USGS Award Number 05HQGR0037

ELECTRONIC FILES OF SHEAR WAVE VELOCITY AND CONE PENETRATION TEST MEASUREMENTS FROM THE GREATER CHARLESTON AREA, SOUTH CAROLINA

Data Report to the
United States Geological Survey

By:

Nisha P. Mohanan
Cedric D. Fairbanks
Ronald D. Andrus
Clemson University

William M. Camp
Timothy J. Cleary
S&ME, Inc.

Thomas J. Casey
William B. Wright
WPC, Inc.

Department of Civil Engineering
Clemson University
Lowry Hall, Box 340911
Clemson, SC 29623-0911 USA
Telephone: (864) 656-0488
Fax: (864) 656-2670
E-mail: randrus@clemson.edu

March 2006

Research supported by the United States Geological Survey (USGS), Department of the Interior, under USGS award number 05HQGR0037. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the United States Government.

USGS Award Number 05HQGR0037

ELECTRONIC FILES OF SHEAR WAVE VELOCITY AND CONE PENETRATION TEST MEASUREMENTS FROM THE GREATER CHARLESTON AREA, SOUTH CAROLINA

Data Report to the United States Geological Survey by
Nisha P. Mohanan[1], Cedric D. Fairbanks[1], Ronald D. Andrus[1],
William M. Camp[2], Thomas J. Casey[3], Timothy J. Cleary[2] and William B. Wright[3]

Department of Civil Engineering
Clemson University
Lowry Hall, Box 340911
Clemson, South Carolina 29623-0911 USA
Telephone: (864) 656-0488
Fax: (864) 656-2670
E-mail: randrus@clemson.edu

ABSTRACT

Electronic files of shear wave velocity (V_s) and Cone Penetration Test (CPT) measurements from 226 investigation sites in the greater Charleston area are presented in this report. Of the 226 investigation sites where shear wave velocity tests were conducted, 135 are sites where electronic files of CPT measurements are also available. Summary information of latitude and longitude coordinates, surficial geology, maximum test depth, groundwater table depth, type of test, and source of test data for each site is also presented. Most of the test locations lie within the artificial fill and Qws surficial deposits mapped by Weems, Lemon and others. Fewer test sites lie within surficial deposits designated as phosphate spoil, Qal, Qht, Qhs, Qhec, Qhes, Qwc, Qwls, Qtc, Qts, Qlc, and Qpc deposits.

[1] Department of Civil Engineering, Clemson University, Clemson, SC, USA.
[2] S&ME, Inc., Mount Pleasant, SC, USA.
[3] WPC, Inc., Mount Pleasant, SC, USA.

ACKNOWLEDGMENTS

This research was supported by the United States Geological Survey (USGS) under grant number 05HQGR0037. The project title of this grant is "NEHRP Site Class and Liquefaction Susceptibility Mapping of the Charleston Quadrangle, South Carolina." John Unger and Michael Blanpied served as the USGS Grants Program Managers. The support of the USGS and the assistance of Drs. Unger and Blanpied are greatly appreciated.

The authors also thank the many individuals who assisted with data collection over the past four years, in particular, Ethan Cargill formerly with S&ME, Glenn Rix and Paul Mayne of the Georgia Institute of Technology, Timothy Adams of the South Carolina Department of Transportation, and Jianfeng Zhang former graduate student at Clemson University.

TABLE OF CONTENTS

TITLE PAGE…… i

ABSTRACT…….. iii

ACKNOWLEDGMENTS..... iv

INTRODUCTION…… 1

DATABASE…….. 2
- **Site Code**…… 2
- **Longitude and Latitude**……... 2
- **Elevation**…… 12
- **Surficial Geology**……..… 12
- **Shear Wave Velocity**……..……. 12
- **Cone Penetration Test**…….. 13
- **Maximum V_s Depth**……. 14
- **Groundwater Table**……. 14
- **Source**…… 14

SUMMARY…….. 15

REFERENCES……. 16

APPENDIX A – ELECTRONIC FILES OF SHEAR WAVE VELOCITY TESTS

APPENDIX B – ELECTRONIC FILES OF CONE PENETRATION TESTS

INTRODUCTION

Charleston, South Carolina is one of the most seismically active regions in the eastern United States. The 1886 Charleston earthquake (moment magnitude, M_w = 6.9 to 7.3) resulted in more than $23 million (1886 dollars) in damages and over 60 deaths. Paleoliquefaction studies conducted during the past 20 years indicate that a minimum of five other large earthquakes have occurred in the South Carolina Coastal Plain in the last 2000 to 5000 years (Obermier et al. 1985; Talwani and Cox 1985; Amick and Gelinas 1991).

Charleston is underlain by sediment deposits that are susceptible to ground motion amplifications and liquefaction-induced ground failures during earthquake shaking. The sediments consist of approximately 800 m of Cretaceous and younger deposits overlying bedrock (Wheeler and Cramer 2000). Distinct differences in average ground motion response spectral shapes of sites with different surficial conditions have been observed by many investigators (e.g., Seed et al. 1976; Idriss 1990; Boore et al. 1994; Borcherdt et al. 1994; Joyner et al. 1994; and Midorikawa et al. 1994). The differences in spectral shapes result from vertical variations of stiffness in the soil profile.

Because shear wave velocity and cone penetration resistance are key information for predicting ground shaking and liquefaction, efforts are underway to compile these measurements and other subsurface data from all areas in South Carolina (e.g., URS et al. 2001; Chapman et al. 2003; Andrus et al. 2003; Zhang et al. 2004; Fairbanks et al. 2004). Fairbanks et al. (2004) compiled electronic shear wave velocity (V_S) and Cone Penetration Test (CPT) measurements from the Charleston quadrangle. The purpose of this report is to expand that data compiling effort to include the greater Charleston area. Presented in the report are electronic files of V_S and CPT measurements from 226 investigation sites in the greater Charleston area. A general description of the test data is presented in the next section.

DATABASE

Shown in Figure 1 are the locations of the 226 investigation sites plotted on a map of the greater Charleston area. Electronic files of both V_S and CPT measurements are available for 135 of the 226 investigation sites (see Appendices A and B). For the other 88 sites, only electronic files of V_S are available. Summary information for the 226 sites is provided in Table 1. The sites are listed in the table by the name of the corresponding 1:24,000 quadrangle. Shown in Figure 2 are the locations of each quadrangle noted on a map. The summary information includes the Clemson University designated site code, the latitude and longitude coordinates, the surficial geology, the maximum V_s test depth, the groundwater table depth, and the source of test data.

Site Code

The Clemson University designated site code begins with one or more letters that represent the organization performing the test: C = Cone Tec; GRG = Gregg In Situ, Inc.; GIT = Georgia Institute of Technology; USG = U.S. Geological Survey; RDP = Red Path Geophysics; S = S&ME, Inc.; W = WPC, Inc.; and A = Applied Research Associates, Inc. The first two numbers following the test organization letters represent the year the test was conducted. The remaining numbers and letters represent the project number and the test site designation. For example, the Site code W99175-SC1 refers to a test made by WPC, Inc. in 1999 for project number 175 at sounding location SC1.

Latitude and Longitude

Values of latitude and longitude for some of the investigation sites were included in the respective project reports. For the other sites, latitude and longitude were approximated based on project location descriptions and addresses. Using the GPS device (Garmin, GPS V), the address of a specific test site was entered as input information to obtain approximate latitude/longitude coordinates. Greater accuracy of the coordinates was then achieved using the mapping software Google Earth. The accuracy of the latitude and longitude values is reflected in the significant digits that are shown in Table 1.

