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Coal Combustion Residue Impoundment

Round 9 - Dam Assessment Report

Canadys Steam Power Station

Ash Pond Embankments
South Carolina Electric & Gas
Canadys, South Carolina

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

Dewberry & Davis, LLC
Fairfax, Virginia

Under Contract Number: EP-09W001727
May 2011

INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards of coal combustion waste from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008 flooded more than 300 acres of land, damaging homes and property. In response the U.S. EPA is assessing the stability and functionality of coal combustion ash impoundments and other management units across the country and, as necessary, identifying any needed corrective measures.

This assessment of the stability and functionality of the Canadys Station management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on February 15, 2011. We found the supporting technical documentation adequate (Section 1.1.3). As detailed in Section 1.2.5, there were two recommendation based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Canadys Station Ash Pond units are POOR for continued safe and reliable operation, due to the factor of safety for seismic loading conditions not meeting required standards. Note that under static conditions the Canadys Station Ash Pond units are Satisfactory for continued safe and reliable operation.

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PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety.)

In early 2009, the EPA sent its first wave of letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion residue. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments. EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is **to evaluate the condition and potential of residue release from management units**. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner. Also, after the field visit, additional information on seismic loading conditions was received by Dewberry & Davis LLC about the Canadys Ash Ponds that were reviewed and used in preparation of this report.

Factors considered in determining the hazard potential classification of the management unit (s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion residue management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit on February 15, 2011, and review of technical documentation provided by South Carolina Electric & Gas (SCE&G).

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The dike embankments and spillway appear to be structurally sound based on a review of the engineering data provided by the owner's technical staff and Dewberry engineers' observations during the site visit; however, factors of safety for seismic loading conditions do not meet required standards. It should be noted that a deep-seated failure that would compromise the overall integrity of the dike during the design earthquake is not likely and that the dike will be capable of retaining the coal ash during and immediately following the design earthquake event.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Adequate capacity and freeboard exists to safely pass the design storm.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Supporting technical documentation is adequate. Engineering documentation reviewed is referenced in Appendix A.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The description of the management unit provided by the owner was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

The overall visual assessment of the ash pond embankment system was that it was in satisfactory condition; however, surficial sloughing was observed along the Ash Pond's downstream slope. Embankments visually appear structurally sound.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be adequate for the ash management unit.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility is rated POOR for continued safe and reliable operation due to the factors of safety for seismic loading conditions that do not meet required standards.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

As recommended by its own engineering studies, additional data are required on the dike and foundation soils to permit a more in-depth analysis of risks from seismic events. An action plan needs to be developed and implemented to take the necessary actions to increase factors of safety, meet all applicable standards and requirements, and to address surficial sloughing.

1.2.2 Recommendations Regarding Maintenance and Methods of Operation

The following issues need to be addressed with routine maintenance:

- Re-vegetate embankment where necessary

1.2.3 Recommendations Regarding Continued Safe and Reliable Operation

- Develop an action plan to increase the factors of safety for the ash pond embankments to meet or exceed the minimum requirement for factors of safety for seismic loading conditions.

- Develop an action plan to address surficial sloughing along downstream slope. Perform remediation along downstream slopes where surficial sloughing is occurring.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Tim Miller, South Carolina Electric & Gas (SCE&G)
Wes Coker, South Carolina Electric & Gas (SCE&G)
Michelle Camburn, South Carolina Electric & Gas (SCE&G)
Tom Effinger, SCANA
Jean-Claude Younan, SCANA
Frederic Shmurak, Dewberry & Davis, Inc.
Justin Story, Dewberry & Davis, Inc.

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on February 15, 2011.

__________________________ __________________________

Frederic Shmurak, P.E. Justin Story, E.I., LEED AP BD+C

2.0 DESCRIPTION OF THE COAL COMBUSTION RESIDUE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Canadys Steam Power Station and ash ponds are located approximately 1 mile north of Canadys, South Carolina along the Edisto River. The town of Givhans is approximately 16 miles downstream of the ash ponds. Figure 2.1a depicts a vicinity map around the Canadys Steam Power Station while Figure 2.1b depicts an aerial view of the Canadys Facility.

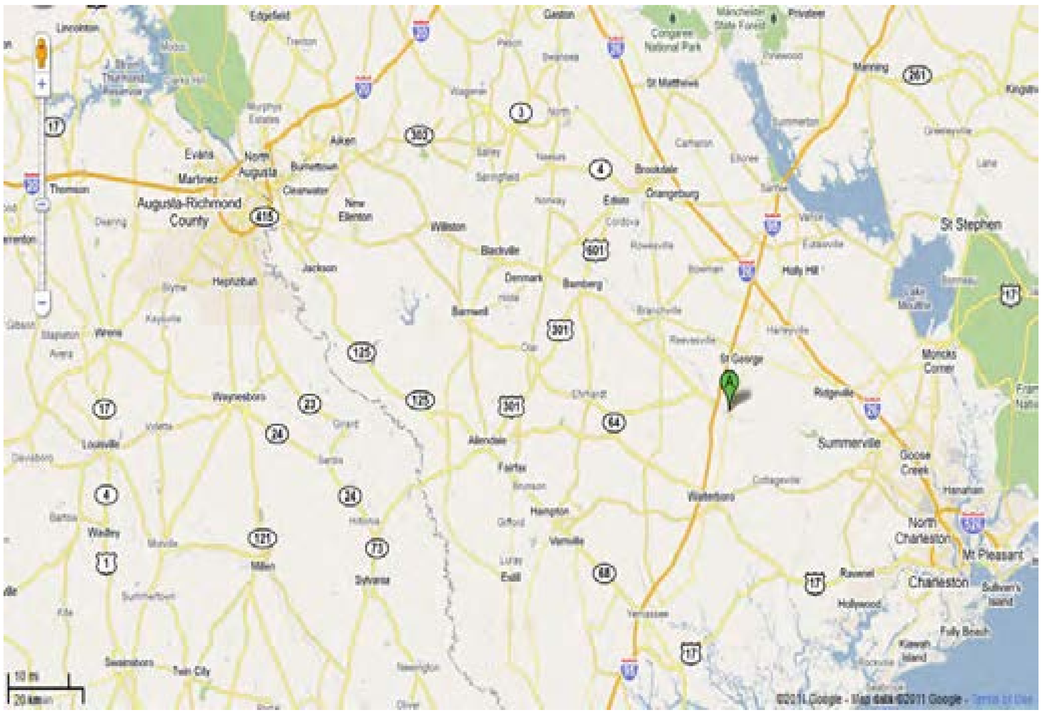

Figure 2.1a: Canadys Steam Power Station Vicinity Map

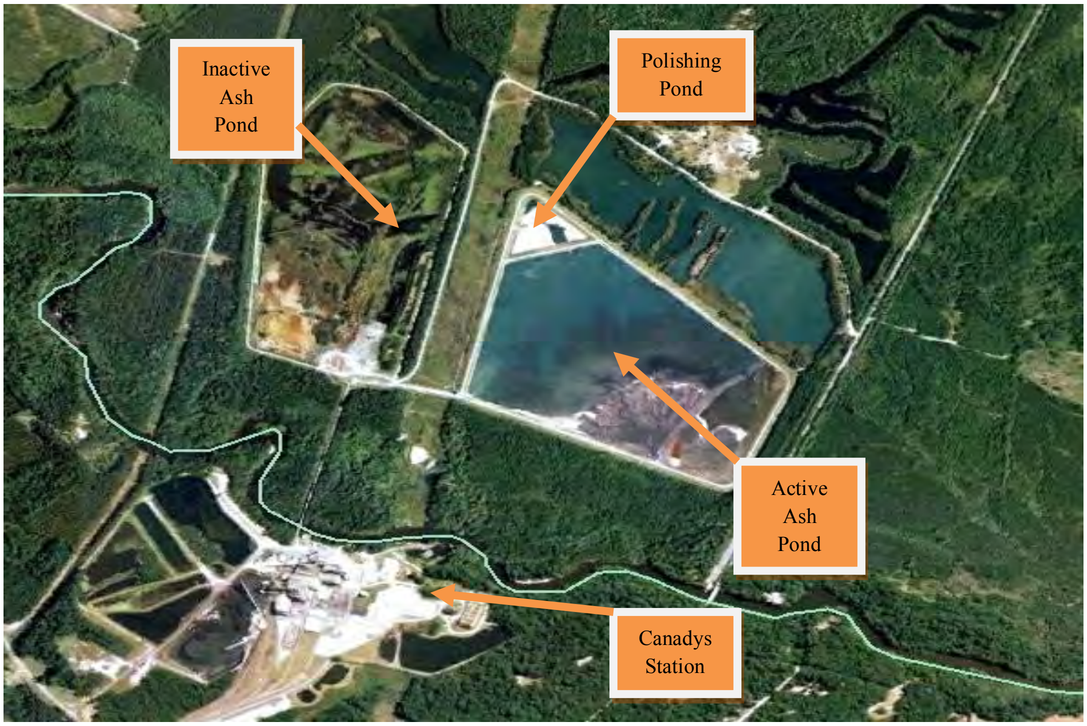

Figure 2.1b: Canadys Steam Power Station Aerial View

2.2 COAL COMBUSTION RESIDUE HANDLING

2.2.1 Fly Ash

Fly ash is collected at the base of the stack by an electrostatic precipitator. The collected ash is stored in hoppers and conveyed pneumatically to a silo (see photo below). From the silo it is conveyed hydraulically in a pipe to the Active Ash Pond. The discharge into the ash pond is continuous. A flowchart for handling the fly ash is shown in Appendix A (Doc 01 - Water Flow Diagram).

Hopper feeding ash sluice line

2.2.2 Bottom Ash

Bottom ash is collected from the furnace and conveyed through the same pipe as the fly ash into the Active Ash Pond.

2.2.3 Boiler Slag

Boiler slag is collected from the boiler and is sluiced into the same pipe that conveys fly and bottom ash into the Active Ash Pond.

2.2.4 Flue Gas Desulfurization Sludge

No scrubbers are used in this plant so there is no flue gas desulfurization (FGD) process or related waste products to be discharged.

2.3 SIZE AND HAZARD CLASSIFICATION

The ash pond is impounded by an earthen embankment system consisting of a dike configuration. There are two main ponds, one that is active with an internal dike separating the ash pond from the polishing pond, and one that is inactive. Table 2.1 provides information on dam height, crest width, length and side slopes.

Table 2.1: Summary of Dam Dimensions and Size		
	Active Ash Pond	**Inactive Ash Pond**
Dam Height (ft)	20	12
Crest Width (ft)	12'/20'	15
Length (ft)	9,050	7,700
Side Slopes (upstream) H:V	2.5:1	1:2
Side Slopes (downstream) H:V	2.5:1	1.5:1

Inactive Pond - The maximum remaining storage volume corresponding to the top of the embankment for the Inactive Ash Pond is 938,300 cubic yards based on an SCE&G Response to EPA (Appendix A: Doc 02 - Response to EPA) dated March 20, 2009. However, the Inactive Ash Pond is no longer used for coal combustion residual productions.

Active Pond - The Active Ash Pond has a maximum remaining storage volume corresponding to the top of the embankment of 80,732 cubic yards based on the SCE&G Response to EPA. It should be noted that since this last evaluation (2009) the Active Pond has been in use and the numbers have most likely changed.

Table 2.2 provides information on the storage capacity and size of the ponds. Based on the storage capacity and other data in Tables 2.1 and 2.2, both ponds are considered Intermediate in size.

Table 2.2: Maximum Capacity of Unit		
	Active Ash Pond	**Inactive Ash Pond**
Surface Area (acre)	95	80
Current Storage Capacity (cubic yards)	2,189,468	675,000
Current Storage Capacity (acre-feet)	1,357	418
Total Storage Capacity (cubic yards)	2,270,200	1,613,300
Total Storage Capacity (acre-feet)	1,407	1,000
Crest Elevation (feet)	80	69.5
Normal Pond Level (feet)	72.1	-

Table 2.3a: USACE ER 1110-2-106 Size Classification		
	Active Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

Table 2.3b: USACE ER 1110-2-106 Size Classification		
	Inactive Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

A Hazard Classification has not been assigned by a regulatory agency, but based on observations and the lack of population in the surrounding area, a classification of **Low** appears to be appropriate. Per the Federal Guidelines for Dam Safety dated April 2004, a Low Hazard Potential classification applies to those dams where failure or mis-operation results in no probable loss of human life and low economic or environmental losses. Losses are principally limited to the owner's property, and the land use surrounding the plant is rural.

Table 2.3b: FEMA Federal Guidelines for Dam Safety Hazard Classification		
	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

2.4 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Both the Inactive Pond and the Active Ash Pond permanently contain fly ash, bottom ash, pyrites and boiler slag. The drainage area is the surface area of the ponds. Please note the polishing pond data is included with the Active Ash Pond for this section.

Principal Project Structures

2.4.1 Earth Embankment

The original material of the embankment appears to be native soils based on Progress Energy's supplied Geotechnical data.

2.4.2 Outlet Structures

The Inactive Ash Pond had a 30" diameter riser and an outlet pipe that is a free outlet with no tailwater condition.

The Active Ash Pond discharges into the polishing pond through a 4' inside diameter riser with a 3' barrel. The discharge into the polishing pond is below the pond surface.

The polishing pond discharges through a Parshall Flume to the Edisto River.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

Critical structures were located by using aerial photography which might not accurately represent what currently exists down-gradient of the site. No critical infrastructure was found to be downstream of the site with the exception of Colleton State Park and Jeffries Hwy/Porter Avenue (HWY 15).

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

Summary of Reports on the Safety of the Management Unit

Progress Energy provided the two most recent annual inspection reports. The most recent is the 2010 Annual Ash Pond Dike Inspection, Canadys Station, dated December 14, 2010 (Appendix A: Doc 03 - 2010 Inspection Report).

- Recommendations from 2009 report had been "aggressively repaired and maintained";
- The trench caused by the slurry wall construction silt fence had been repaired as noted in the 2009 report;
- Minor surface erosion was present along the downstream slope where hydroseeding was not successful;
- Rutting of the downstream slope was observed where mowing equipment was used;
- The berm separating the polishing pond from the active ash pond appears to have "a very small localized slough";
- Woody vegetation observed in 2009 in the rip rap along the downstream slope had been removed.
- Vegetation along the interior embankment had been cut down,
- Tall grass was observed growing in the area of the inactive pond where little or no water was apparent.

2009 Annual Ash Pond Dike Inspection, Canadys Station, dated 12/04/2009. (Appendix A: Doc 04 - 2009 Inspection Report)

Active Ash Pond

- Minor surface erosion was present along the downstream slope;
- Sloughing had occurred where the silt fence was trenched into the dike during recent construction;
- The berm separating the polishing pond and the active ash pond appeared to have been damaged during construction and a small localized slough was noticed.

- Woody vegetation that had established in the rip rap of the downstream slope had been removed.
- Small trees were observed growing on the interior embankment of the ash pond and on the downstream slope near the outfall.
- Deep ruts were noticed along the downstream toe of the ash pond which was noted to have been caused by recent vehicular traffic.

Inactive Ash Pond

- Surficial erosion was observed; it was noted that the areas were small and should “be easily repaired”;
- Thick vegetation has established along the interior bank;
- Tall grass was noted inside the active ash pond where little or no water was apparent.
- The observer noticed “medium, large, and very large trees” flourishing within the ash of both ponds.
- Waterfowl was noticed in the impounded water within the inactive pond.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS

Discharge from the impoundment is regulated by the Federal National Pollutant Discharge Elimination Program (NPDES) and the impoundment has been issued a National Pollutant Discharge Elimination System Permit (No. SC0002020, dated July 18, 1995). The South Carolina Department of Health and Environmental Control periodically inspects the ash ponds for compliance.

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted releases, or other performance related problems with the dam within the last 10 years.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The Inactive Ash Pond was commissioned in 1974. The pond was designed by Gilbert Associates, Inc., but detailed documentation for the original design and construction of the pond was not provided.

The Active Ash Pond was constructed in 1987 from original ground surface at an approximate elevation of 60'.

4.1.2 Significant Changes/Modifications in Design since Original Construction

A new slurry wall was constructed in 2007 within the Active Ash Pond to prevent seepage within the dike. This construction was approved by South Carolina Department of Health and Environmental Control on September 22, 2005.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No documentation of significant repairs/rehabilitation since the original construction was provided.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The original ash pond (i.e., Inactive Ash Pond) and Active Ash Pond are designed and operated for reservoir sedimentation and sediment storage of ash. Plant process waste water, coal combustion waste, coal pile stormwater runoff, and minimal stormwater runoff around the Ash Pond facility are discharged into the reservoirs. Inflow water is treated through gravity settling and deposition, and the treated process water and stormwater runoff are discharged through an unregulated type overflow outlet structure.

4.2.2 Significant Changes in Operational Procedures and Original Startup

No documentation was provided describing any significant changes in Operating Procedures.

4.2.3 Current Operational Procedures

To the best of our knowledge, original operational procedures are in effect. The Inactive Ash Pond received coal combustion by-products until 1989 and it has not been used since.

4.2.4 Other Notable Events since Original Startup

No additional information was provided.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel, Frederic Shmurak, P.E. and Justin Story, E.I., performed a site visit on Tuesday February 15, 2011.

The site visit began at 10:00 AM. The weather was partially cloudy and cool. Photographs were taken of conditions observed. Please refer to the Dam Inspection Checklist in Appendix B for additional site observation information. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit.

The overall assessment of the dam was that it was in satisfactory condition and no significant findings were noted.

5.2 ACTIVE ASH POND

5.2.1 Crest

The crest had no signs of rutting, depressions, tension cracking, or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

5.2.2 Upstream/Inside Slope

The upstream slopes are mostly vegetated with tall grasses and other wetland vegetation. No scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were observed.

5.2.3 Downstream/Outside Slope and Toe

There were signs of surficial sloughing particularly along the downstream slope. Wetlands and a waterway channel are located along the downstream toe of the embankments. (See Photos 1, 2, and 3.)

Photo 1. Standing water in vehicular traffic ruts

Photo 2. Channel along the downstream toe

Photo 3. Surficial sloughing along downstream slope

5.2.4 Abutments and Groin Areas

The ash pond embankment consists of a dike system completely surrounding the pond, therefore the earthen embankment does not abut existing hillsides, rock outcrops or other raised topographic features.

5.3 INACTIVE ASH POND

5.3.1 Crest

The crest had no signs of any rutting, depressions, tension cracking, or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

5.3.2 Upstream/Inside Slope

The interior of the pond is heavily vegetated and it appears the upstream slopes at one point in time had woody vegetation that was recently removed. No scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were observed.

5.3.3 Downstream/Outside Slope and Toe

No scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were observed.

5.3.4 Abutments and Groin Areas

The ash pond embankment consists of a dike system completely surrounding the pond, therefore the earthen embankment does not abut existing hillsides, rock outcrops or other raised topographic features.

5.4 OUTLET STRUCTURES

5.4.1 Overflow Structure

The outlet structures for the Active Ash Pond and the Polishing Pond were properly discharging flow from the pond and visually appeared to be in good condition.

5.4.2 Outlet Conduit

The visual portion of the outlet conduit was functioning properly with no apparent deterioration for the Active, Inactive and Polishing Ponds.

5.4.3 Emergency Spillway

No emergency spillway is present.

5.4.4 Low Level Outlet

No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation was provided about the flood of record. The Active Ash Pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore, the impounded pool would not be anticipated to experience significant changes in flood stage.

6.1.2 Inflow Design Flood

According to FEMA Federal Guidelines for Dam Safety, the current practice in the design of dams is to use the Inflow Design Flood (IDF) that is deemed appropriate for the hazard potential of the dam and reservoir, and to design spillways and outlet works that are capable of safely accommodating the flood flow without risking the loss of the dam or endangering areas downstream from the dam to flows greater than the inflow. The recommended IDF or spillway design flood for a low-hazard intermediate-sized structure (See section 2.3), in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams, ER 1110-2-106 criteria, is the 100-year to ½ PMF (See Table 6.1.2).

Table 6.1.2: USACE Hydrologic Evaluation Guidelines Recommended Spillway Design floods

Hazard	Size	Spillway Design Flood
Low	Small	50 to 100-yr frequency
	Intermediate	100-yr to ½ PMF
	Large	½ PMF to PMF
Significant	Small	100-yr to ½ PMF
	Intermediate	½ PMF to PMF
	Large	PMF
High	Small	½ PMF to PMF
	Intermediate	PMF
	Large	PMF

The Probable Maximum Precipitation (PMP) is defined by the American Meteorological Society as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. The National Weather Service (NWS) further states that in consideration of our limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates. The NWS has published application procedures that can be used with PMP estimates to develop spatial and temporal characteristics of a Probable Maximum Storm (PMS). A PMS thus developed can be used with a precipitation-runoff simulation model to calculate a probable maximum flood (PMF) hydrograph.

The 24-hour, 10-square mile PMP depth is 44 inches (3.7'). The freeboard of the Active Ash Pond is 7.9' and the Polishing Pond is 16.6'. Since the facility has a contributing drainage area equal to the surface area of the impoundment, adequate freeboard exists so the facility would not experience significant flood states and could safely pass the design storm.

6.1.3 Spillway Rating

No spillway rating was provided. The Ash Ponds are a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore, the impounded pool would not be anticipated to experience significant changes in elevation. The outlet structure type is unregulated and, given little change in the normal pool elevation, the resulting discharge rate is expected to be relatively constant.

6.1.4 Downstream Flood Analysis

No downstream flood analysis was provided.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation reviewed by Dewberry is adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Adequate capacity and freeboard exists to safely pass the design storm.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

A stability analysis report for the ash pond dated December 8, 2005, by GEI Consultants, Inc., provides information on the stability analysis results. Updated slope stability analysis reports, prepared by CDM dated March 16, 2011 and May 17, 2011 were provided after the site visit (Appendix A: Doc 11 - Seismic Slope Stability Analysis and Doc 12 – Static Slope Stability Analysis). Steady state (normal) and seismic loading conditions were analyzed and are presented in Section 7.1.4 Factors of Safety and Base Stresses.

7.1.2 Design Parameters and Dam Materials

The GEI Consultants, Inc. 2005 report includes documentation of the shear strength design properties for the ash pond embankments, and is presented in the following section. The CDM 2007 report shows the geotechnical analysis of the new cement-bentonite slurry trench. Soil properties information used in stability analyses from these reports is provided in Table 4a. Additional information on soil properties was provided in the CDM 2011 report, see Table 4b. The soil properties are generally acceptable values for these types of materials.

Table 4a

Soil Properties for Stability Analysis North Embankment

Soil Description (USCS Classification)	Unit Weight (pcf)	Fiction Angle (degrees)	Cohesion (psf)
Dike (SM)	130	34	0
Dike (SC-SM)	125	34	0
Existing Soil – Bentonite Backfill	130	38	0
Proposed Cement Bentonite	70	-	-

Table 4b Soil Properties for Stability Analysis (From March 16, 2011 Report)			
Material	**Unit Weight (pcf)**	**Fiction Angle (degrees)**	**Cohesion (psf)**
Ash	80	0	0
Silty Sand	120	32	0
Clayey Sand	110	30	0
Widely Graded Sand	125	0	550
Sandy Silt (Cooper Marl)	110	0	4,000
Soil-Bentonite slurry-wall	130	0	0
Cement-Bentonite slurry wall	80	0	10,000

Appendix A: Doc 11 – Seismic Slope Stability Analysis

7.1.3 Uplift and/or Phreatic Surface Assumptions

Monitoring instrumentation devices have not been installed to verify water levels within the embankment. The assumed phreatic surfaces are shown on the figures below and the depiction seems appropriate for these types of structures. No additional information was provided. The water level of the Active Ash Pond was stated to be 72.1' and the Polishing Pond to be 63.4'. These elevations were not verified.

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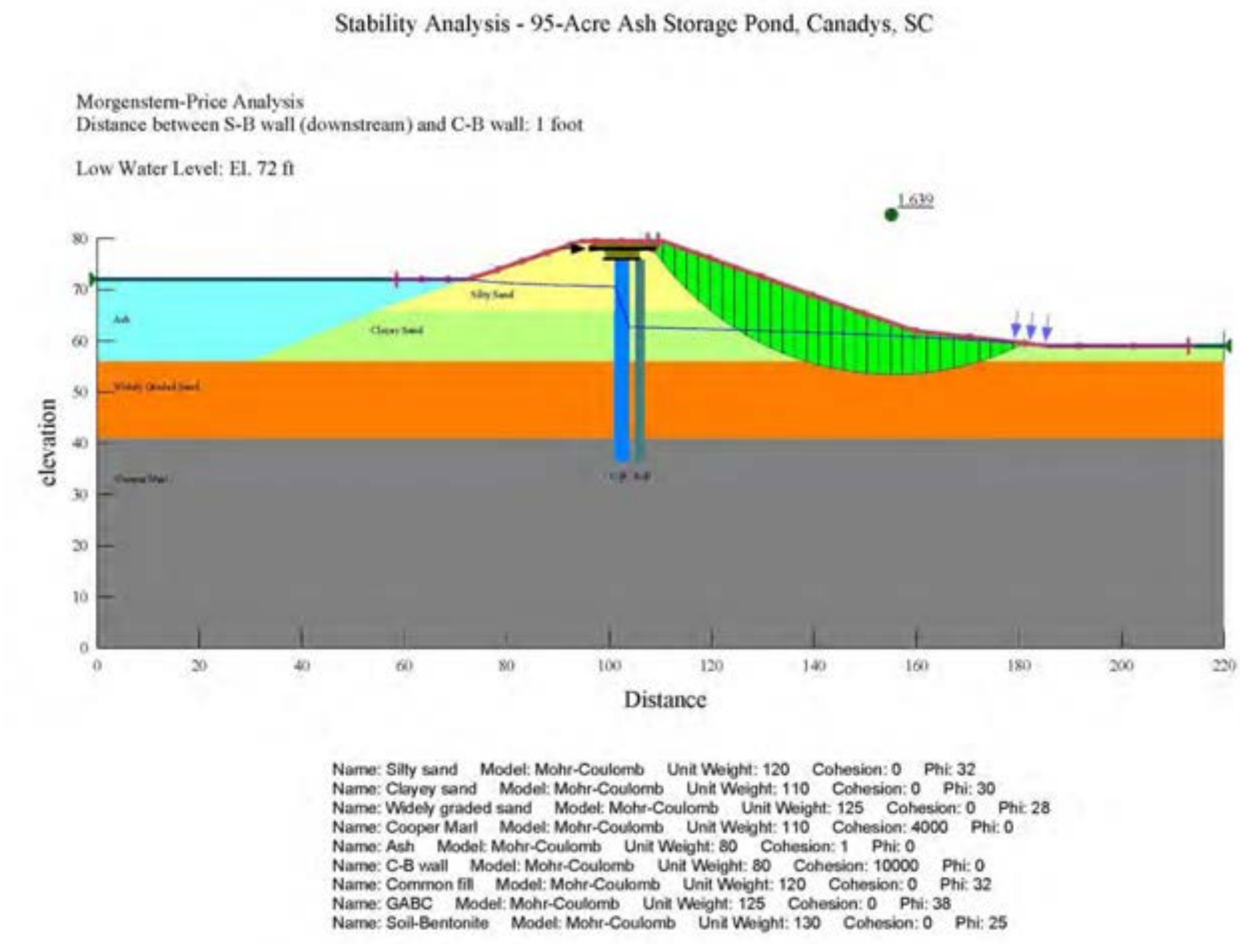


7.1.4 Factors of Safety and Base Stresses

A slope stability analysis was performed determining the factors of safety for the stability of the dike with the new slurry wall installed. A factor of safety of 1.6 for static conditions was determined which exceeds the required standard of 1.5. (See Appendix A: Doc 12 – Static Slope Stability Analysis).

Table 7.1.4a Factor of Safety against Slope Failure (Seismic Conditions)		
Slope	**Factor of Safety Low Water**	**Factor of Safety High Water**
Upstream	1.90	1.88
Downstream	1.64	1.60

Factors of safety for seismic loading conditions are listed in table 7.1.4b and do not meet the minimum required standard of 1.1. It was concluded by CDM that a deep-seated failure that would compromise the overall integrity of the dike during the design earthquake is not likely and that the dike will be capable of retaining the coal ash during and immediately following the design earthquake event. However, significant deformation of the dike slopes during the design earthquake is likely to occur, particularly for the upstream slope. These deformations could threaten the longer term integrity of the dike as a containment facility and not allow the impoundment pond to remain functional following the design seismic event until repairs are made. (Appendix A: Doc 11 – Seismic Slope Stability Analysis).

Table 7.1.4b Factor of Safety against Slope Failure (Seismic Conditions)			
Slope	**Failure Mode**	**Factor of Safety Low Water**	**Factor of Safety High Water**
Upstream	Localized and Surficial Failure	0.19	0.18
	Major and Deep Seated Failure	1.12	1.16
Downstream	Localized and Surficial Failure	0.87	0.80
	Major and Deep Seated Failure	1.01	1.00

See Appendix A: Doc 11 – Seismic Slope Stability Analysis

7.1.5 Liquefaction Potential

The CDM 2011 report evaluated the potential for liquefaction and determined the embankment material is not susceptible to widespread liquefaction with the exception of the soil-bentonite wall material. It was noted that this liquefaction screening evaluation was conducted based on limited boring, laboratory and cone penetrometer test data (Appendix A: Doc 11 – Seismic Slope Stability Analysis). Soil liquefaction in conjunction with seismic activity has been documented in the region by the University of South Carolina as well as USGS.

7.1.6 Critical Geological Conditions

The site is located within the Coastal Plain of South Carolina. The sedimentary rocks of the Coastal Plain partly consist of sediment eroded from the Piedmont and Fall Line and partly of limestone generated by marine organisms and processes. A highly calcareous-cemented clay and silt size stratum refer to as the "Cooper Marl" is typically located about 60' below the surface. The site is also located in a relatively high seismic area. The 1886 Charleston earthquake demonstrated that substantial earthquake hazards exist in the region.

Based on USGS Seismic-Hazard Maps for the Conterminous United States, the facility is located in an area anticipated to experience a 0.45 g acceleration with a 2-percent probability of exceedance in 50 years.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting technical documentation is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the dam visually appears adequate, however based on the factor of safety for seismic loading conditions, the embankment system does not meet required standards.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The ash pond was designed and operated for reservoir sedimentation and sediment storage of ash. Plant process waste water, coal combustion waste, coal pile stormwater runoff, and minimal stormwater runoff around the Ash Pond facility are discharged into the reservoir. Inflow water is treated through gravity settling and deposition, and the treated process water and stormwater runoff is discharged through an NPDES-permitted, unregulated-type overflow outlet structure.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance of the dam and project facilities is adequate, although the following maintenance items need to be addressed:

- Remediate surficial sloughing
- Bare areas should be vegetated

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate.

8.3.2 Adequacy of Maintenance

Based on the assessments of this report, maintenance procedures appear to be adequate, although some minor maintenance repairs are recommended.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Quarterly Inspections:

Quarterly inspections reports were provided by SCE&G/SCANA and can be found in Appendix A: Docs 07 – 10.

Annual Inspections:

Annual inspections were provided by SCE&G/SCANA and can be found in Appendix A: Doc 03 & 04.

9.2 INSTRUMENTATION MONITORING

The Canadys Steam Power Station ash impoundment dikes do not have an instrumentation monitoring system.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

No instrumentation is present at the Active Ash Pond, Inactive Ash Pond or Polishing Pond.

E[2]S ENVIRONMENTAL ENGINEERING SCIENCES, LLC

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION E[2]S ENVIRONMENTAL ENGINEERING SCIENCES, LLC No. 3535

REVISIONS		
No.	By:	Date:

Issued for:	By:	Date:
Review		
X Permitting	JKD	7-26-10
Bidding		
Construction		
As Built		

SCE&G® A SCANA COMPANY

SOUTH CAROLINA ELECTRIC & GAS
~~URQUHART~~ Canadys STATION
WATER FLOW DIAGRAM

Drafter: JKD
Designer: JKD

FIGURE 1

James M. Landreth
Vice President
Fossil & Hydro Operations

jlandreth@scana.com

SCE&G
A SCANA COMPANY

March 20, 2009

Mr. Richard Kinch
US Environmental Protection Agency (5306P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Mr. Kinch:

This document is prepared in response to the letter from Lisa P. Jackson dated March 9, 2009 and from Mr. Barry N. Breen dated March 9, 2009 to Chief Executive Officer, South Carolina Electric & Gas, 1426 Main Street, Columbia, South Carolina and to Plant Manager, Canadys Steam Power Station, Hwy 61, Canadys, South Carolina, Re: Request for Information Under Section 104(e) of the Comprehensive Environment Response, Compensation, and Liability Act, 42 U.S.C. 9604(e).

Please find attached my signed certification and responses to questions set forth in Enclosure A. Additionally, you will find attached Enclosure B identifying the additional facilities on the South Carolina Electric & Gas system having similar diked or bermed management units or management units designated as landfills which receive liquid-borne material from a surface impoundment used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals.

Sincerely,

James M. Landreth

Cc: Mr. William B. Timmerman, CEO
Mr. Stephen A. Byrne, Sr. Vice President Generation, Nuclear & Fossil Hydro
Plant Manager, Canadys Steam Power Station

I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate, and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature:

Name: James R. Landreth

Title: Vice President

Date: 3/23/2009

Enclosure A

1. ***Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less-than-Low, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.***

The Canadys Station management units are comprised of two ash ponds, neither of which has been assigned a hazard rating by the South Carolina Department of Health and Environmental Control. Dams and reservoirs in South Carolina are regulated pursuant to the SC Dams and Reservoirs Safety Act and the regulations pertaining thereto. Regulation 72-2.D.1 of the SC Dams and Reservoirs Safety Act Regulations exempts the following types of dams from the Dams and Reservoirs Safety Act:

> "1. Unless the hazard potential as determined by the Department is such that dam failure or improper reservoir operation may cause loss of human life, any dam which is or shall be (a) less than twenty-five feet in height from the natural bed of the stream or water course measured at the downstream toe of the dam, or twenty-five feet from the lowest elevation of the outside limit of the dam, if it is not across a stream channel or water course, to the maximum water storage elevation and (b) has or shall have an impounding capacity at maximum water storage elevation of less than fifty acre-feet."

The 80-acre "Inactive Ash Pond" and 95-acre "Active Ash Pond" dikes at Canadys Station are no more than 12 feet and 20 feet in height, respectively. Since both of the pond dikes are less than 25 feet in height, the ponds are exempt from the Act per Regulation 72-2.D.1 and therefore no ratings have been assigned.

2. ***What year was each management unit commissioned and expanded?***

The 80-acre "Inactive Ash Pond" was commissioned in 1974 and received coal combustion byproducts until 1989. The 95-acre "Active Ash Pond" was commissioned in 1989 and continues to receive coal combustion byproducts. The description for management units for coal combustion residuals/by-products offered in the USEPA March 9, 2009 letter is widely encompassing and, upon its most conservative interpretation, could be broadly construed to include the following other ponds/basins at the Canadys Steam Power Station:

- Settling Ponds #1 and #2
- Coal Pile Runoff Basins #1 and #2
- Coal Pile Runoff Detention Basin
- Low Volume Waste Ponds A, B, & C
- Spray Pond

The above ponds/basins are primarily used for wastewater treatment purposes and are not designated as landfills/impoundments for the storage or disposal of coal combustion byproducts. SCE&G therefore believes that these ponds/basins are not consistent with the intentions of EPA's Request for Information and we have limited our responses to the "Inactive" and "Active" Ash Ponds.

3. ***What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash; (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).***

Both the "Inactive Ash Pond" and "Active Ash Pond" permanently contain fly ash, bottom ash, pyrites and boiler slag

Enclosure A

4. ***Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?***

The "Active Ash Pond" was designed by a SCE&G Professional Engineer and its construction was performed under the supervision of Professional Engineers.

The "Inactive Ash Pond" was designed by the engineering company of Gilbert Associates, Inc. While detailed documentation for the original design and construction of the pond is limited; in 1995, SCE&G commissioned Coastal Engineering and Testing to conduct a geotechnical engineering evaluation of subsurface soils under the supervision of Professional Engineers. Through soil boring evaluations, the dikes were determined to be of sound construction.

Routine, scheduled inspections and monitoring of the ash ponds are not performed under the supervision of a Professional Engineer. Currently SCE&G performs assessments/evaluations of the dike structure for both ash ponds as part of the NPDES permit on an annual basis. The results are internally documented. The annual inspection reports are not submitted to DHEC unless a finding is identified or a corrective action plan is required. A daily visual inspection is performed to look for signs of cracking, settling, slope movement, erosion and vegetation growth. If any follow up action is required, a Work Order is written and the items completed and closed out in a timely manner. All follow up actions to date have been for minor maintenance.

5. ***When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?***

Structural integrity assessments/evaluations for static stability were performed on the 95-acre "Active Ash Pond" in 2002, 2005, and 2007. The 2002 assessment/evaluation was performed by General Engineering, an engineering consulting firm specializing in environmental consulting and engineering design. The 2005 study was performed by GEI Consultants, Inc (GEI), and the 2007 study was performed by Camp, Dresser, & McKee (CDM). GEI and CDM are geotechnical engineering specialists. No structural integrity corrective actions were taken, planned, or deemed necessary as a result of the 2002, 2005, or 2007 assessments.

As stated in Response #4, in 1995, SCE&G contracted Coastal Engineering and Testing to conduct a geotechnical engineering evaluation of subsurface soils of the 80-acre "Inactive Ash Pond". Through soil boring evaluations, the dikes were determined to be of sound construction. The geotechnical evaluation was performed under the supervision of Professional Engineers

6. ***When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.***

Enclosure A

SCE&G is not aware of past inspections by State or Federal regulatory officials for the purpose of evaluating the safety (structural integrity) of the ponds. SCE&G is not aware of any planned State or Federal inspections in the future.

The South Caroline Department of Health and Environmental Control (SCDHEC) periodically inspects the ash ponds. However, these inspections are generally for NPDES permit compliance purposes and do not involve evaluations of the structural integrity of the ponds.

7. ***Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.***

No

8. ***What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of materials currently stored in each of the management unit(s)? Please provide the date that the volume measurement(s) was taken. Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure.***

The "Inactive Ash Pond" has a surface area of approximately 80 acres and a total calculated storage capacity of 1,613,300 cubic yards. The volume of materials currently stored in the "Active Ash Pond" is estimated to be 675,000 cubic yards SCE&G's estimate of the volume of materials currently stored in the "In Active Ash Pond" is based on a detailed bathymetric survey of the pond performed in September 2004. The maximum height of the pond is 12 feet.

The "Active Ash Pond" has a surface area of approximately 95 acres and a total calculated storage capacity of 2,270,200 cubic yards. The volume of materials currently stored in the "Active Ash Pond" is estimated to be 2,189,468 cubic yards. SCE&G's estimate of the volume of materials currently stored in the "Active Ash Pond" is based on a detailed bathymetric survey of the pond performed in September 2004, ash disposal records for the period September 2004 to present, and ash removed from the pond for recycling for the period September 2004 to present. The maximum height of the pond is 20 feet.

9. ***Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).***

Upon information and belief, there have not been any spills or unpermitted releases from the ash ponds within the last ten years.

10. ***Please identify all current legal owner(s) and operator(s) at the facility.***

The Canadys Steam Power Station facility to include the subject ash ponds is legally owned and operated by SCE&G

Enclosure B

Urquhart Station
100 Keith Mullis Drive
Beech Island, South Carolina 29842

Wateree Station
142 Wateree Station Road
Eastover, South Carolina 29044

2010 ANNUAL ASH POND DIKE INSPECTION
CANADYS STATION

2010 ANNUAL ASH POND DIKE EVALUATION

The earthen retaining structures at the Canadys Station Project were visually evaluated on December 14, 2010. This consisted of visiting the site and visually inspecting the condition of the berms of the operational (active) ash ponds, the berms of the polishing pond, and the berms of the non-functioning (inactive) ash pond. The visual inspection was conducted by James Devereaux and Michelle Camburn.

Prior to arriving on-site, the quarterly inspection sheets were reviewed for any site specific or general concerns by plant personnel, recurrent problems, state of the wet areas observed on June 19, 2009, existing conditions that had been previously addressed, or any concerns regarding the existing conditions, integrity, and/or performance of the earthen retaining structures. The quarterly reports are included in Appendix A of this report.

The purpose of this report is to present the findings and observations noted during the visual inspection of the earthen ash pond dikes. For the purposes of this report, the terms "earthen retaining structure," "berm," and "embankment" are used interchangeably. Also, the term "upstream" shall refer to the interior face of the ash pond and "downstream" shall refer to the exterior and most visible face of the ash pond dike. This report describes the observed site conditions as they appeared during the field reconnaissance of the earthen retaining structures.

The scope of this report is limited to a visual inspection of the physical appearance of the embankments during the on-site reconnaissance, documenting any observed potential indicators of adverse conditions, and drafting a report. This report is in no way presented as, or intended to be, a thorough evaluation of the structural integrity, susceptibility to seismically induced damage, or static and/or dynamic stability of slopes, embankments, berms, impoundments, or other earthen retaining structures.

Potential indicators of adverse conditions sought included, but were not limited to, the presence of additional saturated areas on the downstream face of the slopes, increased flow or deteriorating conditions of the wet areas discovered in June 2010, erosion, the presence of cloudy (turbid) water in ditches/puddles/shallow depressions, the presence of sloughs/slides, the existence of animal burrows or woody vegetation on embankments, extensive/abnormal leakage/erosion at or near drainage structures, general appearance, or the need for routine maintenance. Any such conditions were noted and are included in the findings section of this report as, are recommendations for further action.

To standardize this report, the Wet Areas discovered on June 19, 2009 are designated and distinguished as follows: Wet Area 1 (WA-1) is the area that was excavated, had erosion control sock installed, and had rock placed in it to form a surface relief drain. Wet Area 2 (WA-2) is the wet area where erosion control sock was installed, but no rock.

FINDINGS AND RECOMMENDATIONS

The following situations were noted during field reconnaissance operations:

- Plant personnel have aggressively repaired and maintained the ash pond dikes as recommended in the 2009 Report
- The trench caused by the slurry wall construction silt fence, as noted in 2009 Report, has been completely repaired
- Minor surface erosion is present on some areas of the downstream faces of the ash pond berms where hydroseeding was not successful
- Some rutting of soft surface soils was observed where mowing equipment was used on the exterior face of the active pond
- One berm separating the polishing pond from active ash pond appears to have a very small localized slough
- All of the woody vegetation observed in 2009 to be growing within the rip rap on the downstream slope of the active pond inspections has been removed
- All "volunteer" Wax Myrtle (Privet) growing on the interior embankment face of the inactive pond has been cut down to facilitate visual inspection of the interior face of the dike. Volunteer is a term used to describe vegetation that has grown of its own accord and was not planted by human activity. This vegetation is so thick as to almost appear as a privacy screen or hedgerow
- Inside the area of the inactive pond where little or no water is apparent, grass resembling Pampas Grass, grows thickly and abundantly

WET AREA EVALUATION

WA-1 exhibited no signs of seepage and very little standing water was apparent in this area. After heavier or more extensive rains, water usually ponds downstream of the rock in front of the erosion control sock. WA-2 was completely dry and the soils exhibited no moistness.

RECOMMENDATIONS

1. All eroded areas and areas that need to be re-seeded should have a thin layer (4 in.) of top soil placed over the surface soils, and be re-vegetated.

2. Any new woody vegetation found growing on the upstream face of the active ash pond dike should be removed, to include the root system, and the holes/voids caused by removal should be addressed in the same manner as presented in the 2009 Report.

3. When feasible for the plant, the small trees (approximately 5-10) growing in the active pond should be removed before they get too large.

4. No further action with respect to vegetation, both woody and herbaceous, growing inside the inactive ash pond, other than visual monitoring and routine maintenance of drainage ditches within the pond, needs to be taken at this time.

5. Routine maintenance such as grass mowing, fertilizing, applying herbicide to rip rap armored banks at entry ramp, etc. and regularly scheduled quarterly visual inspections and an annual evaluation by the Dam Safety Engineer (i.e. the implementation of the Ash Pond Inspection Program) should continue. Plant Operations and Management (O&M) Procedures should be modified to include the recommendations specified herein.

6. An Emergency Action Plan (EAP), modeled after similar such FERC mandated plans for high hazard dams, should be crafted by the Hydro Dam Safety Compliance Division. This plan would be internally reviewed and updated annually. A comprehensive review would be conducted every five years with Federal, State, and Local Emergency Response Officials.

CONCLUSIONS

Based on the information presented herein and the visual inspection of the ash pond dikes at Canadys Station, at this time the earthen structures forming both the active and inactive ash pond dikes appear to be stable and functioning as designed.

CERTIFICATION

This report presents my findings and recommendations. If there are any questions or I can be of further assistance, please do not hesitate to contact me.

Respectfully submitted,

James R. Devereaux

James R. Devereaux, P. E.

C: J. M. Landreth/M. C. Summer
T. Miller
K. W. Wicker/M. C. Camburn
Hydro Dam Safety Compliance File
Corporate Records

APPENDIX A
QUARTERLY
INSPECTION
REPORTS

Canady's Station 3/15/10

Pond Dike Inspection Form

Pond Identification: Ash Pond 006 **(example: LVW A, Coalpile Runoff, etc...)**

I. General

a. Weather: Clear 65°

b. Most recent precipitation date, type, and estimated amount: 3/12/10 1 ¼" rainfall

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Nothing at time of inspection

d. Approximate Water Level in Pond: Normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

Is discharge flow muddy, cloudy, dark, or otherwise discolored ____ No ____ Yes

II. Interior Embankment Face Condition

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.):

b. Is *any* woody vegetation present: ✓ No ______ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ______

c. Is surface erosion present: ✓ No ______ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ______

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ______ Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. ______

III. **Exterior (Downstream) Embankment Face Condition**

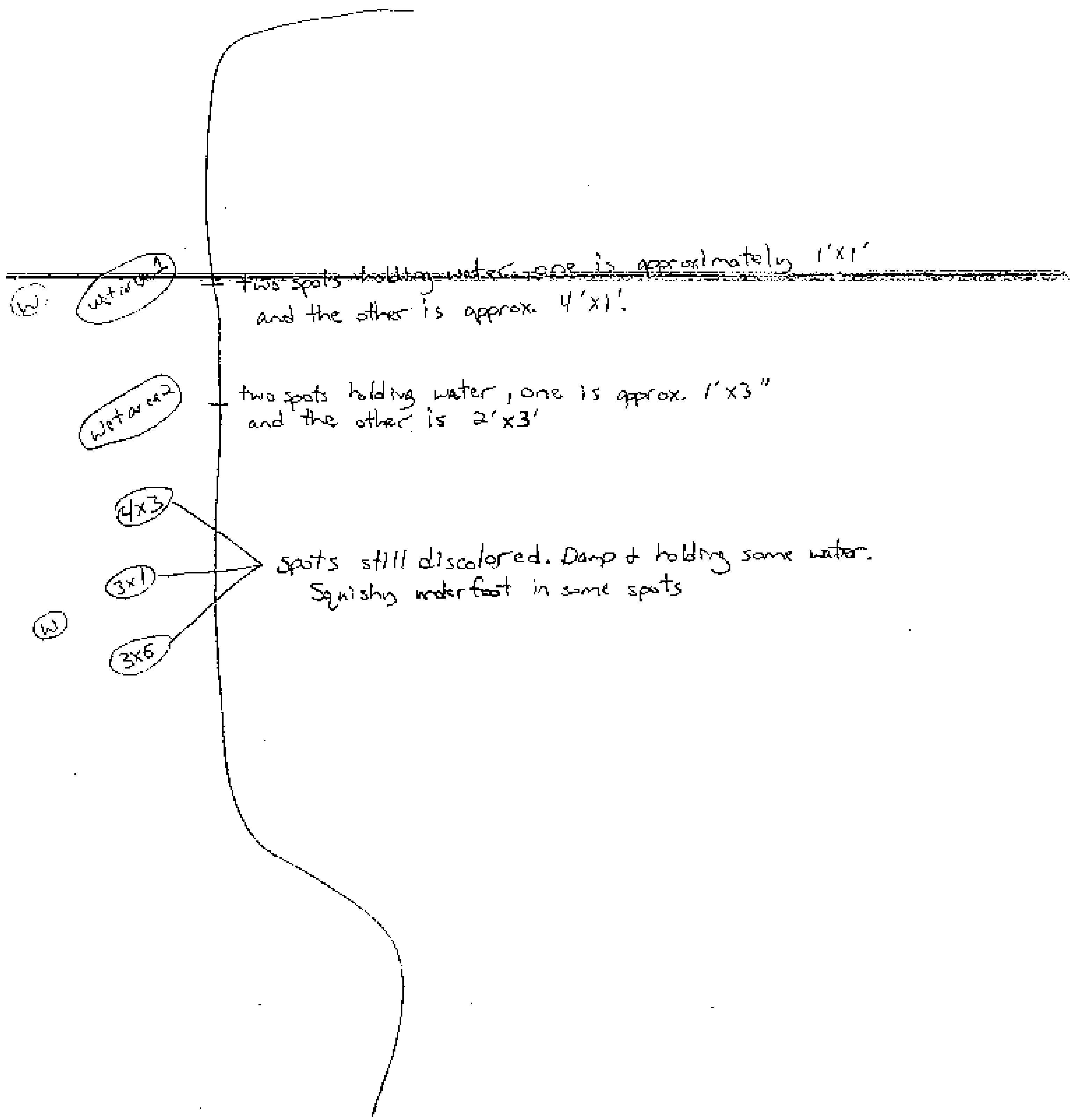
a. Vegetation/Ground Cover Condition: ✓ Satisfactory ______ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ______

b. Is *any* woody vegetation present: ✓ No ______ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ______

c. Surface erosion or gullies present: ✓ No ______ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ______

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ___ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form ______

e. Any wet areas or areas of dark/discolored soil present: ______ No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch. With all of the rain lately not sure of the impact on the areas noted.



W
wet area 1
two spots holding water, one is approximately 1'x1' and the other is approx. 4'x1'.
wet area 2
two spots holding water, one is approx. 1'x3" and the other is 2'x3'
4x3
3x1
3x6
spots still discolored. Damp & holding some water. Squishy underfoot in some spots
W

f. Any visible seepage or presence of areas of flowing water on the berm itself: \/ No___Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No___Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form___

g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: \/ No___Yes, if so, **identify color**, describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form___

h. Any evidence of the presence of burrowing animals: \/ No___Yes, if so, describe___

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot:___No \/ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch. With all of the rain lately not sure of the impact on the areas noted.

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present: \/ No___Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.___

b. Any sloughing, sliding, or other visible signs of embankment failure: \/ No___Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form___

c. Any wet areas or areas of dark/discolored soil present: √ No ____ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: √ No ____ Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

e. Any depressions or sinkholes visible on top of either berm: √ No ____ Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

V. **Other**

VI. Any conditions observed on any portion of the embankment not described above: √ No ____ Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

VII. **Certification of Inspection**

Inspection performed by:

Name	Title	Date
Donald McBauer	Lab Analyst	3/15/10
[signature]	Env. Tech	3/16/10
Michelle Camden	E/S Supervisor	3/16/10

Performed on 6/28/10 7:30 AM

Canady's Station Active Ash Pond Dike Inspection Form

I. General

a. Weather: Clear sky, Hot & Humid

b. Most recent precipitation date, type, and estimated amount: 6/26/10 Rain .05 inches

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Ash removal

d. Approximate Water Level in Pond: Normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

Is discharge flow muddy, cloudy, dark, or otherwise discolored ✓ No ____ Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is *any* woody vegetation present: ✓ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!!*) ____

c. Is surface erosion present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No____
______Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc.______________

III. **Exterior (Downstream) Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory________Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.):______________

b. Is ***any*** woody vegetation present:________No ✓ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* some vegetation along ditch to be pulled soon

c. Surface erosion or gullies present: ✓ No__________Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.______________

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No____Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form______________

e. Any wet areas or areas of dark/discolored soil present:__________No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form______________

f. Any visible seepage or presence of areas of flowing water on the berm itself: ✓ No____Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No____Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form______________

g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: ✓ No ______ Yes, if so, **identify color,** describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ______

h. Any evidence of the presence of burrowing animals: ✓ No ______ Yes, if so, describe ______

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot: ______ No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ______

IV. Crest of Berm Condition

a. Surface erosion or gullies present: ✓ No ______ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ______

b. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ____ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form ______

c. Any wet areas or areas of dark/discolored soil present: ✓ No ______ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: √ No____Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form_________________________________

e. Any depressions or sinkholes visible on top of either berm: √ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form__________

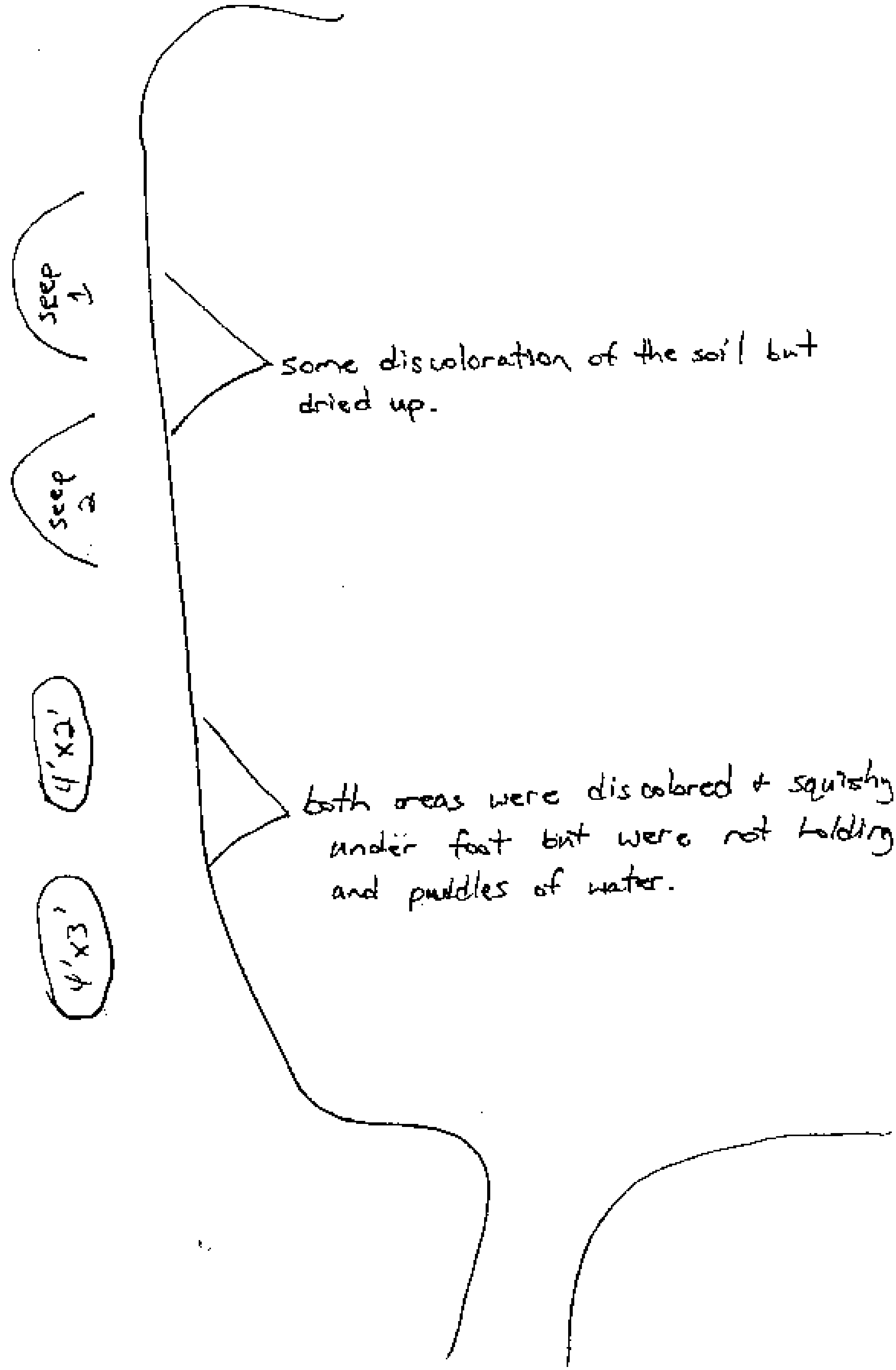
V. **Other**

a. Any conditions observed on any portion of the embankment not described above: √ No ______Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

VI. **Certification of Inspection**

Inspection performed by:

Name	Title	Date
Donald Barco	Lab Analyst	6/29/10
Michelle Cardrera	EIS Supervisor	6/29/10


SEEP 1
seep 2
some discoloration of the soil but dried up.
4'x2'
4'x3'
both areas were discolored + squishy under foot but were not holding and puddles of water.

