Site Certification for the
Williamsburg Cooperative Commerce Centre South
In Williamsburg County, South Carolina

Attachment 24

Geotechnical Study

Report of Geotechnical Exploration for Epps No. 1 Industrial Site

REPORT OF
GEOTECHNICAL EXPLORATION

Epps No. 1 Industrial Site

Kingstree, South Carolina
S&ME Project No. 1633-09-049

Prepared By:

S&ME

1330 Highway 501 Business
Conway, South Carolina 29526

March 10, 2009

S&ME

Celebrating 35 Years
1973 • 2008

March 10, 2009

[redacted]

[redacted]

Reference: **Report of Geotechnical Exploration**
Epps No. 1 Industrial Site
Kingstree, South Carolina
S&ME Project No. 1633-09-049

[redacted]

S&ME, Inc. has completed the subsurface exploration for the referenced project after receiving authorization to proceed from you on February 25, 2009. Our exploration was conducted in general accordance with our Proposal No. 1633-0063-09, dated February 20, 2009.

PROJECT INFORMATION

Project information about the project was obtained through telephone conversations with Michael Harris of S&ME and email correspondence between Josh Rabon of Alliance Consulting Engineers and Jim Palmer of S&ME on February 18, 2009.

The project site is located within the Williamsburg County Industrial Park which is located off of South Carolina Highway 52 in Kingstree, South Carolina. We understand the project includes the geotechnical exploration of a proposed new roadway extending approximately 800 linear feet into the industrial park along with a new turn lane on South Carolina Highway 52. A site vicinity map is included in the appendix as Figure 1.

The purpose of this study was to characterize the near-surface soils along the proposed new roadways for pavement subgrade preparation and pavement section thickness recommendations. This report presents the findings of our exploration along with our conclusions and recommendations.

EXPLORATION PROCEDURES

On February 18 through March 5, 2009, representatives of S&ME, Inc. visited the site. Using the information provided, we performed the following tasks:

- We performed a site walkover, observing features of topography, existing structures, ground cover, and surface soils at the project site.

- We established 5 hand auger (HA) boring locations across the site by roughly measuring distances and turning right angles as interpreted from the site layout plan. The Test Location Sketch is attached in the appendix as Figure 2.

- We advanced 5 hand auger borings (HA-1 through HA-5) with Dynamic cone Penetrometer (DCP) testing to depths ranging from 4 to 5 feet along the proposed new roadway alignment and new turn lane.

- The subsurface water level at each boring was measured in the field at the time of drilling and at least 24 hours after drilling

A description of the field exploration procedures performed during the exploration as well as the hand auger boring logs are attached in the appendix.

LABORATORY TESTING

After the recovered soil samples were brought to our laboratory, a geotechnical professional examined each sample to estimate distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geologic origin in general accordance with ASTM D2488, "*Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*".

The geotechnical professional's classifications are presented on the Boring Logs attached in the appendix. Similar soils were grouped into one or more strata on the logs. The strata contact lines represent approximate boundaries between soil types. The actual transitions between soil types in the field are likely more gradual in both the vertical and horizontal directions than is indicated on the logs.

We performed the following quantitative ASTM-standardized laboratory tests on one bulk sample obtained from the proposed on-site borrow source area that was identified by the client and upon one sample recovered from a hand auger boring, to help classify the soil and formulate our conclusions and recommendations. The laboratory tests performed included the following:

- Atterberg limits (ASTM D 4318) of two soil samples, to determine soil plasticity.

- Particle size analysis without hydrometer (ASTM D 422) of two soil samples, to determine the grain size distribution of the soil.

- Natural moisture content (ASTM D 2216) of two soil samples, to evaluate the in-situ moisture content of the soil.

- Modified Proctor moisture-density relationship testing (ASTM D 1557) of one soil sample obtained from the proposed borrow area, to measure the moisture density relationship and help determine the fill suitability.

- California Bearing Ratio (CBR) (ASTM D 1883) two-point test series compacted to 95 and 100 percent of the modified Proctor maximum dry density of one sample of soil obtained from the proposed borrow area, to allow development of pavement section recommendations.

The laboratory data sheets and procedures for the above listed tests are attached to this report in the appendix.

SURFACE CONDITIONS

The proposed roadway is located within an existing agricultural field and the proposed turn lane is located within the center median of Highway 52. The proposed borrow area is located within the southwestern portion of the site.

Organic topsoil and rootmat was encountered at each hand auger location, and was measured to be approximately 3 to 6 inches thick. Thicker zones of topsoil and rootmat may be encountered in the low-lying areas and swales.

SUBSURFACE CONDITIONS

The generalized subsurface conditions at the site are described below. For more detailed descriptions and stratifications at a test location, the respective boring logs should be reviewed in the appendix.

This section describes the near-surface soil conditions observed across the site. Soils encountered by the borings were grouped into a single generalized stratum based on their estimated physical properties derived from the hand auger boring logs and laboratory test data.

Soil Composition and Consistency

Underlying the topsoil in all of the hand auger borings, a stratum of silty sands was encountered to the hand auger boring termination depths ranging from 4 to 5 feet. These soils were moist to wet and predominately tan, brown, gray, and red in color. These soils exhibited Dynamic Cone Penetrometer (DCP) blow count values ranging from 1 to greater than 20 blows per increment (bpi), but typically ranged from 10 to 20 bpi, indicating a medium dense to dense near surface relative density. However, the silty sands encountered in boring HA-3 exhibited DCP blow count values ranging from 1 to 6 bpi, indicating a very loose to loose near surface relative density.

Natural moisture content of the soil, recovered from boring HA-3 at a depth of 0.5 to 5 feet was 42.1 percent. Fines content of the tested soil was 36.8 percent. Minus No. 40 sieve size material exhibited plastic behavior. These soils exhibited a liquid limit value of 40 percent and a plastic limit value of 26 percent. The Plasticity Index value was 14 percent, indicating low to medium plasticity.

Natural moisture content of the soil, recovered from the borrow area at a depth of 0.5 to 4 feet was 15.2 percent. Fines content of the tested soil was 37.1 percent. Minus No. 40 sieve size material exhibited essentially non-plastic behavior. One bulk sample of this soil was recompacted in modified Proctor molds using ASTM D 1557 Method A. The maximum dry density of the tested soils was 124.6 pcf at an optimum moisture content of 9.4. Based on the laboratory test results, it appears that these soils will be as much as 6 percent wetter than the optimum moisture content and may require moisture content adjustment prior to compaction, such as discing, plowing, or drying depending upon the weather conditions.

Laboratory California Bearing Ratio tests (ASTM D 1883) were conducted upon soaked specimens recompacted to 95 and 100 percent of the modified Proctor maximum dry density, and results are provided in the appendix. CBR values of 27 and 62 percent were obtained for the silty sand when recompacted to 95 percent and 100 percent of modified Proctor maximum dry density, respectively. CBR data indicate these soils have generally fair to good suitability for use as a road subbase material when properly compacted.

Ground Water

At the time of drilling, ground water was not encountered within the hand auger borings except at test location HA-3. The ground water in HA-3 was measured to be 4 inches below the ground surface at the time of drilling, which likely represents a perched water pocket, considering the absence of water in the other borings.

Water levels may fluctuate seasonally at the site, being influenced by rainfall variation and other factors, and during very dry times of the year perched water conditions may subside. Site construction activities can also influence water elevations.

The above description of subsurface conditions is relatively brief and general. More detailed information may be obtained from review of individual boring logs contained in the appendix of this report.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations included in this section are based on the project information outlined previously and the data obtained during our exploration. If the construction scope or site plan are altered, or if conditions are encountered during construction that differ from those encountered by the borings, then S&ME, Inc. should be retained to review the following recommendations based upon the new information and make any necessary changes.

Surface Preparation

The following recommendations are provided regarding site preparation and earthwork:

1. Strip surface vegetation, topsoil, and any other organic or usuitable materials, where encountered, and dispose of outside the construction area. Do not locate burn piles or debris piles within the construction area.

2. We recommend that site drainage be implemented prior to site construction to help control the shallow perched ground water conditions that may occur at the site. Due to the potential for perched water to develop at the site, we recommend drainage ditches be excavated at the site prior to grading.

3. After the stripping operation is complete but before mass grading begins, the stripped surface in all areas to receive fill should be proofrolled under the observation of the geotechnical engineer (S&ME) or his authorized representative by making repeated passes with a fully-loaded dump truck or earth-moving pan. The proofrolling should be conducted only during dry weather and after drainage has been implemented and allowed time to function in order to avoid degrading the surface. Areas of rutting or pumping soils indicated by the proofroll may require selective undercutting or further stabilization prior to fill placement, as determined by the geotechnical engineer. Stabilization may take the form of removal and replacement, plowing and drying, or other means as determined by the geotechnical engineer based on observed field conditions.

4. We anticipate based upon our borings that some localized undercutting and replacement of material may be required in the vicinity of test boring HA-3.

5. The ditch that extends along the shoulder of Highway 52 across must be properly stabilized and drainage rerouted before it can be backfilled. The ditch currently runs directly through the proposed roadway at approximately Station 90+00. To properly stabilize the soils in the ditch, the area must be excavated under the observation of the geotechnical engineer (S&ME) to determine the extent of the unstable soils and sediments to be removed. Before any excavation is performed, new drainage should be implemented to reroute and maintain water removal from the site. After the new drainage is in place, the removal of unstable soils and sediments can proceed. The ditch should be excavated to the depth at which stable soils are present, anticipated to be about 1 to 2 feet below the bottom of the ditch. Once the ditch bottom and sides have been stabilized, the ditch can be backfilled with compacted fill as discussed in the "Fill Placement and Compaction Recommendations" section of this report.

Fill Placement and Compaction Recommendations

Where new fill soils are to be placed, the following recommendations apply:

1. Prior to fill placement, sample and test each proposed fill material to determine suitability for use, maximum dry density, optimum moisture content, and natural moisture content. It is recommended that the fill soils used to build up the roadways

meet the following minimum requirements: plasticity index of 15 percent or less; clay/silt fines content of not greater than 40 percent. The on-site borrow soils that we tested and which we classified as silty sands appear to satisfy these criteria.

2. Where fill soil is required, structural fill should be compacted throughout to at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557). Compacted soils should not exhibit pumping or rutting under equipment traffic. Loose lifts of fill should be no more than 8 inches thick prior to compaction. Structural fill should extend at least 5 feet from the edge of pavements before either sloping or being allowed to exhibit a lower level of compaction.

3. Where present, the ground water level should be maintained at least 2 feet below any surface to be densified prior to beginning compaction. This is to prevent the compaction operation from drawing ground water up to the surface and degrading it.

4. All fill placement should be witnessed by an experienced S&ME soils technician working under the guidance of the geotechnical engineer. In general, at least one field density test for every 2,000 square feet should be conducted for each lift of soil in large area fills, with a minimum of 2 tests per lift. At least one field density test should be conducted for each 50 cubic feet of fill placed in confined areas such as isolated undercuts and in trenches, with a minimum of 1 test per lift.

Pavement Section Design and Construction Recommendations

Based on the roadway profile, we understand that a portion of the roadway will be cut to grade and another portion of the roadway will be raised approximately 1 to 5 feet to achieve the proposed pavement subgrade elevation. Based upon our exploration, we estimate that the native silty sands are a well suited soil type for pavement support when compacted at the proper moisture content. We performed one CBR test series on representative silty sand recovered between depths of approximately 0.5 to 4 feet from the proposed borrow area. The laboratory test result indicated a CBR value of 27 percent for these soils when compacted to 95 percent of modified Proctor maximum dry density near optimum moisture content.

Based on the upper 12 inches of the existing silty sands as well as any new fill being compacted to at least 95 percent of the modified Proctor maximum dry density as recommend above, we estimate a resilient modulus of 21,000 psi to be available for pavement support. Any proposed imported backfill materials should be tested prior to use to verify this assumed design value. If materials having lesser subgrade support values are to be considered for use, the pavement design should be reevaluated and required pavement thicknesses may need to be increased as a result.

Traffic volumes for the proposed development were not provided to us in preparation for our exploration and pavement section analysis. Therefore, we have assumed traffic volumes for the pavements based on 100 passenger car one-way trips per day, and 50 tractor-trailer one-way trips per day, using 3 equivalent single axle loads (ESALS) per truck trip. These values result in an estimated required capacity of roughly 1,072 ESALS per week for all pavements. Assuming a total design life of 20 years, a required capacity of about 1,115,000 ESALs was estimated for the normal-duty areas.

Pavement thickness computations were made using the AASHTO method, assuming an initial serviceability of 4.2, a terminal serviceability index of 2.0, and a reliability factor of 95 percent. ESALs per vehicle were estimated using data provided in the literature. The traffic frequency and wheel loads assumed for the proposed pavement sections are not warranted to represent the actual traffic imposed during the design life of the pavement. You should modify these assumptions if warranted to more accurately reflect the actual traffic loading that you anticipate.

Using the above information, we determined a required structural number (SN) for assumed subgrade bearing, traffic volume, and wheel load configuration for the pavement area. Based upon the SN determined, the estimated traffic capacity required, and the estimated subgrade soil support capacity, the pavement section thicknesses we recommend for this project are shown in Table 1 below.

Table 1: Recommended Pavement Section (a)

Pavement Area	Theoretical Traffic Load (ESALs)	Asphaltic Concrete Type I Surface Course (inches)	Compacted Crushed Stone Base Course [GABC] (inches)
All Pavements	1,115,000	2.5	8.0

(a) Single-stage construction and soil compaction as recommended is assumed; S&ME, Inc. must observe pavement subgrade preparation and pavement installation operations.

General Recommendations for All Pavement Areas

1. At least one laboratory California Bearing Ratio (CBR) test should be performed upon a representative soil sample of each soil type which is planned to be used as pavement subgrade material. This is to establish the relationship between relative compaction and CBR for the soil in question, and to confirm that the obtained CBR value at the required level of compaction is equal to or greater than the CBR value utilized during design of the pavement section.

2. All fill placed in pavement areas should be compacted as recommended in the "Fill Placement and Compaction Recommendations" section. Prior to placement of base course stone, all exposed pavement subgrades should be methodically proofrolled under the observation of the geotechnical engineer (S&ME), and any identified unstable areas should be repaired as directed. Pavement subgrades should not exhibit rutting or pumping under the proofroll load. Pavement underdrainage and/or side ditches or swales may be required to control perched groundwater and stabilize road subgrades, as previously discussed.

Base Course and Asphaltic Concrete Construction

1. Crushed stone aggregate base material used in pavement section construction should consist of graded aggregate base course (GABC) as defined by Section 305 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007). The base course should be compacted to at least 100 percent of the modified Proctor maximum dry density (SC-T-140). The base course material should not exhibit pumping or rutting under equipment traffic.

2. Heavy compaction equipment is likely to be required in order to achieve the required base course compaction, and the moisture content of the material will likely need to be maintained near optimum moisture content in order to facilitate proper compaction.

3. Construct the surface course of asphaltic concrete pavement in accordance with the specifications of Section 403 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007 edition).

4. Compaction should be achieved as specified in Section 401.30 of the SCDOT specification. Asphaltic concrete that is insufficiently compacted will show wear much more rapidly than if it were properly compacted.

5. Experience indicates that a thin surface overlay of asphalt pavement may be required in about 10 years due to normal wear and weathering of the surface. Such wear is typically visible in several forms of pavement distress, such as aggregate exposure and polishing, aggregate stripping, asphalt bleeding, and various types of cracking. There are means to methodically estimate the remaining pavement life based on a systematic statistical evaluation of pavement distress density and mode of failure. We recommend the pavement be evaluated in about 7 years to assess the pavement condition and remaining life.

6. It is recommended that reinforced rigid (Portland cement concrete) pavement be used at dumpster approach pads and dumpster storage areas, dumpster traffic roadways, truck dock aprons, trailer parking spaces, and other high truck traffic areas.

7. If heavy trucks are expected to perform repeated tight turns in specific areas of flexible pavements, it may be desirable to thicken the asphalt by ½ inch or more or use rigid pavement in those zones.

LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations in this report are based on the applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of variations of the soils at the site to those encountered at our hand auger boring locations will not become evident until construction. If variations appear evident, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the project are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by the submitting engineers.

Assessment of site environmental conditions; sampling of soils, ground water or other materials for environmental contaminants; identification of jurisdictional wetlands, rare or endangered species, geological hazards or potential air quality and noise impacts were beyond the scope of this geotechnical exploration.

CLOSURE

S&ME appreciates this opportunity to work with Alliance Consulting Engineers, Inc. as your geotechnical engineering consultant. If you should have any questions concerning this geotechnical report, please do not hesitate to contact us.

Very truly yours,
S&ME, Inc.

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER
No. 26538
3-10-09
CHRISTOPHER M. DOUTON

Christopher M. Douton
Christopher M. Douton, P.E.
Project Engineer

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION
S&ME, INC.
No. C00473

Ron Forest
Ronald P. Forest, Jr., P.E.
Geotechnical Engineer

APPENDIX

SCALE: NTS

SOURCE: Google Earth 2008, Tele Atlas 2009

DRAWN BY: CMD

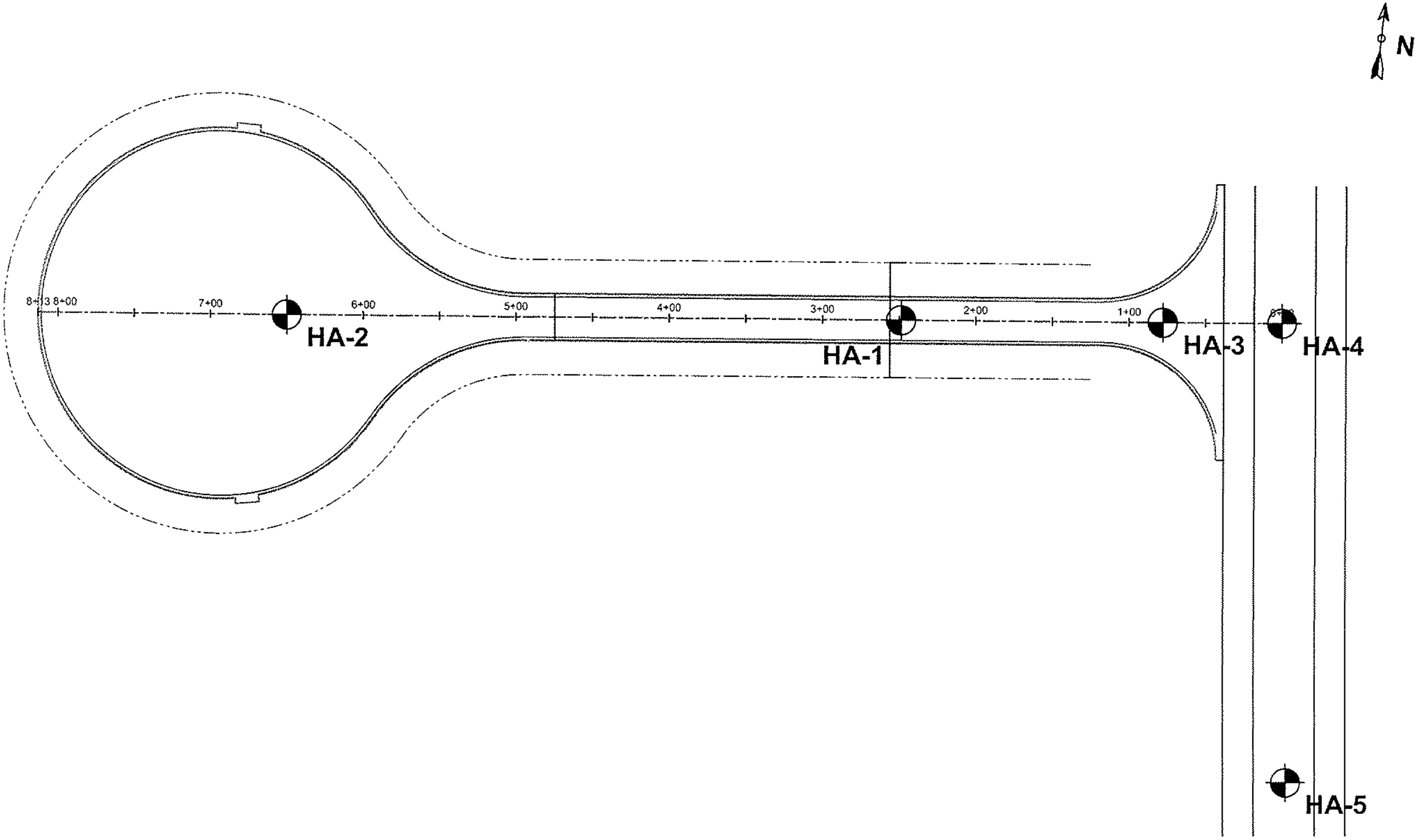
DATE: March, 2009

S&ME
ENVIRONMENTAL SERVICES
ENGINEERING TESTING

SITE VICINITY MAP
Epps No. 1 Industrial Site
Kingstree, South Carolina

JOB NO. 1633-09-049

FIGURE NO 1



Scale: NTS
Checked By: CMD
Drawn By: JDL
Date: March, 2009

S&ME

Test Location Sketch
Epps No. 1 Industrial Site
Kingstree, South Carolina

Job No: 1633-09-049

FIGURE NO
2

SUMMARY OF EXPLORATION PROCEDURES

The American Society for Testing and Materials (ASTM) publishes standard methods to explore soil, rock and ground water conditions in Practice D-420-98, "*Standard Guide to Site Characterization for Engineering Design and Construction Purposes.*" The boring and sampling plan must consider the geologic or topographic setting. It must consider the proposed construction. It must also allow for the background, training, and experience of the geotechnical engineer. While the scope and extent of the exploration may vary with the objectives of the client, each exploration includes the following key tasks:

- Reconnaissance of the Project Area
- Preparation of Exploration Plan
- Layout and Access to Field Sampling Locations
- Field Sampling and Testing of Earth Materials
- Laboratory Evaluation of Recovered Field Samples
- Evaluation of Subsurface Conditions

The standard methods do not apply to all conditions or to every site. Nor do they replace education and experience, which together make up engineering judgment. Finally, ASTM D 420 does not apply to environmental investigations.