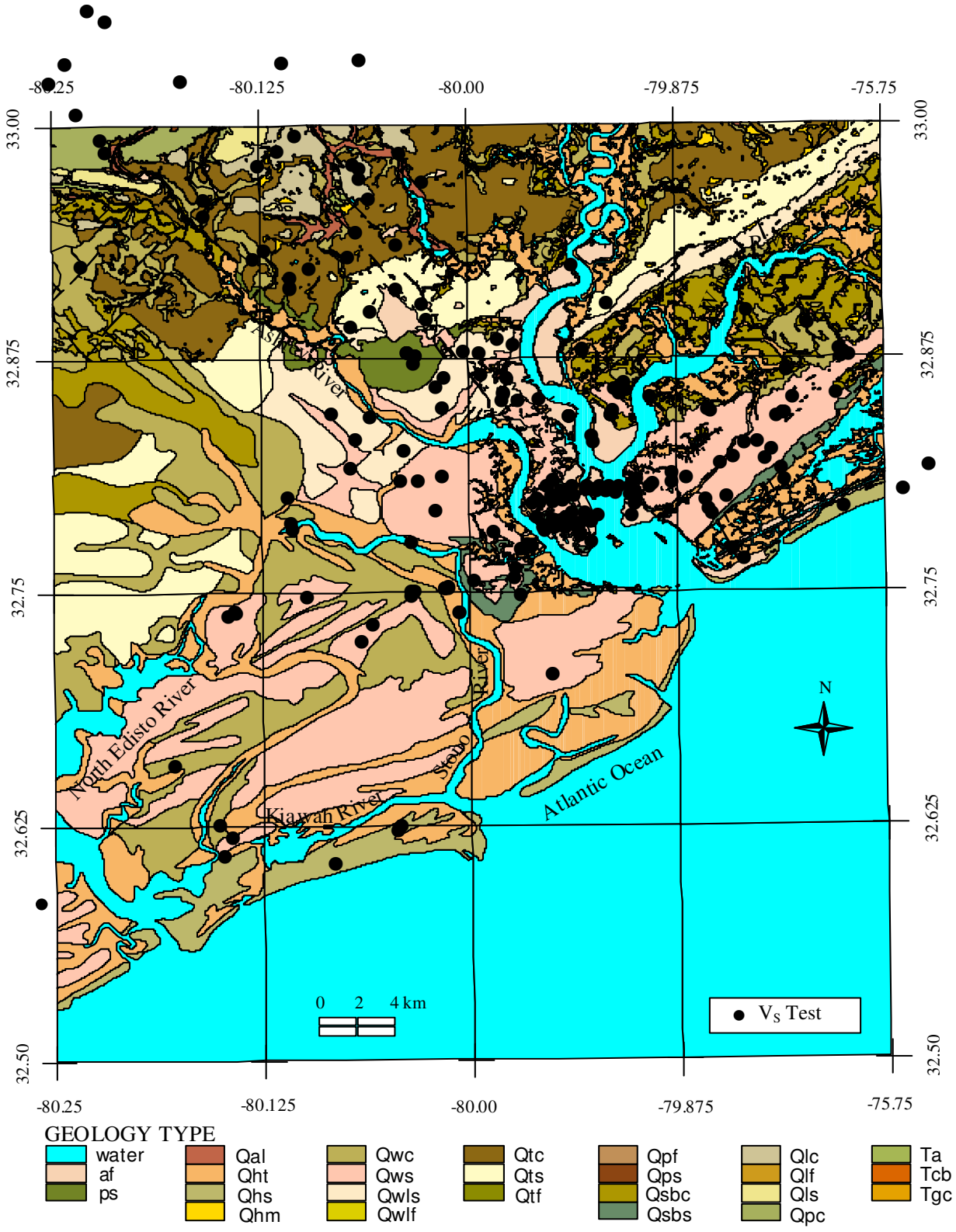

Figure 1 – Composite geologic map of the greater Charleston area assembled by Chapman et al. (2006) showing locations of V_S measurements compiled for this study.

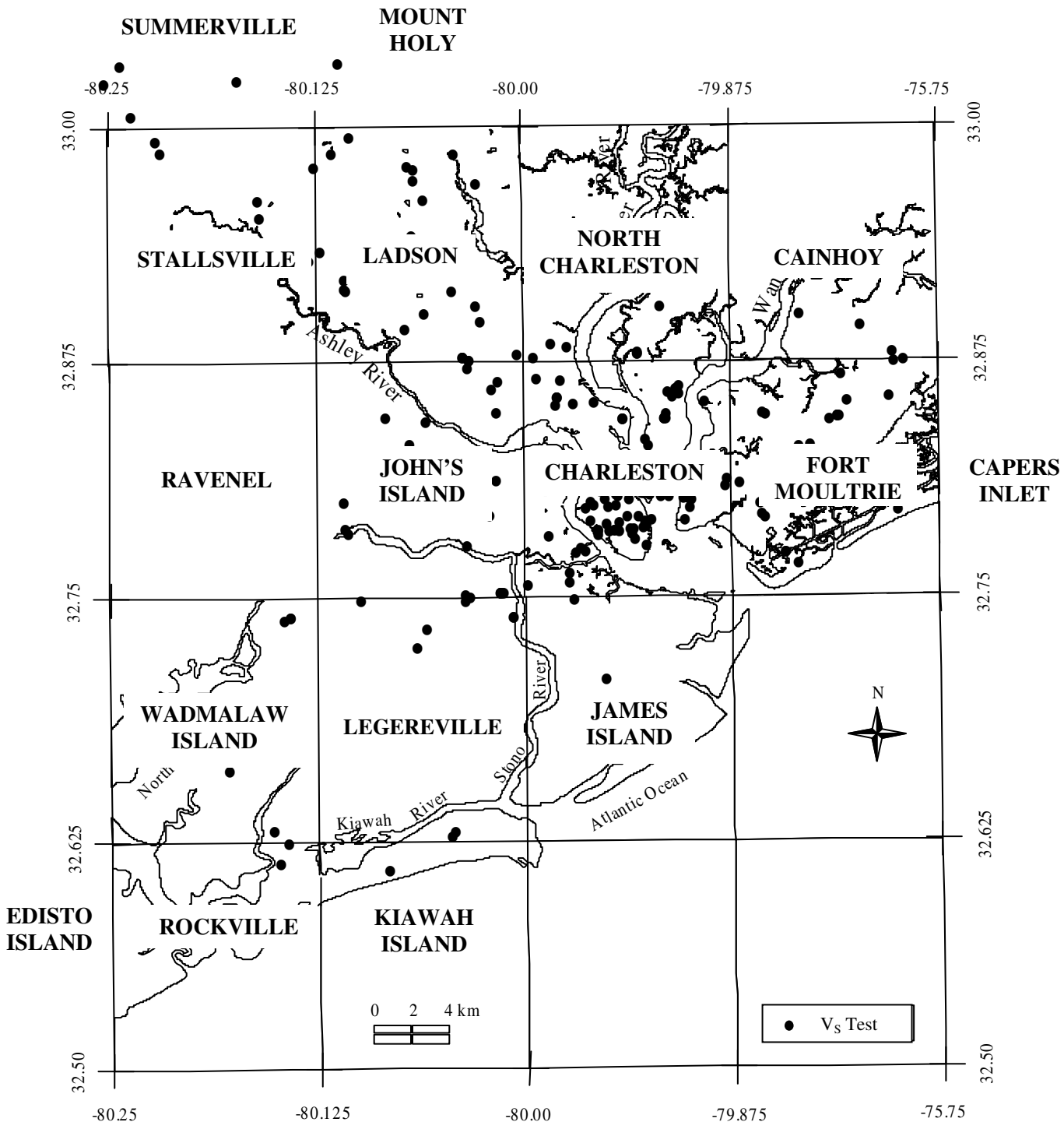

Figure 2 – Map of the greater Charleston area showing the quadrangle names.

