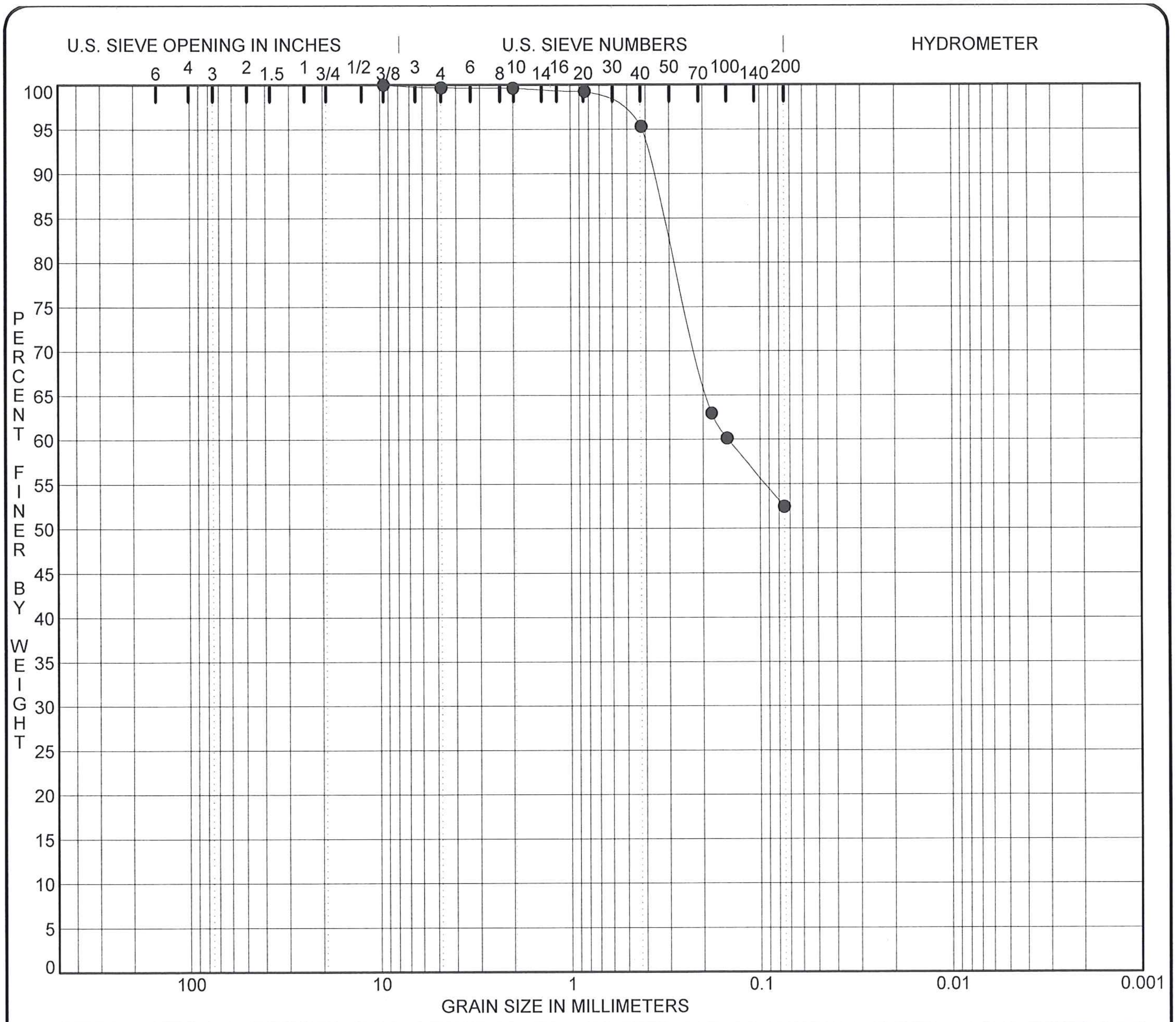
Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/11/11



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<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
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Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B-11 (0490H) 65.0**	**Gray F/M Sandy SILT (ML)**	**46.4**					

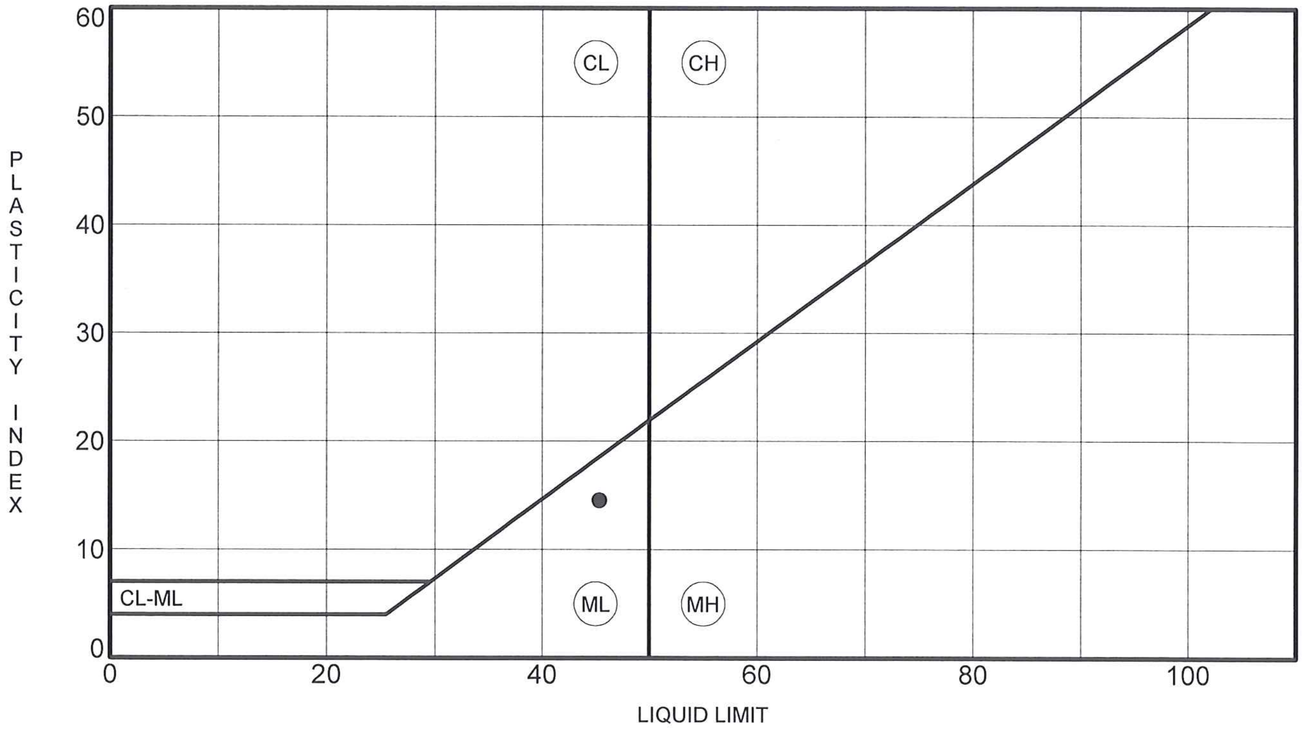
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-11 (0490H) 65.0**	**9.52**	**0.15**			**0.3**	**47.2**	**52.4**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/13/11**

F&ME CONSULTANTS

GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-11 (0490I)**	**65.0**	**45**	**31**	**14**		**Gray F/M Sandy SILT (ML)**

ATTERBERG LIMITS' RESULTS

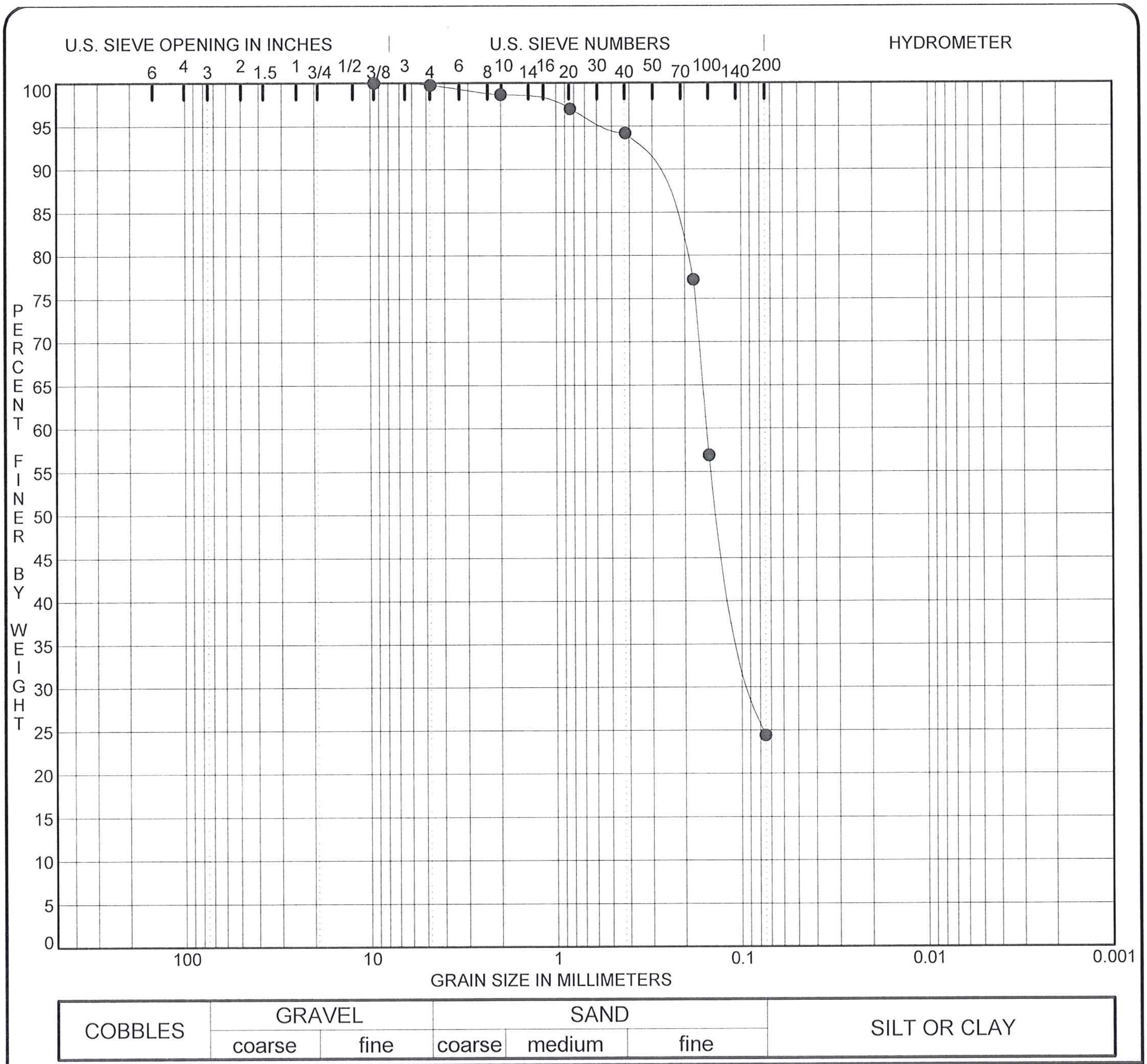
Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**RW-1 (0456B)15.0**	**Gray Silty F/M SAND (SM)**	**33.6**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RW-1 (0456B)15.0**	**9.52**	**0.15**	**0.084**		**0.2**	**75.3**	**24.4**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/4/11**

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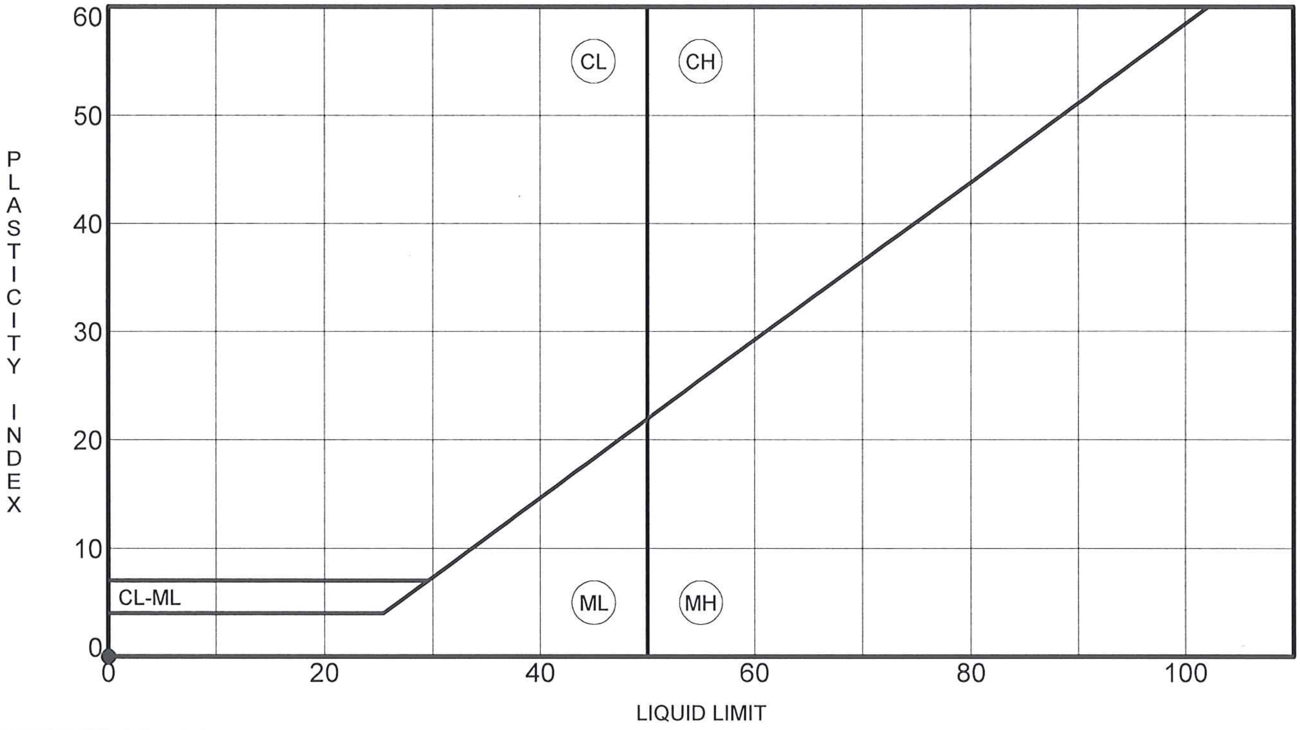
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-1 (0456C)**	**15.0**	**NP**	**NP**	**NP**		**Gray Silty F/M SAND (SM)**

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11

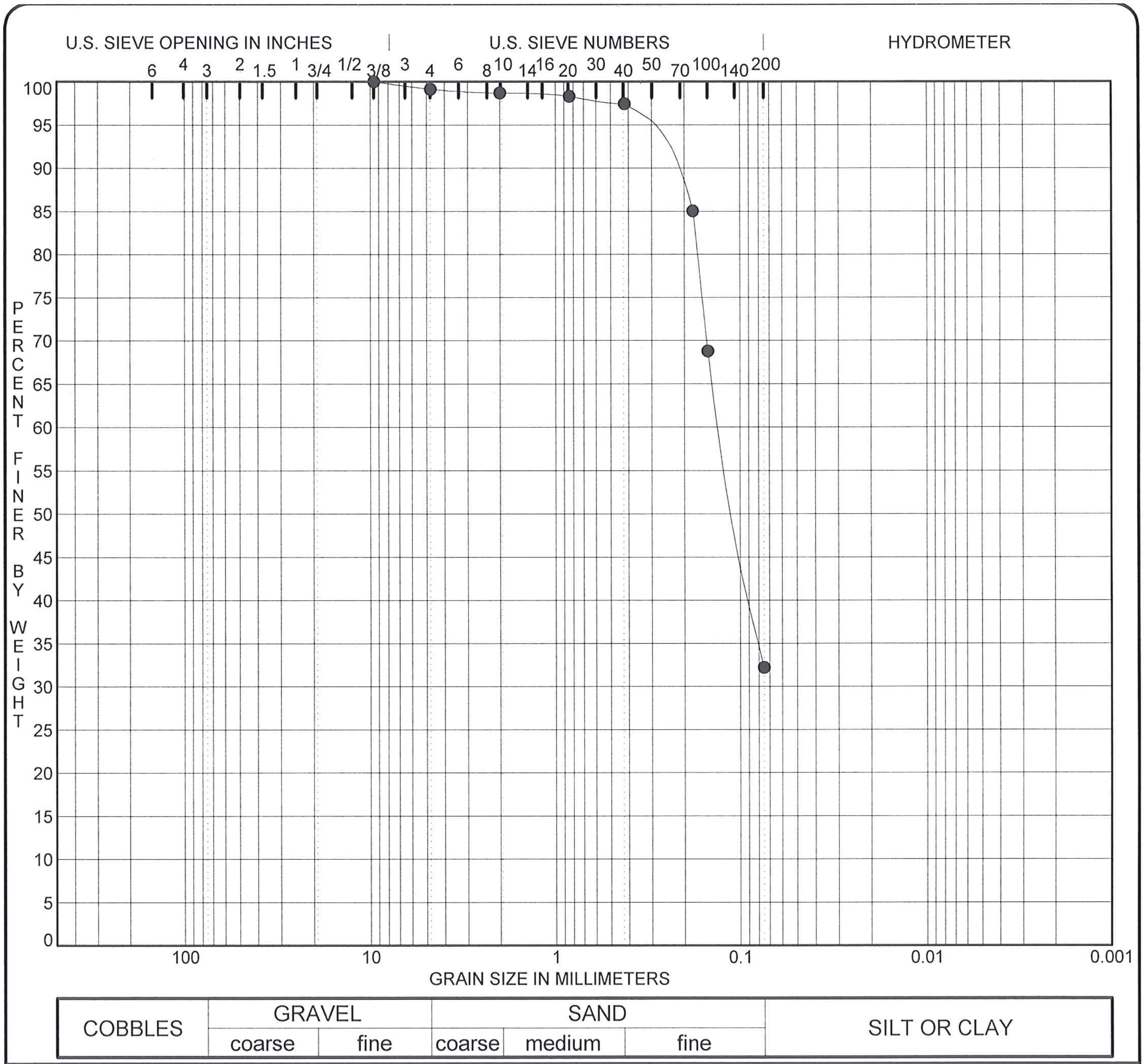
F&ME CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **RW-1 (0456E)20.0**	**Yellow-Tan Silty Fine SAND (SM)**	**38.1**					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **RW-1 (0456E)20.0**	**9.52**	**0.13**			**0.9**	**66.9**	**32.2**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**
JOB NO. **G4067.01**
DATE **4/13/11**

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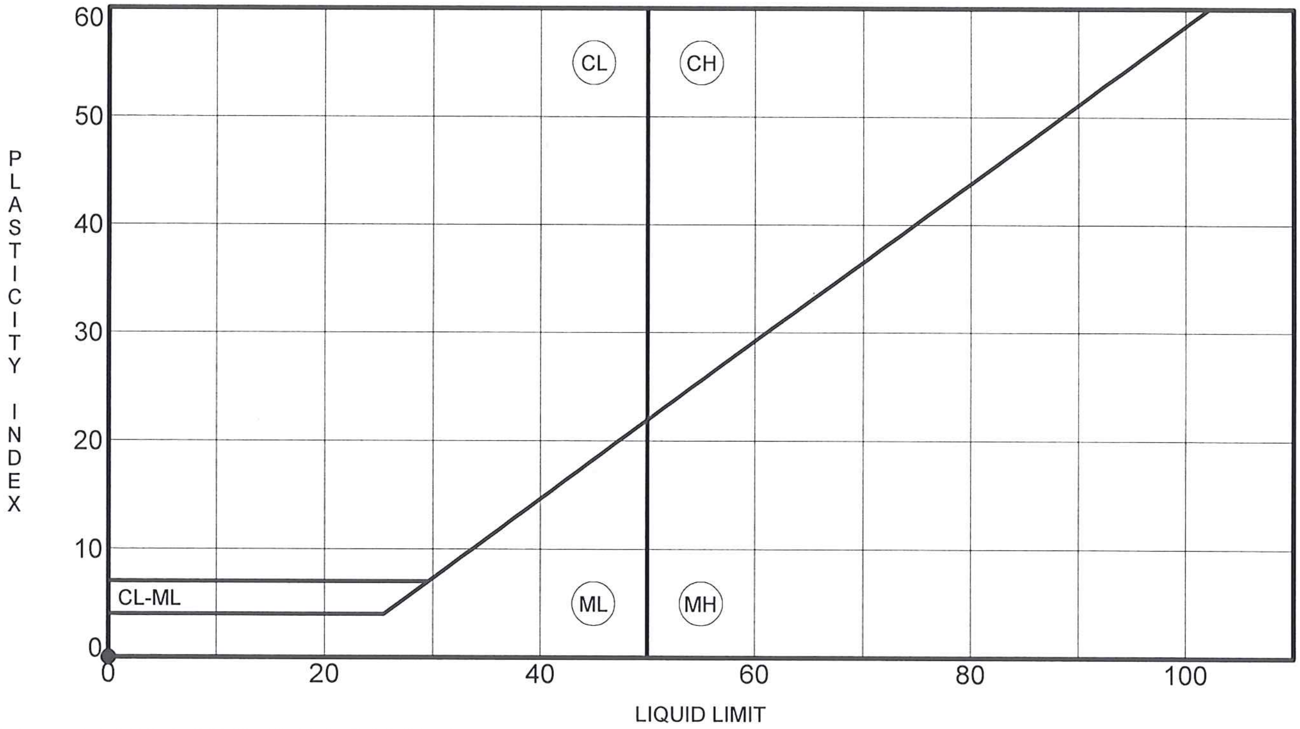
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-1 (0456F)**	**20.0**	**NP**	**NP**	**NP**		**Yellow-Tan Silty Fine SAND (SM)**

ATTERBERG LIMITS' RESULTS

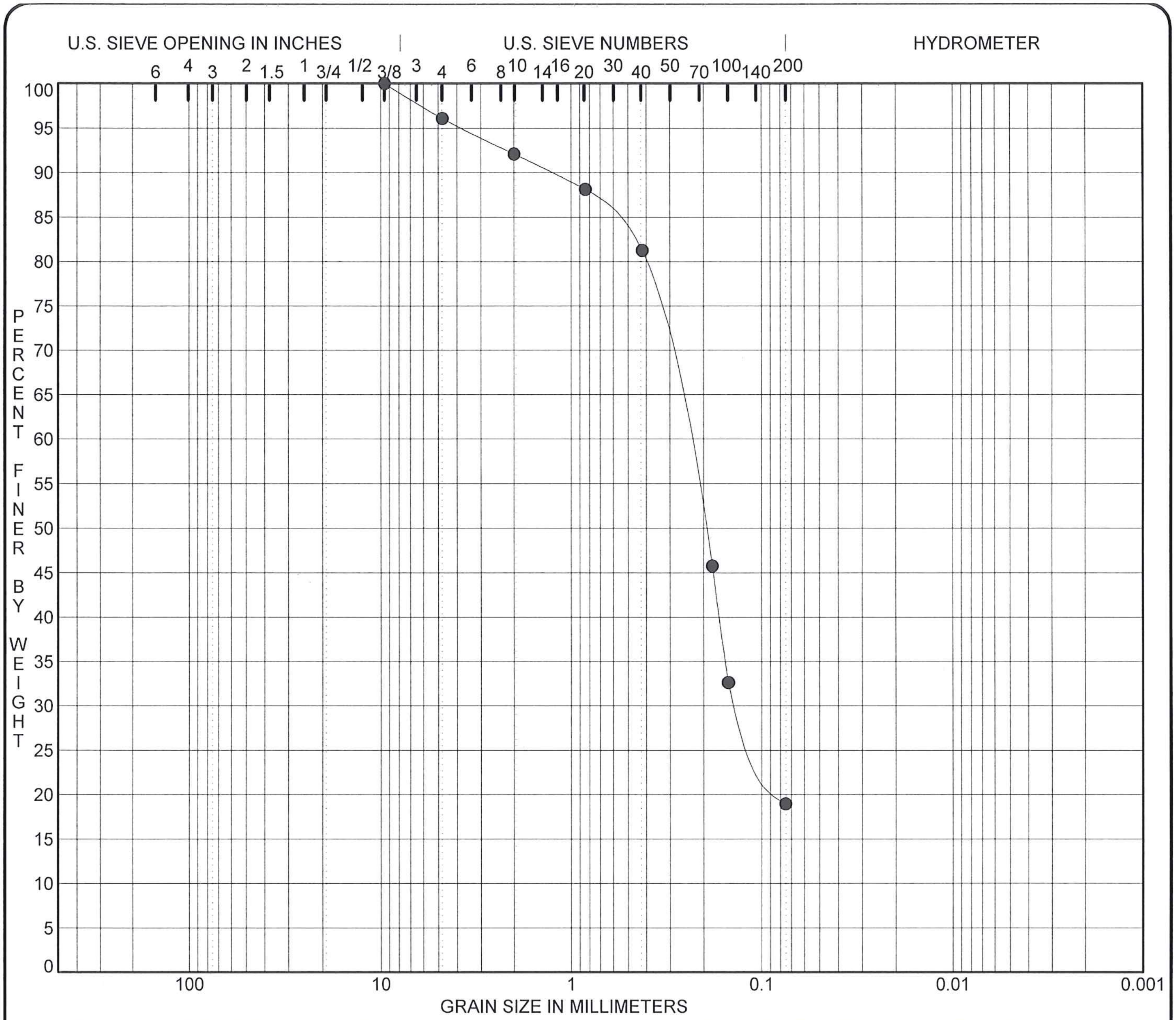
Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/13/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**RW-2 (0457B)15.0**	**White/Orange Silty F/C SAND (SM)**	**35.7**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RW-2 (0457B)15.0**	**9.52**	**0.25**	**0.131**		**3.9**	**77.1**	**19.0**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**
JOB NO. **G4067.01**
DATE **4/13/11**