Canady's Station Active Ash Pond Dike Inspection Form

I. **General**

a. Weather: Clear and around 75°

b. Most recent precipitation date, type, and estimated amount: 9/27/10 2.25"

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Ash removal

d. Approximate Water Level in Pond: Little higher than normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

Is discharge flow muddy, cloudy, dark, or otherwise discolored ___No ___Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is *any* woody vegetation present: ✓ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!*) ____

c. Is surface erosion present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure:___✓___No____ ____Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc.________

III. **Exterior (Downstream) Embankment Face Condition**

a. Vegetation/Ground Cover Condition:_______Satisfactory_✓____Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.):________
Needs mowing

b. Is *any* woody vegetation present:__✓__No______Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)*________

c. Surface erosion or gullies present:_____No______Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.__N/A____

* See back of this page

d. Any sloughing, sliding, or other visible signs of embankment failure:____No____Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form____N/A____

e. Any wet areas or areas of dark/discolored soil present:______No______Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____N/A____

* See back of this page

f. Any visible seepage or presence of areas of flowing water on the berm itself:_✓_No____Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No____Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________

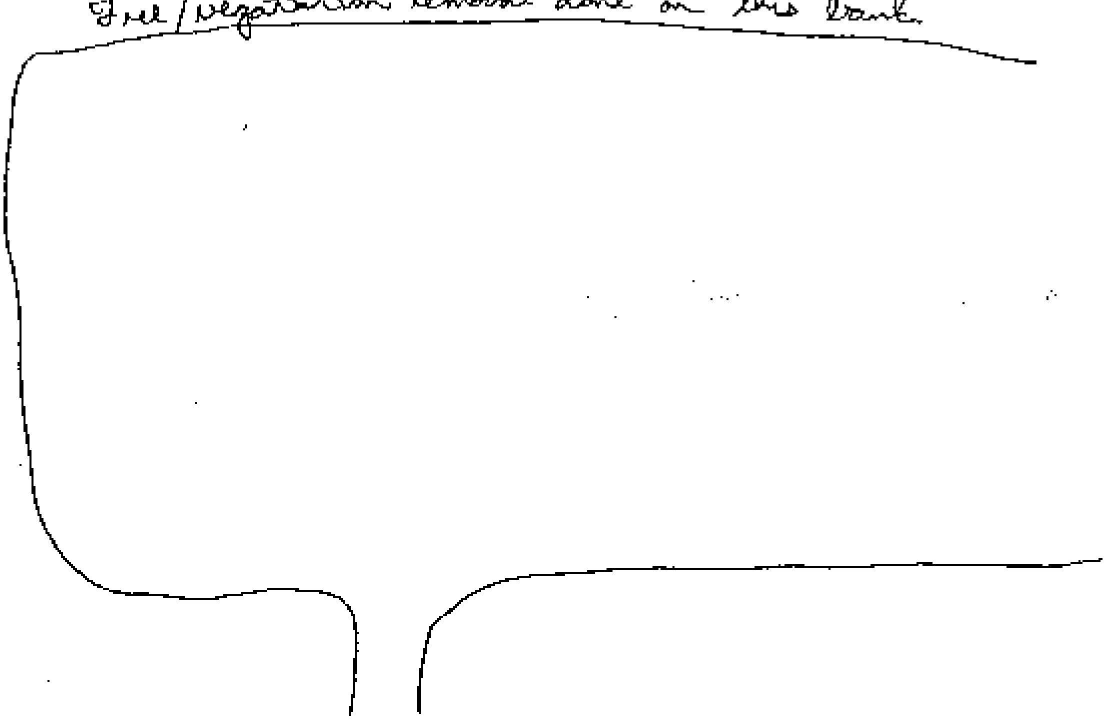
- Clay was packed into areas around the pond where silt fence had previously been and was causing some minor sloughing.

- Because of the height of the uncut grass no inspection was done. The grass is too high to do a proper inspection of the dike wall because you cannot see the ground. This also creates a safety issue because of possibly steping into holes that can't be seen, snakes, deelnis, etc.

- Some tree/vegetation removal was done so the dike is in better condition in those areas.

- Because of heavy rains and equipment driving over the squishy/seep areas, these areas were hard to compare to previous reports. Will report on next inspection.

Tree/vegetation removal done on this bank.



g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: ✓ No ____ Yes, if so, identify color, describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

h. Any evidence of the presence of burrowing animals: ____ No ____ Yes, if so, describe

N/A

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot: ____ No ____ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

N/A

* See back of page 2

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present: ____ No ✓ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.

6' x 8' section next to entrance of deck at pH system building.

b. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ____ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form

c. Any wet areas or areas of dark/discolored soil present: ✓ No ____ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: ✓ No____Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____________

e. Any depressions or sinkholes visible on top of either berm: ✓ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form__________

V. **Other**

a. Any conditions observed on any portion of the embankment not described above: ✓ No ______Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____________

VI. **Certification of Inspection**

Inspection performed by:

Donald Barron	Lab Analyst	9/29/10
Name	Title	Date

Michelle

2009 ANNUAL ASH POND DIKE INSPECTION
CANADYS STATION

2009 ANNUAL ASH POND DIKE EVALUATION

The earthen retaining structures at the Canadys Station Project were visually evaluated on December 4, 2009. This consisted of visiting the site and visually inspecting the condition of the berms of the operational (active) ash ponds, the berms of the polishing pond, and the berms of the non-functioning (inactive) ash pond. The visual inspection was conducted by James Devereaux and Michelle Camburn.

Prior to arriving on-site, the monthly and quarterly inspection sheets were reviewed for any site specific or general concerns by plant personnel, recurrent problems, state of the wet areas observed on June 19, 2009, existing conditions that had been previously addressed, or any concerns regarding the existing conditions, integrity, and/or performance of the earthen retaining structures.

The purpose of this report is to present the findings and observations noted during the visual inspection of the earthen ash pond dikes. For the purposes of this report, the terms "earthen retaining structure," "berm," and "embankment" are used interchangeably. Also, the term "upstream" shall refer to the interior face of the ash pond and "downstream" shall refer to the exterior and most visible face of the ash pond dike. This report describes the observed site conditions as they appeared during the field reconnaissance of the earthen retaining structures.

The scope of this report is limited to a visual evaluation, only, of the physical appearance of the embankments during the on-site reconnaissance, documenting any observed potential indicators of adverse conditions, and drafting a report. This report is in no way presented as, or intended to be, a thorough evaluation of the structural integrity, susceptibility to seismically induced damage, or static and/or dynamic stability of slopes, embankments, berms, impoundments, or other earthen retaining structures.

Potential indicators of adverse conditions sought included, but were not limited to, the presence of additional saturated areas on the downstream face of the slopes, increased flow or deteriorating conditions of the wet areas discovered in June 2009, erosion, the presence of cloudy (turbid) water in ditches/puddles/shallow depressions, the presence of sloughs/slides, the existence of animal burrows or woody vegetation on embankments, extensive/abnormal leakage/erosion at or near drainage structures, general appearance, or the need for routine maintenance. Any such conditions were noted and are included in the findings section of this report as, are recommendations for further action. Photographs are contained in the Appendix A of this report.

To standardize this report, the Wet Areas discovered on June 19, 2009 are designated and distinguished as follows: Wet Area 1 (WA-1) is the area that was excavated, had erosion control sock installed, and had rock placed in it to form a surface relief drain. Wet Area 2 (WA-2) is the wet area where erosion control sock was installed, but no rock.

FINDINGS AND RECOMMENDATIONS

The following situations were noted and photographed during field reconnaissance operations:

Active Pond

- Minor surface erosion is present on some areas of the downstream faces of the ash pond berms
- Some sloughing has occurred where the silt fence was trenched into the dike during the recent slurry wall construction
- One berm separating the polishing pond from active ash pond appears to have been damaged by construction related traffic during the recent slurry wall construction. A small localized slough was noted
- Some of the woody vegetation observed to be growing within the rip rap on the downstream slope of the active pond during earlier inspections has been removed
- Woody vegetation was also observed growing on the downstream slope of the inactive pond
- Small, erosion related slides were noted on the downstream face of the inactive pond berms. They appear to be surficial and easily repaired
- Several small trees were observed growing on the interior embankment face in some areas of the active pond as well as on the downstream side of the embankment near the pipe outfall structure
- Along the downstream toe of the active ash pond dike deep ruts caused by vehicular traffic apparently caused by the Consultant who had recently sampled the monitoring wells were apparent

Inactive Pond

- Most of the upstream face of the inactive ash pond has "volunteer" Wax Myrtle (Privet) growing on the interior embankment face. Volunteer is a term used to describe vegetation that has grown of its own accord and was not planted by human activity. This vegetation is so thick as to almost appear as a privacy screen or hedgerow
- Inside the area of the inactive pond where little or no water is apparent, grass resembling Pampas Grass, grows thickly and abundantly

- Of note in both ponds, is the prevalence of medium, large, and very large trees growing in the ash itself. These plants appear to be flourishing

- Waterfowl have been observed in a small area of impounded water within the inactive pond

WET AREA EVALUATION

WA-1 is constantly seeping and water is readily apparent in this area at any given time. After heavier or more extensive rains, water usually ponds downstream of the rock in front of the erosion control sock. WA-2 is only intermittently wet and the soils in this area exhibit varying degrees of moistness from dry to moist to wet to saturated to submerged.

During the December inspection, areas of standing water were observed on the ash pond dikes at various locations. Each time the standing water was situated at the toe of the berm and very localized. Samples of all puddled water were collected and analyzed for total metals. Samples of sediments underneath were collected and analyzed for Toxicity Characteristic Leaching Procedure (TCLP). Arsenic in all water and soil samples was below detectable limits. Barium was very high in all samples, as is to be expected in this area of South Carolina. Some areas exhibited slightly elevated levels of Selenium, Lead, or Cadmium. Samples taken from WA-1 and WA-2 showed substantial decreases in Arsenic results from the June analyses to the December analyses. The sampling results collected during the December Inspection are included in Appendix B of this report, and show that for all samples the Arsenic concentrations are below the detectable limits.

GEOPHYSICAL INVESTIGATION

On September 29, 2009, F&ME Consultants was commissioned to perform a Geophysical Investigation of the southern berm that parallels SC Highway 15, upon which WA-1 and WA-2 were observed. They were able to ascertain from their investigation that the wet areas are being caused by a combination of a rise in the water table elevation due to increased rainfall in 2009, matric suction induced capillary rise of water within the unsaturated soils overlying the water table and underlying the berm, and perched stormwater within the soils of the ash pond dike itself.

RECOMMENDATIONS

1. All eroded areas, sloughs, and the remaining slurry wall construction silt fence trench within or on the actual berms should be filled with a sandy Clay material, compacted with a man portable compactor (vibratory plate, "jumping jack," etc., have top soil placed over the fill, and be re-vegetated. This work may be performed using Company personnel and equipment

2. Ponding/standing water at the toe of the dikes should be visually monitored for perceived increases in size.

3. Non-construction and maintenance related vehicular traffic at the toe of the berms is to be immediately and strictly prohibited. All vehicles driven in for sampling will be required to drive along the road on the crest of the berm. Wells will have to be accessed by walking down the crest to the instruments to conduct required measurements.

4. All locations where woody vegetation has been removed on the downstream face of the active ash pond dike should have the rip rap removed and addressed in the same manner as described in Recommendation #1 above.

5. Woody vegetation presently growing on the upstream face of the active ash pond dike should be removed, to include the root system, and the holes/voids caused by removal should be filled and addressed in the same manner outlined in Recommendation #1.

6. No further action with respect to vegetation, both woody and herbaceous, growing inside the inactive ash pond, other than visual monitoring and routine maintenance of drainage ditches within the pond, needs to be taken at this time.

7. Routine maintenance such as grass mowing, fertilizing, applying herbicide to rip rap armored banks at entry ramp, etc. and regularly scheduled quarterly visual inspections and an annual evaluation by the Dam Safety Engineer (i.e. the implementation of the Ash Pond Inspection Program) should continue. Plant Operations and Management (O&M) Procedures should be modified to include the recommendations specified herein.

8. An Emergency Action Plan (EAP), modeled after similar such FERC mandated plans for high hazard dams, should be crafted by the Hydro Dam Safety Compliance Division. This plan would be internally reviewed and updated annually. A comprehensive review would be conducted every five years with Federal, State, and Local Emergency Response Officials.

CONCLUSIONS

Based on the information presented herein and the physical inspection of the ash pond dikes at Canadys Station, at this time the earthen structures forming both the active and inactive ash pond dikes appear to be stable and functioning as designed.

CERTIFICATION

This report presents my findings and recommendations. If there are any questions or I can be of further assistance, please do not hesitate to contact me.

Respectfully submitted,

James R. Devereaux, P. E.

C: M.C. Summer
J. K. Todd
T. Miller
K. W. Wicker
M. C. Camburn
S. Mangan-Bryson
T. N. Effinger
J. H. Hamilton
Hydro Dam Safety Compliance File
Corporate Records

APPENDIX A
PHOTOGRAPHS

Figure 1: Perched Water Wet Area (Typical)

Figure 2: WA-2 at Time of Annual Inspection

Figure 3: WA-1 at Time of Annual Inspection

Figure 4: Standing Water Near Rip Rap Armoring at Southwestern Corner of Active Pond

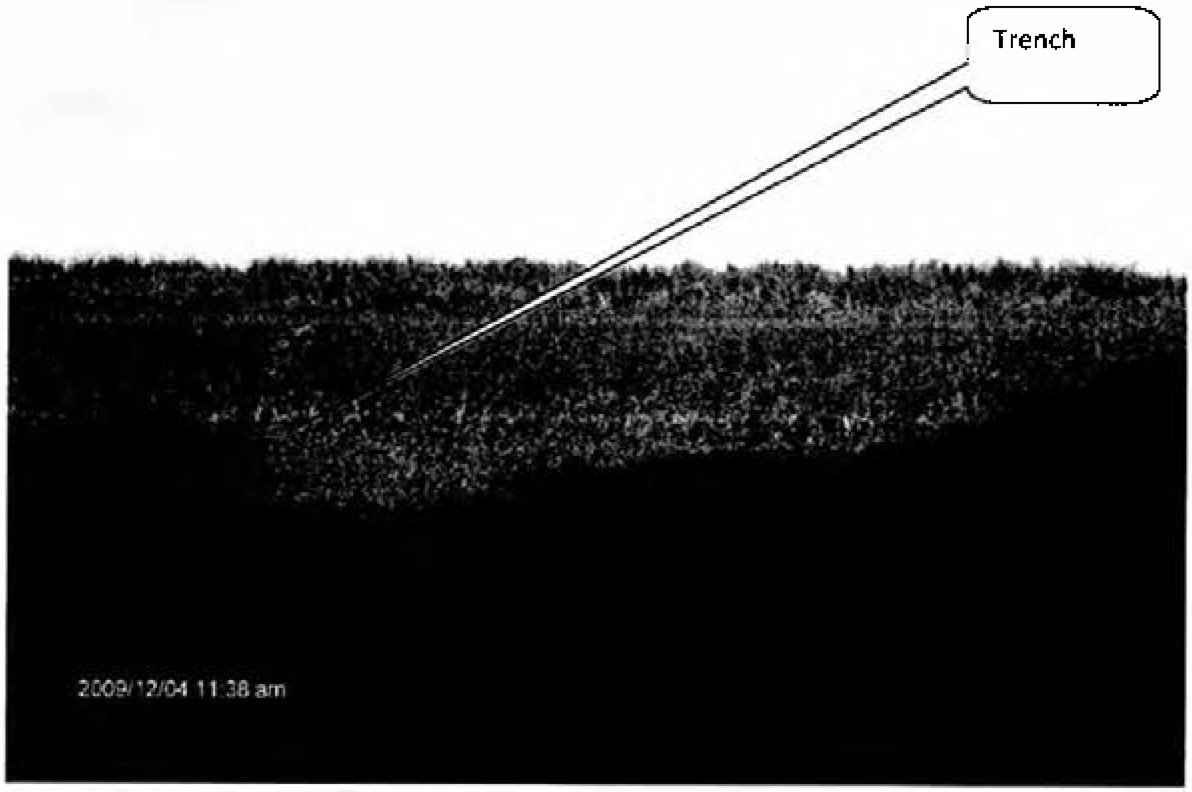


Figure 5: Berm Damage Due to Silt Fence Removal without Properly Backfilling

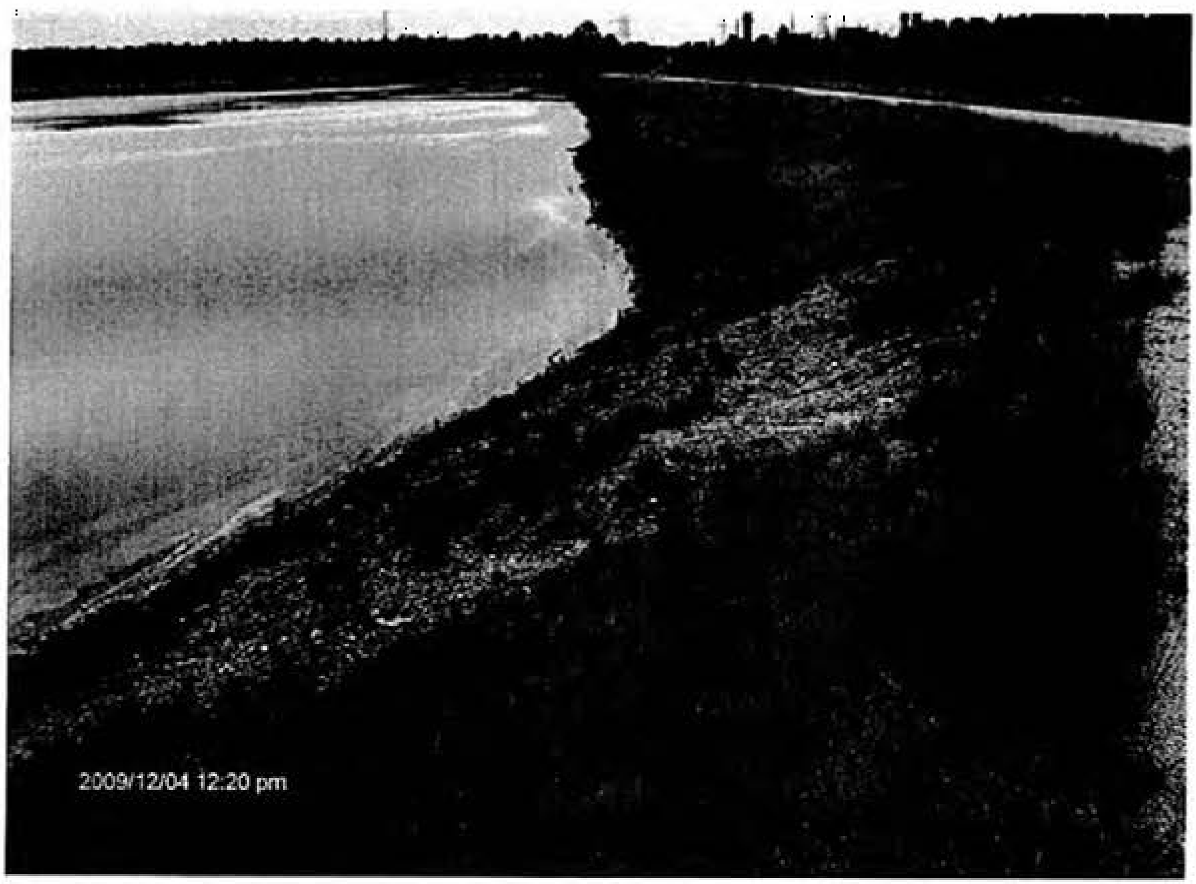


Figure 6: Erosion Damage and Lack of Vegetation Interior of Active Pond

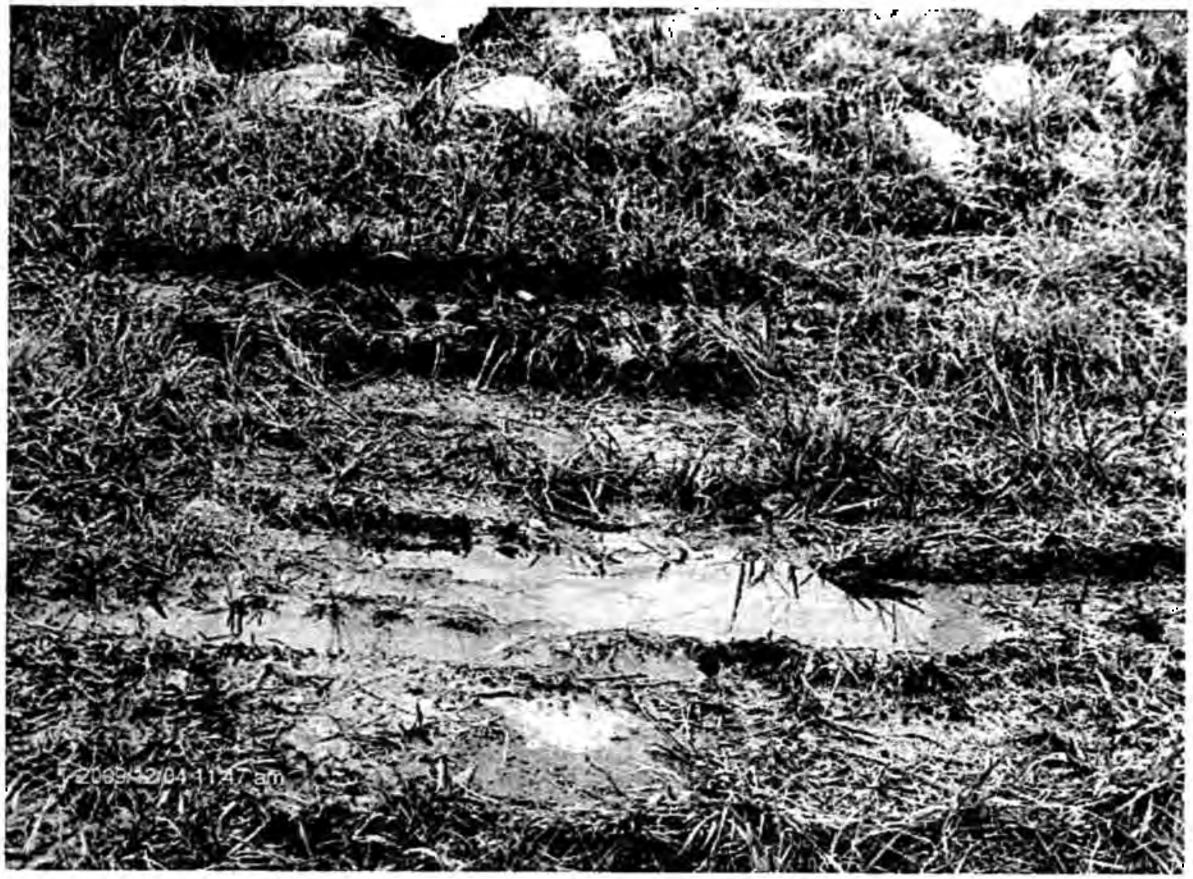


Figure 7: Example of Area of Standing Water along Toe of Active Pond West Berm

Figure 8:Example of Area of Standing Water Along Toe of Active Pond West Berm

Figure 9: Example Damage from Driving Pick-Up Truck on Toe of Berm

Figure 10: Example Damage from Driving Pick-Up Truck on Toe of Berm

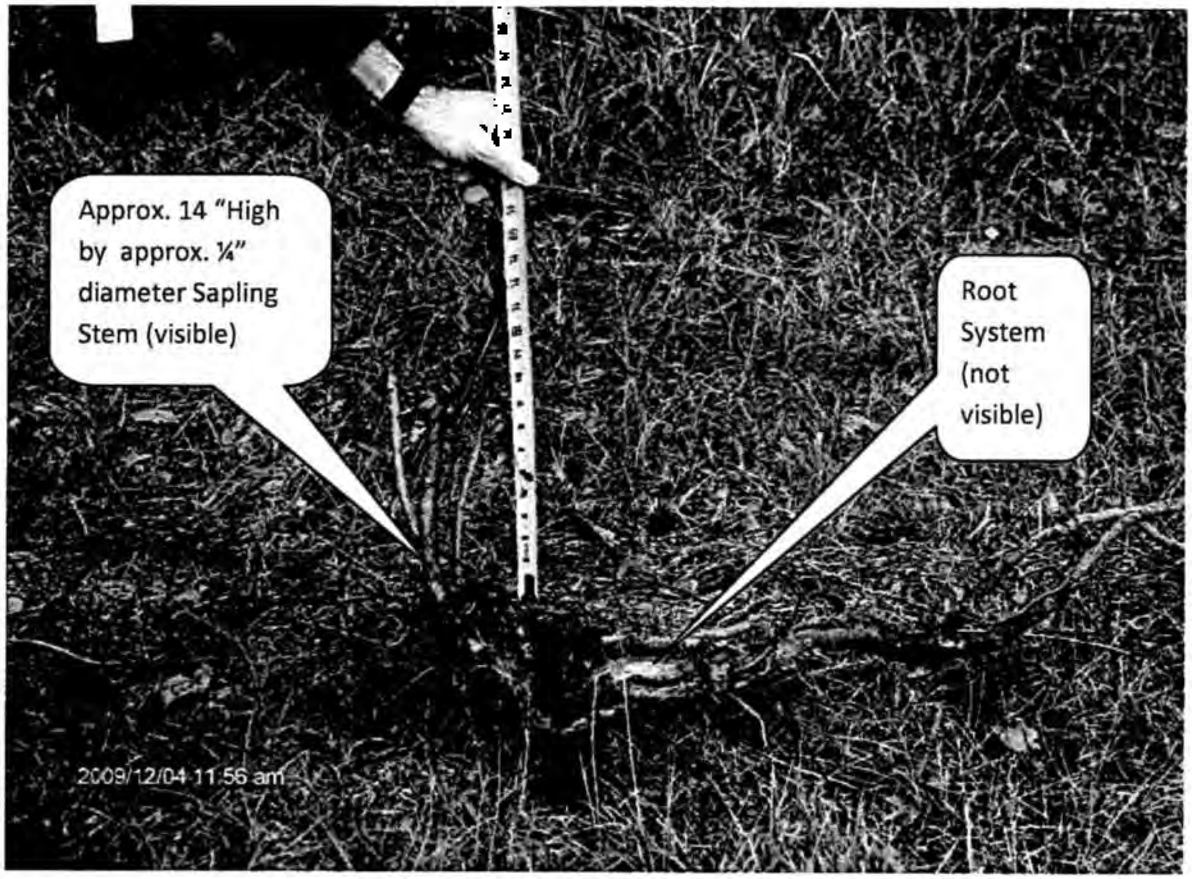


Figure 11: Example of Woody Vegetation Growing on Downstream Side of Berm

Figure 12: Example of Woody Vegetation Growing on Downstream Side of Berm

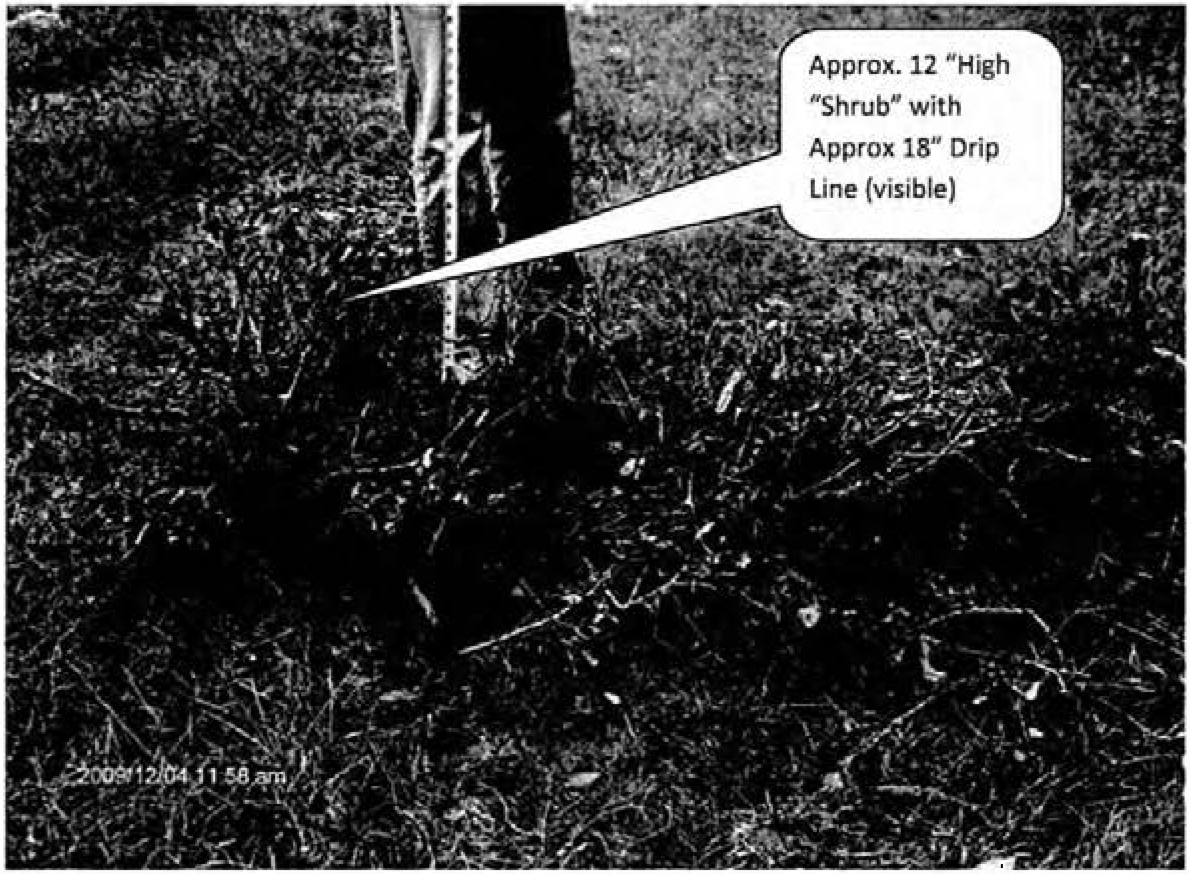


Figure 13: Cut Sapling That Began Growing Shrub-like After Cutting. NOTE: This is the Same Plant Depicted in Figure 12

Figure 14: Volunteer Privet Growing on Interior of Inactive Ash Pond

Figure 15: Thick "Pampas" Type Grass Growing in Inactive Pond

Figure 16: Ducks Swimming in Impounded Water within Inactive Pond

APPENDIX B
DECEMBER 2009
SAMPLING DATA

SCE&G
A SCANA COMPANY

Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84403** **Canadys Wet Area E-15**
	Date & Time Sampled: December 07, 2009 08:40
	Date & Time Submitted: December 07, 2009 12:10
	Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	86	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	5.7	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: ______________________

SCE&G®
A SCANA COMPANY

Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84405** Canadys Wet Area E-21 Date & Time Sampled: December 07, 2009 08:40 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	32	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

SCE&G
A SCANA COMPANY

Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84407** Canadys North End Toe 1A
	Date & Time Sampled: December 07, 2009 08:50
	Date & Time Submitted: December 07, 2009 12:10
	Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	157	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	1.2	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	7.5	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84408** <u>Canadys North End Toe 1B</u> Date & Time Sampled: December 07, 2009 08:50 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	**Result**	**MDL**	**Units**	**Completed Analysis Date & Time**		**Chemist**
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	18	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: ____________

SCE&G®
A SCANA COMPANY

Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84409** Canadys North End Toe Date & Time Sampled: December 07, 2009 08:50 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TCLP

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	250	20.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	2.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Selenium - 6010C (RCRA)	14	10.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
TCLP Extraction, EPA 1311	Completed			12/10/09	11:00	TG

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

SCE&G
A SCANA COMPANY

Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:
Michelle Camburn P04

Sample ID: **AA84410** Canadys Westside Wet Area 1
Date & Time Sampled: December 07, 2009 08:55
Date & Time Submitted: December 07, 2009 12:10
Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	60	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: ____________

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Central Laboratory (P-08)
2102 North Lake Drive
Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:
Michelle Camburn P04

Sample ID: **AA84411** **Canadys Westside Wet Area 1**

Date & Time Sampled: December 07, 2009 08:55

Date & Time Submitted: December 07, 2009 12:10

Collected by: M.CAMBURN Location Code: TCLP

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	254	20.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	2.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Selenium - 6010C (RCRA)	14.6	10.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
TCLP Extraction, EPA 1311	Completed			12/10/09	11:00	TG

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84412** **Canadys Westside Wet Area 2A**
	Date & Time Sampled: December 07, 2009 09:05
	Date & Time Submitted: December 07, 2009 12:10
	Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	22	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Columbia, SC 29212
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December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84413** Canadys Westside Wet Area 2B Date & Time Sampled: December 07, 2009 09:05 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	38	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Fax: (803) 217-9911

December 16, 2009

REPORT TO:

Michelle Camburn P04

Sample ID: **AA84415** **Canadys Westside Wet Area 3**

Date & Time Sampled: December 07, 2009 09:10

Date & Time Submitted: December 07, 2009 12:10

Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	109	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	1.7	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Columbia, SC 29212
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Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84417** **Canadys Eastside Wet Area 1** Date & Time Sampled: December 07, 2009 09:25 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TCLP

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	268	20.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	2.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	11.6	10.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:56	CDB
Selenium - 6010C (RCRA)	19	10.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
TCLP Extraction, EPA 1311	Completed			12/10/09	11:00	TG

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84414** **Canadys Westside Wet Area 2** Date & Time Sampled: December 07, 2009 09:05 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TCLP

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	384	20.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	2.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Selenium - 6010C (RCRA)	14.8	10.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
TCLP Extraction, EPA 1311	Completed			12/10/09	11:00	TG

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Columbia, SC 29212
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Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84404** Canadys Wet Area E-15 Date & Time Sampled: December 07, 2009 08:40 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TCLP

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	294	20.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	2.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Selenium - 6010C (RCRA)	14.2	10.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	20.0	PPB	12/14/09	14:20	CDB
TCLP Extraction, EPA 1311	Completed			12/10/09	11:00	TG

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

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Columbia, SC 29212
Tel: (803)217-9384
Fax: (803) 217-9911

December 16, 2009

REPORT TO:	
Michelle Camburn P04	Sample ID: **AA84418** Canadys Eastside Wet Area 1 Date & Time Sampled: December 07, 2009 09:25 Date & Time Submitted: December 07, 2009 12:10 Collected by: M.CAMBURN Location Code: TOTMETAL

CERTIFIED BY SCDHEC (LAB ID#32006):	Result	MDL	Units	Completed Analysis Date & Time		Chemist
Arsenic - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Barium - 6010C (RCRA)	28	10.0	PPB	12/14/09	14:20	CDB
Cadmium - 6010C (RCRA)	Less than	1.0	PPB	12/14/09	14:20	CDB
Chromium - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Lead - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Mercury(liquid)-7470A (RCRA)	Less than	0.4	PPB	12/16/09	13:58	CDB
Nickel - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB
Selenium - 6010C (RCRA)	Less than	5.0	PPB	12/14/09	14:20	CDB
Silver - 6010C (RCRA)	Less than	10.0	PPB	12/14/09	14:20	CDB

If there are any questions concerning this sample, please contact the lab at (803) 217-9384.

Approved by: [signature]

GEI Consultants

December 8, 2005
Project No. 02225-2

Mr. Mark Landis, P.G., P.E.
Withers & Ravenel
111 MacKenan Drive
Cary, NC 27511

Dear Mr. Landis:

Re: Slope Stability Analyses
Canadys Station Ash Pond Dike

This letter presents a GEI memorandum that summarizes the results of the slope stability analyses that we performed for the Ash Pond Dike at Canadys Station. The analyses were performed for what we understand to be a typical cross section. The geometry and soil parameters for this cross section were provided by Withers & Ravenel. The memorandum presents two separate sets of analyses to evaluate stability during construction of the new seepage cutoff wall and stability for increased pond levels.

Based on the results of these stability analyses we conclude that:

1. Stability during the temporary construction condition is suitable provided that the construction equipment is supported on timber crane mats spanning transverse to the axis of the dike.

2. Raising the pond level 3 feet without repairing the existing seepage cutoff results in marginal stability, but raising the pond can be done safely after the seepage cutoff is repaired.

We have performed slope stability analyses for the 95-Acre Ash Pond dike assuming the current level of water in the pond. We selected geotechnical parameters for the stability analyses based on evaluation of the boring and CPT data from the explorations at the site. Our analyses were based on our engineering judgment and evaluation of: the proposed construction; the site conditions; anticipated conditions during construction; and boring, CPT and other data collected as part of investigations at the site. However, unforeseen conditions are always possibilities during construction at a site and may not be represented by the assumptions used in our analyses. Examples of conditions that may adversely affect dike stability sufficient to result in a release from the pond include: anomalous low strength zones in the dike not detected by subsurface investigations to date; Contractor controlled conditions such as changes in equipment loadings, and lack of control of fluid pressures during jet grouting or excavation/operation errors by equipment operators among others. Evaluation of all of the low probability event scenarios was not part of our scope of work.

GEI Consultants, Inc.
1021 Main Street, Winchester, Massachusetts 01890-1970
781.721.4000 fax: 781.721.4073

Please call us if you have any questions.

Sincerely,

GEI CONSULTANTS, INC.

R. Lee Wooten, P.E.
Design Division Manager

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
13692
RAY LEE WOOTEN

RLW:rr
M:\PROJECT\2002\022715\02225-2\Canadys Stability Analysis.doc

Attachment: GEI Memo "Slope Stability Analyses, Canadys Station Ash Pond Dike, GEI Project Number – 022252," 7/21/05.

GEI

Memo

To: Mark Landis, Withers & Ravenel

From: Marco Boscardin / David Shields

CC: Cameron Patterson / Doug Carr, Withers & Ravenel

Date: 7/21/2005

Re: Slope Stability Analyses

Canadys Station Ash Pond Dike

GEI Project Number 02225-2

This memorandum summarizes the results of the slope stability analyses that we performed for the Ash Pond Dike at Canadys Station. The analyses were performed for a cross section located at Boring Cm-2b, which we understand is reasonably representative of the typical conditions along the dike. The geometry and soil parameters for this cross section were provided by Withers & Ravenel. The analyses were performed using the Modified Bishop method for circular failure surfaces with the computer program GSTABL7.

We performed two separate sets of stability analyses to evaluate:

1. Stability during construction of the new seepage cutoff wall, with surcharge loading from construction equipment and slurry pressure in the trench for the new cutoff wall.

2. Impact of increasing the pond level by up to 3 feet under the existing condition and after installation of the new cutoff wall.

Temporary Construction Condition

The new seepage cutoff wall will be constructed by excavating a slurry-stabilized trench along the crest using a self-hardening slurry that will form the cutoff wall. Construction will progress continuously along the crest with the construction equipment advancing ahead of the slurry trench. Thus, the construction equipment surcharge loading and the slurry-filled trench condition do not occur simultaneously at the same cross section. We analyzed two different loading cases for the temporary construction condition:

1. Construction equipment surcharge applied to the crest - both the inside (upstream) and outside (downstream) slopes were analyzed.

2. Slurry-filled trench condition with no equipment surcharge - the outside (downstream) slope is the most critical and only this slope was analyzed.

1021 Main Street
Winchester, MA 01890-1970
781.721.4000 fax 781.721.4073

Based on information provided by Withers & Ravenel, we assumed for the construction condition:

- The crest will be excavated about 1.5 feet below the existing crest elevation to temporarily increase the width of the crest for construction.
- The equipment surcharge will be approximately 200 kips applied over an area of 20 feet x 15 feet with the long direction parallel to the dike. This yields an average surcharge pressure of 667 psf.

Our initial analyses showed that the surcharge pressure results in localized bearing capacity type failure at the edge of the crest if the surcharge is treated as a flexible loading. For the subsequent analyses it was assumed that the construction equipment will be supported on timber crane mats spanning transverse to the axis of the dike so that the surcharge acts as a rigid loading. This forces the bearing capacity failure to occur over the full width of the surcharge and prevents localized bearing capacity failure at the edges of the crest. We performed separate searches to evaluate the factor of safety against bearing capacity type failure (failure surfaces exiting on the upper portion of the slope) and slope failure (failure surfaces exiting on the lower portion of the slope or beyond the toe of the slope). These separate evaluations were performed because it is desirable to have a higher factor of safety for bearing capacity.

Summary plots for the analyses with the temporary construction surcharge loading are provided in Fig. 1 through Fig. 4 and the results are summarized below:

Analysis Load Case	Min. FS
Outside Slope – Slope Failure	1.35
Outside Slope – Bearing Capacity	1.87
Inside Slope – Slope Failure	1.39
Inside Slope – Bearing Capacity	2.00

It should be noted that these two-dimensional analyses assume that the equipment surcharge extends the full length of the dike while it actually extends only 20 feet along the dike. The actual safety factor is greater than the values indicated above due to the three-dimensional effects associated with the limited length of the surcharge loading.

A summary plot for the analysis with the slurry-filled trench is provided in Fig.5. As shown in the summary plot, the presence of the slurry-filled trench does not affect the factor of safety. We investigated the sensitivity of this result by increasing the slurry pressure until it had an impact on the safety factor, and we found that the pressure had to be increased by a factor of 35 to have any effect.

Increase in Pond Level

We analyzed the outside (downstream) slope for the following conditions to evaluate the effect of raising the water level in the pond:

1. Existing condition.
2. Pond level raised 3 feet with the existing seepage cutoff wall.
3. Pond level raised 3 feet with the new seepage cutoff wall in place.

For these analyses the crest is at the existing elevation and the soil properties of the new cutoff wall are assumed to be the same as for the existing cutoff wall. Based on discussions with Withers & Ravenel, the following assumptions were made for the location of the phreatic surface on the downstream side of the cutoff wall with the increased pond level:

- With the existing cutoff wall only - water level at the cutoff wall increases by 3 feet above the existing level and water level at the toe of the dike increases to ground surface (a 2 foot increase).
- With the new cutoff wall - at the toe of the dike water level increases to ground surface and at the new cutoff wall the water level drops from pond level to 2 feet above the toe of the dike

Summary plots for these analyses are provided in Fig. 6 through Fig. 8, and the results are summarized below:

Analysis Load Case	Min. FS
Existing condition	1.43
Pond raised 3 feet – Existing cutoff only	1.18
Pond raised 3 feet – New cutoff in place	1.44

Conclusions

Based on the results of these stability analyses we conclude that:

1. Stability during the temporary construction condition is okay provided that the construction equipment is supported on timber crane mats spanning transverse to the axis of the dike.
2. Raising the pond level 3 feet without repairing the existing seepage cutoff results in marginal stability, but this can be done safely after the seepage cutoff is repaired.

Please call us if you have any questions.

Enclosures
M:\PROJECT\2002\02225\02225-A\Stability Analysis Memo.doc\rr

Canadys Station Ash Pond Dike - Boring CM2b - Outside Slope with Equip Surcharge

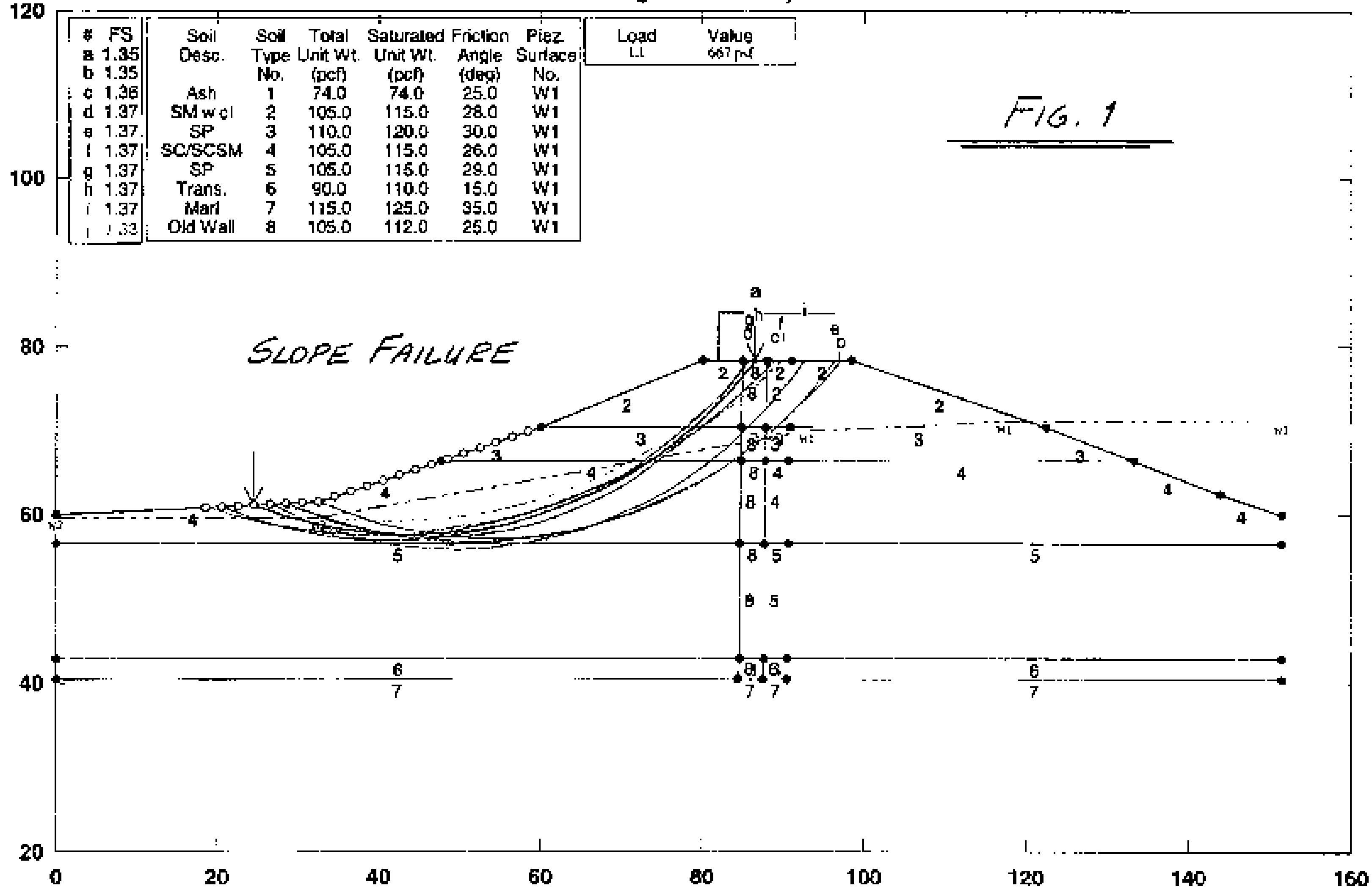
V:\022252-1\SLOPES-1\CM2B_OUT.PL2 Run By: DRS 7/14/2005 12:10PM

#	FS
a	1.35
b	1.35
c	1.36
d	1.37
e	1.37
f	1.37
g	1.37
h	1.37
i	1.37
[illegible]	1.33

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	74.0	74.0	25.0	W1
SM w cl	2	105.0	115.0	28.0	W1
SP	3	110.0	120.0	30.0	W1
SC/SCSM	4	105.0	115.0	26.0	W1
SP	5	105.0	115.0	29.0	W1
Trans.	6	90.0	110.0	15.0	W1
Marl	7	115.0	125.0	35.0	W1
Old Wall	8	105.0	112.0	25.0	W1

Load	Value
L1	667 psf

FIG. 1



GSTABL7 v.2 FSmin=1.35

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM2b - Outside Slope with Equip Surcharge

V:\022252-1\SLOPES-1\CM2_OUTB.PL2 Run By: DRS 7/14/2005 1:00PM

#	FS
a	1.87
b	1.87
c	1.87
d	1.88
e	1.88
f	1.89
g	1.89
h	1.90
i	1.90
j	[illegible]

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	74.0	74.0	25.0	W1
SM w cl	2	105.0	115.0	28.0	W1
SP	3	110.0	120.0	30.0	W1
SC/SCSM	4	105.0	115.0	26.0	W1
SP	5	105.0	115.0	29.0	W1
Trans.	6	90.0	110.0	15.0	W1
Marl	7	115.0	125.0	35.0	W1
Old Weir	8	105.0	112.0	25.0	W1

Load	Value
L1	667 psf

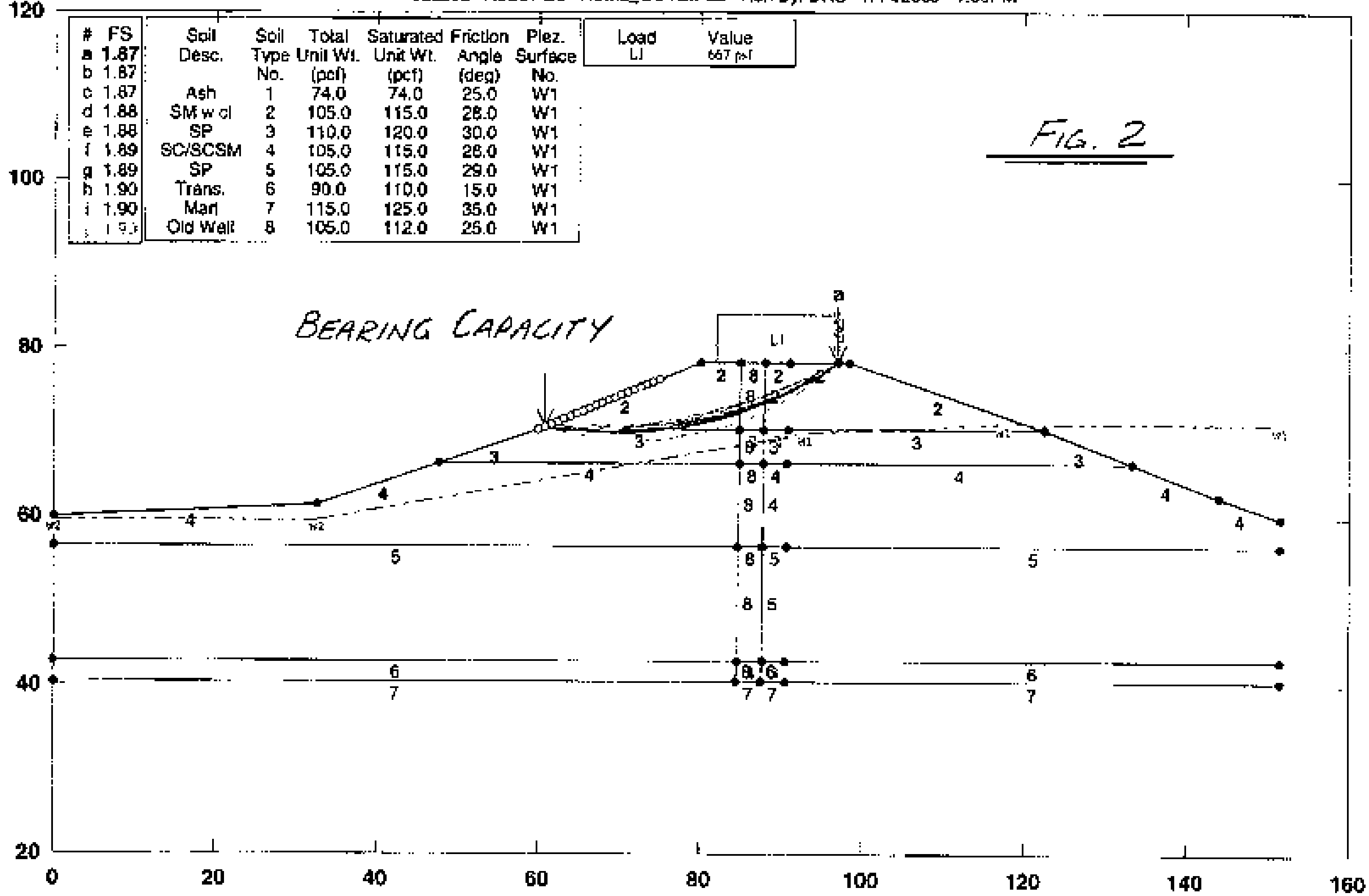


FIG. 2

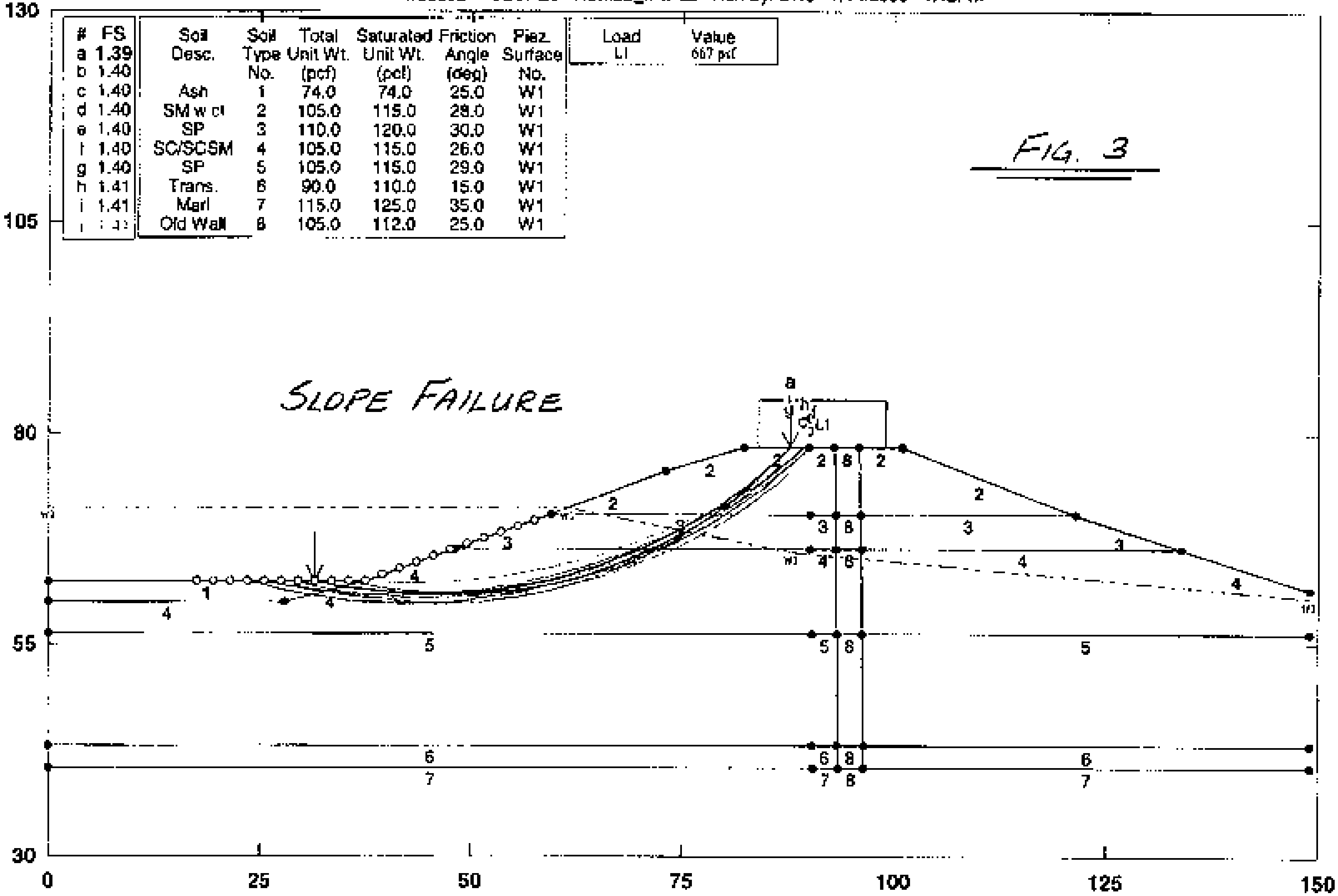
GSTABL7 v.2 FSmin=1.87

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM-2b - Inside Slope with Equip Surcharge

V:\022252-1\SLOPES-1\CM2B_IN.PL2 Run By: DRS 7/14/2005 1:12PM



#	FS
a	1.39
b	1.40
c	1.40
d	1.40
e	1.40
f	1.40
g	1.40
h	1.41
i	1.41
j	[illegible]

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	74.0	74.0	25.0	W1
SM w cl	2	105.0	115.0	28.0	W1
SP	3	110.0	120.0	30.0	W1
SC/SCSM	4	105.0	115.0	26.0	W1
SP	5	105.0	115.0	29.0	W1
Trans.	6	90.0	110.0	15.0	W1
Marl	7	115.0	125.0	35.0	W1
Old Wall	8	105.0	112.0	25.0	W1

Load	Value
L1	667 psf

GSTABL7 v.2 FSmin=1.39
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM-2b - Inside Slope with Equip Surcharge