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
CHARLESTON QUADRANGLE										
W99175-SCPT1	32.789700	-79.927100	N/A [a]	af	138	$SCPT_u$	Yes	38.00	1.01	[31]
W00115-CPT3	32.791379	-79.930725	N/A	Qws	N/A	$SCPT_u$	No	13.05	1.50	[31]
W00172-CPT2	32.787150	-79.926570	N/A	af	N/A	$SCPT_u$	No	9.13	1.50	[31]
W00363-SCPT1	32.779800	-79.933600	7	Qws	253	$SCPT_u$	Yes	19.00	2.29	[31]
W01343-SCPT1	32.808982	-79.941319	5.00	Qws	184	$SCPT_u$	Yes	21.21	3.05	[31]
W01352-SC1	32.784440	-79.955700	0.00	af	228	$SCPT_u$	Yes	20.70	1.10	[31]
W02092-SC1	32.801530	-79.937710	N/A	Qht	N/A	$SCPT_u$	Yes	17.90	1.49	[31]
W02100-SCPT1	32.804450	-79.950870	N/A	Qws	252	$SCPT_u$	Yes	18.00	2.50	[31]
W02120-SC1	32.858384	-79.911230	N/A	Qws	N/A	$SCPT_u$	Yes	10.70	1.30	[31]
W02233-SC1	32.844050	-79.914670	N/A	Qht	N/A	$SCPT_u$	No	16.70	2.49	[31]
W02233-SC2	32.844050	-79.914670	N/A	Qht	N/A	$SCPT_u$	No	14.70	2.49	[31]
W02234-SC1	32.844050	-79.914450	N/A	Qht	N/A	$SCPT_u$	Yes	13.70	2.49	[31]
W02288-SC2	32.788809	-79.946040	N/A	Qhes	N/A	$SCPT_u$	Yes	16.60	2.30	[31]
W03011-SC10	32.856000	-79.979180	N/A	Qwls	N/A	$SCPT_u$	No	6.41	2.70	[31]
W03011-SC11	32.856000	-79.979180	N/A	Qwls	N/A	$SCPT_u$	No	6.41	0.84	[31]
W03044-SC1	32.755910	-79.998010	N/A	Qws	N/A	$SCPT_u$	Yes	11.58	1.00	[31]
W03058-SC6	32.859950	-79.908170	N/A	Qhec	N/A	$SCPT_u$	Yes	12.58	1.70	[31]
W03065-SC1	32.849778	-79.967046	N/A	Qws	N/A	$SCPT_u$	Yes	11.58	1.80	[31]
W03085A-SC1	32.858230	-79.912440	3.5	Qhec	N/A	$SCPT_u$	Yes	12.58	1.80	[31]
W03088-SC1	32.772990	-79.969433	3.96	Qws	N/A	$SCPT_u$	Yes	12.60	0.61	[31]
W03106-SC1	32.776479	-79.926288	N/A	Qws	N/A	$SCPT_u$	Yes	12.10	1.67	[31]
W03114-SC2	32.785500	-79.945530	N/A	Qws	N/A	$SCPT_u$	Yes	24.50	1.60	[31]
W03337-SC1	32.775200	-79.964900	N/A	Qws	N/A	$SCPT_u$	Yes	15.00	1.60	[31]
W03367-SC1	32.774200	-79.963200	N/A	Qws	N/A	$SCPT_u$	Yes	20.00	2.50	[31]
W04016A-SCPT6	32.864490	-79.977420	7.32	Qwls	N/A	$SCPT_u$	Yes	25.91	2.00	[31]
W04030-SC1	32.792430	-79.938030	2.44	Qhes	265	$SCPT_u$	Yes	6.13	2.50	[31]
W04111-SC1	32.757760	-79.973230	N/A	Qws	N/A	$SCPT_u$	Yes	14.94	1.80	[31]
W04131-SC1	32.774818	-79.965442	N/A	Qws	N/A	$SCPT_u$	Yes	14.02	1.60	[31]
W04305-SC5	32.852880	-79.957850	N/A	Qtc	N/A	$SCPT_u$	Yes	10.60	4.00	[31]
W04375-SC1	32.776200	-79.930700	N/A	Qws	N/A	$SCPT_u$	Yes	14.72	1.90	[31]
W04378-SC5	32.857040	-79.906140	N/A	Qhec	N/A	$SCPT_u$	Yes	10.60	1.82	[31]
W04432-SC1	32.855360	-79.979390	N/A	Qwls	N/A	$SCPT_u$	Yes	10.60	1.21	[31]
S99634-DS1	32.801700	-79.901490	3	af	223	$SCPT_u$	Yes	34.00	0.30	[19]
S99634-MPE5	32.801310	-79.899530	2	af	251	$SCPT_u$	Yes	18.00	0.46	[19]
S99634-C27	32.801600	-79.903920	4	af	224	$SCPT_u$	Yes	27.00	1.22	[19]
S99876-CHS4	32.809110	-79.949870	4	Qws	255	$SCPT_u$	Yes	39.00	1.52	[19]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
S99876-CHS20	32.798520	-79.944340	4	af	235	$SCPT_u$	Yes	40.00	2.29	[19]
S99876-CHS24	32.804010	-79.944940	2	af	214	$SCPT_u$	Yes	46.00	0.91	[19]
S99876-CHS26	32.802880	-79.943950	1	af	108	$SCPT_u$	Yes	37.00	0.61	[19]
S99876-MP2	32.803160	-79.917780	0	water	N/A	SL	No	88.00	0.00	[19]
S99876-MP5	32.802800	-79.912650	0	water	N/A	SL	No	89.00	0.00	[19]
S99876-ML15	32.804470	-79.929200	1	af	N/A	$SCPT_u$	Yes	15.00	0.61	[19]
S99876-ML16	32.804820	-79.928460	8	af	158	$SCPT_u$	Yes	22.00	3.51	[19]
S99876-ML18	32.804440	-79.926650	9	af	156	$SCPT_u$	Yes	21.00	5.27	[19]
S99876-ML22	32.804170	-79.925510	1	af	119	$SCPT_u$	Yes	21.00	0.15	[19]
S99876-ML24	32.803880	-79.924220	1	af	N/A	$SCPT_u$	Yes	15.00	0.61	[19]
S00777-SC3	32.790450	-79.903160	4.57	af	N/A	$SCPT_u$	Yes	9.23	3.05	[19]
S01039-B4	32.762200	-79.973030	N/A	Qws	239	$SCPT_u$	Yes	21.79	1.98	[19]
S01049-F1	32.844050	-79.914890	N/A	af	250	$SCPT_u$	Yes	22.12	0.91	[19]
S01049-F10	32.844050	-79.914890	N/A	af	270	$SCPT_u$	Yes	22.18	2.50	[19]
S01317-B2	32.800000	-79.960000	N/A	Qws	274	$SCPT_u$	Yes	22.41	2.13	[19]
S01369-A5	32.784000	-79.949000	N/A	af	168	$SCPT_u$	Yes	24.19	3.05	[19]
S01369-B2	32.784000	-79.949000	N/A	af	228	$SCPT_u$	Yes	24.17	3.05	[19]
S01420-S1	32.790000	-79.960000	N/A	af	131	$SCPT_u$	Yes	22.38	0.91	[19]
S01772-CPT3	32.810000	-79.900000	N/A	Qhes	255	$SCPT_u$	Yes	24.89	1.67	[19]
S02105-B2	32.790700	-79.923100	N/A	af	N/A	$SCPT_u$	Yes	17.24	1.22	[19]
S02315-CPT1	32.846446	-79.943293	N/A	Qhec	186	$SCPT_u$	No	29.93	1.22	[19]
S02354-B4	32.785260	-79.945640	N/A	af	189	$SCPT_u$	Yes	30.13	1.20	[19]
S02457-B1	32.783050	-79.934750	N/A	Qws	N/A	$SCPT_u$	Yes	15.93	1.50	[19]
S02457-B2	32.783050	-79.934750	N/A	Qws	N/A	$SCPT_u$	Yes	20.58	1.50	[19]
S02578-B1	32.783920	-79.942720	N/A	Qhes	219	$SCPT_u$	Yes	30.23	1.67	[19]
S03264-PAL29	32.843520	-79.939700	N/A	af	123	$SCPT_u$	Yes	30.67	1.21	[19]
S03264-PAL53	32.843520	-79.939700	N/A	af	100	$SCPT_u$	Yes	30.18	1.21	[19]
S03264-PAL8	32.843520	-79.939700	N/A	af	125	$SCPT_u$	Yes	30.03	0.76	[19]
S03352-B1	32.784927	-79.944831	N/A	N/A	N/A	$SCPT_u$	Yes	12.65	1.06	[19]
S03462-S1	32.785820	-79.936260	N/A	Qws	213	$SCPT_u$	Yes	30.23	0.90	[19]
S03917-B2	32.797070	-79.962960	N/A	Qws	151	$SCPT_u$	No	22.23	1.07	[19]
S04176-B2	32.785252	-79.934296	4.87	Qws	N/A	$SCPT_u$	No	27.60	N/A	[19]
S04403-B2	32.858132	-79.911918	3.35	Qwc	N/A	$SCPT_u$	No	10.66	N/A	[19]
S04709-C4	32.802948	-79.900293	N/A	Qht	172	$SCPT_u$	No	24.09	2.14	[19]
S04713-SC1	32.853859	-79.885142	3.048	Qht	N/A	$SCPT_u$	No	14.63	2.4	[19]