RECONNAISSANCE OF THE PROJECT AREA

Where practical, we reviewed available topographic maps, county soil surveys, reports of nearby investigations and aerial photographs when preparing the boring and sampling plan. Then we walked over the site to note land use, topography, ground cover, and surface drainage. We observed general access to proposed sampling points and noted any existing structures.

Checks for Hazardous Conditions - State law requires that we notify the Palmetto Utility Protection Service (PUPS) before we drill or excavate at any site. PUPS is operated by the major water, sewer, electrical, telephone, CATV, and natural gas suppliers of South Carolina. PUPS forwarded our location request to the participating utilities. Location crews then marked buried lines with colored flags within 72 hours. They did not mark utility lines beyond junction boxes or meters. We checked proposed sampling points for conflicts with marked utilities, overhead power lines, tree limbs, or man-made structures during the site walkover.

BORING AND SAMPLING

Hand Auger Borings with Dynamic Cone Penetrometer Testing

Auger borings were advanced using hand operated augers. The soils encountered were identified in the field by cuttings brought to the surface. Representative samples of the cuttings were placed in glass jars and later transported to the laboratory. Soil consistency was qualitatively estimated by the relative difficulty of advancing the augers.

Dynamic Cone Penetrometer (DCP) testing was performed in conjunction within the borings in general accordance with ASTM STP 399, "*Dynamic Cone for Shallow In-Situ Penetration Testing*". At selected intervals, the augers were withdrawn and soil consistency measured with a dynamic cone penetrometer. The conical point of the penetrometer was first seated 1-3/4 inches to penetrate any loose cuttings in the boring, then driven two additional 1-3/4 inch increments by a 15 pound hammer falling 20 inches. The number of hammer blows required to achieve this penetration was recorded. When properly evaluated by qualified professional staff, the blow count is an index to the soil strength.

Water Level Determination

Subsurface water levels at the test locations were measured during the onsite exploration by measuring depths from the existing grade to the current water level using a tape.

Bulk Samples

At selected locations and depths, representative bulk samples of the soils were obtained by randomly taking shovel loads from the cuttings or spoil brought to the surface, until a sample of 30 to 50 lbs was obtained. The sample was placed in a cloth or plastic sack marked with appropriate descriptive information.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	●	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			○	GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	◫	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	⁙	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⁚	SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▥	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			☰	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			≋	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			■	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

S&ME

LOG OF HAND AUGER BORING NO. HA-1

PROJECT: **Epps No. 1 Industrial Site**
PROJECT NO: **1633-09-049**
PROJECT LOCATION: **Kingstree, South Carolina**

WATER LEVEL: **Dry at TOB**
Dry after 24 hours

DATE DRILLED: **2/18/09**
DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Hand Auger Boring**

GROUND SURFACE ELEVATION: **59.00**
LOGGED BY: **CMD**

This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE NUMBER	SAMPLE ADVANCE (ft.)	OVA (ppm)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	DCP
								(blows per increment)
1	0.25		59.00	0		▨	**TOPSOIL/ROOTMAT** (3 inches thick)	
2	3.75			1 2 3	SM	⁝	**SILTY SAND (SM)** - Mostly fine to medium sands with some low plasticity fines, tan and gray, moist, medium dense to dense	8-9-9 9-9-9 9-10-12 14-15-16
				4			Hand auger boring terminated at 4 feet	20+

NOTES:

1330 U.S. Highway 501 Bus.
Conway, South Carolina 29526

LOG OF HAND AUGER BORING HA-1

LOG OF HAND AUGER BORING NO. HA-2

PROJECT: **Epps No. 1 Industrial Site**
PROJECT NO: **1633-09-049**
PROJECT LOCATION: **Kingstree, South Carolina**

WATER LEVEL: **Dry at TOB**
Dry after 24 hours

DATE DRILLED: **2/18/09**
DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Hand Auger Boring**

GROUND SURFACE ELEVATION: **59.50**
LOGGED BY: **CMD**

This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE NUMBER	SAMPLE ADVANCE (ft.)	OVA (ppm)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	DCP (blows per increment)
1	0.33		59.50	0		▓	**TOPSOIL/ROOTMAT** (4 inches thick)	
						░	**SILTY SAND (SM)** - Mostly fine to medium sands with some low plasticity fines, tan and gray, moist, medium dense to dense	8-8-8
				1		░		9-8-9
2	3.67			2	SM	░		10-10-11
				3		░		11-13-15
				4			Hand auger boring terminated at 4 feet	15-17-19

NOTES:

LOG OF HAND AUGER BORING NO. HA-3

PROJECT: **Epps No. 1 Industrial Site**
PROJECT NO: **1633-09-049**
PROJECT LOCATION: **Kingstree, South Carolina**
WATER LEVEL: **0.33 feet at TOB**

DATE DRILLED: **3/5/09**
DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Hand Auger Boring**
GROUND SURFACE ELEVATION: **58.00**
LOGGED BY: **CMD**

This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE NUMBER	SAMPLE ADVANCE (ft.)	OVA (ppm)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	DCP (blows per increment)
1	0.25		58.00	0		▨	**TOPSOIL/ROOTMAT** (3 inches thick)	
							SILTYY SAND (SM) - Mostly fine to medium sands with some low to medium plasticity fines, gray and brown, wet, very loose to loose	1-1-2 ∇
				1				3-3-2
				2				1-2-2
2	4.75				SM			
				3				4-2-2
				4				4-4-6
			53.00	5			Hand auger boring terminated at 5 feet	6-6-7

NOTES:

LOG OF HAND AUGER BORING HA-3

LOG OF HAND AUGER BORING NO. HA-4

PROJECT: **Epps No. 1 Industrial Site**
PROJECT NO: **1633-09-049**
PROJECT LOCATION: **Kingstree, South Carolina**

WATER LEVEL: **Dry at TOB**

DATE DRILLED: **3/5/09**
DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Hand Auger Boring**

GROUND SURFACE ELEVATION: **62.00**
LOGGED BY: **CMD**

This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE NUMBER	SAMPLE ADVANCE (ft.)	OVA (ppm)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	DCP (blows per increment)
1	0.33		62.00	0		▨	**TOPSOIL/ROOTMAT** (4 inches thick)	
2	3.67				SM		**SILTY SAND (SM)** - Mostly fine to medium sands with some low plasticity fines, tan, brown, and gray, moist, medium dense to dense	9-9-12
				1				20+
				2				10-10-9
				3				15-16-15
				4			Hand auger boring terminated at 4 feet	13-13-15

NOTES:

LOG OF HAND AUGER BORING NO. HA-5

PROJECT: **Epps No. 1 Industrial Site**
PROJECT NO: **1633-09-049**
PROJECT LOCATION: **Kingstree, South Carolina**

WATER LEVEL: **Dry at TOB**

DATE DRILLED: **3/5/09**
DRILLING CONTRACTOR: **S&ME, Inc.**
DRILLING METHOD: **Hand Auger Boring**

GROUND SURFACE ELEVATION: **62.00**
LOGGED BY: **CMD**

This log is part of the report prepared for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

SAMPLE NUMBER	SAMPLE ADVANCE (ft.)	OVA (ppm)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	DCP (blows per increment)
1	0.5		62.00	0			**TOPSOIL/ROOTMAT** (6 inches thick)	
2	3.5				SM		**SILTY SAND (SM)** - Mostly fine to medium sands with some low plasticity fines, tan, brown, and gray, moist, medium dense to dense	8-10-11
				1				16-15-19
				2				12-9-11
				3				13-17-14
				4			Hand auger boring terminated at 4 feet	15-15-13

NOTES:

S&ME
1330 U.S. Highway 501 Bus.
Conway, South Carolina 29526

LOG OF HAND AUGER BORING HA-5

SUMMARY OF LABORATORY PROCEDURES

Examination of Recovered Soil Samples

Soil and field records were reviewed in the laboratory by the geotechnical professional. Soils were classified in general accordance with the visual-manual method described in ASTM D 2488, "*Standard Practice for Description and Identification of Soils (Visual-Manual Method)*". Representative soil samples were selected for classification testing to provide grain size and plasticity data to allow classification of the samples in general accordance with the Unified Soil Classification System method described in ASTM D 2487, "*Standard Practice for Classification of Soils for Engineering Purposes*". The geotechnical professional also prepared the final boring and sounding records enclosed with this report.

Moisture Content Testing of Soil Samples by Oven Drying

Moisture content was determined in general conformance with the methods outlined in ASTM D 2216, "*Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil or Rock by Mass*." This method is limited in scope to Group B, C, or D samples of earth materials which do not contain appreciable amounts of organic material, soluble solids such as salt or reactive solids such as cement. This method is also limited to samples which do not contain contamination.

A representative portion of the soil was divided from the sample using one of the methods described in Section 9 of ASTM D 2216. The split portion was then placed in a drying oven and heated to approximately 110 degrees C overnight or until a constant mass was achieved after repetitive weighing. The moisture content of the soil was then computed as the mass of water removed from the sample by drying, divided by the mass of the sample dry, times 100 percent. No attempt was made to exclude any particular particle size from the portion split from the sample.

Liquid and Plastic Limits Testing

Atterberg limits of the soils was determined generally following the methods described by ASTM D 4318, "*Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.*" Albert Atterberg originally defined "limits of consistency" of fine grained soils in terms of their relative ease of deformation at various moisture contents. In current engineering usage, the *liquid limit* of a soil is defined as the moisture content, in percent, marking the upper limit of viscous flow and the boundary with a semi-liquid state. The *plastic limit* defines the lower limit of plastic behavior, above which a soil behaves plastically below which it retains its shape upon drying. The *plasticity index* (PI) is the range of water content over which a soil behaves plastically. Numerically, the PI is the difference between liquid limit and plastic limit values.

Representative portions of fine grained Group A, B, C, or D samples were prepared using the wet method described in Section 10.1 of ASTM D 4318. The liquid limit of each sample was determined using the multipoint method (Method A) described in Section 11.

The liquid limit is by definition the moisture content where 25 drops of a hand operated liquid limit device are required to close a standard width groove cut in a soil sample placed in the device. After each test, the moisture content of the sample was adjusted and the sample replaced in the device. The test was repeated to provide a minimum of three widely spaced combinations of N versus moisture content. When plotted on semi-log paper, the liquid limit moisture content was determined by straight line interpolation between the data points at N equals 25 blows.

The plastic limit was determined using the procedure described in Section 17 of ASTM D 4318. A selected portion of the soil used in the liquid limit test was kneaded and rolled by hand until it could no longer be rolled to a 3.2 mm thread on a glass plate. This procedure was repeated until at least 6 grams of material was accumulated, at which point the moisture content was determined using the methods described in ASTM D 2216.

Grain Size Analysis of Samples

The distribution of particle sizes greater than 75 mm was determined in general accordance with the procedures described by ASTM D 421, "*Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants", and D 422, "Standard Test Method for Particle Size Analysis of Soils*," except that the hydrometer portion of the test standard was not utilized. During preparation samples were divided into two portions. The material coarser than the No. 30 U.S. sieve size fraction was dry sieved through a nest of standard sieves as described in Article 6. Material passing the No. 30 sieve was independently passed through a nest of sieves down to the No. 200 size.

Percent Fines Determination of Samples

A selected specimen of soils was washed over a No. 200 sieve after being thoroughly mixed and dried. This test was conducted in general accordance with ASTM D 1140, "*Standard Test Method for Amount of Material Finer Than the No. 200 Sieve*." Method A, using water to wash the sample through the sieve without soaking the sample for a prescribed period of time, was used and the percentage by weight of material washing through the sieve was deemed the "percent fines" or percent clay and silt fraction.

Compaction Tests of Soils Using Modified Effort

Soil placed as engineering fill is compacted to a dense state to obtain satisfactory engineering properties. Laboratory compaction tests provide the basis for determining the percent compaction and water content needed to achieve the required engineering properties, and for controlling construction to assure the required compaction and water contents are achieved. Test procedures generally followed those described by ASTM D 698, "*Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft*^{3})."

The relationship between water content and the dry unit weight is determined for soils compacted in either 4 or 6 inch diameter molds with a 10 lbf rammer dropped from a height of 18 inches, producing a compactive effort of 56,000 lbf/ft^3. ASTM D 1557 provides three alternative procedures depending on material gradation:

Method A	All material passes No. 4 sieve size 4 inch diameter mold Soil in 5 layers with 25 blows per layer	Shall be used if 20 percent or less by weight is retained on No. 4 sieve
Method B	All material passes 3/8 inch sieve 4 inch diameter mold Soil in 5 layers with 25 blows per layer	Shall be used if more than 20 percent by weight is retained on the No. 4 sieve and 20 percent or less by weight is retained on the 3/8 inch sieve.
Method C	All material passes ¾ inch sieve 6-inch diameter mold Soil in 5 layers with 56 blows per layer	Shall be used if more than 20 percent by weight is retained on the 3/8 inch sieve and less than 30 percent is retained on the ¾ inch sieve.

Soil was compacted in the mold in five layers of approximately equal thickness, each compacted with either 25 or 56 blows of the rammer. After compaction of the sample in the mold, the resulting dry density and moisture content was determined and the procedure repeated. Separate soils were used for each sample point, adjusting the moisture content of the soil as described in Section 10.2 (Moist Preparation Method). The procedure was repeated for a sufficient number of water content values to allow the dry density vs. water content values to be plotted and the maximum dry density and optimum moisture content to be determined from the resulting curvilinear relationship.

Laboratory California Bearing Ratio Tests of Compacted Samples

This method is used to evaluate the potential strength of subgrade, subbase, and base course material, including recycled materials, for use in road and airfield pavements. Laboratory CBR tests were run in general accordance with the procedures laid out in ASTM D 1883, "*Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils*." Specimens were prepared in standard molds using two different levels of compactive effort within plus or minus 0.5 percent of the optimum moisture content value. While embedded in the compaction mold, each specimen was inundated for a minimum period of 96 hours to achieve saturation. During inundation, the specimen was surcharged by a weight approximating the anticipated weight of the pavement and base course layers. After removing the sample from the soaking bath, the soil was then sheared by jacking a piston having a cross sectional area of 3 square inches into the end surface of the specimen. The piston was jacked 0.5 inches into the specimen at a constant rate of 0.05 inches per minute.

The CBR is defined as the load required to penetrate a material to a predetermined depth, compared to the load required to penetrate a standard sample of crushed stone to the same depth. The CBR value was usually based on the load ratio for a penetration of 0.10 inches, after correcting the load-deflection curves for surface irregularities or upward concavity. However, where the calculated CBR for a penetration of 0.20 inches was greater than the result obtained for a penetration of 0.10 inches, the test was repeated by reversing the specimen and shearing the opposite end surface. Where the second test indicated a greater CBR at 0.20 inches penetration, the CBR for 0.20 inches penetration was used.

Form No: TR-D2216-T265-1
Revision No. 0
Revision Date: 02/22/08

Laboratory Determination of Water Content

S&ME

ASTM D 2216 ☑ *AASHTO T 265* ☐ *Quality Assurance*

S&ME, Inc. Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #:	**1633-09-049**	**Lab #: 2156**		Report Date:	3/10/09
Project Name:	Epps No. 1 Industrial Site - Roadway			Test Date(s):	2/18/09 & 3/6/09
Client Name:	Alliance Consulting Engineers				
Client Address:	Post Office Box 8147; Columbia, SC 29202				
Sample by:	J Palmer			Sample Date(s):	2/18/09
Sampling Method:	Bulk			Drill Rig :	---

Method: A (1%) ☐ B (0.1%) ☑ *Balance ID.* *Calibration Date:*

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft. or m.		grams	grams	grams	grams	%	
---	Bulk	0.5 - 4'	Sol	330.70	653.80	611.10	42.70	**15.2%**	
HA-1	S-2	0.5-5'	Zr	476.50	722.50	649.60	72.90	**42.1%**	

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

E Nitz
Technician Name

C Douton		Project Engineer	3/10/2009
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No: TR-D422-WH-1
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

ASTM D 422

Quality Assurance

S&ME, Inc. - Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #:	**1633-09-049**	Report Date:	2/25/09
Project Name:	Epps No. 1 Industrial Site - Roadway	Test Date(s):	2/18/09
Client Name:	Alliance Consulting Engineers		
Client Address:	Post Office Box 8147; Columbia, SC 29202		

Sample Id.	Bulk	Sample #:	S-1	Sample Date:	2/18/09
Location:	borrow area	Lab #:	2156	Depth:	0.5 - 4'

Sample Description: Red/Brown Silty Sand (SM)

Description of Sand & Gravel Particles: Rounded ☐ Angular ☒
Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Particle Size Analysis / Without Hydrometer Analysis				*Material Excluded:*	
Tare No.	**Sol**	Tare Wt.	**330.7**	Mass of Sample after Wash + Tare Wt.	
Total Sample Wet Wt. + Tare Wt.			**653.8**	Mass of Sample after Wash	
Total Sample Dry Wt. + Tare Wt.			**611.1**	Mass passing #200	
Total Sample Dry Weight			**280.4**	% Passing #200 **(D1140)**	

Sieve Size		**Retained Weight**	**% Retained Between Sieves**	**% Retained**	**% Passing**	**SPECS**
Standard	*mm.*	*Cumulative*	*Individual*	*Cumulative Total Sample*		
2.0"	50.00	0.0	0.0%	0.0%	**100.0%**	
1.5"	37.50	0.0	0.0%	0.0%	**100.0%**	
1.0"	25.00	0.0	0.0%	0.0%	**100.0%**	
3/4"	19.00	0.0	0.0%	0.0%	**100.0%**	
1/2"	12.50	0.0	0.0%	0.0%	**100.0%**	
3/8"	9.50	0.0	0.0%	0.0%	**100.0%**	
#4	4.75	3.4	1.2%	1.2%	**98.8%**	
#10	2.000	9.9	2.3%	3.5%	**96.5%**	
#30	0.600	21.4	4.1%	7.6%	**92.4%**	
#40	0.425	29.9	3.0%	10.7%	**89.3%**	
#60	0.250	55.3	9.1%	19.7%	**80.3%**	
#100	0.150	132.6	27.6%	47.3%	**52.7%**	
#200	0.075	176.5	15.7%	62.9%	**37.1%**	
Pan	<0.075	176.5		**% Passing #200 (D1140) =**		**37.1%**

D2487	Maximum Particle Size	**9.50 mm**	Medium Sand	< 2.00 mm and > 0.425 mm (#40)	7.1%
Gravel	< 75 mm and > 4.75 mm (#4)	**1.2%**	Fine Sand	< 0.425 mm and > 0.075 mm (#200)	52.3%
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	**2.3%**	% Silt & Clay	< 0.075 mm	37.1%

Notes / Deviations / References:

C Douton	C.M.	Project Engineer	3/4/2009
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