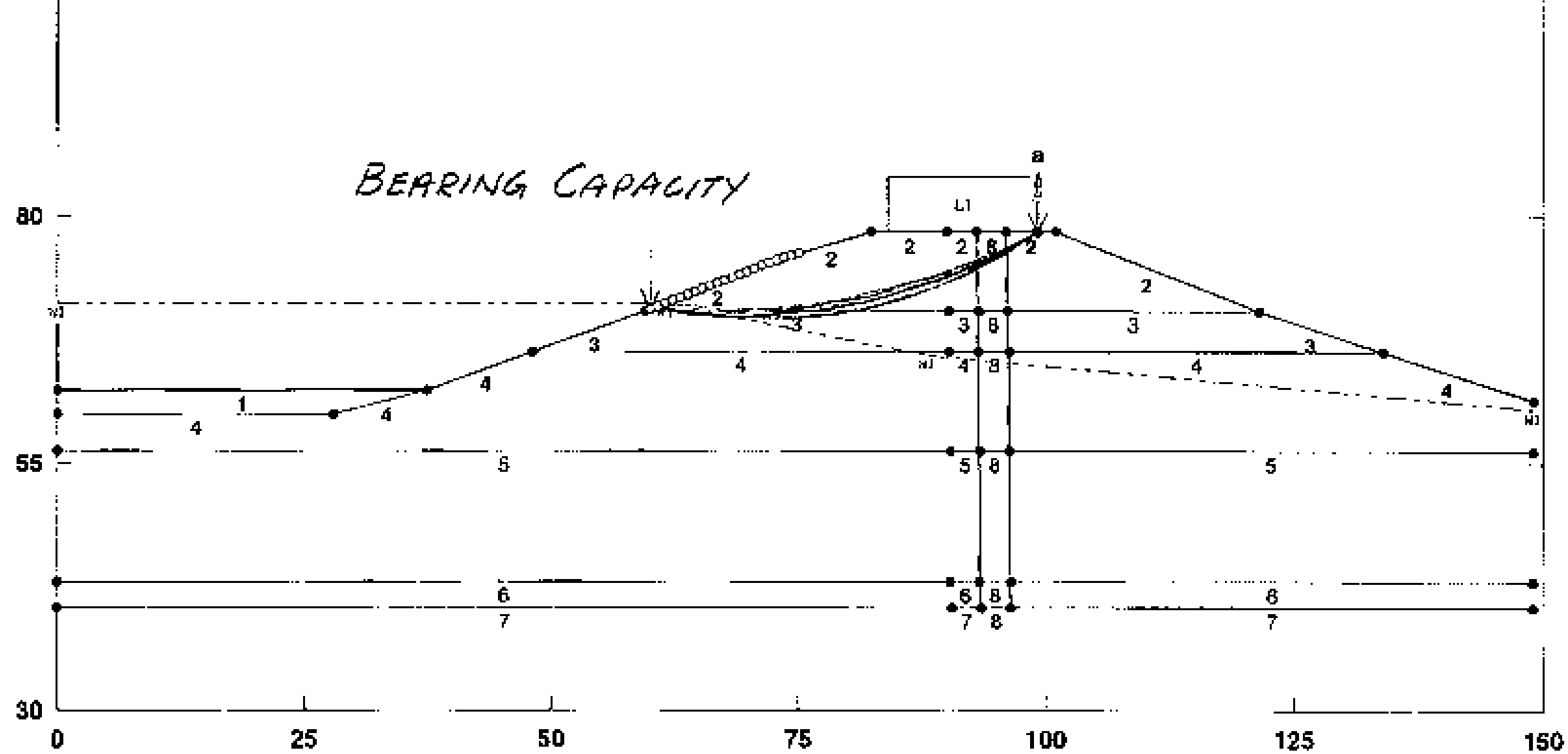
V:\022252-1\SLOPES-1\CM2B_INB.PL2 Run By: DRS 7/14/2005 1:16PM

#	FS
a	2.00
b	2.01
c	2.01
d	2.01
e	2.02
f	2.02
g	2.02
h	2.02
i	2.02
[illegible]	[illegible]

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	74.0	74.0	25.0	W1
SM w cl	2	105.0	115.0	28.0	W1
SP	3	110.0	120.0	30.0	W1
SC/SCSM	4	105.0	115.0	26.0	W1
SP	5	105.0	115.0	29.0	W1
Trans.	6	90.0	110.0	15.0	W1
Marl	7	115.0	125.0	35.0	W1
Old Wall	8	105.0	112.0	25.0	W1

Load	Value
L1	667 psf

FIG. 4



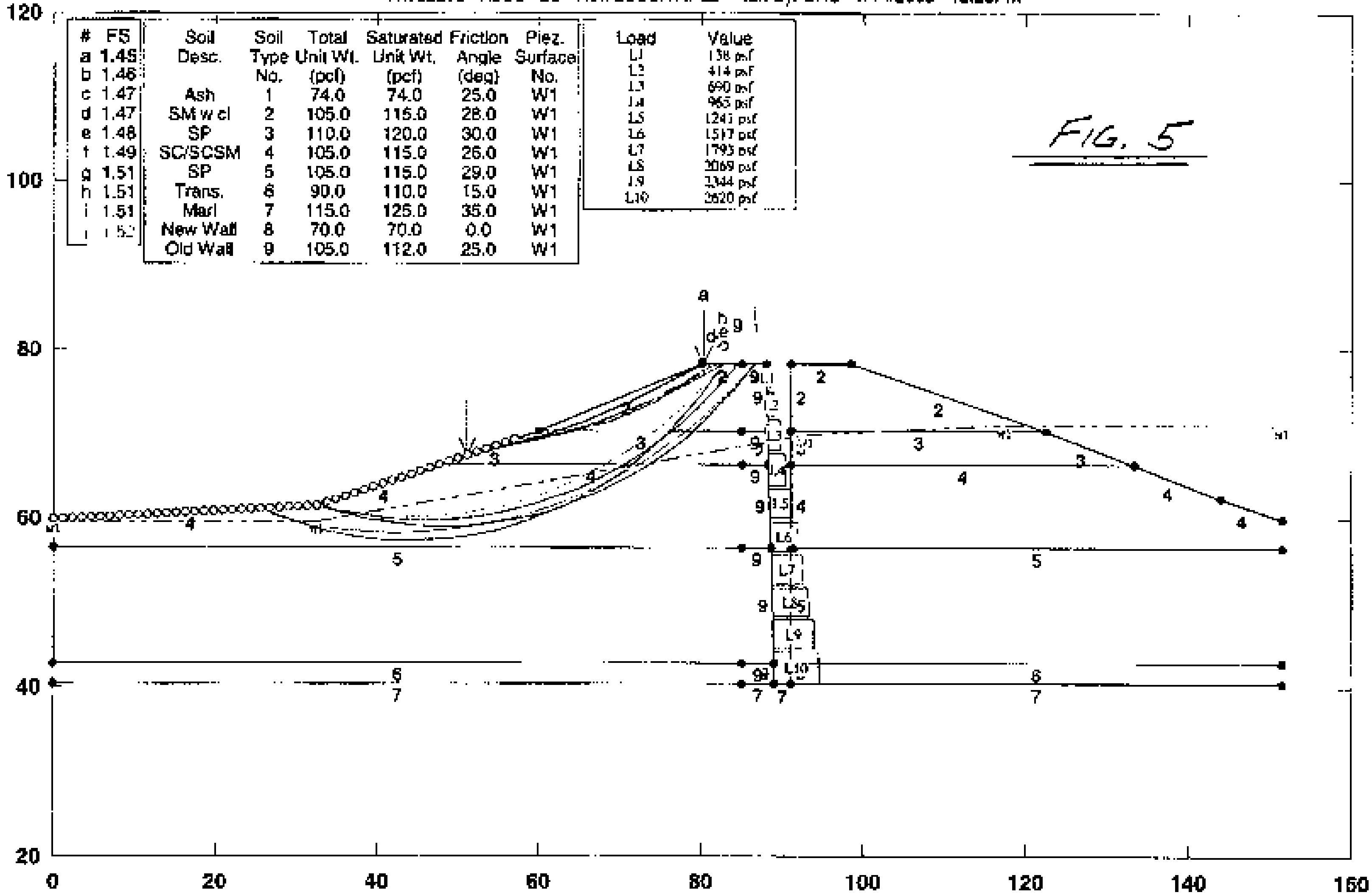
GSTABL7 v.2 FSmin=2.00

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM-2b - Outside Slope with Slurry Trench

V:\022252-1\SLOPES-1\CM2BSLRY.PL2 Run By: DRS 7/14/2006 12:28PM



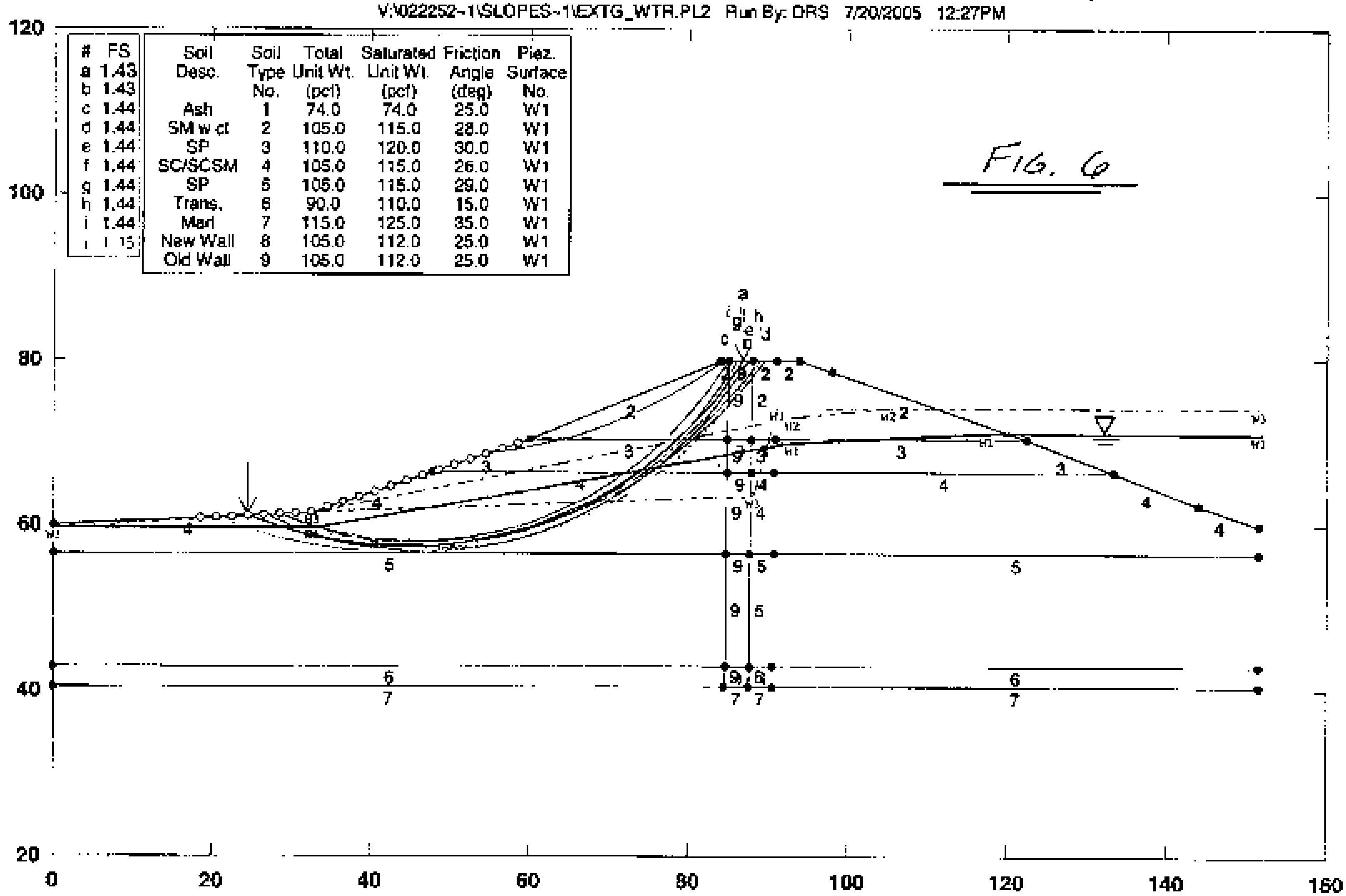
GSTABL7 v.2 FSmin=1.45

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM2b - Outside Slope - Existing Condition

V:\022252-1\SLOPES-1\EXTG_WTR.PL2 Run By: DRS 7/20/2005 12:27PM



#	FS
a	1.43
b	1.43
c	1.44
d	1.44
e	1.44
f	1.44
g	1.44
h	1.44
i	1.44
[illegible]	[illegible]

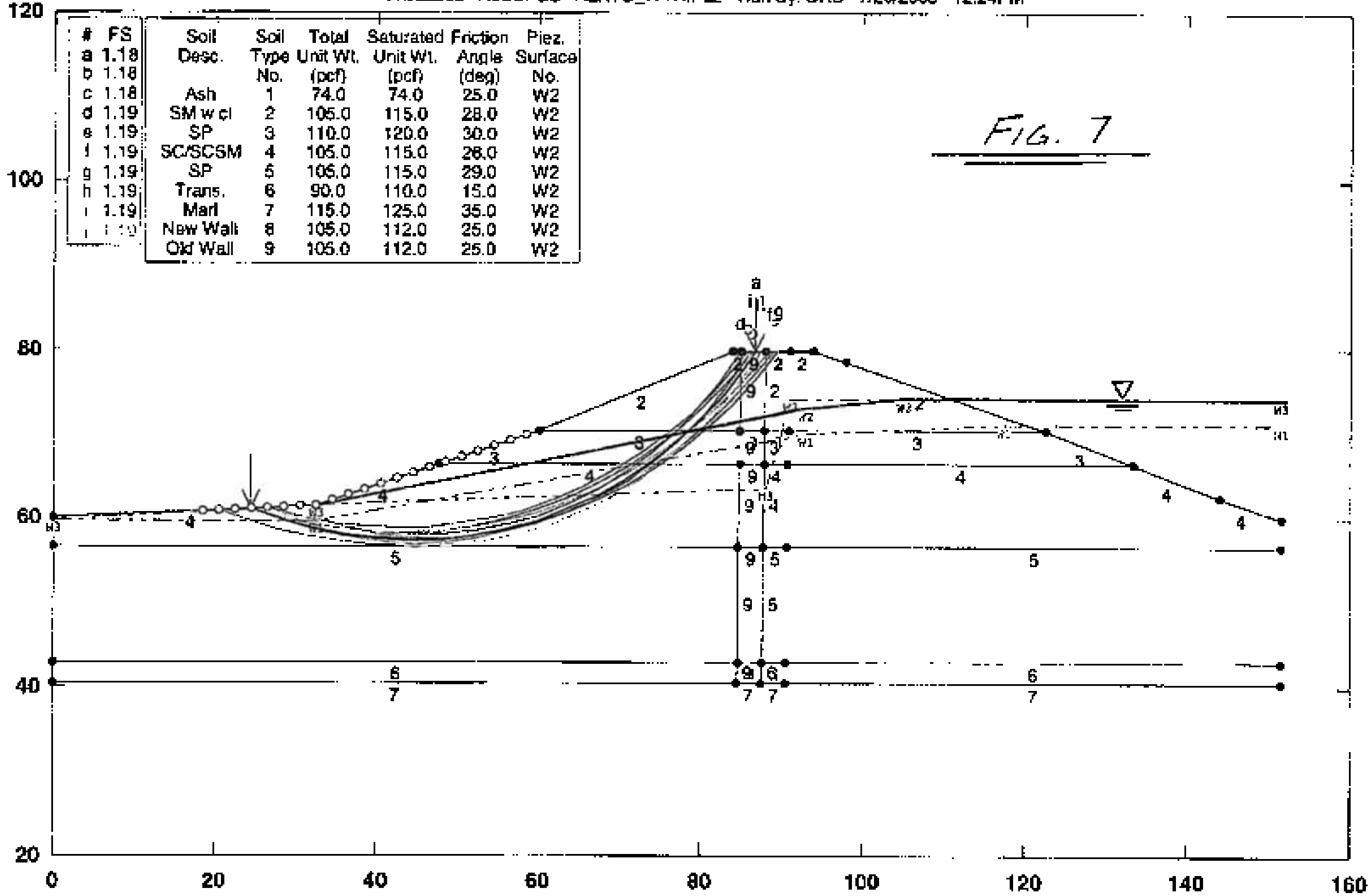
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	74.0	74.0	25.0	W1
SM w ct	2	105.0	115.0	28.0	W1
SP	3	110.0	120.0	30.0	W1
SC/SCSM	4	105.0	115.0	26.0	W1
SP	5	105.0	115.0	29.0	W1
Trans.	6	90.0	110.0	15.0	W1
Marl	7	115.0	125.0	35.0	W1
New Wall	8	105.0	112.0	25.0	W1
Old Wall	9	105.0	112.0	25.0	W1

FIG. 6

GSTABL7

Canadys Station Ash Pond Dike - Boring CM2b - Existing Cutoff - Pond 3 ft Higher

V:\022252-1\SLOPES-1\EXTG_WTR.PL2 Run By: DRS 7/20/2006 12:24PM



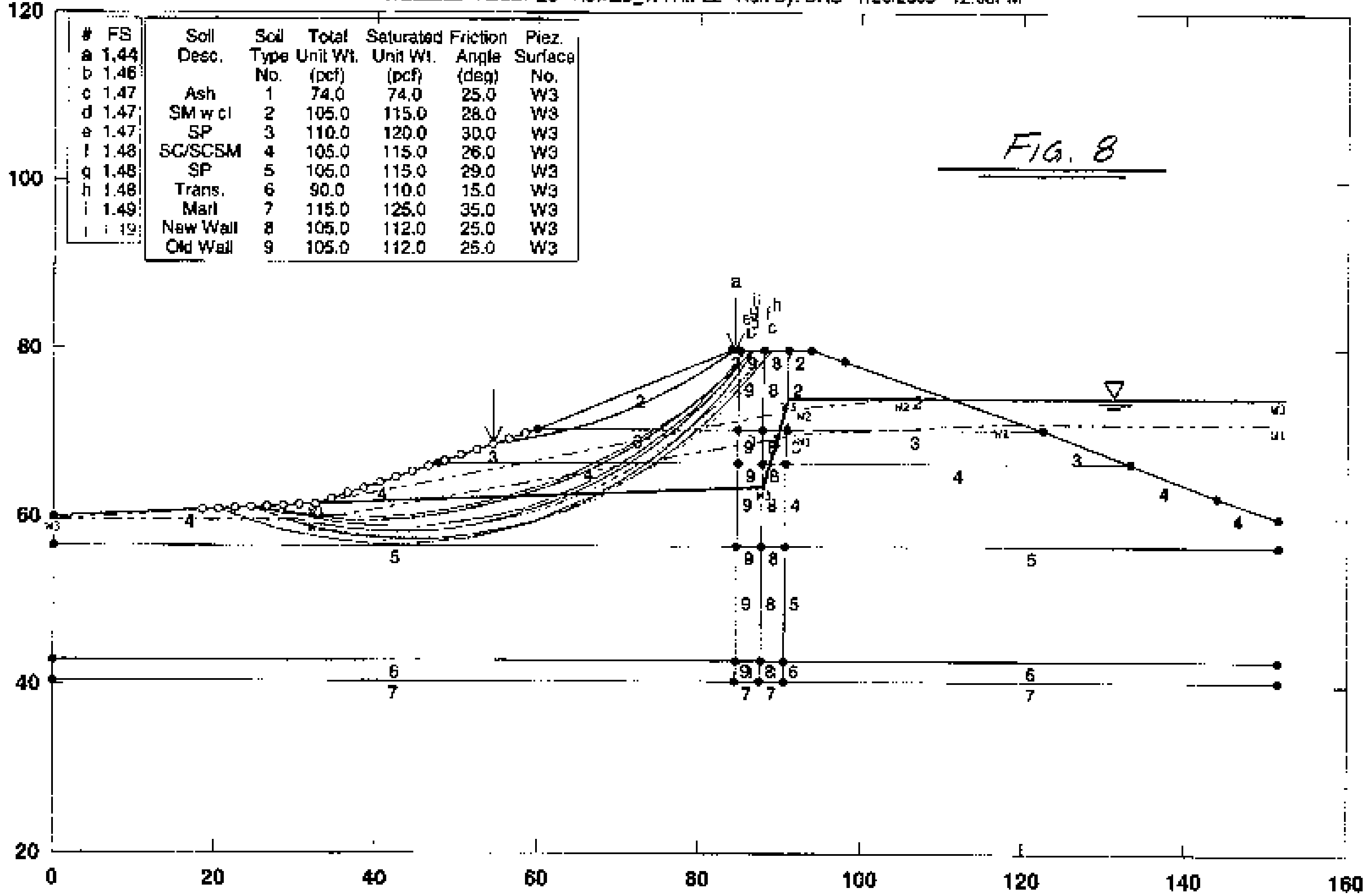
GSTABL7 v.2 FSmin=1.18

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Canadys Station Ash Pond Dike - Boring CM2b - New Cutoff - Pond 3 ft Higher

V:\022252~1\SLOPES~1\CM2B_WTR.PL2 Run By: DRS 7/20/2005 12:08PM



GSTABL7 v.2 FSmin=1.44

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

CDM

Memorandum

To: *Jean-Claude Younan*

From: *François Bernardeau*

Date: *January 09, 2007*

Subject: *Analyses of trench stability against sliding from the existing soil bentonite trench to the proposed cement-bentonite slurry trench*

The alignment of the proposed cement-bentonite slurry trench is to be in close proximity to the existing soil-bentonite trench. In order to estimate the minimum distance between the new and the existing trenches which will result in stable trench sidewalls, CDM completed stability analyses. The analyses were completed based on the results of our meeting on October 10, 2006 and undisturbed sample tests on December 13, 2006. The results of our analyses are summarized in this memorandum

Assumptions

Utilizing the data obtained from the geotechnical borings drilled in the dike materials, CPT results, and undisturbed sample tests of the existing trench material, a general cross-section of the dike was developed for analysis purposes. The data obtained from test borings WR-3 and WR-7OW was the primary basis for the dike cross-section developed. The generalized section is shown in Figure 1 and includes a static groundwater level at Elevation 67.0 which was estimated based on the test boring data.

The engineering properties of materials which were utilized in the analyses are summarized as follows:

Material(USCS Classification)	SPT N-value (Average)	Estimated Moist Unit Weight (pcf)	Estimated Saturated Unit Weight (pcf)	Estimated Friction Angle (degrees)	Estimated Cohesion (pcf)
Dike(SM)	33	110	130	34	0
Dike (SC-SM)	18	105	125	34	0
Existing Soil-Bentonite Backfill	3	130	130	38	0
Proposed Cement Bentonite	-	-	70	-	-

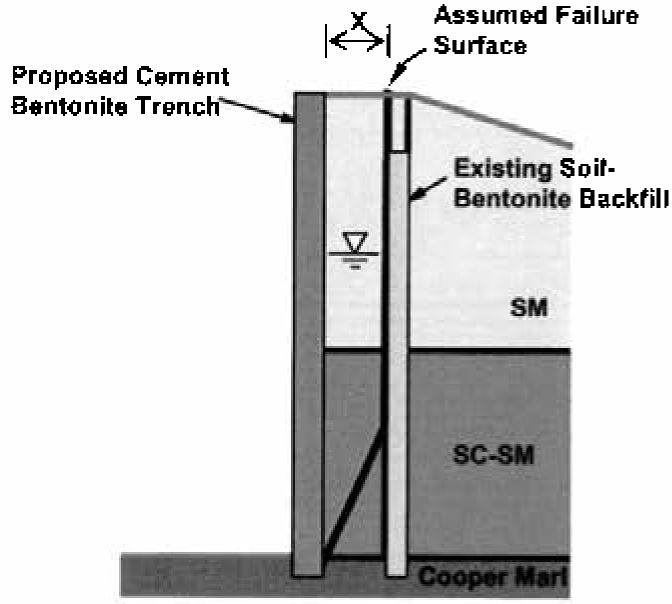


Figure 1
General cross-section used in the analyses to estimate the permissible safe distance (X) between the two trenches

To date, shear strength testing has not been completed on materials which were sampled within the dike material. Therefore, the shear strength parameters (cohesion and friction angle) were estimated by CDM based on laboratory soil classification test results and on the CPT and SPT test results. According to the requested triaxial tests on the undisturbed samples taken from the existing trench, the friction angle of the soil-bentonite backfill is estimated to be 38 degrees. Wedge method was used to estimate the factor of safety with respect to the existing soil-bentonite backfill sliding into the new trench as the distance between the two trenches deceases. The estimated groundwater level within the embankment was also considered in the analyses.

Results

The evaluation of the factor of safety against trench sidewall failure was completed by varying the distance between the two trenches. Three cases were analyzed, i.e., the distance between the proposed trench and the existing soil-bentonite backfill is 5 feet, 3 feet, and 1 foot. The calculated factor of safety is 1.37, 1.36, and 1.35, respectively. The detailed calculations are attached. The results of our analyses indicate that the trench stability against wedge sliding from the existing trench to the new trench is not sensitive to the distance between the two trenches. These safety factors are higher than minimum acceptable for temporary construction.

Appendix 1 Triaxial Test Results

CDM Geotechnical Engineering Laboratory

Consolidated Undrained Triaxial Compression Test for Cohesive Soils - ASTM D4767
Testing Summary

Client:	SCE&G	**Test Date:**	12/13/2006
Project:	Canadys Station Containment Wall	**Exploration No:**	U-1
Location:	Canadys, SC	**Sample No:**	--
Project No:	19888-52459	**Depth (ft):**	15-17
		Sample Description:	--

	Initial	**PreShear**
Water Content:	12.8%	17.5%
Wet Mass (g):	1309.2	1356.7
Dry Density (pcf):	110.2	109.6
Height (in):	6.10	6.08
Diameter (in):	2.90	2.90
Specific Gravity:	2.65	2.65
Voids Ratio:	0.502	0.510

Max Obliquity, R:	4.16
p' @ R_{max} (psi):	12.57
q @ R_{max} (psi):	7.70
ε @ R_{max}:	2.29%

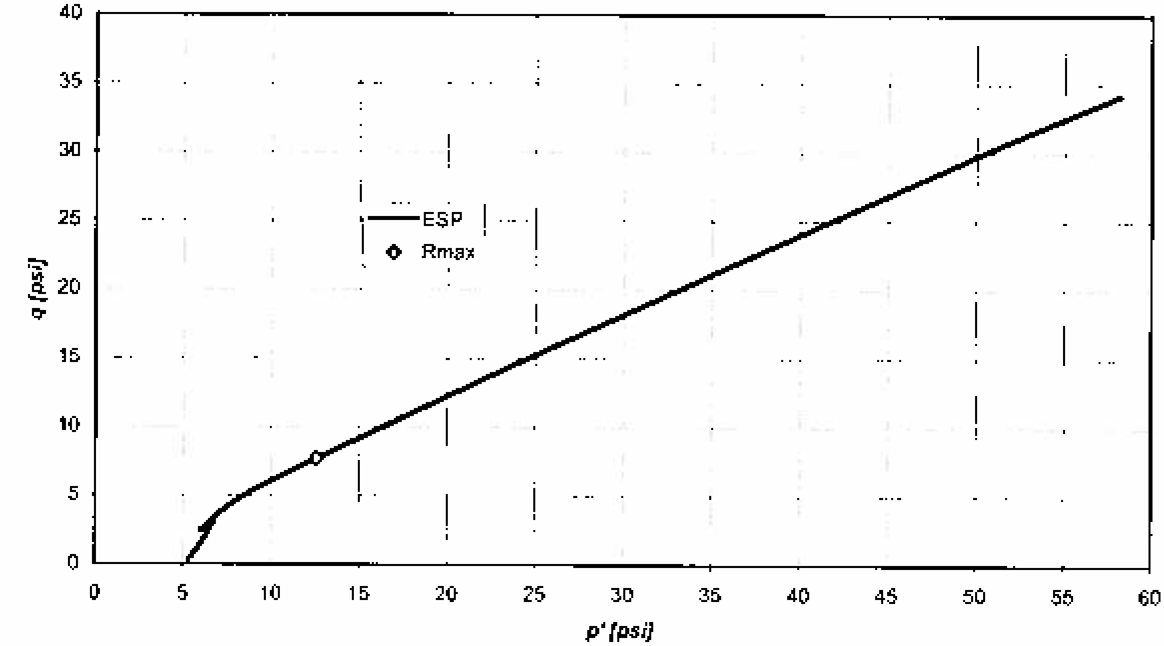
Plasticity Indicies:

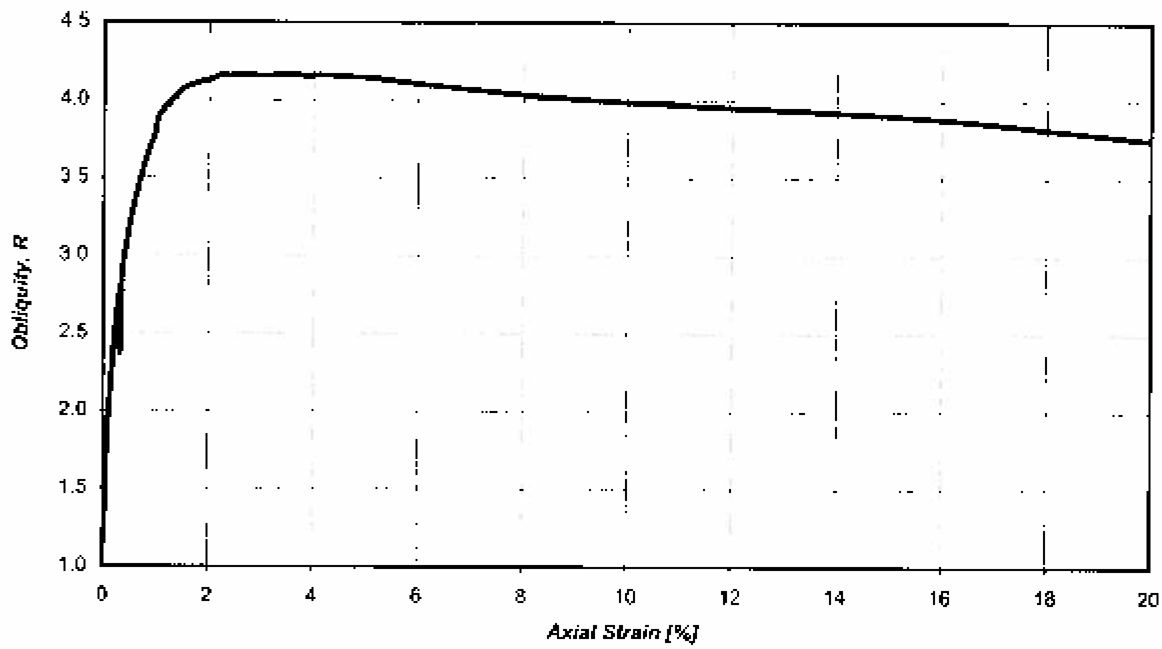
LL :	-
PL :	-
PI :	-

Preconsolidtion Pressure (psi):	-
Vertical Consol Stress (psi):	4.95
Over Consolidation Ratio:	-
B-Coefficient:	95
Back Pressure (psi):	60.09

Axial Strain (%)	σ'_1 (psi)	σ'_3 (psi)	p' (psi)	q (psi)	Excess Pore Press (psi)	Obliquity R
0.1	8.2	4.3	6.3	2.0	0.7	1.928
1.0	12.8	3.4	8.1	4.7	1.5	3.768
2.0	18.4	4.5	11.4	7.0	0.5	4.127
3.0	24.4	5.9	15.1	9.3	-0.9	4.153
5.0	38.4	9.3	23.8	14.6	-4.3	4.144
7.0	41.0	9.9	25.5	15.5	-5.0	4.129
9.0	58.8	14.6	36.7	22.1	-9.7	4.026
11.0	58.8	14.6	36.7	22.1	-9.7	4.026
13.0	73.3	18.5	45.9	27.4	-13.6	3.966
15.0	0.2	0.1	0.1	0.0	-59.9	1.243

Notes:
1. Consolidation phase performed in general accordance with ASTM D2435.





Exploration No:	U-1
Sample No:	--
Depth (ft):	15-17
Sample Description:	--

Preconsolidtion Pressure (psi):	-
Vertical Consol Stress (psi):	5.0
Over Consolidation Ratio:	-
Maximum Obliquity, R:	4.16
q @ R_{max} (psi):	7.70

CDM
Geotechnical Engineering Laboratory

Client: SCE&G
Project: Canadys Station Containment Wall
Project No: 19888-52459

CIUC Triaxial Test
ASTM D4767

CDM Geotechnical Engineering Laboratory

Consolidated Undrained Triaxial Compression Test for Cohesive Soils - ASTM D4767
Testing Summary

Client: SCE&G
Project: Canadys Station Containment Wall
Location: Canadys, SC
Project No: 19888-52459

Test Date: 12/13/2006
Exploration No: U-1
Sample No: --
Depth (ft): 15-17
Sample Description: --

	Initial	PreShear
Water Content:	12.9%	17.0%
Wet Mass (g):	437.0	452.9
Dry Density (pcf):	111.5	111.8
Height (in):	4.31	4.29
Diameter (in):	1.98	1.98
Specific Gravity:	2.65	2.65
Voids Ratio:	0.483	0.480

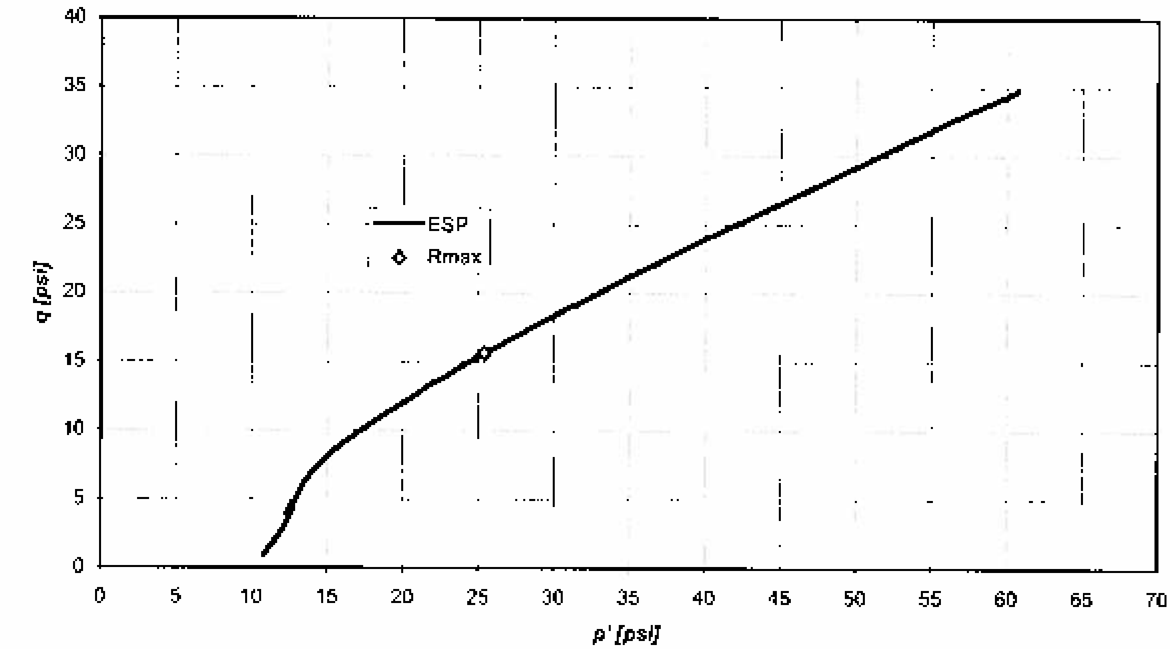
Plasticity Indicies:
LL : -
PL : -
PI : -

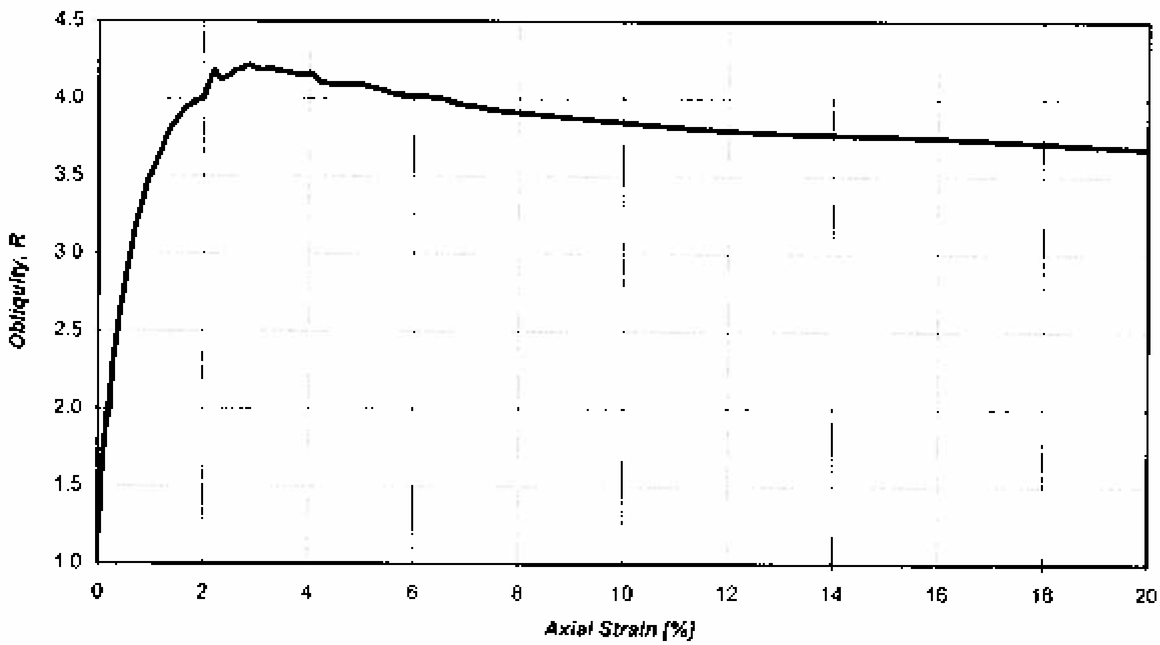
Max Obliquity, R: 4.21
p' @ R_{max} (psi): 25.38
q @ R_{max} (psi): 15.64
ε @ R_{max}: 2.85%

Preconsolidtion Pressure (psi): -
Vertical Consol Stress (psi): 9.87
Over Consolidation Ratio: -
B-Coefficient: 95
Back Pressure (psi): 60.10

Axial Strain (%)	σ'_1 (psi)	σ'_3 (psi)	p' (psi)	q (psi)	Excess Pore Press (psi)	Obliquity R
0.1	15.2	9.1	12.2	3.1	0.8	1.669
1.0	24.3	6.9	15.6	8.7	3.2	3.512
2.0	32.7	8.2	20.4	12.3	2.0	4.008
3.0	41.9	10.0	25.9	15.9	0.1	4.191
5.0	55.2	13.5	34.3	20.9	-3.5	4.095
7.0	65.1	16.4	40.8	24.3	-6.5	3.962
9.0	68.3	17.4	42.9	25.4	-7.4	3.918
11.0	68.3	17.4	42.9	25.4	-7.4	3.918
13.0	80.2	21.1	50.7	29.5	-11.2	3.796
15.0	80.2	21.1	50.7	29.5	-11.2	3.796

Notes:
1. Consolidation phase performed in general accordance with ASTM D2435.



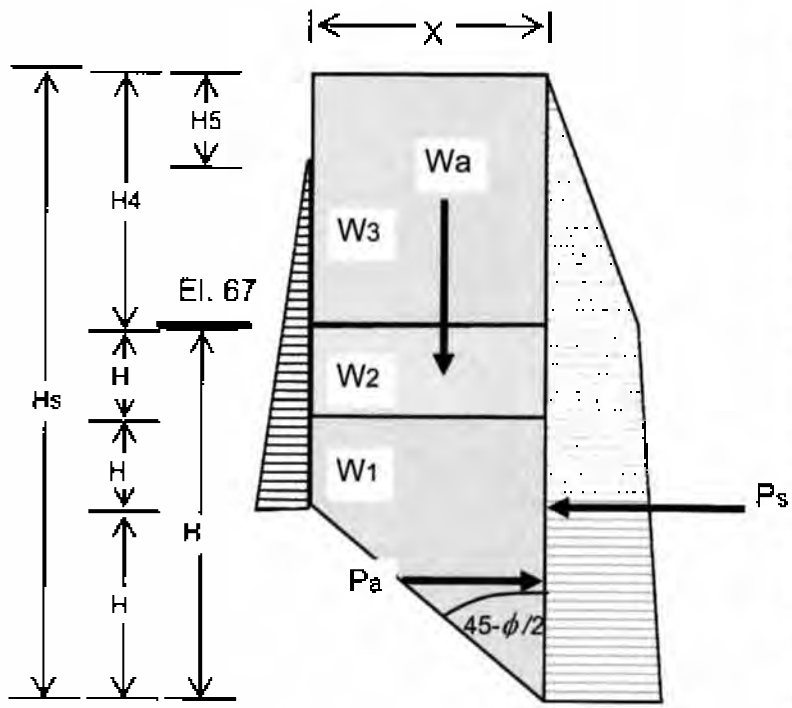


Exploration No:	U-1
Sample No:	--
Depth (ft):	15-17
Sample Description:	--

Preconsolidtion Pressure (psi):	-
Vertical Consol Stress (psi):	9.9
Over Consolidation Ratio:	-
Maximum Obliquity, R:	4.21
q @ R_{max} (psi):	15.64

CDM **Geotechnical Engineering Laboratory**	**Client:** SCE&G **Project:** Canadys Station Containment Wall **Project No:** 19888-52459	**CIUC Triaxial Test** **ASTM D4767**

Appendix 2 Stability Analyses Results



γ_w	62.4	pcf
$\gamma_{SM\text{-}m}$	110	pcf
$\gamma_{SM\text{-}s}$	130	pcf
$\gamma_{SC\text{-}m}$	105	pcf
$\gamma_{SC\text{-}s}$	125	pcf
γ_{BS}	130	pcf
γ_{slurry}	70	pcf
Hs	38.5	ft
Hw	26	ft
ϕ_{sc}	34	degrees
ϕ_{BS}	38	degrees

H1	9.4	ft
H2	7.6	ft
H3	8.0	ft
H4	13.5	ft
H5	5.0	ft
W1	3849	lb/ft
W2	2704	lb/ft
W3	7425	lb/ft
Wa	13978	lb/ft
Ps	51879	lb/ft
Pa	16799	lb/ft
Pw	21091	lb/ft

$\pi/2-\phi/2$	0.5	radians
Ka (SB)	0.24	
Ka (SM)	0.28	

X	5	ft

FS	1.37

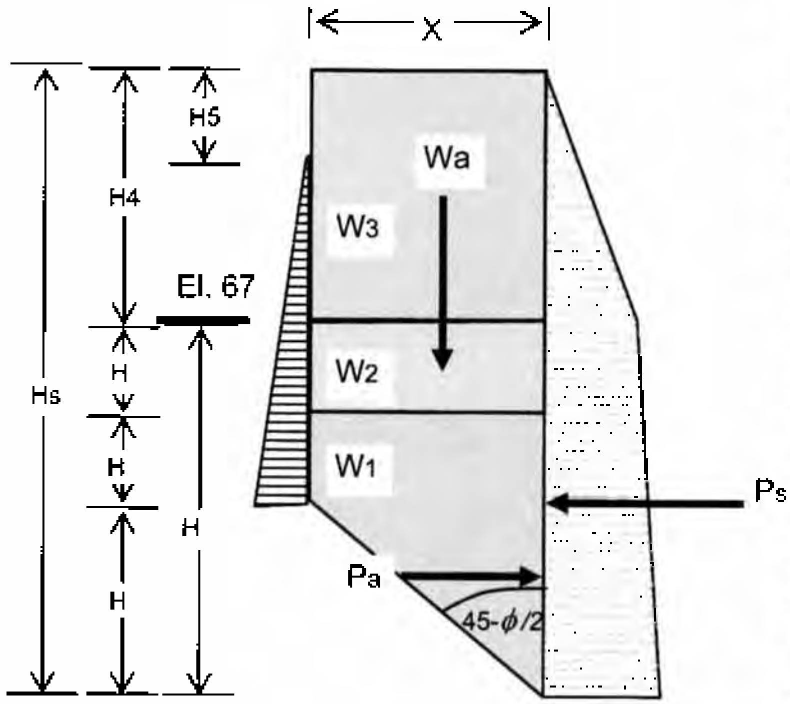
X - Distance between the two trenches.

Ps - Force exerted by CB slurry.

Pa - Force exerted by soil (including the force by existing SB backfill and the soil above it).

Pw - Force exerted by water.

FS=Ps/(Pa+Pw)



γ_w	62.4	pcf
$\gamma_{SM\text{-}m}$	110	pcf
$\gamma_{SM\text{-}s}$	130	pcf
$\gamma_{SC\text{-}m}$	105	pcf
$\gamma_{SC\text{-}s}$	125	pcf
γ_{BS}	130	pcf
γ_{slurry}	70	pcf
Hs	38.5	ft
Hw	26	ft
ϕ_{sc}	34	degrees
ϕ_{BS}	38	degrees

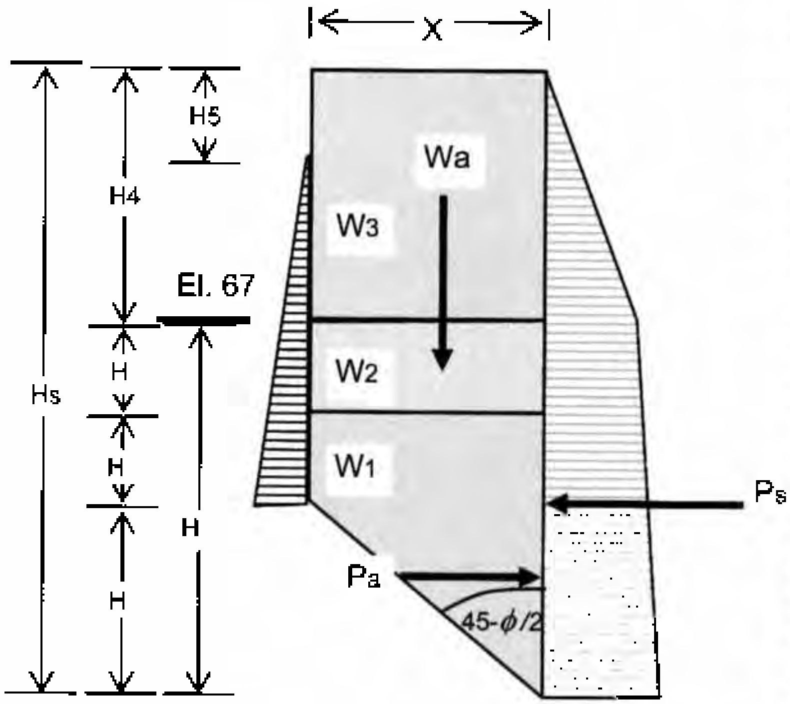
$\pi/2-\phi/2$	0.5	radians
Ka (SB)	0.24	
Ka (SM)	0.28	

X	3	ft

H1	5.6	ft
H2	11.4	ft
H3	8.0	ft
H4	13.5	ft
H5	5.0	ft
W1	2663	lb/ft
W2	1622	lb/ft
W3	4455	lb/ft
Wa	8740	lb/ft
Ps	51879	lb/ft
Pa	17036	lb/ft
Pw	21091	lb/ft

FS	1.36

X - Distance between the two trenches.
Ps - Force exerted by CB slurry.
Pa - Force exerted by soil (including the force by existing SB backfill and the soil above it).
Pw - Force exerted by water.
FS=Ps/(Pa+Pw)



γ_w	62.4	pcf
$\gamma_{SM\text{-}m}$	110	pcf
$\gamma_{SM\text{-}s}$	130	pcf
$\gamma_{SC\text{-}m}$	105	pcf
$\gamma_{SC\text{-}s}$	125	pcf
γ_{BS}	130	pcf
γ_{slurry}	70	pcf
Hs	38.5	ft
Hw	26	ft
ϕ_{sc}	34	degrees
ϕ_{BS}	38	degrees

$\pi/2-\phi/2$	0.5	radians
Ka (SB)	0.24	
Ka (SM)	0.28	
X	1	ft

H1	1.9	ft
H2	15.1	ft
H3	8.0	ft
H4	13.5	ft
H5	5.0	ft
W1	1005	lb/ft
W2	541	lb/ft
W3	1485	lb/ft
Wa	3031	lb/ft
Ps	51879	lb/ft
Pa	17459	lb/ft
Pw	21091	lb/ft
FS	1.35	

X - Distance between the two trenches.
Ps - Force exerted by CB slurry.
Pa - Force exerted by soil (including the force by existing SB backfill and the soil above it).
Pw - Force exerted by water.
FS=Ps/(Pa+Pw)

WITHERS & RAVENEL

ENGINEERS | PLANNERS | SURVEYORS

~TECHNICAL MEMORANDUM~

TO: Project File: Task 1.1

FROM: Mark E. Landis, P.E.

DATE: February 26, 2006

PROJECT: Canadys Station Slurry Wall Remediation Project: Slurry Wall Design

SUBJECT: Slope Stability Analyses with Active Ash Pond Pool Lowered

SCE&G requested that we evaluate the effect of lowering the water level at the Canadys Station active ash pond on containment dike stability during new containment wall construction. We, W&R and GEI, identified section CM-2b as a typical section for our evaluation and ran additional stability analyses for this section. Refer to previous memos from GEI and W&R, dated 7/21/05, 12/8/05, and 12/12/05 for input parameters and analysis methods information.

We have assumed that the water lowering would occur sufficiently slowly and in advance of construction, not instantaneously, so that drained conditions exist in the embankment at the time of construction. Current operating pool level was measured at 71.2, and we considered two cases for water level drops: one 3 feet below current pool and one 6 feet below current pool, which correspond to elevations 68.2 and 65.2, respectively. The results of these stability runs for this location are as follows:

		Factor of Safety	
Section	Normal Pool	-3 feet	-6 feet
Outside slope	1.35	1.39	1.39
Inside Slope	1.39	1.34	1.35

As previously mentioned, our assumptions and limitations from the previous memos referenced above apply. Our design plans and specifications do not reflect these water level drops in the active ash pond with respect to the Containment Wall Design and, therefore, modifications to our design plans and specifications are likely to be required. No guarantees or warranties are implied.

Canady's Station

Pond Dike Inspection Form

Pond Identification: Ash Pond 006 **(example: LVW A, Coalpile Runoff, etc...)**

I. **General**

a. Weather: Clear 75°

b. Most recent precipitation date, type, and estimated amount: 3" of rainfall w/in the last week, since last weekly inspection

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Ash removal, cell construction

d. Approximate Water Level in Pond: Normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

Is discharge flow muddy, cloudy, dark, or otherwise discolored ___ No ___ Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is *any* woody vegetation present: ✓ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____

c. Is surface erosion present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. The corners of the polishing pond where the clay is has shown no changes except for an overgrowth of grass.

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ____ Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

III. **Exterior (Downstream) Embankment Face Condition**

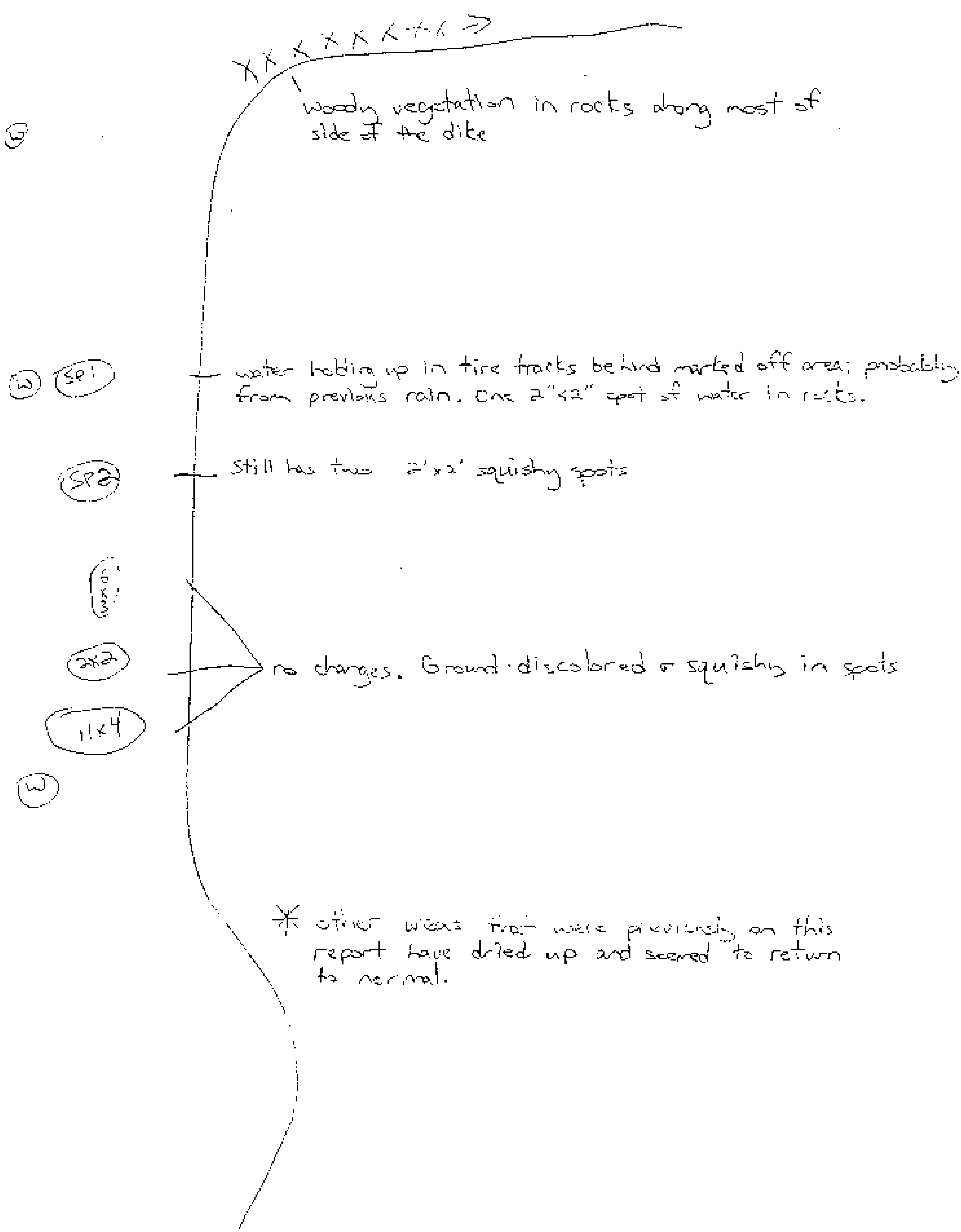
a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is ***any*** woody vegetation present: ____ No ✓ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____
See sketch

c. Surface erosion or gullies present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ____ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form ____

e. Any wet areas or areas of dark/discolored soil present: ____ No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch


XXXXXXX ->
woody vegetation in rocks along most of side of the dike
W
W
SP1
water backing up in tire tracks behind marked off area; probably from previous rain. One 2"x2" spot of water in rocks.
SP2
Still has two 2'x2' squishy spots
6x3
2x2
1'x4
no changes. Ground discolored & squishy in spots
W
* other areas that were previously on this report have dried up and seemed to return to normal.

f. Any visible seepage or presence of areas of flowing water on the berm itself: ✓ No___Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No___Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________

g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: ✓ No__________Yes, if so, **identify color,** describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________

h. Any evidence of the presence of burrowing animals: ✓ No__________Yes, if so, describe________________

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot:______No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present: ✓ No__________Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.________________

b. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No___Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form________________

____

c. Any wet areas or areas of dark/discolored soil present: ✓ No________Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________________

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: ✓ No____Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________________

e. Any depressions or sinkholes visible on top of either berm: ✓ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________________

V. **Other**

VI. Any conditions observed on any portion of the embankment not described above: ✓ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________________

VII. **Certification of Inspection**

Inspection performed by:

Donald Bauman	Lab Analyst	10-2-09
Name	Title	Date
[illegible]	Environmental Tech	10/2/09

Canady's Station

3/15/10

Pond Dike Inspection Form

Pond Identification: Ash Pond 006 **(example: LVW A, Coalpile Runoff, etc...)**

I. **General**

a. Weather: Clear 65°

b. Most recent precipitation date, type, and estimated amount: 3/12/10 1 ¼" rainfall

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Nothing at time of inspection

d. Approximate Water Level in Pond: Normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating:

Is discharge flow muddy, cloudy, dark, or otherwise discolored ___ No ___ Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.):

b. Is *any* woody vegetation present: √ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____

c. Is surface erosion present: √ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: √ No ____ Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

III. **Exterior (Downstream) Embankment Face Condition**

a. Vegetation/Ground Cover Condition: √ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is ***any*** woody vegetation present: √ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____

c. Surface erosion or gullies present: √ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: √ No ____ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form ____

e. Any wet areas or areas of dark/discolored soil present: ____ No √ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch. With all of the rain lately not sure of the impact on the areas noted.

f. Any visible seepage or presence of areas of flowing water on the berm itself: √ No ___Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No___Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form__________

g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: √ No________Yes, if so, **identify color,** describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by **2 ft,** etc. Sketch area on the back of this form__________

h. Any evidence of the presence of burrowing animals: √ No________Yes, if so, describe__________

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot:______No √ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form See sketch. With all of the rain lately not sure of the impact on the areas noted.