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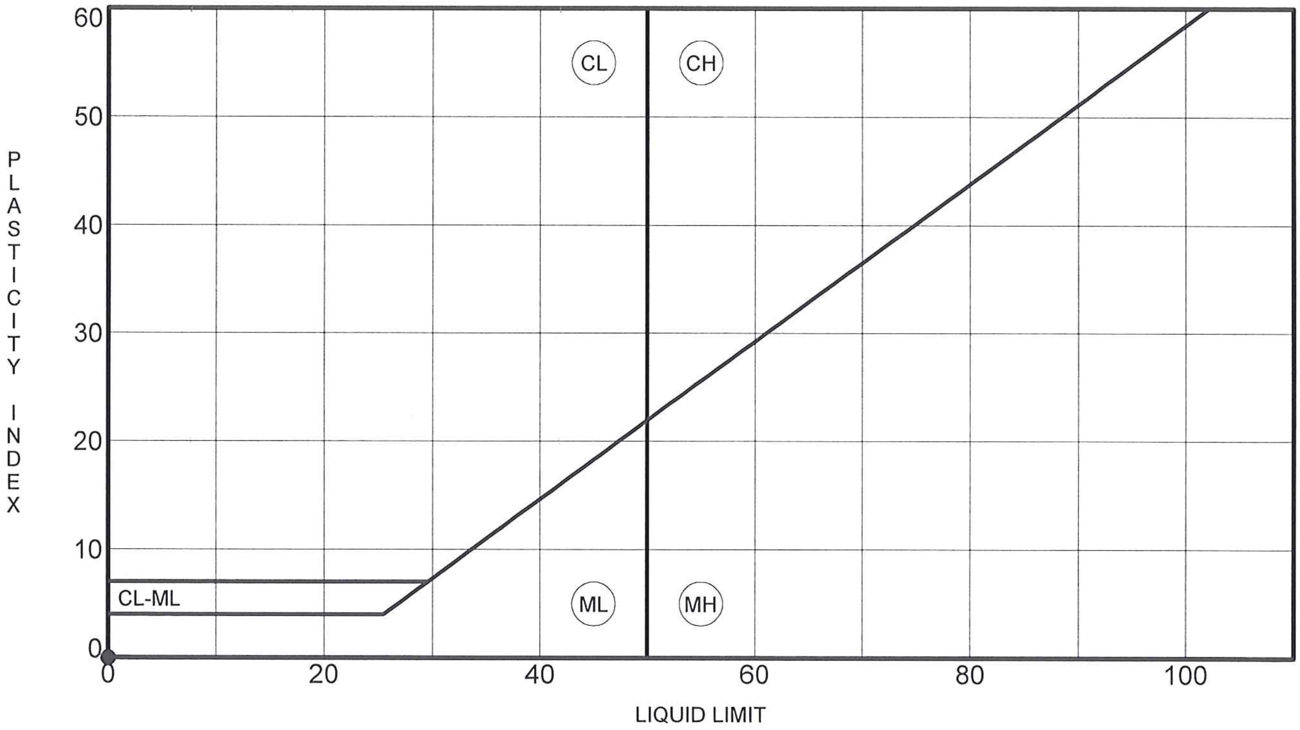
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-2 (0457C)**	**15.0**	**NP**	**NP**	**NP**		**White/Orange Silty F/C SAND (SM)**

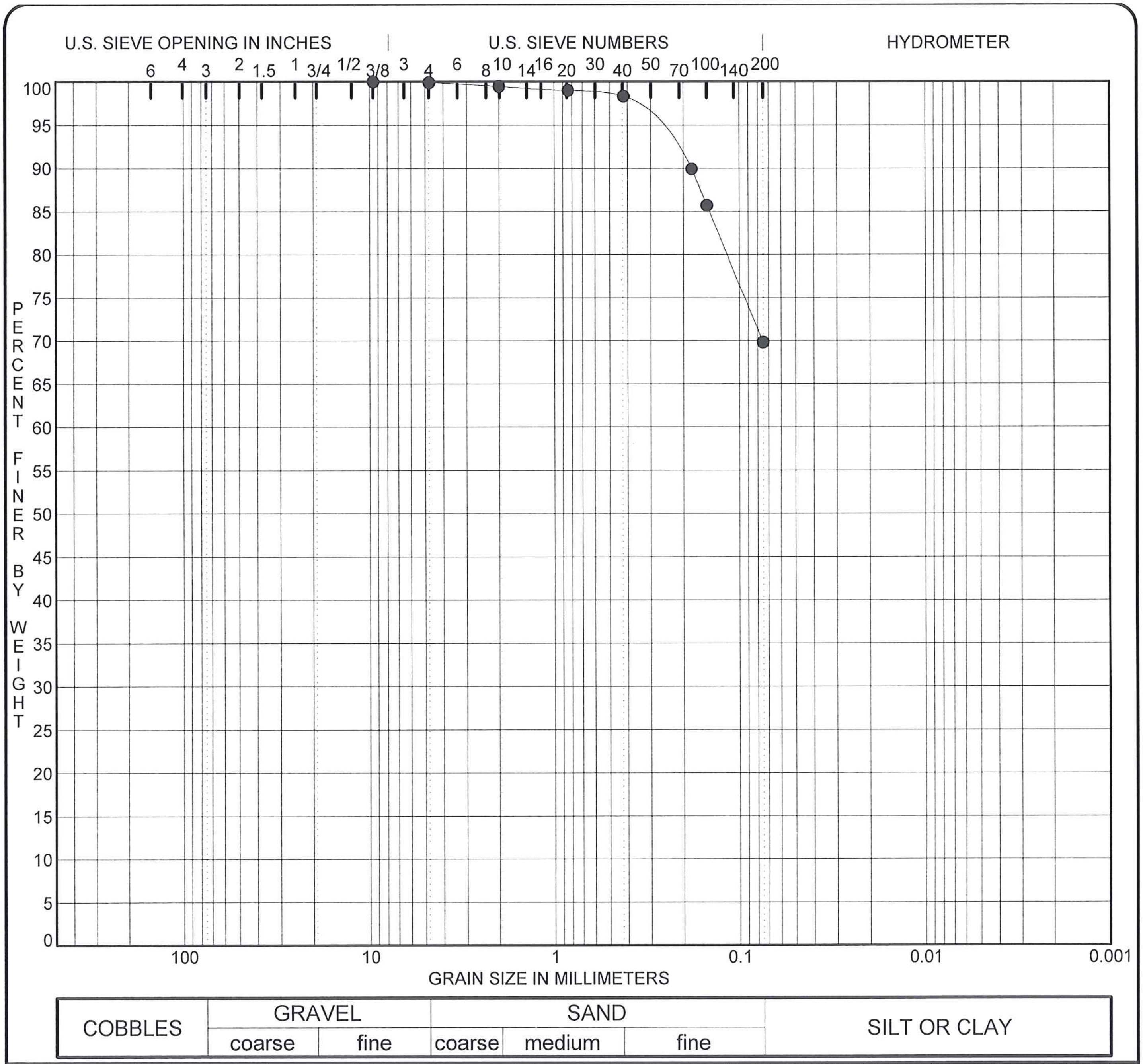
ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **RW-2 (0457E)25.0**	**Tan Fine Sandy SILT (ML)**	**54.6**					

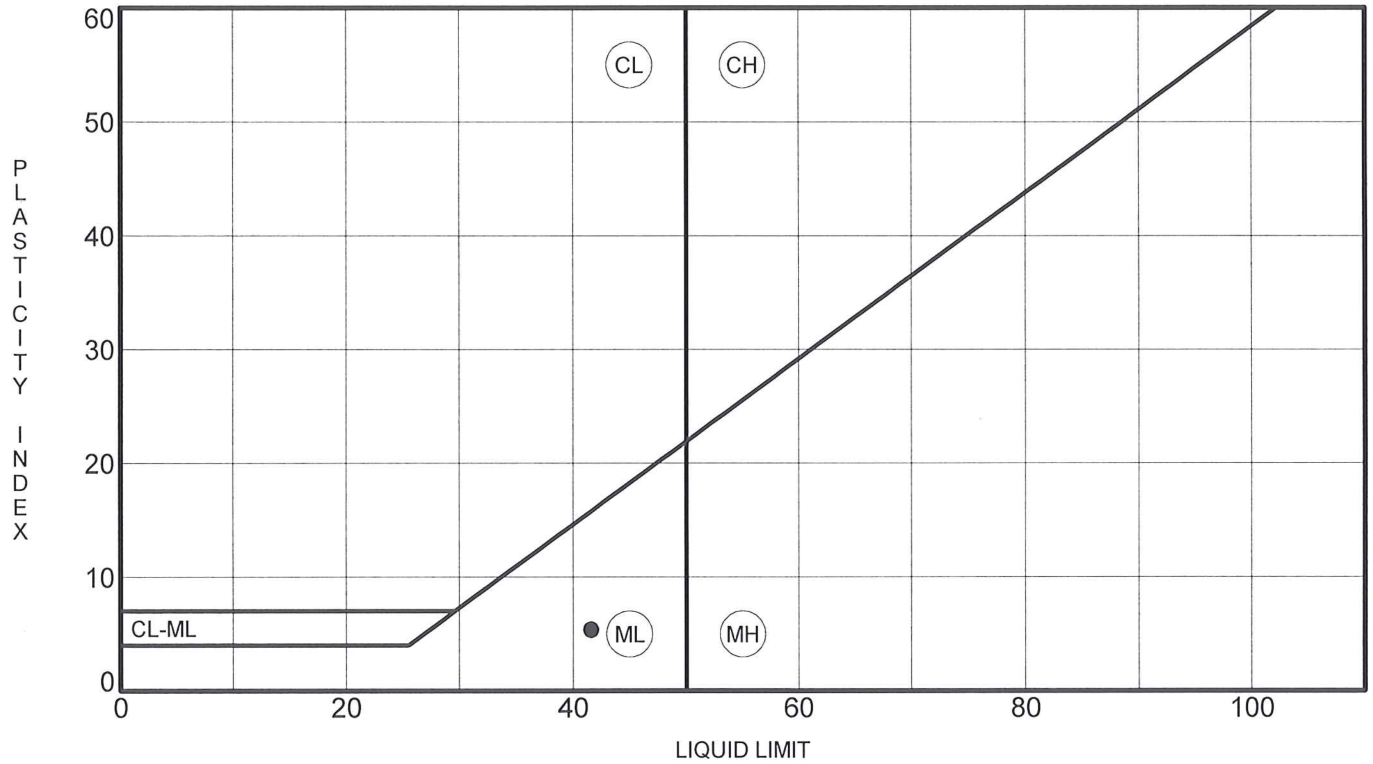
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **RW-2 (0457E)25.0**	**9.52**				**0.1**	**30.1**	**69.8**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/14/11**

F&ME CONSULTANTS

GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-2 (0457F)**	**25.0**	**42**	**36**	**6**		**Tan Fine Sandy SILT (ML)**

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/14/11

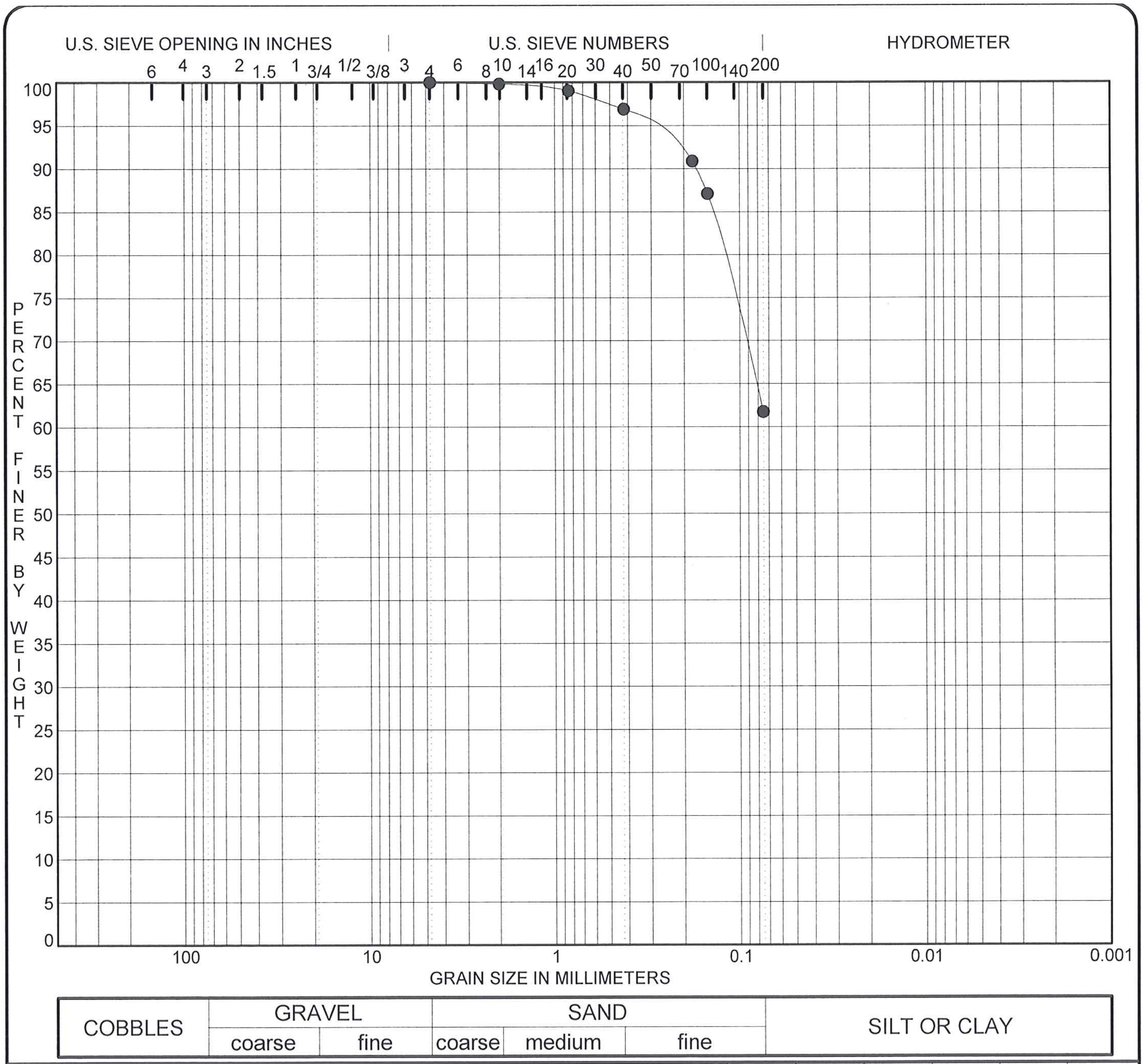
F&ME CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**RW-3 (0458B)10.0**	**Green/Gray/Yellow F/M Sandy SILT (ML)**	**30.9**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RW-3 (0458B)10.0**	**4.76**				**0.0**	**38.3**	**61.7**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/14/11**

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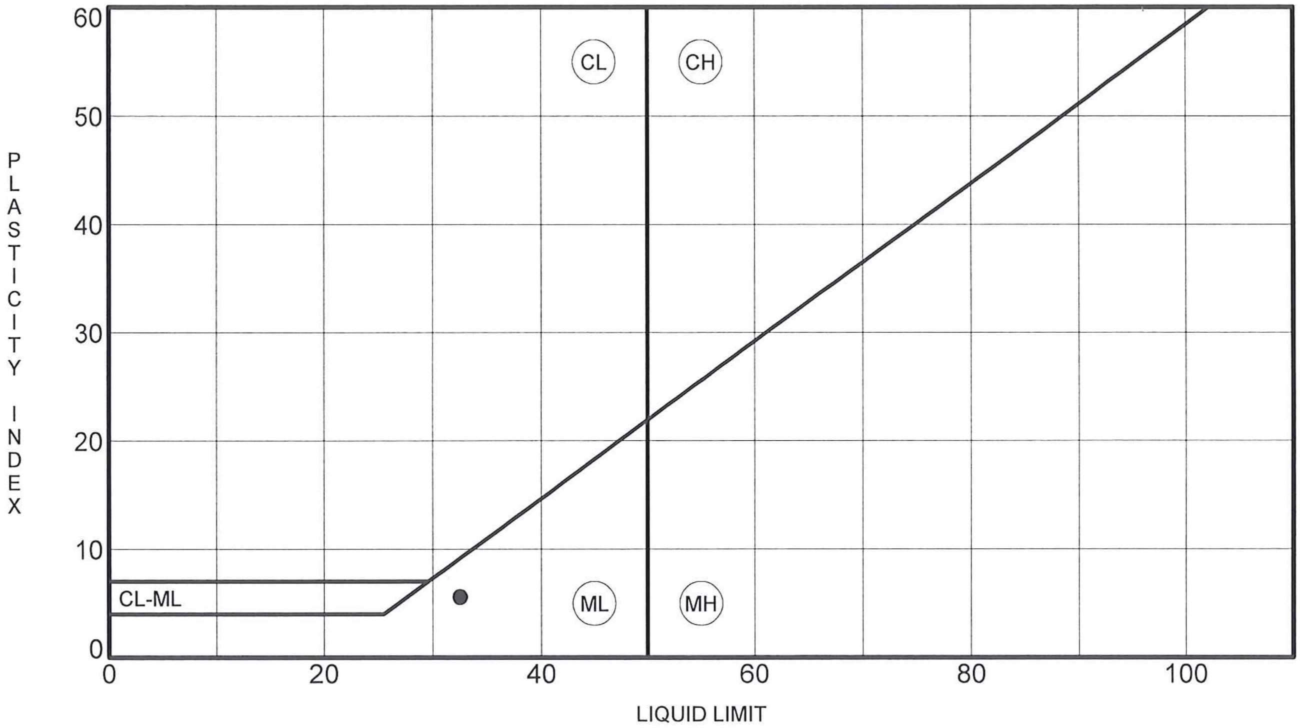
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-3 (0458C)**	**10.0**	**33**	**27**	**6**		**Green/Gray/Yellow F/M Sandy SILT (ML)**

ATTERBERG LIMITS' RESULTS

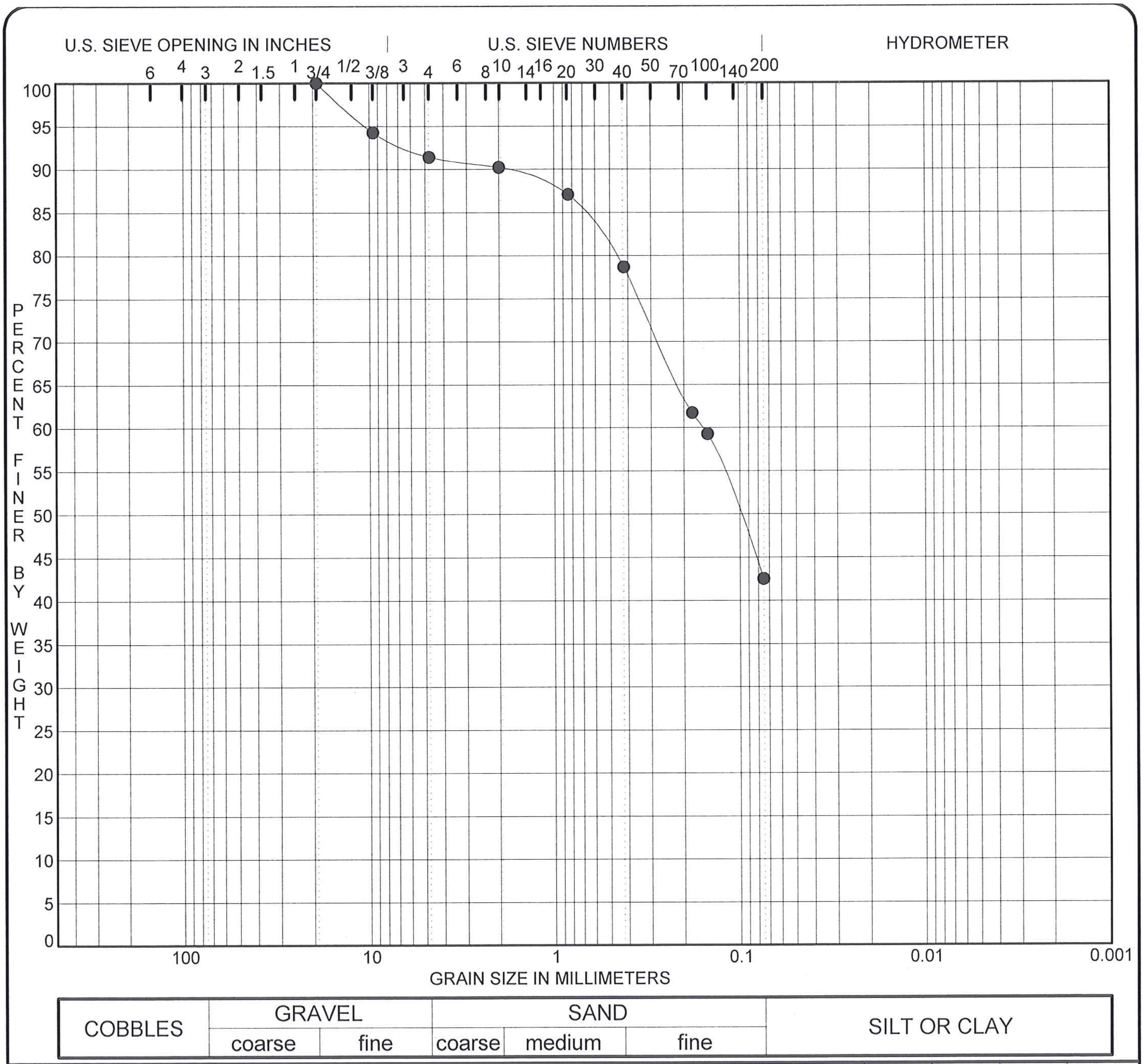
Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01

F&ME CONSULTANTS

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/14/11



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**RW-4 (0459B)10.0**	**Green/Gray/Orange Silty F/C SAND (SM)**	**33.5**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RW-4 (0459B)10.0**	**19.10**	**0.16**			**8.6**	**48.9**	**42.5**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/14/11**