S04832-C1	32.799471	-79.904023	8	af	160	$SCPT_u$	No	26.80	0.30	[19]
S05122-B1	32.809361	-79.878097	N/A	Qws	N/A	$SCPT_u$	No	9.15	1.37	[19]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
S05196-C1	32.805860	-79.892300	7	Qws	N/A	$SCPT_u$	No	14.63	2.28	[19]
S05622-C2	32.859950	-79.908170	N/A	Qhec	N/A	$SCPT_u$	No	14.63	N/A	[19]
C98706-C4	32.806680	-79.948490	3.72	Qws	235	$SCPT_u$	No	41.90	2.51	[17]
C98706-C8	32.803990	-79.945830	1.58	Qws	182	$SCPT_u$	No	41.90	0.9	[17]
C98706-C10	32.806310	-79.946170	3.29	af	257	$SCPT_u$	No	41.90	1.74	[17]
C98706-C15	32.804490	-79.939760	1.89	af	126	$SCPT_u$	No	54.00	1.37	[17]
C98706-C21	32.804690	-79.926790	8.75	af	145	$SCPT_u$	No	42.20	1.37	[17]
C98706-C23	32.804590	-79.922840	0.26	water	159	$SCPT_u$	No	25.20	2.46	[17]
C98706-C27	32.802090	-79.903990	1.3	water	227	$SCPT_u$	No	52.80	2.29	[17]
C98706-C31	32.802170	-79.899940	3.35	Qht	233	$SCPT_u$	No	52.90	1.31	[17]
C97741-C78	32.832910	-79.926440	N/A	Qht	204	$SCPT_u$	No	30.00	N/A	[17]
C97741-C77	32.829440	-79.925070	N/A	Qht	109	$SCPT_u$	No	32.00	N/A	[17]
GRG2-CPT2	32.787000	-79.928000	N/A	af	N/A	$SCPT_u$	No	9.00	3.05	[10]
RDP99526-DS1	32.801690	-79.901492	N/A	af	209	DH	No	107.00	0.61	[19]
GIT-10	32.812650	-79.877817	5	Qws	N/A	SASW	No	15.00	0.91	[18]
USG-6	32.798000	-79.958000	N/A	Qws	248	SRR	No	80.00	N/A	[16]
USG-7	32.785000	-79.955000	N/A	af	182	SRR	No	30.00	N/A	[16]
NORTH CHARLESTON QUADRANGLE										
W02104-SC1	32.904200	-79.917000	N/A	Qts	N/A	$SCPT_u$	Yes	26.70	8.00	[31]
W02115-SC5	32.882200	-79.999660	N/A	Qwls	N/A	$SCPT_u$	Yes	8.60	2.10	[31]
W02127-SC1	32.879766	-79.978903	N/A	af	N/A	$SCPT_u$	Yes	13.70	1.49	[31]
W02219-SC1	32.878790	-79.931450	N/A	Qhec	N/A	$SCPT_u$	Yes	9.60	1.30	[31]
W02301-SC1	32.884500	-79.983100	N/A	Qwls	N/A	$SCPT_u$	Yes	14.70	1.80	[31]
W04144-SC2	32.865860	-79.992210	N/A	Qwls	N/A	$SCPT_u$	Yes	15.24	1.80	[31]
W04337-SCPT3	32.875998	-79.994614	N/A	Qws	228	$SCPT_u$	Yes	24.60	1.50	[31]
S03172-B4	32.902270	-79.915263	N/A	Qhec	275	$SCPT_u$	Yes	27.71	3.96	[19]
S03968-B3	32.915620	-79.884225	8.80	Qhec	232	$SCPT_u$	No	20.12	1.07	[19]
FORT MOULTRIE QUADRANGLE										
W01122-SC1	32.798694	-79.857673	5	Qws	N/A	$SCPT_u$	No	9.65	0.85	[31]
W01165-SC1	32.867420	-79.808780	1	Qhec	246	$SCPT_u$	Yes	17.67	1.50	[31]
W01179-SC1	32.867400	-79.808700	N/A	Qhec	N/A	$SCPT_u$	Yes	17.20	N/A	[31]
W01219-SC1	32.812400	-79.829700	N/A	Qws	N/A	$SCPT_u$	Yes	12.70	0.90	[31]
W01239-SC3	32.843520	-79.815000	6	Qws	N/A	$SCPT_u$	Yes	18.70	4.40	[31]
W01303-SCPT8	32.825400	-79.818610	3	Qws	N/A	$SCPT_u$	No	12.10	1.98	[31]
W02041-SC1	32.845200	-79.811000	1	Qws	N/A	$SCPT_u$	No	20.00	N/A	[31]
W02103-SC1	32.808800	-79.810700	N/A	Qht	N/A	$SCPT_u$	Yes	17.90	3.05	[31]
W02179-SCPT1	32.800700	-79.845800	N/A	Qws	N/A	$SCPT_u$	Yes	8.70	1.70	[31]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
W02182-SC1	32.845200	-79.811000	N/A	Qws	N/A	$SCPT_u$	Yes	15.70	1.30	[31]
W02236-SC1	32.846200	-79.854380	N/A	Qws	N/A	$SCPT_u$	Yes	15.70	2.70	[31]
W02237-SC1	32.818000	-79.849200	N/A	Qal	N/A	$SCPT_u$	Yes	17.70	2.10	[31]
W02314-SC4	32.845200	-79.810000	N/A	Qws	N/A	$SCPT_u$	Yes	22.00	6.00	[31]
W03046-SC1	32.853096	-79.783980	N/A	Qhec	229	$SCPT_u$	Yes	27.58	0.50	[31]
W03071-SC1	32.766720	-79.834900	N/A	Qht	N/A	$SCPT_u$	Yes	13.59	0.50	[31]
W03436-SC1	32.828700	-79.834380	N/A	Qws	N/A	$SCPT_u$	Yes	16.16	0.90	[31]
W03454A-SC1	32.791790	-79.854350	N/A	Qws	N/A	$SCPT_u$	Yes	16.77	1.60	[31]
W04028-SC1	32.852890	-79.804920	N/A	Qws	N/A	$SCPT_u$	Yes	24.09	3.05	[31]
W04093-SC3	32.879000	-79.777000	N/A	Qws	N/A	$SCPT_u$	No	14.02	1.50	[31]
W04132-SCPT10	32.829540	-79.826820	N/A	Qws	226	$SCPT_u$	No	28.08	N/A	[31]
W04225-SC1	32.822159	-79.840927	N/A	Qws	N/A	$SCPT_u$	Yes	17.99	2.60	[31]
S01018-B1	32.810000	-79.87000	N/A	Qws	217	$SCPT_u$	Yes	23.45	0.45	[19]
S01143-B1	32.793620	-79.85638	N/A	Qws	196	$SCPT_u$	Yes	29.62	0.91	[19]
S02784-SBA	32.874480	-79.77618	N/A	Qws	141	$SCPT_u$	Yes	24.20	0.30	[19]
S02891-B2	32.815940	-79.81218	N/A	Qhes	244	$SCPT_u$	Yes	18.54	0.91	[19]
S02902-C13	32.820400	-79.82187	N/A	Qws	248	$SCPT_u$	Yes	22.49	0.91	[19]
S03680-B2	32.840217	-79.85619	6.06	Qws	235	$SCPT_u$	No	18.60	1.07	[19]
S04981-S1	32.772790	-79.84212	N/A	Qht	229	$SCPT_u$	No	29.89	N/A	[19]
S04981-S2	32.772790	-79.84212	N/A	Qht	223	$SCPT_u$	No	29.30	N/A	[19]
USG-8	32.795000	-79.77500	N/A	Qhs	179	SRR	No	30.00	N/A	[16]
JOHN'S ISLAND QUADRANGLE										
W00354-SC1	32.800600	-80.109100	2	N/A	N/A	$SCPT_u$	No	8.00	N/A	[31]
W01211-SCPT4	32.750750	-80.035940	4	N/A	N/A	$SCPT_u$	Yes	11.20	1.83	[31]
W01211-SCPT9	32.750170	-80.033390	4	N/A	N/A	$SCPT_u$	Yes	13.00	2.40	[31]
W01350-SCPT 1	32.825266	-80.039374	3	N/A	N/A	$SCPT_u$	Yes	15.20	2.99	[31]
W02087-SC5	32.847960	-80.016520	N/A	N/A	N/A	$SCPT_u$	Yes	12.19	1.07	[31]
W02195-SC1	32.793280	-80.020940	N/A	N/A	N/A	$SCPT_u$	Yes	10.70	1.89	[31]
W03062-SC2	32.783414	-80.036361	N/A	N/A	N/A	$SCPT_u$	No	12.58	0.92	[31]
W04044-SC12	32.815266	-80.071383	N/A	N/A	N/A	$SCPT_u$	No	7.93	1.60	[31]
W04130-SC1	32.843510	-80.059430	N/A	N/A	N/A	$SCPT_u$	Yes	9.15	1.70	[31]
W04137-SC1	32.809430	-80.031400	N/A	N/A	N/A	$SCPT_u$	Yes	13.11	0.64	[31]
W04206-SC2	32.831310	-80.068470	N/A	N/A	N/A	$SCPT_u$	Yes	10.10	2.00	[31]
W05054-SC7	32.845220	-80.082830	N/A	N/A	N/A	$SCPT_u$	Yes	7.58	1.00	[31]
S99526-E3	32.752000	-80.015000	N/A	N/A	N/A	$SCPT_u$	No	8.49	2.00	[19]