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present: √ No________Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.__________

b. Any sloughing, sliding, or other visible signs of embankment failure: √ No____Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form__________

c. Any wet areas or areas of dark/discolored soil present: √ No ____ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ____

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: √ No ____ Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ____

e. Any depressions or sinkholes visible on top of either berm: √ No ____ Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ____

V. **Other**

VI. Any conditions observed on any portion of the embankment not described above: √ No ____ Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form ____

VII. **Certification of Inspection**

Inspection performed by:

Name	Title	Date
Donald M. Bauer	Lab Analyst	3/15/10
[illegible]	Env. Tech	3/16/10
Michelle Candler	E/S Supervisor	3/16/10

Performed on 6/28/10 7:30 AM

Canady's Station Active Ash Pond Dike Inspection Form

I. **General**

a. Weather: Clear sky, Hot & Humid

b. Most recent precipitation date, type, and estimated amount: 6/26/10 Rain .05 inches

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Ash removal

d. Approximate Water Level in Pond: Normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

Is discharge flow muddy, cloudy, dark, or otherwise discolored ✓ No ____ Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is *any* woody vegetation present: ✓ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____

c. Is surface erosion present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No____ ______Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc.________________

III. **Exterior (Downstream) Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory________Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.):________________

b. Is ***any*** woody vegetation present:________No ✓ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* some vegetation along ditch to be pulled soon

c. Surface erosion or gullies present: ✓ No__________Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.________________

d. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No____Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form________________

e. Any wet areas or areas of dark/discolored soil present:__________No ✓ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________

f. Any visible seepage or presence of areas of flowing water on the berm itself: ✓ No___Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No___Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________

g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas:_____No_____Yes, if so, **identify color,** describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form_____

h. Any evidence of the presence of burrowing animals:_____No_____Yes, if so, describe_____

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot:_____No_____Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form_____

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present:_____No_____Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc._____

b. Any sloughing, sliding, or other visible signs of embankment failure:_____No_____Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form_____

c. Any wet areas or areas of dark/discolored soil present:_____No_____Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: √ No____Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____________________________

e. Any depressions or sinkholes visible on top of either berm: √ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form__________

V. **Other**

a. Any conditions observed on any portion of the embankment not described above: √ No ______Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

VI. **Certification of Inspection**

Inspection performed by:

Name	Title	Date
Donald Barnes	Lab Analyst	6/29/10
Michelle Carbrera	EIS Supervisor	6/29/10

Canady's Station Active Ash Pond Dike Inspection Form

I. **General**

a. Weather: Clear and around 75°

b. Most recent precipitation date, type, and estimated amount: 9/27/10 2.25"

c. Describe any type of activity within the pond itself(cleaning, ash removal, berm construction, etc.): Ash removal

d. Approximate Water Level in Pond: Little higher than normal

e. General Condition of Pond: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

f. General Condition of Inlet: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

g. General Condition of Discharge: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating: ____

Is discharge flow muddy, cloudy, dark, or otherwise discolored ___No ___Yes

II. **Interior Embankment Face Condition**

a. Vegetation/Ground Cover Condition: ✓ Satisfactory ____ Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): ____

b. Is *any* woody vegetation present: ✓ No ____ Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)* ____

c. Is surface erosion present: ✓ No ____ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. ____

d. Any sloughing, sliding, or other visible signs of embankment failure: \/ No___ ___Yes, if so explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc.___

III. Exterior (Downstream) Embankment Face Condition

a. Vegetation/Ground Cover Condition:______Satisfactory \/ ___Unsatisfactory
Explain Unsatisfactory Rating (bare slopes, needs mowing, etc.): Needs mowing

b. Is ***any*** woody vegetation present: \/ No______Yes, if so how was it removed? (pulled, herbicide, etc. **NOTE:** *Do Not Cut Woody Vegetation!)*___

c. Surface erosion or gullies present:_____No______Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc. N/A
* See back of this page

d. Any sloughing, sliding, or other visible signs of embankment failure:___No___Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form N/A

e. Any wet areas or areas of dark/discolored soil present:______No______Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form N/A
* See back of this page

f. Any visible seepage or presence of areas of flowing water on the berm itself: \/ No___Yes, if so is flow muddy, cloudy, dark, or otherwise discolored___No___Yes. Describe any discoloration, identify flow (trickle, rushing, etc. If possible, measure flow.) and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form___

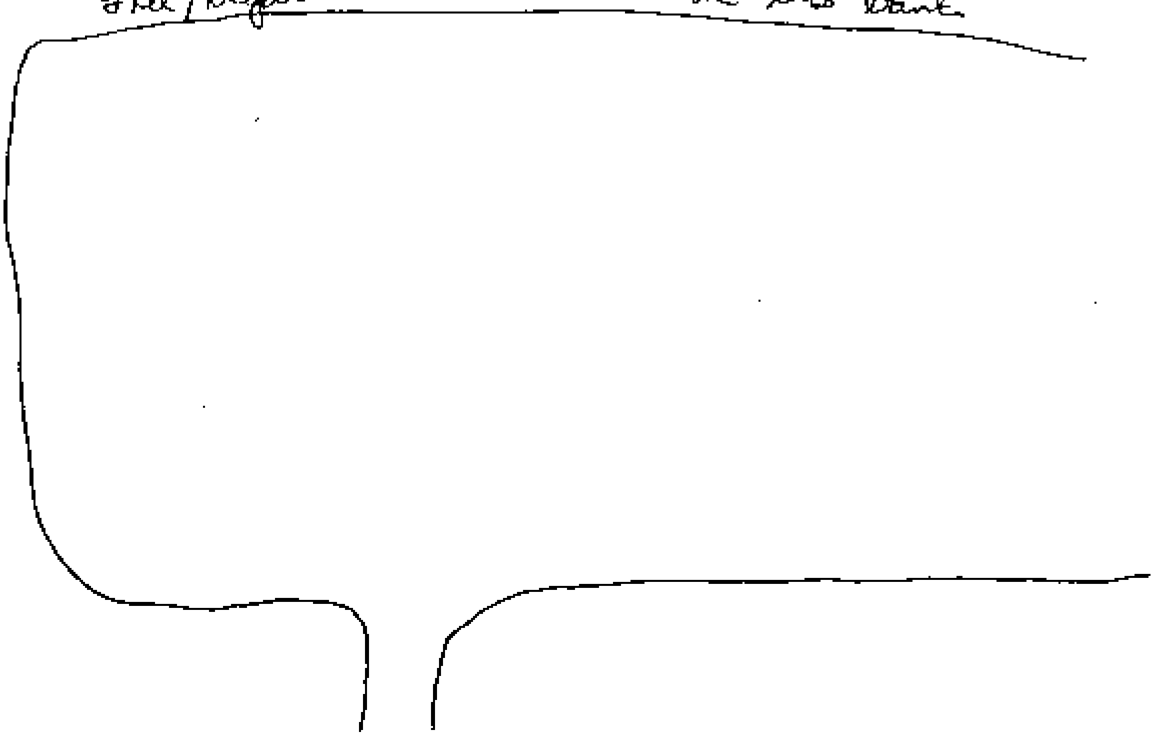
- Clay was packed into areas around the pond where silt fence had previously been and was causing some minor sloughing.

- Because of the height of the uncut grass no inspection was done. The grass is too high to do a proper inspection of the dike wall because you cannot see the ground. This also creates a safety issue because of possibly steping into holes that can't be seen, snakes, debris, etc.

- Some tree/vegetation removal was done so the dike is in better condition in those areas.

- Because of heavy rains and equipment driving over the squishy/seep areas, these areas were hard to compare to previous reports. Will report on next inspection.

Tree/vegetation removal done on this bank



g. Any evidence of the accumulated soils at or beyond the toe of the embankment, especially downstream of any observed seeps or wet areas: ✓ No ______ Yes, if so, **identify color**, describe accumulation (mounding, puddle on the ground, etc.), and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

h. Any evidence of the presence of burrowing animals: ______ No ______ Yes, if so, describe

N/A

i. Any presence of areas of apparently saturated soil that deflect ("pump" or feel "squishy" underfoot), or become wet after tapping ground with foot: ______ No ______ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form

N/A

* See back of page 2

IV. **Crest of Berm Condition**

a. Surface erosion or gullies present: ______ No ✓ Yes, if so quantify to extent possible, i.e. 2 ft by 2 ft, etc.

6' x 8' section next to entrance of deck at pH system building.

b. Any sloughing, sliding, or other visible signs of embankment failure: ✓ No ___ Yes, if so explain, quantify to extent possible, i.e. 2 ft by 2 ft, etc., and sketch area on the back of this form

c. Any wet areas or areas of dark/discolored soil present: ✓ No ______ Yes, if so, explain and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

d. Any semi-circularly shaped cracks visible in the surface soil, especially in the vicinity of the top of either berm face: √ No ____Yes, if so describe cracking and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form________________________________

e. Any depressions or sinkholes visible on top of either berm: √ No____Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form__________

V. **Other**

a. Any conditions observed on any portion of the embankment not described above: √ No ______Yes, if so describe and quantify to extent possible, i.e. 2 ft by 2 ft, etc. Sketch area on the back of this form____

VI. **Certification of Inspection**

Inspection performed by:

Donald Bauer	Lab Analyst	9/29/10
Name	Title	Date

Memorandum

To: *Jean-Claude Younan*

From: *François Bernardeau*
Roger Howard Jr.
Xiaohai Wang

Date: *March 16, 2011*

Subject: *Slope Seismic Stability Analyses, South Carolina Electric & Gas Ash Storage Pond - Canadys Power Station, Canadys, South Carolina*

Introduction and Background

This memorandum summarizes our seismic slope stability analyses for the Ash Storage Pond dike at the Canadys Power Station in Canadys, South Carolina for South Carolina Electric & Gas (SCE&G). These evaluations supplement the static slope stability evaluations conducted by Camp Dresser & McKee Inc. (CDM) for the evaluation of the proposed protective capping system under heavy construction truck activities, provided in CDM's memorandum dated April 3, 2007.

Elevations (El.) herein are in feet and referenced to the North America Vertical Datum (NAVD) of 1988.

Project and Site Description

The 95-acre ash storage pond is located in Canadys, South Carolina, adjacent to the South Carolina Electric & Gas (SCE&G) Canadys Station power plant facility. The ash pond is surrounded by an approximately 8,300 feet long dike as shown in **Figure 1**. The dike was constructed in 1987 from original ground surface at approximately El. 60 to store coal ash generated at the facility. A soil-bentonite (S-B) slurry wall was constructed from the dike crest through the underlying permeable sands to prevent seepage from the pond water into the local groundwater network.

In 2007, a cement-bentonite (C-B) slurry wall was constructed along the centerline of the dike and keyed about 4 feet into Cooper Marl formation to further reduce water seepage. Depending on the location along the dike, the S-B wall is either upstream or downstream of the C-B wall, with the distance between the S-B and C-B walls ranging from 0 to 17 feet. A capping system consisting of one layer of Geosynthetic Clay Liner (GCL), one layer of geogrid, and compacted base course material was constructed on top of the C-B slurry wall at the dike crest. The top of the dike is at approximately EL. 80 with an upstream slope of about 3:1 (H:V) into the pond and the downstream slope of about 2.5:1 (H:V). **Figure 2** presents a typical cross-section of the dike.

The current operating water level in the ash storage pond is at about El. 72, which is approximately 8 feet below the dike crest. CDM understands that SCE&G is considering raising the pond water elevation by 2 feet to El. 74. The groundwater level outside the ash storage pond is at about El. 59.

Figure 1. Aerial Image of Canadys Station Ash Storage Pond Site

Basis of Evaluation

CDM reviewed the existing geotechnical data reports from Withers & Ravenel, Inc. (2003) and F&ME Consultants (2009).

Withers & Ravenel's report presented logs and lab testing data, which included 15 geotechnical test borings and 25 cone penetrometer test (CPT) probes, as well as records of 6 monitoring wells along the dike. The investigation was performed to evaluate the condition of the S-B slurry wall. Therefore, the majority of the borings and CPT probes penetrated through the S-B slurry wall or along the edge of the S-B wall. Only one boring (WR-70W) and 8 CPT probes apparently penetrated the dike soils outside the limits of the S-B wall. In addition, six monitoring wells (GW-33 through GW-38) penetrated through the widely graded sand layer and terminated at the top of Cooper Marl formation. These explorations (1 boring, 8 CPTs, and 6 monitoring wells) were used to evaluate dike and underlying soil properties and as the basis for conducting the liquefaction screening evaluation.

Previous boring logs, lab testing report, CPT logs, and monitoring well records are attached in **Attachments A~D**.

F&ME performed field reconnaissance of wet areas surrounding the pond. Shallow hand augers were used to retrieve soil samples. Due to the limited data, it was not used to evaluate soil properties.

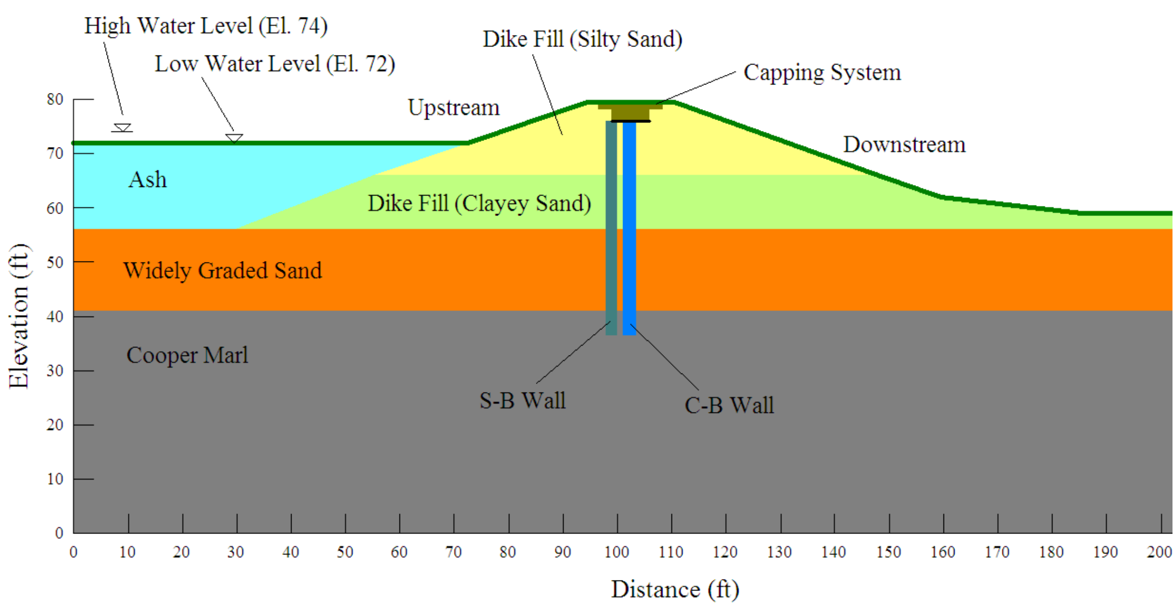


Figure 2. Typical Cross-Section of the Ash Storage Pond Dike

Subsurface Conditions

The following description of the dike material and corresponding Standard Penetration Test (SPT) N-values are mainly based on the boring log at WR-70W in conjunction with our review of the relevant CPT logs. As shown in **Figure 2**, subsurface conditions underlying the dike generally include a sequence of dike fill consisting of silty sand and clayey sand, overlying a naturally deposited widely graded sand deposit, over the Cooper Marl formation.

Dike Fill. The upper approximately 15 feet of the Dike Fill generally consists of silty sand. The silty sand generally consists of medium dense fine to medium subangular SAND with about 15 to 20% fines. SPT N values in the silty sand range from 27 to 29 blows per foot (bl/ft) with an average of 28 bl/ft. CPT tip resistance values typically ranged from 75 to 100 tsf with occasional looser zones around 30 tsf. The Dike Fill underlying the silty sand consists of clayey sand and extends to a depth of about 24 feet. The clayey sand is medium dense fine to medium subangular SAND with about 40 to 50% fines. SPT N values in the clayey sand range from 24 to 29 bl/ft with an average of 26 bl/ft. CPT tip resistance values typically ranged from 80 to 100 tsf with occasional looser zones around 40 tsf.

Widely Graded Sand. A Widely Graded Sand layer underlies the Dike Fill and is about 16 feet thick. It consists of medium dense to dense fine to coarse subrounded to subangular SAND with about 5 to 10% fines. SPT N values in the Widely Graded Sand range from 24 to 54 bl/ft with an average of 39 bl/ft from log of WR-7OW and range from 8 to 32 lb/ft with an average of 17 bl/ft based on the well logs. CPT tip resistance values typically ranged from 60 to 80 tsf with occasional looser zones around 40 tsf.

Cooper Marl. The Widely Graded Sand is underlain by a sandy silt layer locally termed the Cooper Marl formation. It consists of dense fine subangular sandy SILT. The average N-value in the layer is over 50 bl/ft and CPT tip resistance values typically ranged over 200 tsf with occasional zones around 100 tsf.

The existing S-B wall was encountered by most of the borings and CPT probes. It consists of fine to medium subangular clayey SAND. Lab testing data show that the fine content of this material ranges from 3.0 to 33.6% with an average of 13.6%. SPT N-values within the S-B material range from 0 to 21 bl/ft and CPT tip resistance values typically ranged from 2 to 10 tsf with occasional values over 20 tsf.

The recently constructed C-B wall is about 2.5 feet wide and located approximately along the dike centerline. Unconfined compressive strength of C-B samples ranged from 137 pound per square inch (psi) to 421 psi with an average of 236 psi.

Seismic Slope Stability Evaluation Overview

Our seismic slope stability evaluation followed typical recommended practices for a screening level analysis. This process consists of several steps:

1. Establish seismic criteria for a design earthquake – select a set of criteria with earthquake return interval(s) based on the seismic hazard, relevant codes/regulation, type and importance of the structure, risk of loss of life, loss of service, etc.;

2. Develop ground motions parameters – determine ground motion parameters from USGS maps for the design earthquake;

3. Develop a 2D dike model – identify the typical dike geometry and soil profile, determine dynamic soil strength properties, and determine if soil strength loss could occur during the design earthquake due to liquefaction or stain softening; and

4. Perform a dynamic slope stability analysis – evaluate the dike slope stability as it is subjected to the design seismic event, using pseudostatic slope stability evaluation methods.

The purpose of a screening level seismic slope stability analysis is to determine if it is probable that significant deformations could occur during strong ground shaking. If the results suggest such deformations are likely, then additional analysis should be considered. Each of the above steps can be performed to a higher standard using more sophisticated procedures, most of which are likely to require a more detailed understanding of site-specific conditions. The objective of the more sophisticated analysis is to develop a better understanding of the probable horizontal and vertical deformations that could occur in the dike and foundation soils.

Seismic Design Criteria

Seismic design criteria are typically formulated in terms of probability of occurrence of the design earthquake event (recurrence interval) and criteria for the performance of the structure/facility when subjected to the given level of shaking.

Probability of Occurrence. Common probabilities/recurrence intervals used in current building codes and standards are:

- 2% probability of exceedance in 50 years (return period of 2,475 years), and

- 10% probability of exceedance in 50 years (return period of 475 years).

Performance Criteria. Performance criteria typically specify the acceptable level of performance (or damage and/or interruption of service) under a specific seismic event defined by a recurrence interval. Different design earthquakes may be selected with different recurrence intervals. Performance criteria will vary for different design earthquakes and it is generally accepted that as the probability of an event decreases a lower level of performance is deemed acceptable.

Project Seismic Design Criteria. Currently there are no seismic design criteria that govern coal ash storage ponds. However, USEPA RCRA Subtitle D (385) (1995) provides guidelines and procedures for the seismic design and seismic stability evaluation for landfills. Because of the similarity in function and structure of the coal ash dike to landfill facilities and the fact that the US EPA regulates both facilities, we consider that it is appropriate and conservative to use the EPA guidelines (1995) for evaluating the seismic stability of the ash storage pond.

These EPA guidelines define the design earthquake as an event with a 10% probability of exceedance in 250 years, which corresponds to a return period of 2,373 years. We recommend that the associated performance criteria for this high level of design earthquake be that the dike is capable of retaining the coal ash following the design event, but that the dike may experience localized surficial failures and deformation which will require repair to facilitate continued use of the pond.

Ground Motion Parameters

The geometric mean peak ground acceleration (PGA) was estimated using the 2008 USGS National Seismic Hazards Mapping Project data and the project location at -80.6164° W and 33.0713° N. The 2008 USGS data set reflects the state of the art in ground motion evaluations and has been incorporated in the latest version of ASCE Standard 7-10 "Minimum Design Loads for Buildings and Other Structures" (2010). ASCE 7-10 defines the geometric mean PGA as the standard for evaluation of liquefaction, lateral spreading, seismic settlements, and other soil related issues. Accordingly, the ASCE 7-10 PGA value is judged to be appropriate for use in seismic slope stability evaluation of the coal ash retaining dike.

ASCE 7-10 defines a maximum considered earthquake (MCE) to be an event with a 2% probability of exceedance in 50 years (2,475 yr return interval), which is close to and slightly greater than the return interval for the recommended design event of 10% probability of exceedance in 250 years (2,373 yr return interval) specified in the EPA guidelines (1995).

The ground motion parameters obtained using ASCE 7-10 are summarized in **Table 1**, below. In addition, we estimated the associated earthquake magnitude for the design event as the mean earthquake magnitude from a deaggregation of the 2008 USGS earthquake hazard data associated with 2,475 year design event.

Table 1. Summary of Ground Motion Parameters

Site Class	Return Period (years)	Peak Ground Acceleration (g)	Mean Magnitude
B	2,475	0.47	6.8
D	2,475	0.48	6.8

The PGA values obtained from the USGS seismic hazard mapping are applicable to soft rock sites (Site Class B). The Site Class B ground motions have been adjusted to Site Class D to account for site-specific subsurface conditions using the procedures outlined in ASCE 7-10.

Dike Stability Model

Model Geometry

The dike geometry was developed based on typical dike cross-section and the soil profile, as presented in **Figure 2**. The subsurface layering was developed based on the subsurface conditions interpreted from the available boring and CPT data.

The dike crest width is 16 feet, based on the an average current dike width and the upstream side slope is 3:1 (H:V) and the downstream slope is 2.5:1 (H:V), based on the data provided by SCE&G during C-B slurry wall construction in 2007. The toe of the dike is set to be at El. 60, which is close to the low point outside the pond and is conservative for the downstream side slope stability in the analysis.

Soil Parameters

The soil properties are evaluated based on boring logs, lab testing data, and CPT tip resistance data provided in Withers & Ravenel, Inc. report. The unit weight and friction angle values of the sandy soils are estimated using correlations with SPT N-values provided in NAVFAC DM-7.1 (1986) and correlations with CPT tip resistance provided by Robertson and Campanella (1983). Lab testing data were used to estimate the unit weight of the S-B wall material. The stability evaluation soil parameters are summarized in **Table 2,** below.

Table 2. Dike Soil Properties for Stability Analysis

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Remarks
Ash	80	0	0	Assume no strength
Silty Sand	120	32	0	Average N=28; average CPT tip resistance = 68 tsf
Clayey Sand	110	30	0	Average N=26; average CPT tip resistance = 80 tsf
Widely Graded Sand	125	0	550	Assume liquefiable under the design earthquake event. Residual shear strength of 550 psf is used in the analysis (see Liquefaction Evaluation, below).
Sandy Silt (Cooper Marl)	110	0	4,000	N>50, CPT tip resistance > 100 tsf
Soil-Bentonite slurry wall	130	0	0	N ranges from 0 to 21. Assuming no strength during earthquake due to liquefaction (see Liquefaction Evaluation, below)
Cement-Bentonite slurry wall	80	0	10,000	Tested unconfined compressive strength >137 psi

In addition to evaluating the slope stability with the baseline parameters summarized in **Table 2**, additional parametric analyses were conducted to account for the potential variation of the dike soil parameters along the length of the dike. The parametric evaluation considered a variation (reduction) of friction angles of the dike by up to 3 degrees.

Liquefaction Evaluation

Background. Liquefaction is the loss of strength that can occur in a loose, saturated sand and silt during (or immediately following) seismic shaking. As loose granular soils are shaken, their tendency to contract and compress leads to the development of positive pore pressures. If the intensity or duration of the shaking is large enough and/or long enough, the buildup in pore pressure can produce a significant loss of shear strength. Liquefaction is said to occur when the excess pore pressures exceed the effective stress of the soil. If the shaking continues after the onset of liquefaction, liquefaction can produce a number of ground effects (e.g., loss of soil strength, sand boils, settlement, lurching, and lateral deflection).

The susceptibility of a granular soil to liquefaction is a function of the age, gradation, density, and fines content of the soil. The susceptibility to liquefaction decreases with respective increases in: (a) distribution of grain size, (b) soil density, (c) fines content, and (d) clay-size fraction of the fines. The susceptibility to liquefaction also tends to decrease as a function of the age of the deposit.

The screening evaluation of the liquefaction susceptibility of the soil deposits was primarily based on the procedure recommended by the National Center for Earthquake Engineering Research (NCEER), as summarized in Youd et al. (1996). The NCEER procedure is generally consistent with the liquefaction evaluation procedures outlined in the referenced EPA guidance (1995) document, but is considered a more advanced evaluation procedure than the older EPA procedure.

Screening Evaluation and Results. Based on limited available blow count data the dike fill material is not susceptible to widespread liquefaction (with the exception of the S-B wall material). However, the available CPT data suggest that localized zones within the dike may experience liquefaction during the design seismic event. Based on the available blow count, grain size data and CPT data the Widely Graded Sand layer underlying the dike is likely susceptible to liquefaction during the design seismic event.

To account for the strength loss associated with liquefaction, the stability analyses were conducted assuming zero strength for the S-B wall material and a residual shear strength of 550 psf for the Widely Graded Sand, based on residual strength relationships established by Idriss and Boulanger (2007).

We note that this liquefaction screening evaluation was conducted based on the limited available boring (blow count), laboratory (grain size) and CPT data. In addition, the quality of the available blow count data (e.g. hammer type, hammer energy, drilling methods, etc) used in the liquefaction evaluations is not well documented. Finally, depending on the proximity of the borings and CPT probes to the S-B wall, the relatively soft/loose S-B wall material may have impacted the blow counts and CPT data.

Dynamic Slope Stability Analysis

The seismic stability analysis performed generally followed the procedures provided in EPA Guidelines (1995), which include:

1. Assign appropriate dynamic strength parameters. The parameters in **Table 2** have been already adjusted based on the results of the liquefaction screening evaluation.

2. Evaluate the seismic coefficient, k. The EPA guidelines (1995) state that the maximum value of k may be determined as $k = 0.5\ a_{max}/g$ to limit permanent seismic deformations to less than 1 foot. For our analysis, a_{max} is the geometric mean PGA determined in accordance with ASCE 7-10 adjusted for site class (0.48g). Therefore:

$$k = 0.5\ a_{max}/g = 0.24$$

3. Perform a pseudo-static stability analysis for different cases using the Morgenstern-Price methods in the computer program SLOPE/W (GEO-SLOPE, version 2007). The program applies the pseudo-static load representing seismic loading acting through the sliding slice centroid in a limit-equilibrium analysis. Cases studied include stability for both the upstream and downstream side slopes of the dike and ash storage pond water levels (at El. 72 and 74).

Analysis Results

The dynamic slope stability factor of safety for each analyzed case is summarized in **Table 3**.

The factor of safety for major and deep seated slope failures (global failure) that pass through the C-B containment wall and would compromise the ability of the dike to retain the stored ash during the design earthquake is above 1.0 for both upstream and downstream slopes. The factor of safety for localized and surficial failure on both upstream and downstream slopes is less than 1.0 indicating that deformation exceeding 1 foot is likely during the design seismic event. The decrease of factor of safety due to rising of pond water level from El. 72 to 74 is not significant (within 5%).

Table 3. Factor of Safety against Slope Failure

Slope	Failure Mode	Factor of Safety Low Water	Factor of Safety High Water
Upstream	Localized and Surficial Failure	0.19	0.18
	Major and Deep Seated Failure	1.12	1.16
Downstream	Localized and Surficial Failure	0.87	0.80
	Major and Deep Seated Failure	1.01	1.00

To assess the effect of the possible variability of soil density, a parametric evaluation was conducted by reducing the friction angle of the dike materials by up to 3 degrees. The parametric evaluations indicate that the factor of safety remains greater than 1.0 with the reduced friction angles for major and deep seated slope failures. Additional stability analyses were conducted using a range of seismic coefficients to verify convergence of the analyses as recommended by GEO-SLOPE. The results of the analyses show a gradual reduction of factor of safety and good convergence of the analyses with the increase of the seismic coefficient.

Output plots from the program are included in **Attachment E**.

Conclusions and Recommendations

Based on the results of this screening level seismic slope stability analysis, we conclude that a deep-seated failure that would compromise the overall integrity of the dike during the design earthquake is not likely and that the dike will be capable of retaining the coal ash during and immediately following the design earthquake event.

However, significant deformation of the dike slopes during the design earthquake is likely to occur, particularly for the upstream slope. These deformations could threaten the longer term integrity of the dike as a containment facility and not allow the impoundment pond to remain functional following the design seismic event until repairs are made.

Our evaluation is based on limited geotechnical data for the dike. This data indicates there is a risk of liquefaction and significant deformation of the dike slopes during the design earthquake. We recommend that additional analysis be performed to better define the risks, as well as provide a better estimate of the likely deformation and required repairs required following a significant seismic event. However, it would not be beneficial to perform more detailed analysis without obtaining additional data on the dike and foundation soils and their strength. We can assist with developing and executing an investigation and analysis program that will provide a much better estimate of probable slope movements during a significant design earthquake.

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Reviewed By: John E. Newby

Attachment A

Previous Boring Logs

WITHERS & RAVENEL Engineering & Surveying, Inc. 111 MacKenan Drive · Cary, N.C 27511	LOG OF BORING WR-1 (Page 1 of 1)

South Carolina Electric & Gas

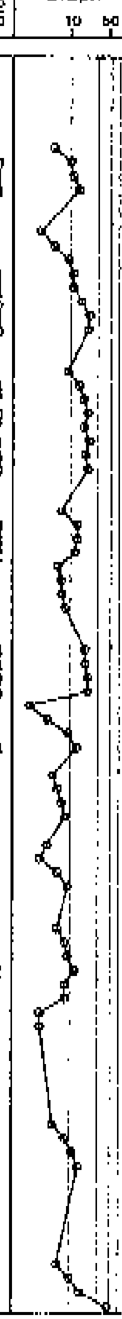
Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99075.18

Date Started	July 11, 2002	Drilling Method	: Mud Rotary
Date Completed	July 11, 2002	Sampling Method	: Split Spoon
Drilling Company	: Superior Drilling, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	Floyd Cox	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev 80	USCS	DESCRIPTION
0	80	SW	ROADBASE; Mostly fine slightly silty sand with gravel and wood debris.
		SM	SILTY SAND; Fine to medium subangular sand, approx 20% silty fines, low elasticity, moist.
			4.0 - 6.0 Approx. 6" layer of CL (approx. 20-30% fine sand, low plasticity)
			6.0 - 8.0 Approx. 15% clayey fines, low plasticity.
			11.0 - 13.0 Lenses/layers of clayey sand; low plasticity, approx. 30% clayey fines.
			16.0 - 18.0 Occasional coarse sand.
			18.0 - 23.0 Mostly fine sand, approx. 25-40% silty fines
		SW-SM	SILTY SAND with GRAVEL; Fine to coarse subangular sand, approx. 5% subrounded gravel to 1/4", 10-15% silty fines, wet, tan/grey.
35	45	ML	SANDY SILT; Apparent Cooper Formation, low elasticity, approx. 15% fine sand, wet/saturated, olive-grey.
45			

Samples	Blow Count	REMARKS
1	5-10-11-14	Penetration - 2.0' Recovery - 1.6'
2	[illegible]	Penetration - 2.0' Recovery - 1.7'
3	[illegible]	Penetration - 2.0' Recovery - 1.4'
4	9-14-17-20	Penetration - 2.0' Recovery - 1.3'
5	[illegible]	Penetration - 2.0' Recovery - 1.8'
6	[illegible]	Penetration - 2.0' Recovery - 1.1'
7	[illegible]	Penetration - 2.0' Recovery - 1.2'
8	[illegible]	Penetration - 2.0' Recovery - 1.5'
9	[illegible]-13	Penetration - 2.0' Recovery - 1.2'
10	5-6-7-8	Penetration - 2.0' Recovery - 1.0'
11	4-3-8-9	Penetration - 2.0' Recovery - 0.9'
12	[illegible]	Penetration - 2.0' Recovery - 1.0'
13	[illegible]	Penetration - 2.0' Recovery - 1.1'
14	5-8-11-14	Penetration - 2.0' Recovery - 2.0'
15	6-10-15-46	Penetration - 2.0' Recovery - 2.0'

Blow Count Graph



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LOG OF BORING WR-2

South Carolina Electric & Gas

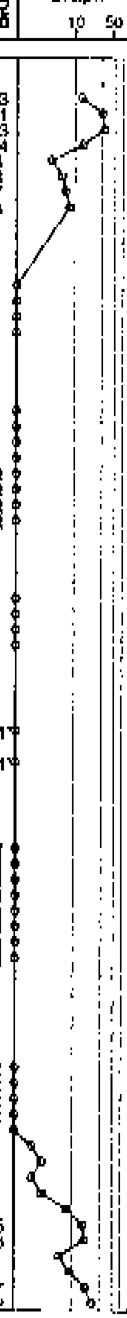
Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: July 12, 2002	Drilling Method	: Mud Rotary
Date Completed	: July 12, 2002	Sampling Method	: Split Spoon
Drilling Company	: Superior Drilling, Inc	Ground Elevation	: El. 80 (estimated)
Driller	: Floyd Cox	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION
0	80	SM	SILTY SAND; Mostly fine to medium subangular sand, approx. 30% silty fines, moist to dry, grey/tan/brown.
		SC	CLAYEY SAND; Apparent slurry wall, fine to medium subangular sand, approx. 30% clayey-like fines, very low to low plasticity, moist, grey, clods of hydrated bentonite to 1".
5	75		
		SC	CLAYEY SAND; Apparent slurry wall, fine to coarse subangular sand, approx. 30% clayey-like fines, low plasticity, moist, grey.
10	70		
15	65		
		SC	CLAYEY SAND; Apparent slurry wall, fine to medium subangular sand, approx. 30% clayey-like fines, low plasticity, moist, grey.
20	60		
		SC	CLAYEY SAND; Apparent slurry wall, fine to medium with occasional coarse (subrounded, pebbly) sand, approx. 30% clayey-like fines, low plasticity, moist, grey.
25	55		
30	50		29.0 to 31.5 - Drill rods and bit dropped under their own weight (WOR/30")
35	45	SW/SC	SLIGHTLY CLAYEY SAND; Apparent slurry wall, fine to coarse subangular sand, approx. 10-15% clayey-like fines, low plasticity, moist, grey.
		ML	SANDY SILT; Apparent Cooper Formation, low to medium elasticity, approx. 15-30% fine sand, wet, olive green.
40			

Samples	Blow Count	REMARKS
		R - weight of rods H - weight of hammer
1	13, 31, 33, 14	Penetration - 2.0' Recovery - 2.0'
2	4, 6, 7, 8	Penetration - 2.0' Recovery - 1.3' Sample UD-1 collected (5.0-7.0)
3	1, 1, 1, 1	Penetration - 2.0' Recovery - 1.1' Sample UD-2 collected (9.0-11.0)
4	1, 1, 1, 1	Penetration - 2.0' Recovery 0.3'
5	R, R, R, R	Penetration - 2.0' Recovery - 0.6' Sample UD-3 collected (15.0-17.0)
6	1, 1, 1, 1	Penetration - 2.0' Recovery - 1.2' Sample UD-4 collected (19.0-21.0)
7	1/1", 1/1"	Penetration - 2.0' Recovery -1.3' Sample UD-5 collected (23.0-25.0)
8	H, H, H, H	Penetration - 2.0' Recovery - 0
9	R, R, R, R	Penetration - 2.0' Recovery - 0
10	R, R, R, R	Penetration - 2.0' Recovery - 0
11	1, 2, 3, 3	Penetration - 2.0' Recovery - 0.0'
12	2, 3, 8, 15	Penetration - 2.0' Recovery - 2.0'
13	16, 6, 9, 17, 22	Penetration - 2.0' Recovery - 2.0'

Blow Count Graph



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LOG OF BORING WR-3

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: July 11, 2002	Drilling Method	: Mud Rotary
Date Completed	: July 11, 2002	Sampling Method	: Split Spoon
Drilling Company	: Superior Drilling, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Floyd Cox	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0	80	SW	ROADBASE: Mostly fine slightly silty sand with gravel and wood debris.	1	6, 18, 21, 10	Penetration - 2.0' Recovery - 1.5'
		SM	SILTY SAND; Mostly fine to medium with occasional coarse, subangular sand, approx. 15% non-plastic fines, moist, brown/tan.			
5	75					
				2	6, 10, 18, 19	Penetration - 2.0' Recovery - 1.2'
10	70		10.0 - 12.0 Increased coarse sand and gravel content (subrounded to subangular fragments to 1/4")			
			12.0 - 13.0 Wood fragments			
				3	10, 17, 18, 18	Penetration - 2.0' Recovery - 0.8'
15	65		13.0 - 18.0 Mostly fine to medium subangular sand, tan to grey.			
		SC	CLAYEY SAND; Mostly fine to medium subangular sand, approx. 30-40% low plasticity clayey fines, moist to wet, brown/black.	4	5, 10, 8, 8	Penetration - 2.0' Recovery - 1.0'
20	60	SM	SILTY SAND; Mostly fine to medium subangular sand, approx. 10-15% low elasticity silty fines, moist/wet, tan/grey to light tan.			
				5	8, 10, 14, 15	Penetration - 2.0' Recovery - 0.9'
25	55					
				6	7, 7, 8, 7	Penetration - 2.0' Recovery - 0.8'
30	50		28.0 - 33.0 Fine to coarse sand, tan/grey			
		ML	SANDY SILT; Apparent transition to Cooper Formation, low to medium elasticity, approx. 15-30% fine sand, wet/saturated, olive-grey	7	15, 11, 4, 4	Penetration - 2.0' Recovery - 2.0'
35	45					
40						

Blow Count Graph: 10 60

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LOG OF BORING WR-4

South Carolina Electric & Gas

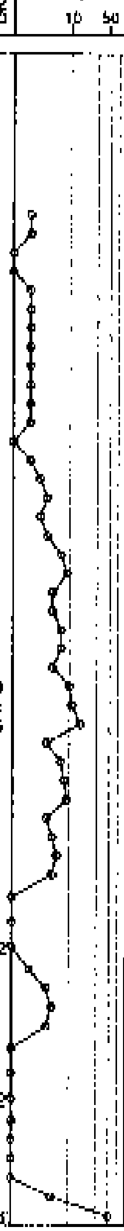
Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: July 11, 2002	Drilling Method	: Mud Rotary
Date Completed	: July 11, 2002	Sampling Method	: Split Spoon
Drilling Company	: Superior Drilling, Inc	Ground Elevation	: El. 80 (estimated)
Driller	: Floyd Cox	Logged By	: Stefan Bray
Rig / Equipment	CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	REMARKS
0	80	SM	SILTY SAND; Fine to coarse subangular sand, approx. 20% silty fines, moist to dry, grey, trace clods of hydrated bentonite.	R - weight of rods H - weight of hammer
5	75			
6.0		SC	CLAYEY SAND; Apparent slurry wall, fine to medium subangular sand, approx. 15% clayey fines (approx. 25% clayey fines at 6.0' to 8.0'), very low plasticity, moist/wet, grey. 10.0 to 12.0 - Grey/brown sand.	6.0' to 16.0' Material not cohesive enough to collect undisturbed (UD) tube sample including by means of piston sampler.
10	70			
15	65			
16.0		SC	CLAYEY SAND; Apparent slurry wall, fine to medium with occasional coarse subangular sand, approx. 15% clayey fines, very low plasticity, moist/wet, grey. 16.0 to 18.0 - Grey/tan. 18.0 to 20.0 - Mostly fine to medium sand.	16.0' to 24.0' Material not cohesive enough to collect undisturbed (UD) tube sample including by means of piston sampler.
20	60			
24.0		SC	CLAYEY SAND; Apparent slurry wall, fine to coarse subangular sand, approx. 15% clayey fines, very low plasticity, moist/wet, grey.	24.0' to 28.0' Material not cohesive enough to collect undisturbed (UD) tube sample including by means of piston sampler.
25	55			
28.0		SC	CLAYEY SAND; Apparent slurry wall, fine to medium with occasional coarse (subrounded, pebbly) sand, approx. 15% clayey fines, very low plasticity, moist/wet, grey.	28.0' to 30.5' Material not cohesive enough to collect undisturbed (UD) tube sample including by means of piston sampler. Boring terminated at 30.5'
30		ML	SANDY SILT; Apparent Cooper Formation, low to medium elasticity, approx. 15-30% fine sand, wet, olive green.	

Samples	Blow Count
1	2, 2, 1, 1
2	2, 2, 2, 2
3	2, 2, 2, 2
4	1, 2, 3, 4
5	3, 4, 7, 9
6	5, 5, 7, 7
7	5, 10, 11, 15
8	4, 7, 8, 9
9	4, 5, 6, 5
10	1, 1, 1/12
11	2, 4, 6, 4
12	1, 1, 1/12
13	R, R, R, R
14	5, 50/3

Blow Count Graph



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LOG OF BORING WR-5

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	January 7, 2003	Sampling Method	Split Spoon, Piston Shelby
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefen Bray, PE
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL: Silty Sand and Roadbase, Mostly fine to medium subangular sand, approx 10-15% non-elastic fines, moist, tan/brown			
4	76	SC	SLURRY WALL 4.0' - 6.0': Clayey Sand, fine to medium subangular sand, approx. 30-35% clayey-like fines, medium plasticity, moist to wet, grey/black.	1	1 2 2 2	S-1 (4'-6') Penetration - 2.0' Recovery - 1.1'
8	72		9.0' - 11.0': Clayey Sand, mostly fine with some medium subangular sand, approx. 35-45% clay-like fines, medium to high plasticity, moist/wet, grey/black.	2	H H H H	S-2 (9'-11') Penetration - 2.0' Recovery - 0.3'
12	68		14.0' - 16.0: Clayey Sand, mostly fine to medium subangular sand, approx. 20-35% clayey-like fines.			UD-1 (14'-16') Penetration - 2.0' Recovery - 2.0'
16	64		16.0' - 18.0': Clayey Sand, mostly fine to medium with occasional coarse (subrounded, pebbly) subangular sand, approx. 20-30% clayey-like fines, moist to wet, grey/black.	3	2 2 2 2	S-3 (16'-18') Penetration - 2.0' Recovery - 1.0'
20	60		19.0' - 21.0' Clayey Sand, fine to medium subangular sand, approx. 15-20% clayey-like fines, wet, grey.	4	1/1 1/1	S-4 (19'-21') Penetration - 2.0' Recovery - 1.1'
			Drilling above 24.5' appeared as wall rather than SM (i.e., consistent soft/easy drilling)			
24	56	SM	24.5' - 26.0' Silty Sand (SM); medium subangular to coarse subrounded sand, approx. 10-15% non-nonelastic silty fines, tan/grey, wet, with mostly fine subangular sand, approx. 40% non-elastic fines, tan/grey/wet in lower 2" of spoon.	5	R 4 4 5	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
28	52		29.0' - 31.0' Silty Sand (SM); fine to coarse to fine subangular sand (coarse sand mostly subrounded), approx. 10%-30% non-elastic silty fines, grey/tan, wet.	6	4 6 4 4	S-6 (29'-31') Penetration - 2.0' Recovery - 1.0'
32	48					
			34.0 - 36.0' COOPER MARL FORMATION: Sandy Silt (ML), Low plasticity, approx. 35-40% fine sand, green/grey.	7	6 12 28 50/3"	S-7 (34'-35.75') Penetration - 1.8' Recovery - 1.8'
36	44					

Blow Count Graph

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LOG OF BORING WR-6

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99070.18

Date Started	: January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 7, 2003	Sampling Method	Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, Mostly fine to medium subangular sand, approx. 10-15% non-elastic fines, moist, tan/brown.			
4	76			1	[illegible]	S-1 (4' - 6') Penetration - 2.0' Recovery - 1.2'
		SC	SLURRY WALL			
8	72		9.0' - 11.0' Spoon dropped 24" under weight of hammer (WOH/24"), no recovery. Wash appeared as clayey sand, fine to medium subangular sand, grey/black.	2	[illegible]	S-2 (9' - 11') Penetration - 2.0' Recovery - 0'
12	68					
16	64		14.0' - 16.0' Clayey Sand, fine to medium subangular sand, approx. 25-40% low to medium plasticity clayey-like fines, black/grey, wet.	3	[illegible]	S-3 (14' - 16') Penetration - 2.0' Recovery - 1.1'
20	60		19.0' - 21.0' Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey/black.	4	[illegible]	S-4 (19' - 21') Penetration - 2.0' Recovery - 1.5' UD-1 (22' - 24') Penetration - 2.0' Recovery - 16"
24	56		24.0' - 26.0' Clayey Sand, fine to medium subangular sand, approx. 25-30% low plasticity clayey-like fines, black/grey, wet.	5	[illegible]	S-5 (24' - 26') Penetration - 2.0' Recovery - 0.4'
28	52		29.0' - 31.0' Spoon dropped greater than 4' under weight of rods (WOR/4'+). Spoon drop stop of driller, no recovery.	6	[illegible]	S-6 (29' - 31' (33')) Penetration - 4.0'+ Recovery - 0.2'
32	48		34.0' - 36.0' Spoon dropped approximately 3' under weight of rods (WOR/3'); Clayey Sand, fine to mostly medium subangular sand, some (< 5-10%) subrounded coarse sand, approx. 30% low to medium plasticity clayey-like fines, grey/black, one piece of .5" diameter wood to width of spoon.	7	[illegible]	S-7 (34' - 36' (37')) Penetration - 3.0' Recovery - 0.7'
36	44	ML	~37'-38': Driller became harder (appearent top of Cooper Marl) COOPER MARL FORMATION			
40	40			8	10 18 36 50/4"	S-8 (39' - 41') Penetration - 1.8' Recovery - 1.8'
44	36					

Blow Count Graph: 10, 50

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LOG OF BORING WR-7

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 89076.18

Date Started	January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	January 7, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: Ft. 80 (estimated)
Driller	Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand with roadbase, mostly fine to medium subangular sand, approx 15% non-elastic silty fines, moist, tan.			
4	76	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30% low to medium plasticity clayey-like fines, grey, moist.	1	3 3 1 1	S-1 (4'-6') Penetration - 2.0' Recovery - 1.2'
8	72		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey, moist to wet, with approx. 6" of fine to mostly coarse (subrounded pebbly) at tip (less than 15% non-plastic fines). Coarser sand appears as potential caves from above (lack of slurry consistency and color).	2	1 1 1 5	S-2 (9'-11') Penetration - 2.0' Recovery - 2.0'
12	68		S-3 (14' - 16') Clayey Sand, fine to coarse subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey. Generally fine to medium in lower 3", medium to mostly course in upper 3"	3	3 2 2 2	S-3 (14'-16') Penetration - 2.0' Recovery - 0.5'
16	64					
20	60		S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 20-50% low plasticity clayey-like fines, grey, wet, 40-50% medium plasticity fines in lower 7" and 20-30% low plasticity fines in upper 17"	4	2 1 1 2	S-4 (19'-21') Penetration - 2.0' Recovery - 2.0'
24	56		S-5 (24' - 26') Drill rods & spoon dropped approx. 5.5' - 6.0' after being detached from winch (WOR/5.5'); Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey, moist to wet.	5	R R R R	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
28	52		Hole cleaned/drilled from 24' - 31'			
32	48		UD-1 (31' - 33') Tube sank/dropped 3' under weight of rods, no recovery.			UD-1 (31'-33') Penetration 3.0' Recovery - 0'
36	44		UD-2 (34' - 36') Sample obtained. Sample determined to be disturbed (appeared as soil/wall plug in tube, material moved & deformed during tube sealing)			UD-2 (34'-36') Penetration - 2.0' Recovery - 0.4'
40	40	ML	S-6 (39' - 41') COOPER MARL FORMATION; Drilling did not appear to become harder above 39' (i.e., Cooper encountered during spoon interval)	6	1 13 50/5"	S-6 (39'-41') Penetration - 1.4' Recovery - 1.3'
44	36					

Blow Count Graph: 10 50

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LOG OF BORING WR-7OW

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 6, 2003	Drilling Method	Mud Rotary
Date Completed	: January 6, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc	Ground Elevation	: El. 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0	80	SM	SILTY SAND; fine to medium subangular sand, approx. 15-20% non-elastic silty fines, moist, tan to light grey/tan.			R - weight of rods H - weight of hammer
4	76	SM	SILTY SAND; fine to mostly medium subangular sand, approx. 15% non-elastic silt fines, moist, grey/tan.	1	10 13 14	S-1 (4'-5.5') Penetration - 1.5' Recovery - 1.2'
8	72	SM	SILTY SAND; with lense of clayey sand; fine to medium to coarse subangular sand, approx. 15-20% non-elastic silty fines, approx. 4" lense of fine to medium sand with approx. 40-50% low-plasticity clayey-like fines (possible well intrusion), moist/wet, grey/tan. Coarse sand layer observed in upper 2" of spoon; fine to coarse (subrounded, pebbly) subangular sand.	2	10 12 17	S-2 (9'-10.5') Penetration - 1.5' Recovery - 1.4'
12	68	SM-SC	CLAYEY SAND; mostly fine to medium subangular sand, approx. 40-50% low plasticity clayey-like fines, organic debris (wood fibers), wet/moist, appearent non-fill or original grade or new subsurface, black/grey.	3	8 11 18	S-3 (14'-15.5') Penetration - 1.5' Recovery - 1.2'
16	64	SC	SILTY SAND; mostly fine subangular sand in lower 5" and fine to medium with coarse in upper 7", approx. 10-15% non-elastic silt fines in lower 5" and approx. 20-25% non-elastic silt fines in upper 7", moist/wet, grey/tan in upper and tan/white in lower.	4	8 11 13	S-4 (19'-20.5') Penetration - 1.5' Recovery - 1.3'
20	60	SM	WIDELY GRADED SAND; fine to coarse (subrounded, pebbly) subangular sand, less than 5-10% fines, grey/white/tan, wet.	5	18 22 29	S-5 (24'-25.5') Penetration - 1.5' Recovery - 1.0'
24	56	SW	WIDELY GRADED SAND; fine to coarse (subrounded, pebbly) subangular sand, less than 5-10% fines, grey/white/tan, wet.	6	10 10 14	S-6 (29'-30.5') Penetration - 1.5' Recovery - 1.3'
28	52			7	13 13 16	S-7 (34'-35.5') Penetration - 1.5' Recovery - 1.3'
32	48		Drilling became harder at ~37', then soft again at ~38'			
36	44					
40	40	ML	COOPER MARL FORMATION	8	9 10 46	S-8 (39'-40.5') Penetration - 1.5' Recovery - 1.5'
44	36					

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LOG OF BORING WR-8

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 9, 2003	Drilling Method	Mud Rotary
Date Completed	January 9, 2003	Sampling Method	Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	EL 80 (estimated)
Driller	Scott Tillerson	Logged By	Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 20% non-elastic silty fines,moist, tan.			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to mostly medium subangular sand, approx. 35-45% low plasticity clayey-like fines, grey, wet (saturated).	1	1 1 1 1	S-1 (4'-6') Penetration - 2.0' Recovery - 0.4'
10	70	SC	S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey, wet (saturated).	2	1 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.7'
15	65	SC	S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 35-45% fines in upper 6", approx. 20-25% in lower 8", low plasticity, wet, grey.	3	3 4 3 3	S-3 (14'-16') Penetration - 2.0' Recovery - 1.2'
		SC	UD-1 (17' - 19') Top/bottom of tube is wall material			UD-1 (17'-19') Penetration - 2.0' Recovery - 1.7'
20	60	SC	S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 30% low elasticity clayey-like fines, grey, wet/saturated.	4	2 2 2 1	S-4 (19'-21') Penetration - 2.0' Recovery - 1.3'
25	55	SC	S-5 (24' - 26') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey.	5	1 1 1 1	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
		SC	UD-2 (28' - 30') Top/bottom of tube is wall material			UD-2 (28'-30') Penetration - 2.0' Recovery - 0.4'
30	50	SC	S-6 (30' - 32') Upper4" - Clayey Sand, fine to coarse, approx. 20-25% low plasticity clayey fines; Lower 3" -Silty Sand, fine to medium subangular sand with 10-15% nonelastic silty fines. (WOR/18", WOH/6")	6	R R R H	S-6 (30'-32') Penetration - 2.0' Recovery - 0.6'
		SC	S-7 (32' - 34') Clayey Sand, fine to medium subangular sand, approx 20-25% clayey fines with approx. 1 to 1.5' lense of clod of moderate plasticity clayey-like material. (WOR/24"+)	7	R R R R	S-7 (32'-34') Penetration - 2.0' Recovery - 0.4'
35	45	SC	S-8 (34' - 36') Widely Graded Sand with Clayey-like fines, fine to mostly medium with some coarse subangular sand, less than 10% fines, wet, tan/grey. (WOR/24"+)	8	R R R R	S-8 (34'-36') Penetration - 2.0' Recovery - 0.3'
		ML	COOPER MARL FORMATION	9	3 8 13 18	S-9 (36'-38') Penetration - 2.0' Recovery - 2.0'
40	40					

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LOG OF BORING WR-9

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 8, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 8, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL: Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 20% non-elastic silty fines, moist, tan/brown.			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey/black, moist/wet.	1	4 3 4 4	Penetration - 2.0' Recovery - 2.0'
10	70	SC	S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, grey/black, wet.	2	H H H H	Penetration - 2.0' Recovery - 0.6'
		SC	UD-1 (12' - 14') top/bottom of tube - wall			Sample UD-1 collected (12.0-14.0)
15	65	SC	S-3 (14' - 16') Clayey Sand, mostly fine subangular sand, approx. 30-40% low plasticity clayey-like fines, moist/wet, grey.	3	3 3 1 2	Penetration - 2.0' Recovery - 0.7'
20	60	SC	S-4 (19' - 21') Clayey Sand, mostly fine to medium subangular sand, approx. 35-50% low to medium plasticity clayey-like fines, grey, moist/wet.	4	H H H H	Penetration - 2.0' Recovery - 1.1'
25	55	SC	S-5 (24' - 26') Spoon dropped ~24+" under weight of rods & hammer (WOH/24"+), no recovery.	5	H H H H	Penetration - 2.0' Recovery - 0'
		SC	Hole drilled/cleaned to 27.5'			
		SC	UD-2 (27.5' - 29.5') Tube sank approx. 3.5' under weight of rods (WOH/3.5'), 14" recovery.	6	R R R R	Penetration - 3.0' Recovery - 0' Sample UD-2 collected (27.5.0-29.5)
30	50					
		ML	COOPER MARL FORMATION S-6 (31' - 31.8') Sandy Silt, fine subangular sand, approx. 20-40% fine sand, low plasticity, green.	7	22 50/3"	Penetration - 0.8' Recovery - 0.8'
35	45					

Blow Count Graph

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LOG OF BORING WR-10

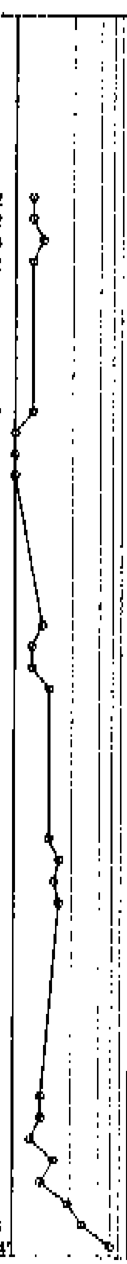
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 10, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 10, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL: Silty Sand, fine subsubangular sand, approx. 15-20% non-elastic fines, tan/brown, moist.			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to mostly medium subangular sand, approx. 35-45% low plasticity clayey-like fines, grey/black, wet (saturated).	1	2, 2, 3, 2	S-1 (4'-6') Penetration - 2.0' Recovery - 0.7'
10	70	SC	S-2 (9' - 11') Clayey Sand, fine to coarse subangular sand, approx. 15-20% non-plastic clayey-like fines, grey/black, wet.	2	2, 1, 1, 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.6'
15	65		S-3 (14' - 16') Upper 6" of sample: Fine to coarse subangular sand, approx. 15% non-plastic fines, wet, grey. Middle 3" of sample: Mostly fine subangular sand, approx 40-50% low plasticity clayey-like fines, dark grey. Lower 3" of sample: Fine to medium subangular sand, less than 5% fines, wet, tan	3	3, 2, 2, 4	S-3 (14'-16') Penetration - 2.0' Recovery - 1.0'
20	60	SC-SM	S-4 (19' - 21') Upper 4" of sample: Fine to medium subangular sand, approx. 20-25% non-plasticity fines, grey/black. Middle 2" of sample: Sandy Clay, approx. 40-50% fine sand, low plasticity, grey/brown, wet. Lower 3" of sample: Silty Sand, fine sand, approx. 30% non-plastic fines, tan/brown, wet.	4	4, 6, 5, 8	S-4 (19'-21') Penetration - 2.0' Recovery - 0.8'
			UD-1 (23' - 25')			UD-1 (23'-25') Penetration - 2.0' Recovery - 1.8'
25	55	SM	S-5 (25' - 27') Silty Sand, fine to medium subangular sand, approx. 10-15% non-elastic fines, wet, grey/tan.	5	3, 3, 2, 5	S-5 (25'-27') Penetration - 2.0' Recovery - 0.8'
		ML	COOPER MARL FORMATION S-6 (27' - 29') Sandy Silt	6	3, 9, 16, 50/4	S-6 (27'-29') Penetration - 2.0' Recovery - 0.6'
30	50					