ASTM D 422

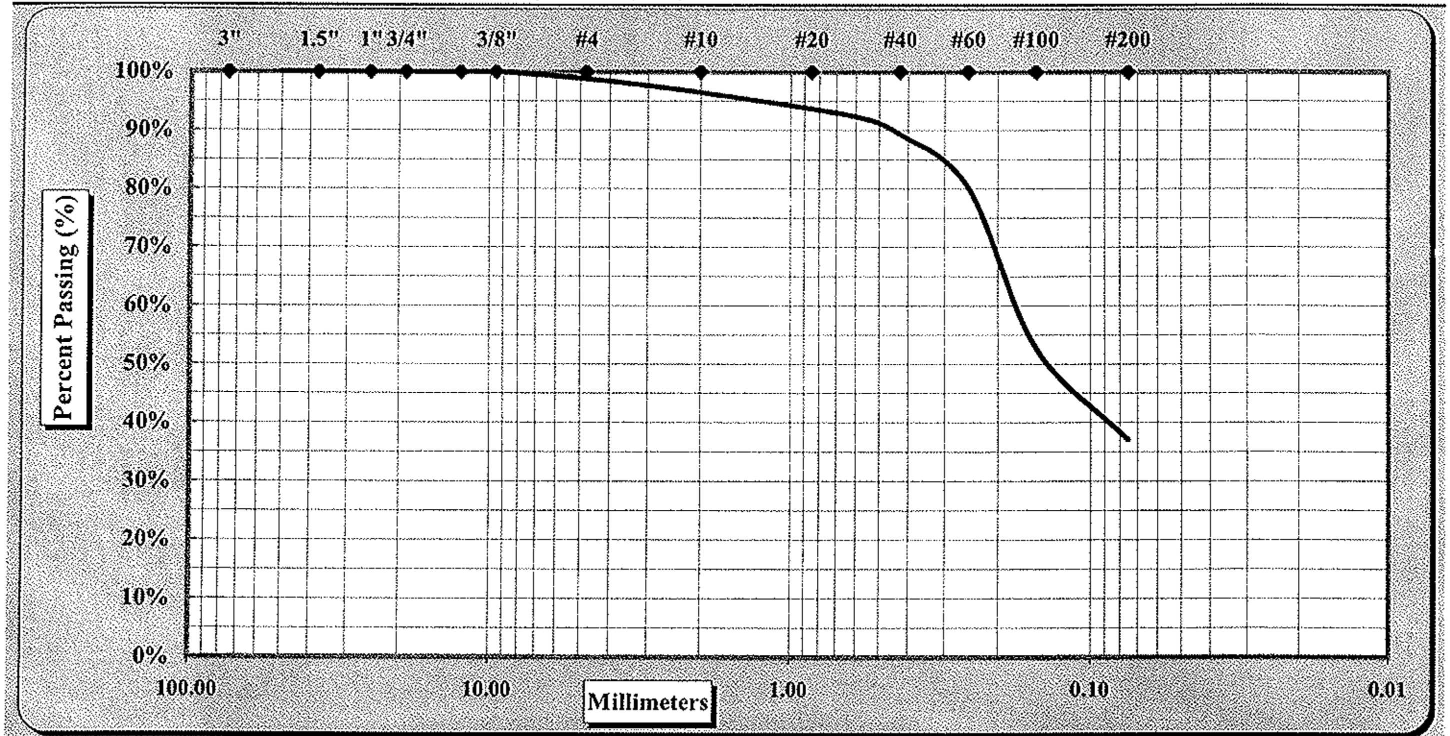
Quality Assurance

S&ME, Inc. - Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #:	**1633-09-049**	Report Date:	2/25/09
Project Name:	Epps No. 1 Industrial Site - Roadway	Test Date(s):	2/18/09
Client Name:	Alliance Consulting Engineers		
Client Address:	Post Office Box 8147; Columbia, SC 29202		

Sample Id.	Bulk	Sample #:	S-1	Sample Date:	2/18/09
Location:	borrow area	Lab #:	2156	Depth:	0.5 - 4'

Sample Description: Red/Brown Silty Sand (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	9.50 mm	Coarse Sand	2.3%	Fine Sand	52.3%
Gravel	1.2%	Medium Sand	7.1%	Silt & Clay	37.1%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity	---	Cc =	Cu =	Moisture Content	
Coarse Sand	2.3%	Medium Sand	7.1%	Fine Sand	52.3%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☒
Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

C Douton	C.M. Douton	Project Engineer	3/4/2009
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D4318-T89-90 *Client code* *Client Test #* *state #*
Revision No. 0
Revision Date: 11/20/07

S&ME

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ *Quality Assurance*

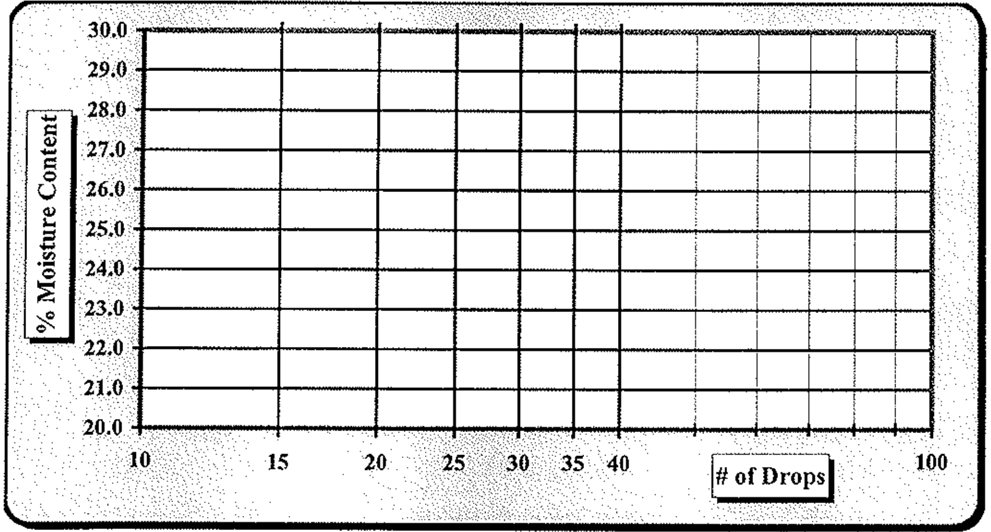
S&ME, Inc. Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: **1633-09-049** Report Date: 2/25/09
Project Name: Epps No. 1 Industrial Site - Roadway Test Date(s) 2/18/09
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia, SC 29202

Boring #: Bulk Sample #: S-1 Sample Date: 2/18/09
Location: Borrow Area Lab #: 2156 Depth: 0.5 - 4'
Sample Description: Red/Brown Silty Sand (SM)

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	007-008	7/8/2008	Grooving tool	11304	7/11/2008
LL Apparatus	18801	7/11/2008	Grooving tool		
Oven	17745	7/17/2008	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	1	2	3	4	5	6	7	8	9
A	Tare Weight									
B	Wet Soil Weight + A								NP	
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture (D/E)*100									
N	# OF DROPS							*Moisture Contents determined by ASTM D 2216*		
LL	LL = F * FACTOR									
Ave.	*Average*									



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic	☒
Liquid Limit	---
Plastic Limit	**NP**
Plastic Index	---
Group Symbol	**SM**
Multipoint Method	☐
One-point Method	☑

Wet Preparation ☑ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

C Douton — *Technical Responsibility*
C.M. — *Signature*
Project Engineer — *Position*
3/4/2009 — *Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D698-2
Revision No. : 0
Revision Date: 11/21/07

Moisture - Density Report

S&ME
Quality Assurance

S&ME, Inc.- Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

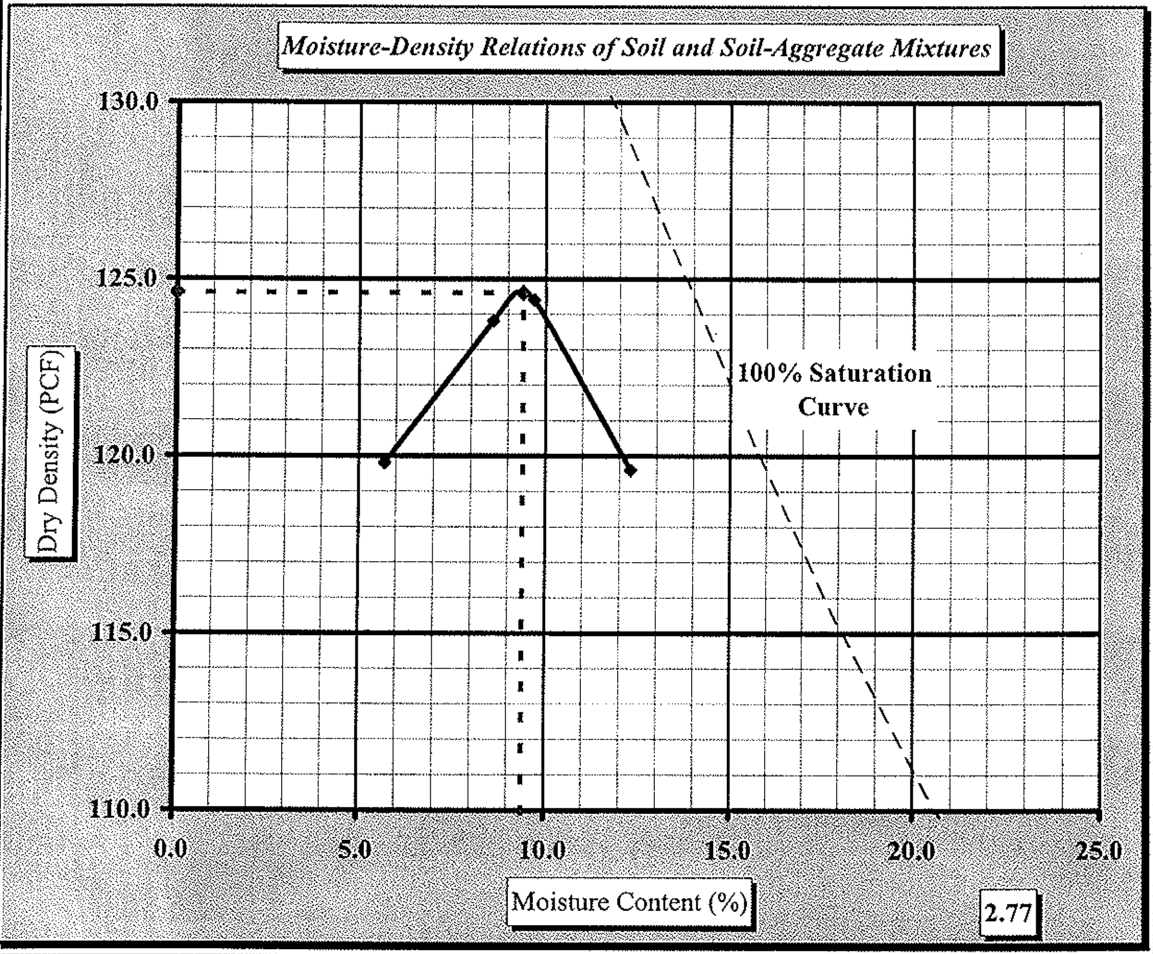
S&ME Project #:	**1633-09-049**	Report Date:	2/20/09
Project Name:	Epps No. 1 Industrial Site - Roadway	Test Date(s):	2/19/09
Client Name:	Alliance Consulting Engineers		
Client Address:	Post Office Box 8147; Columbia, SC 29202		

Boring #:	Bulk	Sample #:	S-1	Sample Date:	2/18/2009
Location:	Borrow Area	Lab #:	2156	Depth:	0.5 - 4'

Sample Description: Red/Brown Silty Sand (SM)

Maximum Dry Density 124.6 PCF. Optimum Moisture Content 9.4%

ASTM D1557 - - Method A



Soil Properties

Natural Moisture Content	**15.2%**
Specific Gravity of Soil	--
Liquid Limit	--
Plastic Limit	**NP**
Plastic Index	--

% Passing

3/4"	100.0%
3/8"	100.0%
#4	98.8%
#10	96.5%
#40	89.3%
#60	80.3%
#100	52.7%
#200	37.1%

Oversize Fraction

Bulk Gravity	
% Moisture	
% Oversize	#DIV/0!
MDD	
Opt. MC	

Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☐

Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Rammer ☒ Manual Rammer ☐ Moist Preparation ☐ Dry Preparation ☒

References / Comments / Deviations:

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort

C Douton		Project Engineer	3/4/2009
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D1833-T193-3
Revision No. 0
Revision Date: 2/6/08
Modified

CBR (California Bearing Ratio) of Laboratory Compacted Soil

ASTM D 1883

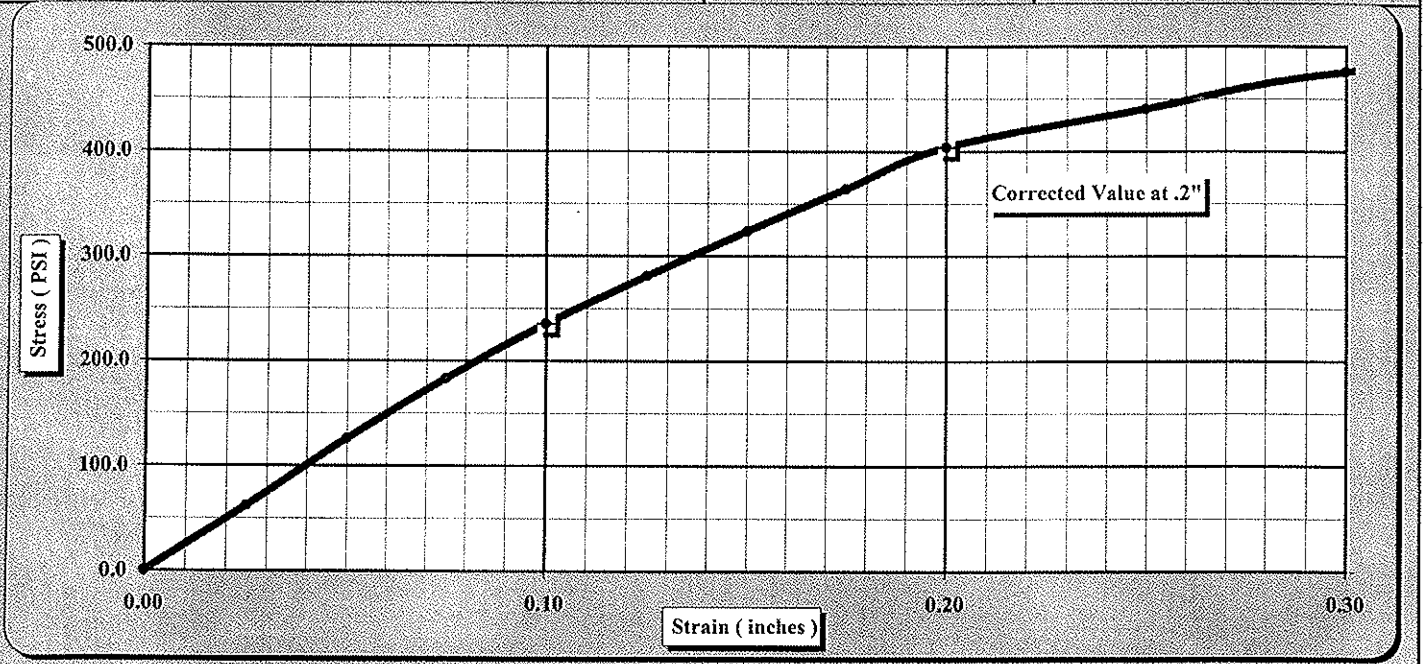
S&ME
Quality Assurance

S&ME, Inc.Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: 1633-09-049
Report Date: 2/25/09
Project Name: Epps No. 1 Industrial Site - Roadway
Test Date(s) 2/20/2009
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia, SC 29202
Boring #: Bulk
Sample #: S-1
Sample Date: 2/18/2009
Location: Borrow Area
Lab # 2156
Elevation: 0.5 - 4'
Sample Description: Red/Brown Silty Sand (SM)

ASTM D1557 *Method A* Maximum Dry Density: 124.6 PCF Optimum Moisture Content: 9.4%
Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 0.0%

Uncorrected CBR Values				Corrected CBR Values			
CBR at 0.1 in.	23.5	**CBR at 0.2 in.**	26.9	**CBR at 0.1 in.**	23.5	**CBR at 0.2 in.**	26.9



CBR Sample Preparation:
The replacement method was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1

Before Soaking		*After Soaking*	
Compactive Effort (Blows per Layer)	25	Final Dry Density (PCF)	117.8
Initial Dry Density (PCF)	118.2	Average Final Moisture Content	10.9%
Moisture Content of the Compacted Specimen	9.5%	Moisture Content (top 1" after soaking)	11.2%
Percent Compaction	94.9%	Percent Swell	0.0%

Soak Time: 96 hrs. Surcharge Weight 10.0 Surcharge Wt. per sq. Ft. 51.0
Liquid Limit --- Plastic Index --- Apparent Relative Density ---
Notes/Deviations/References: Liquid Limit: ASTM D 4318, Specific Gravity: ASTM D 854, Classification: ASTM D 2487

C Douton
Technical Responsibility

Signature

Project Engineer
Position

3/4/2009
Date

This report shall not be reproduced, except in full without the written approval of S&ME, Inc.

Form No. TR-D1833-T193-3
Revision No. 0
Revision Date: 2/6/08
Modified

CBR (California Bearing Ratio) of Laboratory Compacted Soil

ASTM D 1883

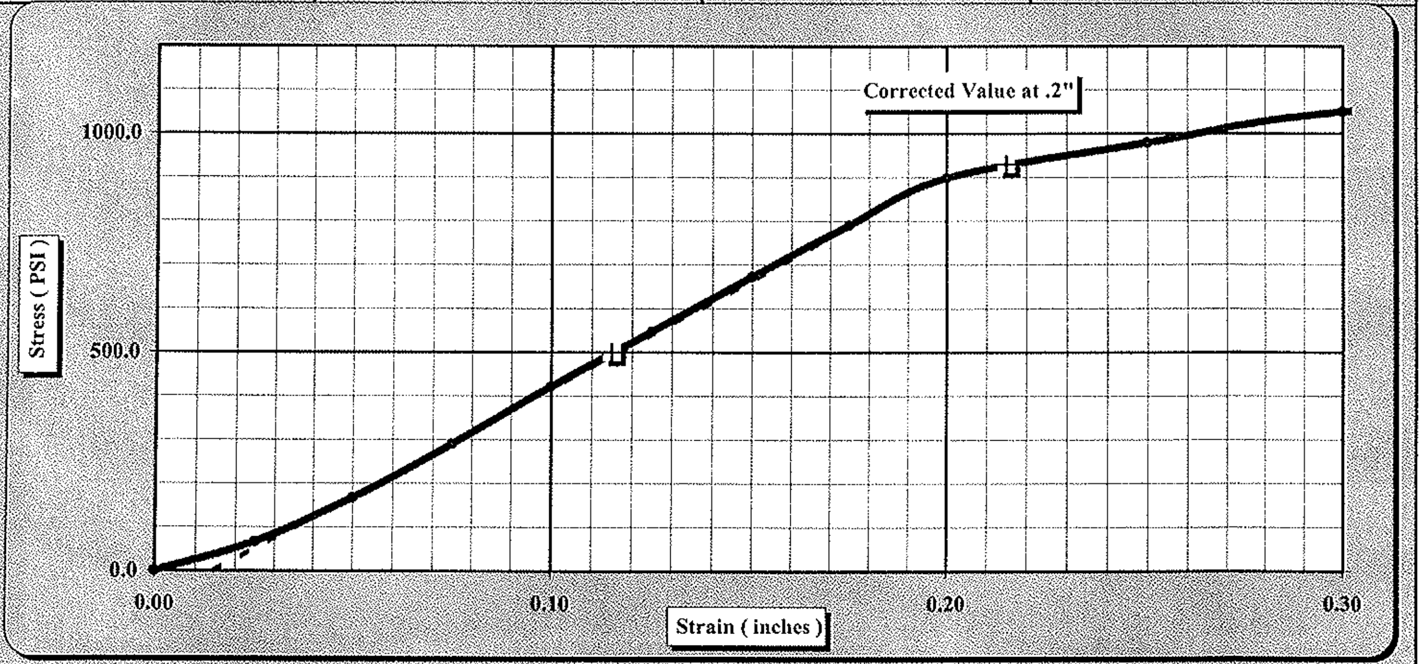
S&ME
Quality Assurance

S&ME, Inc.Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: 1633-09-049 Report Date: 2/25/09
Project Name: Epps No. 1 Industrial Site - Roadway Test Date(s) 2/20/2009
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia , SC 29202
Boring #: Bulk Sample #: S-1 Sample Date: 2/18/2009
Location: Borrow Area Lab # 2156 Elevation: 0.5 - 4'
Sample Description: Red/Brown Silty Sand (SM)

ASTM D1557 *Method A* Maximum Dry Density: 124.6 PCF Optimum Moisture Content: 9.4%
Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 0.0%

Uncorrected CBR Values		Corrected CBR Values	
CBR at 0.1 in. 42.1	**CBR at 0.2 in. 59.9**	**CBR at 0.1 in. 50.0**	**CBR at 0.2 in. 62.0**



CBR Sample Preparation:

The replacement method was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1

Before Soaking		*After Soaking*	
Compactive Effort (Blows per Layer)	56	Final Dry Density (PCF)	125.4
Initial Dry Density (PCF)	124.3	Average Final Moisture Content	9.6%
Moisture Content of the Compacted Specimen	9.5%	Moisture Content (top 1" after soaking)	10.4%
Percent Compaction	99.8%	Percent Swell	0.0%

Soak Time: 96 hrs. Surcharge Weight 10.0 Surcharge Wt. per sq. Ft. 51.0
Liquid Limit --- Plastic Index --- Apparent Relative Density ---
Notes/Deviations/References: Liquid Limit: ASTM D 4318, Specific Gravity: ASTM D 854, Classification: ASTM D 2487

C Douton		Project Engineer	3/4/2009
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full without the written approval of S&ME, Inc.