S99526-E6	32.752000	-80.015000	N/A	N/A	273	$SCPT_u$	No	25.19	1.22	[19]
S99526-MS9	32.752000	-80.015000	N/A	N/A	314	$SCPT_u$	No	23.62	0.00	[19]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
S99526-SC12	32.752000	-80.015000	N/A	N/A	185	$SCPT_u$	No	26.11	0.61	[19]
S03508-CPT1	32.864300	-80.015400	N/A	N/A	N/A	$SCPT_u$	Yes	17.68	1.52	[19]
S04789-C2	32.793510	-80.032810	N/A	N/A	349	$SCPT_u$	No	19.5	1.21	[19]
S05SEIS-C2	32.871810	-80.033550	N/A	N/A	304	$SCPT_u$	No	23.16	1.50	[19]
S05SEIS-C1	32.811910	-80.016720	N/A	N/A	320	$SCPT_u$	No	26.50	1.50	[19]
A92262-C10	32.777000	-80.035000	2.1	N/A	229	$SCPT_u$	No	33.40	N/A	[19]
C98706-C1	32.786700	-80.107600	1	N/A	160	$SCPT_u$	No	31.00	N/A	[17]
C98706-C2	32.783800	-80.106500	2	N/A	240	$SCPT_u$	No	31.00	N/A	[17]
RDP99526-PS1	32.752347	-80.013015	N/A	N/A	245	DH	No	107.00	N/A	[19]
GIT-STON1A	32.752400	-80.013350	0	N/A	260	$SCPT_u$	No	25.05	2.36	[18]
GIT-9	32.860083	-80.019433	8	N/A	N/A	SASW	No	15.00	N/A	[18]
LADSON QUADRANGLE										
W00386-SC1	32.877500	-80.036700	N/A	ps	N/A	$SCPT_u$	No	14.00	N/A	[31]
W00386-SC12	32.877500	-80.036700	9.00	ps	N/A	$SCPT_u$	No	7.00	N/A	[31]
W00386-SC17	32.877500	-80.036700	9.00	ps	N/A	$SCPT_u$	No	6.00	N/A	[31]
W01163-SCPT1	32.994100	-80.103750	10.66	Qlc	N/A	$SCPT_u$	Yes	9.65	2.30	[31]
W01218-SC1	32.935510	-80.043350	9.00	Qtc	N/A	$SCPT_u$	Yes	10.20	1.98	[31]
W01292-SC1	32.900270	-80.059500	11.00	Qts	N/A	$SCPT_u$	Yes	12.10	3.04	[31]
W02059-B06	32.922900	-80.095200	9.00	Qtc	N/A	$SCPT_u$	Yes	13.89	N/A	[31]
W02073-SC6	32.960300	-80.059600	10.00	Qlc	N/A	$SCPT_u$	Yes	7.89	1.49	[31]
W02162-SC1	32.985840	-80.114820	N/A	Qlc	N/A	$SCPT_u$	Yes	8.70	2.00	[31]
W02202-SC1	32.892330	-80.071230	N/A	Qwls	N/A	$SCPT_u$	Yes	10.70	2.49	[31]
W02216-SC8	32.913760	-80.107790	N/A	Qtc	N/A	$SCPT_u$	No	8.70	1.30	[31]
W02218-SC1	32.878680	-80.003320	N/A	Qwls	N/A	$SCPT_u$	Yes	14.70	1.53	[31]
W03137-SC1	32.978400	-80.069000	N/A	Qlc	N/A	$SCPT_u$	Yes	9.60	1.50	[31]
W03390-SC2	32.977070	-80.065230	N/A	Qlc	N/A	$SCPT_u$	Yes	8.23	2.00	[31]
W03422-SC1	32.971540	-80.065250	N/A	Qlc	N/A	$SCPT_u$	Yes	10.06	1.50	[31]
W03435-SC1	32.942205	-80.067000	N/A	Qtc	N/A	$SCPT_u$	No	7.93	0.55	[31]
W04029-SC8	32.933400	-80.122300	N/A	Qhes	N/A	$SCPT_u$	No	9.15	1.60	[31]
W04269-SC1	32.918520	-80.107610	N/A	Qtc	N/A	$SCPT_u$	No	7.60	1.50	[31]
W04307-SCPT3	32.913060	-80.107130	N/A	Qtc	378	$SCPT_u$	No	24.60	1.80	[31]
W04320-SCPT1	32.912430	-80.043230	N/A	Qtc	N/A	$SCPT_u$	Yes	24.60	3.81	[31]
W05043-SC1	32.903750	-80.028390	N/A	Qts	N/A	$SCPT_u$	Yes	9.60	1.52	[31]
S00645-C1	32.984940	-80.040850	4.57	Qal	334	$SCPT_u$	No	29.94	1.21	[19]
S03489-B1	32.969620	-80.027310	N/A	Qtc	205	$SCPT_u$	Yes	30.34	2.42	[19]
S041024-C1	32.977121	-80.072199	N/A	Qws	N/A	$SCPT_u$	No	10.21	N/A	[19]
S041143- B4	32.875860	-80.032380	3.65	ps	N/A	$SCPT_u$	No	23.17	2.43	[19]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
S041143- B14	32.875860	-80.032380	3.65	Qtc	356	$SCPT_u$	No	30.48	2.43	[19]
S05287-C2	32.929460	-80.072560	N/A	Qtc	N/A	$SCPT_u$	No	10.67	1.82	[19]
GIT-8	32.896083	-80.025567	9	Qts	N/A	SASW	No	15.00	N/A	[18]
SUMMERVILLE QUADRANGLE										
W04096-SC5	33.061810	-80.228110	N/A	Qpc	N/A	$SCPT_u$	No	9.45	1.80	[31]
W04282-SCPT2	33.006300	-80.235200	N/A	Qpc	N/A	$SCPT_u$	Yes	13.6	1.70	[31]
W04282-SCPT3	33.023210	-80.251410	N/A	Qpc	N/A	$SCPT_u$	Yes	7.93	1.60	[31]
W05024-SC2	33.033260	-80.241710	N/A	Qwc	N/A	$SCPT_u$	Yes	8.68	0.82	[31]
S02823-C1	33.056140	-80.217010	N/A	Qpc	N/A	$SCPT_u$	Yes	8.02	0.91	[19]
S03541-B1	33.024213	-80.171846	N/A	Qpc	362	$SCPT_u$	No	21.90	0.91	[19]
JAMES ISLAND QUADRANGLE										
W01317-SC2	32.706028	-79.951450	1.00	N/A	279	$SCPT_u$	Yes	22.80	2.20	[31]
W03045-SC2	32.747720	-79.969442	N/A	N/A	N/A	$SCPT_u$	Yes	17.58	1.80	[31]
CAINHOY QUADRANGLE										
W01187-SC1	32.899490	-79.832900	2.00	Qhec	N/A	$SCPT_u$	Yes	11.52	1.20	[31]
W01252-SC3	32.875200	-79.771000	7.00	Qws	N/A	$SCPT_u$	No	10.70	1.30	[31]
W01277-SC1	32.884056	-79.784470	N/A	Qws	N/A	$SCPT_u$	Yes	7.10	1.50	[31]
W04154-SC10	32.893010	-79.796030	N/A	Qwc	N/A	$SCPT_u$	Yes	14.94	1.60	[31]
W04431-SCPT1	32.883730	-79.785390	N/A	Qhec	N/A	$SCPT_u$	Yes	11.58	1.79	[31]
CAPERS INLET QUADRANGLE										
W04204-SC13	32.803410	-79.739320	N/A	N/A	N/A	$SCPT_u$	Yes	17.60	N/A	[31]
W04243-SC2	32.816500	-79.723300	N/A	N/A	N/A	$SCPT_u$	No	25.61	1.73	[31]
LEGAREVILLE QUADRANGLE										
W01172-SC1	32.628290	-80.097940	N/A	N/A	N/A	$SCPT_u$	Yes	11.20	5.70	[31]
W01339-SC1	32.723417	-80.065306	N/A	N/A	N/A	$SCPT_u$	Yes	12.10	1.67	[31]
W02044-SCPT8	32.747778	-80.036028	N/A	N/A	N/A	$SCPT_u$	No	12.19	N/A	[31]
W02212-SCPT1	32.748130	-80.098640	N/A	N/A	N/A	$SCPT_u$	Yes	8.70	1.20	[31]
A92262-C26	32.739000	-80.007000	1.2	N/A	243	$SCPT_u$	No	28.50	N/A	[19]
A92262-C36	32.739000	-80.007000	2.1	N/A	266	$SCPT_u$	No	41.00	N/A	[19]
S00297-SC1	32.732620	-80.059140	N/A	N/A	N/A	$SCPT_u$	Yes	22.38	1.82	[19]
STALLSVILLE QUADRANGLE										
W02250-SC1	32.99250	-80.22080	N/A	Qpc	N/A	$SCPT_u$	Yes	12.70	3.01	[31]
W04077-SC1	32.978520	-80.125820	N/A	Qtc	N/A	$SCPT_u$	No	10.06	1.35	[31]
W04179-SC1	32.92833	-80.12910	N/A	Qtc	N/A	$SCPT_u$	Yes	10.98	1.90	[31]
W04282-SCPT1	32.95150	-80.15908	N/A	Qhec	N/A	$SCPT_u$	No	7.62	2.00	[31]
W04368-SCPT1	32.96063	-80.15913	N/A	Qwc	351	$SCPT_u$	No	24.60	1.37	[31]
W04446-SCPT10	32.98610	-80.21810	N/A	Qpc	N/A	$SCPT_u$	No	13.60	1.70	[31]