Blow Count Graph



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LOG OF BORING WR-11

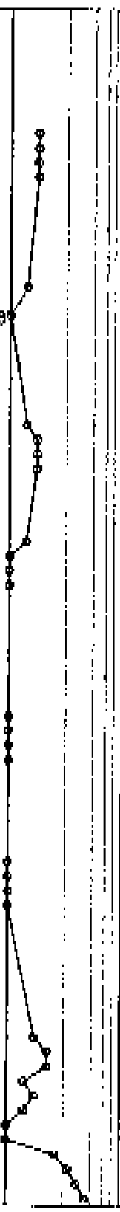
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	January 10, 2003	Drilling Method	Mud Rotary
Date Completed	January 10, 2003	Sampling Method	Split Spoon, Piston Tube
Drilling Company	Geotechnologies, Inc.	Ground Elevation	El. 80 (estimated)
Driller	Scott Tillerson	Logged By	Stefan Bray
Rig / Equipment	CME 550		

Depth in Feet	Surf Elev. 80	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW		WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR		FILL; Silty Sand, fine subangular sand, approx. 10-15% non-plastic fines, moist/wet, tan/brown.			
4	76	SC		SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey/black, wet.	1	3 3 3 3	S-1 (4'-6') Penetration - 2.0' Recovery - 1.5'
8	72						
				S-2 (9' - 11') Clayey Sand, mostly fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey/black, saturated.	2	2 1/18"	S-2 (9'-11') Penetration - 2.0' Recovery - 0.4'
12	68						
				S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 15-20% , wet, low plasticity clayey-like fines, black/grey, wet/moist.	3	2 3 3 3	S-3 (14'-16') Penetration - 2.0' Recovery - 1.8'
16	64			UD-1 (16' - 18') Top/bottom of tube appeared as S-3			UD-1 (16'-18') Penetration - 2.0' Recovery - 1.3'
				S-4 (18' - 20') Clayey Sand, fine to medium subangular sand, approx. 30-35% low plasticity clayey-like fines. grey/black, saturated,	4	2 1 1 1	S-4 (18'-20') Penetration - 2.0' Recovery - 1.1'
20	60						
24	56			S-5 (24' - 26') Clayey Sand, fine to coarse subangular sand, approx. 25-30% low plasticity clayey-like fines, saturated, grey/black, (1,WOH/18")	5	1 H H H	S-5 (24'-26') Penetration - 2.0' Recovery - 0.6'
				UD-2 (27' - 29') Top/bottom of tube as S-5, WOR/24"			UD-2 (27'-29') Penetration - 2.0' Recovery - 2.0'
28	52			S-6 (29' - 31') Clayey Sand, fine to coarse subangular sand, approx 30% low plasticity fines, saturated, grey/black, WOR/24"+	6	R R R R	S-6 (29'-31') Penetration - 2.0' (3.0') Recovery - 2.0'
32	48						
				S-7 (35' - 37') Widely-Graded Sand, fine to coarse subangular sand, less than 10% fines, wet, tan/grey. with .75" thick layer of clayey sand approx. 2" from bottom of spoon.	7	[illegible]	S-7 (35'-37') Penetration - 2.0' Recovery - 0.7'
36	44			S-8 (37' - 39') Transition into Upper Cooper, clayey/silty fine sand with approx. 7"-thick layer of medium to mostly coarse (pebbly) sand with gravel, <5% fines from 38-38.5'	8	[illegible]	S-8 (37'-39') Penetration - 2.0' Recovery - 2.0'
40	40	ML		COOPER MARL FORMATION S-9 (39' - 41')	9	7 12 17 24	S-9 (39'-41') Penetration - 2.0' Recovery - 2.0'
44	36						

Blow Count Graph



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LOG OF BORING WR-12

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started : January 8, 2003
Date Completed : January 8, 2003
Drilling Company : Geotechnologies, Inc.
Driller : Scott Tillerson
Rig / Equipment : CME 550

Drilling Method : Mud Rotary
Sampling Method : Split Spoon, Piston Tube
Ground Elevation : EL 80 (estimated)
Logged By : Stefan Bray

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 15% non-elastic fines, brown/tan, moist			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet, with approx. 4" lense of sandy clay (approx. 30-40% fine sand, medium to high plasticity, saturated).	1	2 1 2 1	S-1 (4'-6') Penetration - 2.0' Recovery - 1.1'
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet, with clods of OL (approx. 0.5" to 1.5" thick), WOH/24"+ 12' - Drilling appeared to firm-up	2	H H H H	S-2 (9'-11') Penetration - 2.0' Recovery - 1.0'
15	65		S-3 (14' - 16') Clayey Sand, fine to mostly medium subangular sand, approx. 20-30% low plasticity clayey-like fines, moist/wet, grey/black.	3	6 6 5 5	S-3 (14'-16') Penetration - 2.0' Recovery - 0.8'
20	60		S-4 (19' - 21')Clayey Sand, fine to coarse subangular sand, approx. 30% clayey-like fines, grey/black, wet.	4	2 1 1 1	S-4 (19'-21') Penetration - 2.0' Recovery - 0.6'
			UD-1 (22' - 24') Tube & rods sank ~2.5'-3.0' after being detached from winch			UD-1 (22'-24') Penetration - 2.0' (3.0') Recovery - 1.5'
25	55		S-5 (25' - 27') No recovery, WOR/24"	5	R R R R	S-5 (25'-27') Penetration - 2.0' Recovery - 0'
			S-6 (27' - 29') Spoon/rods dropped ~56 inches (5.75') under weight of hammer (WOH/56") ~31' - Drilling became firmer, appeared as gravelly zone ~33' - Appearent top of Upper Cooper	6	H H H H	S-6 (27'-29') Penetration - 2.0' Recovery - 0.2'
30	50					
35	45	ML	COOPER MARL FORMATION S-7 (34' - 36')	7	22 50/3"	S-7 (34'-37.5') Penetration - 0.8' Recovery - 0.8'

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LOG OF BORING WR-13

(Page 1 of 1)

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 10, 2003	Drilling Method	Mud Rotary
Date Completed	: January 10, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL: Roadbase			R - weight of rods H - weight of hammer
		AR	FILL: Silty Sand, mostly fine subangular sand, approx 15-20% non-plastic silt fines, moist to wet, tan/grey			
5	75			1	8 6 5 4	S-1 (4.5'-6.5') Penetration - 2.0' Recovery - 0.9'
		SC	SLURRY WALL S-1 (4.5' - 6.5') Clayey Sand, fine to medium subangular sand, approx. 20% low plasticity clayey-like fines, grey/black, moist			
10	70	SC	S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 35-40% low plasticity fines, grey/black, wet (saturated). ~10' - 14': Above-normal drilling mud loss	2	1 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.0'
15	65	SC	S-3 (14' - 16') Clayey Sand, mostly fine subangular sand, approx. 10-15% non-plastic to low plasticity fines, grey, moist. ~17.5' - 18.5': Drilling relatively easier (softer)	3	5 6 13 13	S-3 (14'-16') Penetration - 2.0' Recovery - 1.0'
20	60	SC-SM	S-4 (19' - 21') Upper 6" of spoon: Silty Sand, fine to coarse subangular sand, approx. 10-15% non elastic silt fines, grey/tan, wet. Lower 4" of spoon: Sandy Clay, approx. 15-20% fine sand, low plasticity, moist, tan	4	7 4 3 7	S-4 (19'-21') Penetration - 2.0' Recovery - 0.9'
25	55	SW-SM	S-5 (24' - 26') Widely Graded Sand, mostly fine to fine to medium subangular sand, less than 5% fines, wet, tan/white. ~26' - 28': Drilling relatively easier (softer)	5	8 9 9 4	S-5 (24'-26') Penetration - 2.0' Recovery - 0.8'
30	50		S-6 (29' - 31') Widely Graded Sand with Silt, mostly fine to medium subangular sand, approx. 5-15% non-elastic silty fines, wet, tan/grey/white. ~32': Drilling relatively harder (firmer)	6	4 5 5 4	S-6 (29'-31') Penetration - 2.0' Recovery - 2.0'
35	45	ML	COOPER MARL FORMATION S-7 (34' - 36') Sandy Silt, mostly fine sand, low elasticity, green.	7	14 22 28 34	S-7 (34'-36') Penetration - 2.0' Recovery - 2.0'
40	40					

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LOG OF BORING WR-14

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 9, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 9, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillman	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Blow Count Graph (10, 50)	REMARKS
0		GW		WIDELY-GRADED GRAVEL; Roadbase				R - weight of rods H - weight of hammer
		AR		FILL; Silty Sand, mostly fine sand, approx 10-15% non-elastic fines, moist, tan/brown				
		SC		SLURRY WALL				
5	75			S-1 (4' - 6') Clayey Sand, mostly fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet.	1	1 1 1 1		S-1 (4'-6') Penetration - 2.0' Recovery - 1.8'
				UD-1 (7' - 9') Top/bottom of tube - wall				UD-1 (7'-9') Penetration - 2.0' Recovery - 1.7'
10	70			S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 20-25% low, plasticity clayey-like fines, grey/black, wet.	2	1 1 1 1		S-2 (9'-11') Penetration - 2.0' Recovery - .0'
15	65			S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 20-25% low plasticity clayey-like fines, wet, grey/black.	3	1 1 1 1		S-3 (14'-16') Penetration - 2.0' Recovery - 0.4'
20	60	SC		S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, grey/black, wet, with approx. 4-5" layer of mostly coarse (subangular/subrounded & pebbly) sand and less than 10-15% fines (at bottom of spoon.	4	1 1 1 1		S-4 (19'-21') Penetration - 2.0' Recovery - 1.5'
25	55			S-5 (24' - 26') Clayey Sand, fine to medium with some coarse (<15%) subangular sand approx. 10-20% low plasticity clayey-like fines, with .75" thick piece of wood to diameter spoon, wet, grey/black with tan.	5	3 3 4 3		S-5 (24'-26') Penetration - 2.0' Recovery - 0.8'
30	50			S-6 (29' - 31') Clayey Sand, fine to medium with some coarse (45%) subangular sand, approx. 10-20% low plasticity clayey-like fines, with 5" layer of fine sandy clay in upper 5" of spoon (medium plasticity, approx. 15% fine sand), wet, grey/black.	6	1 1 1 1		S-6 (29'-31') Penetration - 2.0' Recovery - 1.4'
35	45			S-7 (34' - 36') Clayey Sand, medium to mostly coarse subangular to subrounded sand less than 10% fines, wet, with a layer (approx. 1.5" thick) of clayey sand with approx 40-50% low plasticity clayey-like fines.	7	[illegible]		S-7 (34'-36') Penetration - 2.0' Recovery - 0.7'
				~38' - Drilling became relatively harder (firmer)				
		ML		COOPER MARL FORMATION				
40	40			S-8 (39' - 41') Sandy Silt, mostly fine sand, low plasticity fines, green	8	14 22 23 [illegible]		S-8 (39'-41') Penetration - 2.0' Recovery 2.0'

09-22-2003 k:\...\Boring Logs\WR-14.bor

Attachment B

Previous lab Testing Report

GEI Consultants, Inc.

July 16, 2003
Project 02225-0

1021 Main Street
Winchester, MA 01890-1970
781•721•4000
781•721•4073 Fax

Mr. Cameron Patterson
Withers & Ravenel, Inc.
111 MacKenan Drive
Cary, NC 27511

Dear Mr. Patterson:

**Re: Additional Forensic Testing Report
Existing Slurry Wall
Canadys Station
Dorchester County, SC**

The purpose of this letter is to present the results of GEI Consultants, Inc.'s (GEI's) second phase of laboratory testing of soil samples from the existing soil-clay slurry wall located within the ash storage pond dikes at Canadys Station. This work was performed in accordance with GEI's proposal dated February 4, 2003. The first phase of laboratory testing was performed in August and September 2002, and is summarized in our report entitled "Evaluation of Existing Slurry Wall, Ash Storage Pond, Canadys Station," dated September 24, 2002.

Summary

The hydraulic conductivity of the 8 samples tested ranged between 5 x 10^{-6} and 6 x 10^{-4} centimeters per second (cm/s), with the majority (6 samples) greater than 1 x 10^{-5} cm/s, and a geometric mean of approximately 5 x 10^{-5} cm/s. X-ray diffraction (XRD) testing performed on these samples and other samples from the wall indicates that kaolinite is the primary clay additive in the wall. These results are consistent with the findings of the first phase of laboratory testing. The XRD testing also indicates that bentonite is present in 9 of 13 samples tested in proportions of 3 percent or less. Bentonite was not present in 4 of the 13 samples tested. Lower proportions of bentonite tend to correlate to higher hydraulic conductivities.

Background

Canadys Station utilizes two large (95- and 80-acre) ash storage ponds to manage ash generated by three coal-fired power-generating units. The ash storage ponds are the source of arsenic-contaminated groundwater identified downgradient of the ponds. Groundwater seeps identified in previous General Engineering reports were visible at several locations along the exterior toe of the dikes surrounding the ponds. Withers & Ravenel, Inc. (W&R) only observed one such wet seep during their visit on June 5, 2002. Therefore, the South Carolina Electric and Gas Company (SCE&G) has concerns with respect to the ability of the existing slurry wall to contain water within the ash storage ponds. Soil conditions immediately downslope of the ponds generally consist of silty and clayey sands overlying dense sandy silt referred to locally as the Cooper Formation.

Scope of Work

GEI's evaluation included:

- Review of recent reports, drawings, boring logs, and construction documents relating to the ash ponds.
- A one-day site visit during boring installation and sample collection.
- Twelve laboratory grain-size analyses of soil samples from the slurry wall.
- Eight laboratory hydraulic conductivity tests on soil samples from the slurry wall.
- Thirteen XRD tests on soil samples from the slurry wall.

Soil and Groundwater Sampling

W&R provided the documents and soil samples used for the evaluation. The soil samples included; near surface hand-auger samples, 1.5-inch-diameter split-spoon samples, and 3-inch-diameter undisturbed tube samples taken from ten borings (WR-5 through WR-14) across the length of the dike surrounding what is referred to as the New Ash Storage Pond. Copies of the boring logs prepared by W&R are contained in Appendix A. W&R also provided water from within the pond that was used by GEI to perform the hydraulic conductivity tests described in this report.

Test Results

The results of the grain size, hydraulic conductivity, and XRD tests are summarized in Table 1. Detailed data sheets for the grain size and hydraulic conductivity tests are contained in Appendix B. Detailed data sheets for the XRD tests are contained in Appendix C. The rationale and results for each test type are discussed in the following sections:

- <u>Hydraulic Conductivity Tests</u>: Eight standard tests using water collected from the ash pond were performed on undisturbed samples from the borings within the slurry wall. These tests are referred to as K1 through K8. The two samples were selected to be generally representative of conditions throughout the slurry wall above and below the groundwater table. The hydraulic conductivity of the samples tested ranged between 5×10^{-6} and 6×10^{-4} cm/s, with the majority (6 samples) greater than 1×10^{-5} cm/s. The mean hydraulic conductivity is approximately 5×10^{-5} cm/s. All of the permeability tests were performed in general accordance with American Society for Testing and Materials (ASTM) Method D5084.
- <u>Grain-Size Analyses</u>: Grain-size analyses were performed on all of the hydraulic conductivity test specimens and four split-spoon samples selected to be generally representative of conditions throughout the slurry wall above and below the groundwater table. The results confirmed the presence of clayey sand in the slurry

wall, although the percentage of fines in the samples varied between 3 and 34 percent, with most samples between 5 and 18 percent.

- XRD Tests: XRD tests were performed on all of the hydraulic conductivity samples, two split-spoon samples, and two hand-auger samples to determine the type of clay contained in the samples. One control sample that consisted of a type of bentonite used for slurry wall construction was also tested. The hand-auger samples were collected from areas of the top of the slurry wall that were observed to have visual-manual properties typical of a bentonite-soil mix. Kaolinite was the primary clay identified in all of the hydraulic conductivity and split-spoon samples and one (WR-14) of the hand-auger samples. Bentonite was the primary clay identified in the control sample and the hand-auger sample. The XRD tests were performed by The Mineral Laboratory of Lakewood, Colorado (Mineral). Copies of their reports are contained in Appendix C. Please note that in the Mineral reports, bentonite is described by its generic mineralogical name "smectite."

Findings

The most significant findings of this second phase of testing are as follows:

- The hydraulic conductivity of the soil samples taken from the slurry wall are typically two to three orders of magnitude *higher* than the 1×10^{-7} cm/s typically specified for cut-off applications.[1]
- The primary clay component of the slurry wall is kaolinite, not bentonite (a.k.a. sodium montmorillonite and smectite). Kaolinite has inherently higher permeability than bentonite and requires a much lower void ratio (higher density) to be effective.[2] It is GEI's experience that it is difficult to achieve permeabilities lower than 10^{-5} to 10^{-6} cm/s with slurry wall mixes based on Kaolinite.
- Based on the boring logs and grain-size tests, the deeper portions of the slurry wall appear to have less fine material (silt and clay) than the upper portions of the wall, suggesting that the bottom of the wall is likely to generally have higher hydraulic conductivities. This situation is often the result of inadequate slurry de-sanding and/or backfill mixing during construction.

Recommendation

If the existing hydraulic conductivity of the slurry wall is the "weak link" that is causing the unacceptable downgradient arsenic migration, potential design mixes for a replacement slurry wall or other types of cut-off walls should be evaluated. Other types of walls that should be evaluated include sealed-joint steel sheetpile walls and high-density polyethylene (HDPE) sheetpile walls.

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[1] LaGrega, Buckingham, and Evans, *Hazardous Waste Management*, 1994, McGraw-Hill , Inc., New York.
[2] Lambe and Whitman, *Soil Mechanics*, 1969, John Wiley & Sons, New York. **Relevant excerpt contained in Appendix C.**

Limitations

This report was prepared for use on the Canadys Station Ash Storage Ponds project, exclusively. The conclusions provided by GEI in this report are based on the information reported in this document. Additional information not available to GEI at the time this report was prepared may result in a modification of the findings of this report. This report has been prepared in accordance with generally accepted engineering and geohydrological practices. No warranty, expressed or implied, is made.

Please call me at 781.721.4011 if GEI can be of any further assistance in this matter, or if you have any questions.

Sincerely,

GEI CONSULTANTS, INC.

Thomas W. Kahl

Thomas W. Kahl, P.E.
Senior Project Manager

TWK:lek
Enclosures

Table 1

Results of Laboratory Testing for Geotechnical Parameters

Canadys Station Slurry Wall Evaluation
W&R Project No. 99076.18
Dorchester County, SC

Boring	Sample Identity	Depth Top of Sample (ft bgs)	Hydraulic Conductivity cm/s	Log K	Grain Size % fines	XRD Results: Clay-Size Fraction (A) % kaolinite	XRD Results: Clay-Size Fraction (A) % bentonite	XRD Results: Estimated Max. In Situ (B) % kaolinite	XRD Results: Estimated Max. In Situ (B) % bentonite
WR-5	UD1	14	9.1E-05	-4.04	11.1	75	0	8	0
WR-11	UD2	27	4.7E-06	-5.33	12.5	35	30	4	4
WR-11	UD1	16	3.2E-05	-4.49	13.6	80	0	11	0
WR-10	UD1	23	6.4E-04	-3.19	5.3	70	0	4	0
WR-8	UD1	17	5.4E-05	-4.27	12.6	60	26	8	3
WR-14	UD1	7	6.8E-06	-5.17	13.8	60	20	8	3
WR-6	UD1	22	1.5E-04	-3.82	12.6	72	10	9	1
WR-9	UD1	12	1.5E-04	-3.82	18.2	80	9	15	2
WR-13	S3	14			22.9	85	0	19	0
WR-13	S6	29			3.0				
WR-5	S6	29			3.6				
WR-7	S4	19			33.6	80	5	27	2
WR-14	hand-auger cutting	6				45	25	14	5
WR-9	hand-auger cutting	6				13	75	8	5
WR-S	B1 (bentonite control)	NA				0	70		

maximum	6.4E-04	-3.19
minimum	4.7E-06	-5.33
average	1.4E-04	-4.27
maximum		6.4E-04
minimum		4.7E-06
	Geometric Mean	5.4E-05

General Notes:
1. K = Hydraulic Conductivity
2. ft bgs = feet below ground surface
3. cm/s = centimeters per second
4. NA = Not Applicable
5. XRD = X-Ray Diffraction

Footnotes:
A. Clay-size fraction = Percent of kaolinite or bentonite in material <2 μm.
B. Estimated maximum insitu clay content based on the product of the percent fines (material <7.5 μm) and the percent of kaolinite or bentonite in the clay fraction (material <2 μm). The actual clay content is likely somewhat less because the fines fraction may include some silt in the 2 to 7.5 μm range.

Appendix A

Boring Logs

WITHERS & RAVENEL
Engineering & Surveying, Inc.
111 MacKenan Drive · Cary, N.C. 27511

LOG OF BORING WR-5

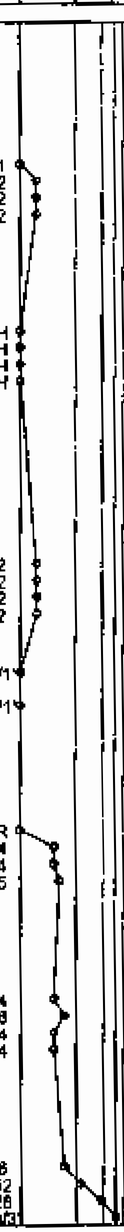
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 7, 2003	Sampling Method	: Split Spoon, Piston Shelby
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray, PE
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL: Roadbase			R - weight of rods H - weight of hammer
		AR	FILL: Silty Sand and Roadbase, Mostly fine to medium subangular sand, approx 10-15% non-elastic fines, moist, tan/brown.			
4	76	SC	SLURRY WALL 4.0' - 6.0': Clayey Sand, fine to medium subangular sand, approx. 30-35% clayey-like fines, medium plasticity, moist to wet, grey/black.	1	1 2 2 2	S-1 (4'-6') Penetration - 2.0' Recovery - 1.1'
8	72		9.0' - 11.0': Clayey Sand, mostly fine with some medium subangular sand, approx. 35-45% clay-like fines, medium to high plasticity, moist/wet, grey/black.	2	H H H H	S-2 (9'-11') Penetration - 2.0' Recovery - 0.3'
12	68		14.0' - 16.0': Clayey Sand, mostly fine to medium subangular sand, approx. 20-35% clayey-like fines.			UD-1 (14'-16') Penetration - 2.0' Recovery - 2.0' ✓
16	64		16.0' - 18.0': Clayey Sand, mostly fine to medium with occasional coarse (subrounded, pebbly) subangular sand, approx. 20-30% clayey-like fines, moist to wet, grey/black.	3	2 2 2 2	S-3 (16'-18') Penetration - 2.0' Recovery - 1.0'
20	60		19.0' - 21.0' Clayey Sand, fine to medium subangular sand, approx. 15-20% clayey-like fines, wet, grey. Drilling above 24.5' appeared as wall rather than SM (i.e., consistent soft/easy drilling)	4	1/1 1/1	S-4 (19'-21') Penetration - 2.0' Recovery - 1.1'
24	56	SM	24.5' - 26.0' Silty Sand (SM); medium subangular to coarse subrounded sand, approx. 10-15% non-nonelastic silty fines, tan/grey, wet, with mostly fine subangular sand, approx. 40% non-elastic fines, tan/grey/wet in lower 2" of spoon.	5	R 4 4 5	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
28	52		29.0' - 31.0' Silty Sand (SM); fine to coarse to fine subangular sand (coarse sand mostly subrounded), approx. 10%-30% non-elastic silty fines, grey/tan, wet.	6	4 6 4 4	S-6 (29'-31') Penetration - 2.0' Recovery - 1.0'
32	48					
36	44		34.0 - 36.0' COOPER MARL FORMATION; Sandy Silt (ML), Low elasticity, approx. 35-40% fine sand, green/grey.	7	6 12 26 50/3	S-7 (34'-35.75') Penetration - 1.8' Recovery - 1.8'

Blow Count Graph



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Engineering & Surveying, Inc.
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LOG OF BORING WR-6

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 7, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase		R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, Mostly fine to medium subangular sand, approx. 10-15% non-elastic fines, moist, tan/brown.		
4	76			1	S-1 (4' - 6') Penetration - 2.0' Recovery - 1.2'
		SC	SLURRY WALL		
8	72		9.0' - 11.0' Spoon dropped 24" under weight of hammer (WOH/24"), no recovery. Wash appeared as clayey sand, fine to medium subangular sand, grey/black.	2	S-2 (9' - 11') Penetration - 2.0' Recovery - 0'
12	68				
			14.0' - 16.0' Clayey Sand, fine to medium subangular sand, approx. 25-40% low to medium plasticity clayey-like fines, black/grey, wet.	3	S-3 (14' - 16') Penetration - 2.0' Recovery - 1.1'
16	64				
			19.0' - 21.0' Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey/black.	4	S-4 (19' - 21') Penetration - 2.0' Recovery - 1.5'
20	60				UD-1 (22'-24') Penetration - 2.0' Recovery - 18"
24	56		24.0' - 26.0' Clayey Sand, fine to medium subangular sand, approx. 25-30% low plasticity clayey-like fines, black/grey, wet.	5	S-5 (24' -26') Penetration - 2.0' Recovery - 0.4'
28	52		29.0' - 31.0' Spoon dropped greater than 4' under weight of rods (WOR/4'+). Spoon drop stop of driller, no recovery.	6	S-6 (29' - 31' (33')) Penetration - 4.0'+ Recovery - 0.2"
32	48				
			34.0' -36.0' Spoon dropped approximately 3' under weight of rods (WOR/3'); Clayey Sand, fine to mostly medium subangular sand, some (< 5-10%) subrounded coarse sand, approx. 30% low to medium plasticity clayey-like fines, grey/black, one piece of .5" diameter wood to width of spoon.	7	S-7 (34' - 36' (37')) Penetration - 3.0' Recovery - 0.7"
36	44				
		ML	~37'-38': Driller became harder (appearent top of Cooper Marl)	8	S-8 (38' - 41') Penetration - 1.8' Recovery - 1.8'
40	40		COOPER MARL FORMATION		
44	36				

WITHERS & RAVENEL
Engineering & Surveying, Inc.
111 MacKenan Drive • Cary, N.C. 27511

LOG OF BORING WR-7

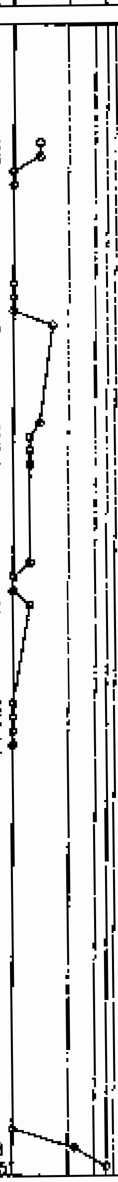
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 7, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 7, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Titerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand with roadbase, mostly fine to medium subangular sand, approx 15% non-plastic silty fines, moist, tan.			
4	76	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30% low to medium plasticity clayey-like fines, grey, moist.	1		S-1 (4'-6') Penetration - 2.0' Recovery - 1.2'
8	72		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey, moist to wet, with approx. 6" of fine to mostly coarse (subrounded pebbly) at tip (less than 15% non-plastic fines). Coarser sand appears as potential caves from above (lack of slurry consistency and color).	2	5	S-2 (9'-11') Penetration - 2.0' Recovery - 2.0'
12	68		S-3 (14' - 16') Clayey Sand, fine to coarse subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey. Generally fine to medium in lower 3", medium to mostly course in upper 3"	3	2	S-3 (14'-16') Penetration - 2.0' Recovery - 0.5'
16	64		S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 20-60% low plasticity clayey-like fines, grey, wet, 40-50% medium plasticity fines in lower 7" and 20-30% low plasticity fines in upper 17"	4	2 2	S-4 (19'-21') Penetration - 2.0' Recovery - 2.0'
20	60		S-5 (24' - 26') Drill rods & spoon dropped approx. 5.5' - 6.0' after being detached from winch (WOR/5.5'); Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey, moist to wet.	5	R R R R	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
24	56		Hole cleaned/drilled from 24' - 31'			
28	52		UD-1 (31' - 33') Tube sank/dropped 3' under weight of rods, no recovery.			UD-1 (31'-33') Penetration - 3.0' Recovery - 0'
32	48		UD-2 (34' - 36') Sample obtained. Sample determined to be disturbed (appeared as soil/wall plug in tube, material moved & deformed during tube sealing)			UD-2 (34'-36') Penetration - 2.0' Recovery - 0.4'
36	44					
40	40	ML	S-6 (39' - 41') COOPER MARL FORMATION; Drilling did not appear to become harder above 39' (i.e., Cooper encountered during spoon interval)	6	1 13 50/5"	S-6 (39'-41') Penetration - 1.4' Recovery - 1.3'
44	36					

Blow Count Graph



02-06-2003 k:\99\99-076\99076.18\Boring Logs\WR-7.bor

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Engineering & Surveying, Inc.
111 MacKenan Drive · Cary, N.C. 27511

LOG OF BORING WR-7OW

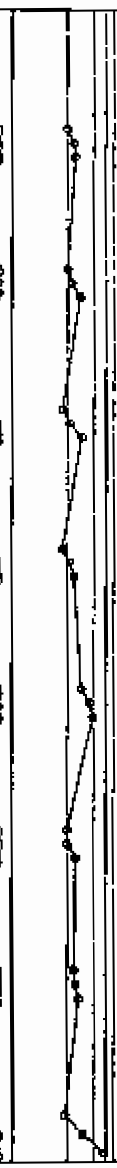
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 8, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 8, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		SM	SILTY SAND; fine to medium subangular sand, approx. 15-20% non-elastic silty fines, moist, tan to light grey/tan.			R - weight of rods H - weight of hammer
4	76	SM	SILTY SAND; fine to mostly medium subangular sand, approx. 15% non-elastic silt fines, moist, grey/tan.	1	10 13 14	S-1 (4'-5.5') Penetration - 1.5' Recovery - 1.2'
8	72	SM	SILTY SAND; with lense of clayey sand; fine to medium to coarse subangular sand, approx. 15-20% non-elastic silty fines, approx. 4" lense of fine to medium sand with approx. 40-50% low-plasticity clayey-like fines (possible well intrusion), moist/wet, grey/tan. Coarse sand layer observed in upper 2" of spoon; fine to coarse (subrounded, pebbly) subangular sand.	2	10 12 17	S-2 (9'-10.5') Penetration - 1.5' Recovery - 1.4'
12	68					
16	64	SM-SC	CLAYEY SAND; mostly fine to medium subangular sand, approx. 40-50% low plasticity clayey-like fines, organic debris (wood fibers), wet/moist, appearent non-fill or original grade or new subsurface, black/grey.	3	9 11 18	S-3 (14'-15.5') Penetration - 1.5' Recovery - 1.2'
20	60	SC	SILTY SAND; mostly fine subangular sand in lower 5" and fine to medium with coarse in upper 7", approx. 10-15% non-elastic silt fines in lower 5" and approx. 20-25% non-elastic silt fines in upper 7", moist/wet, grey/tan in upper and tan/white in lower.	4	8 11 13	S-4 (19'-20.5') Penetration - 1.5' Recovery - 1.3'
24	56	SM	WIDELY GRADED SAND; fine to coarse (subrounded, pebbly) subangular sand, less than 5-10% fines, grey/white/tan, wet.	5	18 25 29	S-5 (24'-25.5') Penetration - 1.5' Recovery - 1.0'
28	52	SW	WIDELY GRADED SAND; fine to coarse (subrounded, pebbly) subangular sand, less than 5-10% fines, grey/white/tan, wet.	6	10 10 14	S-6 (29'-30.5') Penetration - 1.5' Recovery - 1.3'
32	48					
36	44			7	13 13 16	S-7 (34'-35.5') Penetration - 1.5' Recovery - 1.3'
			Drilling became harder at ~37', then soft again at ~38'	8	9 19 46	S-8 (39'-40.5') Penetration - 1.5' Recovery - 1.5'
40	40	ML	COOPER MARL FORMATION			
44	36					

Blow Count Graph (10, 50)



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LOG OF BORING WR-8

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.16

Date Started	: January 9, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 9, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 60 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 60	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WELL-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 20% non-elastic silty fines, moist, tan.			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to mostly medium subangular sand, approx. 35-45% low plasticity clayey-like fines, grey, wet (saturated).	1	1 1 1 1	S-1 (4'-6') Penetration - 2.0' Recovery - 0.4'
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey, wet (saturated).	2	1 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.7'
15	65		S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 35-45% fines in upper 6", approx. 20-25% in lower 8", low plasticity, wet, grey.	3	3 4 3 3	S-3 (14'-16') Penetration - 2.0' Recovery - 1.2'
			UD-1 (17' - 19') Top/bottom of tube is wall material			UD-1 (17'-19') Penetration - 2.0' Recovery - 1.7'
20	60		S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 30% low elasticity clayey-like fines, grey, wet/saturated.	4	2 2 2 1	S-4 (19'-21') Penetration - 2.0' Recovery - 1.3'
25	55		S-5 (24' - 26') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, wet, grey.	5	1 1 1 1	S-5 (24'-26') Penetration - 2.0' Recovery - 1.0'
			UD-2 (28' - 30') Top/bottom of tube is wall material			UD-2 (28'-30') Penetration - 2.0' Recovery - 0.4'
30	50		S-6 (30' - 32') Upper4" - Clayey Sand, fine to coarse, approx. 20-25% low plasticity clayey fines; Lower 3" -Silty Sand, fine to medium subangular sand with 10-15% nonelastic silty fines. (WOR/18", WOH/6")	6	R R R H	S-6 (30'-32') Penetration - 2.0' Recovery - 0.6'
			S-7 (32' - 34') Clayey Sand, fine to medium subangular sand, approx 20-25% clayey fines with approx. 1 to 1.5' lense of clod of moderate plasticity clayey-like material. (WOR/24"+)	7	R R R R	S-7 (32'-34') Penetration - 2.0' Recovery - 0.4'
35	45		S-8 (34' - 36') Widely Graded Sand with Clayey-like fines, fine to mostly medium with some coarse subangular sand, less than 10% fines, wet, tan/grey. (WOR/24"+)	8	R R R R	S-8 (34'-36') Penetration - 2.0' Recovery - 0.3'
		ML	COOPER MARL FORMATION	9	3 8 13 13	S-9 (36'-38') Penetration - 2.0' Recovery - 2.0'
40	40					

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LOG OF BORING WR-9

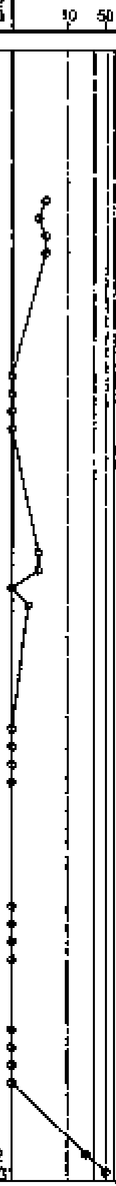
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 8, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 8, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 20% non-elastic silty fines, moist, tan/brown.			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30% low plasticity clayey-like fines, grey/black, moist/wet.	1	4 3 4 4	Penetration - 2.0' Recovery - 2.0'
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, grey/black, wet.	2	H H H H	Penetration - 2.0' Recovery - 0.6'
			UD-1 (12' - 14') top/bottom of tube - wall			Sample UD-1 collected (12.0-14.0)
15	65		S-3 (14' - 16') Clayey Sand, mostly fine subangular sand, approx. 30-40% low plasticity clayey-like fines, moist/wet, grey.	3	3 3 1 2	Penetration - 2.0' Recovery - 0.7'
20	60		S-4 (19' - 21') Clayey Sand, mostly fine to medium subangular sand, approx. 35-50% low to medum plasticity clayey-like fines, grey, moist/wet.	4	H H H H	Penetration - 2.0' Recovery - 1.1'
25	55		S-5 (24' - 26') Spoon dropped ~24+" under weight of rods & hammer (WOH/24"+), no recovery. Hole drilled/cleaned to 27.5'	5	H H H H	Penetration - 2.0' Recovery - 0'
			UD-2 (27.5' - 29.5') Tube sank approx. 3.5' under weight of rods (WOH/3.5'), 14" recovery.	6	R R R R	Penetration - 3.0' Recovery - 0' Sample UD-2 collected (27.5-29.5)
30	50	ML	COOPER MARL FORMATION S-6 (31' - 31.8') Sandy Silt, fine subangular sand, approx. 20-40% fine sand, low elasticity, green.	7	22 50/3"	Penetration - 0.8' Recovery - 0.8'
35	45					

Blow Count Graph



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LOG OF BORING WR-10

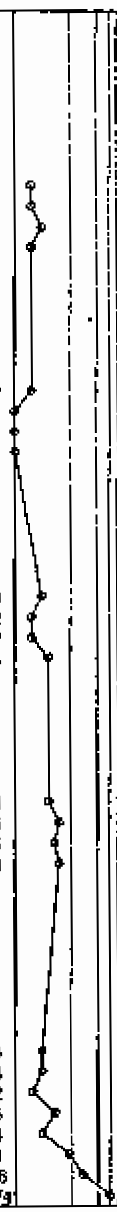
South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 10, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 10, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, fine subsubangular sand, approx. 15-20% non-elastic fines, tan/brown, moist			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to mostly medium subangular sand, approx. 35-45% low plasticity clayey-like fines, grey/black, wet (saturated).	1	2 2 3 2	S-1 (4'-6') Penetration - 2.0' Recovery - 0.7'
10	70		S-2 (9' - 11') Clayey Sand, fine to coarse subangular sand, approx. 15-20% non-plastic clayey-like fines, grey/black, wet.	2	2 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.6'
15	65		S-3 (14' - 16') Upper 6" of sample: Fine to coarse subangular sand, approx. 15% non-plastic fines, wet, grey. Middle 3" of sample: Mostly fine subangular sand, approx 40-50% low plasticity clayey-like fines, dark grey. Lower 3" of sample: Fine to medium subangular sand, less than 5% fines, wet, tan	3	3 2 2 4	S-3 (14'-16') Penetration - 2.0' Recovery - 1.0'
20	60	SC-SM	S-4 (19' - 21') Upper 4" of sample: Fine to medium subangular sand, approx. 20-25% non-plasticity fines, grey/black. Middle 2" of sample: Sandy Clay, approx. 40-50% fine sand, low plasticity, grey/brown, wet. Lower 3" of sample: Silty Sand, fine sand, approx. 30% non-elastic fines, tan/brown, wet. UD-1 (23' -25')	4	4 6 5 6	S-4 (19'-21') Penetration - 2.0' Recovery - 0.8' UD-1 (23'-25') Penetration - 2.0' Recovery - 1.8' ✓
25	55	SM	S-5 (25' - 27') Silty Sand, fine to medium subangular sand, approx. 10-15% non-elastic fines, wet, grey/tan.	5	3 3 2 5	S-5 (25'-27') Penetration - 2.0' Recovery - 0.8'
		ML	COOPER MARL FORMATION S-6 (27' - 29') Sandy Silt	6	3 9 16 50/3"	S-6 (27'-29') Penetration - 2.0' Recovery - 0.6'
30	50					

Blow Count Graph (10, 50)



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LOG OF BORING WR-11

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South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 10, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 10, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, fine subangular sand, approx. 10-15% non-elastic fines, moist/wet, tan/brown.			
4	76	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey/black, wet.	1		S-1 (4'-6') Penetration - 2.0' Recovery - 1.5'
8	72		S-2 (9' - 11') Clayey Sand, mostly fine to medium subangular sand, approx. 30-40% low plasticity clayey-like fines, grey/black, saturated.	2	2 0/18"	S-2 (9'-11') Penetration - 2.0' Recovery - 0.4'
12	68		S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 15-20% , wet, low plasticity clayey-like fines, black/grey, wet/moist.	3		S-3 (14'-16') Penetration - 2.0' Recovery - 1.0'
16	64		UD-1 (16' - 18') Top/bottom of tube appeared as S-3			UD-1 (16'-18') Penetration - 2.0' Recovery - 1.3'
			S-4 (18' - 20') Clayey Sand, fine to medium subangular sand, approx. 30-35% low plasticity clayey-like fines, grey/black, saturated.	4		S-4 (18'-20') Penetration - 2.0' Recovery - 1.1'
20	60					
24	56		S-5 (24' - 26') Clayey Sand, fine to coarse subangular sand, approx. 25-30% low plasticity clayey-like fines, saturated, grey/black, (1,WOH/18")	5		S-5 (24'-26') Penetration - 2.0' Recovery - 0.6'
			UD-2 (27' - 29') Top/bottom of tube as S-5, WOR/24"			UD-2 (27'-29') Penetration - 2.0' Recovery - 2.0'
28	52		S-6 (29' - 31') Clayey Sand, fine to coarse subangular sand, approx 30% low plasticity fines, saturated, grey/black, WOR/24"+	6		S-6 (29'-31') Penetration - 2.0' (3.0') Recovery - 2.0'
32	48					
			S-7 (35' - 37') Widely-Graded Sand, fine to coarse subangular sand, less than 10% fines, wet, tan/grey, with .75" thick layer of clayey sand approx. 2" from bottom of spoon.	7		S-7 (35'-37') Penetration - 2.0' Recovery - 0.7'
36	44		S-8 (37' - 39') Transition into Upper Cooper, clayey/silty fine sand with approx. 7"-thick layer of medium to mostly coarse (pebbly) sand with gravel, <5% fines from 38-38.5'	8		S-8 (37'-39') Penetration - 2.0' Recovery - 2.0'
40	40	ML	COOPER MARL FORMATION S-9 (39' - 41')	9		S-9 (39'-41') Penetration - 2.0' Recovery - 2.0'
44	36					

Blow Count Graph (10, 50)

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LOG OF BORING WR-12

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 8, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 8, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 60 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 60	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx. 15% non-elastic fines, brown/tan, moist			
5	75	SC	SLURRY WALL S-1 (4' - 6') Clayey Sand, fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet, with approx. 4" lense of sandy clay (approx. 30-40% fine sand, medium to high plasticity, saturated).	1	2 1 2 1	S-1 (4'-6') Penetration - 2.0' Recovery - 1.1'
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet, with clods of OL (approx. 0.5" to 1.5" thick), WOH/24"+ 12' - Drilling appeared to firm-up	2	H H H H	S-2 (9'-11') Penetration - 2.0' Recovery - 1.0'
15	65		S-3 (14' - 16') Clayey Sand, fine to mostly medium subangular sand, approx. 20-30% low plasticity clayey-like fines, moist/wet, grey/black.	3	5 6 5 5	S-3 (14'-16') Penetration - 2.0' Recovery - 0.8'
20	60		S-4 (19' - 21')Clayey Sand, fine to coarse subangular sand, approx. 30% clayey-like fines, grey/black, wet.	4	2 1 1 1	S-4 (19'-21') Penetration - 2.0' Recovery - 0.6'
			UD-1 (22' - 24') Tube & rods sank ~2.5'-3.0' after being detached from winch			UD-1 (22'-24') Penetration - 2.0' (3.0') Recovery - 1.5'
25	55		S-5 (25' - 27') No recovery, WOR/24"	5	R R R R	S-5 (25'-27') Penetration - 2.0' Recovery - 0'
			S-6 (27' - 29') Spoon/rods dropped ~56 inches (5.75') under weight of hammer (WOH/56")	6	H H H H	S-6 (27'-29') Penetration - 2.0' Recovery - 0.2'
30	50		~31' - Drilling became firmer, appeared as gravelly zone ~33' - Appearent top of Upper Cooper			
35	45	ML	COOPER MARL FORMATION S-7 (34' - 36')	7	22 50/3"	S-7 (34'-37.5') Penetration - 0.8' Recovery - 0.8'

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LOG OF BORING WR-13

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076.18

Date Started	: January 10, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 10, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	: Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth In Feet	Surf. Elev. 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine subangular sand, approx 15-20% non-elastic silt fines, moist to wet, tan/grey			
5	75			1	6 6 5 4	S-1 (4.5'-6.5') Penetration - 2.0' Recovery - 0.9'
		SC	SLURRY WALL S-1 (4.5' - 6.5') Clayey Sand, fine to medium subangular sand, approx. 20% low plasticity clayey-like fines, grey/black, moist			
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 35-40% low plasticity fines, grey/black, wet (saturated). ~10' - 14': Above-normal drilling mud loss	2	1 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - 0.8'
15	65	SC	S-3 (14' - 16') Clayey Sand, mostly fine subangular sand, approx. 10-15% non-plastic to low plasticity fines, grey, moist. ~17.5' - 18.5': Drilling relatively easier (softer)	3	5 6 13 13	[redacted] Penetration - 2.0' Recovery - 1.0'
20	60	SC-SM	S-4 (19' - 21') Upper 6" of spoon: Silty Sand, fine to coarse subangular sand, approx. 10-15% non elastic silt fines, grey/tan, wet. Lower 4" of spoon: Sandy Clay, approx. 15-20% fine sand, low plasticity, moist, tan	4	7 4 3 7	S-4 (19'-21') Penetration - 2.0' Recovery - 0.9'
25	55	SW-SM	S-5 (24' - 26') Widely Graded Sand, mostly fine to fine to medium subangular sand, less than 5% fines, wet, tan/white. ~26' - 28': Drilling relatively easier (softer)	5	8 9 9 4	S-5 (24'-26') Penetration - 2.0' Recovery - 0.6'
30	50		S-6 (29' - 31') Widely Graded Sand with Silt, mostly fine to medium subangular sand, approx. 5-15% non-elastic silty fines, wet, tan/grey/white. ~32': Drilling relatively harder (firmer)	6	5 5 5 4	[redacted]) Penetration - 2.0' Recovery - 2.0'
35	45	ML	COOPER MARL FORMATION S-7 (34' - 36') Sandy Silt, mostly fine sand, low elasticity, green.	7	14 22 28 34	S-7 (34'-36') Penetration - 2.0' Recovery - 2.0'
40	40					

Blow Count Graph 10 50

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LOG OF BORING WR-14

South Carolina Electric & Gas

Canadys Station Ash Pond Slurry Wall
Dorchester County, SC
W&R Project No. 99076 18

Date Started	: January 9, 2003	Drilling Method	: Mud Rotary
Date Completed	: January 9, 2003	Sampling Method	: Split Spoon, Piston Tube
Drilling Company	: Geotechnologies, Inc.	Ground Elevation	: EL 80 (estimated)
Driller	Scott Tillerson	Logged By	: Stefan Bray
Rig / Equipment	: CME 550		

Depth in Feet	Surf. Elev 80	USCS	DESCRIPTION	Samples	Blow Count	REMARKS
0		GW	WIDELY-GRADED GRAVEL; Roadbase			R - weight of rods H - weight of hammer
		AR	FILL; Silty Sand, mostly fine sand, approx 10-15% non-elastic fines, moist, tan/brown			
5	75		SLURRY WALL S-1 (4' - 6') Clayey Sand, mostly fine to medium subangular sand, approx. 30-40% low to medium plasticity clayey-like fines, grey/black, moist/wet.	1	1 1 1 1	S-1 (4'-6') Penetration - 2.0' Recovery - 1.8'
			UD-1 (7' - 9') Top/bottom of tube - wall			UD-1 (7'-9') Penetration - 2.0' Recovery - 1.7'
10	70		S-2 (9' - 11') Clayey Sand, fine to medium subangular sand, approx. 20-25% low plasticity clayey-like fines, grey/black, wet.	2	1 1 1 1	S-2 (9'-11') Penetration - 2.0' Recovery - .9'
15	65		S-3 (14' - 16') Clayey Sand, fine to medium subangular sand, approx. 20-25% low plasticity clayey-like fines, wet, grey/black.	3	1 1 1 1	S-3 (14'-16') Penetration - 2.0' Recovery - 0.4'
20	60	SC	S-4 (19' - 21') Clayey Sand, fine to medium subangular sand, approx. 20-30% low plasticity clayey-like fines, grey/black, wet, with approx. 4-5" layer of mostly coarse (subangular/subrounded & pebbly) sand and less than 10-15% fines lat bottom of spoon	4	1 1 1 1	S-4 (19'-21') Penetration - 2.0' Recovery - 1.5'
25	55		S-5 (24' - 26') Clayey Sand, fine to medium with some coarse (<15%) subangular sand approx. 10-20% low plasticity clayey-like fines, with .75" thick piece of wood to diameter spoon, wet, grey/black with tan.	5	3 3 4 3	S-5 (24'-26') Penetration - 2.0' Recovery - 0.8'
30	50		S-6 (29' - 31') Clayey Sand, fine to medium with some coarse (45%) subangular sand, approx. 10-20% low plasticity clayey-like fines, with 5" layer of fine sandy clay in upper 5" of spoon (medium plasticity, approx. 15% fine sand), wet, grey/black.	6	1 1 1 1	S-6 (29'-31') Penetration - 2.0' Recovery - 1.4'
35	45		S-7 (34' - 36') Clayey Sand, medium to mostly coarse subangular to subrounded sand less than 10% fines, wet, with a layer (approx 1.5" thick) of clayey sand with approx 40-50% low plasticity clayey-like fines. ~38' - Drilling became relatively harder (firmer)	7	3 2 2 1	S-7 (34'-36') Penetration - 2.0' Recovery - 0.7'
40	40	ML	COOPER MARL FORMATION S-8 (39' - 41') Sandy Silt, mostly fine sand, low elasticity fines, green.	8	14 22 23 50/5	S-8 (39'-41') Penetration - 2.0' Recovery - 2.0'

Blow Count Graph: 10 50

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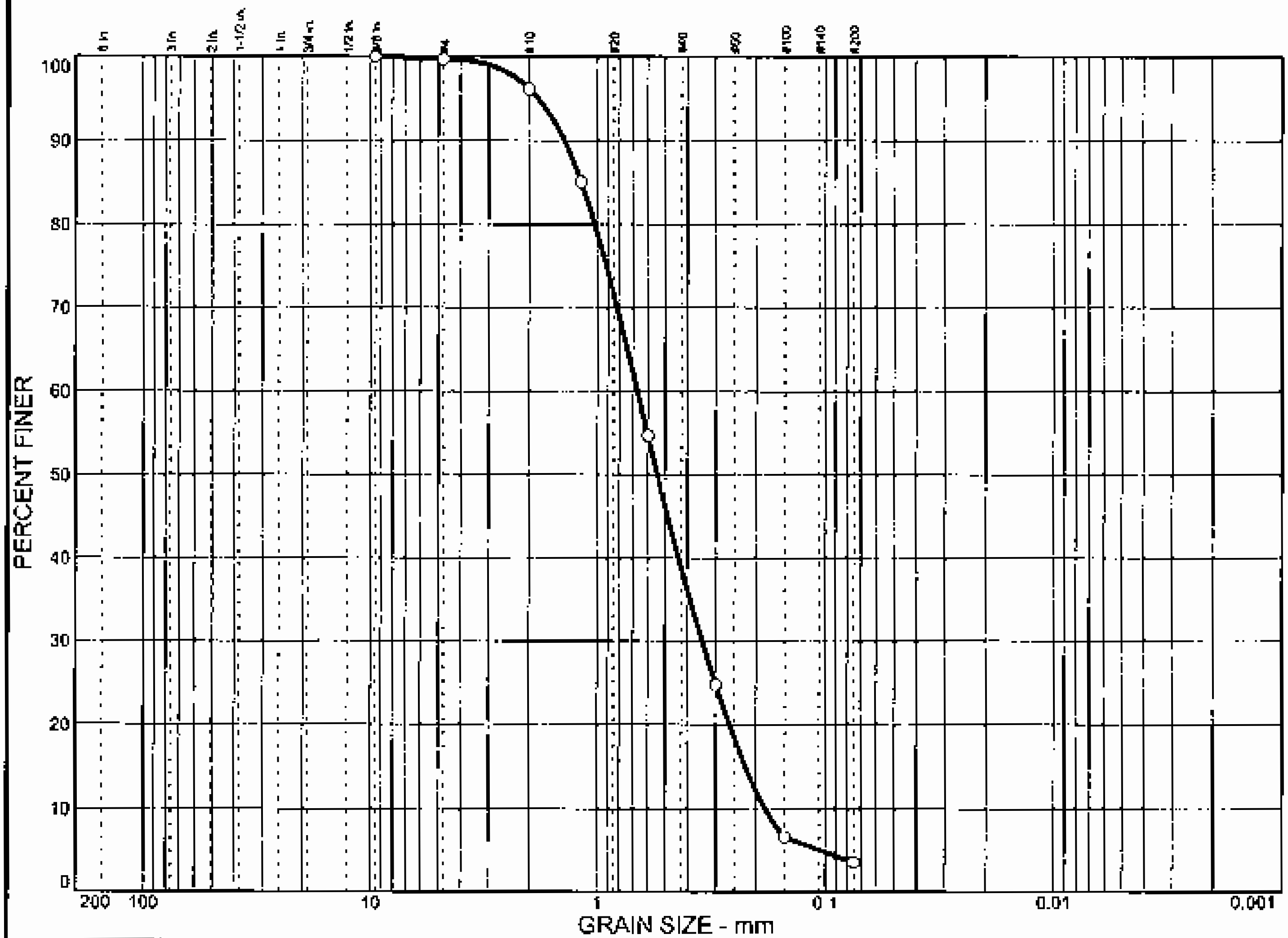
Appendix B

Laboratory Grain-Size and
Hydraulic Conductivity Tests

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	0.3	96.1	3.6	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o			1.18	0.668	0.544	0.344	0.222	0.182	0.98	3.68

MATERIAL DESCRIPTION	USCS	AASHTO
o Narrowly Graded SAND	SP	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

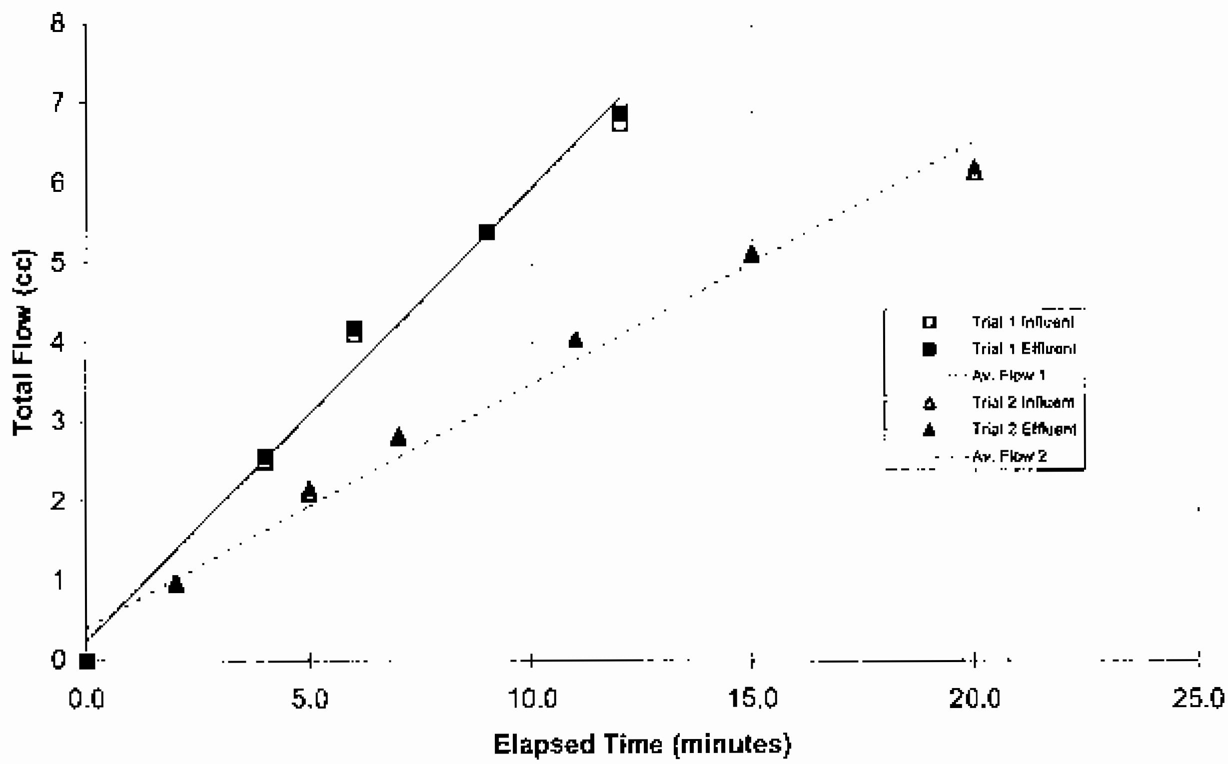
o **Source:** WR-5 **Sample No.:** S6 **Elev./Depth:** 29-31 ft.