Form No: TR-D422-WH-1
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

ASTM D 422

S&ME

Quality Assurance

S&ME, Inc. - Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: **1633-09-049** Report Date: 3/10/09
Project Name: Epps No. 1 Industrial Site - Roadway Test Date(s): 3/6/09
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia, SC 29202
Sample Id. --- Sample #: S-2 Sample Date: 3/6/09
Location: HA-3 Lab #: 2166 Depth: 0.5 - 5.0'
Sample Description: Dark Brown Silty Sand (SM)

Description of Sand & Gravel Particles: Rounded ☐ Angular ☒
Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Particle Size Analysis / Without Hydrometer Analysis				*Material Excluded:*	
Tare No.	**Zr**	Tare Wt.	**476.5**	Mass of Sample after Wash + Tare Wt.	
Total Sample Wet Wt. + Tare Wt.			**722.5**	Mass of Sample after Wash	
Total Sample Dry Wt. + Tare Wt.			**649.6**	Mass passing #200	
Total Sample Dry Weight			**173.1**	% Passing #200 **(D1140)**	

Sieve Size		Retained Weight	% Retained Between Sieves	% Retained	% Passing	SPECS
				Cumulative		
Standard	*mm.*	*Cumulative*	*Individual*	*Total Sample*		
2.0"	50.00	0.0	0.0%	0.0%	**100.0%**	
1.5"	37.50	0.0	0.0%	0.0%	**100.0%**	
1.0"	25.00	0.0	0.0%	0.0%	**100.0%**	
3/4"	19.00	0.0	0.0%	0.0%	**100.0%**	
1/2"	12.50	0.0	0.0%	0.0%	**100.0%**	
3/8"	9.50	0.0	0.0%	0.0%	**100.0%**	
#4	4.75	0.0	0.0%	0.0%	**100.0%**	
#10	2.000	0.8	0.5%	0.5%	**99.5%**	
#30	0.600	12.1	6.5%	7.0%	**93.0%**	
#40	0.425	20.8	5.0%	12.0%	**88.0%**	
#60	0.250	42.2	12.4%	24.4%	**75.6%**	
#100	0.150	82.9	23.5%	47.9%	**52.1%**	
#200	0.075	109.4	15.3%	63.2%	**36.8%**	
Pan	<0.075	109.5		**% Passing #200 (D1140) =**		**36.8%**

D2487	Maximum Particle Size	**4.75 mm**	Medium Sand	< 2.00 mm and > 0.425 mm (#40)	11.6%
Gravel	< 75 mm and > 4.75 mm (#4)	**0.0%**	Fine Sand	< 0.425 mm and > 0.075 mm (#200)	51.2%
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	**0.5%**	% Silt & Clay	< 0.075 mm	36.8%

Notes / Deviations / References:

C Douton
Technical Responsibility

Signature

Project Engineer
Position

3/10/2009
Date

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

S&ME

Sieve Analysis of Soils

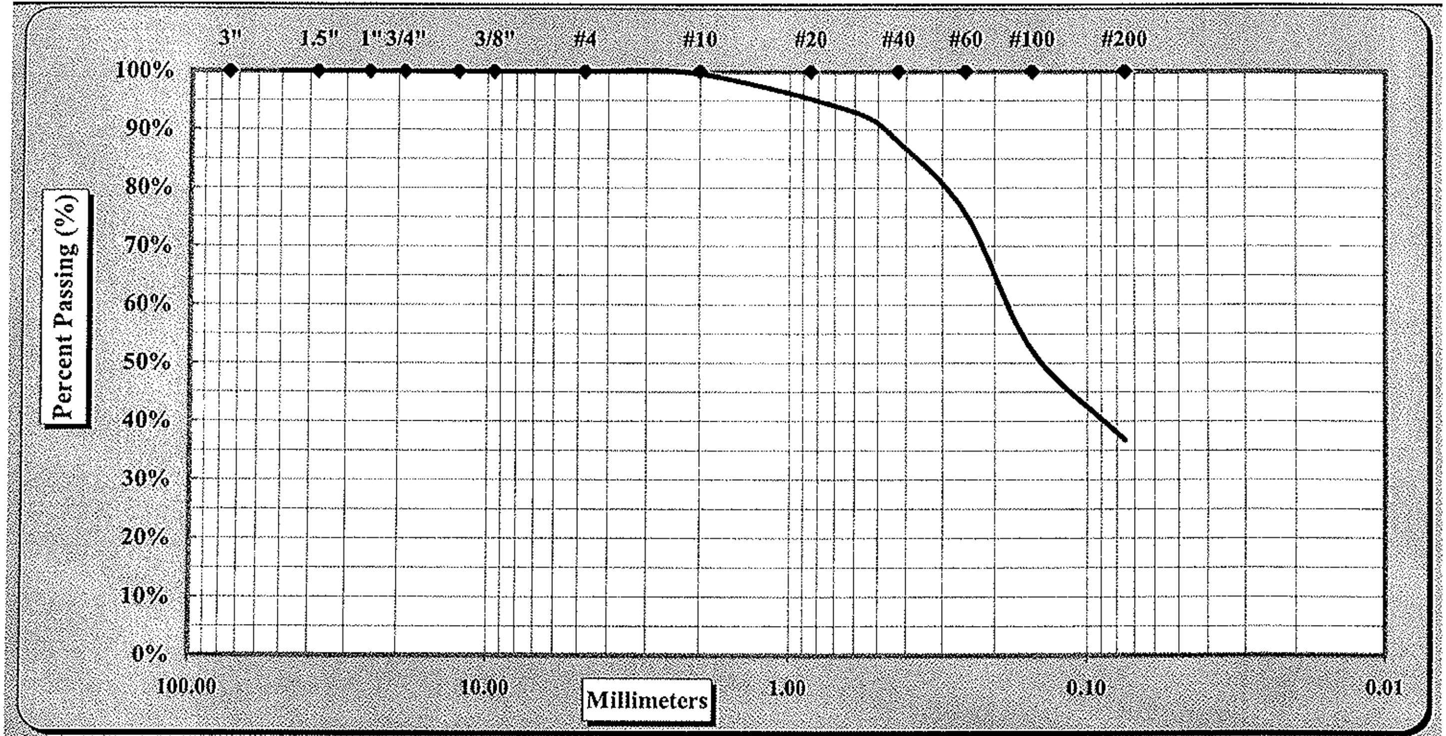
ASTM D 422

Quality Assurance

S&ME, Inc. - Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: **1633-09-049** Report Date: 3/10/09
Project Name: Epps No. 1 Industrial Site - Roadway Test Date(s): 3/6/09
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia, SC 29202
Sample Id. --- Sample #: S-2 Sample Date: 3/6/09
Location: HA-3 Lab #: 2166 Depth: 0.5 - 5.0'

Sample Description: Dark Brown Silty Sand (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	<2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	4.75 mm	Coarse Sand	0.5%	Fine Sand	51.2%
Gravel	0.0%	Medium Sand	11.6%	Silt & Clay	36.8%
Liquid Limit	40	Plastic Limit	26	Plastic Index	14
Specific Gravity	---	Cc =	Cu =	Moisture Content	42.1%
Coarse Sand	0.5%	Medium Sand	11.6%	Fine Sand	51.2%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☒
Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

C Douton
Technical Responsibility

Signature

Project Engineer
Position

3/10/2009
Date

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D4318-T89-90 *Client code* *Client Test #* *state #*
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

S&ME

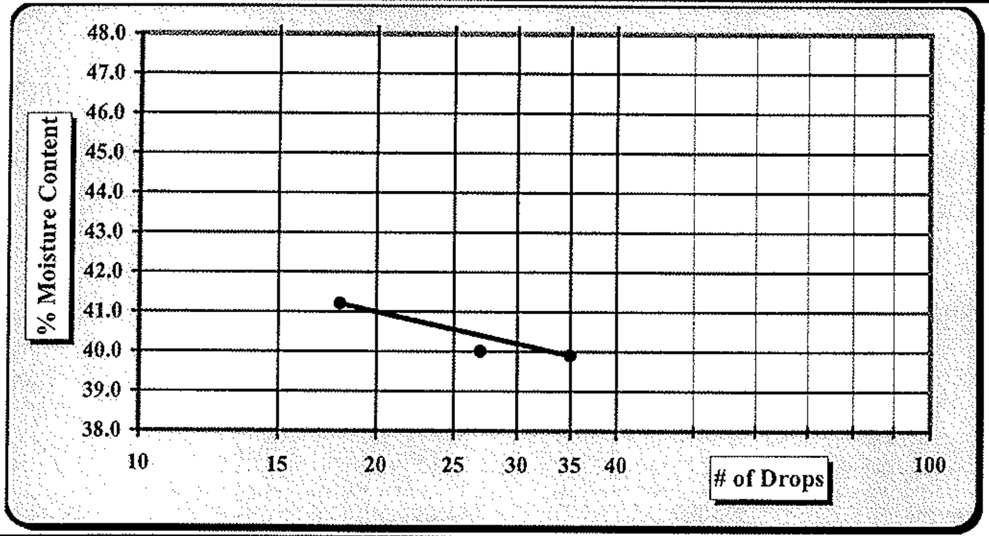
Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

S&ME, Inc. Myrtle Beach 1330 Highway 501 Business; Conway, SC 29526

Project #: **1633-09-049** Report Date: 3/10/09
Project Name: Epps No. 1 Industrial Site - Roadway Test Date(s) 3/6/09
Client Name: Alliance Consulting Engineers
Client Address: Post Office Box 8147; Columbia, SC 29202
Boring #: HA-3 Sample #: S-2 Sample Date: 3/6/09
Location: --- Lab #: 2166 Depth: 0.5 - 5.0'
Sample Description: Dark Brown Silty Sand (SM)

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	007-008	7/8/2008	Grooving tool	11304	7/11/2008
LL Apparatus	18801	7/11/2008	Grooving tool		
Oven	17745	7/17/2008	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	1	2	3	4	5	6	7	8	9
A	Tare Weight	14.21	10.90	14.81				14.80	14.71	
B	Wet Soil Weight + A	26.79	23.43	28.55				20.89	19.67	
C	Dry Soil Weight + A	23.20	19.85	24.54				19.64	18.66	
D	Water Weight (B-C)	3.59	3.58	4.01				1.25	1.01	
E	Dry Soil Weight (C-A)	8.99	8.95	9.73				4.84	3.95	
F	% Moisture (D/E)*100	39.9%	40.0%	41.2%				25.8%	25.6%	
N	# OF DROPS	35	27	18				*Moisture Contents determined by ASTM D 2216*		
LL	LL = F * FACTOR									
Ave.	*Average*							**25.7%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic	☐
Liquid Limit	**40**
Plastic Limit	**26**
Plastic Index	**14**
Group Symbol	**SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☑ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

C Douton
Technical Responsibility

Signature

Project Engineer
Position

3/10/2009
Date

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Site Certification for the
Williamsburg Cooperative Commerce Centre South
In Williamsburg County, South Carolina

Attachment 24

Geotechnical Study

Report of Preliminary Geotechnical Exploration including Site Class Determination and Liquefaction Assessment

MACTEC

REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

EPPS-1 INDUSTRIAL SITE

WILLIAMSBURG COUNTY, SOUTH CAROLINA

Prepared for:

B.P. Barber & Associates, Inc.

Columbia, South Carolina

Submitted by:

MACTEC Engineering and Consulting, Inc.

Columbia, South Carolina

MACTEC Project No. 6671-03-0184.02.04

January 19, 2004

MACTEC

January 19, 2004

Ms. Candy Mitchell
B.P. Barber & Associates, Inc.
Post Office Box 1116
Columbia, South Carolina 29202

Subject: **Report of Preliminary Geotechnical Exploration**
EPPS-1 Industrial Site
Williamsburg County, South Carolina
MACTEC Project Number 6671-03-0184.02.04

Dear Ms. Mitchell:

As authorized by your acceptance of our proposal No. PROP03COLM.464 Revision 1, dated October 23, 2003, MACTEC Engineering and Consulting, Inc. (MACTEC) has completed a preliminary geotechnical exploration at the above referenced site. The purpose of this preliminary exploration was to develop information about the site and subsurface conditions that could be used in determining the feasibility of constructing various light manufacturing and industrial facilities at the site. This report describes the work performed and presents the results obtained, along with our preliminary geotechnical evaluation and recommendations.

1.0 PROJECT DESCRIPTION

MACTEC received project information from Candy Mitchell with B.P. Barber & Associates, Inc. during the week of September 10, 2003. We understand that the site is intended for manufacturing and/or industrial development. Such developments typically involve single story steel framed buildings with column support and metal or masonry walls. Shallow spread footings, where feasible, are the most economical foundation type for such buildings. This exploration was performed to assess the site for foundation support capabilities. Site grading plans and structural loading are not available at this time.

MACTEC Engineering and Consulting
720 Gracern Road, Suite 132 • Columbia, SC 29210
803-798-1200 • Fax: 803-750-1303

2.0 SITE DESCRIPTION

On December 12, 2003, a member of our geotechnical staff visited the site. The approximate 100-acre project site is located along the west side of U.S. Highway 52 approximately one mile south of its intersection with State Road 45-382 in Williamsburg County, South Carolina (Figure 1). The site is bordered to the north and south by agricultural fields, to the west by undeveloped woodlands, and to the east by U.S. Highway 52. The proposed site presently consists of undeveloped woodlands and agricultural fields. Potential wetland areas were observed in the wooded western portion of the site. A former borrow pit (currently full of water) was also observed near the wood-line in the western portion of the site. Ditches containing some standing water were observed along the eastern and southern property boundaries. A small stream containing standing water was observed along the northern property boundary.

The site is relatively flat with an estimated topographic relief of less than 5 feet across the site. The surficial soils, where visible, consist of loose silty sands with varying organic content. As outlined above, portions of the western site-area consists of wetlands and contains the associated hydric soils. Some surface water was observed in the wetland areas in the western portion of the site and in the ditches and stream during our site visit.

3.0 FIELD EXPLORATION

3.1 Soil Test Borings

Six soil test borings were made at the site at the locations shown on the attached Boring Location Plan (Figure 2). The field test procedures are described in the Appendix. The boring depths and locations were selected and located in the field by a MACTEC representative. The boring locations were selected in the cleared, readily accessible portions of the site (agricultural fields). No mechanized and/or hand clearing was done to advance borings in the wooded areas of the site. A topographic survey of the site has not been provided at this time. For the purposes of this report, we have assumed a ground surface elevation of 0 feet for each of the soil test borings. The surface elevations at the soil test boring locations should be determined when a site-specific topographic survey has been completed.

4.0 AREA GEOLOGY

South Carolina falls into two geologic regions, separated along a line through Augusta, Columbia, Camden, and Chesterfield. The Atlantic Coastal Plain forming the eastern portion of the state is comprised of interbedded silts, sands and clays deposited by marine or fluvial action during recent geologic time. The western portion of the state forms the Carolina Piedmont, underlain by ancient predominantly crystalline rock.

The site lies within the Lower Atlantic Coastal Plain. Specifically, the subsurface soils are those of the Waccamaw and Black Mingo Formations. This area is formed of older, generally well consolidated layers of interbedded sands, silts, or clays, which were deposited by marine or fluvial action during a period of fluctuating sea level. Predominantly, sediments lie in nearly horizontal layers; however, erosional episodes occurring between deposition of successive layers are often expressed by undulations in the contacts between the formations. Due to their age, sediments exposed at the ground surface are often heavily eroded. Ridges or hills may be capped by either terrace gravels or wind-deposited sands. Younger alluvial soils may mask Coastal Plain sediments in swales or stream valleys.

5.0 SUBSURFACE CONDITIONS

5.1 Soil Test Borings

Topsoil was encountered in all borings to a depth of about 1 foot. Below the topsoil, the borings encountered disturbed very loose to loose plow zone soils to depths ranging from 2 to 3.5 feet below ground surface (bgs). The plow zone soils consisted of silty and clayey sands with Standard Penetration Test (SPT) values ranging from 2 to 7 blows per foot (bpf). Beneath the topsoil and plow zone soils, the soil profile consists of the Williamsburg Formation underlain by the older, more consolidated Black Mingo Formation (encountered only in deep boring B-1). The subsurface conditions within these units are described in the following paragraphs.

Waccamaw Formation: This unit was encountered below the plow zone soils in the borings and extended to a depth of 68.5 feet in boring B-1, and to the boring termination depths in borings B-2 through B-6. This unit consists predominantly of very loose to very dense silty and clayey sands. Very loose soils are present at the upper bound of this layer, with consistency increasing with depth. Lenses of very stiff to hard lean clays and silts were encountered in some of the borings. In addition, very hard cemented layers were encountered in boring B-1 from 63.5 to 65 feet, and 66.5 to 67.5 feet. The SPT values for the sands ranged from 4 to greater than 100 bpf. Typical SPT values for the deeper silts and clays ranged from 17 to 36 bpf. SPT values immediately beneath the plow zone soils ranged from 4 to 9, and were typically 4 or 5.

Black Mingo Formation: The soils of the Black Mingo Formation were encountered in boring B-1 at a depth of 68.5 and extended to the boring termination depth. The soils of this unit consisted of very dense clayey sands. Very hard cemented layers which were moderately resistant to our drilling equipment were encountered in this unit from 82 to 83 feet, and from 92.5 to 95 feet. The SPT values for the clayey sands ranged from 35 to greater than 100 bpf.

5.2 Ground-Water Conditions

Due to the rotary wash drilling procedure used to advance the borings, groundwater level measurements were not obtained at the time of drilling. In borings B-1 through B-6, the stabilized groundwater levels ranged from a depth of 2.8 to 5.3 feet below existing ground surface. As outlined in the USDA Soil Survey for this area, seasonal high groundwater levels (apparent) are reported to range from 0 to 6 feet below the ground surface during the months between November and April. Groundwater levels may fluctuate several feet with seasonal and rainfall variations and with changes in the water level in adjacent drainage features. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

The above descriptions provide a general summary of the subsurface conditions encountered. Subsurface profiles of the site are attached as Figure 3. The attached Soil Test Boring Records contain detailed information recorded at the boring locations. The Soil Test Boring Records represent our interpretation of the field log based on engineering examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual.

6.0 PRELIMINARY RECOMMENDATIONS FOR SITE PREPARATION AND FOUNDATION DESIGN

Economical development of light industrial structures is frequently based on a system of shallow foundations, with a concrete slab-on-grade floor system. The several feet of loose surface soils and a relatively shallow groundwater table on this site will require one or more sequenced construction activities during site development.

The loose plow-zone sands and the underlying loose clayey sands may be either removed and replaced with compacted structural fill, or may receive additional compacted structural fill to raise site grades. Site improvements using rammed aggregate piers may also be a feasible system for this site. Rammed aggregate piers are typically installed beneath shallow footing locations and serve to strengthen bearing soils to provide settlement and bearing capacity improvement. Rammed aggregate piers are constructed by drilling a hole to create a cavity, removing a volume of compressible subsoil materials, then building a bottom bulb of clean, open-graded stone. These measures should receive careful attention in design explorations for specific structures. The preferred site development activities will be a function of the finished floor elevation, footing bearing level, and intended use of new structures.

Our ground-water level measurements, site observations and USDA Soil Survey data indicate that groundwater levels are within potential construction depths. Temporary and permanent control of groundwater will also require evaluation during design. Based on the limited data obtained, the following preliminary conclusions and recommendations are provided.

6.1 Earthwork

Based on the types of structures, structural loading, or the thickness of cut or fill, the loose plow zone sands and underlying loose clayey sands should be removed and replaced with properly compacted structural fill, or bridged with several feet of new compacted fill to raise site grades.

The sandy natural soils encountered by the borings generally appear suitable for use as compacted fill, although adjustments in moisture content may be required to properly compact the fill. The subgrades should be proof-rolled both in proposed fill areas (prior to fill placement) and proposed cut areas (after rough grades are established) to identify soft or yielding areas that may need special treatment. Additional detailed recommendations regarding site preparation should be developed in later geotechnical exploration work. If feasible, site grading activities should be scheduled for the drier, hotter months of the year to reduce the potential for construction problems associated with wet soils, groundwater, and wet weather.