TABLE 1: SUMMARY OF V_S PROFILES FROM THE GREATER CHARLESTON AREA										
Site Code	**Latitude**	**Longitude**	**Elevation**	**Surficial Geology**	**V_{S30}**	**Test Type[b]**	**CPT E-file Available? [c]**	**Max. V_S Test Depth**	**Water Table Depth**	**Source[d]**
	(degree)	(degree)	(m)		(m/s)			(m)	(m)	
S041171-NC11	32.92480	-80.23316	6.41	Qwc	432	$SCPT_u$	No	20.43	1.21	[19]
MOUNT HOLY QUADRANGLE										
W02332-SC1	33.035030	-80.064080	N/A	Qwc	N/A	$SCPT_u$	No	9.50	1.89	[31]
W04390-SCPT3	33.033300	-80.110800	N/A	Qlc	N/A	$SCPT_u$	Yes	7.59	1.50	[31]
S04062-CPT4	33.079191	-80.040805	8.84	Qtc	N/A	$SCPT_u$	No	14.9	N/A	[19]
ROCKVILLE QUADRANGLE										
W02096-SCPT1	32.61914	-80.143830	N/A	N/A	223	$SCPT_u$	Yes	19.20	1.80	[31]
W02130-SC8	32.60890	-80.148500	N/A	N/A	246	$SCPT_u$	Yes	22.60	1.50	[31]
KIAWAH ISLAND QUADRANGLE										
S02522-B4	32.62476	-80.04264	N/A	N/A	230	$SCPT_u$	Yes	20.39	2.29	[19]
S03304-B1	32.62253	-80.04506	N/A	N/A	255	$SCPT_u$	Yes	19.60	1.21	[19]
S03305-B1	32.60466	-80.08237	N/A	N/A	N/A	$SCPT_u$	Yes	14.34	1.52	[19]
EDISTO ISLAND QUADRANGLE										
W02299-SC1	32.5833	-80.3455	N/A	N/A	253	$SCPT_u$	Yes	18.60	0.50	[31]
WADMALAW ISLAND QUADRANGLE										
W01235-SC1	32.625600	-80.151600	N/A	N/A	256	$SCPT_u$	Yes	18.70	1.50	[31]
W04260-SC2	32.657892	-80.178616	N/A	N/A	N/A	$SCPT_u$	No	10.60	2.90	[31]
GIT-SODFM1	32.73955	-80.14157	3	N/A	311	$SCPT_u$	No	35.00	3.11	[18]
GIT-SODFM2	32.739300	-80.141267	4	N/A	315	$SCPT_u$	No	30.00	3.15	[18]
GIT-6	32.737600	-80.145383	3	N/A	N/A	SASW	No	15.00	N/A	[18]