Remarks:

o

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 9.1×10^{-5} cm/sec   METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-5	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	14 to 16 feet	Description:	Narrowly graded SAND with clay

SPECIMEN INFORMATION

Height:	4.40 inch	Water Content:	17.3 %
Diameter:	2.87 inch	Total Unit Weight:	131.9 pcf
Area:	6.46 in²	Dry Unit Weight:	112.5 pcf

TEST DATA

			Gradient	Flow Rate cm³/min	Permeability cm/sec
Consolidation Stress	1.4 ksf				
Permeant	water from pond				
B - Value	0.96	Trial 1	2.54	0.57	9.0×10^{-5}
		Trial 2	1.34	0.31	9.2×10^{-5}

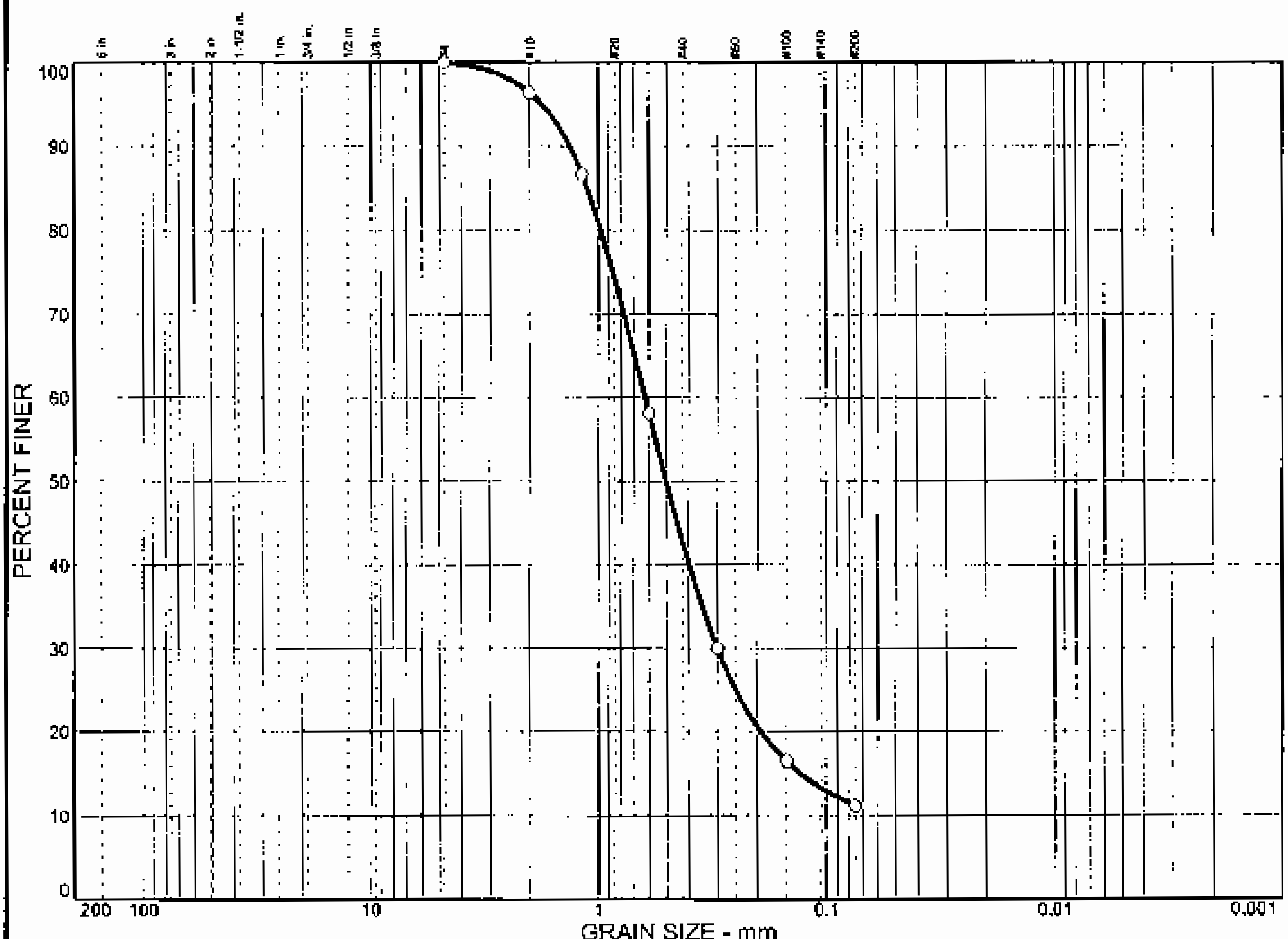
Remarks: -

Test by: M. Cole/K. Wood Test Date: 2/21/03 Checked By: T. Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K1 Boring WR-5 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	88.9	11.1	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.12	0.625	0.503	0.300	0.130			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Narrowly graded SAND with clay	SP-SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

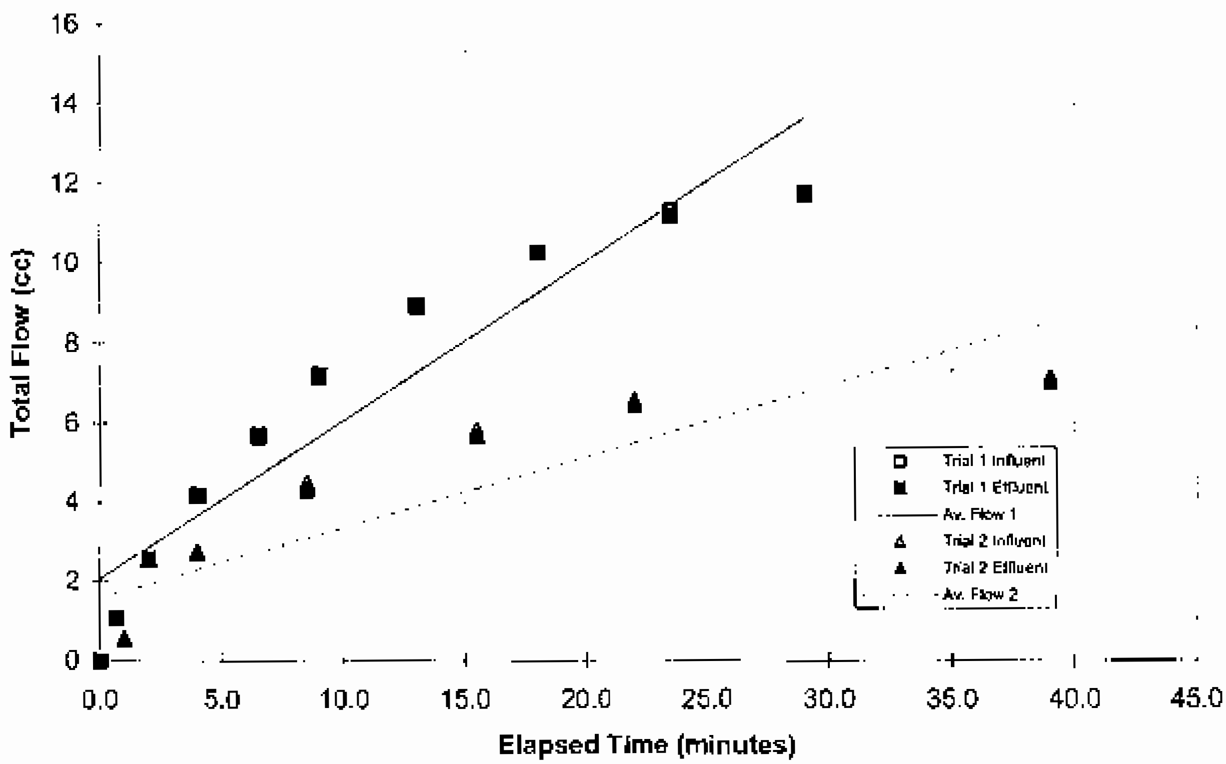
○ **Source:** WR-5 **Sample No.:** UD-1

Remarks:

○ Sample taken from 1/4 of permeability test sample K1.

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 1.2×10^{-4} cm/sec

METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-6	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	22 to 24 ft.	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	3.98 inch	Water Content:	17.0 %
Diameter:	2.88 inch	Total Unit Weight:	130.0 pcf
Area:	6.50 in²	Dry Unit Weight:	111.1 pcf

TEST DATA

			Gradient	Flow Rate cm³/min	Permeability cm/sec
Consolidation Stress	1.3 ksf				
Permeant	water from pond				
B - Value	0.95	Trial 1	Increasing Tailwater		1.4×10^{-4}
		Trial 2	Increasing Tailwater		1.1×10^{-4}

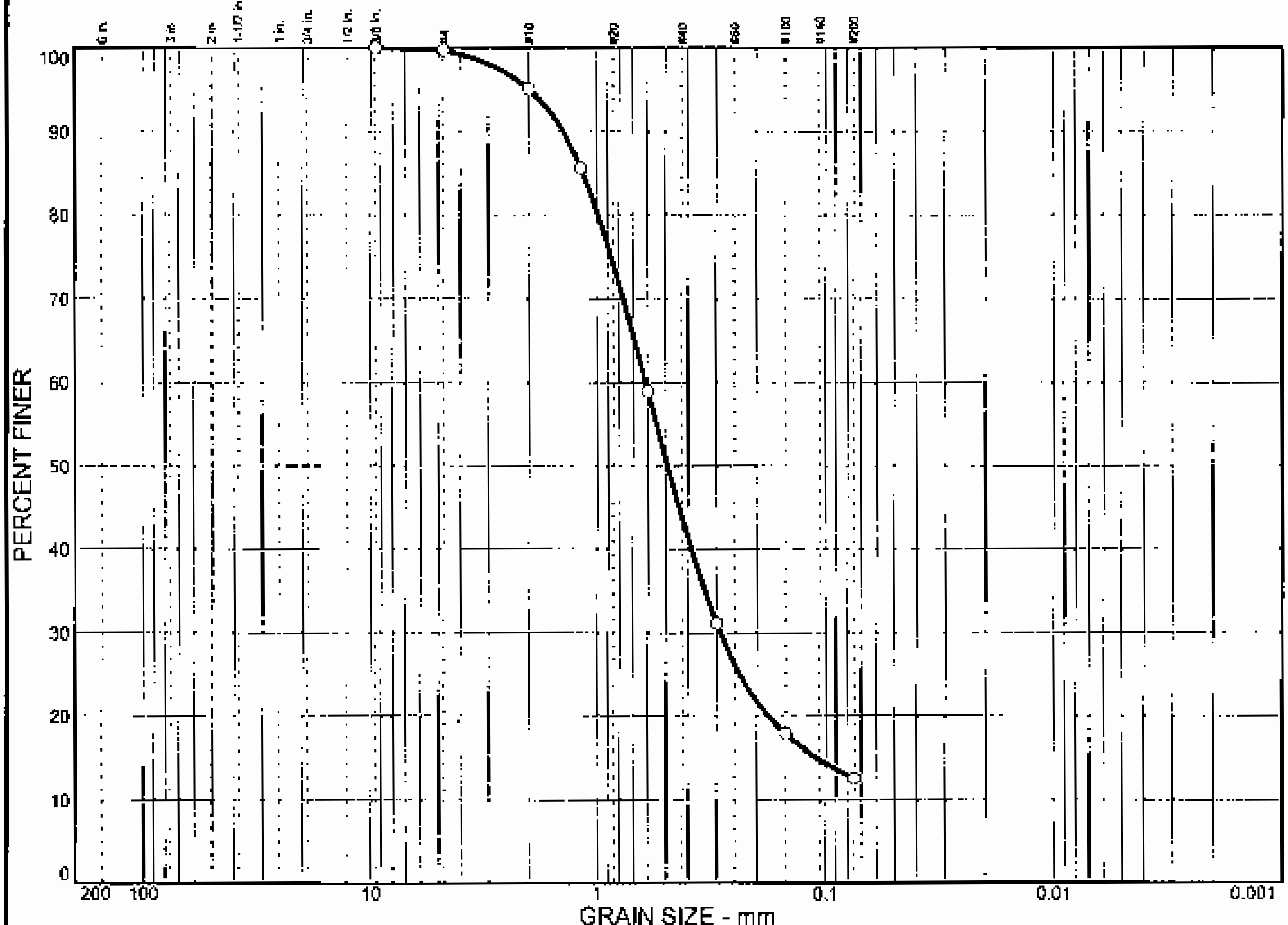
Remarks:

Test by: M. Cole Test Date: 4/3/03 Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K7 Boring WR-6 Sample UD-1
Φ GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	87.1	12.6	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.15	0.613	0.491	0.289	0.109			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

○ **Source:** WR-6 **Sample No.:** UD-1

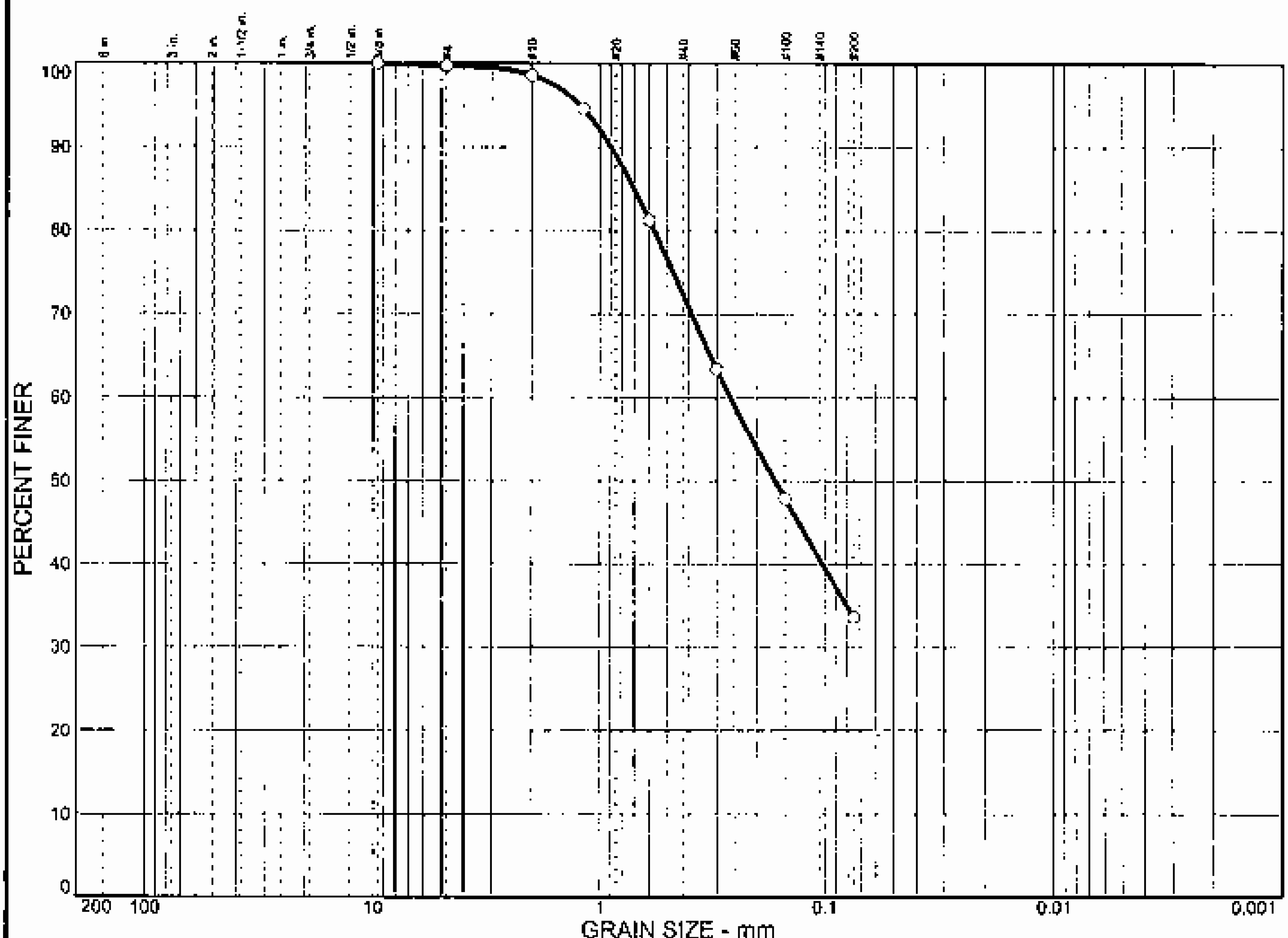
GEI Consultants, Inc.

Remarks:

○

Fig.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	66.1	33.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.701	0.261	0.166					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

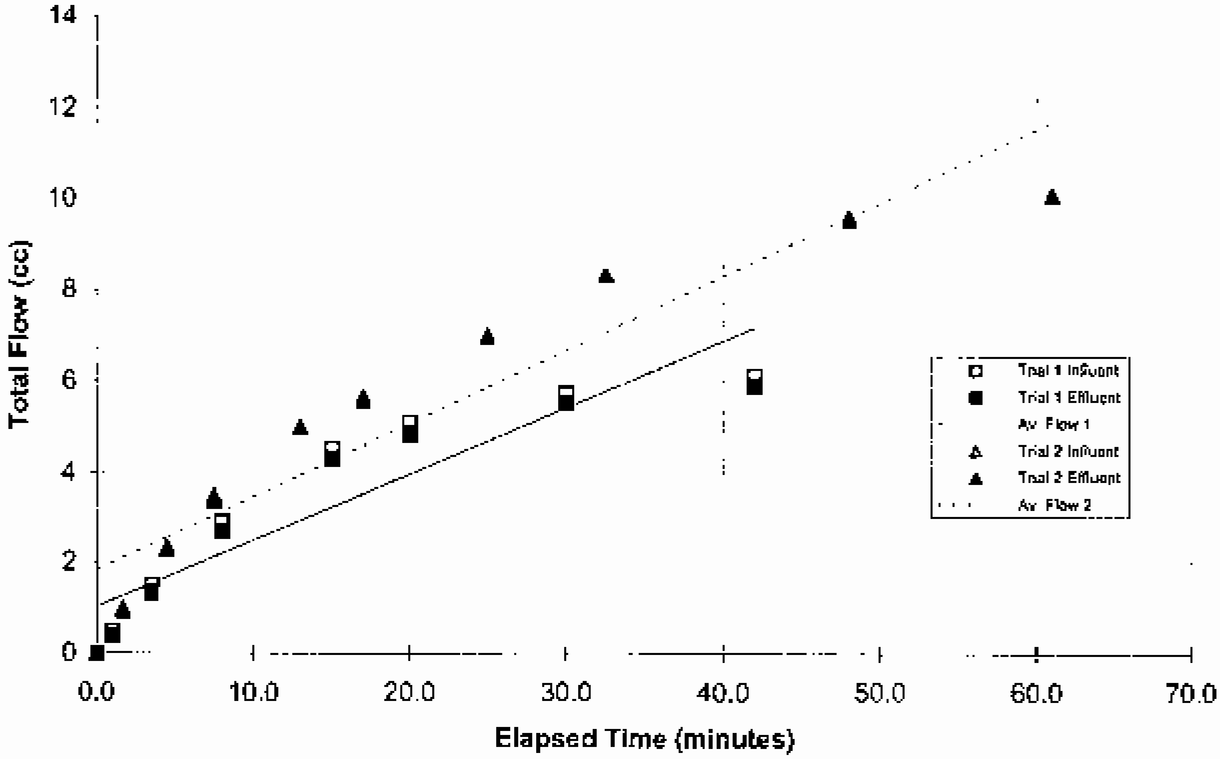
○ **Source:** WR-7 **Sample No.:** S4 **Elev./Depth:** 19-21 ft.

Remarks:

○

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 1.2×10^{-4} cm/sec   METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-8	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	17 to 19 feet	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	4.90 inch	Water Content:	17.0 %
Diameter:	2.87 inch	Total Unit Weight:	129.1 pcf
Area:	6.49 in²	Dry Unit Weight:	110.3 pcf

TEST DATA

			Gradient	Flow Rate cm³/min	Permeability cm/sec
Consolidation Stress	1.1 ksf				
Permeant	water from pond				
B - Value	0.97	Trial 1	Increasing Tailwater		1.6×10^{-4}
		Trial 2	Increasing Tailwater		7.6×10^{-5}

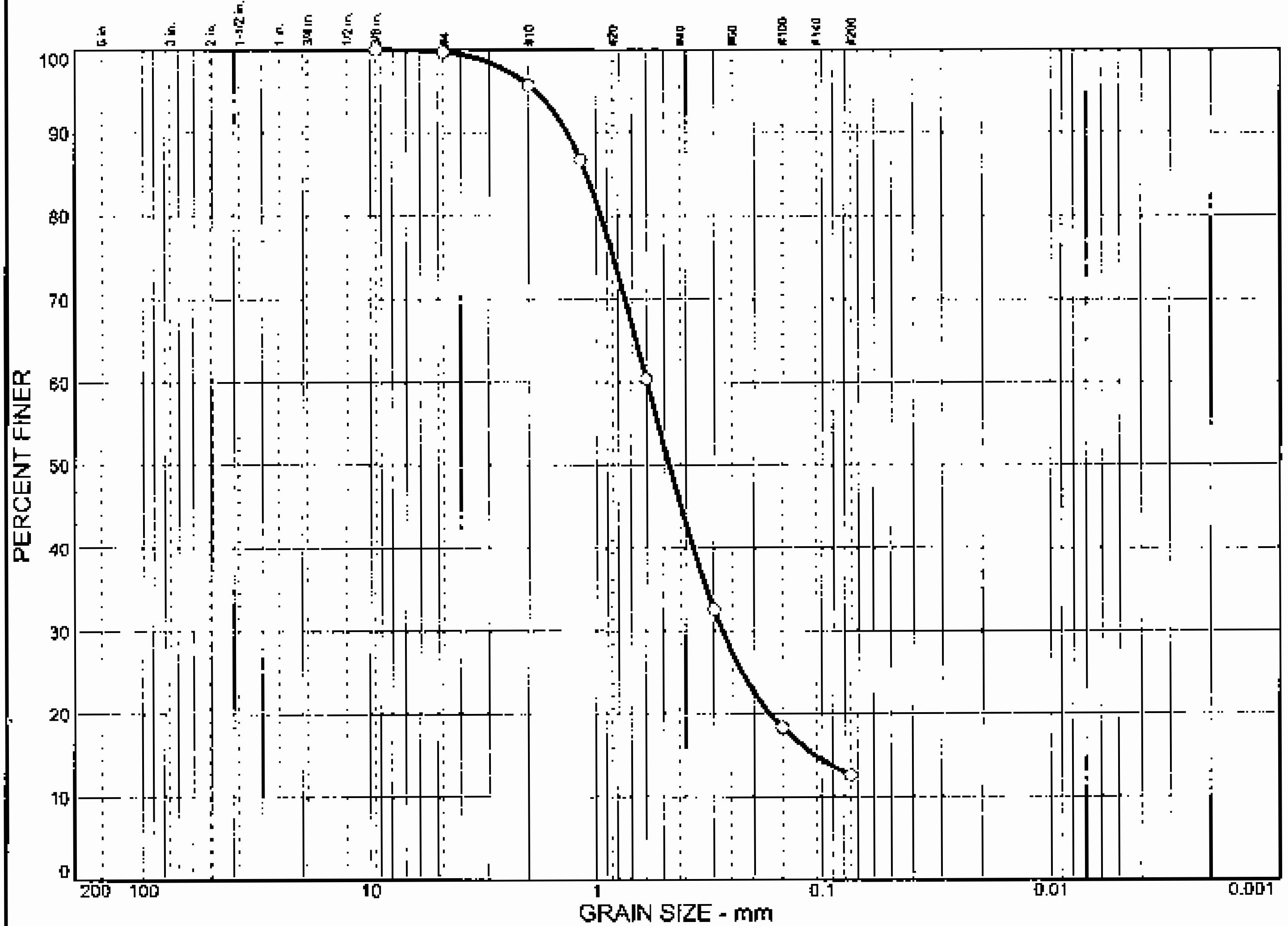
Remarks:

Test by: M.Cole   Test Date: 3/31/03   Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K5 Boring WR-8 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.3	87.1	12.6	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.11	0.595	0.474	0.275	0.107			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

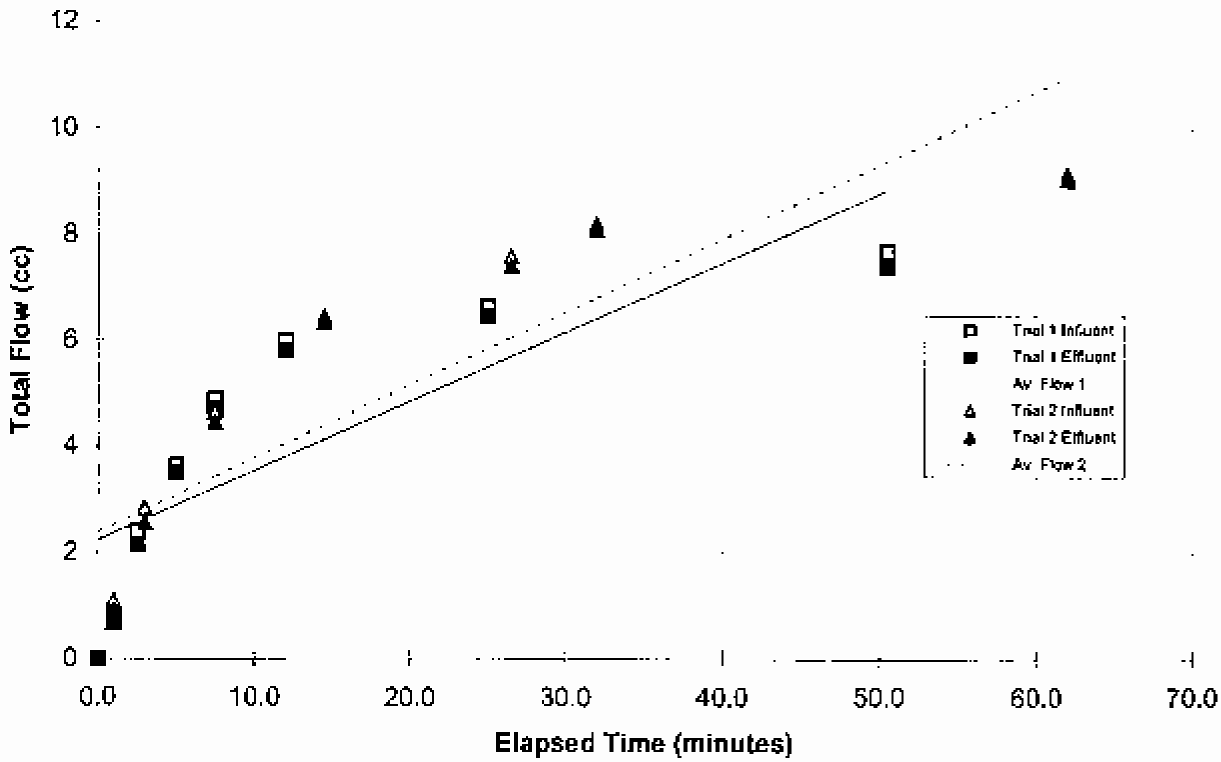
○ **Source:** WR-8 **Sample No.:** UD-1

Remarks:

○

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 7.1×10^{-5} cm/sec METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR9	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	12 to 14 feet	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	3.53 inch	Water Content:	14.8 %
Diameter:	2.85 inch	Total Unit Weight:	134.9 pcf
Area:	6.38 in^2	Dry Unit Weight:	117.4 pcf

TEST DATA

			Gradient	Flow Rate cm³/min	Permeability cm/sec
Consolidation Stress	0.7 ksf				
Permeant	water from pond				
B - Value	0.96	Trial 1	Increasing Tailwater		7.0×10^{-5}
		Trial 2	Increasing Tailwater		7.2×10^{-5}

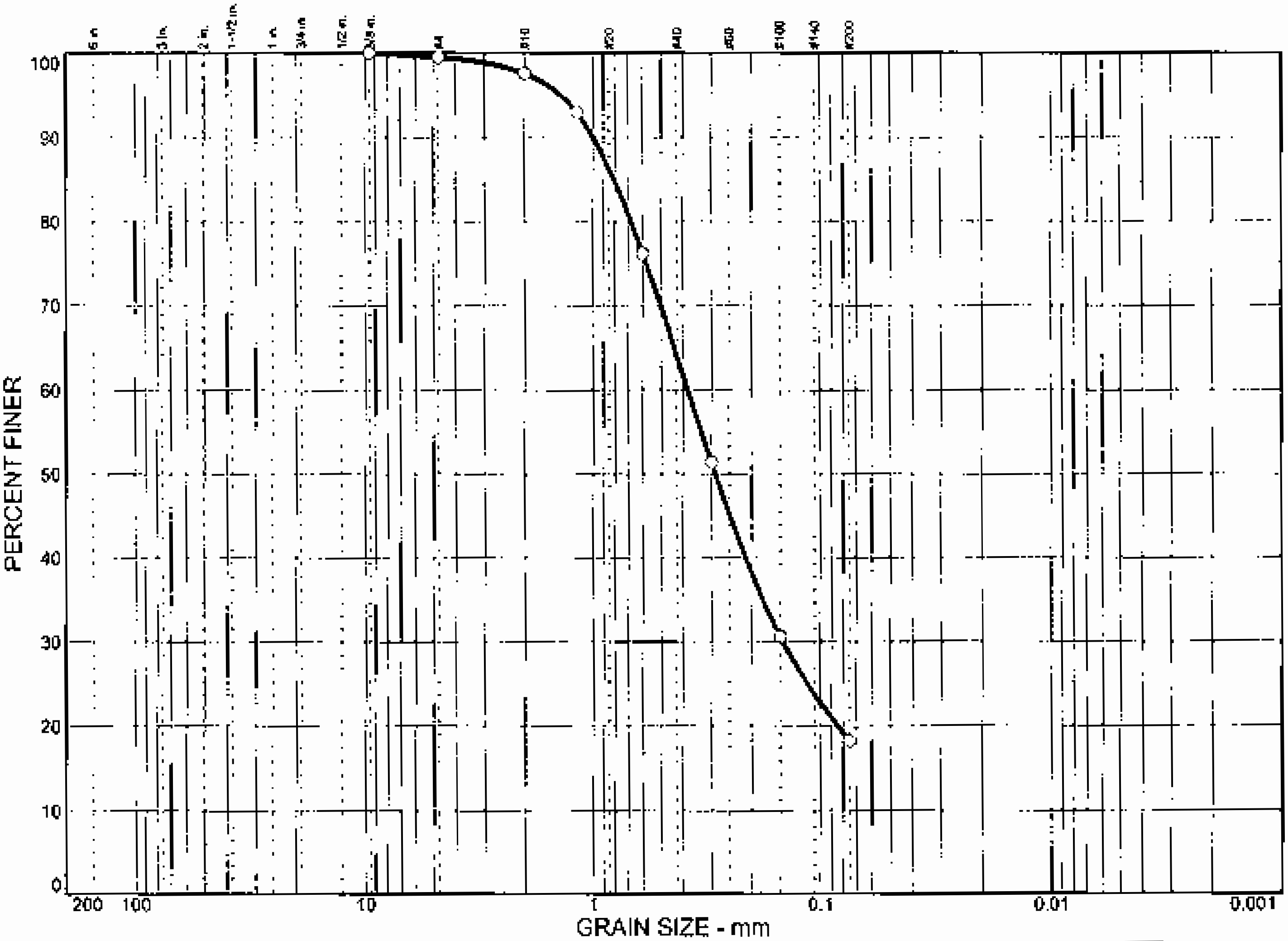
Remarks:

Test by: M. Cole Test Date: 4/3/03 Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K8 Boring WR9 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.5	81.3	18.2	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.807	0.380	0.288	0.146				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

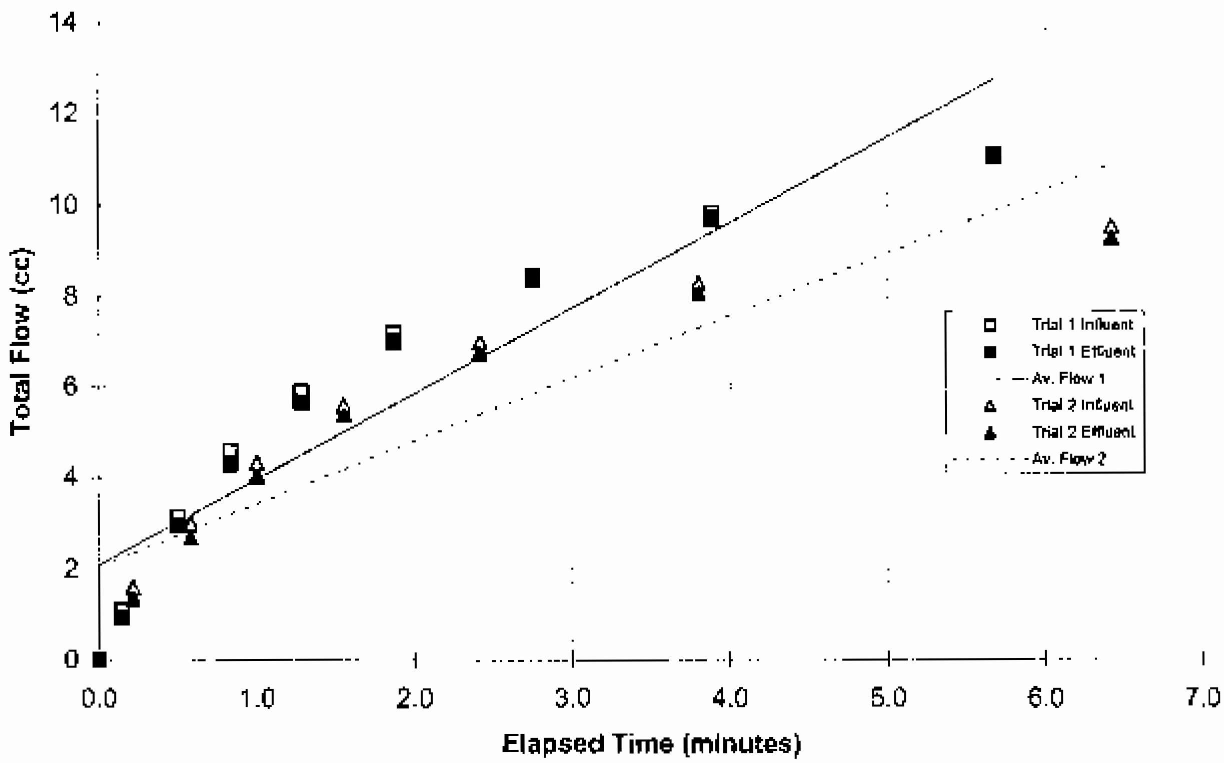
○ **Source:** WR-9 **Sample No.:** UD-1

GEI Consultants, Inc.

Remarks:

○

Fig.



TEST SUMMARY

PERMEABILITY : 5.7×10^{-4} cm/sec METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-10	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	23 to 25 ft.	Description:	Narrowly graded SAND with clay

SPECIMEN INFORMATION

Height:	3.89 inch	Water Content:	19.6 %
Diameter:	2.88 inch	Total Unit Weight:	125.3 pcf
Area:	6.49 in^2	Dry Unit Weight:	104.7 pcf

TEST DATA

			Gradient	Flow Rate cm^3/min	Permeability cm/sec
Consolidation Stress	1.2 ksf				
Permeant	water from pond				
B - Value	0.96	Trial 1	Increasing Tailwater		5.4×10^{-4}
		Trial 2	Increasing Tailwater		6.0×10^{-4}

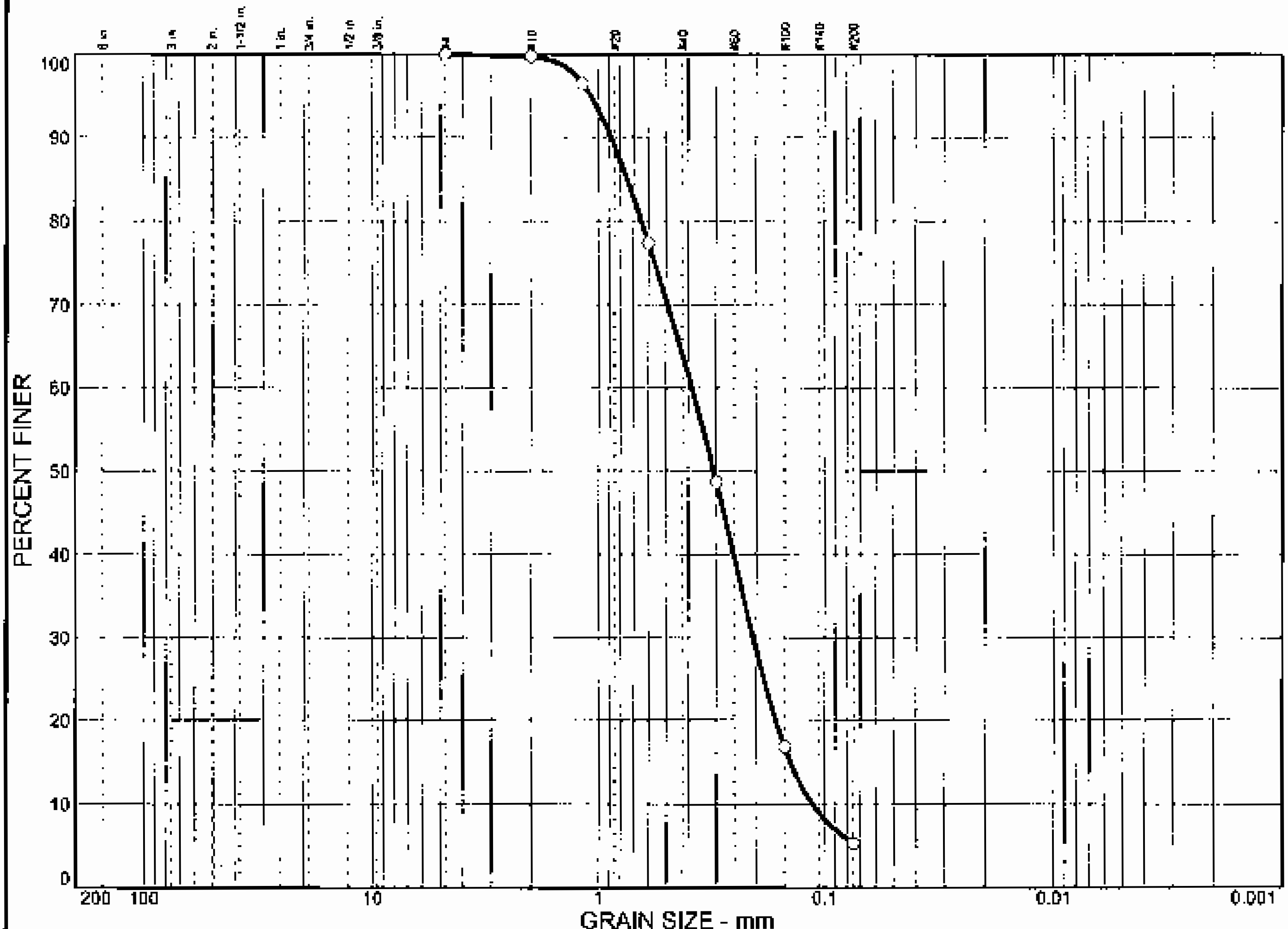
Remarks:

Test by: M.Cole Test Date: 3/19/03 Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K4 Boring WR-10 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	94.7	5.3	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.747	0.385	0.308	0.206	0.141	0.113	0.97	3.39

MATERIAL DESCRIPTION	USCS	AASHTO
○ Narrowly graded SAND with clay	SP-SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

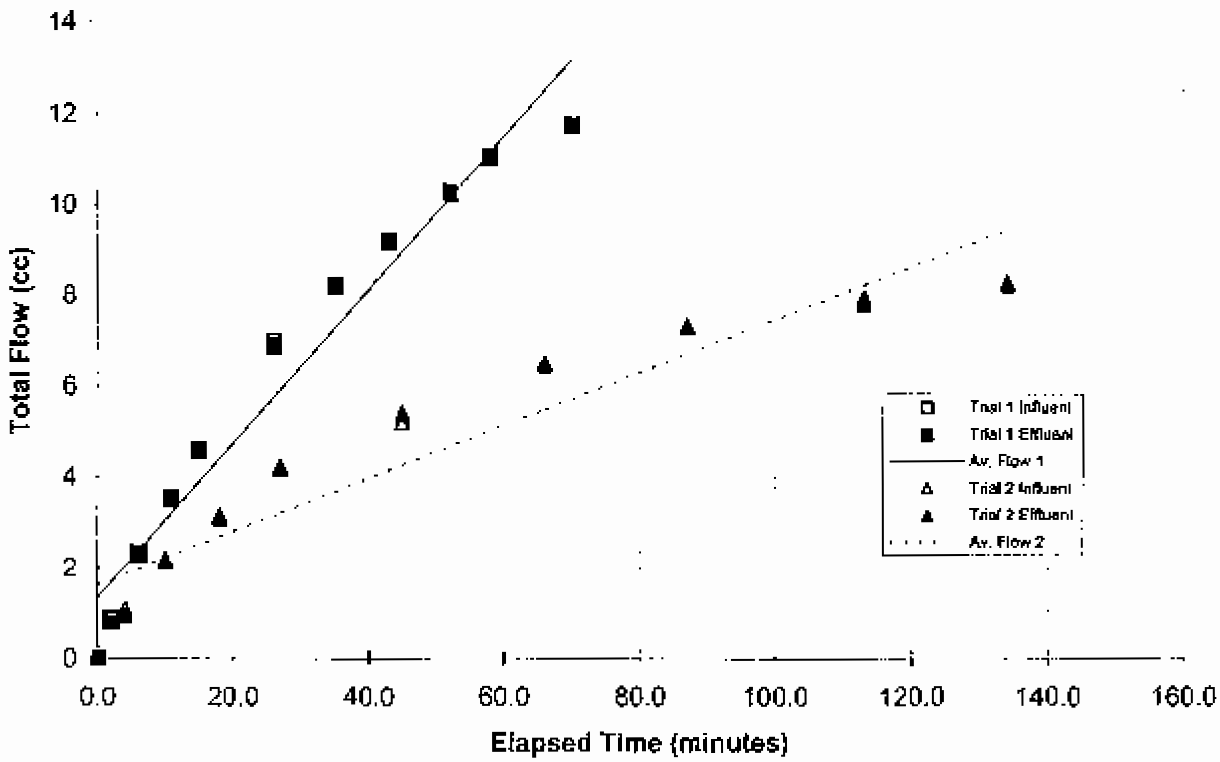
○ **Source:** WR-10 **Sample No.:** UD1

Remarks:

○

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 3.0×10^{-5} cm/sec

METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-11	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	16 to 18 feet	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	4.05 inch	Water Content:	14.8 %
Diameter:	2.86 inch	Total Unit Weight:	132.6 pcf
Area:	6.44 in^2	Dry Unit Weight:	115.6 pcf

TEST DATA

Consolidation Stress	1.0 ksf		Gradient	Flow Rate	Permeability
Permeant	water from pond			cm^3/min	cm/sec
B - Value	0.96	Trial 1	Rising Tailwater		3.7×10^{-5}
		Trial 2	Rising Tailwater		2.3×10^{-5}

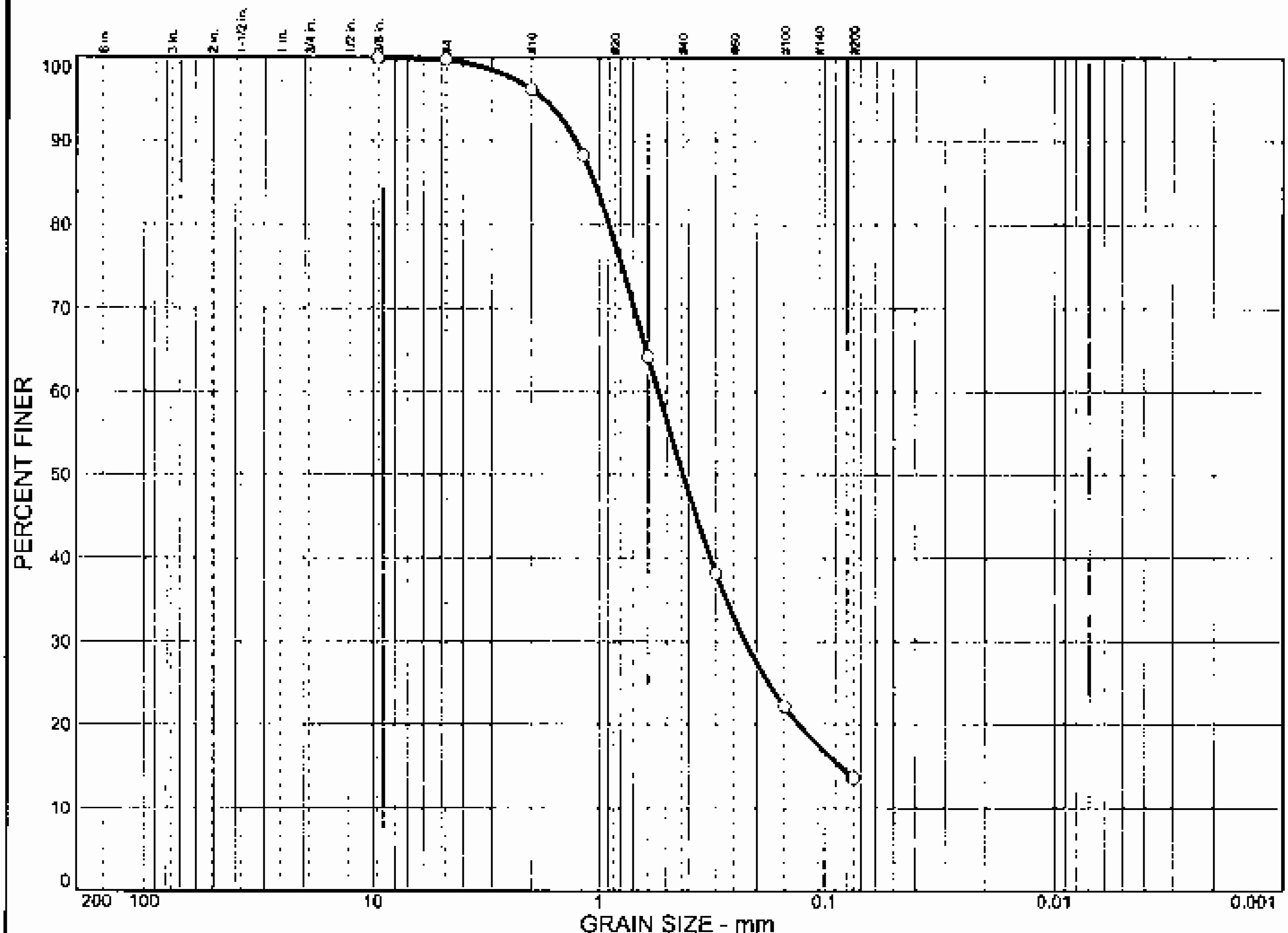
Remarks:

Test by: M.Cole Test Date: 3/14/03 Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K3 Boring WR-11 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.2	86.2	13.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.05	0.541	0.420	0.222	0.0856			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

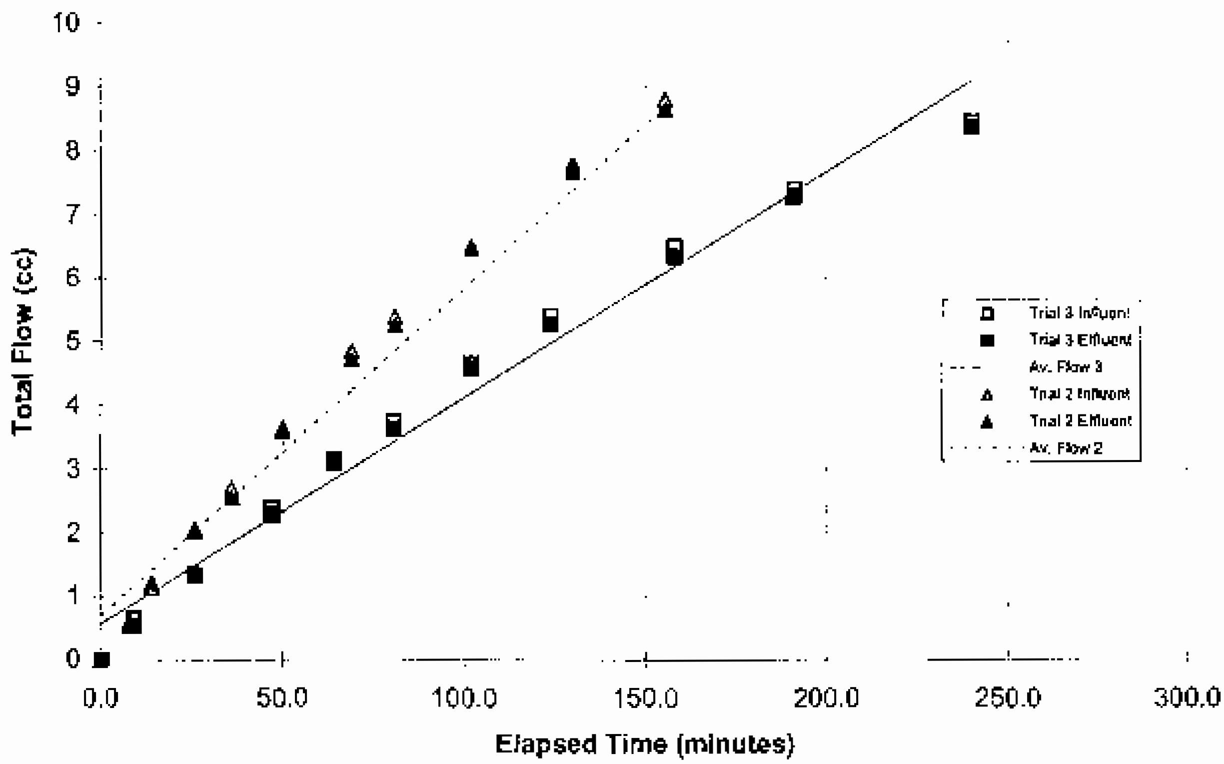
○ **Source:** WR-11 **Sample No.:** UD1

Remarks:

○

GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 4.7×10^{-6} cm/sec

METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-11	Type:	3-inch dia. tube sample
Sample:	UD-2		
Depth:	27 to 29 feet	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	3.62 inch	Water Content:	17.8 %
Diameter:	2.86 inch	Total Unit Weight:	130.7 pcf
Area:	6.43 in²	Dry Unit Weight:	111.0 pcf

TEST DATA

			Gradient	Flow Rate cm³/min	Permeability cm/sec
Consolidation Stress	1.4 ksf				
Permeant	water from pond				
B - Value	0.97	Trial 3	4.07	0.04	3.5×10^{-6}
		Trial 2	3.51	0.05	5.9×10^{-6}

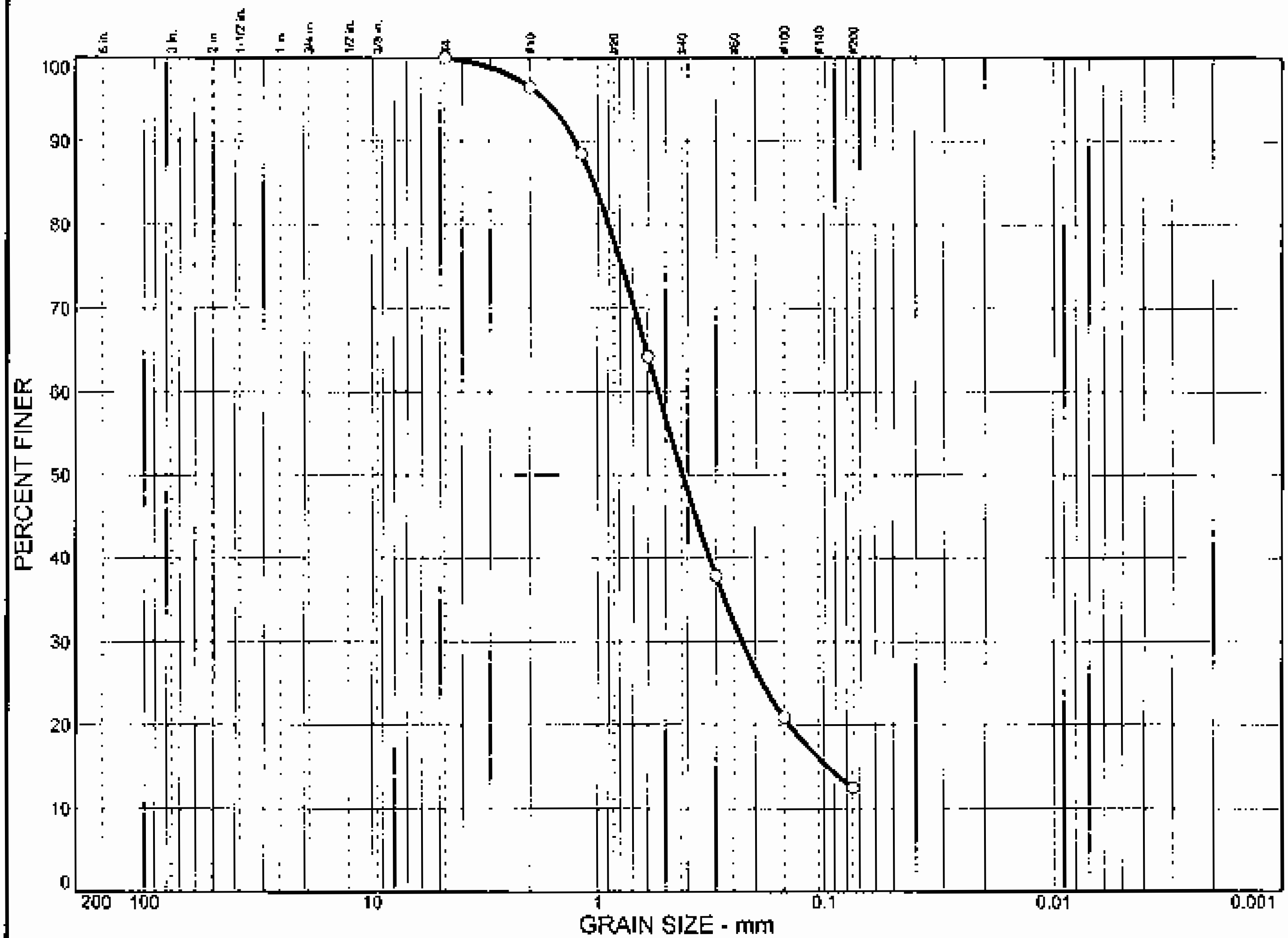
Remarks:

Test by: M. Cole Test Date: 3/10/03 Checked By: T. Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K2 Boring WR-11 Sample UD-2
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	87.5	12.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.04	0.540	0.420	0.229	0.0963			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

○ **Source:** WR-11 **Sample No.:** UD2

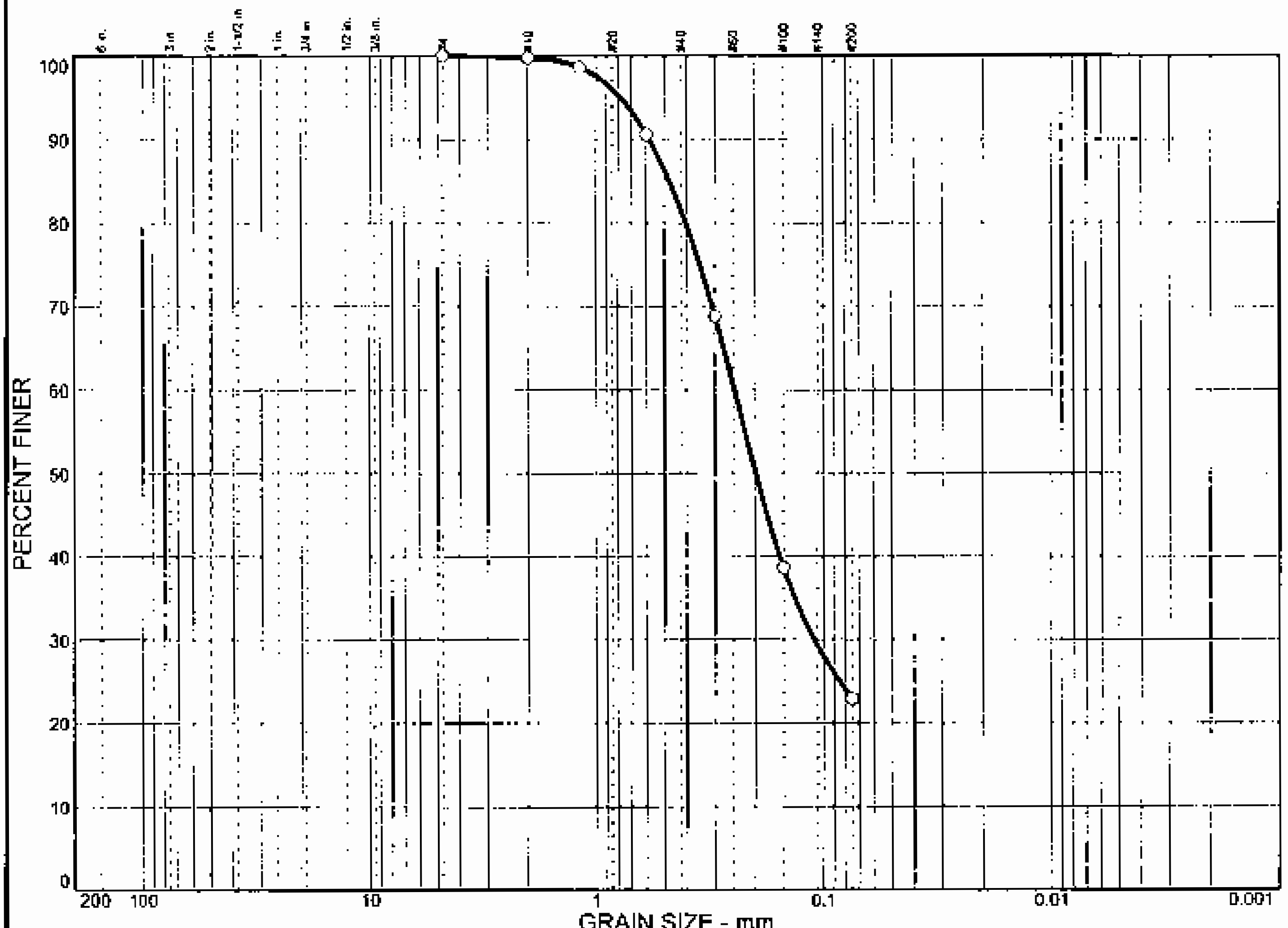
Remarks:

○

GEI Consultants, Inc.