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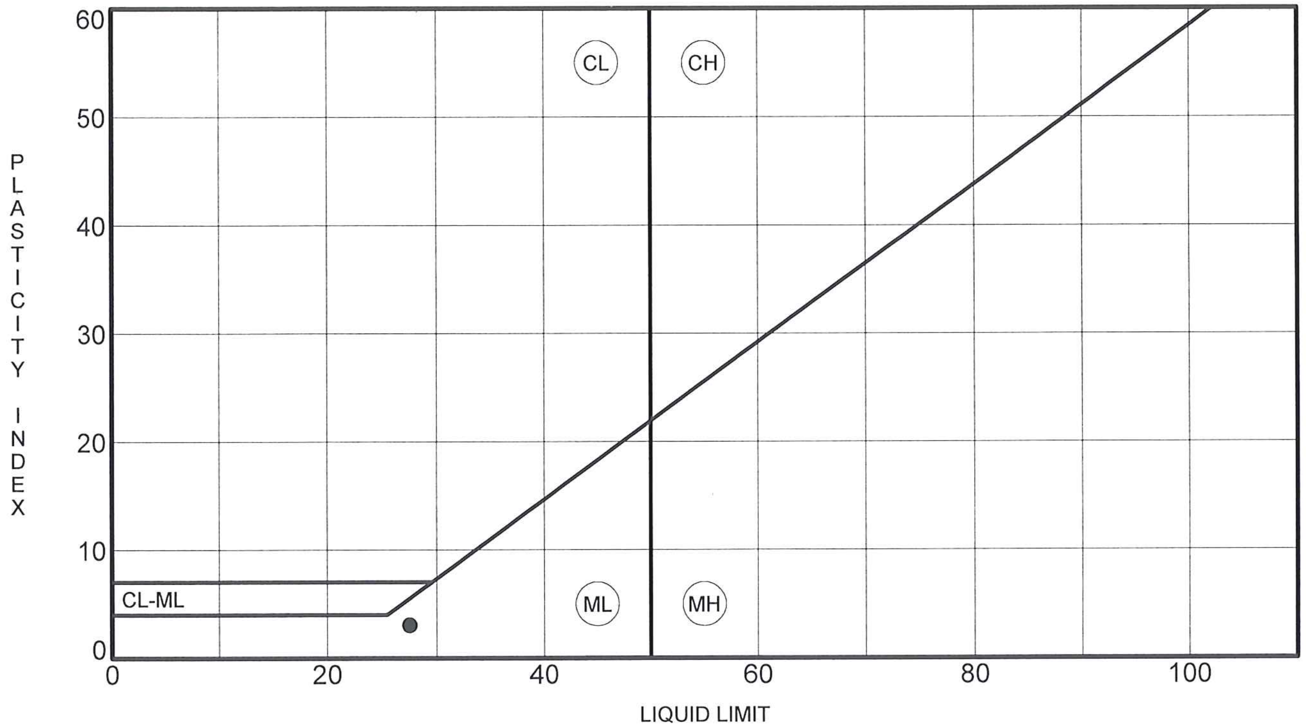
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-4 (0459C)**	**10.0**	**28**	**24**	**4**		**Green/Gray/Orange Silty F/C SAND (SM)**

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/14/11

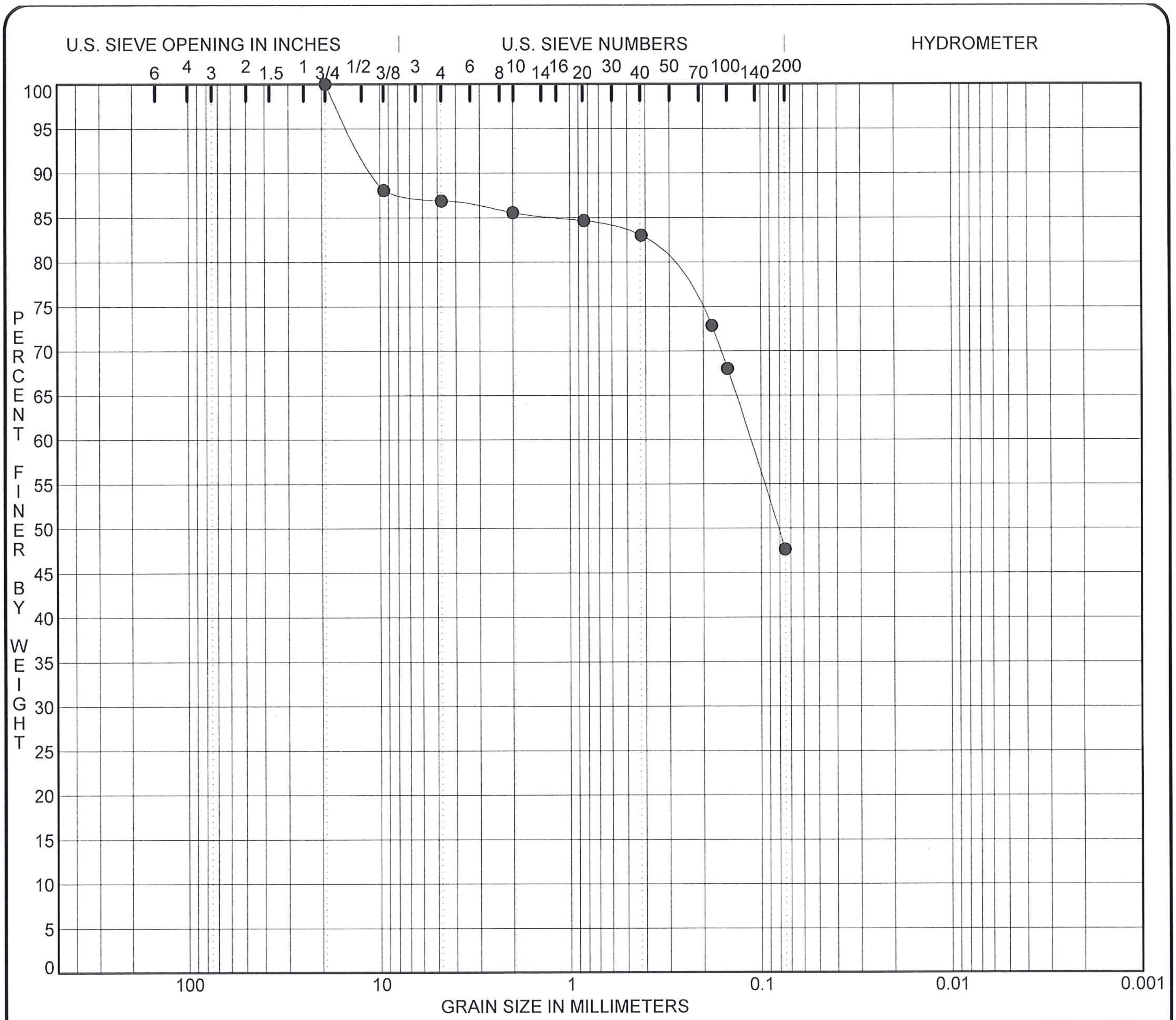
F&ME
CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**RW-4 (0459E)15.0**	**Tan/Yellow Silty F/C SAND (SM)**	**33.8**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**RW-4 (0459E)15.0**	**19.10**	**0.11**			**13.1**	**39.2**	**47.6**	

PROJECT **SC-41**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067.01**
DATE **4/14/11**

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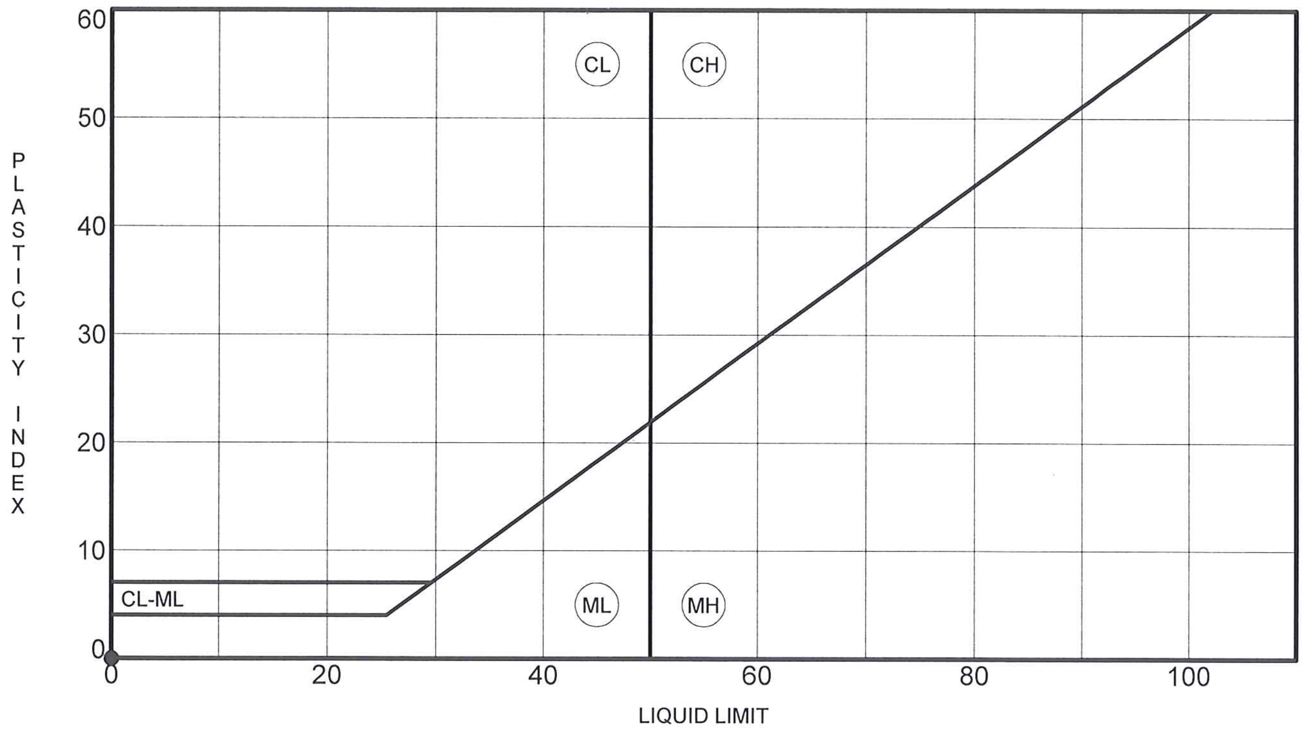
GRADATION CURVES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW-4 (0459F)**	**15.0**	**NP**	**NP**	**NP**		**Tan Silty F/C SAND (SM)**

US ATTERBERG LIMITS G4067.01LAB.GPJ US LAB.GDT 4/14/11

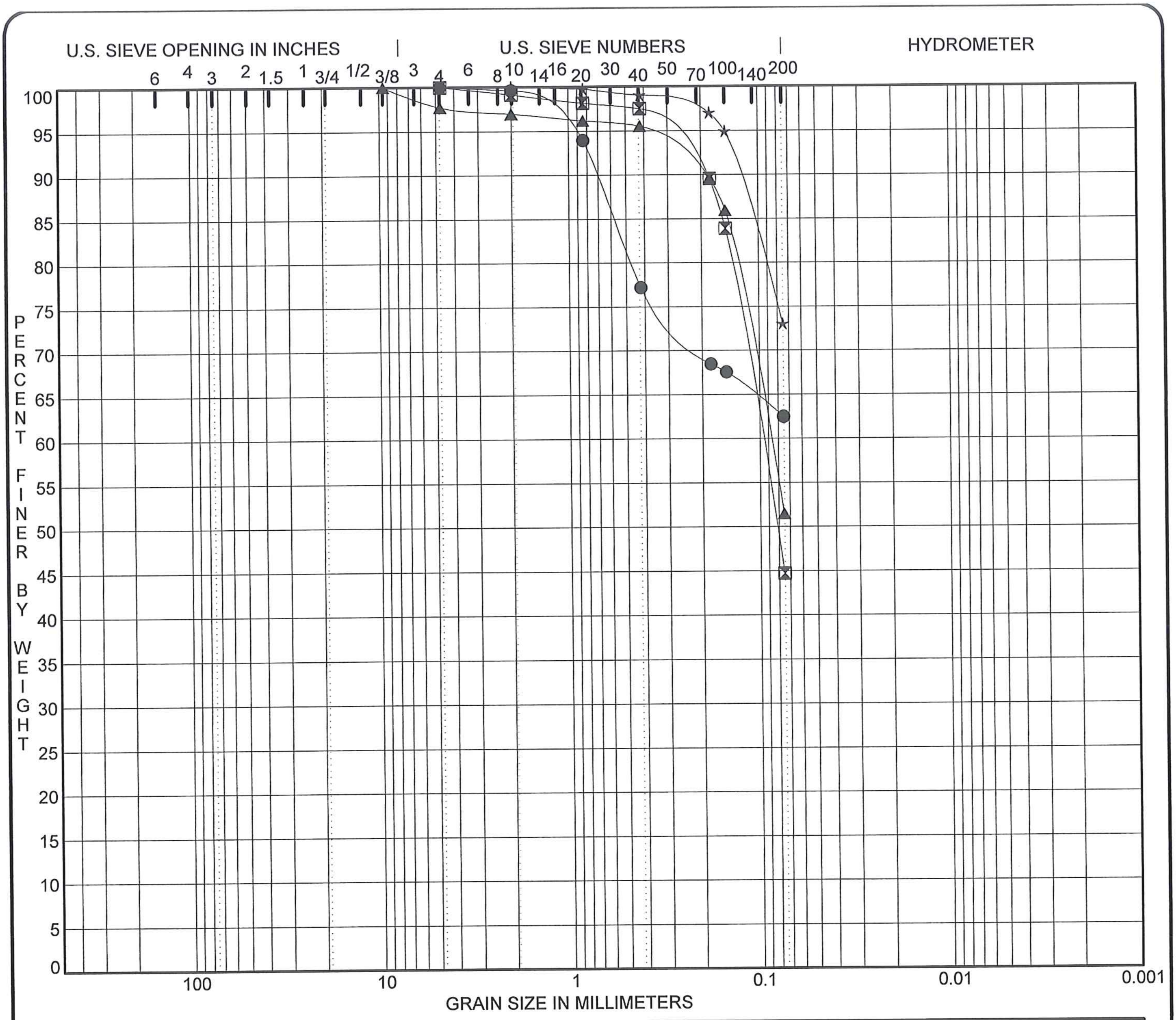
F&ME
CONSULTANTS

ATTERBERG LIMITS' RESULTS

Project: SC-41

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067.01



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● WB 3	6.0'-7.5'	Grayish Orange F-M Sandy Lean CLAY (CL)	29.0	41	20	22		
☒ WB-3	18.5'-20.0'	Tan Silty F-M SAND (SM)	47.1	NP	NP	NP		
▲ WB-4	18.5'-20.0'	Gray F-M Sandy SILT (ML)	45.9	NP	NP	NP		
★ WB-6	13.5'-15.0'	Gray F-M Sandy Lean to Elastic CLAY (CL-CH)	45.7	50	23	27		

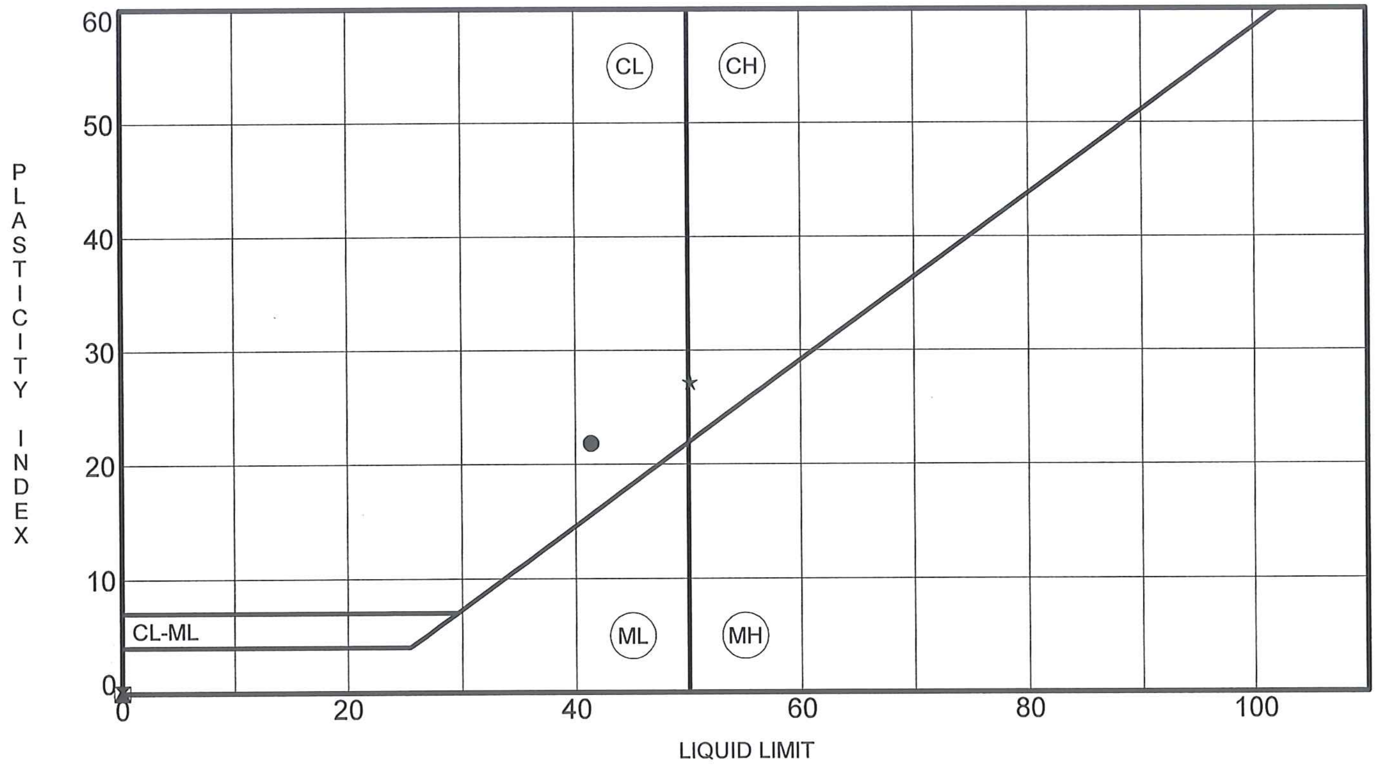
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● WB 3	6.0'-7.5'	4.76				0.0	37.5	62.5	
☒ WB-3	18.5'-20.0'	4.76	0.10			0.0	55.3	44.7	
▲ WB-4	18.5'-20.0'	9.52	0.09			2.3	46.2	51.5	
★ WB-6	13.5'-15.0'	2.00				0.0	27.0	73.0	

PROJECT **SC-41 Bridge Replacement Over Wando River**
LOCATION **Berkeley/Charleston Counties, South Carolina**

JOB NO. **G4067**
DATE **4/25/05**

F&ME
CONSULTANTS

GRADATION CURVES



Specimen Identification			LL	PL	PI	Fines	Classification
●	**WB 3**	**7.5**	**41**	**20**	**21**	**62**	**Grayish Orange F-M Sandy Lean CLAY (CL)**
☒	**WB-3**	**20.0**	**NP**	**NP**	**NP**	**45**	**Tan Silty F-M SAND (SM)**
▲	**WB-4**	**20.0**	**NP**	**NP**	**NP**	**51**	**Gray F-M Sandy SILT (ML)**
★	**WB-6**	**15.0**	**50**	**23**	**27**	**73**	**Gray F-M Sandy Lean to Elastic CLAY (CL-CH)**

F&ME
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ATTERBERG LIMITS' RESULTS

Project: SC-41 Bridge Replacement Over Wando River

Location: Berkeley/Charleston Counties, South Carolina

Number: G4067

SC DEPARTMENT OF
TRANSPORTATION FORM
930 (REV. 8/01)

TEST REPORT OF
SOIL

LABORATORY NO. 0019
COLUMBIA, SC

FILE NO.

PROJECT NO. G4067

PIN.

SAMPLE OF	Soil	SUBMITTED BY	Wade Myers
DATE SAMPLED	01/06/2005	ADDRESS	F&ME Consultants
IDENTIFICATION	0019	TESTED FOR USE IN	N/A
SAMPLE TAKEN FROM	WS-3	DATE RECEIVED	01/19/2005
SAMPLED BY	R. Wessinger	DATE TESTED	02/02/2005
QUANTITY	Shelby Tube Sample	OTHER INFORMATION	7.1'-7.6'
SUPPLY SOURCE	N/A	TESTED BY	BS
ADDRESS	N/A		

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2"	
PASSING 1 1/2"	
PASSING 3/4"	
PASSING 3/8"	
PASSING NO. 4	100
PASSING NO. 10	96
SILT	2
CLAY	61

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20	2
PASSING NO. 20 RET. NO. 40	7
PASSING NO. 40 RET. NO. 60	3
SAND ABOVE NO. 60	12
PASSING NO. 60 RET. NO. 100	4
PASSING NO. 100 RET. NO. 200	19
TOTAL SAND	34
SILT	2
CLAY (BY ELUTRIATION)	64

OPT. MOIS. CONTENT, % (AASHTO T-99)	NOT REQUESTED
MAX. DRY DENSITY, PCF (AASHTO T-99)	NOT REQUESTED
LIQUID LIMIT (AASHTO T-89)	51
PLASTIC INDEX (AASHTO T-90)	32
COLOR	Blue-Gray
LOSS OF IGNITION (SC T-36)	NOT REQUESTED
AASHTO CLASSIFICATION (M-145)	A-7-6(18)
ASTM CLASSIFICATION (D2487)	NOT REQUESTED

Remarks: ______________________

COPY TO: ______________ COPY TO: ______________
COPY TO: ______________ COPY TO: ______________
COPY TO: ______________ COPY TO: ______________

NOTE: VARIATIONS FROM SPECIFICATIONS MARKED THUS: (X)

NOTE: CORRECTIONS NOTED WITH AN ASTERISK: (*)

Wade Myers

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

SC DEPARTMENT OF
TRANSPORTATION FORM
930 (REV. 8/01)

TEST REPORT OF
SOIL

LABORATORY NO. 0019
COLUMBIA, SC

FILE NO.

PROJECT NO. G4067

PIN.

SAMPLE OF	Soil	SUBMITTED BY	Wade Myers
DATE SAMPLED	01/06/2005	ADDRESS	F&ME Consultants
IDENTIFICATION	0019	TESTED FOR USE IN	N/A
SAMPLE TAKEN FROM	WS-3	DATE RECEIVED	01/19/2005
SAMPLED BY	R. Wessinger	DATE TESTED	02/07/2005
QUANTITY	Shelby Tube Sample	OTHER INFORMATION	21.5'-22.0'
SUPPLY SOURCE	N/A	TESTED BY	BS
ADDRESS	N/A		

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2"	
PASSING 1 1/2"	
PASSING 3/4"	
PASSING 3/8"	
PASSING NO. 4	100
PASSING NO. 10	99
SILT	2
CLAY	51

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20	0
PASSING NO. 20 RET. NO. 40	1
PASSING NO. 40 RET. NO. 60	2
SAND ABOVE NO. 60	3
PASSING NO. 60 RET. NO. 100	7
PASSING NO. 100 RET. NO. 200	37
TOTAL SAND	47
SILT	2
CLAY (BY ELUTRIATION)	51

OPT. MOIS. CONTENT, % (AASHTO T-99)	NOT REQUESTED
MAX. DRY DENSITY, PCF (AASHTO T-99)	NOT REQUESTED
LIQUID LIMIT (AASHTO T-89)	-
PLASTIC INDEX (AASHTO T-90)	NP
COLOR	Marl. Green/Gray
LOSS OF IGNITION (SC T-36)	NOT REQUESTED
AASHTO CLASSIFICATION (M-145)	A-4(0)
ASTM CLASSIFICATION (D2487)	NOT REQUESTED

Remarks: ______

COPY TO: ______ COPY TO: ______
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NOTE: VARIATIONS FROM SPECIFICATIONS MARKED THUS: (X)

NOTE: CORRECTIONS NOTED WITH AN ASTERISK: (*)

Wade Myers

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

SC DEPARTMENT OF
TRANSPORTATION FORM
930 (REV. 8/01)

TEST REPORT OF
SOIL

LABORATORY NO. 0019
COLUMBIA, SC

FILE NO.
PROJECT NO. G4067
PIN.