[a] N/A = Not available

[b] $SCPT_u$ = Seismic CPT with pore water pressure measurements; SASW = Spectral Analysis of Surface Wave Test; SRR =Seismic Refraction/Reflection Test; DH = Downhole Test; SL = Suspension Logger

[c] No = CPT electronic file is not available, Yes = CPT electronic file is in Appendix B

[d] Source information is listed in the Reference section of this report.

Elevation

Ground surface elevation information is available for only 73 sites. No elevation information is currently available for the other 153 sites, because it was not provided in the project reports and values determined by the GPS device are considered not sufficiently accurate to be useful. Elevations for the 73 test sites range from 0 m to 11 m above mean sea level. Fifty-one of the 73 test sites have ground surface elevations of 5 m or less.

Surficial Geology

Geologic maps at a scale of 1:24,000 are currently available for 8 of the 16 quadrangles shown in Figure 2. The 8 quadrangles are: Charleston, North Charleston, Fort Moultrie, Ladson, Summerville, Cainhoy, Stallsville, and Mount Holy (Weems and Lemon 1984a, 1984b, 1988, 1993; Weems et al. 1997b).

The surficial deposits include various deposits of recent man-made fill and Holocene to Pleistocene natural sediments. Recent fills are designated as artificial fill (af) and phosphate spoil (ps) ranging from engineered construction fill to non-engineered (dumped) fill. Holocene-age (<10,000 years or <10 ka) deposits include alluvium sands (Qal), beach to barrier-island sands (Qhs), and tidal marsh clayey sands and clays (Qht). Early Holocene to late Pleistocene deposits include estuarine silty to sandy clays (Qhec), which range in age from 6 ka to 85 ka.

Pleistocene deposits include beach to barrier-island sands (Qhes), which range in age from 33 ka to 85 ka. Older Pleistocene deposits exposed in the study area include: the Wando Formation (Qwc, Qws, Qwls), which is about 70 ka to 130 ka in age; the Ten mile Hill beds (Qtc, Qts), which are about 200 ka to 240 ka in age; the Ladson Formation (Qlc) which is about 450 ka in age; and the Penholoway Formation (Qpc), which is about 1,000 ka in age.

Shear Wave Velocity

Of the 226 V_S profiles, 215 were determined by the seismic CPT method with pore water pressure measurements (SCPTu). Of the other 11 V_S profiles, 4 were determined by the Spectral Analysis of Surface Waves (SASW) test, 3 by the seismic refraction/reflection (SRR) test, 2 by the suspension logger (SL) test, and 2 by the seismic downhole (DH) test.

Values of V_S reported by the testing organization are entered directly into the database and assigned to the depths corresponding to the center of the measurement intervals. The values of average shear wave velocity in the top 30 m, V_{S30}, listed in Table 1 are calculated using the following equation (BSSC 2000; ICC 2000):

$$V_{S30} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{V_{Si}}} \quad (1)$$

where d_i is the thickness of i^{th} layer between the depths of 0 m and 30 m, V_{si} is the shear wave velocity of that layer, and thicknesses of the *n* layers sum up to 30 m. Equation (1) provides an average that favors the lower V_S layers. It is calculated in this manner to classify a soft soil layer on rock as a soft soil site, even when the depth of rock is less than 30 m (Dobry et al. 2000).

To ensure reasonably accurate V_{S30} values, they are calculated for only profiles extending to depths of 30 m, or test depths □ 18 m and into the Cooper marl. Of the 226 V_S profiles, 102 extend to depths □ 18 m. For the V_S profiles extending into the Cooper marl but not to a depth of 30 m, the velocity between the maximum measured depth and 30 m is assumed equal to 400m/s to a depth of 25 m and 435 m/s between 25 m and 30 m. These assumed V_S values are average for the Cooper marl (Andrus et al. 2005). If testing did not extend into the Cooper marl or to a depth of 30 m, then "N/A" (not available) is entered in the Table 1 for the V_{S30} value. Many of the V_S profiles from the Charleston quadrangle, along with computed values of V_{S30}, are discussed in the dissertation by Zhang (2004) and a technical paper by Zhang et al. (2004).

Cone Penetration Test

The electronic files for 135 seismic CPT sites are contained in the folder labeled as Appendix B – Electronic Files of Cone Penetration Tests. The CPT measurements include: uncorrected cone tip resistance, q_c; uncorrected sleeve friction, f_s; pore water pressure measured at the u_2 position (behind the cone tip), u; and cone tip resistance corrected for pore pressure acting behind the cone tip, q_t.

Maximum V_s Test Depth

The maximum V_s test depth varies from 3 m to 107 m, as listed in Table 1. Thirty-five of the 226 V_S profiles extend to depths of 30 m or greater.

Groundwater Table

Groundwater Table (GWT) depths for 194 of the 226 sites were given in the project reports. The GWT depths range from 0 m to 6 m. About 90 % of the 196 sites have GWT depths less than 3 m.

Source

The source (or reference number) for each V_s test is noted in the last column of Table 1. This number corresponds to a citation in the Reference section.

SUMMARY

Electronic files of V_s and CPT measurements from 226 investigation sites in the greater Charleston area are presented. Also presented is available information about latitude and longitude coordinates, surficial geology, maximum test depth, groundwater table depth, test type, and source information for each profile. Several of the profile locations lie within the af and Qws surficial deposits. Fewer profile locations lie within the ps, Qal, Qht, Qhs, Qhec, Qhes, Qwc, Qwls, Qtc, Qts, Qlc, and Qpc deposits.

The compiling of these test data represents an initial step in the development of seismic hazard maps of the Charleston quadrangle at a scale useful for planners and engineers. These electronic files are made available in this report to assist other researchers also working to identify and reduce seismic hazards in the Charleston area.

REFERENCES

[1] Amick, P., and Gelinas R. (1991). "The search for evidence of large prehistoric earthquakes along the Atlantic Seaboard," *Science*, Vol. 251, pp 655-658.

[2] Andrus, R.D., Zhang, J., Ellis, B.S., and Juang, C.H. (2003). "Guide for estimating the dynamic properties of South Carolina soils for ground response analysis," Final report to the South Carolina Department of Transportation, Clemson University, Clemson, SC.

[3] Andrus, R.D., Fairbanks, C.D., Zhang, J., Camp, W.M., Cleary, T.J., Casey, T.J., and Wright, W.B (2005). "Shear-wave velocity and seismic response of near-surface sediments in Charleston quadrangle, South Carolina," Final report to the United States Geological Survey, Clemson University, Clemson, SC.

.

[4] Boore, D.M., Joyner W.B., and Fumal, T.E. (1994). "Estimation of response spectra and peak acceleration from western North American earthquakes: an interim report, Part 2," *USGS Open-File Report 94-124*, U.S. Geological Survey, Reston, VA.