Fig.

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	77.1	22.9	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.476	0.246	0.198	0.110				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

○ **Source:** WR-13 **Sample No.:** S3 **Elev./Depth:** 14-16 ft.

GEI Consultants, Inc.

Remarks:

○

Fig.

GRAIN SIZE DISTRIBUTION TEST REPORT

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
O	0.0	0.7	96.3	3.0	

X	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
O			1.29	0.812	0.691	0.457	0.266	0.208	1.24	3.91

MATERIAL DESCRIPTION	USCS	AASHTO
O Narrowly Graded SAND	SP	

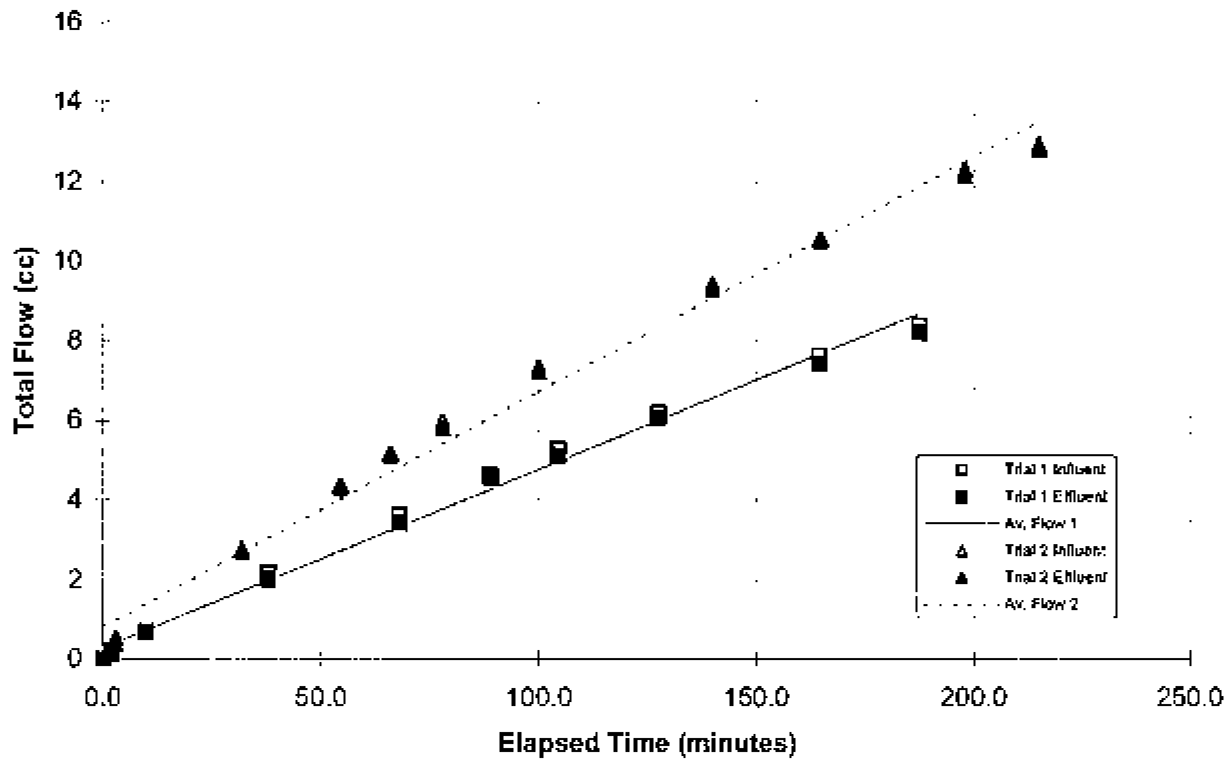
Project No. 022251 **Client:** Withers and Ravenal, Inc.
Project: Canady's Station Preliminary Mix Design

O **Source:** WR-13 **Sample No.:** S6 **Elev./Depth:** 29-31 ft.

Remarks:
O Small clumps of fibrous peat, wood in the sample. All of the plus No. 4 material was wood.

Φ GEI Consultants, Inc.

Fig.



TEST SUMMARY

PERMEABILITY : 6.8×10^{-6} cm/sec

METHOD: Performed in general accordance with ASTM D5084

SAMPLE INFORMATION

Boring:	WR-14	Type:	3-inch dia. tube sample
Sample:	UD-1		
Depth:	7 to 9 feet	Description:	Clayey SAND, gray

SPECIMEN INFORMATION

Height:	4.32 inch	Water Content:	19.4 %
Diameter:	2.87 inch	Total Unit Weight:	126.5 pcf
Area:	6.46 in^2	Dry Unit Weight:	106.0 pcf

TEST DATA

			Gradient	Flow Rate cm^3/min	Permeability cm/sec
Consolidation Stress	0.7 ksf				
Permeant	water from pond				
B - Value	0.96	Trial 1	1.99	0.04	9.0×10^{-6}
		Trial 2	5.12	0.06	4.6×10^{-6}

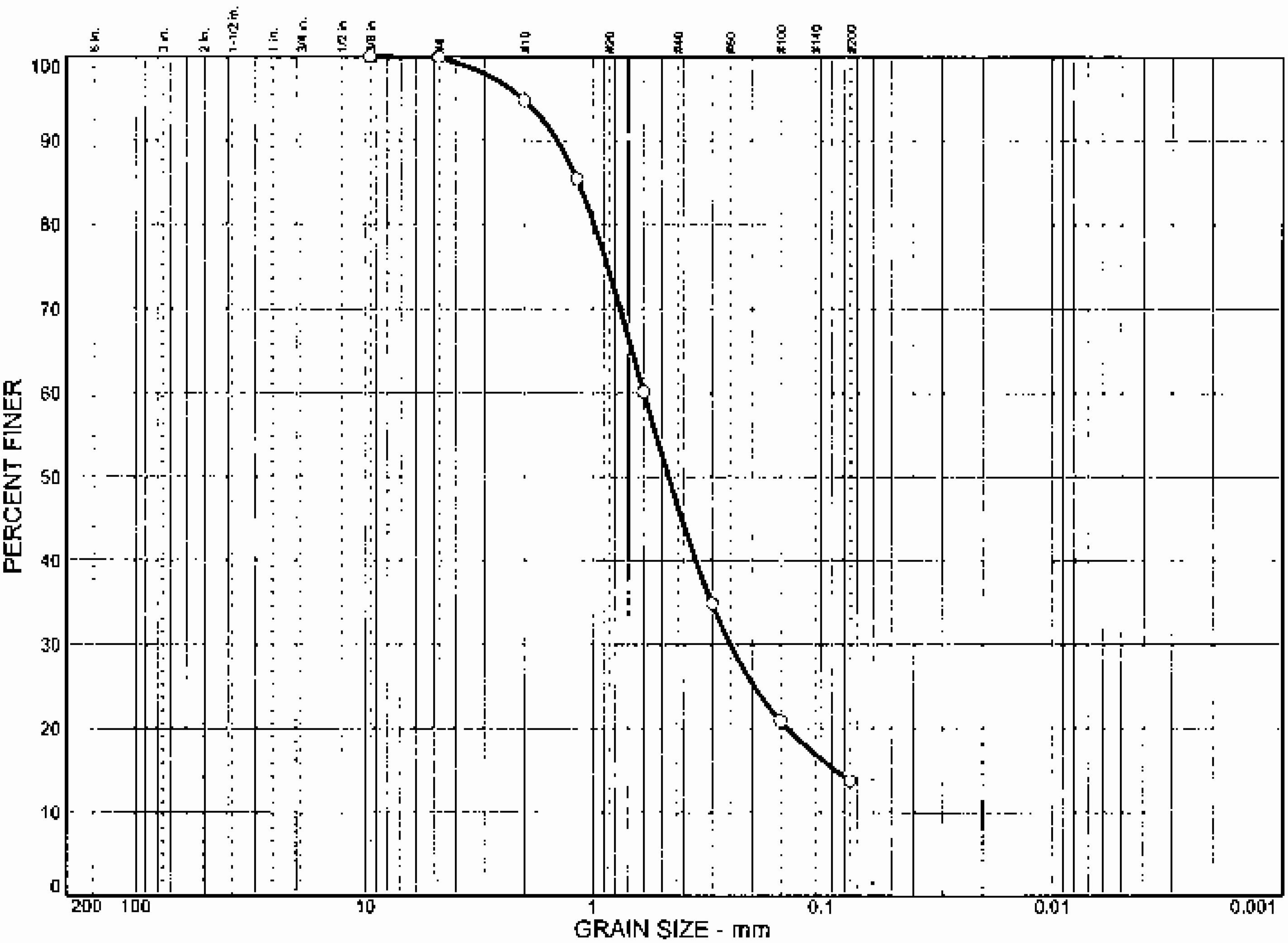
Remarks:

Test by: M. Cole Test Date: 3/26/03 Checked By: T.Kahl

Withers & Ravenal, Inc. Cary, NC	Canady's Station Preliminary Mix Design Dorchester County, NC	TRIAXIAL PERMEABILITY TEST K6 Boring WR-14 Sample UD-1
GEI Consultants, Inc.	Project 02225-1	May 2003

5/5/03

GRAIN SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.1	86.1	13.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.16	0.597	0.466	0.249	0.0861			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Clayey SAND	SC	

Project No. 022251 **Client:** Withers and Ravenal, Inc.

Project: Canady's Station Preliminary Mix Design

○ **Source:** WR-14 **Sample No.:** UD-1

Φ GEI Consultants, Inc.

Remarks:

○

Fig.

Appendix C

X-Ray Diffraction Tests

The Mineral Lab Inc.
2700 Youngfield Suite 105
Lakewood, CO 80215
(303) 232-8708

RECEIVED
MAR 3 1 2003
GEI CONSULTANTS, INC

March 26, 2003
Lab no. 203179

Mr. Thomas W. Kahl
GEI Consultants, Inc
1021 Main Street
Winchester, Massachusetts 01890

Dear Mr. Kahl:

Enclosed are the x-ray diffraction (XRD) analytical results for four "Canadys Station 022251" samples received last week. Also enclosed is a copy of our 2003 brochure. These analyses will be billed to your VISA card no. 4326 8932 1034 4872 (exp 10/03), as requested.

The samples were air-dried before grinding and analysis. A representative portion of each dry sample was ground to approximately -400 mesh in a steel swing mill, packed into a well-type plastic holder and then scanned with the diffractometer over the range, 3-61° 2θ using Cu-Kα radiation. Sample, "WRS-B1" was also mixed with distilled water, drawn onto a cellulose acetate filter and then the deposited material was rolled onto a glass disk forming an "oriented mount." The oriented mount was scanned over the range, 2-30° 2θ, treated with glycol and then re-scanned over the range, 2-22°. The results of the scans are summarized as approximate mineral weight percents on the enclosed table labeled, "XRD Results for Bulk 'Canadys Station 022251' Samples". Estimetes of mineral concentretions were made using our XRF-determined elemental compositions and the relative peak heights/areas on the XRD scans. The detection limit for an average mineral in these samples is ~1-3% and the analytical reproducibility is approximately equal to the square root of the amount. "Unidentified" accounts for that portion of the XRD scan which could not be resolved and a "?" indicates doubt in both mineral identification and amount.

All samples, except, "WRS-B1" were subjected to a size separation procedure based on Stokes' Law to concentrate the clay-size (-2μm) fraction for XRD analysis. A representative split of each sample was blended with distilled water and 10 ml of 5% Calgon solution to disaggregate the sample without reducing grein size. Each mixture was brought up to volume in a 1000 ml graduated cylinder. Each mixture was allowed to settle for 19.5 hrs and then 20 ml of the material suspended above the 300 ml mark in the cylinder were drawn into a pre-weighed beaker, dried at ~75°C and the weight of the clay-size material determined. The table labeled, "Clay Size Separation Results for 'Canadys Station 022251' Samples" lists the weight percent -2μm particles concentrated by this procedure. These figures should not be interpreted as the total weight percent of clay minerals in the samples but as the weight percent of -2μm material concentrated by this procedure.

Each remaining suspension was siphoned off for XRD analysis of the clay-size fraction. A portion of each suspension was drawn onto a cellulose acetate filter and then the deposited material was rolled onto a glass disk forming an "oriented mount." Each oriented mount was scanned over the range, 2-62° 2θ using Cu-Kα radiation, treated with glycol and then re-scanned over the range, 2-22°. The table labeled, "XRD Results for -2µm Fractions of 'Canadys Station 022251' Samples" summarizes the results of these scans as approximate mineral weight percents. Estimates of mineral concentrations are based on the relative peak areas on the XRD scans and comparison to the XRD results for the bulk samples. The detection limits and reproducibility are similar to those for the bulk samples.

Thank you for the opportunity to be of continuing service to GEI Consultants.

Sincerely,

Peggy Dalheim

Peggy Dalheim
The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for Clay-Size Fractions of "Canadys Station 022251" Samples

March 26, 2003
Lab no. 203179

Mineral Name	Chemical Formula	Approx. Wt % WR14 Hand Auger 6.5-7'	WR9 Hand Auger -6'	~~WR5-UD1~~ WR11-UD2
Kaolinite	$Al_2Si_2O_5(OH)_4$	45	13	35
Smectite	$(Ca,Na)_x(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot nH_2O$	25	75	30
Chlorite	$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$	25	—	30
Quartz	SiO_2	<3	<3	<3
Cristobalite/Opal	SiO_2	—	<3	—
Gibbsite	$Al(OH)_3$	—	5	—
"Unidentified"	?	<5	<5	<5

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
Clay Size Separation Results for "Canadys Station 022251" Samples

March 26, 2003
Lab no. 203179

Sample	Weight % -2μm Material Concentrated
WR-14 Hand Auger 6.5-7'	9
WR-9 Hand Auger ~6'	11
~~WR5-UD1~~ WR11-UD2	3

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for XRD Results for Bulk "Canadys Station 022251" Samples

March 26, 2003
Lab no. 203179

Mineral Name	Chemical Formula	Approx. Wt %			
		WR-14 Hand Auger 6.5-7'	WR-9 Hand Auger ~6'	WRS-B1	~~WR5-UD1~~ WR11-UD2
Quartz	SiO_2	>80	>80	5	>85
Kaolinite	$Al_2Si_2O_5(OH)_4$	14	8	—	5
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	—	<3	5	<3
K-feldspar	$KAlSi_3O_8$	<2	<3	—	<1?
Smectite	$(Ca,Na)_x(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot nH_2O$	—	<5?	>70	—
Mica/illite	$(K,Na,Ca)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH,F)_2$	—	—	7	—
Clinoptilolite	$KNa_2Ca_2Al_7Si_{29}O_{72} \cdot 32H_2O$	—	—	5	—
Cristobalite/Opal	SiO_2	—	<3	<5	—
Calcite	$CaCO_3$	—	<1?	<2?	<1
Dolomite	$Ca(Mg,Fe)(CO_3)_2$	—	—	—	<1?
Gibbsite	$Al(OH)_3$	—	<2?	—	<3?
"Unidentified"	?	<5	<5	<5	<5

Analysis performed by The Mineral Lab, Inc

The Mineral Lab, Inc.
2700 Youngfield Suite 105
Lakewood, CO 80215
(303) 232-8708

RECEIVED
APR 14 2003
GEI CONSULTANTS, INC

April 10, 2003
Lab no. 203206

Mr. Thomas W. Kahl
GEI Consultants, Inc
1021 Main Street
Winchester, Massachusetts 01890

Dear Mr. Kahl:

Enclosed are the x-ray diffraction (XRD) analytical results for five "Canadys Station 022251" samples received last week. I apologize for the long turnaround time. We have had some equipment problems the past several days. This report will be faxed and mailed to you. The analyses will be billed to your VISA card no. 4326 8932 1034 4872 (exp 10/03), as requested.

A representative portion of each sample was ground to approximately -400 mesh in a steel swing mill, packed into a well-type plastic holder and then scanned with the diffractometer over the range, 3-61° 2θ using Cu-Kα radiation. The results of the scans are summarized as approximate mineral weight percents on the enclosed table labeled, "XRD Results for Bulk 'Canadys Station 022251' Samples". Estimates of mineral concentrations were made using our XRF-determined elemental compositions and the relative peak heights/areas on the XRD scans. The detection limit for an average mineral in these samples is ~1-3% and the analytical reproducibility is approximately equal to the square root of the amount. "Unidentified" accounts for that portion of the XRD scan which could not be resolved and a "?" indicates doubt in both mineral identification and amount.

Each sample was subjected to a size separation procedure based on Stokes' Law to concentrate the clay-size (-2µm) fraction for XRD analysis. A representative split of each sample was blended with distilled water and 10 ml of 5% Calgon solution to disaggregate the sample without reducing grain size. Each mixture was brought up to volume in a 1000 ml graduated cylinder. Each mixture was allowed to settle for 19.5 hrs and then 20 ml of the material suspended above the 300 ml mark in the cylinder were drawn into a pre-weighed beaker, dried at ~75°C and the weight of the clay-size material determined. The table labeled, "Clay Size Separation Results for 'Canadys Station 022251' Samples" lists the weight percent -2µm particles concentrated by this procedure. These figures should not be interpreted as the total weight percent of clay minerals in the samples but as the weight percent of -2µm material concentrated by this procedure.

April 10, 2003
Lab no. 203206

Each remaining suspension was siphoned off for XRD analysis of the clay-size fraction. A portion of each suspension was drawn onto a cellulose acetate filter and then the deposited material was rolled onto a glass disk forming an "oriented mount." Each oriented mount was scanned over the range, 2-62° 2θ using Cu-Kα radiation, treated with glycol and then re-scanned over the range, 2-22°. The table labeled, "XRD Results for -2μm Fractions of 'Canadys Station 022251' Samples" summarizes the results of these scans as approximate mineral weight percents. Estimates of mineral concentrations are based on the relative peak areas on the XRD scans and comparison to the XRD results for the bulk samples. The detection limits and reproducibility are similar to those for the bulk samples.

Thank you for the opportunity to be of continuing service to GEI Consultants.

Sincerely,

Peggy Dalheim
The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for XRD Results for Bulk "Canadys Station 022251" Samples

April 10, 2003
Lab no. 203206

		Approx. Wt %				
Mineral Name	**Chemical Formula**	**WR5A, UD1** *	**WR7, S4** *	**WR10, UD1**	**WR11, UD1**	**WR13, S3** *
Quartz	SiO_2	16	18	>90	87	19
Kaolinite	$Al_2Si_2O_5(OH)_4$	70	70	5	9	70
Chlorite/Smectite*	$(Ca,Na)_x(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot nH_2O$	<5	<10	—	—	<5
Mica/illite	$(K,Na,Ca)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH,F)_2$	—	<3?	—	—	<3
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	<3?	—	—	—	—
K-feldspar	$KAlSi_3O_8$	<2?	—	—	—	<2?
Calcite	$CaCO_3$	5	—	—	<2	—
Gibbsite	$Al(OH)_3$	<3?	<3	—	—	<3?
Anatase	TiO_2	<2?	<2?	—	—	<2?
Dolomite	$Ca(Mg,Fe)(CO_3)_2$	—	—	—	<1?	—
Zinc	Zn	<1?	—	—	—	—
"Unidentified"	?	<5	<5	<5	<5	<5

*The formula for smectite is given. See the XRD results for clay-size fractions for the chlorite formula.

* Bulk analysis performed on #200 sieve material from grain size analyses; thus quartz (sand) content is low and results are very similar to clay size analyses.

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
Clay Size Separation Results for "Canadys Station 022251" Samples

April 10, 2003
Lab no. 203206

Sample	Weight % -2µm Material Concentrated
WR5A, UD1	9
WR7, S4	23
WR10, UD1	2
WR11, UD1	3
WR13, S3	30

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for Clay-Size Fractions of "Canadys Station 022251" Samples

April 10, 2003
Lab no. 203206

		Approx. Wt %				
Mineral Name	**Chemical Formula**	**WR5A, UD1**	**WR7, S4**	**WR10, UD1**	**WR11, UD1**	**WR13, S3**
Quartz	SiO_2	<3	<3	<5	<3	<5
Kaolinite	$Al_2Si_2O_5(OH)_4$	>75	>80	70	80	>85
Chlorite	$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$	15	12	23	17	9
Mica/illite	$(K,Na,Ca)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH,F)_2$	<5	—	<5	<3	<5
Smectite	$(Ca,Na)_x(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot nH_2O$	—	<5	—	—	—
Cristobalite/Opal	SiO_2	—	—	<3?	—	—
Gibbsite	$Al(OH)_3$	—	—	—	—	<3
"Unidentified"	?	<5	<5	<5	<5	<5

Analysis performed by The Mineral Lab, Inc

The Mineral Lab Inc
2700 Youngfield Suite 105
Lakewood, CO 80215
(303) 232-8708

April 17, 2003
Lab no. 203231

Mr. Thomas W. Kahl
GEI Consultants, Inc
1021 Main Street
Winchester, Massachusetts 01890

Dear Mr. Kahl:

Enclosed are the x-ray diffraction (XRD) analytical results for four "Canadys Station 022251 UD-1" samples received last week. The analyses will be billed to your VISA card no. 4326 8932 1034 4872 (exp 10/03), as requested.

A representative portion of each sample was ground to approximately -400 mesh in a steel swing mill, packed into a well-type plastic holder and then scanned with the diffractometer over the range, 3-61° 2θ using Cu-Kα radiation. The results of the scans are summarized as approximate mineral weight percents on the enclosed table labeled, "XRD Results for Bulk 'Canadys Station 022251' Samples". Estimates of mineral concentrations were made using our XRF-determined elemental compositions and the relative peak heights/areas on the XRD scans. The detection limit for an average mineral in these samples is ~1-3% and the analytical reproducibility is approximately equal to the square root of the amount. "Unidentified" accounts for that portion of the XRD scan which could not be resolved and a "?" indicates doubt in both mineral identification and amount.

Each sample was subjected to a size separation procedure based on Stokes' Law to concentrate the clay-size (-2μm) fraction for XRD analysis. A representative split of each sample was blended with distilled water and 10 ml of 5% Calgon solution to disaggregate the sample without reducing grain size. Each mixture was brought up to volume in a 1000 ml graduated cylinder. Each mixture was allowed to settle for 19.5 hrs and then 20 ml of the material suspended above the 300 ml mark in the cylinder were drawn into a pre-weighed beaker, dried at ~75°C and the weight of the clay-size material determined. The table labeled, "Clay Size Separation Results for 'Canadys Station 022251' Samples" lists the weight percent -2μm particles concentrated by this procedure. These figures should not be interpreted as the total weight percent of clay minerals in the samples but as the weight percent of -2μm material concentrated by this procedure.

April 17, 2003
Lab no. 203231

Each remaining suspension was siphoned off for XRD analysis of the clay-size fraction. A portion of each suspension was drawn onto a cellulose acetate filter and then the deposited material was rolled onto a glass disk forming an "oriented mount." Each oriented mount was scanned over the range, 2-62° 2θ using Cu-Kα radiation, treated with glycol and then re-scanned over the range, 2-22°. The table labeled, "XRD Results for -2μm Fractions of 'Canadys Station 022251' Samples" summarizes the results of these scans as approximate mineral weight percents. Estimates of mineral concentrations are based on the relative peak areas on the XRD scans and comparison to the XRD results for the bulk samples. The detection limits and reproducibility are similar to those for the bulk samples.

Thank you for the opportunity to be of continuing service to GEI Consultants.

Sincerely,

Peggy Dalheim

Peggy Dalheim
The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for XRD Results for Bulk "Canadys Station 022251 UD-1" Samples

April 17, 2003
Lab no. 203231

Mineral Name	Chemical Formula	Approx. Wt % WR8	WR14	WR6	WR9
Quartz	SiO_2	>85	>85	>85	>80
Kaolinite	$Al_2Si_2O_5(OH)_4$	7	8	<5?	10
Plagioclase feldspar	$(Na,Ca)Al(Si,Al)_3O_8$	—	<1?	—	—
K-feldspar	$KAlSi_3O_8$	—	<2?	—	<2
Calcite	$CaCO_3$	<2	—	<2	<2
Dolomite	$Ca(Mg,Fe)(CO_3)_2$	<1?	—	—	—
Iron	Fe	—	—	<1?	<1?
"Unidentified"	?	<5	<5	<5	<5

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
Clay Size Separation Results for "Canadys Station 022251 UD-1" Samples

April 17, 2003
Lab no. 203231

Sample	Weight % -2µm Material Concentrated
WR8	6
WR14	5
WR6	1
WR9	5

Analysis performed by The Mineral Lab, Inc

GEI Consultants, Inc
XRD Results for Clay-Size Fractions of "Canadys Station 022251 UD-1" Samples

April 17, 2003
Lab no. 203231

		Approx. Wt %			
Mineral Name	**Chemical Formula**	**WR8**	**WR14**	**WR6**	**WR9**
Kaolinite	$Al_2Si_2O_5(OH)_4$	60	60	72	80
Smectite	$(Ca,Na)_x(Al,Mg,Fe)_4(Si,Al)_8O_{20}(OH)_4 \cdot nH_2O$	26	20	10	9
Chlorite	$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$	5	5	13	6
Mica/illite	$(K,Na,Ca)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH,F)_2$	—	<5	<3?	<3?
Quartz	SiO_2	<5	<5	<3	<5
Gibbsite	$Al(OH)_3$	<3?	<3?	—	—
Cristobalite/Opal	SiO_2	—	<3?	—	—
"Unidentified"	?	<5	<5	<5	<5

Analysis performed by The Mineral Lab, Inc

FROM LAMBE + WHITMAN "SOIL MECHANICS", 1969

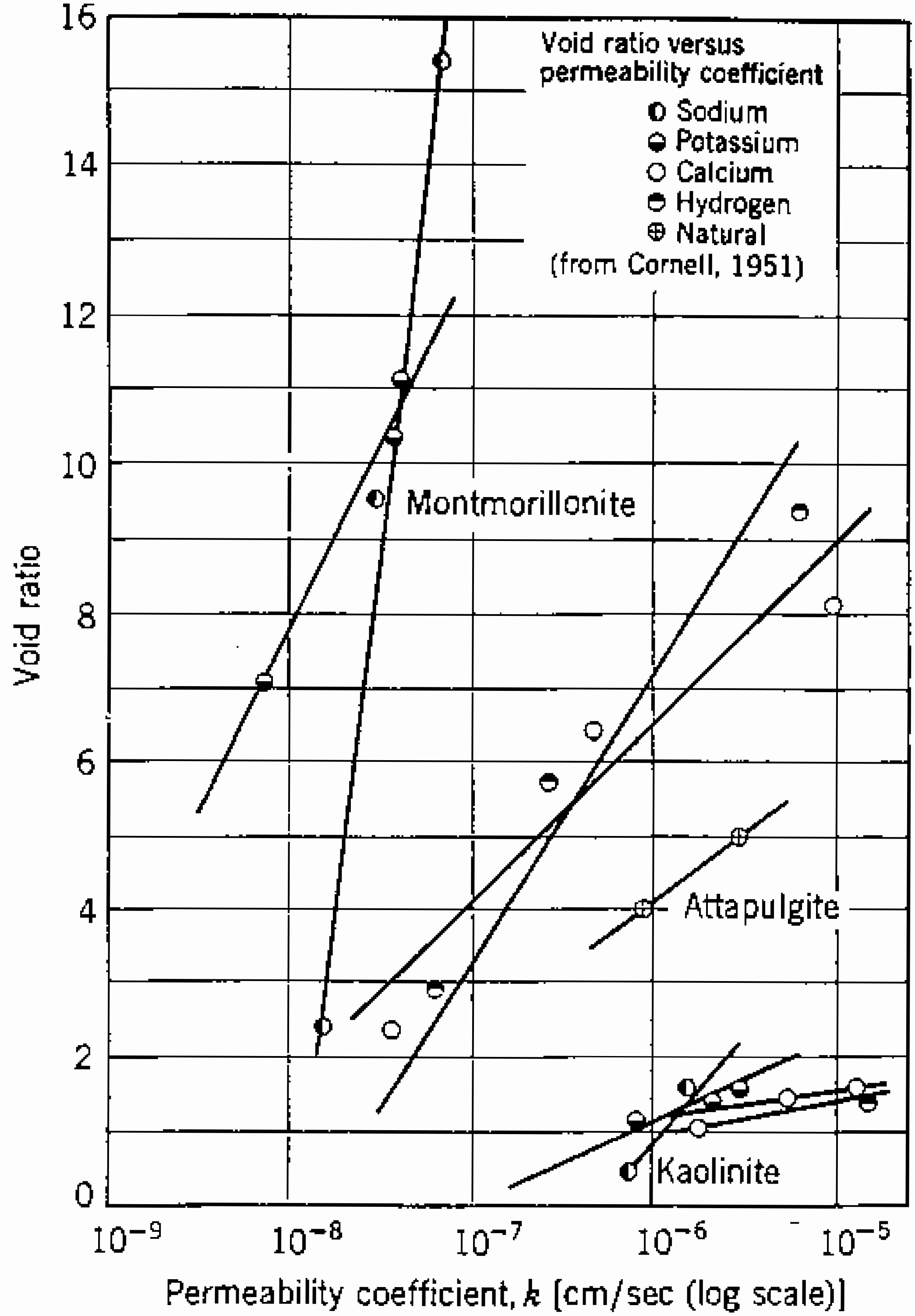


Fig. 19.10 Void ratio versus permeability.

relatively close to straight lines. The test data in Fig. 19.7 show that a plot of k versus $e^3/(1+e)$ for kaolinite is not a straight line. In general, e versus $\log k$ is close

Attachment C

Previous Cone Penetrometer Testing Report

GREGG

GREGG DRILLING AND TESTING, INC.
GREGG IN SITU, INC.
ENVIRONMENTAL AND GEOTECHNICAL INVESTIGATION SERVICES

April 14, 2003

Withers & Ravenel, Inc.
Mr. Brian Bellis
111 Makenan Drive
Cary, North Carolina 27511

Subject: Canadys Slurry Wall
CPT Geotechnical / Environmental Site Investigation
Canadys, South Carolina
GREGG Project Number: 03-044SC

Dear Brian:

The following report presents the results of GREGG IN SITU's Cone Penetration Test investigation for the above referenced site.

GREGG IN SITU appreciates the opportunity to provide our testing services on this project. We trust that the information presented in this report is sufficient for your purposes.

If you have any questions regarding the contents of this report, please do not hesitate to contact our office at (843) 832-4918.

Sincerely,
GREGG IN SITU, Inc.

Timothy J. Cleary
Operations Manager

106 Butternut Road • Summerville, South Carolina 29483 • (843) 832-4918 • FAX (843) 832-4919
OTHER OFFICES: LOS ANGELES • SAN FRANCISCO • SALT LAKE CITY • HOUSTON • VANCOUVER • WEST BERLIN (NJ) • AUGUSTA
www.greggdrilling.com

PRESENTATION OF CONE PENETRATION TEST DATA

CANADYS SLURRY WALL

GEOTECHNICAL / ENVIRONMENTAL INVESTIGATION

CANADYS, SOUTH CAROLINA

MARCH 2003

Prepared for:

WITHERS & RAVENEL, INC.
111 Makenan Drive
Cary, North Carolina 27511

Prepared by:

GREGG

GREGG IN SITU, INC.
106 Butternut Road
Summerville, South Carolina 29483

April 14, 2003

TABLE OF CONTENTS

1.0 INTRODUCTION

This report contains the results of Cone Penetration Testing conducted at an SCE&G facility in Canadys, South Carolina. The program consisted of thirty three CPT soundings to depths of 3.20 to 41.75 feet below the existing ground surface. Additionally, the CPT soundings measured pore pressure decay at selected intervals throughout the push. Gregg In Situ's 20 Ton RHINO drill rig and associated tooling were used for the CPT soundings. A data acquisition system collected information from the cone as it penetrated the soils. The scope of work was completed at the direction of Withers & Ravenel personnel. The investigation program was conducted on March 24 through 28, 2003.

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 Electric Cone Penetration Testing

The Cone Penetration Tests (CPT) were performed GREGG IN SITU of Summerville, South Carolina using an integrated electronic cone system. The CPT soundings were performed in general accordance with ASTM D5778-00 and in industry standards.

A 20-ton compression type cone was utilized at this site. The 20-ton cone has a tip area (A_c) of 15cm^2 and a friction sleeve area of 225cm^2. A pore water pressure transducer and filter is located directly behind the cone tip. The 5.0 mm filter element is composed of a porous plastic and is saturated in glycerin under vacuum pressure prior to use. An illustration of the cone is shown in Figure 1.

The GREGG IN SITU cone is designed with an equal end area friction sleeve and a tip net area ratio, a, of 0.85 (based on A_c equal to 15cm^2). The net area ratio, a, has been verified in the laboratory by subjecting the cone to a known pressure then measuring the load recorded on the tip. The net area ratio can then be calculated by dividing the measured pressure on the tip by the known applied pressure.

The cone is capable of recording the following parameters at 2.5-cm depth intervals:

Tip Resistance	(q_c)
Sleeve Friction	(f_s)
Dynamic Pore Pressure	(u_2)

Due to the inner geometry of the cone, the measured tip resistance (q_c) is influenced by the ambient pore water pressure. This effect is commonly referred to as the "unequal area effect." Therefore, a corrected total cone tip resistance (q_t) is utilized for CPT correlations, where:

$$q_t = q_c + (1-a) \times u_2$$

where: q_c is the recorded tip stress
a is the net area ratio (Based on Laboratory Measurements)
u_2 is the dynamic pore pressure measured just behind the tip

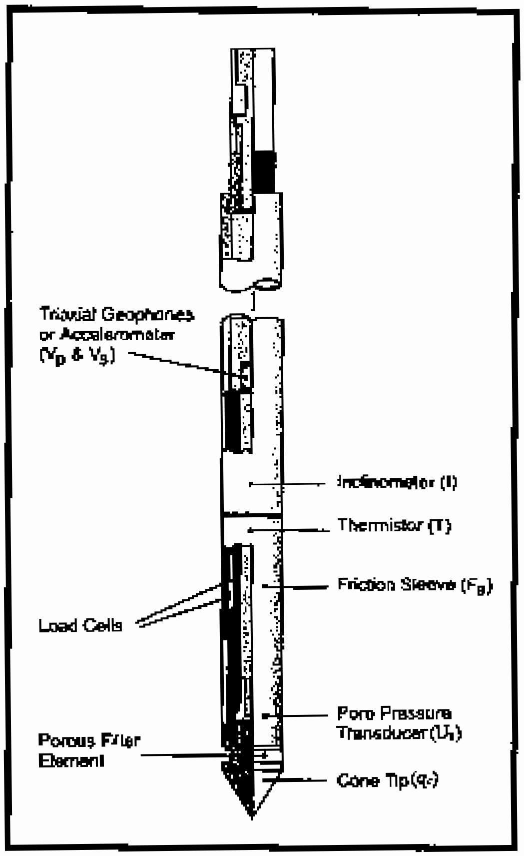


Figure 1
Gregg In Situ Cone Penetrometer
(Type 2 Shoulder Cone)

Complete sets of baseline readings were taken prior to and after the sounding to determine temperature shifts and any zero load offsets. Establishing temperature shifts and load offsets enables corrections to be made to the cone data where necessary.

The CPT soundings were advanced using GREGG IN SITU's 25 ton CPT rig and associated tooling.

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 CPT Data

The CPT testing program has been summarized in Table 1.

Table 1
CPT Testing Summary

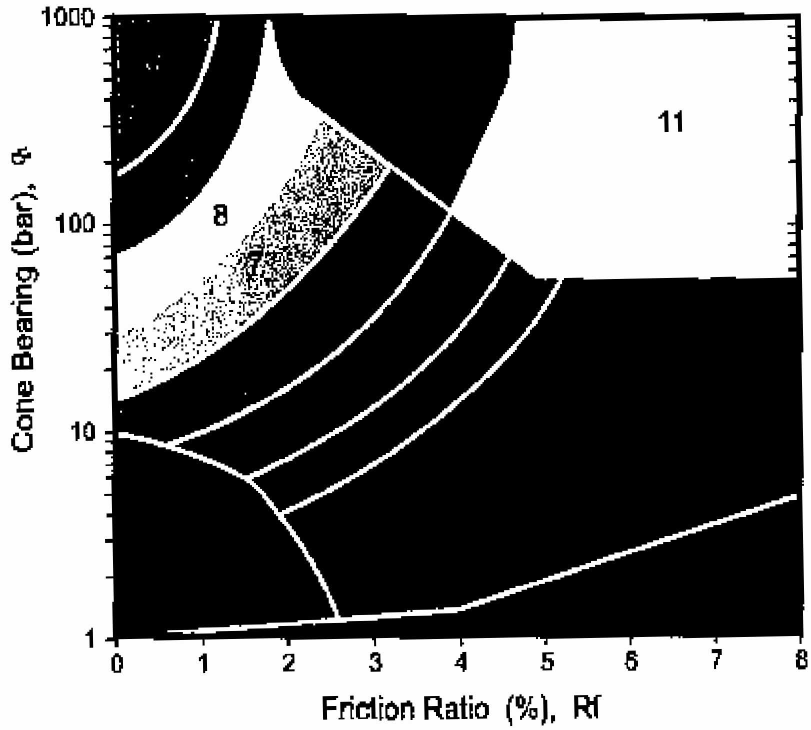
Sounding Number	Sounding Date	Total Depth (Feet)	Tested Parameters
CPT-01	3/28/03	31.17	q_c, f_s, u
CPT-02	3/26/03	9.43	q_c, f_s, u
CPT-02A	3/27/03	9.27	q_c, f_s, u
CPT-02B	3/28/03	31.41	q_c, f_s, u
CPT-03	3/27/03	33.71	q_c, f_s, u
CPT-04	3/27/03	39.78	q_c, f_s, u
CPT-05	3/27/03	41.26	q_c, f_s, u
CPT-06	3/27/03	32.97	q_c, f_s, u
CPT-07	3/27/03	32.97	q_c, f_s, u
CPT-07A	3/28/03	33.46	q_c, f_s, u
CPT-08	3/27/03	32.89	q_c, f_s, u
CPT-09	3/24/03	39.53	q_c, f_s, u
CPT-10	3/24/03	41.75	q_c, f_s, u
CPT-11	3/24/03	4.10	q_c, f_s, u
CPT-11A	3/24/03	41.34	q_c, f_s, u
CPT-12	3/25/03	39.29	q_c, f_s, u
CPT-13	3/25/03	39.45	q_c, f_s, u
CPT-14	3/25/03	6.73	q_c, f_s, u
CPT-14A	3/25/03	37.57	q_c, f_s, u
CPT-15	3/28/03	36.66	q_c, f_s, u
CPT-16	3/25/03	39.21	q_c, f_s, u
CPT-17	3/25/03	29.86	q_c, f_s, u
CPT-17A	3/25/03	39.37	q_c, f_s, u

Sounding Number	Sounding Date	Total Depth (Feet)	Tested Parameters
CPT-18	3/25/03	38.96	q_c, f_s, u
CPT-19	3/26/03	40.76	q_c, f_s, u
CPT-20	3/26/03	40.27	q_c, f_s, u
CPT-21	3/26/03	40.68	q_c, f_s, u
CPT-22	3/26/03	3.28	q_c, f_s, u
CPT-22A	3/26/03	39.21	q_c, f_s, u
CPT-23	3/28/03	40.19	q_c, f_s, u
CPT-24	3/26/03	33.87	q_c, f_s, u
CPT-24A	3/26/03	3.20	q_c, f_s, u
CPT-25	3/26/03	31.25	q_c, f_s, u

The cone penetration test data and pore pressure measurements are presented in graphical form in Appendix A. Penetration depths are referenced to the existing ground surface at the time of the investigation.

The inferred stratigraphic profile at each CPT test location is included with this report. The stratigraphic soil type behavior interpretations are based on relationships between q_t, f_s, and u_2. The friction ratio (f_s/q_t) is a calculated parameter that is indicative of soil behavior and is therefore used to identify the soil behavior type.

Generally, cohesive soils have high friction ratios, low cone bearing and generate large excess pore water pressures. Cohesionless soils have lower friction ratios, high cone bearing and generate little in the way of excess pore water pressures. In this report, the classification of soils is based on the correlations developed by Robertson (1990) shown in Figure 2.



Zone		q_t/N	Soil Behaviour Type
1	■	2	sensitive fine grained
2	■	1	organic material
3	■	1	clay
4	■	1.5	silty clay to clay
5	■	2	clayey silt to silty clay
6	■	2.5	sandy silt to clayey silt
7	▒	3	silty sand to sandy silt
8		4	sand to silty sand
9	■	5	sand
10	■	6	gravelly sand to sand
11		1	very stiff fine grained *
12	■	2	sand to clayey sand *

* overconsolidated or cemented

Figure 2
Soil Behavior Type Classification Chart
(Robertson 1990)

3.2 PORE PRESSURE DISSIPATION TEST RESULTS

Pore water pressures are monitored in order to measured hydrostatic water pressures and approximate the depth to the groundwater table. Pore pressure dissipations were automatically recorded at 5-second intervals and where appropriate during pauses in the penetration. Complete dissipations were conducted at selected depths. The select pore pressure dissipations conducted as part of this investigation are included in Appendix B.

Pore pressure dissipations conducted in sounding CPT-09 at a depth of 39.53 feet and sounding CPT-24 at a depth of 8.04 feet appear to be influenced from the slurry wall material. For such tests the pore pressure exerted on the filter element can be reported, however interpretation of hydrostatic conditions cannot be conducted without knowing the unit weight of the slurry wall material. Due to the properties of the slurry wall material these tests do not behave within the realm of soil mechanics but fluid mechanics. In cases such as these GREGG recommends further analysis of dissipations conducted on the upstream side of the wall to evaluate the stability of the wall.

3.3 CPT INTERPRETATION SUMMARY

The data diskette in Appendix D presents a generalized summary of the soil parameters with respect to depth. These methods are based on general geotechnical engineering principles and current literature being published in the discipline of CPT technologies. A listing of definitions and interpretation methodologies is presented in the Appendix C.

The interpretations of soils encountered are conducted using correlations developed by Robertson 1990. It should be noted that it is not always possible to clearly identify a soil type based on q_c, f_s and u. In these situations, experience and judgement and an assessment of the pore pressure dissipation test data should be used to infer the soil behavior type.

4.0 DATA DISKETTE

The enclosed data diskette contains the data files recorded and generated for this testing program. The following table details the different files.

Files on Data Diskette

File Extension	File Description
COR	Gregg format CPT file: Column 1: Depth (m) Column 2: Tip Resistance – qc (tsf) Column 3: Sleeve Friction – fs (tsf) Column 4: Dynamic Pore Pressure – u (psi)
PPD	Pore pressure dissipation file
IFI	Interpretation output file

These files and parameters were generated for 044CP01.*, 044CP02.*, etc. The Data Diskette is included in Appendix D.

APPENDIX A

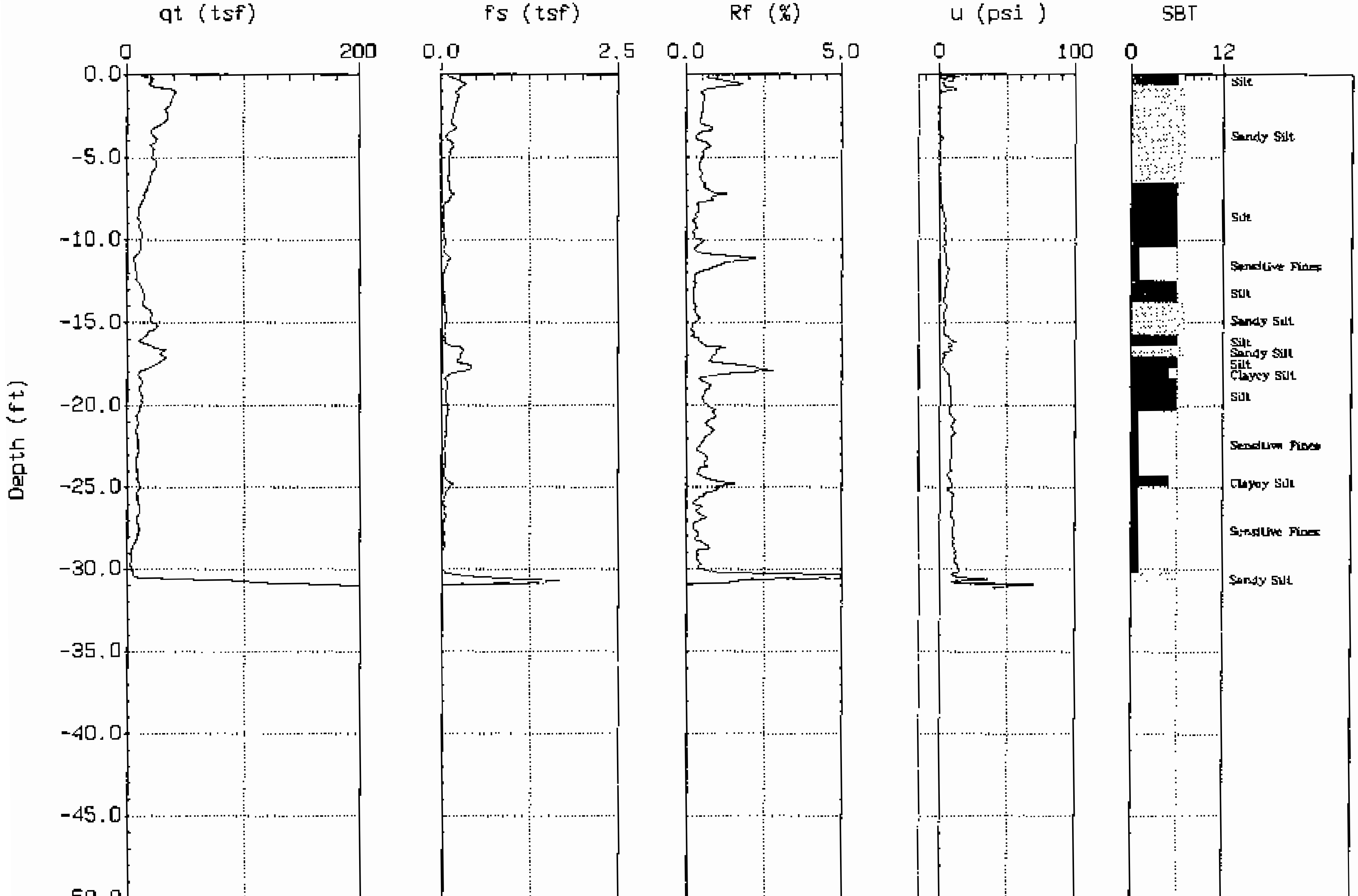
STANDARD CPT PLOTS

GREGG

Withers & Ravenel

Sounding: CPT-01
Location: Canadys, SC

Oversite: S. Bray
Date: 03:28:03 13:15



Max. Depth: 31.17 (ft)

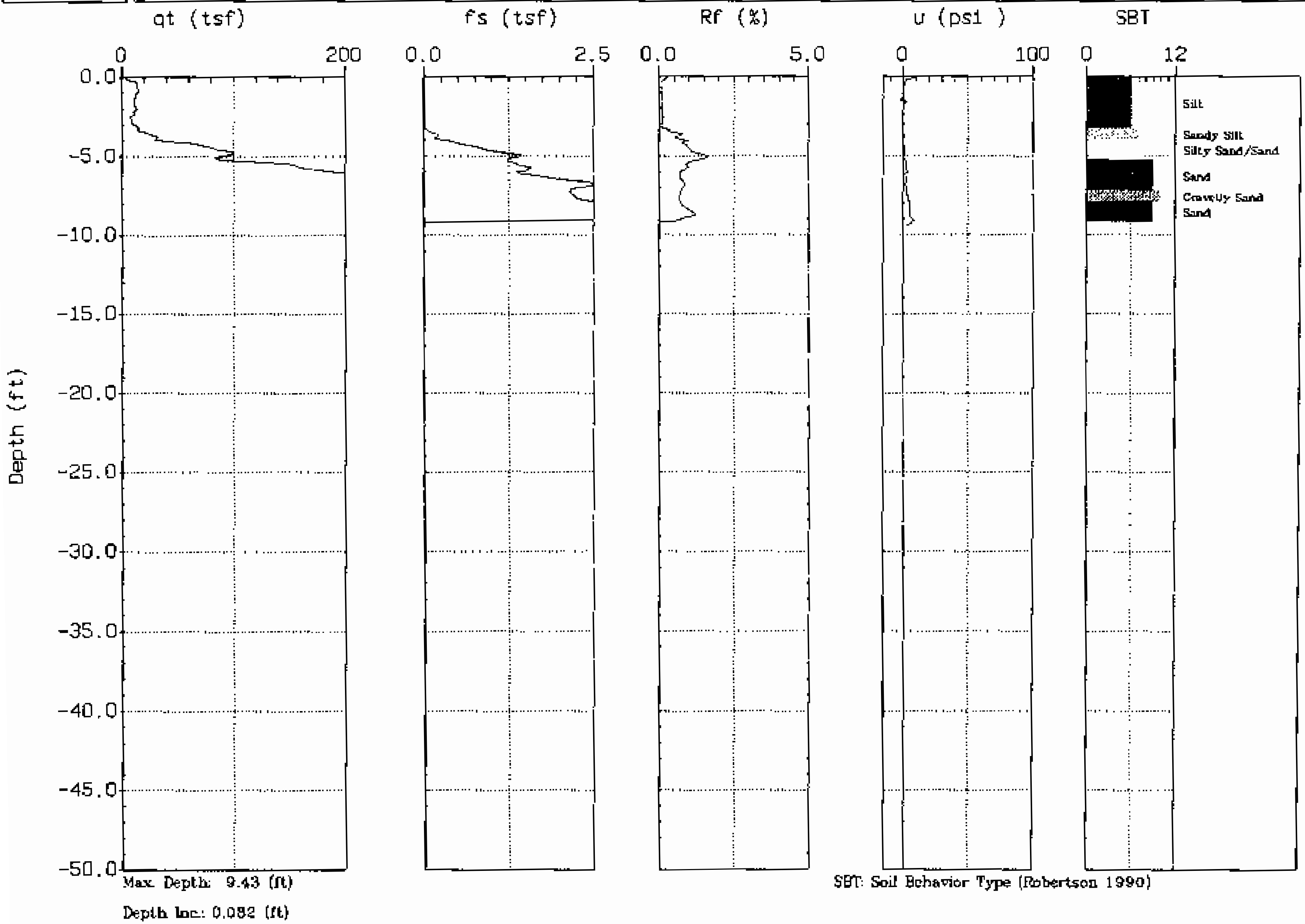
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-02
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 18:00

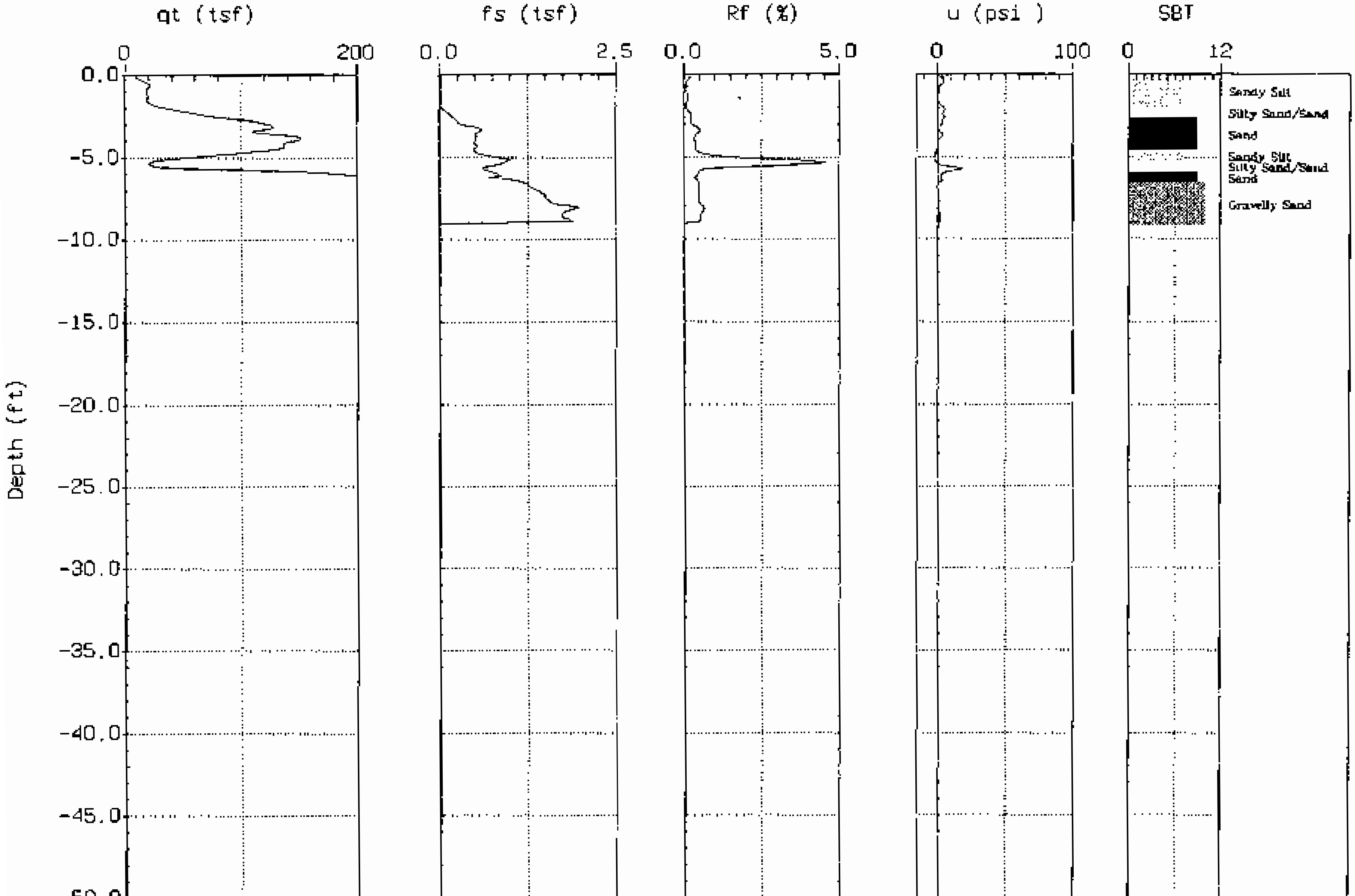


GREGG

Withers & Ravenel

Sounding: CPT-029
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 09:02



Max. Depth: 9.27 (ft)