SAMPLE OF	Soil	SUBMITTED BY	Wade Myers
DATE SAMPLED	01/06/2005	ADDRESS	F&ME Consultants
IDENTIFICATION	0019	TESTED FOR USE IN	N/A
SAMPLE TAKEN FROM	WS-4	DATE RECEIVED	01/19/2005
SAMPLED BY	R. Wessinger	DATE TESTED	02/07/2005
QUANTITY	Shelby Tube Sample	OTHER INFORMATION	22.0'-22.5'
SUPPLY SOURCE	N/A	TESTED BY	BS
ADDRESS	N/A		

SAMPLE AS A WHOLE: (SC T-34)

PASSING 2 1/2"	
PASSING 1 1/2"	
PASSING 3/4"	
PASSING 3/8"	
PASSING NO. 4	100
PASSING NO. 10	99
SILT	1
CLAY	48

MATERIAL UNDER NO. 10: (SC T-34)

RETAINED NO. 20	1
PASSING NO. 20 RET. NO. 40	1
PASSING NO. 40 RET. NO. 60	2
SAND ABOVE NO. 60	3
PASSING NO. 60 RET. NO. 100	11
PASSING NO. 100 RET. NO. 200	36
TOTAL SAND	50
SILT	1
CLAY (BY ELUTRIATION)	49

OPT. MOIS. CONTENT, % (AASHTO T-99)	NOT REQUESTED
MAX. DRY DENSITY, PCF (AASHTO T-99)	NOT REQUESTED
LIQUID LIMIT (AASHTO T-89)	-
PLASTIC INDEX (AASHTO T-90)	NP
COLOR	Marl. Green/Gray
LOSS OF IGNITION (SC T-36)	NOT REQUESTED
AASHTO CLASSIFICATION (M-145)	A-4(0)
ASTM CLASSIFICATION (D2487)	NOT REQUESTED

Remarks: ______________________

COPY TO: ______________ COPY TO: ______________
COPY TO: ______________ COPY TO: ______________
COPY TO: ______________ COPY TO: ______________

NOTE: VARIATIONS FROM SPECIFICATIONS MARKED THUS: (X)

NOTE: CORRECTIONS NOTED WITH AN ASTERISK: (*)

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

SC DEPARTMENT OF
TRANSPORTATION FORM
930 (REV. 8/01)

TEST REPORT OF
SOIL

LABORATORY NO. 0019
COLUMBIA, SC

FILE NO.
PROJECT NO. G4067
PIN.

SAMPLE OF	Soil	SUBMITTED BY	Wade Myers
DATE SAMPLED	01/06/2005	ADDRESS	F&ME Consultants
IDENTIFICATION	0019	TESTED FOR USE IN	N/A
SAMPLE TAKEN FROM	WS-6	DATE RECEIVED	01/19/2005
SAMPLED BY	R. Wessinger	DATE TESTED	02/02/2005
QUANTITY	Shelby Tube Sample	OTHER INFORMATION	13.5'-14.3'
SUPPLY SOURCE	N/A	TESTED BY	BS
ADDRESS	N/A		

SAMPLE AS A WHOLE: (SC T-34)	
PASSING 2 1/2"	
PASSING 1 1/2"	
PASSING 3/4"	
PASSING 3/8"	
PASSING NO. 4	100
PASSING NO. 10	99
SILT	1
CLAY	59
MATERIAL UNDER NO. 10: (SC T-34)	
RETAINED NO. 20	0
PASSING NO. 20 RET. NO. 40	0
PASSING NO. 40 RET. NO. 60	1
SAND ABOVE NO. 60	1
PASSING NO. 60 RET. NO. 100	1
PASSING NO. 100 RET. NO. 200	36
TOTAL SAND	39
SILT	1
CLAY (BY ELUTRIATION)	60
OPT. MOIS. CONTENT, % (AASHTO T-99)	NOT REQUESTED
MAX. DRY DENSITY, PCF (AASHTO T-99)	NOT REQUESTED
LIQUID LIMIT (AASHTO T-89)	26
PLASTIC INDEX (AASHTO T-90)	3
COLOR	Blue-Gray
LOSS OF IGNITION (SC T-36)	NOT REQUESTED
AASHTO CLASSIFICATION (M-145)	A-4(0)
ASTM CLASSIFICATION (D2487)	NOT REQUESTED

Remarks: ______________________________

COPY TO: ____________ COPY TO: ____________
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NOTE: VARIATIONS FROM SPECIFICATIONS MARKED THUS: (X)

NOTE: CORRECTIONS NOTED WITH AN ASTERISK: (*)

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

Consolidation Test Report

ASTM D 2435-04

Client: SCDOT
Project: SC-41 Bridge Replacement Over Wando River
Project Number (PIN): 32099
File Number: 8.158B/10.032102

Sample Data

Lab Number: 11-0412D
Depth of Sample: 4.0'-5.5'
Location: B-7/ST-2
Soil Description: Gray Elastic SILT (MH) AASHTO: A-4(2)
Liquid Limit: 86 Plastic Limit: 61 Plasticity Index: 25

Consolidation Test (Sample Data)

Before Consolidation Test

Diameter: 2.511"
Height: 0.93"
Area: 4.952 in^2
Specific Gravity: 2.543
Degree of Saturation: 89%
Void Ratio: 1.613
Mass of Wet Soil: 128.02 grams
Moisture Content: 67.75%
Mass of Dry Soil: 76.34 grams

After Consolidation Test

Mass of Wet Soil: 106.50 grams
Mass of Dry Soil: 73.46 grams
Mass of Water in Soil: 33.04 grams
Moisture Content: 45.00%
Void Ratio: 0.950

C_c=0.55
Preconsolidation Pressure=0.48

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Geotechincal-Environmental-Materials

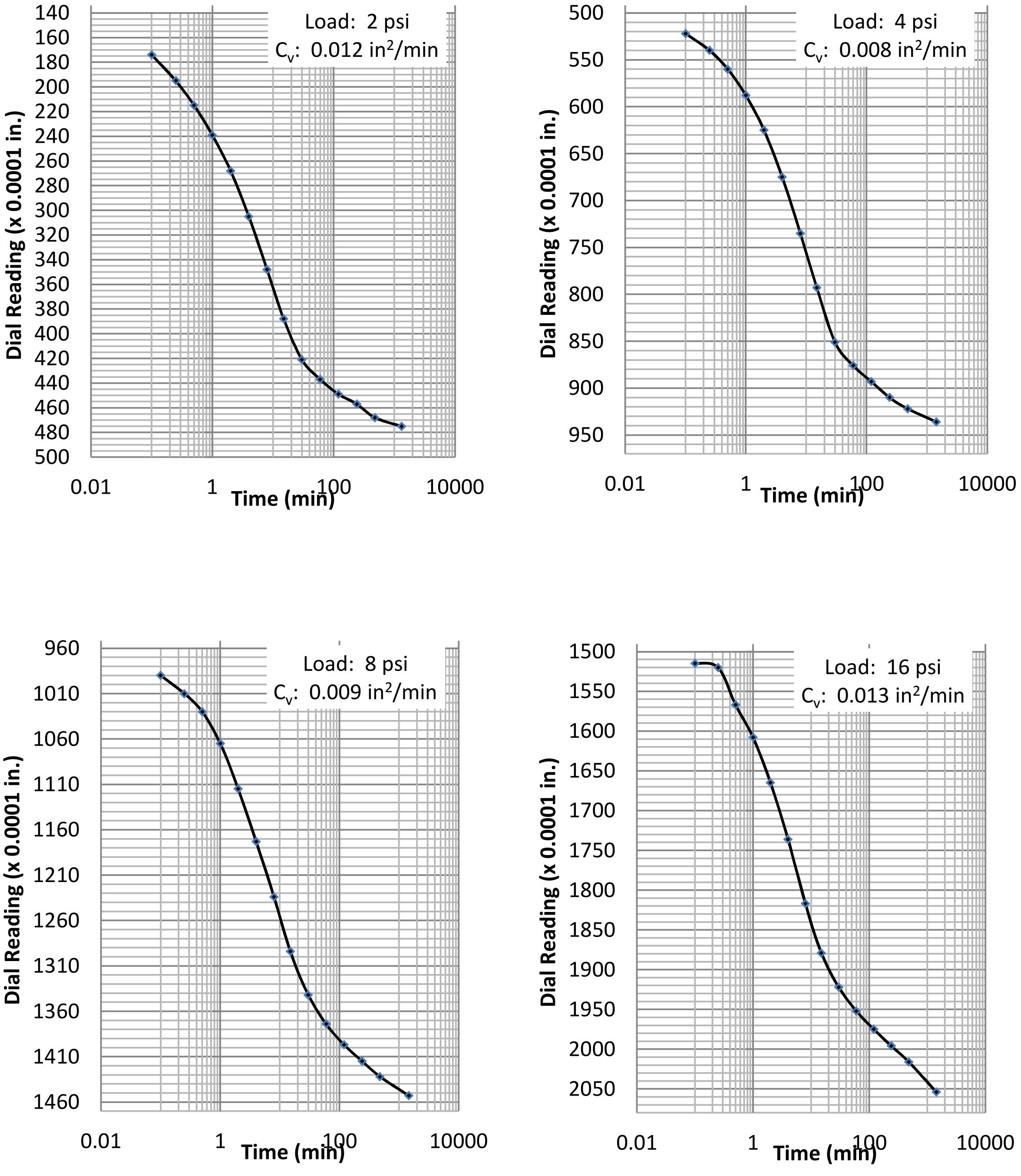
Consolidation Test Report

ASTM D 2435-04

Load (psi)	Final Dial Reading (in)	2H (in)	Void Height	Void Ratio	C_v (in^2/sec)
0		0.930	0.574	1.613	
2	0.048	0.883	0.527	1.481	0.012
4	0.094	0.836	0.480	1.350	0.008
8	0.145	0.785	0.429	1.205	0.009
16	0.205	0.725	0.369	1.036	0.013
32	0.262	0.668	0.312	0.876	0.006
4	0.236	0.694	0.338	0.950	0.010

Consolidation Test Report

ASTM D 2435-04



Time-Deformation Curve From Log of Time Method

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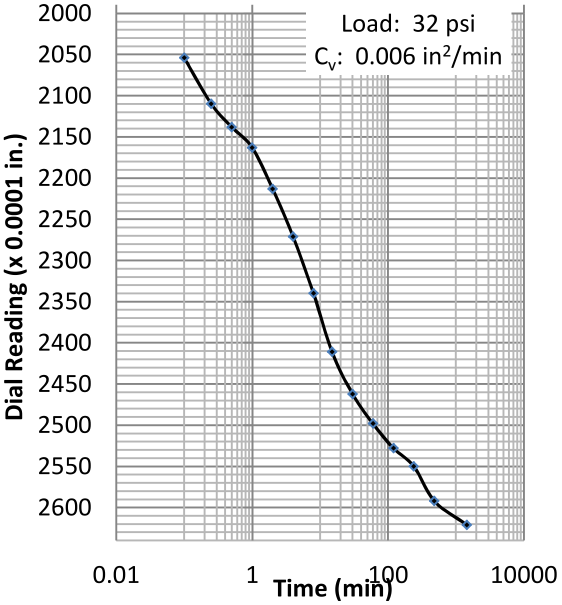
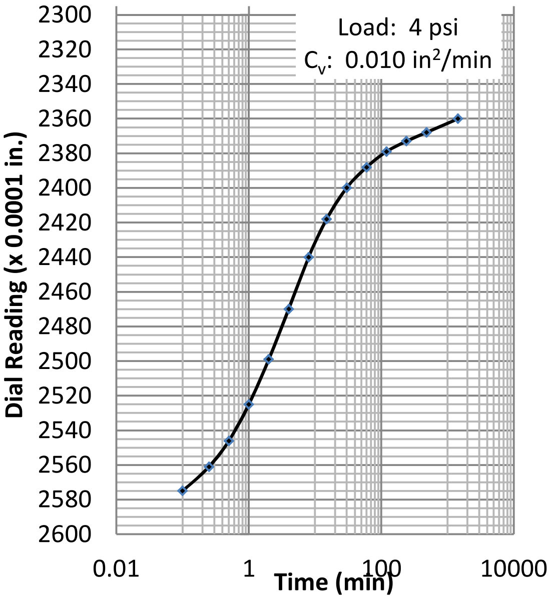
Consolidation Test Report

ASTM D 2435-04





Time-Deformation Curve From Log of Time Method

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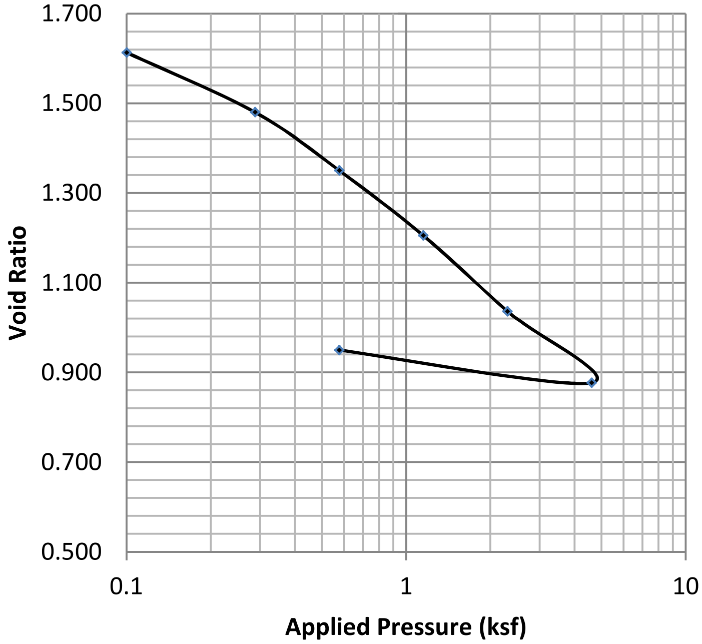
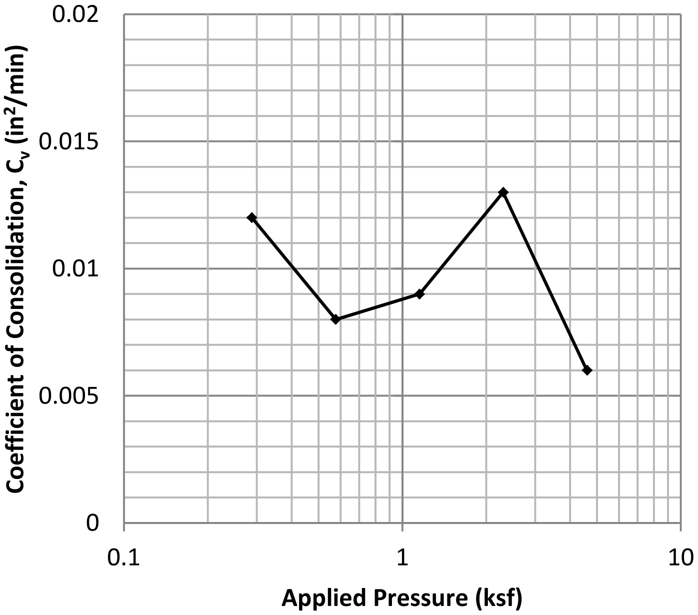
Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04



Void Ratio Versus Log of Pressure Curve



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Consolidation Test Report

ASTM D 2435-04

Test Results (Load=2 psi)

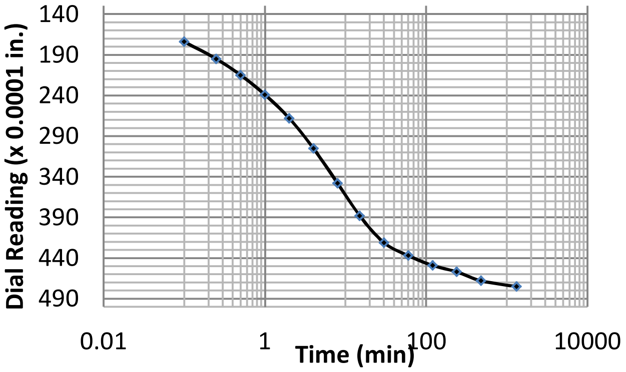
Elasped Time (min)	Dial Reading
0.1	174
0.25	195
0.5	215
1	239
2	268
4	305
8	348
15	388
30	421
60	437
120	449
240	457
480	468
1320	475

D_0= 151 D_{50}= 293 D_{100}= 435

t_{50}= 3.2 min

C_v= 0.012 in^2/min

Void Ratio= 1.481



Test Results (Load=4 psi)

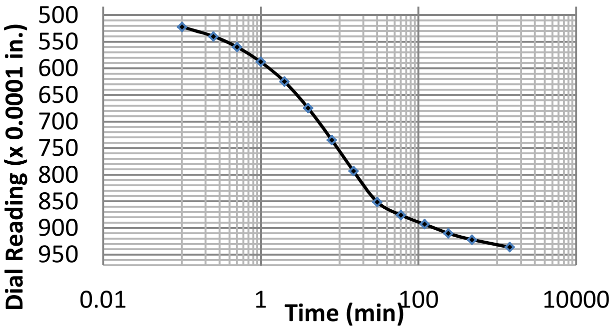
Elasped Time (min)	Dial Reading
0.1	522
0.25	540
0.5	560
1	588
2	625
4	675
8	735
15	793
30	851
60	876
120	893
240	910
480	922
1440	936

D_0= 492 D_{50}= 686 D_{100}= 880

t_{50}= 4.5 min

C_v= 0.008 in^2/min

Void Ratio= 1.350



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Consolidation Test Report

ASTM D 2435-04

Test Results (Load=8 psi)

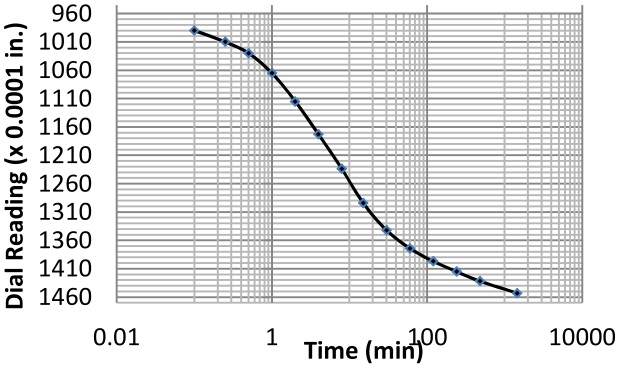
Elasped Time (min)	Dial Reading
0.1	990
0.25	1010
0.5	1030
1	1065
2	1115
4	1173
8	1234
15	1294
30	1342
60	1374
120	1397
240	1415
480	1432
1440	1453

D_0= 955 D_{50}= 1165 D_{100}=1375

t_{50}= 3.5 min

C_v= 0.009 in^2/min

Void Ratio= 1.205



Test Results (Load=16 psi)

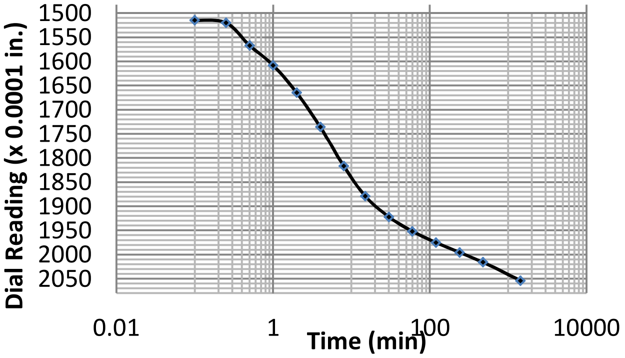
Elasped Time (min)	Dial Reading
0.1	1515
0.25	1520
0.5	1567
1	1608
2	1665
4	1736
8	1817
15	1879
30	1922
60	1952
120	1975
240	1996
480	2016
2783	2054

D_0= 1432 D_{50}= 1673.5 D_{100}=1915

t_{50}= 2.2 min

C_v= 0.013 in^2/min

Void Ratio= 1.036



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Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04

Test Results (Load=32 psi)

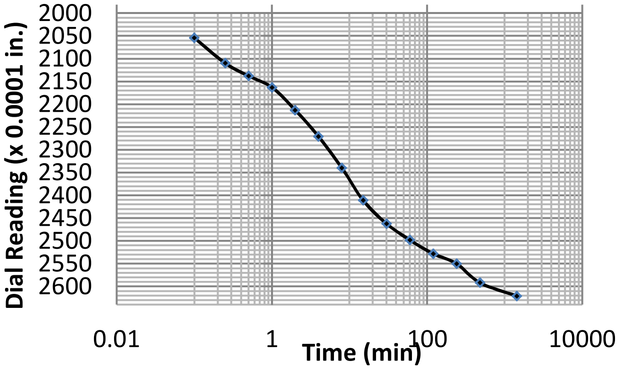
Elasped Time (min)	Dial Reading
0.1	2110
0.25	2138
0.5	2163
1	2213
2	2271
4	2340
8	2411
15	2462
30	2498
60	2528
120	2550
240	2572
480	2592
1440	2621

D_0= 2057 D_{50}= 2266 D_{100}=2475

t_{50}= 3.8 min

C_v= 0.006 in^2/min

Void Ratio= 0.876



Test Results (Load=4 psi)

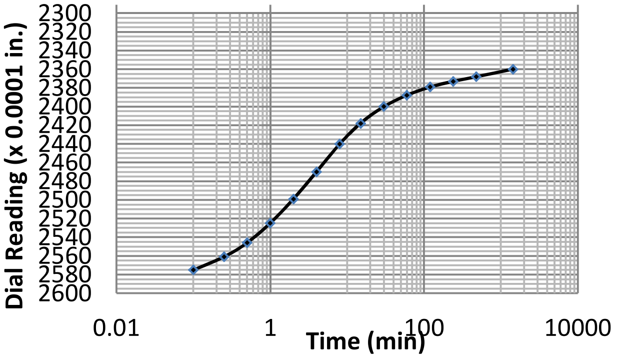
Elasped Time (min)	Dial Reading
0.1	2575
0.25	2561
0.5	2546
1	2525
2	2499
4	2470
8	2440
15	2418
30	2400
60	2388
120	2379
240	2373
480	2368
1440	2360

D_0= 2597 D_{50}= 2492.5 D_{100}=2388

t_{50}= 2.3 min

C_v= 0.010 in^2/min

Void Ratio= 0.950



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Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04

Client: SCDOT

Project: SC-41 Bridge Replacement Over Wando River

Project Number (PIN): 32099

File Number: 8.158B/10.032102

Sample Data

Lab Number: 11-0329F

Depth of Sample: 10'-12.5'

Location: CPT-2

Soil Description: Brown/Gray Fine Sandy Lean CLAY (CL) AASHTO: A-4(2)

Liquid Limit: 31 Plastic Limit: 23 Plasticity Index: 8

Consolidation Test (Sample Data)

Before Consolidation Test	After Consolidation Test
Diameter: 2.511"	Mass of Wet Soil: 134.34 grams
Height: 0.98"	Mass of Dry Soil: 110.60 grams
Area: 4.952 in^2	Mass of Water in Soil: 23.74 grams
Specific Gravity: 2.61	Moisture Content: 21.46%
Degree of Saturation: 89%	Void Ratio: 0.607
Void Ratio: 0.872	
Mass of Wet Soil: 152.55 grams	C_c=0.24
Moisture Content: 29.8%	Preconsolidation Pressure=0.74
Mass of Dry Soil: 117.53 grams	

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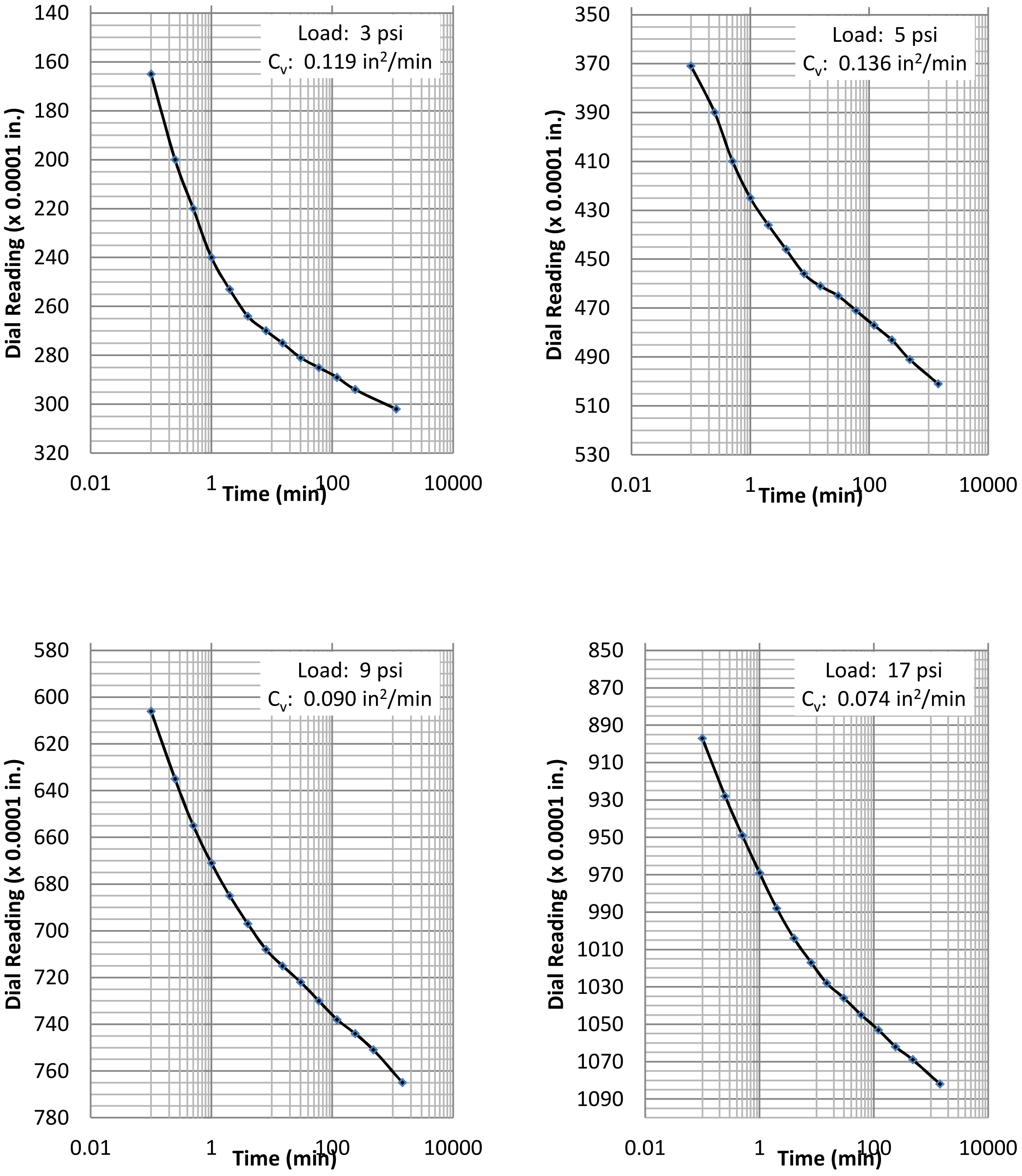
Consolidation Test Report