[5] Borcherdt, R.D. (1994). "Simplified site classes and empirical amplification factors for site-dependent code provisions," *In Proceedings of the 1992 NCEER/SEAOC/BSSC Workshop on Site Response during Earthquake and Seismic Code Provisions*, National Center for Earthquake Engineering Research Special Publication NCEER-94-SP01, Buffalo, NY.

[6] Building Seismic Safety Council (BSSC 2000). "NEHRP recommended provisions for seismic regulations for new and other structures," Federal Emergency Management Agency, Washington, D.C.

[7] Chapman, M.C., Martin, J.R., Olgun, G., and Regmi, B. (2003). "Prediction and geographical information system (GIS) mapping of ground motions and site response in Charleston, SC and two neighboring counties: first phase development of a GIS for seismic hazard evaluation," Final report to the U.S. Geological Survey, Virginia Polytechnic Institute and State University, Blacksburg, VA.

[8] Dobry, R., Borcherdt, R.D., Crouse, C.B., Idriss, I.M., Joyner, W.B., Martin, G.R., Power, M.S., Rinne, E.E., and Seed, R.B. (2000). "New site coefficients and site classification system used in recent building seismic code provisions," *Earthquake Spectra*, Vol. 16, pp. 41-67.

[9] Fairbanks, C.D., Andrus, R.D., Zhang, J., Camp, W.M., Cleary, T.J., and Casey, T.J (2004), "Electronic files of shear-wave velocity and cone penetration test measurements from the Charleston quadrangle, South Carolina," Data report to the United States Geological Survey, Clemson University, Clemson, SC.

[10] Gregg In Situ (1999). Unpublished project report by Gregg In Situ, Inc., Summerville, SC.

[11] Idriss, I.M. (1990). "Response of soft soil sites during earthquake," *In Proceedings of H. Bolton Seed Memorial Symposium*, Vol. 2, pp. 273-289.

[12] International Code Council (2000). *International Building Code*, Falls Church, VA.

[13] Joyner, W.B., Fumal, T.E., and Glassmoyer, G. (1994). "Empirical spectral response ratios for strong motion data from the 1989 Loma Prieta, California, earthquake," *In Proceedings of the 1992 NCEER/SEAOC/BSSC Workshop on Site Response during Earthquake and Seismic Code Provisions*, National Center for Earthquake Engineering Research Special Publication NCEER-94-SP01, Buffalo, NY.

[14] Midorikawa, S., Matsuoka, M., and Sakugawa, K. (1994). "Site effects on strong-motion records observed during the 1987 Chiba-Ken-Toho-Oki, Japan earthquake," *In Proceedings of the 9th Japan Earthquake Symposium*, Vol. 3, pp. E085-E090.

[15] Obermeier, S.F., Gohn, G.S., Weems, R.E., Gelinas, R.L., and Rubin, M. (1985). "Geologic evidence for recurrent moderate to large earthquakes near Charleston, South Carolina," *Science*, Vol. 227, pp. 408-411.

[16] Odum, J.K., Williams, R.A., Stephenson, W.J., and Worley, D.M. (2003). "Near-surface S-wave and P-wave seismic velocities of primary geological formations on the Piedmont and Atlantic and Coastal Plain of South Carolina, USA," *USGS Open-file-Report 03-043*, U.S. Geological Survey, Reston, VA.

[17] Parsons Brinckerhoff Quade & Douglas, Inc. (1999). "Supplemental geotechnical investigation data report for U.S. 17 Cooper River Bridges Charleston, South Carolina," Final report to the South Carolina Department of Transportation, Columbia, SC.

[18] Rix, G.J., and Indridason, J.S. (1999). "Liquefaction during the 1886 Charleston Earthquake." In *Proceedings of the XIII International Conference on Soil Mechanics and Foundation Engineering,* Balkema, Rotterdam, pp. 1321-1324.

[19] S&ME (1998-2005). Various unpublished project reports by S&ME, Mount Pleasant, SC.

[20] Seed, H.B., Murarka, R., Lysmer, J., and Idriss, I.M. (1976). "Relationship between maximum acceleration, maximum velocity, distance from source and local site conditions for moderately strong earthquakes," *Bulletin of the Seismological Society of America*, Vol. 66, pp. 323-1342.

[21] Talwani, P., and Cox, J. (1985). "Paleoseismic evidence for recurrence of earthquakes near Charleston, South Carolina," *Science*, Vol. 229, pp. 379-381.

[22] URS Corporation, Durham Technologies, Inc., ImageCat, Inc., Pacific Engineering & Analysis, and S&ME, Inc. (2001). "Comprehensive seismic risk and vulnerability study

for the state of South Carolina," Final report to the South Carolina Emergency Preparedness Division, Columbia, SC.

[23] Weems, R.E., and Lemon, E.M., Jr. (1984b). "Geology of the Stallsville quadrangle, Dorchester and Charleston counties, South Carolina," *USGS Misc. Investigation Map GQ-1581, Scale 1:24,000,* U.S. Geological Survey, Reston, VA.

[24] Weems, R.E., and Lemon, E.M., Jr. (1984a). "Geology of the Mount Holly Quadrangle, Berkeley and Charleston counties, South Carolina," *USGS Misc. Investigation Map GQ-1579, Scale 1:24,000,* U.S. Geological Survey, Reston, VA.

[25] Weems, R.E., and Lemon, E.M., Jr. (1985). "Detailed section from auger holes and outcrops in the Cainhoy, Charleston, and Fort Moultrie quadrangles, South Carolina," *USGS Open-File Report 85-378*, U.S. Geological Survey, Reston, VA.

[26] Weems, R.E., and Lemon, E.M., Jr. (1988). "Geology of the Ladson quadrangle, Berkeley, Charleston, and Dorchester counties, South Carolina," *USGS Misc. Investigation Map GQ-1630, Scale 1:24,000,* U.S. Geological Survey, Reston, VA.

[27] Weems, R.E., and Lemon, E.M., Jr. (1993). "Geology of the Cainhoy, Charleston, Fort Moultrie, and North Charleston quadrangles, Charleston and Berkeley counties, South Carolina," *USGS Misc. Investigation Map I-1935, Scale 1:24,000,* U.S. Geological Survey, Reston, VA.

[28] Weems, R.E., Lemon, E.M., Jr., and Chirico, P. (1997a). "Digital geology and topography of the Charleston quadrangle, Charleston and Berkeley counties, South Carolina," *USGS Open-file Report 97-531*, U.S. Geological Survey, Reston, VA.

[29] Weems, R.E., Lemon, E.M. Jr., and Nelson, M.S (1997b). "Geology of the Pringletown, Ridgeville, Summerville, and Summerville Northwest 7.5-minute quadrangles, Berkeley, Charleston, and Dorchester counties, South Carolina," *USGS Misc. Investigation Map Map I-2502, Scale 1:24,000,* U.S. Geological Survey, Reston, VA.

[30] Wheeler, R.L., and Cramer, C.H. (2000). "Preliminary estimated of the amplification of possible earthquake ground motion at a site in Charleston county, South Carolina," *USGS Open-File Report 00-0484*, U.S. Geological Survey, Reston, VA.

[31] WPC (1999-2005). Various unpublished project reports, WPC, Inc., Mount Pleasant, SC.

[32] Zhang, J. (2004). "Characterizing the dynamic properties of South Carolina soils for ground motion evaluation," *Ph.D. dissertation*, Clemson, SC.

[33] Zhang, J, Andrus, R.D., Camp, W. M., Casey, T. J., and Cleary T.J. (2004). "In situ V_S and NEHRP site classification in the greater Charleston area," In *Proceedings of the 11th International Conference on Soil Dynamics & Earthquake Engineering and the 3rd International Conference on Earthquake Geotechnical Engineering,* Berkeley, California, Vol. 1, pp. 437-444.