6.2 Foundations

Subject to the results of a final subsurface exploration at specific building or construction sites, the preliminary data indicates that the natural soils encountered at the site are capable of supporting structural loads of around 150 kips or less on shallow spread footing foundations. The available soil bearing pressures would be in the range of 1500 to 2500 psf, depending on column loading, acceptable settlement magnitude, foundation depths, and finished grades. Based on our experience with similar soils, loading as described should produce settlements within tolerable limits for most conventional light to moderately loaded manufacturing and/or industrial buildings. The loose plow zone soils and underlying loose clayey sands within the upper 3 to 4 feet of existing grade may have to be removed and replaced with compacted structural fill. Careful selection of finished floor elevations may allow "bridging" these loose soils with several feet of new earth fill. Foundations placed on new structural fill, compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor test (ASTM D-698), are generally suitable for support of footings designed for bearing pressures up to 2,500 psf. If feasible, the use of rammed aggregate piers beneath footings would result in allowable bearing pressures in the range of 3,000 psf or greater.

Groundwater was encountered near the ground surface and within the potential construction depths in the borings. The water level in the abandoned borrow pit is at or near the observed water level in our soil test borings. USDA Soil Survey data also indicates shallow groundwater depths at the site. Thus, groundwater control will be required during construction operations. The removal and replacement option discussed above for loose soil will likely require area dewatering. Permanent dewatering and/or groundwater control likely will be required for pits or basements on this site.

6.3 Pavements and Floor Slabs

Soils of the type encountered by the borings can provide adequate support for properly designed floor slabs and pavement systems. Once properly compacted, the natural soils encountered should provide a California Bearing Ratio (CBR) in the range of 5 to 10, for preliminary pavement design purposes. The loose surficial soil conditions observed will likely require improvement or replacement of soils within the upper two to three feet below finished grades to satisfactorily support industrial traffic loads. The final designs should be based on the results of tests run on the soils, which will provide subgrades for the pavement. If scheduling will allow, we recommend that California Bearing Ratio (CBR) tests be conducted during or following the grading operations on the actual subgrade materials.

The information obtained in our preliminary geotechnical exploration indicates that floor slabs may be ground supported. Concrete slabs on grade for the proposed structures can likely be designed using a modulus of subgrade reaction (k) in the range of 100 to 200 pounds per square inch per inch. The presence of shallow groundwater may require detailing of floor slab cross sections for moist conditions, depending on selection of finished elevations.

6.4 Seismic Analysis

Based on the SPT N-Values obtained from boring B-1, the soil profile type falls into Site Class D in accordance with the 2000 International Building Code (IBC). The saturated poorly graded sands encountered in the borings performed for this preliminary exploration are not considered to be susceptible to earthquake-induced liquefaction due to their relatively high SPT N-Values. However, the possibility exists that isolated zones of liquefiable sands exist in other unexplored portions of the site. The presence or absence of liquefiable soils beneath structures should be determined and their impacts assessed during the design geotechnical exploration.

6.5 Additional Subsurface Exploration

This exploration is preliminary in nature and should be used for general site planning and feasibility evaluation only. Further exploration and evaluation will be required prior to design of the foundations. The scope of additional work will depend on the building locations, the grade elevations, and the loading conditions. It may include additional borings to locate areas of unsuitable material and to obtain additional soil consistency data, evaluation of the available fill material and possible laboratory tests on undisturbed or recompacted samples to determine engineering characteristics of soil strata. Additional data regarding the ground water table will be necessary.

Once the project plans are more definite, we will be pleased to discuss more specifically requirements of the design phase(s) of the geotechnical exploration.

7.0 QUALIFICATION OF REPORT

Our evaluation of foundation support conditions for this preliminary geotechnical exploration has been based on our understanding of the project and site information and the data obtained in our exploration. The general subsurface conditions utilized in our evaluation of foundations are based on interpolation of subsurface data between the widely spaced borings. In evaluating the boring data obtained in this preliminary geotechnical exploration, we have examined previous correlations between penetration resistances and foundation bearing pressures observed in soil conditions similar to those at your site. As previously noted, this exploration is for assistance in preliminary planning. Our opinion is that six soil test borings for a site of this size are not sufficient to adequately define subsurface conditions for final design purposes. The assessment of site environmental conditions or the presence of pollutants in the soil, rock and ground water of the site was excluded by the scope of this exploration.

8.0 CLOSING

Thank you for the opportunity to provide our professional geotechnical services during this phase of your project. Please contact us when we can be of further service or if you have any questions concerning this report.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Matthew F. Cooke, P.G.
Project Geologist

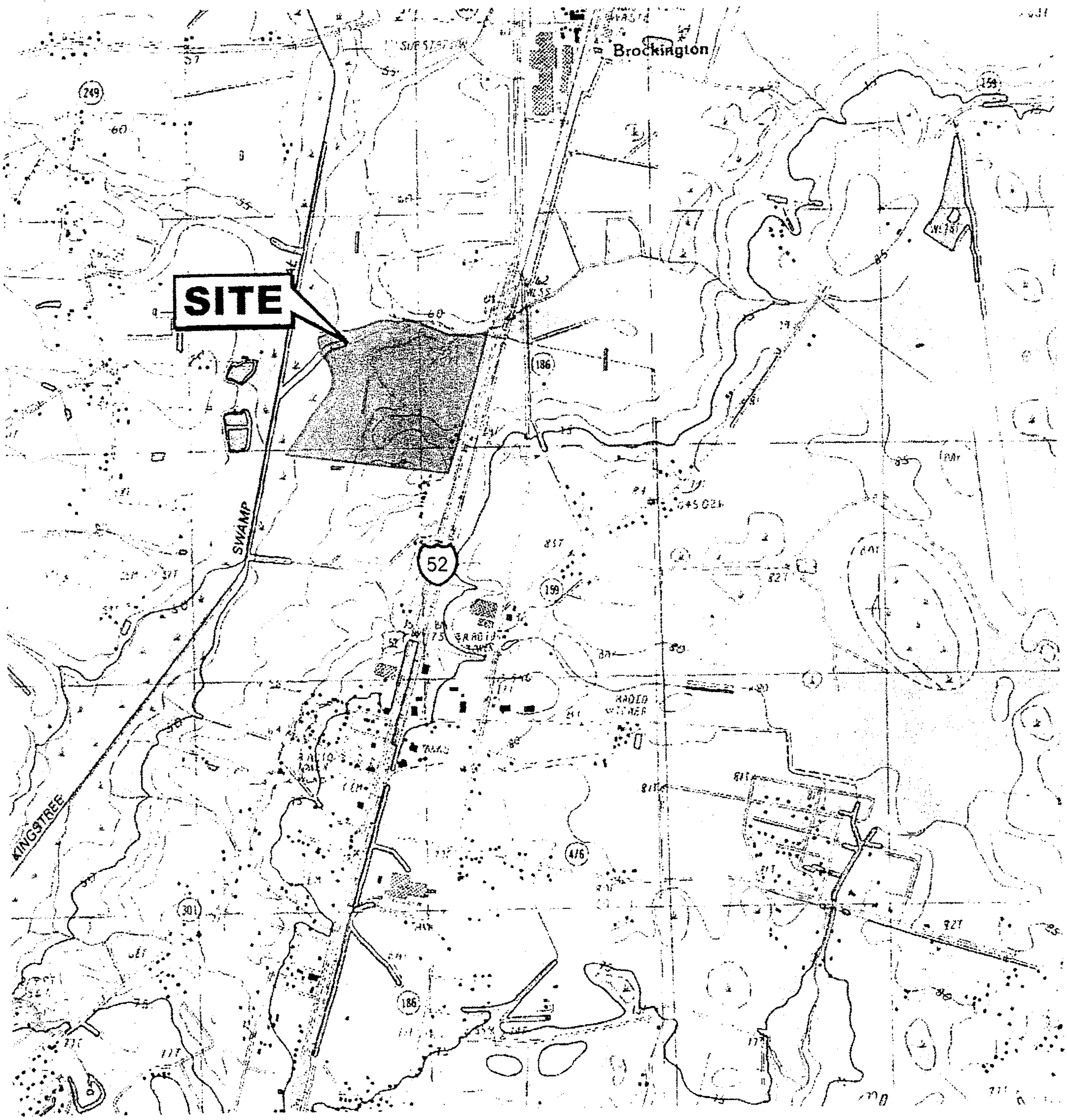
Robert N. McLeod, P.E.
Principal Engineer
Registered S.C. 10333

MFC/RNM: mfc

FIGURES
Figure 1 - Site Location Map
Figure 2 - Boring Location Plan
Figure 3 – Subsurface Profiles

APPENDIX
Field Exploratory Procedures
Soil Test Boring Record Key Sheet
Soil Test Boring Records

FIGURES



Source: B.P. Barber and Associates

NORTH
⇑

Approximate Scale
0 (feet) 2000

B.P. Barber & Associates, Inc.

Columbia, South Carolina

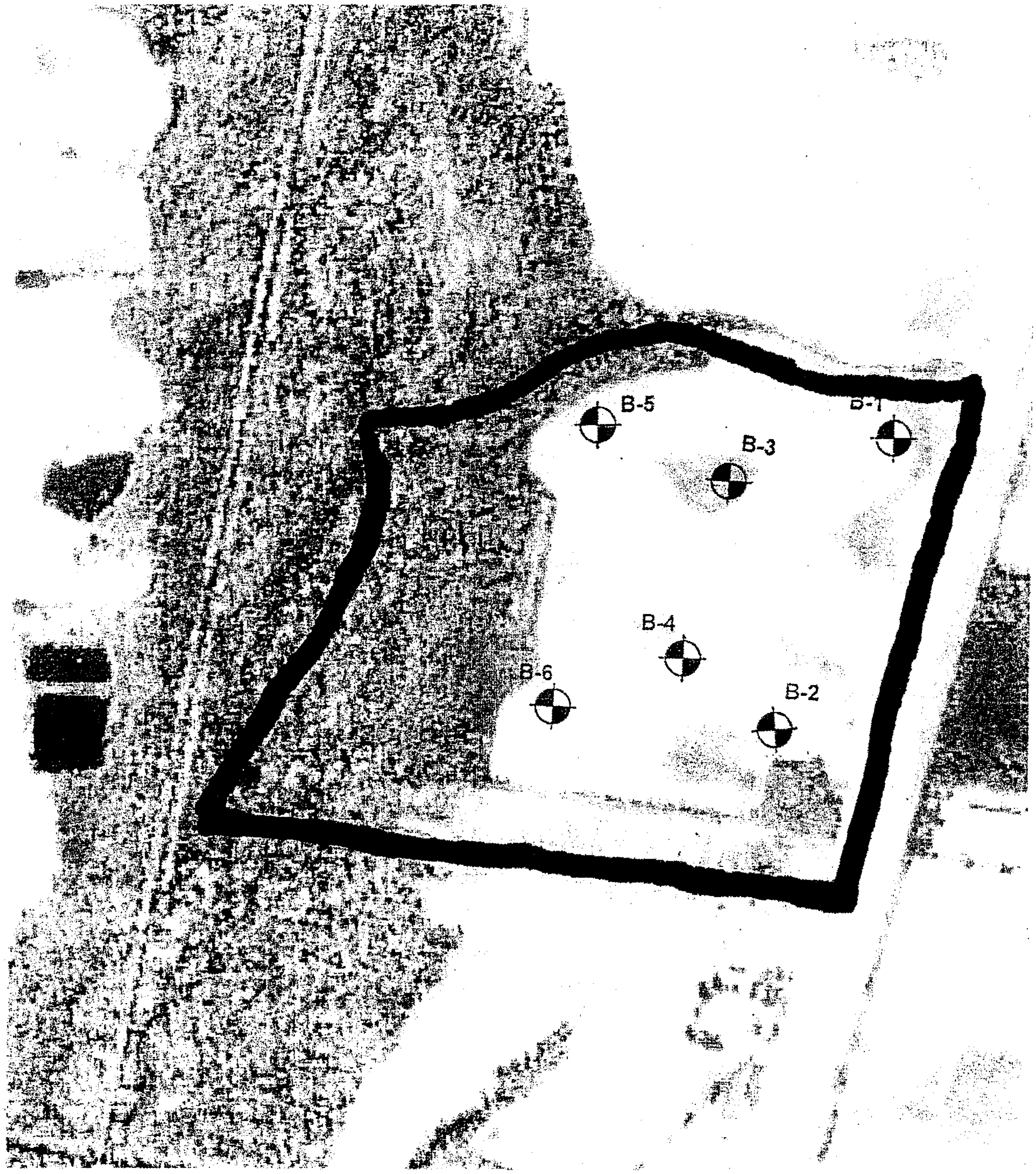
MACTEC
Columbia, South Carolina

SITE LOCATION PLAN
EPPS-1 Industrial Site
Williamsburg County, South Carolina

Prepared by: Date:

Checked by: Date:

Job No. 6671-03-0184.02 Figure 1



Approximate Scale: 1” = 650’

Source: 1994 Aerial Photograph

⇑
North

⊕ Denotes boring location

B.P. Barber & Associates, Inc.

Columbia, South Carolina

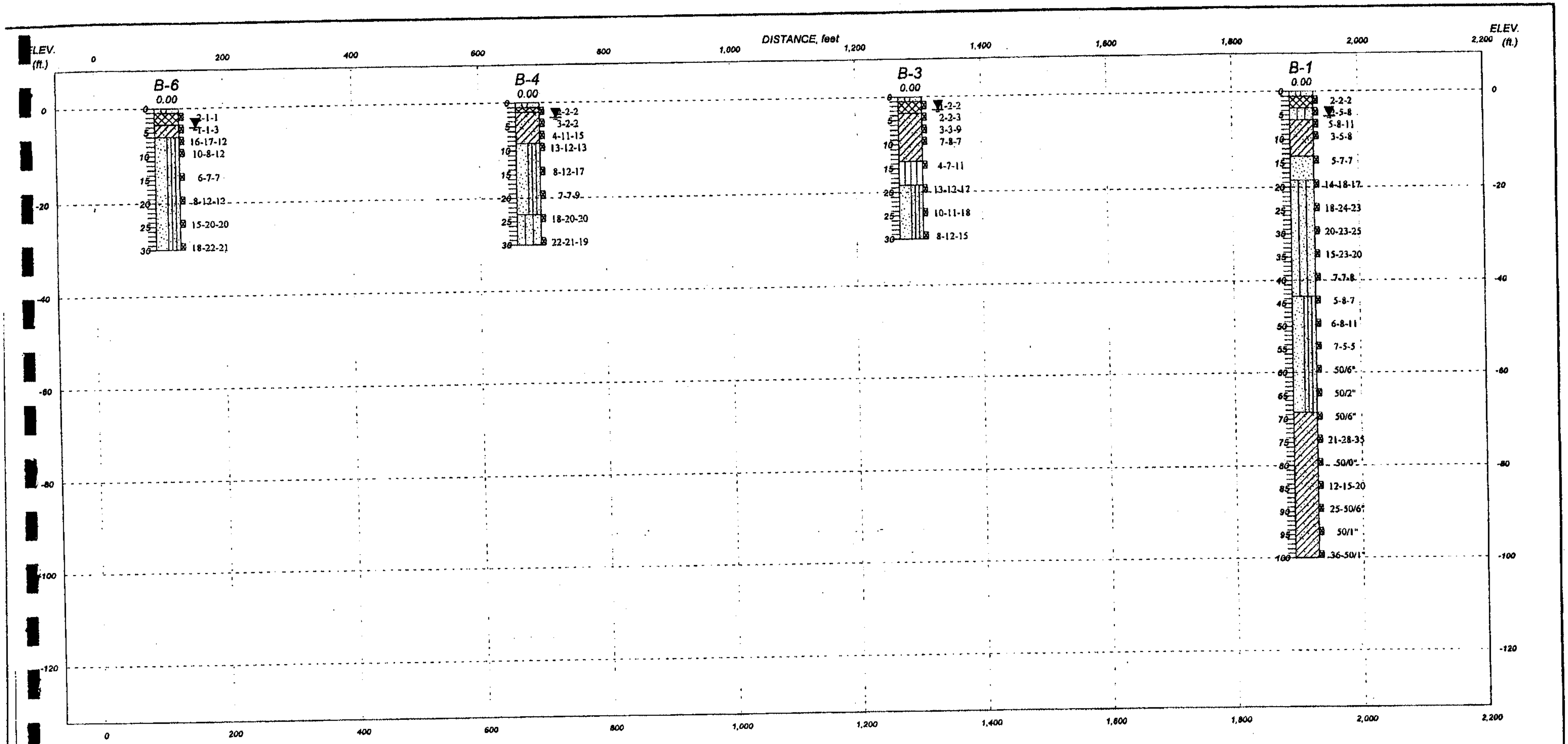
MACTEC
Columbia, South Carolina

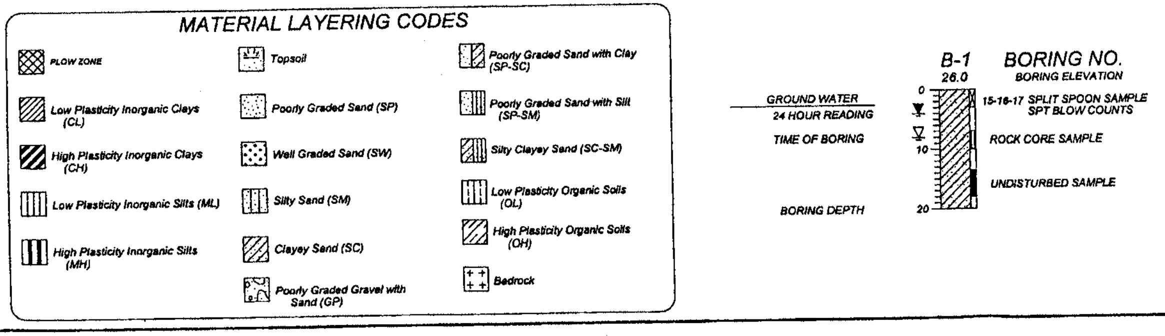
BORING LOCATION PLAN
EPPS-1 Industrial Site
Williamsburg County, South Carolina

Prepared by: Date:

Checked by: Date:

Job No. 6671-03-0184.02 Figure 2





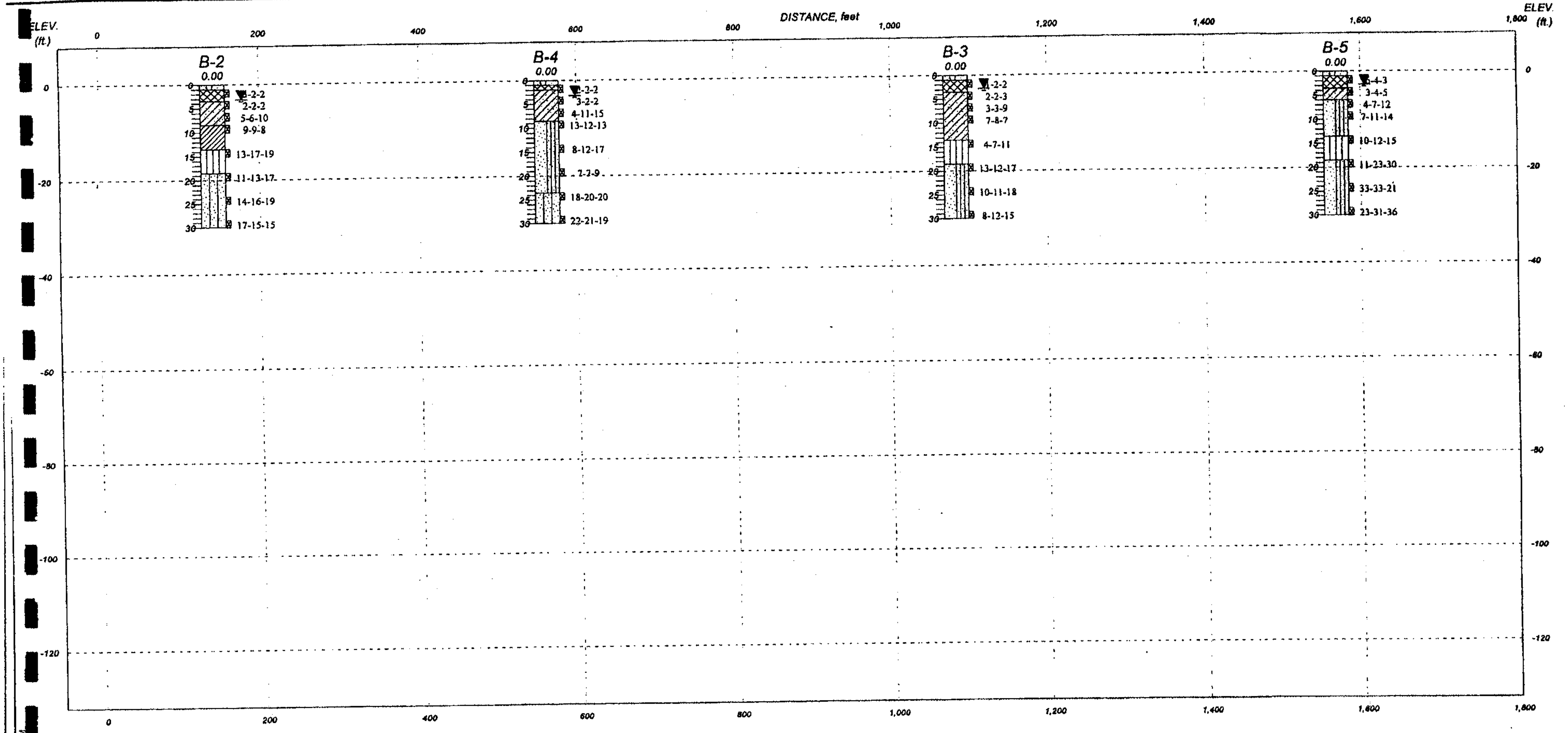
THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE 1