ASTM D 2435-04

Load (psi)	Final Dial Reading (in)	2H (in)	Void Height	Void Ratio	C_v (in^2/sec)
0		0.980	0.456	0.872	
3	0.030	0.950	0.426	0.814	0.119
5	0.050	0.930	0.406	0.776	0.136
9	0.077	0.904	0.380	0.726	0.090
17	0.108	0.872	0.348	0.665	0.074
33	0.144	0.837	0.313	0.598	0.052
9	0.139	0.841	0.318	0.607	0.012

Consolidation Test Report

ASTM D 2435-04



Time-Deformation Curve From Log of Time Method

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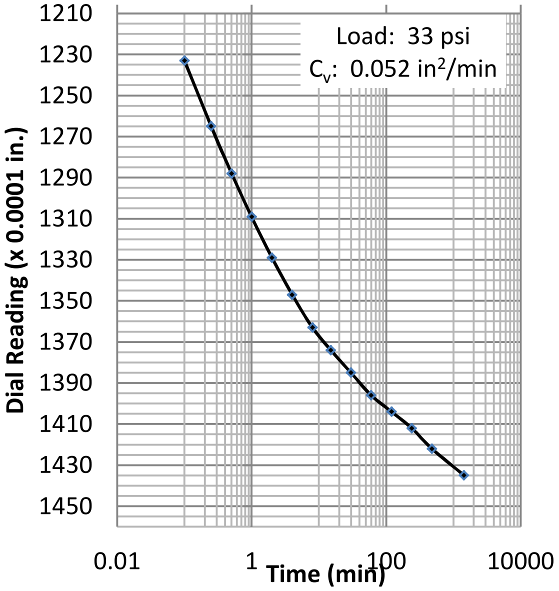
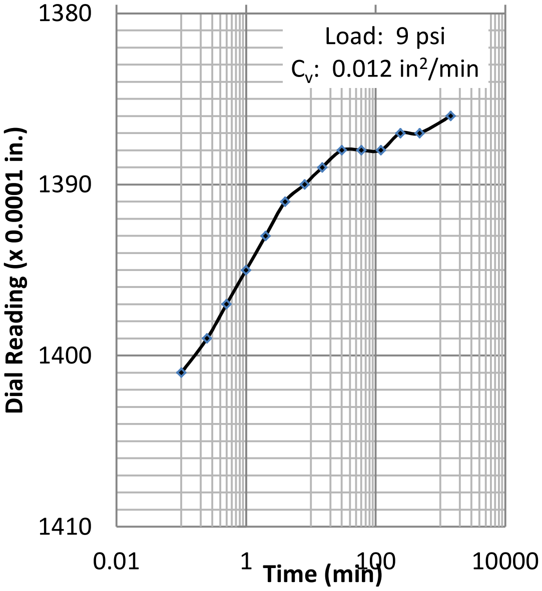
Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04





Time-Deformation Curve From Log of Time Method

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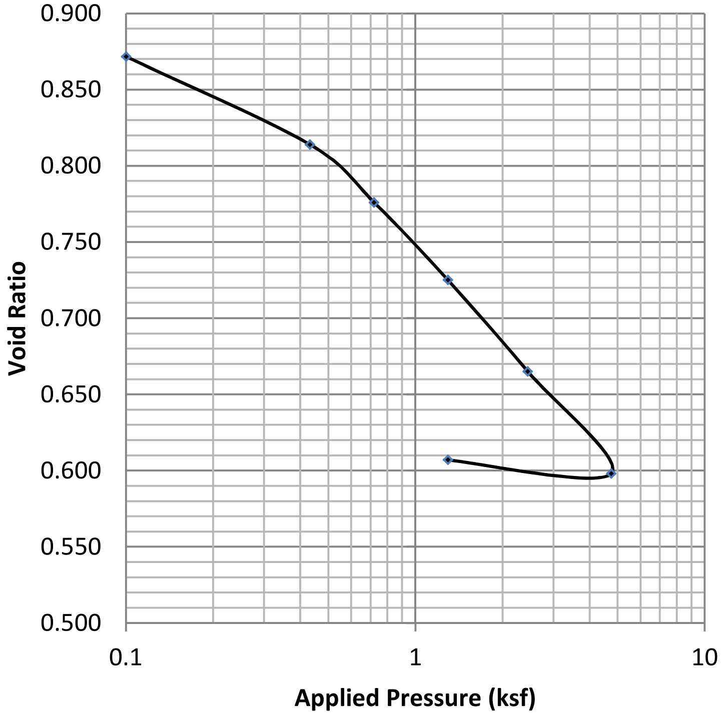
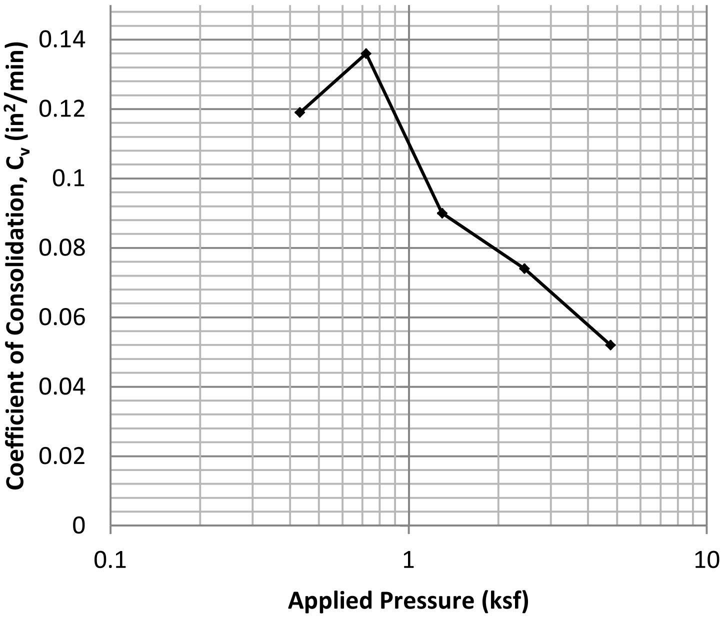
Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04



Void Ratio Versus Log of Pressure Curve



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Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04

Test Results (Load=3 psi)

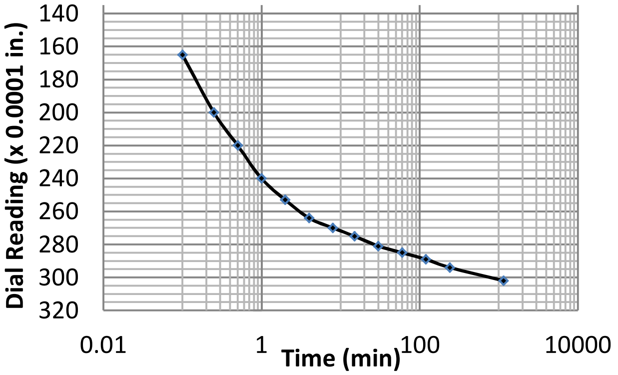
Elasped Time (min)	Dial Reading
0.1	165
0.25	200
0.5	220
1	240
2	253
4	264
8	270
15	275
30	281
60	285
120	289
240	294
480	-
1152	302

D_0= 160 D_{50}= 212.5 D_{100}= 265

t_{50}= 0.38 min

C_v= 0.119 in^2/min

Void Ratio= 0.8140



Test Results (Load=5 psi)

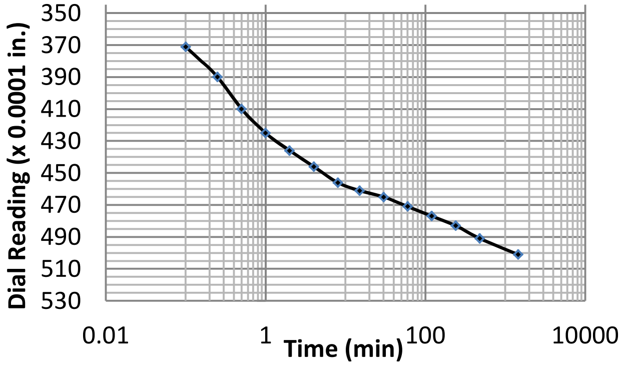
Elasped Time (min)	Dial Reading
0.1	371
0.25	390
0.5	410
1	425
2	436
4	446
8	456
15	461
30	465
60	471
120	477
240	483
480	491
1449	501

D_0= 355 D_{50}= 397.5 D_{100}= 440

t_{50}= 0.32 min

C_v= 0.136 in^2/min

Void Ratio= 0.7760



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Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04

Test Results (Load=9 psi)

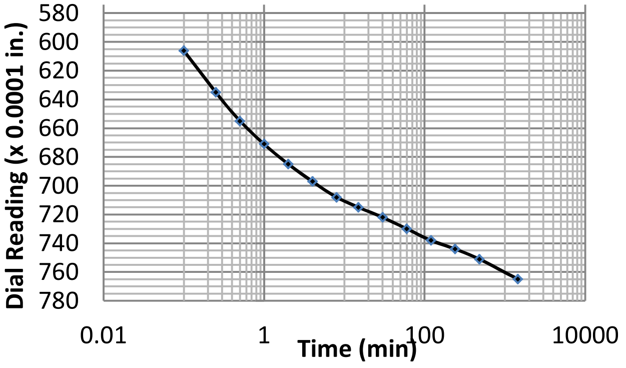
D_0= 599 D_{50}= 650 D_{100}= 700

t_{50}= 0.46 min

C_v= 0.090 in^2/min

Void Ratio= 0.7256

Elasped Time (min)	Dial Reading
0.1	606
0.25	635
0.5	655
1	671
2	685
4	697
8	708
15	705
30	722
60	730
120	738
240	744
480	751
1452	765



Test Results (Load=17 psi)

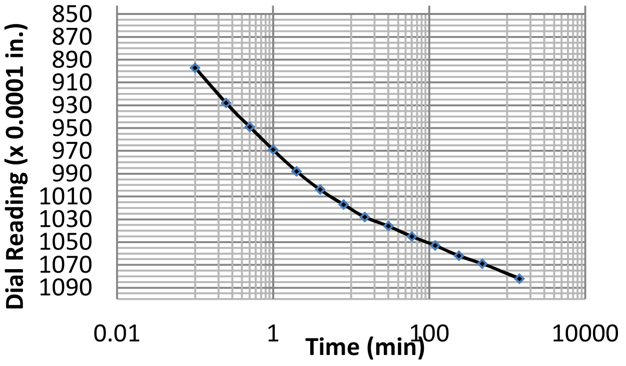
D_0= 887 D_{50}= 952 D_{100}= 1017

t_{50}= 0.52 min

C_v= 0.074 in^2/min

Void Ratio= 0.6650

Elasped Time (min)	Dial Reading
0.1	897
0.25	928
0.5	949
1	969
2	988
4	1004
8	1017
15	1028
30	1036
60	1045
120	1053
240	1062
480	1069
1440	1082



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Geotechincal-Environmental-Materials

Consolidation Test Report

ASTM D 2435-04

Test Results (Load=33 psi)

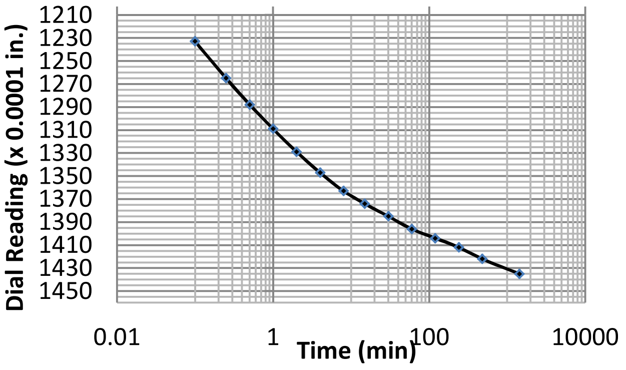
Elasped Time (min)	Dial Reading
0.1	1233
0.25	1265
0.5	1288
1	1309
2	1329
4	1347
8	1363
15	1374
30	1385
60	1396
120	1404
240	1412
480	1422
1440	1435

D_0= 1221 D_{50}= 1298 D_{100}=1375

t_{50}= 0.69 min

C_v= 0.052 in^2/min

Void Ratio= 0.5976



Test Results (Load=9 psi)

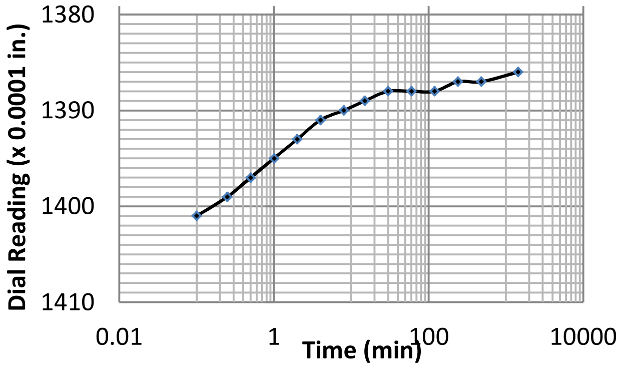
Elasped Time (min)	Dial Reading
0.1	1401
0.25	1399
0.5	1397
1	1395
2	1393
4	1391
8	1390
15	1389
30	1388
60	1388
120	1388
240	1387
480	1387
1440	1386

D_0= 1395 D_{50}= 1392 D_{100}=1388

t_{50}= 3 min

C_v= 0.012 in^2/min

Void Ratio= 0.6070



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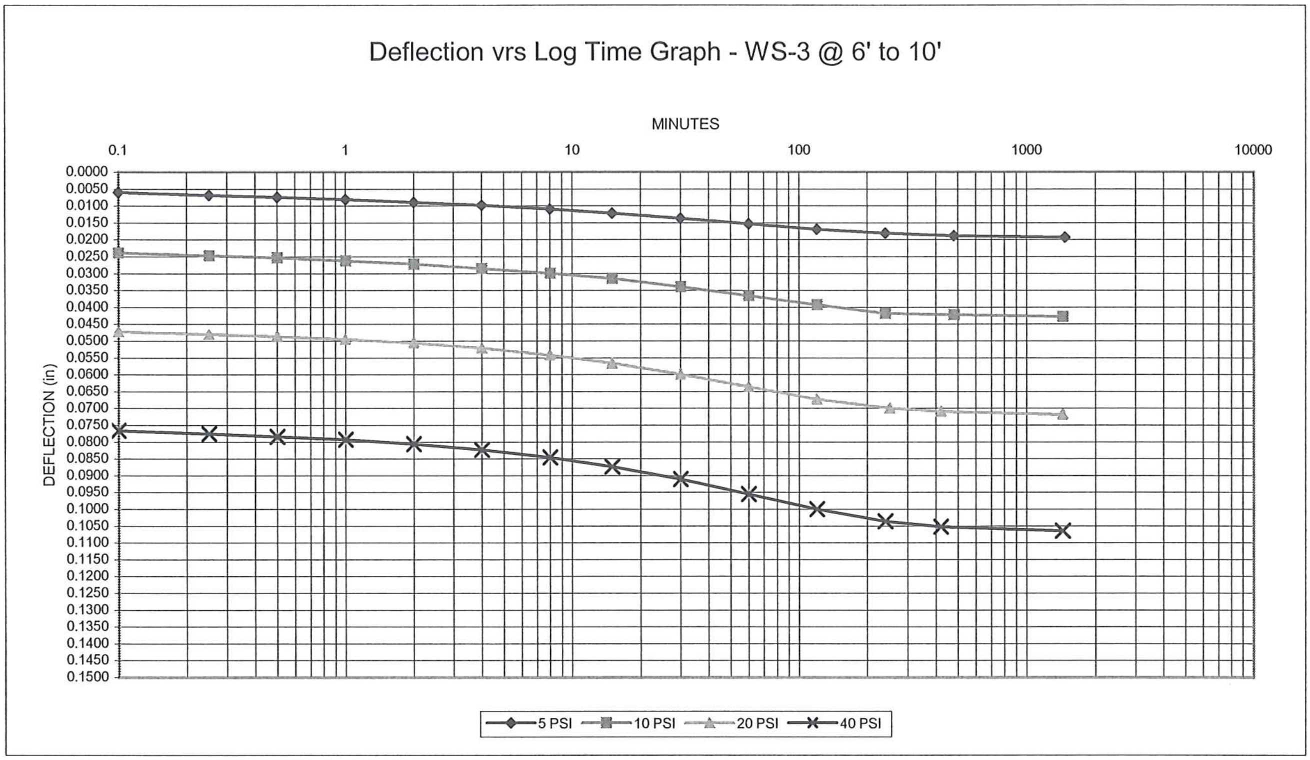
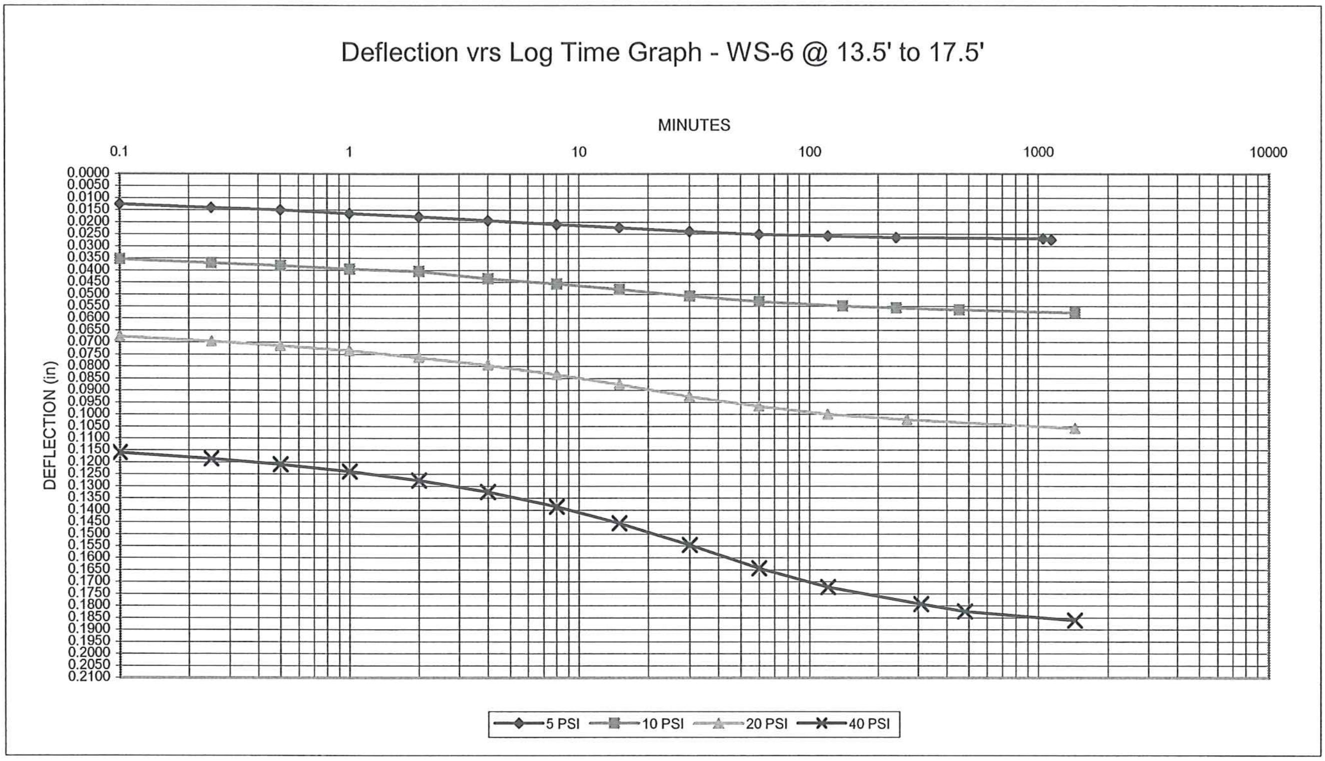


Series 1		Series 2		Series 3		Series 4			
5 psi		10 psi		20 psi		40 psi			
min	DR	min	DR	min	DR	min	DR		
0.1	0.0060	0.1	0.0239	0.1	0.0472	0.1	0.0766		
0.25	0.0068	0.25	0.0247	0.25	0.0480	0.25	0.0776		
0.5	0.0074	0.5	0.0253	0.5	0.0487	0.5	0.0784		
1	0.0081	1	0.0262	1	0.0495	1	0.0793		
2	0.0089	2	0.0272	2	0.0506	2	0.0806		
4	0.0098	4	0.0285	4	0.0521	4	0.0823		
8	0.0109	8	0.0299	8	0.0542	8	0.0846		
15	0.0122	15	0.0315	15	0.0566	15	0.0874		
30	0.0137	30	0.0339	30	0.0599	30	0.0911		
60	0.0153	60	0.0366	60	0.0636	60	0.0955		
120	0.0169	120	0.0393	120	0.0673	120	0.1000		
240	0.0181	240	0.0418	251	0.0700	240	0.1036		
480	0.0188	480	0.0422	420	0.0709	420	0.1052		
1470	0.0193	1440	0.0428	1440	0.0719	1440	0.1065		
Ca=	0.0011	Ca=	0.0013	Ca=	0.0020	Ca=	0.0027		

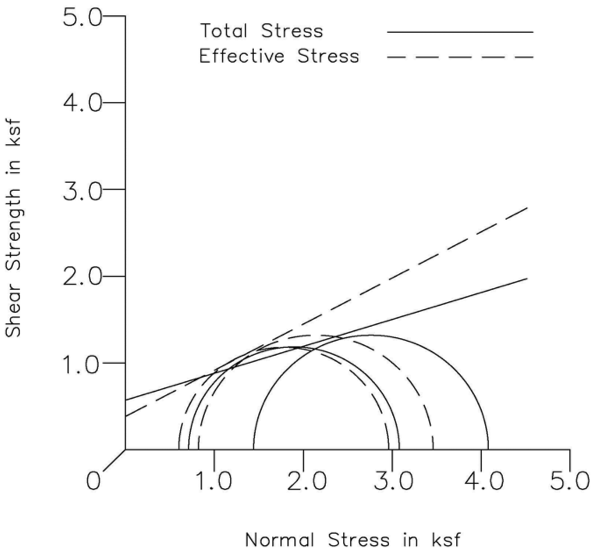
DR=Dial Reading (adjusted for test equipment calibration)

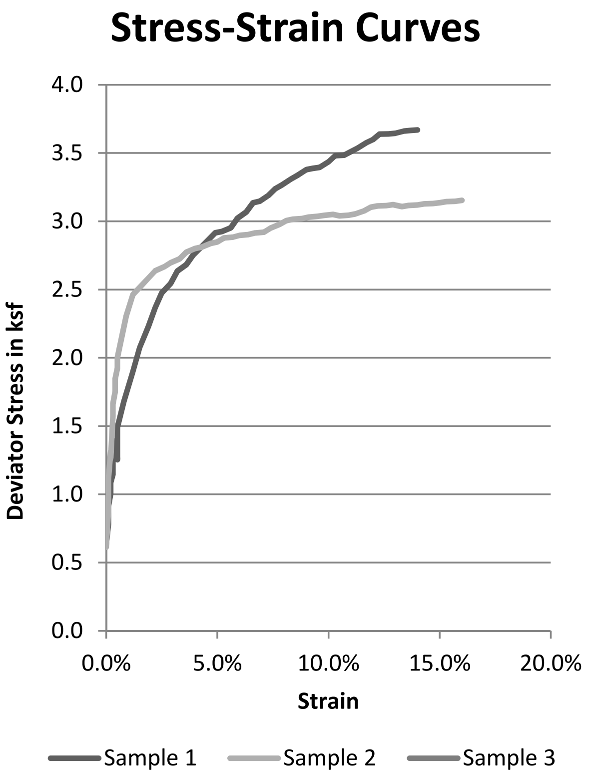

Deflection vrs Log Time Graph - WS-6 @ 13.5' to 17.5'

Series 1		Series 2		Series 3		Series 4	
5 psi		10 psi		20 psi		40 psi	
min	DR	min	DR	min	DR	min	DR
0.1	0.0125	0.1	0.0354	0.1	0.0675	0.1	0.1160
0.25	0.0140	0.25	0.0370	0.25	0.0696	0.25	0.1186
0.5	0.0150	0.5	0.0381	0.5	0.0714	0.5	0.1210
1	0.0164	1	0.0395	1	0.0734	1	0.1239
2	0.0178	2	0.0404	2	0.0763	2	0.1276
4	0.0194	4	0.0435	4	0.0796	4	0.1324
8	0.0210	8	0.0457	8	0.0835	8	0.1386
15	0.0223	15	0.0479	15	0.0876	15	0.1455
30	0.0239	30	0.0507	30	0.0926	30	0.1546
60	0.0251	60	0.0530	60	0.0967	60	0.1643
120	0.0258	139	0.0549	120	0.1000	120	0.1722
240	0.0264	240	0.0557	267	0.1022	309	0.1793
1050	0.0269	453	0.0565	1440	0.1059	480	0.1823
1140	0.0274	1440	0.0577			1440	0.1861
Ca=	0.0008	Ca=	0.0024	Ca=	0.0051	Ca=	0.0080

DR=Dial Reading (adjusted for test equipment calibration)

TRIAXIAL SHEAR TEST REPORT
ASTM D4767





			Sample	
		1	2	3
Initial	Water Content, %	29.8%	29.8%	
	Void Ratio	0.80	0.83	
	Diameter, in.	2.87	2.86	
	Height, in.	5.91	5.80	
	Volume, in^3	38.25	37.32	
Final	Water Content, %	29.8%	31.0%	
	Void Ratio	0.79	0.84	
	Diameter, in.	2.87	2.86	
	Height, in.	5.86	5.75	
	Volume, in^3	37.93	37.02	
	Saturation, %	100.0%	97.7%	
	Dry Density, PCF	121.2	116.4	
	Cell Pressure (ksf)	8.64	8.64	
	Sample Pressure (ksf)	7.92	7.20	
	Stress at Failure (ksf)	2.36	2.64	
	Strain at Failure, %	2.2%	2.2%	
	σ_1 at Failure (ksf)	3.08	4.08	
	σ_3 at Failure (ksf)	0.72	1.44	
	σ'_1 at Failure (ksf)	2.96	3.46	
	σ'_3 at Failure (ksf)	0.60	0.82	

Project Name: SC-41 over the Wando River

Project Number: G4067.01 Date: 3/24/2011

SCDOT File #: 8.158B / 10.032102 PIN #: BR88(079)

Sample/Location: CPT-2 / 11-0329C

Depth/Elevation: 10.0' - 12.5'

Type of Test : Consolidated Undrained

Sample Type : Undisturbed - Shelby Tube

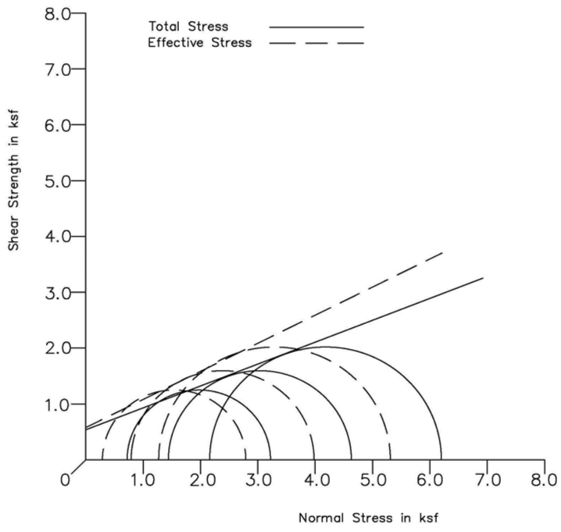
Description: Brown Gray Fine Sandy Lean CLAY (CL), A-4(2)

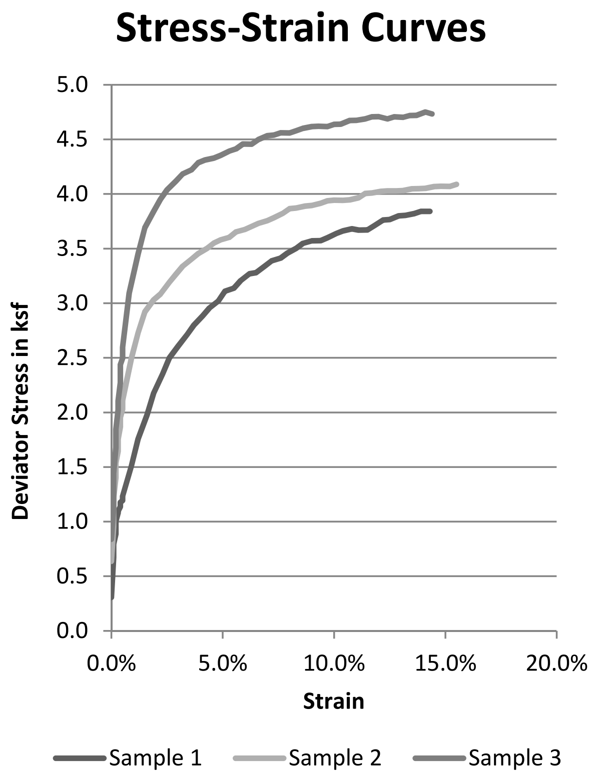
PI= 8 % Fines= 51.5

C= 0.57 ksf C'= 0.38 ksf

ϕ= 17° ϕ'= 28°

TRIAXIAL SHEAR TEST REPORT
ASTM D4767





		Sample 1	Sample 2	Sample 3
Initial	Water Content, %	27.5%	27.5%	27.5%
	Void Ratio	0.73	0.73	0.74
	Diameter, in.	2.88	2.88	2.88
	Height, in.	5.67	5.87	5.90
	Volume, in^3	36.85	37.70	38.02
Final	Water Content, %	29.3%	28.9%	28.6%
	Void Ratio	0.82	0.76	0.74
	Diameter, in.	2.88	2.88	2.88
	Height, in.	5.83	5.82	5.84
	Volume, in^3	37.89	37.75	37.47
	Saturation, %	94.4%	99.9%	100.0%
	Dry Density, PCF	122.3	120.5	120.9
	Cell Pressure (ksf)	8.64	8.64	8.64
	Sample Pressure (ksf)	7.92	7.20	6.48
	Stress at Failure (ksf)	2.50	3.19	4.04
	Strain at Failure, %	2.6%	2.6%	2.5%
	σ_1 at Failure (ksf)	3.22	4.63	6.20
	σ_3 at Failure (ksf)	0.72	1.44	2.16
	σ'_1 at Failure (ksf)	2.79	3.98	5.31
	σ'_3 at Failure (ksf)	0.29	0.79	1.27

Project Name: SC-41 over the Wando River

Project Number: G4067.01 Date: 3/24/2011

SCDOT File #: 8.158B / 10.032102 PIN #: BR88(079)

Sample/Location: CPT-3 / 11-0330C

Depth/Elevation: 8.5'-10.5'

Type of Test : Consolidated Undrained

Sample Type : Undisturbed - Shelby Tube

Description: Brown Gray Fine Sandy Lean CLAY (CL), A-4(3)

PI= 9 % Fines= 58.8

C= 0.54 ksf C'= 0.58 ksf

ϕ= 21° ϕ'= 27°

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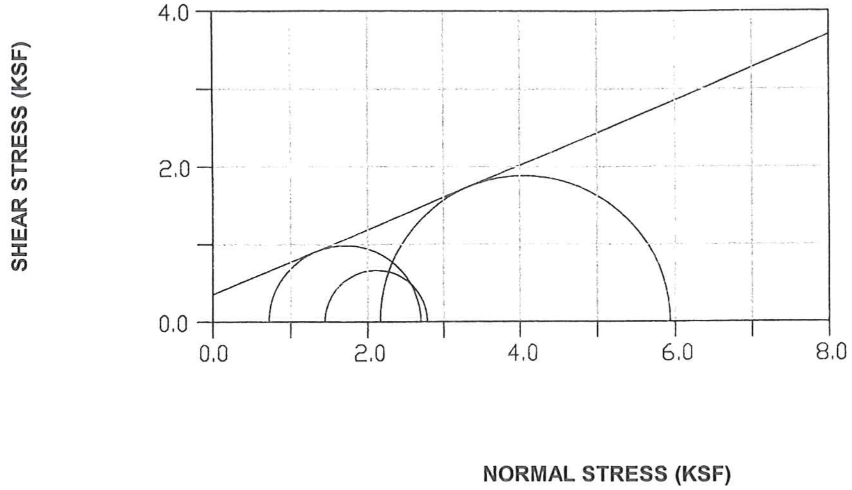
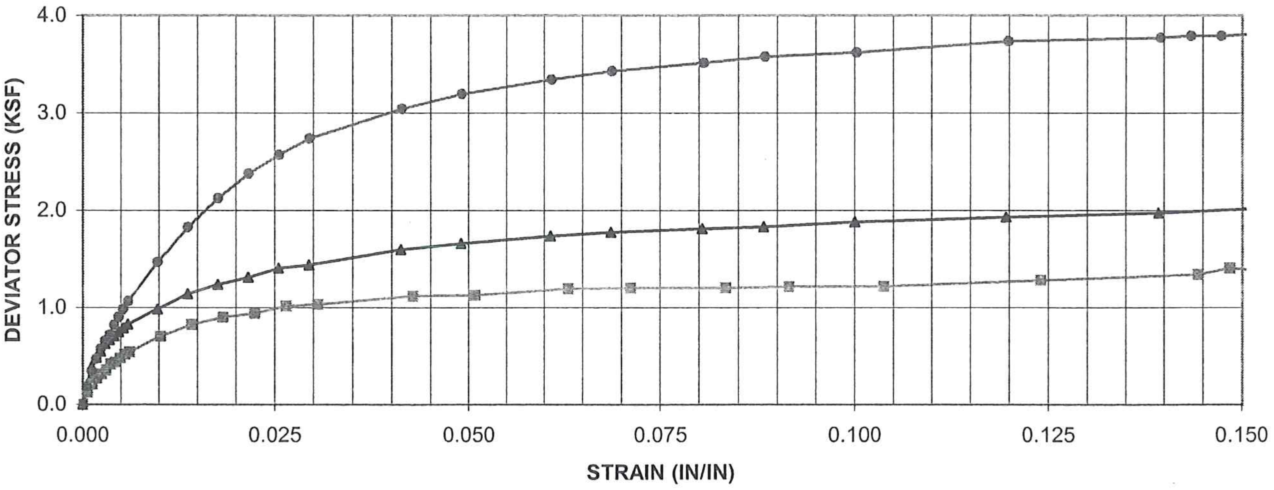


C =0.35 KSF
ϕ= 23.0 Degrees



TRIAXIAL SHEAR TEST

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SAMPLE ID: WS-3	**DEPTH**: 7.0'-10.0'

LL:51 **PL**:19 **PI**:32

SOIL DESC.: Blue/Gray Fine Sandy Lean/Elastic CLAY (CL/CH)

PROJECT: SC Hwy 41 over Wando River - MSE Wall Study

TEST TYPE: CONSOLIDATED UNDRAINED

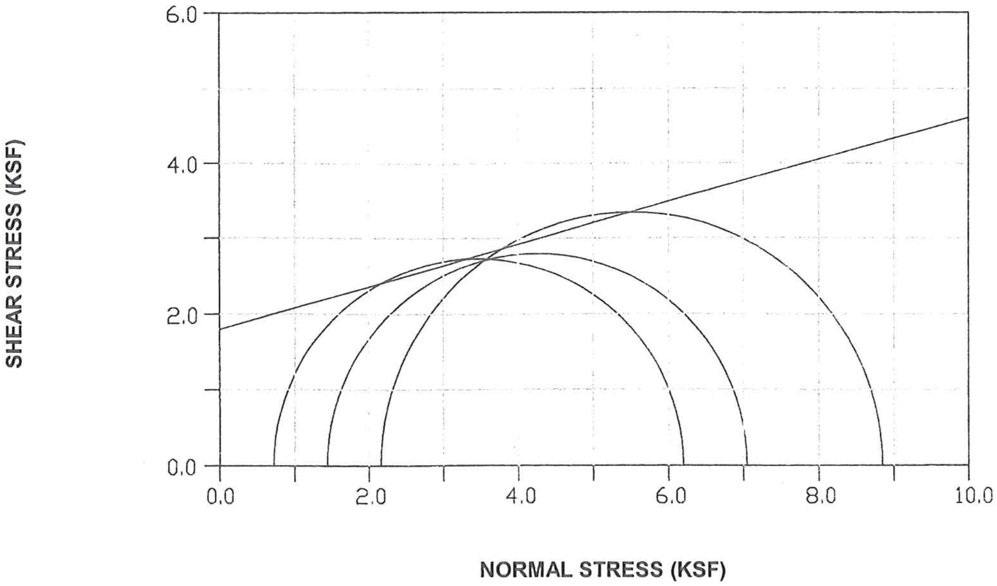
SAMPLE NO.	1	2	3
VOID RATIO	---	---	---
SATURATION (Si)	97%	92%	100%
SATURATION (Sf)	---	---	---
SPECIFIC GRAVITY	2.65	2.65	2.65
CHAMBER STRESS	0.720	1.440	2.160
DEVIATOR STRESS	2.016	1.381	3.807

SAMPLE NO.	1	2	3
INITIAL WEIGHT (lbs.)	2.364	2.170	2.409
INITIAL HEIGHT (In.)	5.100	4.918	5.088
INITIAL DIAMETER (In.)	2.883	2.842	2.861
INITIAL WET DENSITY (pcf)	122.68	120.20	127.28
MOISTURE CONTENT (w%)	25.19	25.22	22.71
INITIAL DRY DENSITY (pcf)	97.99	95.99	103.73

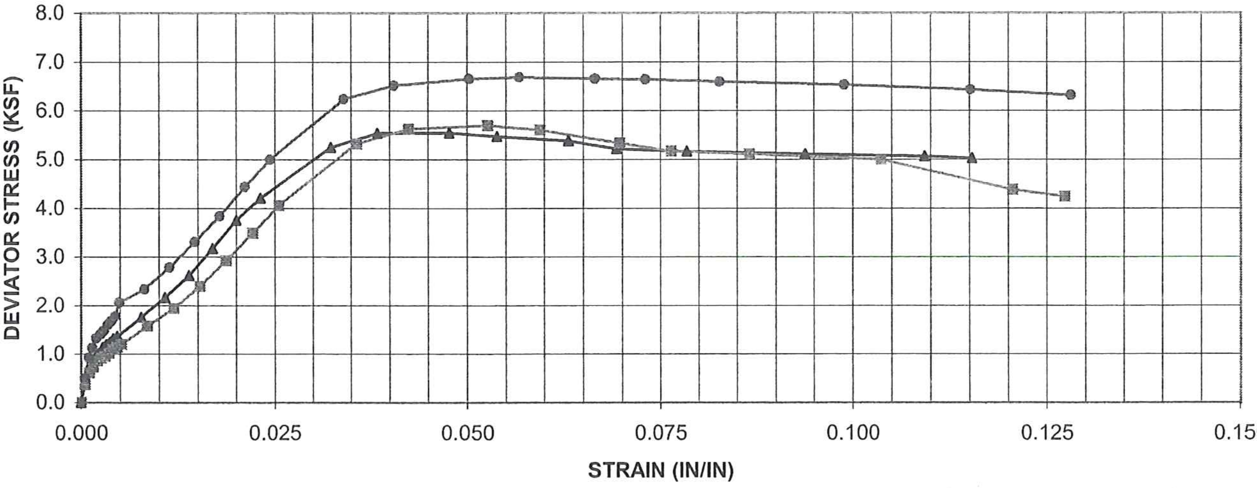
TRIAXIAL TEST DATA

Plotted at ~15% Strain - Specific Gravity Assumed

Sample No. 2 Deleted From Shear Strength Determination



C =1.8 KSF
ϕ= 15.7 Degrees



TRIAXIAL SHEAR TEST

F&ME

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SAMPLE ID: WS-3
DEPTH: 20.5' - 22.5'
LL: NP
PL: NP
PI: NP
SOIL DESC.: MARL - Green/Gray Fine Sandy SILT (ML)
PROJECT: SC Hwy 41 over Wando River - MSE Wall Study

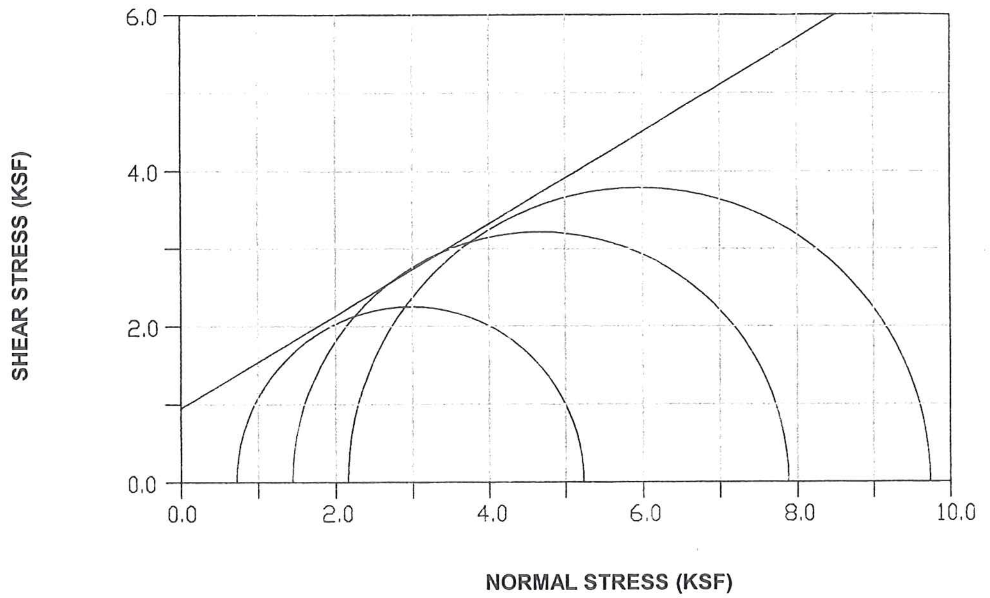
TEST TYPE: CONSOLIDATED UNDRAINED

SAMPLE NO.	1	2	3
VOID RATIO	---	---	---
SATURATION (Si)	100%	100%	98%
SATURATION (Sf)	---	---	---
SPECIFIC GRAVITY	2.65	2.65	2.65
CHAMBER STRESS	0.720	1.440	2.160
DEVIATOR STRESS	5.554	5.700	6.686

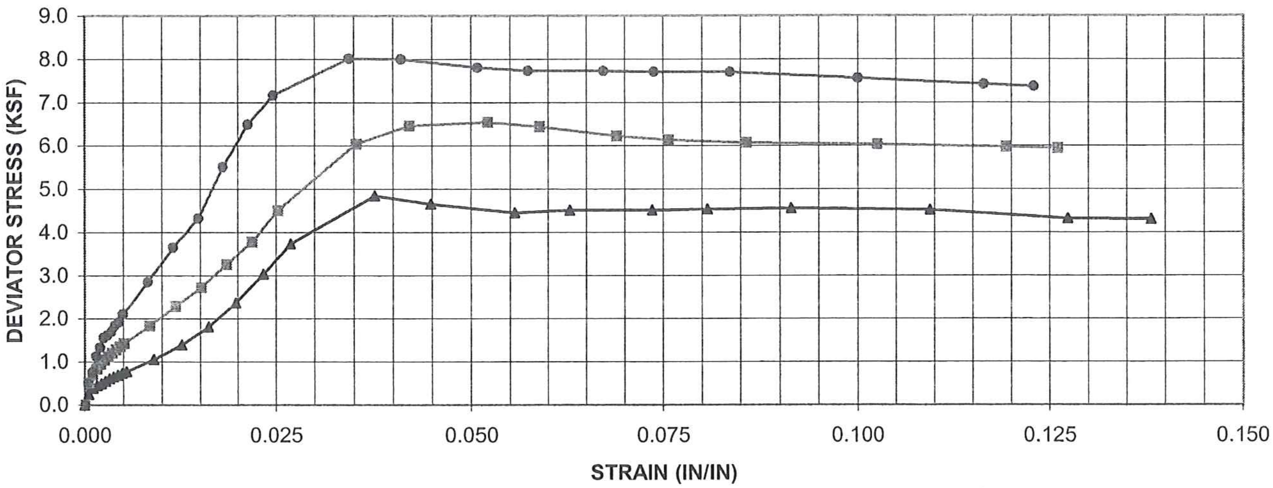
SAMPLE NO.	1	2	3
INITIAL WEIGHT (Lbs.)	2.659	2.392	2.528
INITIAL HEIGHT (In.)	6.502	5.890	6.167
INITIAL DIAMETER (In.)	2.874	2.875	2.896
INITIAL WET DENSITY (pcf)	108.94	108.12	107.56
MOISTURE CONTENT (w%)	47.50	47.32	45.58
INITIAL DRY DENSITY (pcf)	73.86	73.39	73.88

TRIAXIAL TEST DATA

Specific Gravity Assumed - Plotted at Peak Stress



C = 0.95 KSF
ϕ = 30.7 Degrees



TRIAXIAL SHEAR TEST
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SAMPLE ID: WS-4
DEPTH: 20.5' - 22.5'
LL: NP
PL: NP
PI: NP
SOIL DESC.: MARL - Green/Gray Silty Fine SAND (SM)
PROJECT: SC Hwy 41 over Wando River - MSE Wall Study

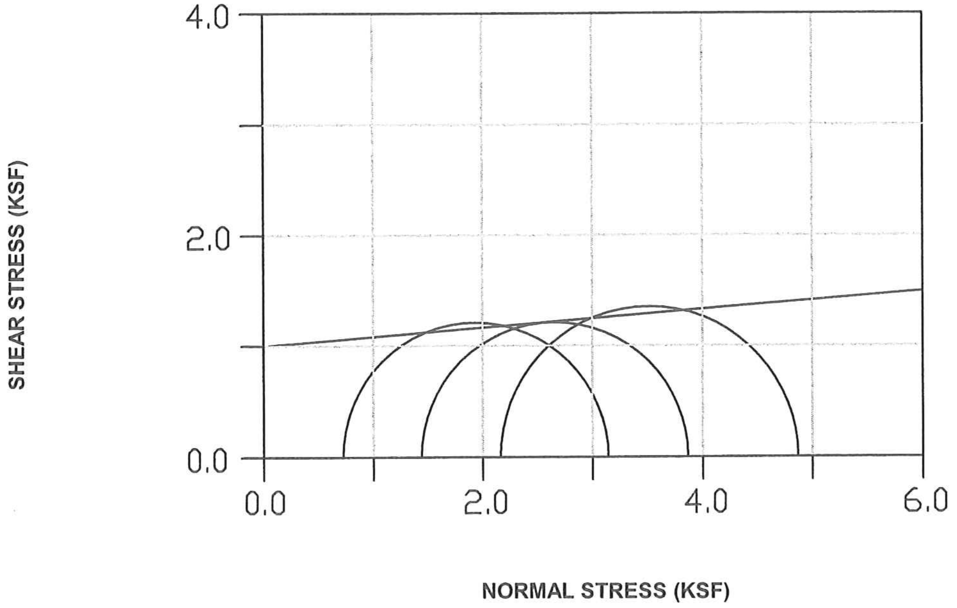
TEST TYPE: CONSOLIDATED UNDRAINED

SAMPLE NO.	1	2	3
VOID RATIO	---	---	---
SATURATION (Si)	99%	98%	100%
SATURATION (Sf)	---	---	---
SPECIFIC GRAVITY	2.65	2.65	2.65
CHAMBER STRESS	0.720	1.440	2.160
DEVIATOR STRESS	4.842	6.543	8.015