FIGURE 3, Sheet 1 of 2

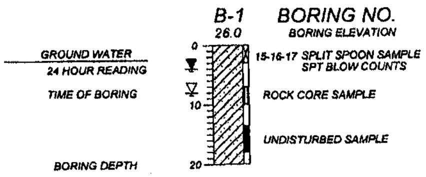
PROJECT EPPS-1 Site
PROJECT NO. 6671-03-0184.02.04

MACTEC



MATERIAL LAYERING CODES

- ▩ PLOW ZONE
- ▨ Low Plasticity Inorganic Clays (CL)
- ▨ High Plasticity Inorganic Clays (CH)
- ▥ Low Plasticity Inorganic Silts (ML)
- ▥ High Plasticity Inorganic Silts (MH)
- Topsoil
- Poorly Graded Sand (SP)
- Well Graded Sand (SW)
- ▥ Silty Sand (SM)
- ▨ Clayey Sand (SC)
- Poorly Graded Gravel with Sand (GP)
- ▨ Poorly Graded Sand with Clay (SP-SC)
- ▥ Poorly Graded Sand with Silt (SP-SM)
- ▥ Silty Clayey Sand (SC-SM)
- ▥ Low Plasticity Organic Soils (OL)
- ▨ High Plasticity Organic Soils (OH)
- ⊞ Bedrock



THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE 2

FIGURE 3, Sheet 2 of 2

PROJECT	EPPS-1 Site
PROJECT NO.	6671-03-0184.02.04

MACTEC

APPENDIX

FIELD EXPLORATORY PROCEDURES
KEY TO SYMBOLS AND DESCRIPTIONS
SOIL TEST BORING RECORDS

FIELD EXPLORATORY PROCEDURES

Soil Test Borings

The borings were made by a rotary wash drilling procedure in which drilling mud was maintained in the borehole to stabilize the borehole walls and to flush the soil cuttings to the surface. Soil sampling and penetration testing were performed in general accordance with ASTM D 1586. At assigned intervals, soil samples were obtained with standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "penetration resistance." The penetration resistance, when properly evaluated, is an index to the strength of the soil and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer or engineering geologist to verify the field classifications of the driller. Soil Test Boring Records are attached, showing a detailed description of subsurface conditions encountered in each boring.

Backfill

The borings were backfilled with soil cuttings and earth fill to ground surface after 24 hours. There is the possibility of future borehole subsidence depending on actual subsurface conditions, surface drainage, etc. The property owner should monitor the boring locations over time to discover subsidence and make the necessary repairs.

MAJOR DIVISIONS			GROUP SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	●	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			●	GP	Poorly graded gravels or grave - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	○	GM	Silty gravels, gravel - sand - silt mixtures.
			▨	GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 Sieve Size)	CLEAN SANDS (Little or no fines)	░	SW	Well graded sands, gravelly sands, little or no fines.
			░	SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	▥	SM	Silty sands, sand - silt mixtures
			▨	SC	Clayey sands, sand - clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		▥	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts and with slight plasticity.
			▨	CL	Inorganic lays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			▥	OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		▥	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			▨	CH	Inorganic clays of high plasticity, fat clays
			▨	OH	Organic clays of medium to high plasticity, organic silts.
FILL			▦		Various soil types modified by human activity

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

■	Undisturbed Sample	▮	Auger Cuttings
☒	Split Spoon Sample	≀	Bulk Sample
▯	Rock Core	▦	Crandall Sampler
▦	Dilatometer	^	Pressure Meter
□	Packer	○	No Recovery
▽	Water Table at time of drilling	▼	Water Table after 24 hours

Correlation of Penetration Resistance with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 1	Very Soft
5 - 10	Loose	2 - 4	Soft
11 - 20	Firm	5 - 8	Firm
21 - 30	Very Firm	9 - 15	Stiff
31 - 50	Dense	16 - 30	Very Stiff
Over 50	Very Dense	Over 31	Hard

KEY TO SYMBOLS AND DESCRIPTIONS

MACTEC

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	ELEV (ft)
0	0.0
5	-5.0
10	-10.0
15	-15.0
20	-20.0
25	-25.0
30	-30.0
35	-35.0
40	-40.0
45	-45.0

1' LOAMY TOPSOIL

SILTY SAND (SM) - brown, fine to medium, very loose, dry to moist, PLOW ZONE.

SILTY SAND (SM) - brown, fine to medium, loose, moist, WACCAMAW FORMATION

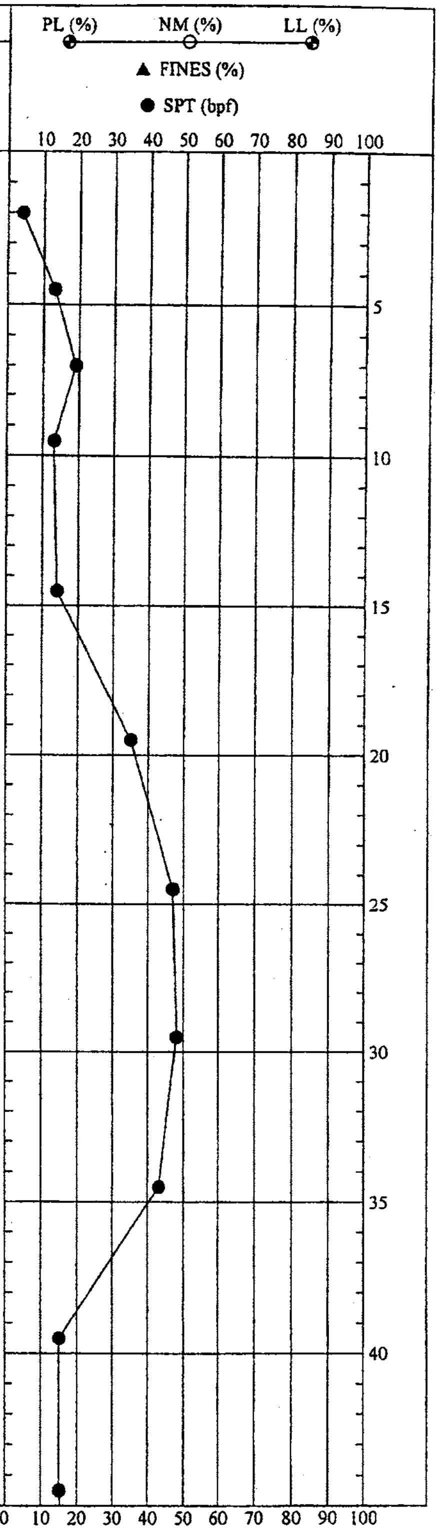
CLAYEY SAND (SC) - gray, fine to medium, firm, wet.

POORLY GRADED SAND (SP) - tan, fine to medium, firm, wet.

SILTY SAND (SM) - gray, fine, firm to dense, moist to wet.

SAMPLES

IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SS-1	☒	2-2-2
SS-2	☒	2-5-8
SS-3	☒	5-8-11
SS-4	☒	3-5-8
SS-5	☒	5-7-7
SS-6	☒	14-18-17
SS-7	☒	18-24-23
SS-8	☒	20-23-25
SS-9	☒	15-23-20
SS-10	☒	7-7-8
SS-11	☒	5-8-7



SOIL 0184-02.GPJ LAW GIBB.GDT 1/13/044:39:44 PM

DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

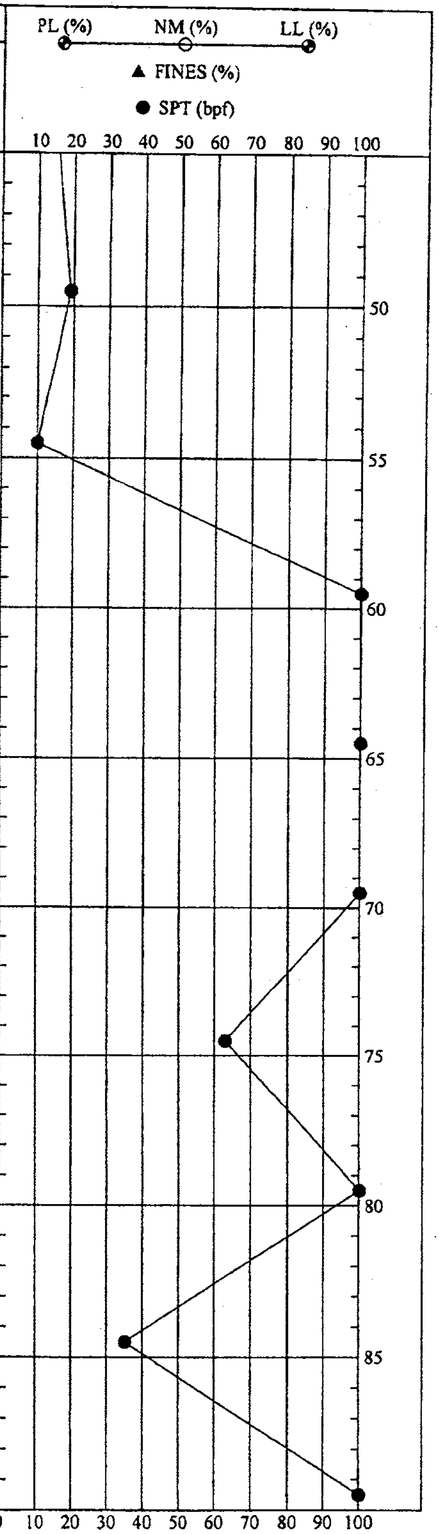
SOIL TEST BORING RECORD

BORING NO: B-1
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: January 6, 2004
PROJECT No: 6671-03-0184.02.04 **PAGE 1 OF 3**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)
45	POORLY GRADED SAND WITH SILT (SP-SM) - gray, fine to medium, firm to very dense, moist. HARD CEMENTED LAYER @ 63.5' to 65' and 66.5' to 67.5'	-45.0
68.5	CLAYEY SAND (SC) - dark-gray, fine, very dense, moist, strongly reactive to HCl, BLACK MINGO FORMATION. HARD CEMENTED LAYERS @ 82' to 83' and 92.5' to 95'	
90		-90.0

SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SS-12	☒	6-8-11
SS-13	☒	7-5-5
SS-14	☒	50/6"
SS-15	☒	50/2"
SS-16	☒	50/6"
SS-17	☒	21-28-35
SS-18	☒	50/0"
SS-19	☒	12-15-20
SS-20	☒	25-50/6"



DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

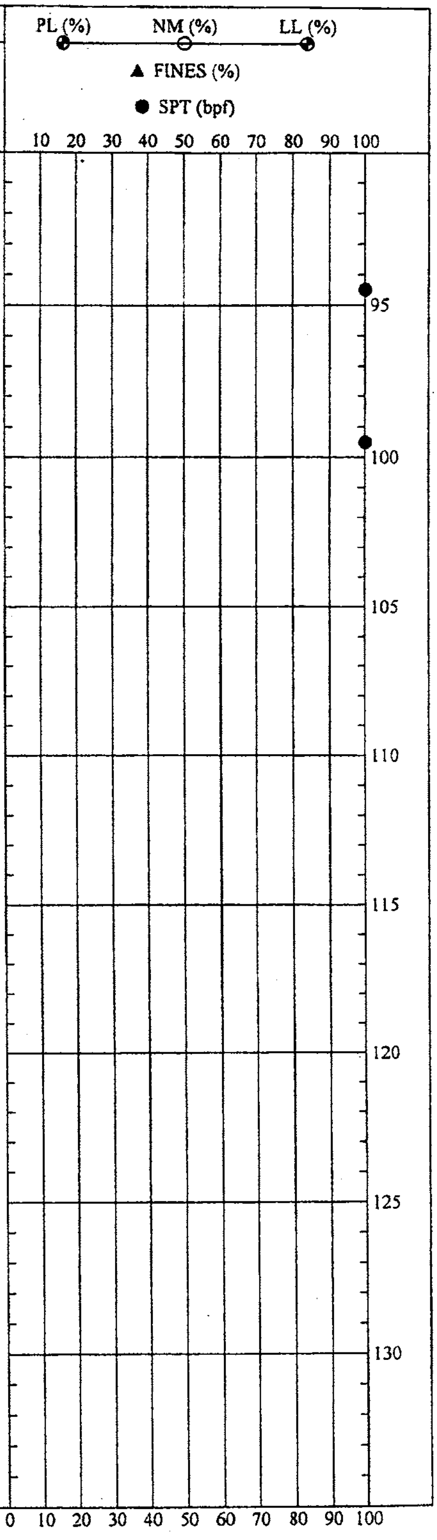
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-1
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: January 6, 2004
PROJECT No: 6671-03-0184.02.04

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
90	CLAYEY SAND (SC) - dark-gray, fine, very dense, moist, strongly reactive to HCl, BLACK MINGO FORMATION. HARD CEMENTED LAYERS @ 82' to 83' and 92.5' to 95'	▨	-90.0			
95		▨	-95.0	SS-21	☒	50/1"
100	Boring Terminated at 100 Feet. Ground water level measured at 5.3 feet after 24 hours.		-100.0	SS-22	☒	36-50/1"
105			-105.0			
110			-110.0			
115			-115.0			
120			-120.0			
125			-125.0			
130			-130.0			
135			-135.0			



DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-1
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: January 6, 2004
PROJECT No: 6671-03-0184.02.04

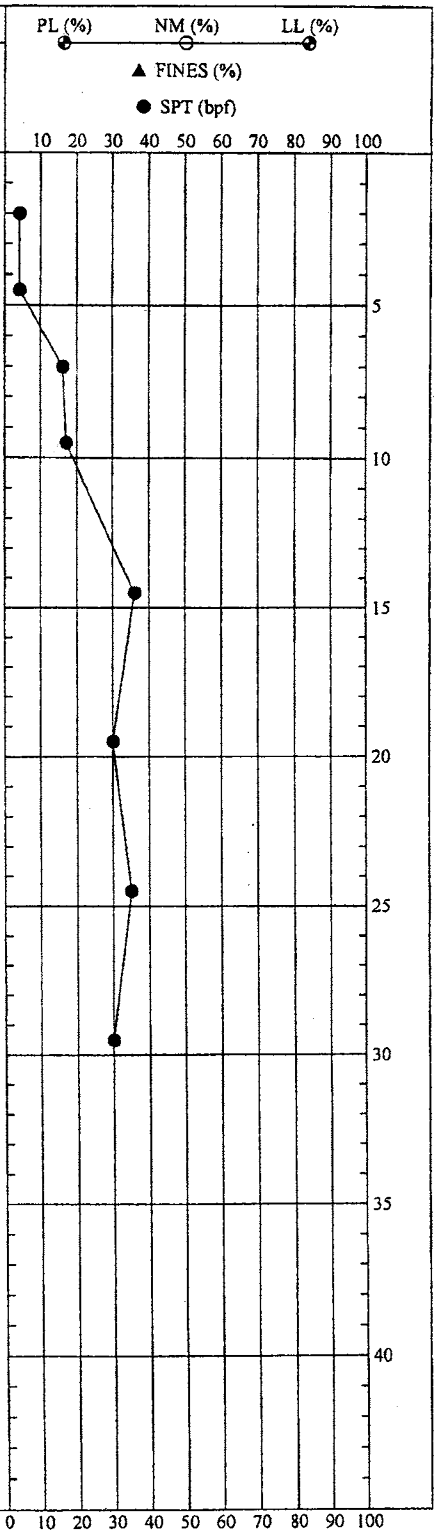
MACTEC

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

SOIL CLASSIFICATION AND REMARKS	SAMPLES IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
1' LOAMY TOPSOIL		
SILTY SAND (SM) - dark-brown, fine, very loose, moist, PLOW ZONE.	SS-1	3-2-2
CLAYEY SAND (SC) - dark-gray, fine, very loose to firm, moist, WACCAMAW FORMATION.	SS-2 SS-3	2-2-2 5-6-10
SANDY LEAN CLAY (CL) - light gray, very stiff, fine sand, moist.	SS-4	9-9-8
SANDY SILT (ML) - dark green, hard, fine sand, moist.	SS-5	13-17-19
SILTY SAND (SM) - dark green, very firm to dense, fine sand, moist.	SS-6 SS-7 SS-8	11-13-17 14-16-19 17-15-15
Boring Terminated at 30 Feet. Ground water level measured at 3.2 feet after 24 hours.		

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

ELEV (ft): 0.0, -5.0, -10.0, -15.0, -20.0, -25.0, -30.0, -35.0, -40.0, -45.0



SOIL 0184-02.GPJ LAW GIBB.GDT 1/15/04 4:39:47 PM

DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-2
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: December 30, 2003
PROJECT No: 6671-03-0184.02.04 **PAGE 1 OF 1**

MACTEC

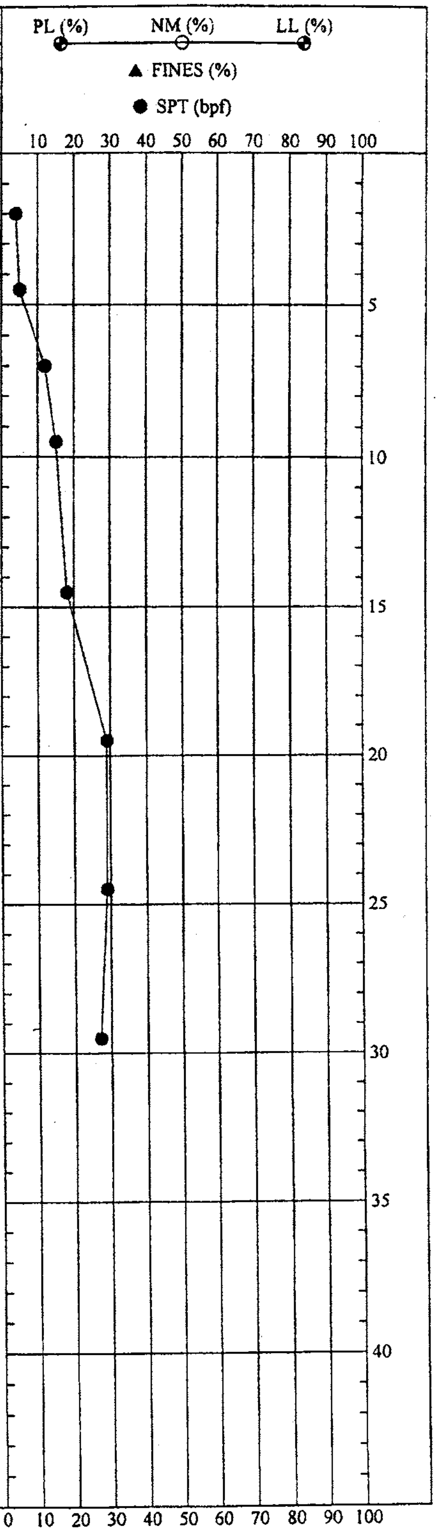
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	1' LOAMY TOPSOIL	0.0
	CLAYEY SAND (SC) - brown, fine, very loose to firm, moist, PLOW ZONE. ▼	
	CLAYEY SAND (SC) - brown, fine, very loose to firm, moist, WACCAMAW FORMATION.	
5		-5.0
10		-10.0
	SANDY SILT (ML) - dark green, very stiff, fine sand, moist, laminated structure.	
15		-15.0
	POORLY GRADED SAND WITH SILT (SP-SM) - dark green, very firm, fine sand, moist.	
20		-20.0
25		-25.0
30	Boring Terminated at 30 Feet. Ground water level measured at 2.8 feet after 24 hours.	-30.0
35		-35.0
40		-40.0
45		-45.0