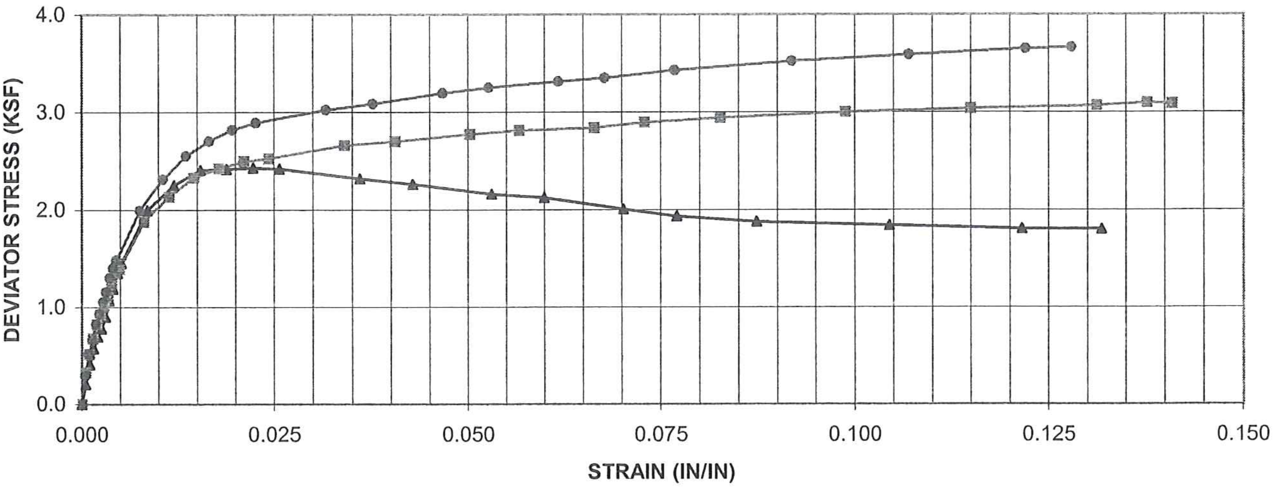
SAMPLE NO.	1	2	3
INITIAL WEIGHT (Lbs.)	2.284	2.466	2.489
INITIAL HEIGHT (In.)	5.575	5.950	6.100
INITIAL DIAMETER (In.)	2.872	2.869	2.866
INITIAL WET DENSITY (pcf)	109.28	109.90	109.27
MOISTURE CONTENT (w%)	44.60	42.47	45.16
INITIAL DRY DENSITY (pcf)	75.57	77.14	75.28

TRIAXIAL TEST DATA

Specific Gravity Assumed - Plotted at Peak Stress



C =1.0 KSF
ϕ = 4.7 Degrees



TRIAXIAL SHEAR TEST
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SAMPLE ID: WS-6
DEPTH: 13.5' - 17.5'
LL: 26
PL: 23
PI: 3
SOIL DESC.: Blue/Gray Fine Sandy SILT (ML)
PROJECT: SC Hwy 41 over Wando River - MSE Wall Study

TEST TYPE: CONSOLIDATED UNDRAINED

SAMPLE NO.	1	2	3	SAMPLE NO.	1	2	3
VOID RATIO	---	---	---	INITIAL WEIGHT (Lbs.)	3.208	2.859	3.014
SATURATION (Si)	100%	100%	100%	INITIAL HEIGHT (In.)	6.858	6.175	6.640
SATURATION (Sf)	---	---	---	INITIAL DIAMETER (In.)	2.851	2.865	2.856
SPECIFIC GRAVITY	2.65	2.65	2.65	INITIAL WET DENSITY (pcf)	126.61	124.11	122.42
CHAMBER STRESS	0.720	1.440	2.160	MOISTURE CONTENT (w%)	25.24	27.03	27.76
DEVIATOR STRESS	5.14	6.66	10.93	INITIAL DRY DENSITY (pcf)	101.09	97.70	95.82

TRIAXIAL TEST DATA

Specific Gravity Assumed - Plotted at Peak Stress

ACCESS
ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION
Jason Stewart

PROJECT ID
SC 41 Over Wando

LABORATORY REPORT NUMBER
1104649

DATE
April 15, 2011

Primary Data Review By

Nicole L. Jessup

Nicole Jessup
Project Manager, AES

Secondary Data Review By

Ashley Amick

Project Manager, Access Analytical
aamick@axs-inc.com

PLEASE NOTE:

- **Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3785 Presidential Parkway, Atlanta, GA 30340.**
- **AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582**
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll fee at 883.315.4243

Access Analytical - Chain of Custody Record

Project Submission #________ **PO #**________ **Laboratory ID:** 1104649

Company Name: F&ME Consultants

Report To: Jason Stewart

Address: 3112 Devine Street

City: Columbia State: SC Zip: 29205

Phone: 803-254-4540 Fax: 803-254-4542

Email: jstewart@fmecol.com

Project Name: SC 41 Over Wando

Sampled By (print): Tom Martin

* Preservative Codes (*place corresponding # in block above analysis field*): 0=None, 1=HCL, 2=HNO_3, 3=H_2SO_4, 4=NaOH, 5=$Na_2S_2O_3$, 6=$NaHSO_4$, Other=Specify

ACCESS
ANALYTICAL, INC.

7478 Carlisle Street
Irmo, SC 29063

Phone: (803) 781-4243
Fax: 781-4303
Toll Free (888) 315-4243
www.accessanalyticalinc.com

Sample Label	Date Collected	Time Collected	Matrix	# of Cont	Preservative: (*see codes below) ↓ REQUESTED LAB ANALYSIS: ↓	pH Determination	Resistivity	Chloride	Sulfate				NOTES / COMMENTS
11-0488 (28.5-30) B-5	4/2/11		S	1		X	X	X	X				
11-0489 (48.5-50) B-10	4/3/11		S	1		X	X	X	X				
11-0490 (58.5-60) B-11	4/6/11		S	1		X	X	X	X				

Turnaround Time:

X Std. (5-7 Bus. days)
___**RUSH***
***Date Required:**________
(For rush work, results faxed by end of business day on date required)

Samples Recd. on Ice?
___Yes
X No

Project Location:
X SC
___NC
___Other______(specify)

Relinquished By:	Date:	Time:	Received By:
Shawn Daniels	4/7/11	1450	M. Roberts
	4/8/11	11:00	

Pg____of____

Access Analytical, Inc.
See Reverse for Terms and Conditions

Original Copy - Returned w/Report
Yellow Copy - Access File Copy
Pink Copy - Client Copy

Analytical Environmental Services, Inc. **Date:** *15-Apr-11*

CLIENT: F&ME Consultants
Project: SC 41 Over Wando
Lab Order: 1104649

CASE NARRATIVE

Sample Receiving Nonconformance:

Samples for pH analysis by Method 9045D were received and analyzed outside Method specified holding time of immediate or 15 minutes.

Analytical Environmental Services, Inc

Date: 14-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0488 B-5 (28.5-30)
Project Name:	SC 41 Over Wando	**Collection Date:**	4/2/2011
Lab ID:	1104649-001	**Matrix:**	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	679	0		ohms*cm	144807	1	04/12/2011 16:45	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	7.99	0.01	H	pH Units	144836	1	04/11/2011 13:25	SR
ION SCAN SW9056A				**(SW9056)**				
Chloride	930	180		mg/Kg-dry	144765	10	04/12/2011 20:06	GR
Sulfate	460	18		mg/Kg-dry	144765	1	04/11/2011 20:51	GR
PERCENT MOISTURE D2216								
Percent Moisture	44.5	0		wt%	R194832	1	04/14/2011 10:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 14-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0489 B-10 (48.5-50)
Project Name:	SC 41 Over Wando	**Collection Date:**	4/3/2011
Lab ID:	1104649-002	**Matrix:**	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	382	0		ohms*cm	144807	1	04/12/2011 16:45	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.33	0.01	H	pH Units	144836	1	04/11/2011 13:25	SR
ION SCAN SW9056A				**(SW9056)**				
Chloride	1700	160		mg/Kg-dry	144765	10	04/12/2011 20:21	GR
Sulfate	440	16		mg/Kg-dry	144765	1	04/11/2011 21:06	GR
PERCENT MOISTURE D2216								
Percent Moisture	37.4	0		wt%	R194832	1	04/14/2011 10:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 14-Apr-11

Client: F&ME Consultants
Project Name: SC 41 Over Wando
Lab ID: 1104649-003

Client Sample ID: 11-0490 B-11 (58.5-60)
Collection Date: 4/6/2011
Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	504	0		ohms*cm	144807	1	04/12/2011 16:45	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.29	0.01	H	pH Units	144836	1	04/11/2011 13:25	SR
ION SCAN SW9056A				**(SW9056)**				
Chloride	1900	270		mg/Kg-dry	144765	10	04/12/2011 20:35	GR
Sulfate	930	27		mg/Kg-dry	144765	1	04/11/2011 21:20	GR
PERCENT MOISTURE D2216								
Percent Moisture	64.1	0		wt%	R194832	1	04/14/2011 10:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access

Work Order Number 1104649

Checklist completed by Mark (Signature) 4-8-11 (Date)

Carrier name: [✓ FedEx] UPS __ Courier __ Client __ US Mail __ Other ______

Shipping container/cooler in good condition? [✓ Yes] No __ Not Present __

Custody seals intact on shipping container/cooler? Yes __ No __ [✓ Not Present]

Custody seals intact on sample bottles? Yes __ No __ [✓ Not Present]

Container/Temp Blank temperature in compliance? (4°C±2)* [✓ Yes] No __

Cooler #1 4.3°c Cooler #2 4.7°c Cooler #3 ______ Cooler #4 ______ Cooler#5 ______ Cooler #6 ______

Chain of custody present? [✓ Yes] No __

Chain of custody signed when relinquished and received? [✓ Yes] No __

Chain of custody agrees with sample labels? [✓ Yes] No __

Samples in proper container/bottle? [✓ Yes] No __

Sample containers intact? [✓ Yes] No __

Sufficient sample volume for indicated test? [✓ Yes] No __

All samples received within holding time? Yes __ [✓ No]

Was TAT marked on the COC? [✓ Yes] No __

Proceed with Standard TAT as per project history? Yes __ No __ [✓ Not Applicable]

Water - VOA vials have zero headspace? [✓ No VOA vials submitted] Yes __ No __

Water - pH acceptable upon receipt? Yes __ No __ [✓ Not Applicable]

Adjusted? ______ Checked by ______

Sample Condition: [✓ Good] Other(Explain) ______

(For diffusive samples or AIHA lead) Is a known blank included? Yes __ [✓ No]

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

\L\Quality Assurance\Checklists Procedures Sign-Off Templates\Checklists\Sample Receipt Checklists\Sample_Cooler_Receipt_Checklist

Client: F&ME Consultants
Project Name: SC 41 Over Wando
Workorder: 1104649

ANALYTICAL QC SUMMARY REPORT

BatchID: **144765**

Sample ID: **MB-144765** Client ID: Units: **mg/Kg** Prep Date: **04/11/2011** Run No: **194600**
SampleType: **MBLK** TestCode: **ION SCAN SW9056A** BatchID: **144765** Analysis Date: **04/11/2011** Seq No: **4060347**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	BRL	10	0	0	0	0	0	0	0	0	
Sulfate	BRL	10	0	0	0	0	0	0	0	0	

Sample ID: **LCS-144765** Client ID: Units: **mg/Kg** Prep Date: **04/11/2011** Run No: **194600**
SampleType: **LCS** TestCode: **ION SCAN SW9056A** BatchID: **144765** Analysis Date: **04/11/2011** Seq No: **4060348**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	94.20	10	100	1.249	93	90	110	0	0	0	
Sulfate	235.6	10	250	0	94.2	90	110	0	0	0	

Sample ID: **1104452-001AMS** Client ID: Units: **mg/Kg-dry** Prep Date: **04/11/2011** Run No: **194600**
SampleType: **MS** TestCode: **ION SCAN SW9056A** BatchID: **144765** Analysis Date: **04/11/2011** Seq No: **4060350**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	117.8	12	118.3	7.411	93.4	80	120	0	0	0	
Sulfate	104.2	12	295.7	0	35.2	80	120	0	0	0	S

Sample ID: **1104452-001AMSD** Client ID: Units: **mg/Kg-dry** Prep Date: **04/11/2011** Run No: **194600**
SampleType: **MSD** TestCode: **ION SCAN SW9056A** BatchID: **144765** Analysis Date: **04/11/2011** Seq No: **4060355**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	115.3	12	118.3	7.411	91.2	80	120	117.8	2.21	20	
Sulfate	100.9	12	295.7	0	34.1	80	120	104.2	3.23	20	S

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: SC 41 Over Wando
Workorder: 1104649

ANALYTICAL QC SUMMARY REPORT

BatchID: **144807**

Sample ID: **LCS-144807** Client ID: Units: **ohms*cm** Prep Date: **04/11/2011** Run No: **194644**
SampleType: **LCS** TestCode: **Soil Resistivity SW9050A** BatchID: **144807** Analysis Date: **04/12/2011** Seq No: **4061127**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	9737	0	10000	0	97.4	90	110	0	0	0	

Sample ID: **1104649-003ADUP** Client ID: **11-0490 B-11 (58.5-60)** Units: **ohms*cm** Prep Date: **04/11/2011** Run No: **194644**
SampleType: **DUP** TestCode: **Soil Resistivity SW9050A** BatchID: **144807** Analysis Date: **04/12/2011** Seq No: **4061134**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	516.8	0	0	0	0	0	0	504.3	2.45	30	

Qualifiers:

> Greater than Result value	< Less than Result value	B Analyte detected in the associated method blank
BRL Below reporting limit	E Estimated (value above quantitation range)	H Holding times for preparation or analysis exceeded
J Estimated value detected below Reporting Limit	N Analyte not NELAC certified	R RPD outside limits due to matrix
Rpt Lim Reporting Limit	S Spike Recovery outside limits due to matrix	

Analytical Environmental Services, Inc

Date: 14-Apr-11

Client: F&ME Consultants
Project Name: SC 41 Over Wando
Workorder: 1104649

ANALYTICAL QC SUMMARY REPORT

BatchID: **144836**

Sample ID: **LCS-144836** Client ID: Units: **pH Units** Prep Date: **04/11/2011** Run No: **194586**
SampleType: **LCS** TestCode: **Laboratory Hydrogen Ion (pH) SW9045D** BatchID: **144836** Analysis Date: **04/11/2011** Seq No: **4060127**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	7.010	0.01	7	0	100	90	110	0	0	0	

Sample ID: **1104737-001ADUP** Client ID: Units: **pH Units** Prep Date: **04/11/2011** Run No: **194586**
SampleType: **DUP** TestCode: **Laboratory Hydrogen Ion (pH) SW9045D** BatchID: **144836** Analysis Date: **04/11/2011** Seq No: **4060137**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	7.000	0.01	0	0	0	0	0	7.080	1.14	10	H

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

ACCESS ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION
Jason Stewart

PROJECT ID
SC41 Over Wando

LABORATORY REPORT NUMBER
1103S04

DATE
April 07, 2011

Primarv Data Review Bv	Secondarv Data Review Bv
Nicole 2. Jessup	Ashley Amick
Nicole Jessup Project Manager, AES	Project Manager, Access Analytical aamick@axs-inc.com

PLEASE NOTE:

- **Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3785 Presidential Parkway, Atlanta, GA 30340.**
- **AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582**
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll fee at 883.315.4243

Access Analytical - Chain of Custody Record

Project Submission #________ **PO #**________ **Laboratory ID:** 1103304

Company Name: F&ME Consultants
Report To: Jason Steward
Address: 3112 Devine Street
City: Columbia State: SC Zip: 29205
Phone: 803-254-4540 Fax: 803-254-4542
Email: jstewart@fmecol.com
Project Name: SC 41 Over Wando
Sampled By (print): Tom Martin

Preservative: (*see codes below)

↓ REQUESTED LAB ANALYSIS: ↓

Sample Label	Date Collected	Time Collected	Matrix	# of Cont	pH Determination	Resistivity	Chloride	Sulfate			
11-0429 (13.5'-15') B-6	3/18/11		S	1	X	X	X	X			
11-0435 (23.5'-25') B-7	3/17/11		S	1	X	X	X	X			
11-0430 (33.5'-35') B-8	3/22/11		S	1	X	X	X	X			
11-0431 (43.5'-45') B-9	3/23/11		S	1	X	X	X	X			

* Preservative Codes (*place corresponding # in block above analysis field*): 0=None, 1=HCL, 2=HNO_3, 3=H_2SO_4, 4=NaOH, 5=$Na_2S_2O_3$, 6=$NaHSO_4$, Other=Specify

ACCESS
ANALYTICAL, INC.

7478 Carlisle Street
Irmo, SC 29063
Phone: (803) 781-4243
Fax: 781-4303
Toll Free (888) 315-4243
www.accessanalyticalinc.com

NOTES / COMMENTS

Turnaround Time:

☒ Std. (5-7 Bus. days)
☐ **RUSH***
***Date Required:**______
(For rush work, results faxed by end of business day on date required)

Samples Recd. on Ice?
☐ Yes
☒ No

Project Location:
☒ SC
☐ NC
☐ Other______(specify)

Relinquished By:	Date:	Time:	Received By:
Sharon Daniels	3/30/11	1500	M. Robertson
M. Robertson	3/30/11	1700	FedEx
	3/31/11	11:00	

Pg____of____

Access Analytical, Inc.
See Reverse for Terms and Conditions

Original Copy - Returned w/Report
Yellow Copy - Access File Copy
Pink Copy - Client Copy

Date: 8-Apr-11

Client: F&ME Consultants
Project: SC41 Over Wando
Lab ID: 1103S04

Case Narrative

Sample Receiving Nonconformance:

Sample(s) for pH analysis by Method S9045D were received and analyzed outside Method specified holding time of immediate or 15 minutes.

Ion Chromatography Analysis by Method 9056:

Due to sample matrix, sample(s) 1103S04-001A, -002A, -003A, and -004A required a dilution during preparation and/or analysis resulting in elevated reporting limits for Sulfate.

Analytical Environmental Services, Inc

Date: 8-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0429 (13.5'-15') B-6
Project Name:	SC41 Over Wando	**Collection Date:**	3/18/2011
Lab ID:	1103S04-001	**Matrix:**	Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	127	0		ohms*cm	144523	1	04/05/2011 16:50	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.09	0.01	H	pH Units	144435	1	04/05/2011 10:40	MP
ION SCAN SW9056A				**(SW9056)**				
Chloride	6300	1600		mg/Kg-dry	144429	100	04/05/2011 11:16	GR
Sulfate	BRL	1600		mg/Kg-dry	144429	100	04/05/2011 11:16	GR
PERCENT MOISTURE D2216								
Percent Moisture	39.4	0		wt%	R194199	1	04/05/2011 17:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 8-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0435 (23.5'-25') B-7
Project Name:	SC41 Over Wando	**Collection Date:**	3/17/2011
Lab ID:	1103S04-002	**Matrix:**	Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	272	0		ohms*cm	144523	1	04/05/2011 16:50	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.11	0.01	H	pH Units	144435	1	04/05/2011 10:45	MP
ION SCAN SW9056A				**(SW9056)**				
Chloride	2700	1700		mg/Kg-dry	144429	100	04/05/2011 12:02	GR
Sulfate	BRL	1700		mg/Kg-dry	144429	100	04/05/2011 12:02	GR
PERCENT MOISTURE D2216								
Percent Moisture	39.9	0		wt%	R194199	1	04/05/2011 17:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 8-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0430 (33.5'-35) B-8
Project Name:	SC41 Over Wando	**Collection Date:**	3/22/2011
Lab ID:	1103S04-003	**Matrix:**	Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	355	0		ohms*cm	144523	1	04/05/2011 16:50	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.30	0.01	H	pH Units	144435	1	04/05/2011 10:55	MP
ION SCAN SW9056A				**(SW9056)**				
Chloride	2500	1600		mg/Kg-dry	144429	100	04/05/2011 12:17	GR
Sulfate	BRL	1600		mg/Kg-dry	144429	100	04/05/2011 12:17	GR
PERCENT MOISTURE D2216								
Percent Moisture	39.5	0		wt%	R194199	1	04/05/2011 17:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 8-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	11-0431 (43.5'-45') B-9
Project Name:	SC41 Over Wando	**Collection Date:**	3/23/2011
Lab ID:	1103S04-004	**Matrix:**	Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Soil Resistivity SW9050A				**(SW9050A)**				
Resistivity (@100% Moisture Saturation)	304	0		ohms*cm	144523	1	04/05/2011 16:50	CG
Laboratory Hydrogen Ion (pH) SW9045D				**(SW9045D)**				
pH	8.36	0.01	H	pH Units	144435	1	04/05/2011 11:05	MP
ION SCAN SW9056A				**(SW9056)**				
Chloride	2800	1600		mg/Kg-dry	144429	100	04/05/2011 12:32	GR
Sulfate	BRL	1600		mg/Kg-dry	144429	100	04/05/2011 12:32	GR
PERCENT MOISTURE D2216								
Percent Moisture	39.0	0		wt%	R194199	1	04/05/2011 17:00	AS

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access

Work Order Number 1103804

Checklist completed by ____ Signature

3-31-11 Date

Carrier name: [✓ FedEx] UPS __ Courier __ Client __ US Mail __ Other ____

Shipping container/cooler in good condition? [✓ Yes] No __ Not Present __

Custody seals intact on shipping container/cooler? Yes __ No __ [✓ Not Present]

Custody seals intact on sample bottles? Yes __ No __ [✓ Not Present]

Container/Temp Blank temperature in compliance? (4°C±2)* [✓ Yes] No __

Cooler #1 4.3° Cooler #2 4.0° Cooler #3 ____ Cooler #4 ____ Cooler#5 ____ Cooler #6 ____

Chain of custody present? [✓ Yes] No __

Chain of custody signed when relinquished and received? [✓ Yes] No __

Chain of custody agrees with sample labels? [✓ Yes] No __

Samples in proper container/bottle? [✓ Yes] No __

Sample containers intact? [✓ Yes] No __

Sufficient sample volume for indicated test? [✓ Yes] No __

All samples received within holding time? Yes __ [✓ No]

Was TAT marked on the COC? [✓ Yes] No __

Proceed with Standard TAT as per project history? Yes __ No __ [✓ Not Applicable]

Water - VOA vials have zero headspace? [✓ No VOA vials submitted] Yes __ No __

Water - pH acceptable upon receipt? Yes __ No __ [✓ Not Applicable]

Adjusted? ____ Checked by ____

Sample Condition: [✓ Good] Other(Explain) ____

(For diffusive samples or AIHA lead) Is a known blank included? Yes __ [✓ No]

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

\L\Quality Assurance\Checklists Procedures Sign-Off Templates\Checklists\Sample Receipt Checklists\Sample_Cooler_Receipt_Checklist