SAMPLES

IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
SS-1	☒	1-2-2
SS-2	☒	2-2-3
SS-3	☒	3-3-9
SS-4	☒	7-8-7
SS-5	☒	4-7-11
SS-6	☒	13-12-17
SS-7	☒	10-11-18
SS-8	☒	8-12-15



SOIL 0184-02.GPJ LAW_GIBB.GDT 1/13/04 4:39:48 PM

DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-3
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: December 30, 2003
PROJECT No: 6671-03-0184.02.04 **PAGE 1 OF 1**

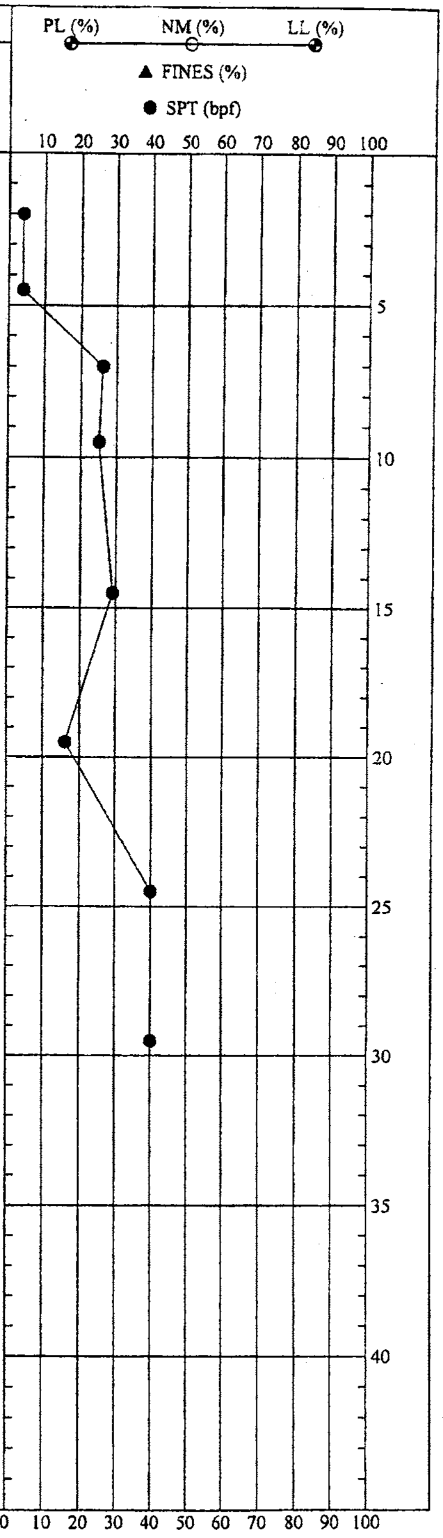
MACTEC

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	1' LOAMY TOPSOIL	0.0
	CLAYEY SAND (SC) - brown, very loose to very firm, fine to medium, moist, PLOW ZONE.	
	CLAYEY SAND (SC) - brown, very loose to very firm, fine to medium, moist, WACCAMAW FORMATION.	
5		-5.0
	POORLY GRADED SAND WITH SILT (SP-SM) - light gray-tan, firm to very firm, fine, moist to wet.	
10		-10.0
15		-15.0
20		-20.0
	SILTY SAND (SM) - dark green, dense, fine sand, moist.	
25		-25.0
30	Boring Terminated at 30 Feet. Ground water level measured at 3.2 feet after 24 hours.	-30.0
35		-35.0
40		-40.0
45		-45.0

SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SS-1	☒	2-2-2
SS-2	☒	3-2-2
SS-3	☒	4-11-15
SS-4	☒	13-12-13
SS-5	☒	8-12-17
SS-6	☒	7-7-9
SS-7	☒	18-20-20
SS-8	☒	22-21-19



DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-4
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: December 30, 2003
PROJECT No: 6671-03-0184.02.04

PAGE 1 OF 1

MACTEC

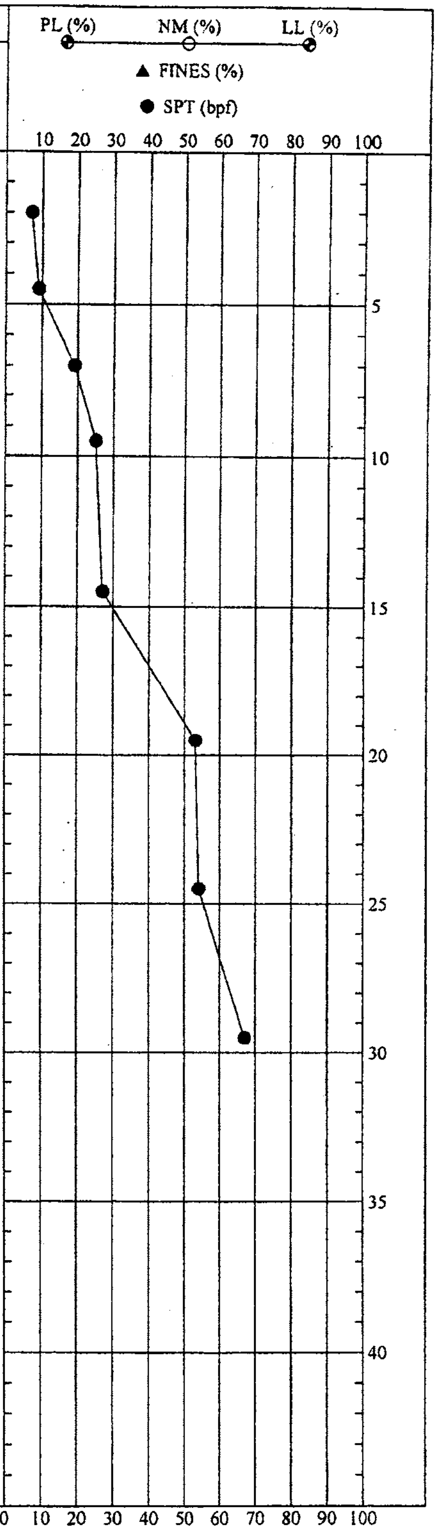
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	1' LOAMY TOPSOIL	0.0
	SILTY SAND (SM) - brown, fine, loose, moist, PLOW ZONE. ▼	
	CLAYEY SAND (SC) - brown-red, fine, loose, moist, WACCAMAW FORMATION.	
5		-5.0
	POORLY GRADED SAND WITH SILT (SP-SM) - tan, firm to very firm, fine sand, wet.	
10		-10.0
	SANDY SILT (ML) - dark green, very stiff, fine, moist.	
15		-15.0
	POORLY GRADED SAND WITH SILT (SP-SM) - brown-dark green, fine, very dense, moist.	
20		-20.0
25		-25.0
30	Boring Terminated at 30 Feet. Ground water level measured at 2.8 feet after 24 hours.	-30.0
35		-35.0
40		-40.0
45		-45.0

SAMPLES

IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SS-1	☒	6-4-3
SS-2	☒	3-4-5
SS-3	☒	4-7-12
SS-4	☒	7-11-14
SS-5	☒	10-12-15
SS-6	☒	11-23-30
SS-7	☒	33-33-21
SS-8	☒	23-31-36



DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-5
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: December 30, 2003
PROJECT No: 6671-03-0184.02.04 **PAGE 1 OF 1**

MACTEC

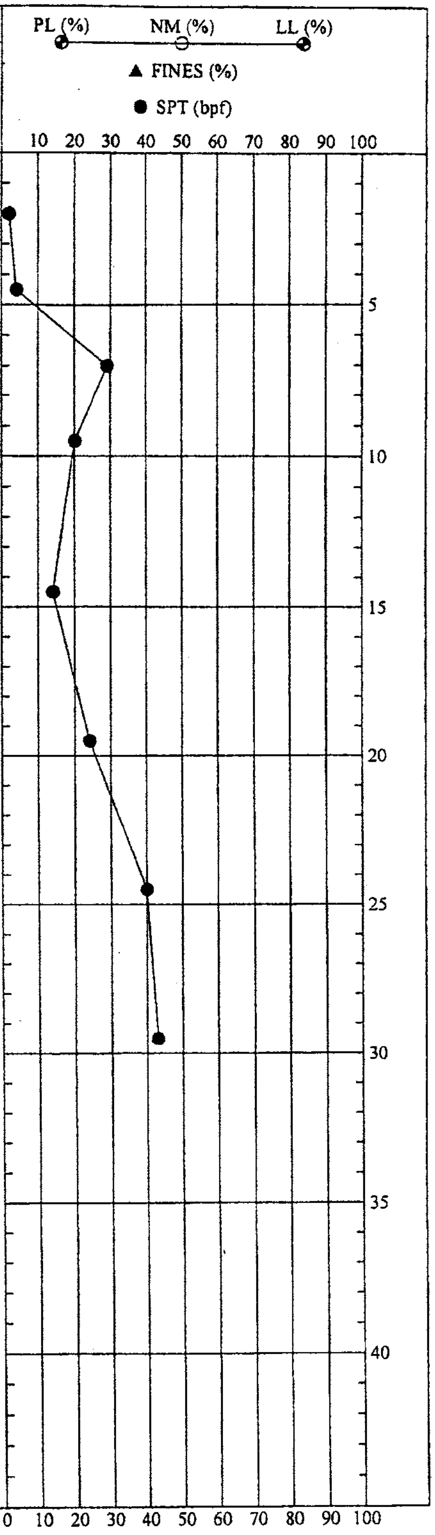
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	1' LOAMY TOPSOIL	0.0
	SILTY SAND (SM) - brown, fine, very loose, moist, PLOW ZONE.	
	CLAYEY SAND (SC) - dark-brown, fine to medium, very loose, moist, WACCAMAW FORMATION. ▼	
5		-5.0
	POORLY GRADED SAND WITH SILT (SP-SM) - dark green-tan, firm to dense, fine sand, moist to wet.	
10		-10.0
15		-15.0
20		-20.0
25		-25.0
30	Boring Terminated at 30 Feet. Ground water level measured at 4.1 feet after 24 hours.	-30.0
35		-35.0
40		-40.0
45		-45.0

SAMPLES

IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SS-1	☒	2-1-1
SS-2	☒	1-1-3
SS-3	☒	16-17-12
SS-4	☒	10-8-12
SS-5	☒	6-7-7
SS-6	☒	8-12-12
SS-7	☒	15-20-20
SS-8	☒	18-22-21



SOIL 0184-02.GPJ LAW_GIBB.GDT 1/13/04 4:39:53 PM

DRILLER: Mid-Atlantic Drilling, Inc.
EQUIPMENT: CME-45
METHOD: Mud Rotary
HOLE DIA.: 4"
REMARKS: SAFETY HAMMER

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.

SOIL TEST BORING RECORD

BORING NO: B-6
PROJECT: EPPS-1 Site
Williamsburg County, South Carolina
DRILLED: December 30, 2003
PROJECT No: 6671-03-0184.02.04 **PAGE 1 OF 1**

MACTEC

Site Certification for the
Williamsburg Cooperative Commerce Centre South
In Williamsburg County, South Carolina

Attachment 24

Geotechnical Study

Report of Preliminary Geotechnical Assessment for Williamsburg County Industrial Park

PRELIMINARY GEOTECHNICAL ASSESSMENT

SOUTH CAROLINA DEPARTMENT OF COMMERCE

PROPOSED WILLIAMSBURG COUNTY INDUSTRIAL PARK
KINGSTREE, SOUTH CAROLINA

S&ME PROJECT NO. 1614-97-247

Prepared For:

South Carolina Department of Commerce
Post Office Box 927
Columbia, South Carolina 29202

Prepared By:

S&ME, Inc.
400 Northeast Dr. Suite A
Columbia, South Carolina 29203

June 24, 1997

June 24, 1997

Mr. Hilton McGill
Williamsburg County Economic Development Corporation
Post Office Box 1132
Kingstree, South Carolina 29556

Reference: Preliminary Geotechnical Assessment
Proposed Industrial Park
Kingstree, South Carolina
S&ME Project No. 1614-97-247

Dear Mr. Clawson:

We are pleased to present our report of the preliminary geotechnical assessment and our recommendations for the above site. A boundary survey and additional project information was provided by Williamsburg County's Economic Developer, F. Hilton McGill, Jr. It is our understanding that this is only a preliminary study to determine general soil stratigraphy and constructability of the site.

PROJECT INFORMATION

The proposed industrial park site is located along the western side of US Highway 52 approximately 2 miles north of the town of Kingstree, South Carolina. Information provided to us indicates that the proposed industrial park contains a total of 235 acres with approximately 150 acres available for development. Ten individual parcels of varying acreage are proposed within the park for light industrial development.

A speculative building is being considered for Parcel 2 located within the southwestern corner of the park. We have assumed maximum wall and column loads of 2 kips per linear foot and 50 kips, respectively. The proposed building will likely have finished floor elevations near existing grades.

WORK AT THE SITE

We generally followed the approach described in our proposal 1614-0338-97. On May 13 and 14, 1997, our staff was present on-site. Using the provided plan, we performed the following main tasks:

- Observed topography, surface soils and ground cover in accessible areas.
- Laid out soil borings by rough measurement from site features. The rough boring location plan in Figure 1 indicates very approximate locations. Elevations shown on the boring logs were estimated from USGS topographic maps and should be considered approximate.
- Advanced 3 soil test borings to 25 feet by mechanical auger. We conducted Standard penetration tests at 2.5 to 5 ft. intervals to estimate soil consistency and recover disturbed soil samples. Boring SB-01was converted to a temporary groundwater monitoring well (TMW-04). Three additional temporary monitoring wells were also installed on-site for environmental sampling of groundwater.

Recovered soil samples were classified in the field and representative portions of the samples placed in glass jars. Samples and field logs were returned to our laboratory the next day for further study. Our field crew also measured ground water levels when encountered in borings. Where feasible, measurements were repeated at least 24 hours later. The attached boring logs present soil descriptions and penetration data.

CONDITIONS AT THE SITE

Surface relief on the site is less than 5 feet. Surface conditions we observed at the time of our exploration are summarized below:

- Topography - relatively flat with very gentle grade toward the west.
- Ground Cover - planted row crops are currently growing on-site. At the time of our reconnaissance, the site surface consisted of cultivated soils. Wooded wetland areas are located along the western boundary of the site.
- Surface Soils - very loose to loose cultivated silty sands. Topsoil thicknesses were generally 6 to 10 inches. The USDA Soil Survey Map shows Eulonia, Goldsboro, and Yemassee Series soils in the proposed industrial park area. The three soil series are relatively similar in soil composition consisting of nearly 1 foot of loamy sands underlain by silty sands, clayey sands, and clay loam. These soils are moderately well drained, moderately permeable soils formed in loamy marine sediment. The site soils are indicated as having a perched high water table of 1 to 3 feet during seasonally wet months which would likely be a major geotechnical consideration to site development.
- Surface Water - none observed on-site within the non-wetland areas.

INTERPRETED SOIL PROFILE

The strata encountered consisted of residual soils of the Middle South Carolina Coastal Plain. These soils were generally very loose to medium dense silty sands or clayey sands with standard penetration test (SPT) N-values ranging from 2 to 29 blows per foot and a mean N-value of 9 blows per foot in the upper 5 feet. The upper stratum of silty and clayey sands is underlain by very loose to medium dense saturated poorly graded sand to depths of 17 to 25 feet with N-values of 3 to 17 blows per foot. Borings SB-01 and SB-03 encountered a stratum of silty sands at depths of 17 to 18 feet which extended to depths of 23 to 25 feet.

GROUND WATER

Ground water was encountered in each of the 3 borings. Ground water depths at time of drilling ranged from 3 to 5.5 feet below the existing ground surface. Groundwater depths measured in the 4 monitoring wells installed on-site ranged from 3.1 to 4.8 feet below ground surface.

Fluctuations in ground water elevation will often occur with rainfall variation, construction activities, surface runoff, and other factors. The potential exists for perched ground water at elevations higher than those encountered during our investigation. However, strategic placement of ditches will help to lower the ground water on-site during construction.

RECOMMENDATIONS FOR SITE CONSTRUCTION

Based on the limited information obtained, the soil profile encountered will likely be suitable for the proposed development. Shallow foundations appear feasible for support of the proposed structure with little risk of excessive settlement, provided recommendations below are followed.

1. Topsoil (cultivated soil) should be stripped and wasted outside building and pavement areas. Topsoil thicknesses observed at boring locations were typically 6 to 10 inches. Soils at the surface have likely been disturbed by past plowing to depths of up to 2 feet.

2. The site surface soils appear suitable for use as structural fill; however, moisture adjustment will likely be required to achieve a high degree of compaction. The soil samples collected from the 3 borings appeared to be at or above their optimum moisture content. The only source of on-site fill material will likely be from excavations for possible storm water detention basins given the flat surface relief throughout the site. The suitability of all fill soils, on-site or borrow, should be verified by appropriate laboratory testing prior to use.

3. Excavations below 3 feet depth will likely encounter ground water. Dewatering methods such as local sumps, ditching, and 'french' drains may be necessary to maintain ground water levels below desired excavation base levels. Elevating individual building sites with fill would help to raise excavation base levels above the high water table and avoid dewatering. Truck docks, if depressed below ground level, should be maintained at least 1 foot above the water table unless provided with suitable gravity drains or sumps.

4. Based on our widely spaced borings a net bearing pressure of 3000 psf is likely available for individual spread footings or wall footings bearing on residual soils. To reduce the potential for local punching shear minimum individual spread footing and wall footing widths should be at least 24 and 16 inches, respectively, with a minimum embedment of 18 inches.

RECOMMENDATIONS FOR ADDITIONAL WORK

Our borings to date are widely spaced and of minimal quantity for the site area available for development. The borings were intended to gain very general data regarding site soil stratification and the suitability of the site soils for light industrial development. We recommend that additional borings be performed in Parcel 2 once the final configuration and location of the speculative building have been determined. Borings should also be performed within proposed building footprints of each of the individual parcels.

LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations in this report are based on the applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the vary preliminary data obtained from the subsurface exploration. If variations become evident in the course of further exploration, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the building are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by the submitting engineers.

Assessment of site environmental conditions; sampling of soils, ground water or other materials for environmental contaminants; identification of jurisdictional wetlands, rare or endangered species, geological hazards or potential air quality and noise impacts was beyond the scope of this project.

CLOSURE

We appreciate the opportunity to work with the South Carolina Department of Commerce by providing the geotechnical engineering services for this project. Should any questions arise regarding information presented in this report or when we may be of further assistance, please contact us.

Sincerely,

S&ME, Inc.

Dreher Whetstone Staff Professional	John C. Lessley, P.E. Chief Engineer

FIELD TESTING PROCEDURES

TEST BORINGS

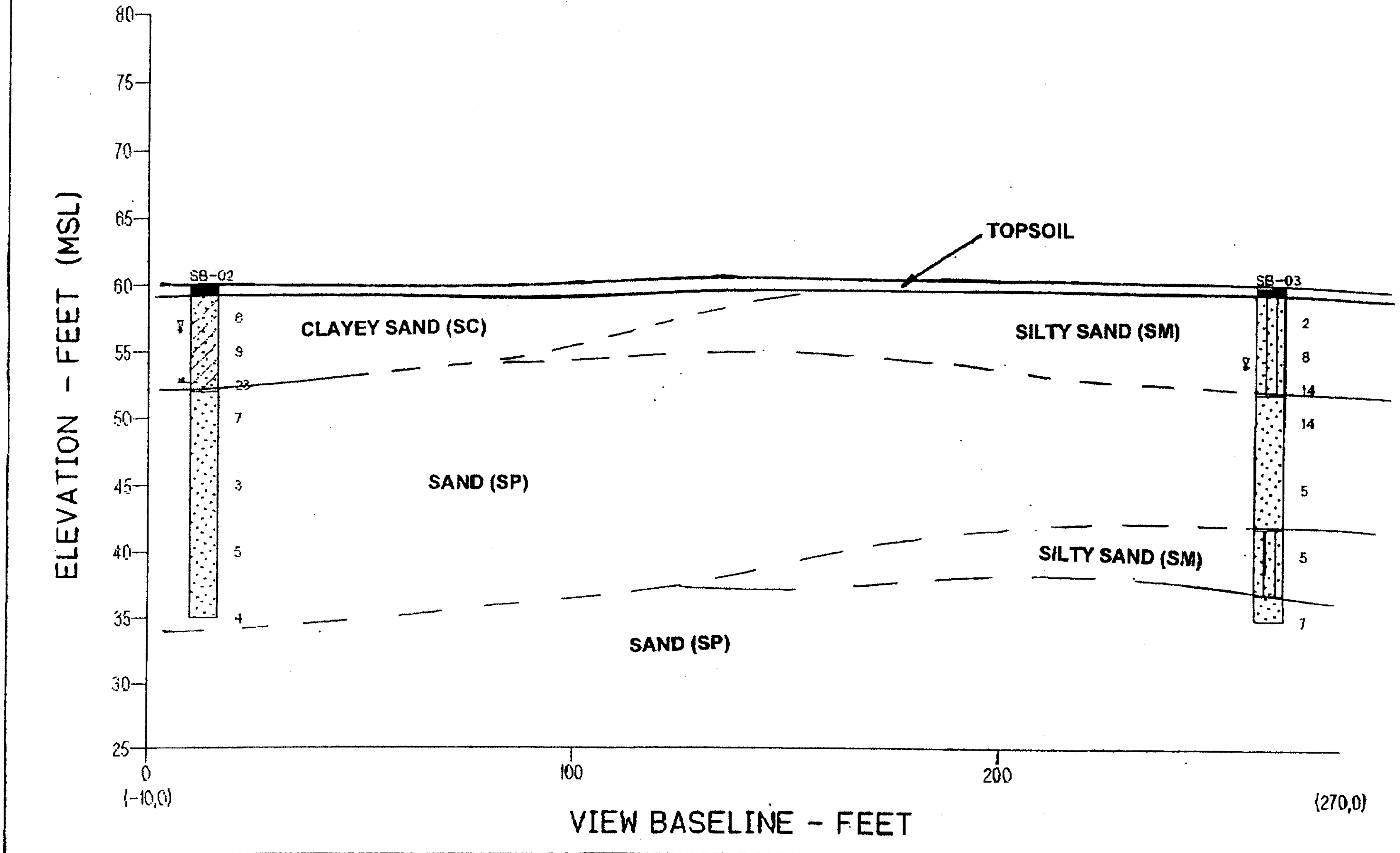
All borings and sampling were conducted in accordance with ASTM designation D-1586. Initially, the borings were advanced by either mechanically augering or wash boring through the soils. When necessary, a heavy drilling fluid is used below the water table to stabilize the sides and bottom of the drill hole. At regular intervals, soil samples were obtained with a standard 1.4 inch I.D., 2-inch O.D., split-barrel samples. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "standard penetration resistance". The penetration resistance, when evaluated, is an index to the soil strength and compressibility.