Analytical Environmental Services, Inc

Date: 7-Apr-11

Client: F&ME Consultants
Project: SC41 Over Wando
Lab Order: 1103S04

Dates Report

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
1103S04-001A	11-0429 (13.5'-15') B-6	3/18/2011 12:00:00AM	Solid	Laboratory Hydrogen Ion (pH)		04/04/2011	04/05/2011
1103S04-001A	11-0429 (13.5'-15') B-6	3/18/2011 12:00:00AM	Solid	Soil Resistivity		04/04/2011	04/05/2011
1103S04-001A	11-0429 (13.5'-15') B-6	3/18/2011 12:00:00AM	Solid	ION SCAN		04/04/2011	04/05/2011
1103S04-001A	11-0429 (13.5'-15') B-6	3/18/2011 12:00:00AM	Solid	PERCENT MOISTURE			04/05/2011
1103S04-002A	11-0435 (23.5'-25') B-7	3/17/2011 12:00:00AM	Solid	Laboratory Hydrogen Ion (pH)		04/04/2011	04/05/2011
1103S04-002A	11-0435 (23.5'-25') B-7	3/17/2011 12:00:00AM	Solid	Soil Resistivity		04/04/2011	04/05/2011
1103S04-002A	11-0435 (23.5'-25') B-7	3/17/2011 12:00:00AM	Solid	ION SCAN		04/04/2011	04/05/2011
1103S04-002A	11-0435 (23.5'-25') B-7	3/17/2011 12:00:00AM	Solid	PERCENT MOISTURE			04/05/2011
1103S04-003A	11-0430 (33.5'-35) B-8	3/22/2011 12:00:00AM	Solid	Laboratory Hydrogen Ion (pH)		04/04/2011	04/05/2011
1103S04-003A	11-0430 (33.5'-35) B-8	3/22/2011 12:00:00AM	Solid	Soil Resistivity		04/04/2011	04/05/2011
1103S04-003A	11-0430 (33.5'-35) B-8	3/22/2011 12:00:00AM	Solid	ION SCAN		04/04/2011	04/05/2011
1103S04-003A	11-0430 (33.5'-35) B-8	3/22/2011 12:00:00AM	Solid	PERCENT MOISTURE			04/05/2011
1103S04-004A	11-0431 (43.5'-45') B-9	3/23/2011 12:00:00AM	Solid	Laboratory Hydrogen Ion (pH)		04/04/2011	04/05/2011
1103S04-004A	11-0431 (43.5'-45') B-9	3/23/2011 12:00:00AM	Solid	Soil Resistivity		04/04/2011	04/05/2011
1103S04-004A	11-0431 (43.5'-45') B-9	3/23/2011 12:00:00AM	Solid	ION SCAN		04/04/2011	04/05/2011
1103S04-004A	11-0431 (43.5'-45') B-9	3/23/2011 12:00:00AM	Solid	PERCENT MOISTURE			04/05/2011

Client: F&ME Consultants
Project Name: SC41 Over Wando
Workorder: 1103S04

ANALYTICAL QC SUMMARY REPORT

BatchID: **144429**

Sample ID: **MB-144429** Client ID: Units: **mg/Kg** Prep Date: **04/04/2011** Run No: **194163**
SampleType: **MBLK** TestCode: **ION SCAN SW9056A** BatchID: **144429** Analysis Date: **04/05/2011** Seq No: **4051021**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	BRL	10	0	0	0	0	0	0	0	0	
Sulfate	BRL	10	0	0	0	0	0	0	0	0	

Sample ID: **LCS-144429** Client ID: Units: **mg/Kg** Prep Date: **04/04/2011** Run No: **194163**
SampleType: **LCS** TestCode: **ION SCAN SW9056A** BatchID: **144429** Analysis Date: **04/05/2011** Seq No: **4051023**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	54.96	10	50	0	110	90	110	0	0	0	
Sulfate	234.3	10	250	0	93.7	90	110	0	0	0	

Sample ID: **1103S04-001AMS** Client ID: **11-0429 (13.5'-15') B-6** Units: **mg/Kg-dry** Prep Date: **04/04/2011** Run No: **194163**
SampleType: **MS** TestCode: **ION SCAN SW9056A** BatchID: **144429** Analysis Date: **04/05/2011** Seq No: **4051028**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	6214	1600	81.9	6274	-73.1	80	120	0	0	0	S
Sulfate	1740	1600	409.5	1405	81.9	80	120	0	0	0	

Sample ID: **1103S04-001AMSD** Client ID: **11-0429 (13.5'-15') B-6** Units: **mg/Kg-dry** Prep Date: **04/04/2011** Run No: **194163**
SampleType: **MSD** TestCode: **ION SCAN SW9056A** BatchID: **144429** Analysis Date: **04/05/2011** Seq No: **4051030**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	5999	1600	8190	6274	-3.36	80	120	6214	3.53	20	S
Sulfate	1641	1600	409.5	1405	57.6	80	120	1740	5.89	20	S

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: SC41 Over Wando
Workorder: 1103S04

ANALYTICAL QC SUMMARY REPORT

BatchID: **144435**

Sample ID: **LCS-144435**	Client ID:	Units: **pH Units**	Prep Date: **04/04/2011**	Run No: **193997**
SampleType: **LCS**	TestCode: **Laboratory Hydrogen Ion (pH) SW9045D**	BatchID: **144435**	Analysis Date: **04/04/2011**	Seq No: **4047612**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	7.050	0.01	7	0	101	90	110	0	0	0	

Sample ID: **1103S04-003ADUP**	Client ID: **11-0430 (33.5'-35) B-8**	Units: **pH Units**	Prep Date: **04/04/2011**	Run No: **193997**
SampleType: **DUP**	TestCode: **Laboratory Hydrogen Ion (pH) SW9045D**	BatchID: **144435**	Analysis Date: **04/05/2011**	Seq No: **4047621**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	8.320	0.01	0	0	0	0	0	8.300	0.241	10	H

Sample ID: **1103S45-001BDUP**	Client ID:	Units: **pH Units**	Prep Date: **04/04/2011**	Run No: **193997**
SampleType: **DUP**	TestCode: **Laboratory Hydrogen Ion (pH) SW9045D**	BatchID: **144435**	Analysis Date: **04/04/2011**	Seq No: **4047624**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	10.10	0.01	0	0	0	0	0	10.11	0.099	10	H

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Analytical Environmental Services, Inc

Date: 7-Apr-11

Client: F&ME Consultants
Project Name: SC41 Over Wando
Workorder: 1103S04

ANALYTICAL QC SUMMARY REPORT

BatchID: **144523**

Sample ID: **LCS-144523** Client ID: Units: **ohms*cm** Prep Date: **04/04/2011** Run No: **194172**
SampleType: **LCS** TestCode: **Soil Resistivity SW9050A** BatchID: **144523** Analysis Date: **04/05/2011** Seq No: **4051088**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	9970	0	10000	0	99.7	90	110	0	0	0	

Sample ID: **1103S04-001ADUP** Client ID: **11-0429 (13.5'-15') B-6** Units: **ohms*cm** Prep Date: **04/04/2011** Run No: **194172**
SampleType: **DUP** TestCode: **Soil Resistivity SW9050A** BatchID: **144523** Analysis Date: **04/05/2011** Seq No: **4051095**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	133.7	0	0	0	0	0	0	127.4	4.83	30	

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

ACCESS
ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION

Glynn Ellen

PROJECT ID

SC-41 Over Wando River

LABORATORY REPORT NUMBER

1104E68

DATE

April 20, 2011

Primary Data Review By	Secondary Data Review By
Nicole J. Jessup	Ashley Amick
Nicole Jessup Project Manager, AES	Project Manager, Access Analytical aamick@axs-inc.com

PLEASE NOTE:

- **Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3785 Presidential Parkway, Atlanta, GA 30340.**
- **AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582**
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll fee at 883.315.4243

1104E68

Access Analytical - Chain of Custody Record

LAB USE ONLY
Project Work Order #

PO # 64067.01

Access Quote #

LAB USE ONLY
Laboratory ID:

ACCESS
ANALYTICAL, INC.

7478 Carlisle Street
Irmo, SC 29063
Phone: (803) 781-4243
Fax: 781-4303
Toll Free (888) 315-4243
www.axs-inc.com

Company Name: FEME CONSULTANTS
Report To: GLYNN ELLEN
Address: 3112 DEVINE ST.
City: COLUMBIA State: SC. Zip: 29205
Phone: (803) 254-4540 Fax: (803) 254-4542
Email: glynn@fmecol.com
Project Name: SC-41 OVER WANDO RIVER
Sampled By: JEFF SMALL

Preservative: (*see codes below)

↓ REQUESTED LAB ANALYSIS: ↓

Sample Location/Description	Date Collected:	Time Collected:	Type: (grab or composite)	Matrix: (see codes)	# of cont.	PH	RESISTIVITY	CHLORIDES	SULFATES						
GAS STATION SIDE	4/18/11	1:00	G	OT	1	X	X	X	X						
OTHER SIDE	4/18/11	1:15	G	OT	1	X	X	X	X						

***Preservative Codes** (*place corresponding # in black above analysis field*): 0=None, 1=HCL, 2=HNO_3, 3=H_2SO_4, 4=NaOH, 5=$Na_2S_2O_3$, 6=$NaHSO_4$, Other=Specify

***Matrix Codes** (*place corresponding code in sample matrix column*): **GW**=ground water, **WW**=waste water, **DW**=drinking water, **S**=soil, **SL**=sludge, **A**=air, **IW**=industrial waste, **WO**=waste oil, **OT**=other (*Specify in comments section*)

NOTES / COMMENTS
(*if sample is a composite please use space below to note start/finish times & dates*)

Turnaround Time:
__ ~~Standard~~
✓ RUSH*
*Date Required: 4/19/11
(For rush work, results emailed/faxed by end of business day on date required)

LAB USE ONLY
Samples Recd. on Ice?
___Yes
___No
Receipt Temp ____

Project Location:
✓ SC
___NC
___Other_____(specify)

Relinquished By:	Date:	Time:	Received By:
	4/18/11	5:00PM	A Martin
A Martin	4/18/11	1710	FedEx
FedEx			
	4/19/11	~~10:15~~	

See Reverse for Terms and Conditions

mj 4/19/11
1130

Pg____of____

Original Copy - Returned w/Report
Yellow Copy - Access File Copy
Pink Copy - Client Copy

Analytical Environmental Services, Inc **Date:** 20-Apr-11

Client: F&ME Consultants
Project: SC-41 Over Wando River
Lab ID: 1104E68

Case Narrative

pH Analysis by Method E150.1/SM4500 H+ B

Samples for pH analysis by Method E150.1/SM4500 H+ B were received and analyzed outside holding time requirement of "immediate or 15 minutes".

Analytical Environmental Services, Inc **Date:** 22-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	GAS STATION SIDE
Project Name:	SC-41 Over Wando River	**Collection Date:**	4/18/2011 1:00:00 PM
Lab ID:	1104E68-001	**Matrix:**	Aqueous

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Resistivity SW9050A								
Resistivity (@100% Moisture Saturation)	33.3	0		ohms*cm	R195118	1	04/19/2011 13:30	CG
ION SCAN SW9056A								
Chloride	12000	1000		mg/L	R195134	1000	04/19/2011 13:20	GR
Sulfate	1600	1000		mg/L	R195134	1000	04/19/2011 13:20	GR
Hydrogen Ion (pH)(E150.1/SM4500 H+ B)								
pH	7.64	0.01	H	pH Units	R195156	1	04/19/2011 16:45	SR

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc **Date:** 22-Apr-11

Client:	F&ME Consultants	**Client Sample ID:**	OTHER SIDE
Project Name:	SC-41 Over Wando River	**Collection Date:**	4/18/2011 1:15:00 PM
Lab ID:	1104E68-002	**Matrix:**	Aqueous

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Resistivity SW9050A								
Resistivity (@100% Moisture Saturation)	33.0	0		ohms*cm	R195118	1	04/19/2011 13:30	CG
ION SCAN SW9056A								
Chloride	11000	1000		mg/L	R195134	1000	04/19/2011 13:34	GR
Sulfate	1700	1000		mg/L	R195134	1000	04/19/2011 13:34	GR
Hydrogen Ion (pH)(E150.1/SM4500 H+ B)								
pH	7.49	0.01	H	pH Units	R195156	1	04/19/2011 16:50	SR

Qualifiers:

*	Value exceeds maximum contaminant level	E	Estimated (value above quantitation range)
BRL	Below reporting limit	S	Spike Recovery outside limits due to matrix
H	Holding times for preparation or analysis exceeded	Narr	See case narrative
N	Analyte not NELAC certified	NC	Not confirmed
B	Analyte detected in the associated method blank	<	Less than Result value
>	Greater than Result value	J	Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access

Work Order Number 1104E68

Checklist completed by ____ Signature 4/19/11 Date

Carrier name: [✓ FedEx] UPS __ Courier __ Client __ US Mail __ Other ____

Shipping container/cooler in good condition? [✓ Yes] No __ Not Present __

Custody seals intact on shipping container/cooler? Yes __ No __ [✓ Not Present]

Custody seals intact on sample bottles? Yes __ No __ [✓ Not Present]

Container/Temp Blank temperature in compliance? (4°C±2)* [✓ Yes] No __

Cooler #1 3.3c Cooler #2 ____ Cooler #3 ____ Cooler #4 ____ Cooler#5 ____ Cooler #6 ____

Chain of custody present? [✓ Yes] No __

Chain of custody signed when relinquished and received? [✓ Yes] No __

Chain of custody agrees with sample labels? [✓ Yes] No __

Samples in proper container/bottle? [✓ Yes] No __

Sample containers intact? [✓ Yes] No __

Sufficient sample volume for indicated test? [✓ Yes] No __

All samples received within holding time? Yes __ [✓ No]

Was TAT marked on the COC? [✓ Yes] No __

Proceed with Standard TAT as per project history? Yes __ No __ [✓ Not Applicable]

Water - VOA vials have zero headspace? [✓ No VOA vials submitted] Yes __ No __

Water - pH acceptable upon receipt? [✓ Yes] No __ Not Applicable __

Adjusted? ________ Checked by M.D

Sample Condition: [✓ Good] Other(Explain) ________

(For diffusive samples or AIHA lead) Is a known blank included? Yes __ [✓ No]

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

\L\Quality Assurance\Checklists Procedures Sign-Off Templates\Checklists\Sample Receipt Checklists\Sample_Cooler_Receipt_Checklist

Analytical Environmental Services, Inc **Date:** 22-Apr-11

Client: F&ME Consultants
Project: SC-41 Over Wando River
Lab Order: 1104E68

Dates Report

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
1104E68-001A	GAS STATION SIDE	4/18/2011 1:00:00AM	Aqueous	Laboratory Hydrogen Ion (pH)			04/19/2011
1104E68-001A	GAS STATION SIDE	4/18/2011 1:00:00AM	Aqueous	Resistivity			04/19/2011
1104E68-001A	GAS STATION SIDE	4/18/2011 1:00:00AM	Aqueous	ION SCAN			04/19/2011
1104E68-002A	OTHER SIDE	4/18/2011 1:15:00AM	Aqueous	Laboratory Hydrogen Ion (pH)			04/19/2011
1104E68-002A	OTHER SIDE	4/18/2011 1:15:00AM	Aqueous	Resistivity			04/19/2011
1104E68-002A	OTHER SIDE	4/18/2011 1:15:00AM	Aqueous	ION SCAN			04/19/2011

Date: 20-Apr-11

Client: F&ME Consultants
Project Name: SC-41 Over Wando River
Workorder: 1104E68

ANALYTICAL QC SUMMARY REPORT

BatchID: **R195118**

Sample ID: **LCS-R195118** Client ID: Units: **ohms*cm** Prep Date: Run No: **195118**
SampleType: **LCS** TestCode: **Resistivity SW9050A** BatchID: **R195118** Analysis Date: **04/19/2011** Seq No: **4072592**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	9337	0	10000	0	93.4	90	110	0	0	0	

Sample ID: **1104E68-001ADUP** Client ID: **GAS STATION SIDE** Units: **ohms*cm** Prep Date: Run No: **195118**
SampleType: **DUP** TestCode: **Resistivity SW9050A** BatchID: **R195118** Analysis Date: **04/19/2011** Seq No: **4072595**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturatic	33.30	0	0	0	0	0	0	33.30	0	20	

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: SC-41 Over Wando River
Workorder: 1104E68

ANALYTICAL QC SUMMARY REPORT

BatchID: **R195134**

Sample ID: **MB-R195134** Client ID: Units: **mg/L** Prep Date: Run No: **195134**
SampleType: **MBLK** TestCode: **ION SCAN SW9056A** BatchID: **R195134** Analysis Date: **04/19/2011** Seq No: **4072016**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	BRL	1.0	0	0	0	0	0	0	0	0	
Sulfate	BRL	1.0	0	0	0	0	0	0	0	0	

Sample ID: **LCS-R195134** Client ID: Units: **mg/L** Prep Date: Run No: **195134**
SampleType: **LCS** TestCode: **ION SCAN SW9056A** BatchID: **R195134** Analysis Date: **04/19/2011** Seq No: **4072018**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	9.093	1.0	10	0	90.9	90	110	0	0	0	
Sulfate	23.09	1.0	25	0	92.4	90	110	0	0	0	

Sample ID: **1104E34-001BMS** Client ID: Units: **mg/L** Prep Date: Run No: **195134**
SampleType: **MS** TestCode: **ION SCAN SW9056A** BatchID: **R195134** Analysis Date: **04/19/2011** Seq No: **4072025**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	114.2	10	100	21.08	93.1	90	110	0	0	0	
Sulfate	245.9	10	250	16.52	91.8	90	110	0	0	0	

Sample ID: **1104E34-001BMSD** Client ID: Units: **mg/L** Prep Date: Run No: **195134**
SampleType: **MSD** TestCode: **ION SCAN SW9056A** BatchID: **R195134** Analysis Date: **04/19/2011** Seq No: **4072028**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Chloride	112.2	10	100	21.08	91.1	90	110	114.2	1.75	20	
Sulfate	244.8	10	250	16.52	91.3	90	110	245.9	0.456	20	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: SC-41 Over Wando River
Workorder: 1104E68

ANALYTICAL QC SUMMARY REPORT

BatchID: **R195156**

Sample ID: **LCS-R195156** Client ID: Units: **pH Units** Prep Date: Run No: **195156**
SampleType: **LCS** TestCode: **Hydrogen Ion (pH)(E150.1/SM4500 H+ B)** BatchID: **R195156** Analysis Date: **04/19/2011** Seq No: **4072570**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	7.000	0.01	7	0	100	90	110	0	0	0	

Sample ID: **1104F00-002BDUP** Client ID: Units: **pH Units** Prep Date: Run No: **195156**
SampleType: **DUP** TestCode: **Hydrogen Ion (pH)(E150.1/SM4500 H+ B)** BatchID: **R195156** Analysis Date: **04/19/2011** Seq No: **4072576**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
pH	6.400	0.01	0	0	0	0	0	6.400	0	10	H

Qualifiers:

>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

F&ME
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AASHTO R18

AASHTO ACCREDITED LABORATORY

www.fmecol.com

August 16, 2011

Mr. Chris Gaskins, P.E., P.G.
SCDOT
955 Park Street
Columbia, South Carolina 29202

Re.: Geophysical Investigation Report
SC 41 Replacement Bridge over Wando River
Charleston/Berkeley County, South Carolina
SCDOT File No. 8.158B/10.032102; PIN: 32099
F&ME Project No. G4067.01

Dear Chris:

Submitted herein is the report from the performed geophysical investigation for the above referenced bridge project. Included is a summary of the field investigation, our analysis of the subsurface findings, and our conclusions for the proposed bridge system.

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

Sincerely,

F&ME CONSULTANTS

James R Wessinger
James R. Wessinger, P.G.
Project Geologist

John F. Hamilton, E.I.T.
Staff Engineer

attachments (CD)

JRW/jfh

GEOPHYSICAL INVESTIGATION

F&ME performed a geophysical investigation on November 10, 2004 at select locations within the Wando River to supplement our geotechnical investigation. The geophysical investigation was accomplished through two-dimensional Electrical Resistivity (ER) imaging. The main objective of our geophysical investigation was to provide a continuous indication of subsurface conditions to interpolate between widely spaced test borings. The borings and soundings from the geotechnical exploration were used to proof the geophysical data allowing additional refinement and interpretation.

(i) General Information

F&ME utilized the SuperSting Earth Resistivity System manufactured by Advanced Geosciences, Inc. (AGI). The system consists of the SuperSting 8-channel resistivity meter and a multi-electrode cable with 42 electrodes at nine (9) foot spacing and an automatic switching unit. The eight channels allow for eight resistivity measurements to be taken simultaneously. The electrodes are ‘grounded’ at the desired design electrode spacing utilizing steel spring clips and stakes pushed into the ground.

ER imaging is based on the principle that materials have unique physical characteristics, which determine how well, or poorly, the material can conduct an electrical current. The current is injected at two points and then measured at other pre-determined points depending upon the electrode arrangement for the selected in-situ measurement methodology. Analysis of the potential electrical current drops between electrodes using a finite difference algorithm that allows a determination of the resistance of the subsurface material (expressed as ohms/meter).

Resistivity values of soil and rock are affected by mineral composition, porosity, moisture, dissolved electrolytes, and temperature. Soils generally have low resistivity values, whereas rock has a relativity high resistivity value. A soil or rock resistivity can vary greatly depending on whether it is wet or dry. Because of overlap in the range of resistivity for various materials, this method is used in conjunction with other geotechnical methods to verify data interpretation.

The ‘resolution’ that the ER equipment can detect is a function of the electrode probe spacing. In general, objects and soil strata which are smaller or thinner than one-half the individual electrode probe spacing may not be easily discernable. The depth of investigation that ER data acquisition is capable is a function of the total survey line length. Therefore, the depth that can be interpreted with a reasonable resolution is approximately one-fourth to one-fifth of the total survey line length.

Points to remember when reviewing the data collected from resistivity surveys are as follows:

1. The resistivity imaging technique is ‘side-looking’. This results in the fact that while the ER profiles depict a vertical slice, roughly perpendicular to ground surface, the indicated anomalies may be located to either side of the survey line;
2. The resistivity image may be distorted by unknown formations;
3. Constructed objects at ground surface (e.g. metallic fencing, power lines, grounding systems, etc.) and below ground (e.g. metallic pipe lines, bridge steel piling, foundation reinforcing steel, etc.) will provide ‘artificial’ high conductivity values;
4. Clay layers at ground surface or below grade with relatively high electro-chemical conductivities can ‘mask’ deeper soil and rock strata;

5. The resistivity image is a picture in terms of electrical resistivity and not a true picture of subsurface strata as we are accustomed to visualizing (i.e. pseudo-section); and,
6. The electrical resistivity of the strata will slightly change depending on the electrode signal configuration.

(ii) Field Work

A continuous marine survey was performed at the bridge site on November 10, 2004. A special marine electrode cable was towed behind a boat at 2 to 3 knots and the data gathered includes: resistivity, location (GPS), temperature (affects resistivity), and depth. The electrode spacing used here was five (5) meters. By knowing the boat location, the GPS unit can calculate the position of each electrode at any given moment. The continuous survey allows survey lines to be 1000 feet or more and consist of thousands of data points. The data is then converted to a “straight line” and then analyzed through the inversion process. This gives a two-dimensional picture of the river bottom which shows apparent resistivity, depth, temperature, and beginning/ending latitude and longitude. In addition, an image is created that shows the actual plan view of the ER survey line.

Due to the current in the river, it was necessary to perform the survey at low tide. This minimized the current affecting the cable and the boat. Several survey lines had to be terminated due to the current moving the boat off course.

Nine (9) successful survey lines were performed at the site. Three (3) survey lines were located to the southeast of the existing bridge, and they were in the approximate footprint of the proposed new bridge. The other six (6) survey lines were run perpendicular to the bridge, between the following bents (numbered from the north end of the existing bridge); 4 and 5, 8 and 9, 13 and 14, 19 and 20, 25 and 26 and the south side of the swing gate bridge. No survey was performed near the southern end of the existing bridge due to the shipyard structures on the southwest side of the bridge.

AREA GEOLOGY

The bridge site is located within the Lower Coastal Plain Physiological Province of South Carolina. The Coastal Plain consists of a wedge of sedimentary deposits which overlie basement rocks beginning at the Fall Line and increase in thickness moving seaward. In the Charleston area this sediment wedge is on the order of 2500 feet thick. The surface deposits of this physiological province were formed during the Pleistocene epoch of the Quaternary period and generally consist of sand and clay layers with varying amounts of shells and occasional organics. Underlying the surface deposits (about 17 feet on the north side of the river to about 22 feet on the south side of the river) is the stiff fine grained soils of the Cooper Marl Formation.

The Cooper Marl Formation varies in composition depending upon depositional environments and was formed in the Upper Cretaceous age. For engineering purposes, Cooper Marl is classified as silt, clay, or silty sand. The formation is over-consolidated with plasticity ranging from low to high. Properties of Cooper Marl are well documented in Charleston in that it is the predominant support formation for most major structures.

ER SURVEY RESULTS

The ER survey of the river bottom shows that the Wando River has cut into the Cooper Marl in the main river channel and there appear to be remnants of previous main channel locations. In the channel (high flow zone), there appears to be little sediment on top of the Cooper Marl. In low flow zones, there is approximately 8 to 10 feet of sediment, which is predominantly coarse grained material.

We have provided the results from the performed ER survey on the disc submitted with this report.

LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to the referenced bridge project. The conclusions and recommendations contained herein are based upon the provided test borings and testing results contained within, and applicable standards in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

In the event that any changes in nature, design, or location of the structure and/or foundation elements are planned, the recommendations contained in this report will not be considered valid unless the changes are reviewed and verified in writing.