WATER LEVEL READINGS

Water table readings are normally taken in conjunction with borings and are recorded on the Test Boring Records. These readings indicate the approximate location of the hydrostatic water table at the time of our field exploration. The groundwater table may be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should also be expected with variations in surface run-off, evaporation and other factors.

Occasionally the boreholes will cave-in, preventing the water level readings from being obtained or trapping drilling water above the cave-in zone. The cave-in depth is measured and recorded on the Test Boring Records. Water Level readings taken during the field operations do not provide information on the long-term fluctuations of the water table. When this information is required, piezometers are necessary to prevent the boreholes from caving.

SOIL PROFILE



REVISION:
SCALE: AS SHOWN
APPROVED BY:
DRAWN BY:
DATE: 06/11/1997

JOB NUMBER: 1614-97-247

FIGURE NO: 2

PROJECT: Williamsburg County Industrial Park
Williamsburg Co., SC

TEST BORING RECORD SB-01

PROJECT NO.: *1614-97-247*
ELEVATION: *80.0 Ground Surface*
NOTES:
LOGGED BY: *DDW*
BORING DEPTH: *25 FEET*
DATE DRILLED: *5/13/97*
WATER LEVEL: *5.5' @ TOB*
DRILLING METHOD: *3.25" H.S.A.*
DRILL RIG: *CME-55*

DEPTH (ft) | GRAPHIC LOG | Soil Description | OVM (ppm) | WATER LEVEL | SAMPLE | ELEV. | Standard Penetration Test Data (Blows/ft) | BPF

Topsoil, 6 inches

CLAYEY SAND (SC) ; mostly fine to medium sand, little medium plasticity fines, moist, loose, tan.

CLAYEY SAND (SC); mostly fine to medium sands, some medium plasticity fines, moist, medium dense, mottled gray, tan, and red.

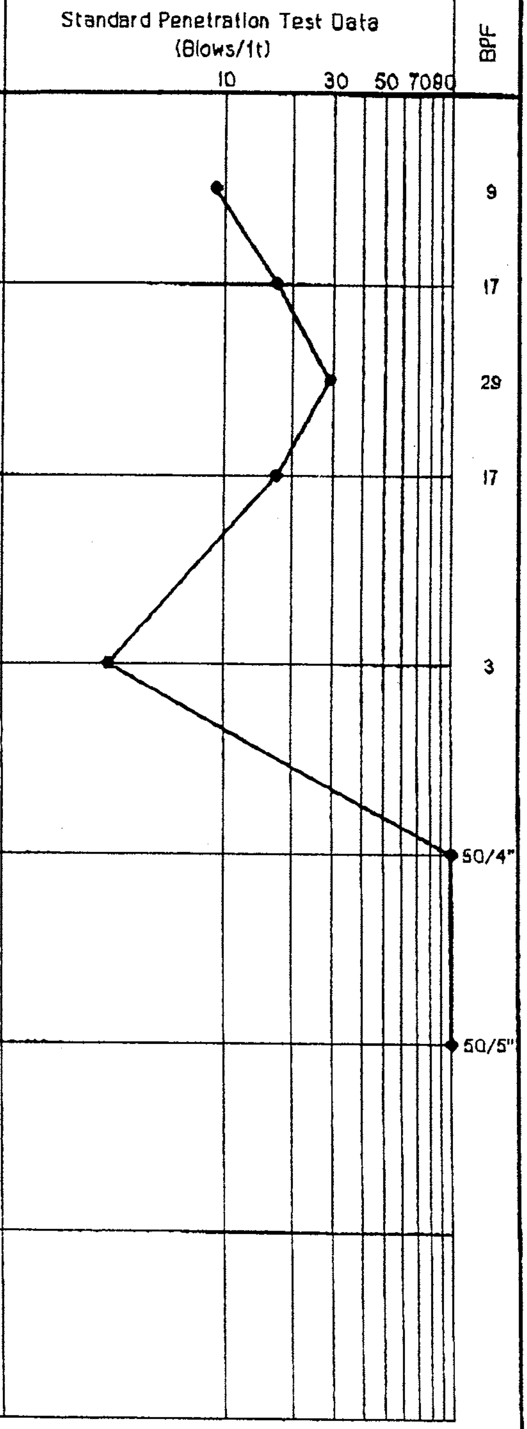
mostly fine sand, little low plasticity fines.

SAND (SP-SM) ; mostly fine sand, saturated, medium dense to very loose, tan.

SILTY SAND (SM) ; mostly fine sand, little low plasticity fines, moist, very dense, dark gray.

Boring Terminated.

DEPTH (ft)	WATER LEVEL	SAMPLE	ELEV.	BPF
		☒		9
5	▽	☒	55.0	17
		☒		29
10		☒	50.0	17
15		☒	45.0	3
20		☒	40.0	50/4"
25		☒	35.0	50/5"
30			30.0	
35			25.0	

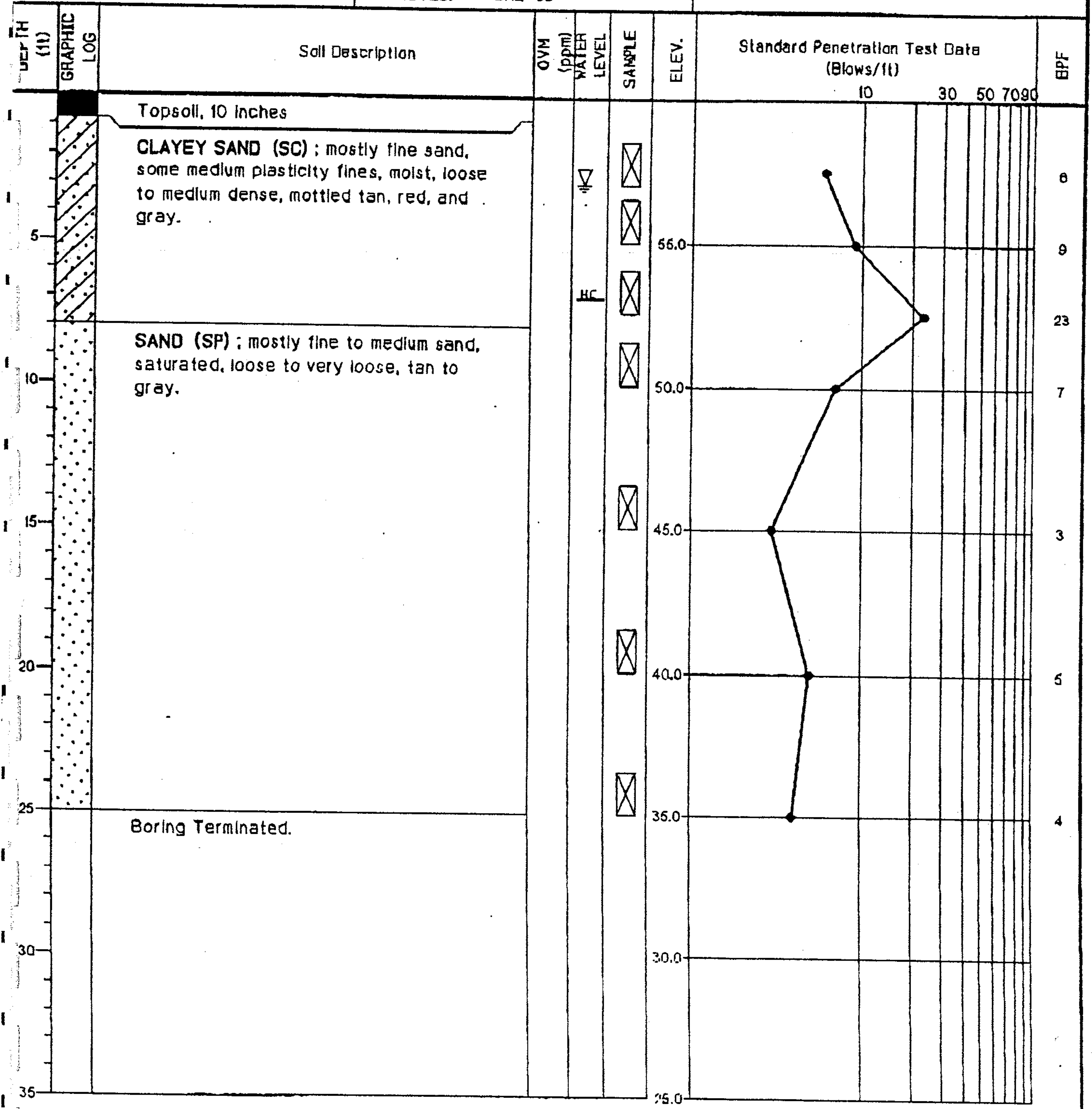


S&ME
Environmental Services
Engineering * Testing

PROJECT: Williamsburg County Industrial Park
Williamsburg Co., SC

TEST BORING RECORD SB-02

PROJECT NO.: 1814-97-247
ELEVATION: 60.0 Ground Surface
NOTES:
LOGGED BY: DDW
BORING DEPTH: 25 FEET
DATE DRILLED: 5/13/97
WATER LEVEL: 3' @ TOB
DRILLING METHOD: 3.25" H.S.A.
DRILL RIG: CME-55



Topsoil, 10 inches

CLAYEY SAND (SC) ; mostly fine sand, some medium plasticity fines, moist, loose to medium dense, mottled tan, red, and gray.

SAND (SP) ; mostly fine to medium sand, saturated, loose to very loose, tan to gray.

Boring Terminated.

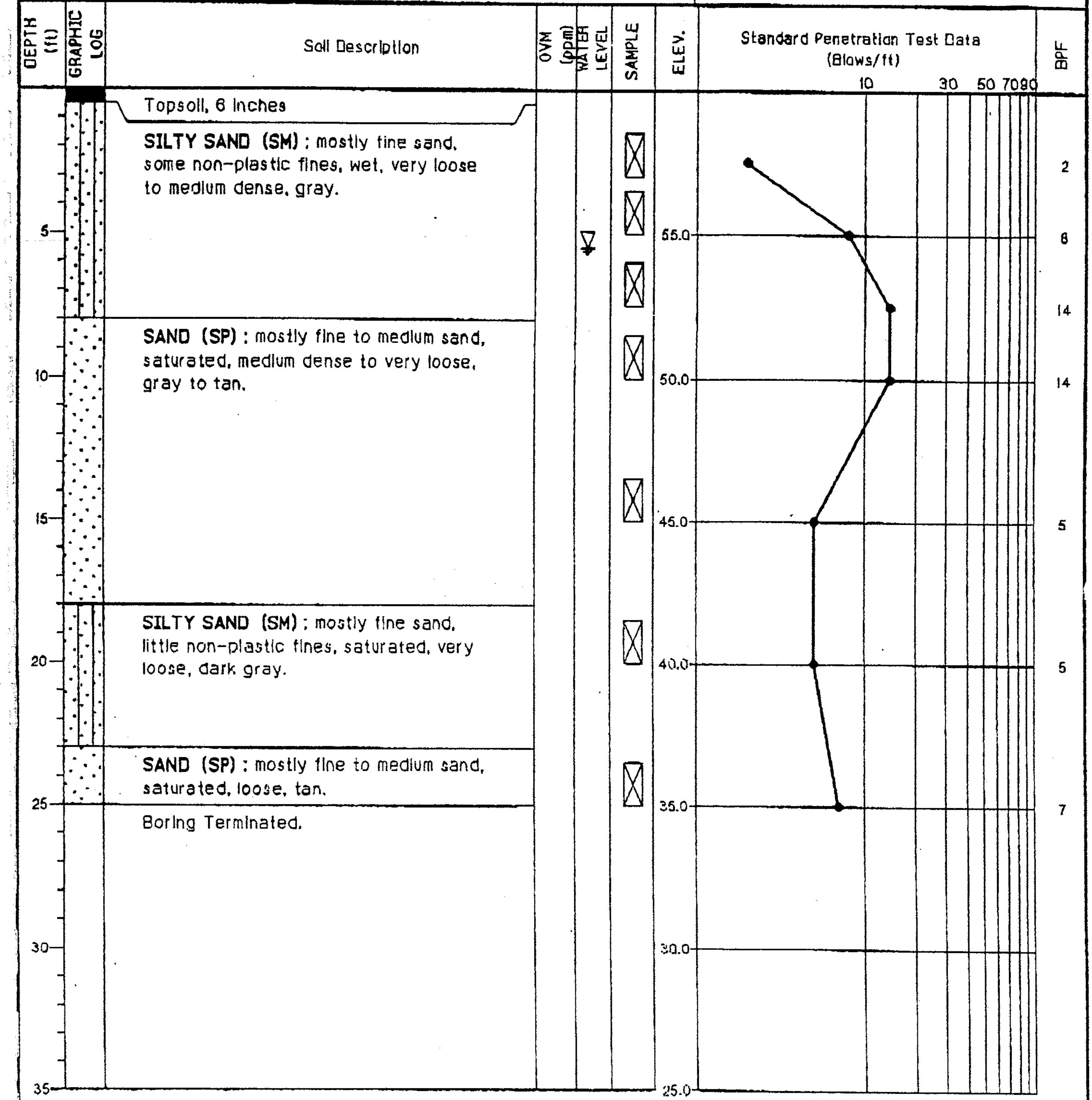
S&ME
Environmental Services
Engineering * Testing

Williamsburg County Industrial Park
Williamsburg Co., SC

TEST BORING RECORD SB-03

PROJECT NO. :	*1614-97-247*	**ELEVATION:**	*60.0 Ground Surface*
LOGGED BY:	*DDW*	**BORING DEPTH:**	*25 FEET*
DATE DRILLED:	*5/14/97*	**WATER LEVEL:**	*5.5' @ TOB*
DRILLING METHOD:	*3.25" H.S.A.*	**DRILL RIG:**	*CME-55*

NOTES:



Topsoil, 6 inches

SILTY SAND (SM) : mostly fine sand, some non-plastic fines, wet, very loose to medium dense, gray.

SAND (SP) : mostly fine to medium sand, saturated, medium dense to very loose, gray to tan.

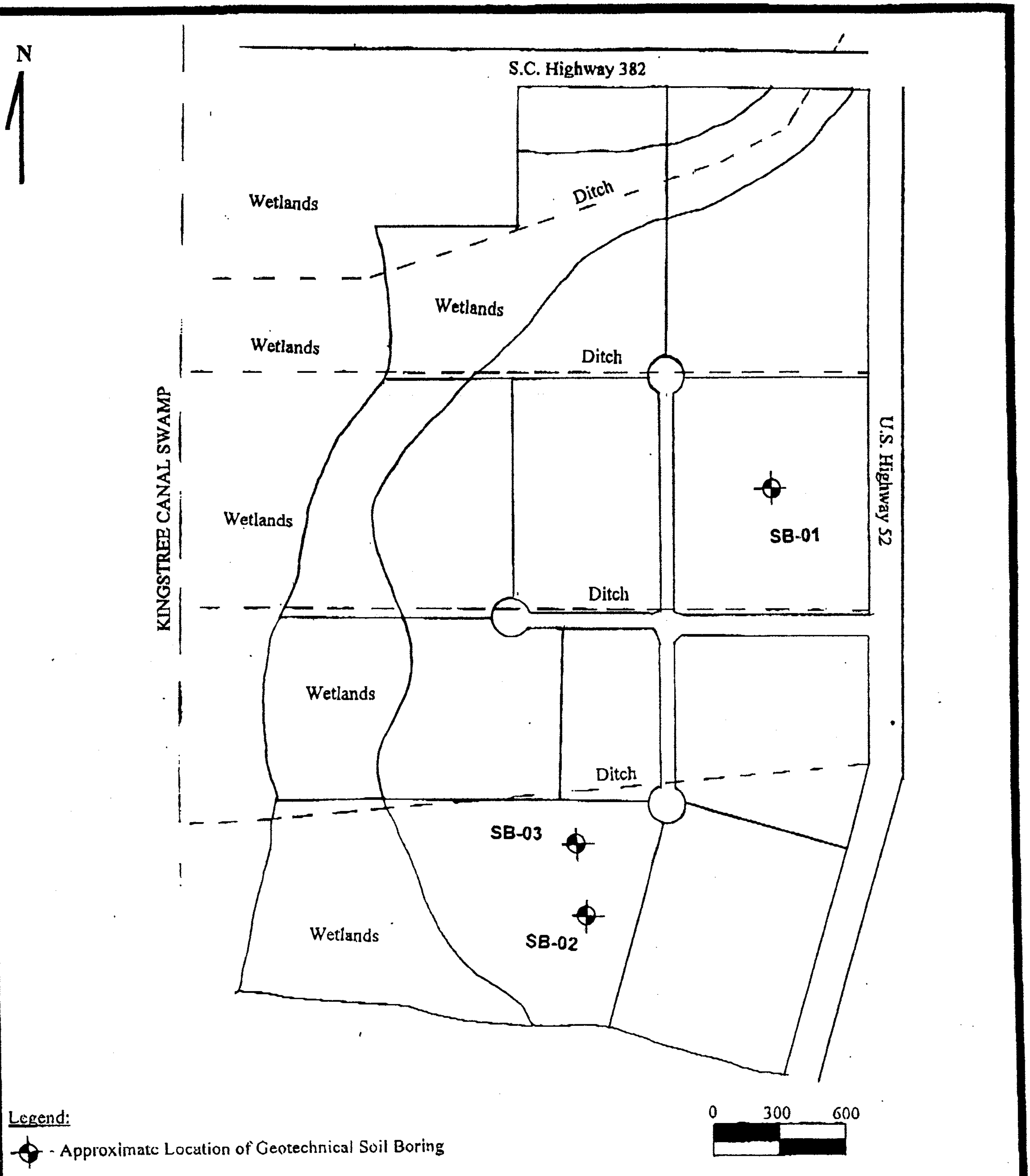
SILTY SAND (SM) : mostly fine sand, little non-plastic fines, saturated, very loose, dark gray.

SAND (SP) : mostly fine to medium sand, saturated, loose, tan.

Boring Terminated.

ELEV.	BPF
	2
55.0	8
	14
50.0	14
45.0	5
40.0	5
35.0	7

S&ME
Environmental Services
Engineering * Testing



WILLIAMSBURG COUNTY ECONOMIC
DEVELOPMENT CORPORATION
KINGSTREE, SOUTH CAROLINA

SCALE	DATE	DRAWN BY	CHECKED BY
1" = 600'	05-20-97	JW	

S&ME

ENVIRONMENTAL SERVICES
ENGINEERING ● TESTING

Geotechnical Boring Location Plan

Proposed Williamsburg County Industrial Park
Kingstree, South Carolina

JOB NO.	FIGURE NO
1614-97-247	1