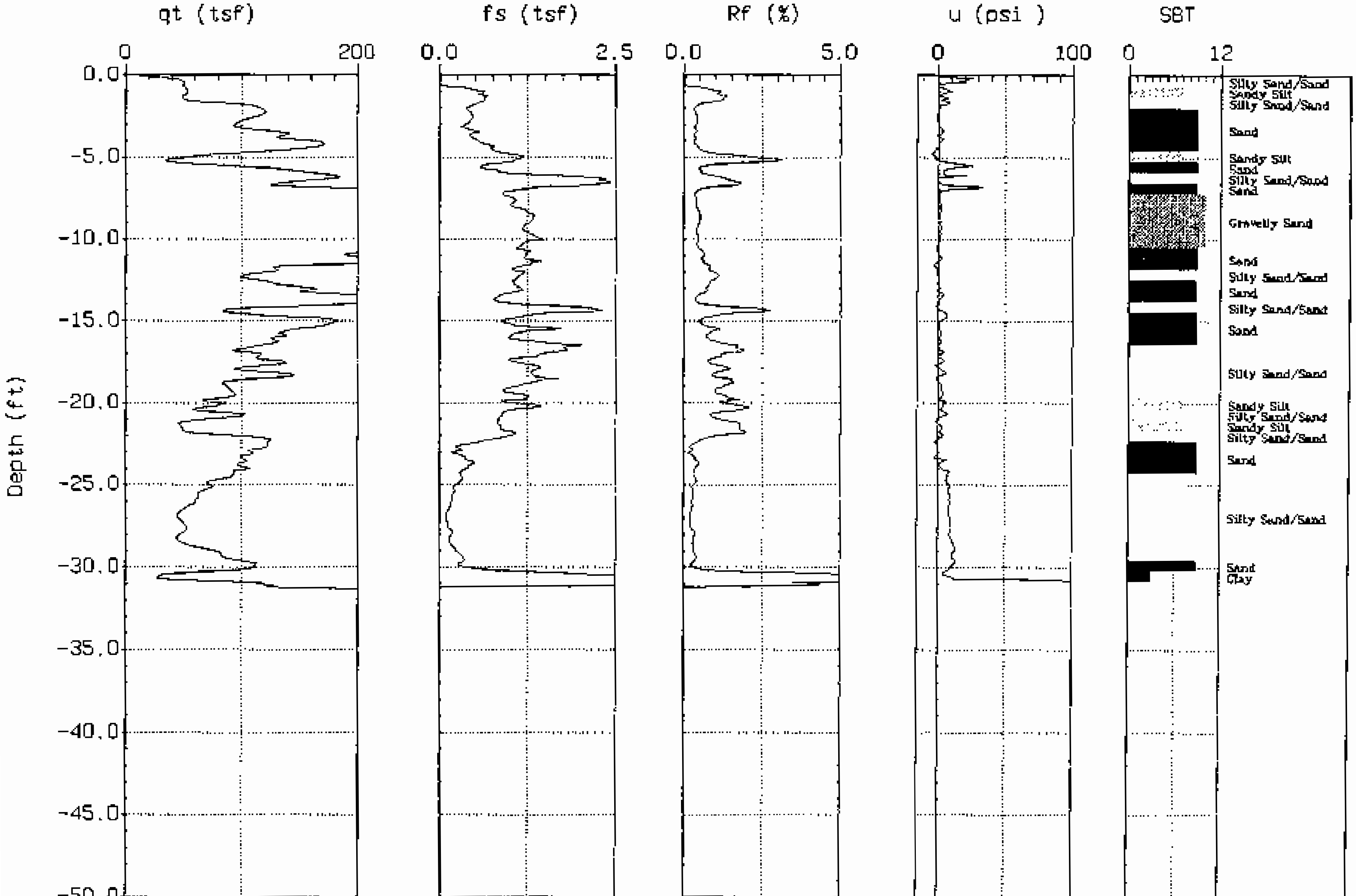
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-028
Location: Canadys, SC

Oversite: S. Bray
Date: 03:28:03 14:20



Max. Depth: 31.41 (ft)

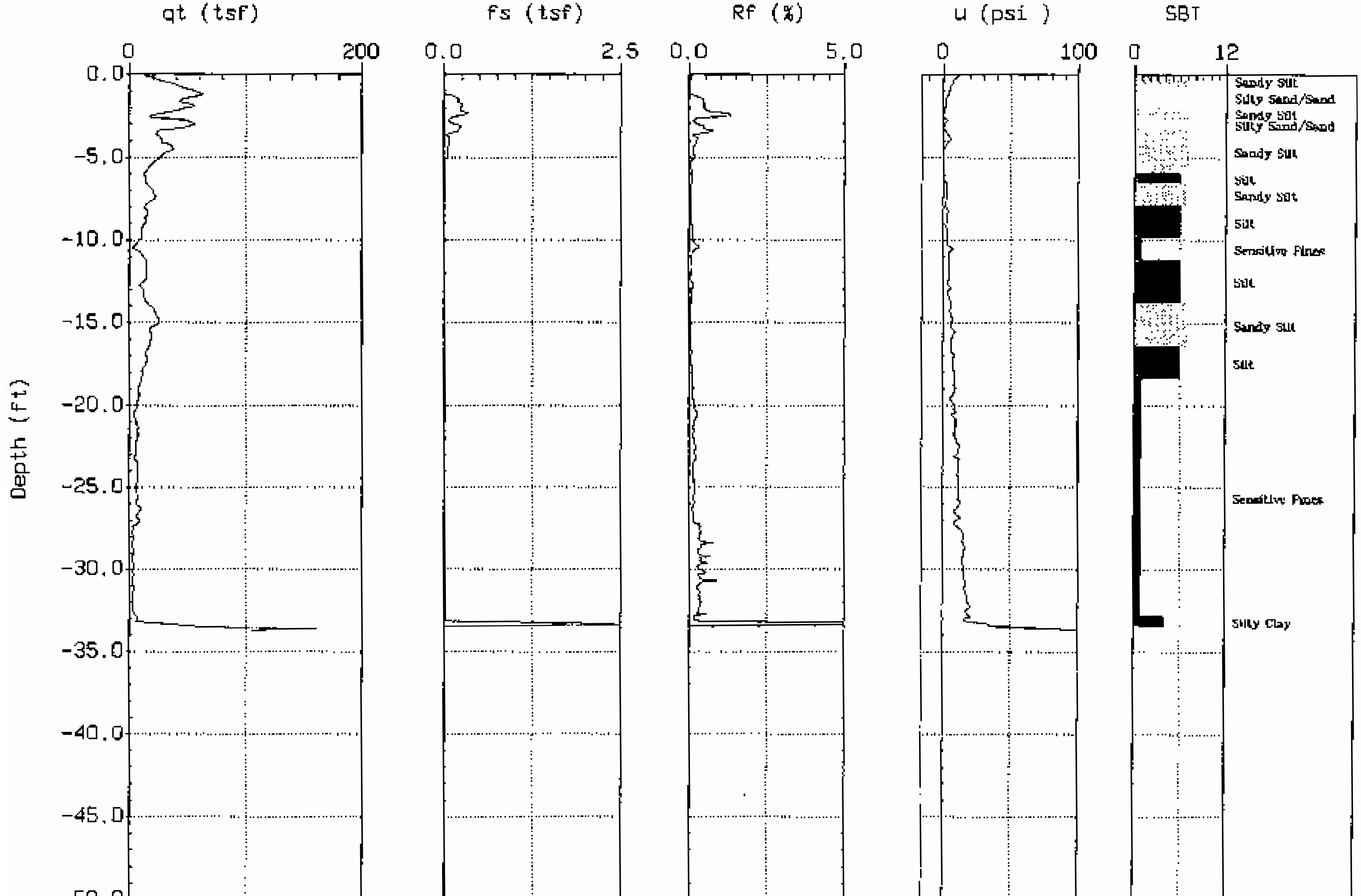
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-03
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 09:38



Max. Depth: 33.71 (ft)

Depth Inc.: 0.082 (ft)

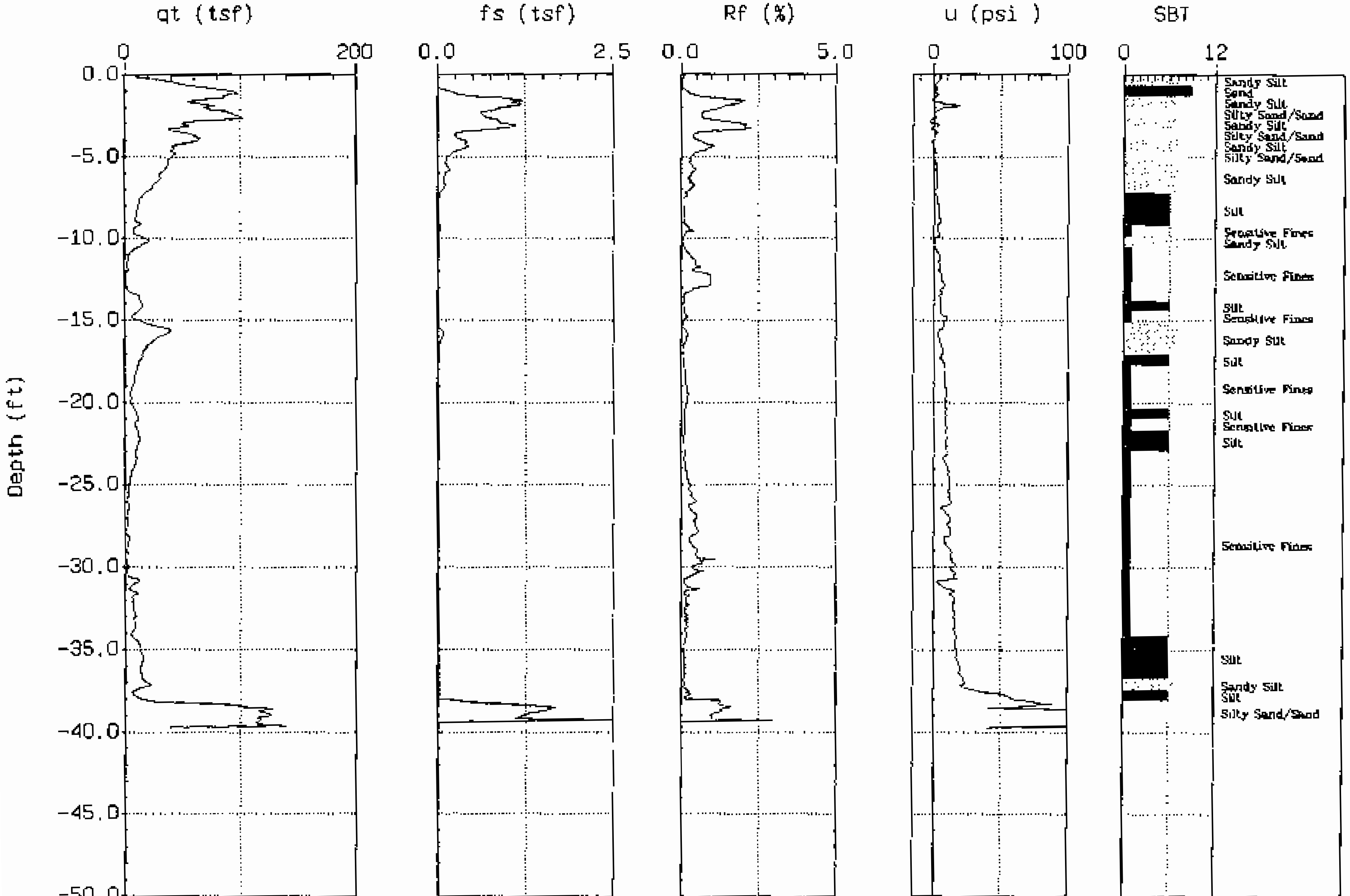
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-04
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 11:47



Max. Depth: 39.78 (ft)

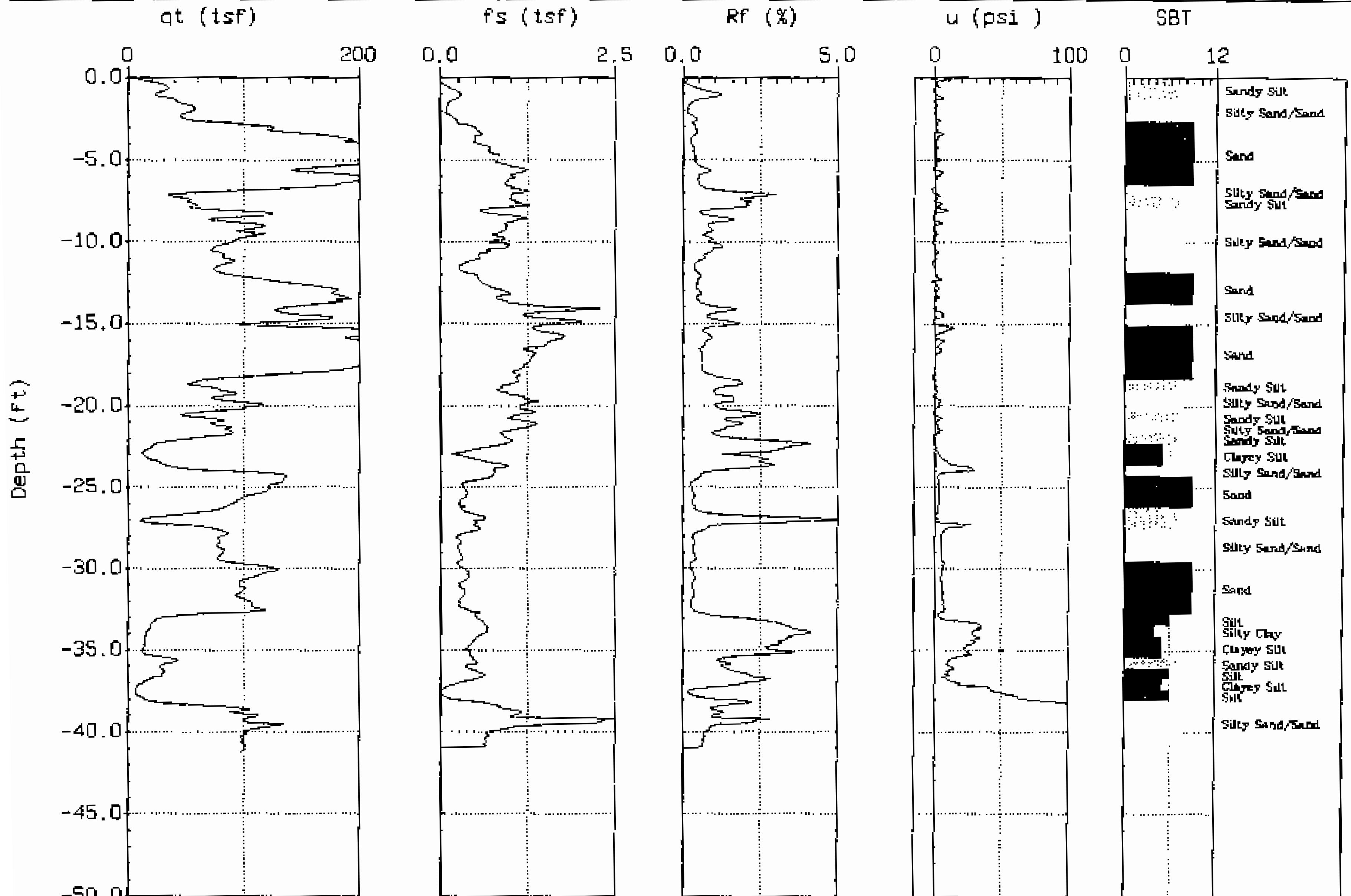
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-05
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 14:02



Max. Depth: 41.26 (ft)

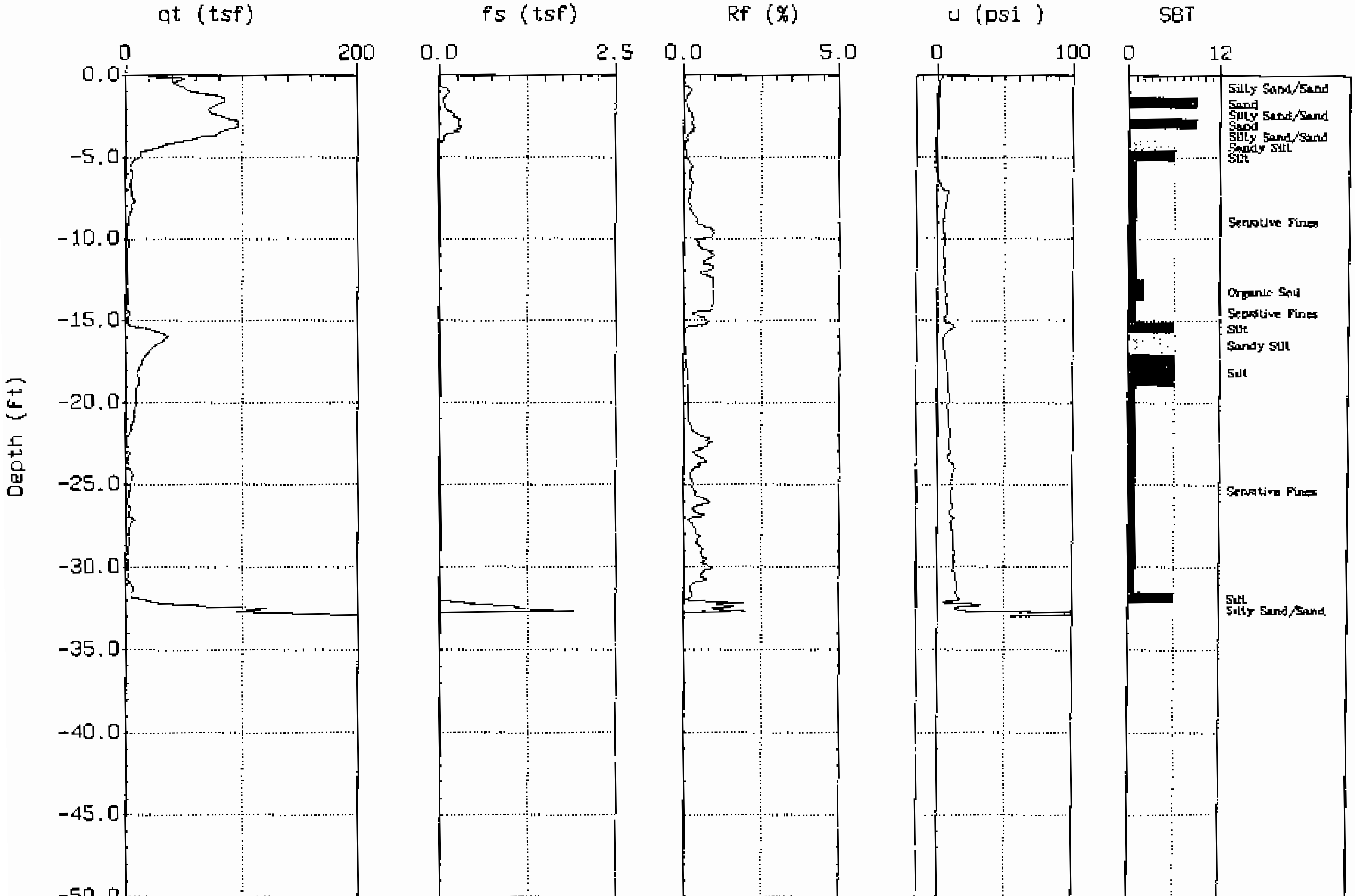
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-06
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 14:51



Max. Depth: 32.97 (ft)

Depth Inc.: 0.082 (ft)

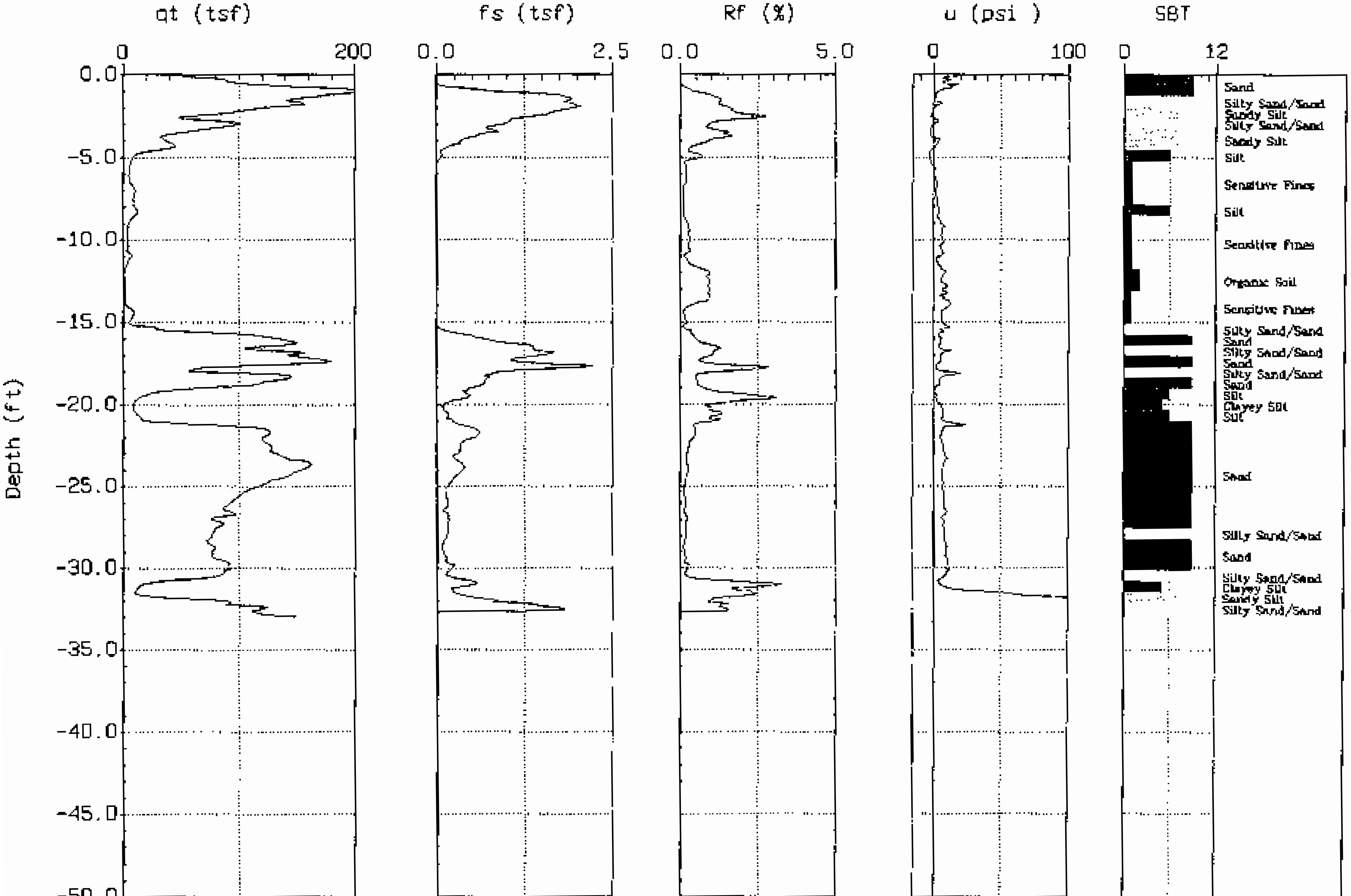
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-07
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 16:35



Max. Depth: 32.97 (ft)

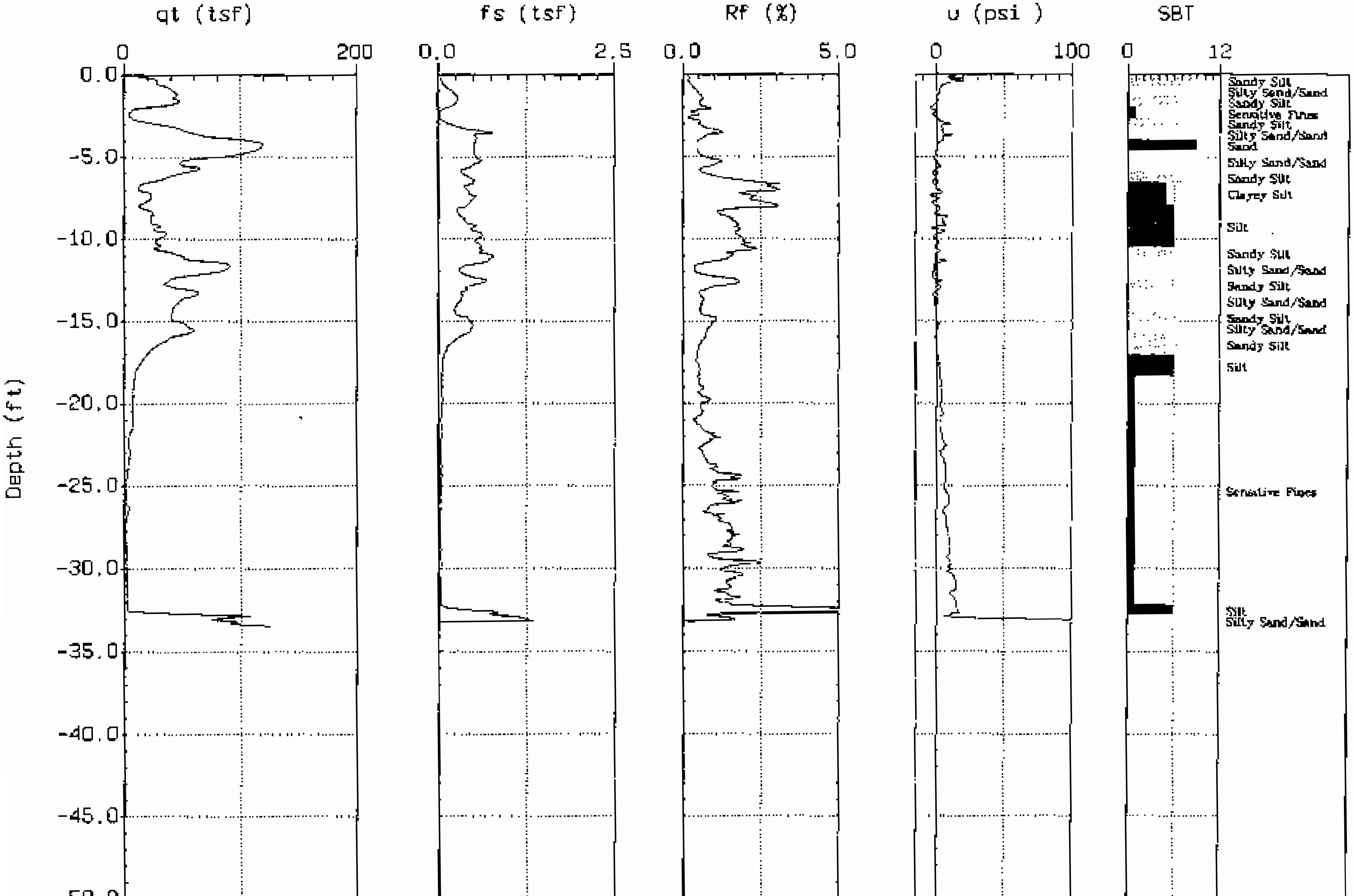
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-07A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:28:03 08:20



Max. Depth: 33.46 (ft)

Depth Inc.: 0.082 (ft)

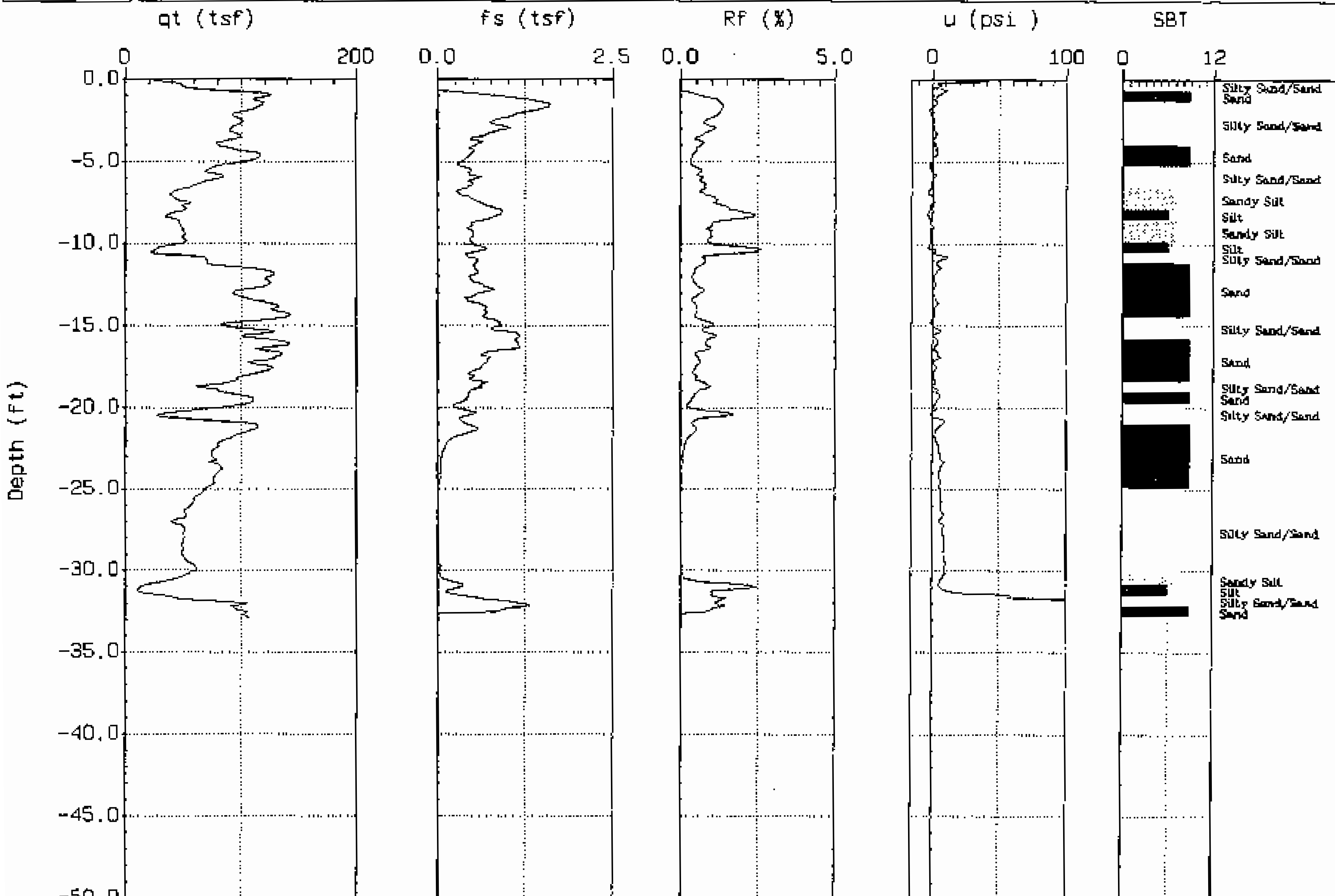
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-08
Location: Canadys, SC

Oversite: S. Bray
Date: 03:27:03 17:20



Max. Depth: 32.89 (ft)

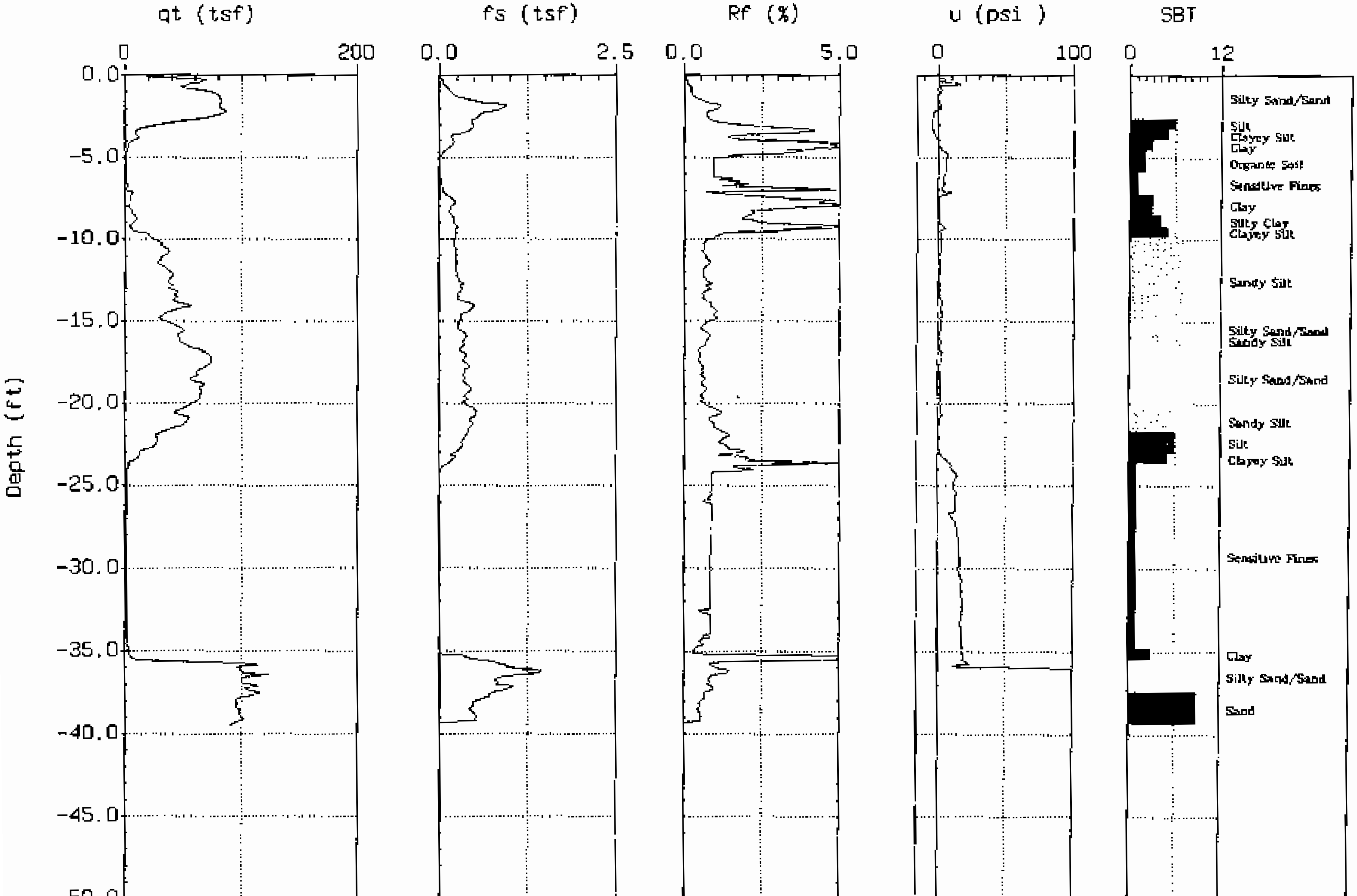
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-09
Location: Canadys, SC

Oversite: S. Bray
Date: 03:24:03 13:55



Max. Depth: 39.53 (ft)

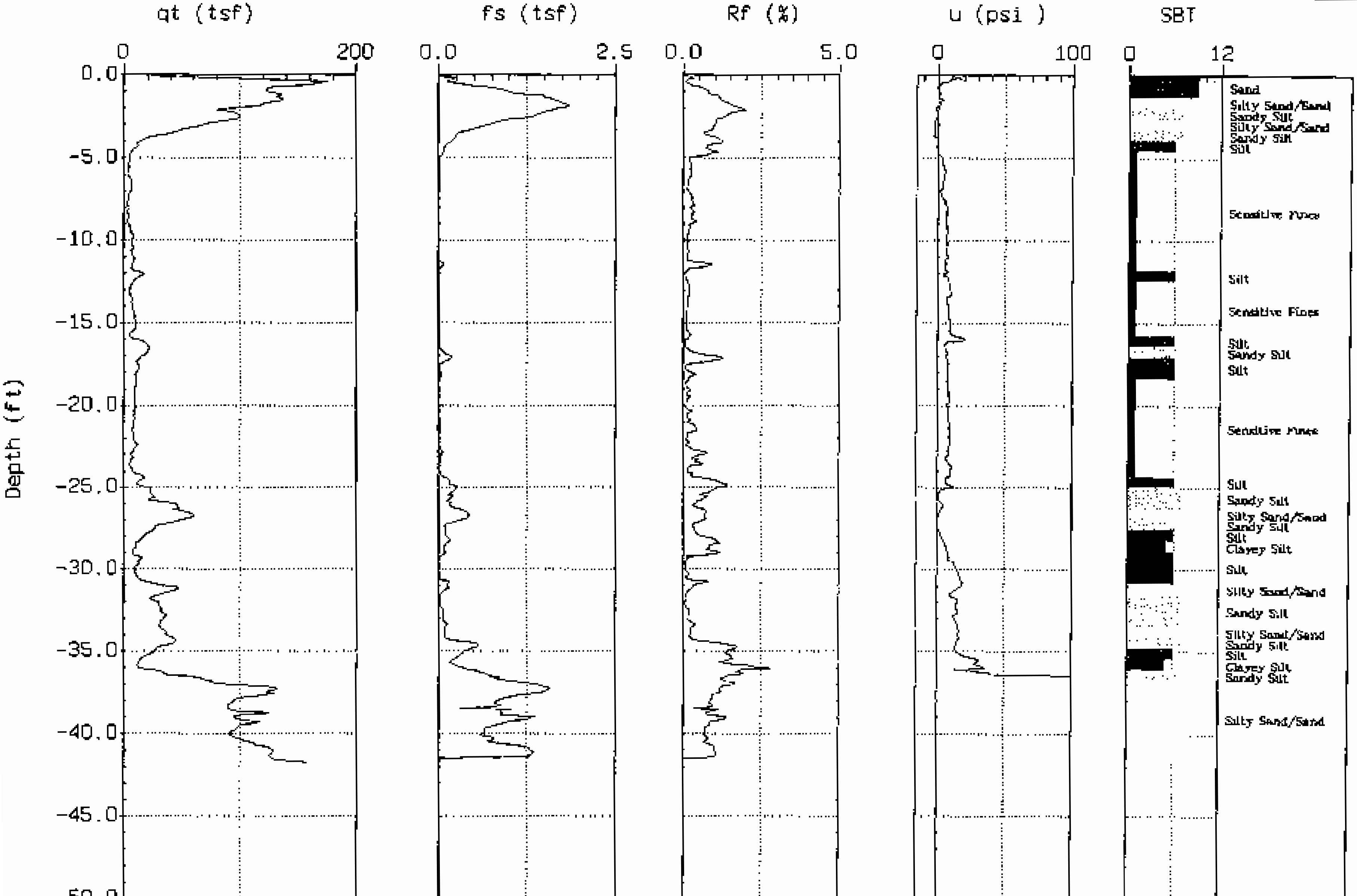
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-10
Location: Canadys, SC

Oversite: S. Bray
Date: 03:24:03 15:11



Max. Depth: 41.75 (ft)

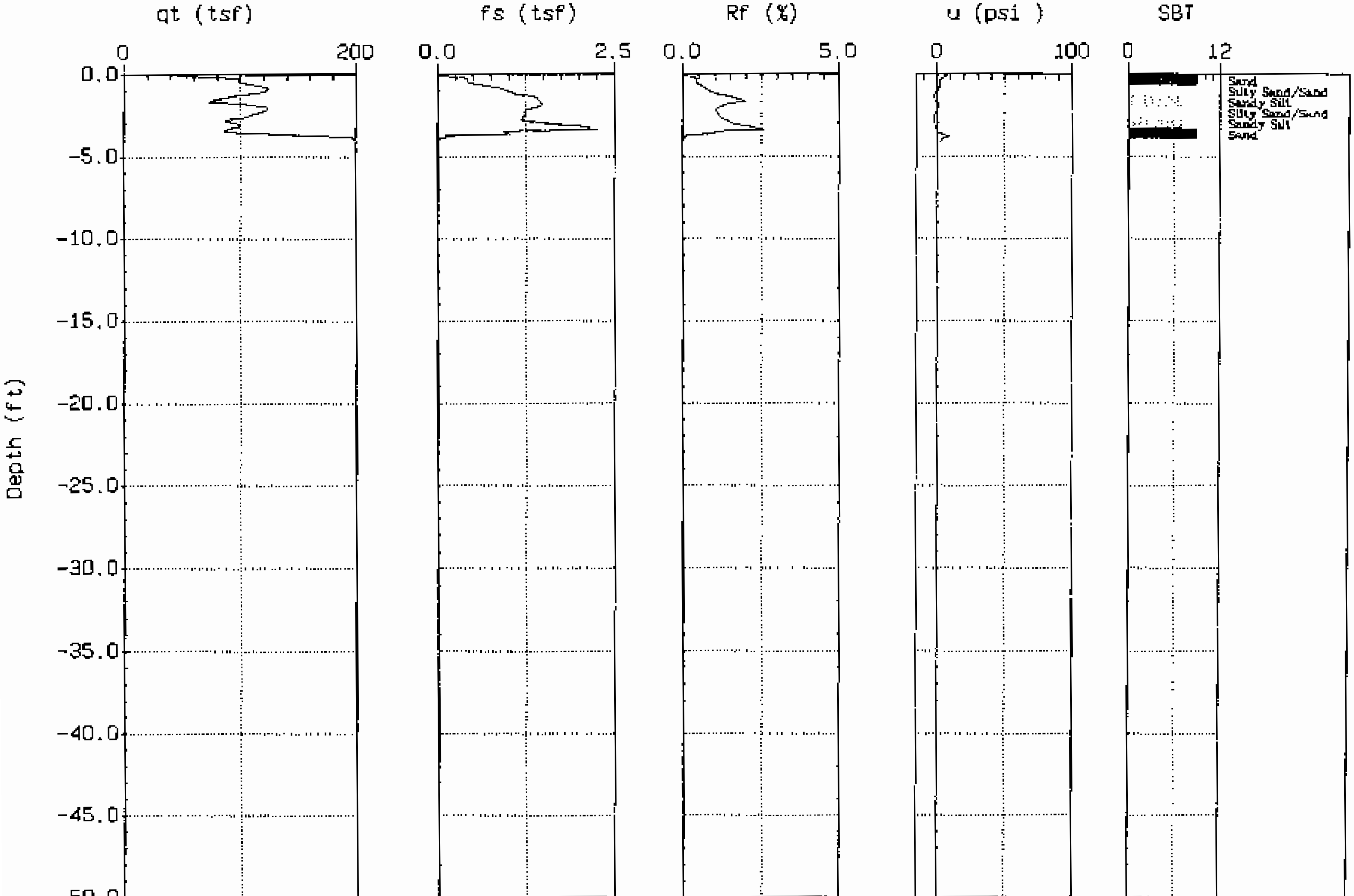
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-11
Location: Canadys, SC

Oversite: S. Bray
Date: 03:24:03 16:15



Max. Depth: 4.10 (ft)
Depth Inc: 0.082 (ft)

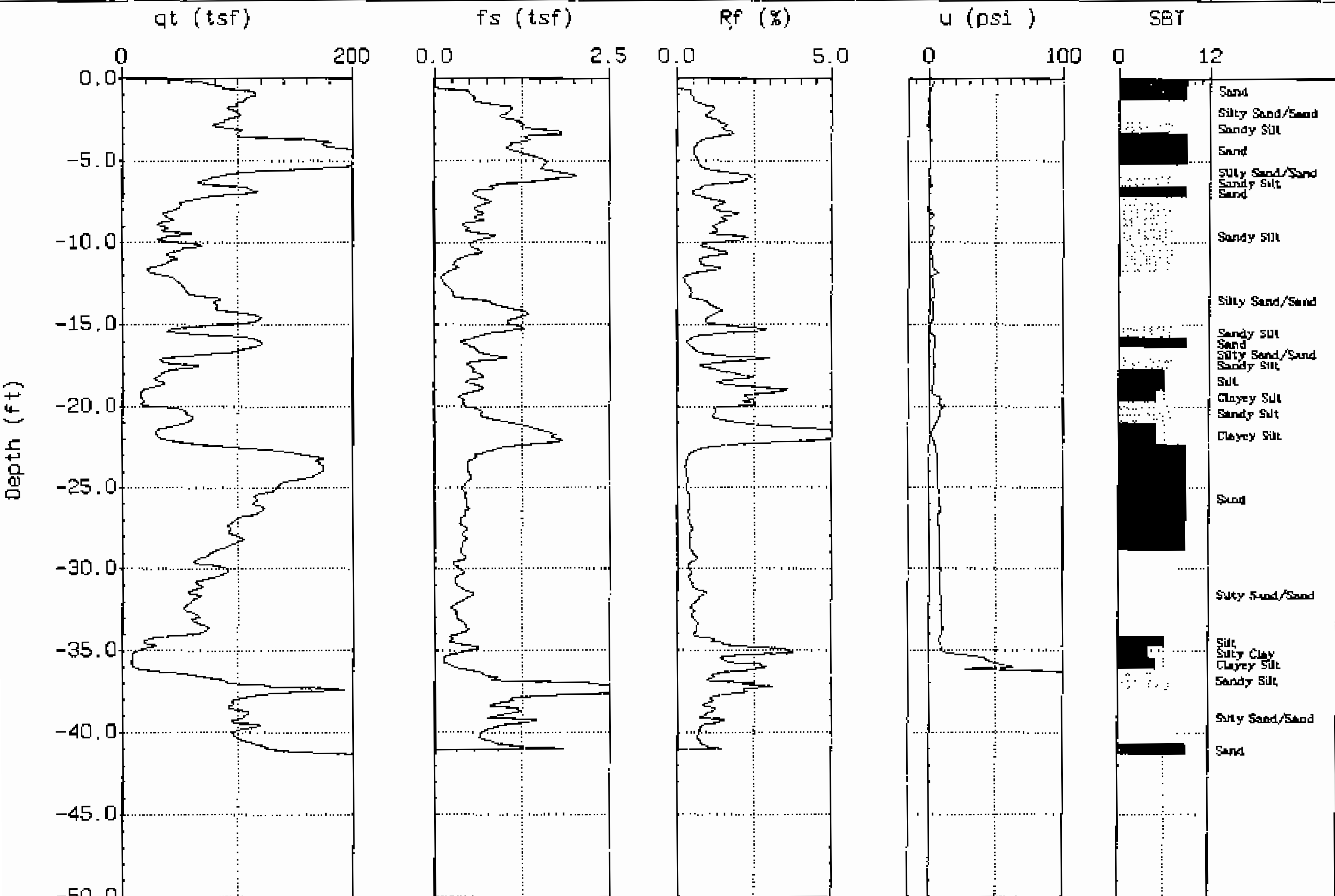
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-11A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:24:03 16:43



Max. Depth: 41.34 (ft)

Depth Inc.: 0.082 (ft)

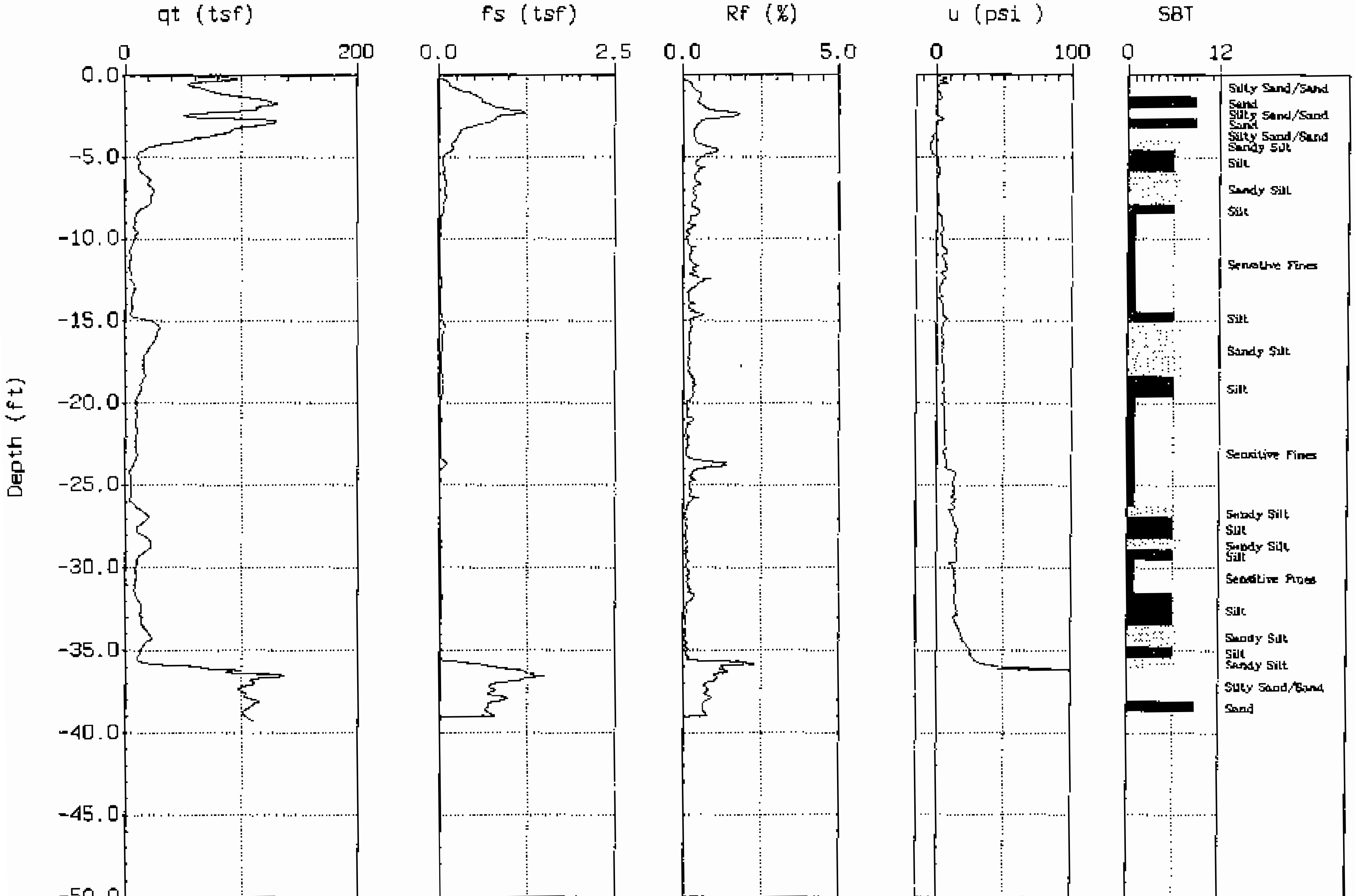
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-12
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 08:20



Max. Depth: 39.29 (ft)

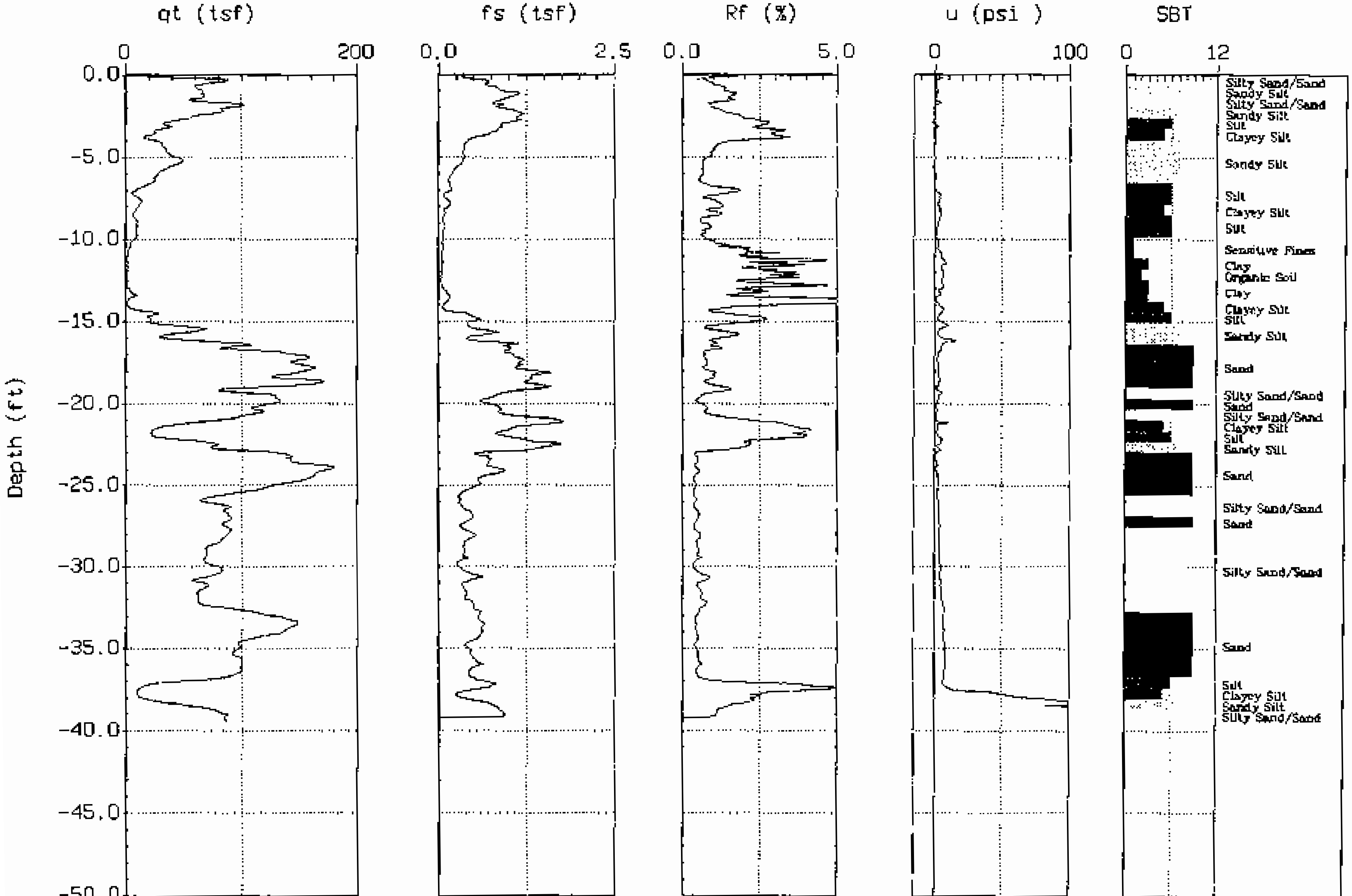
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-13
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 09:22



Max. Depth: 39.45 (ft)

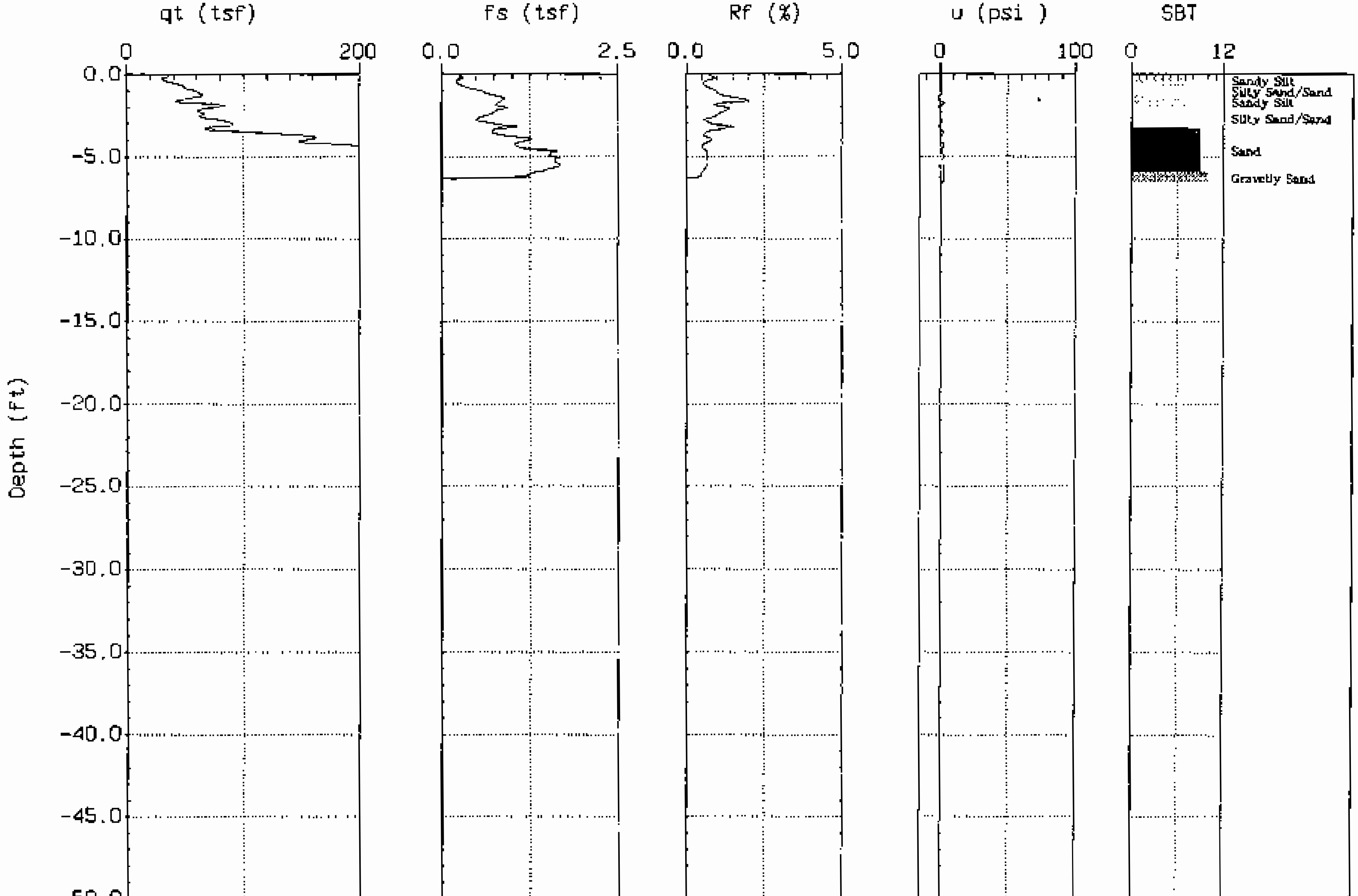
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-14
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 10:14



Max. Depth: 6.73 (ft)

Depth Inc: 0.082 (ft)

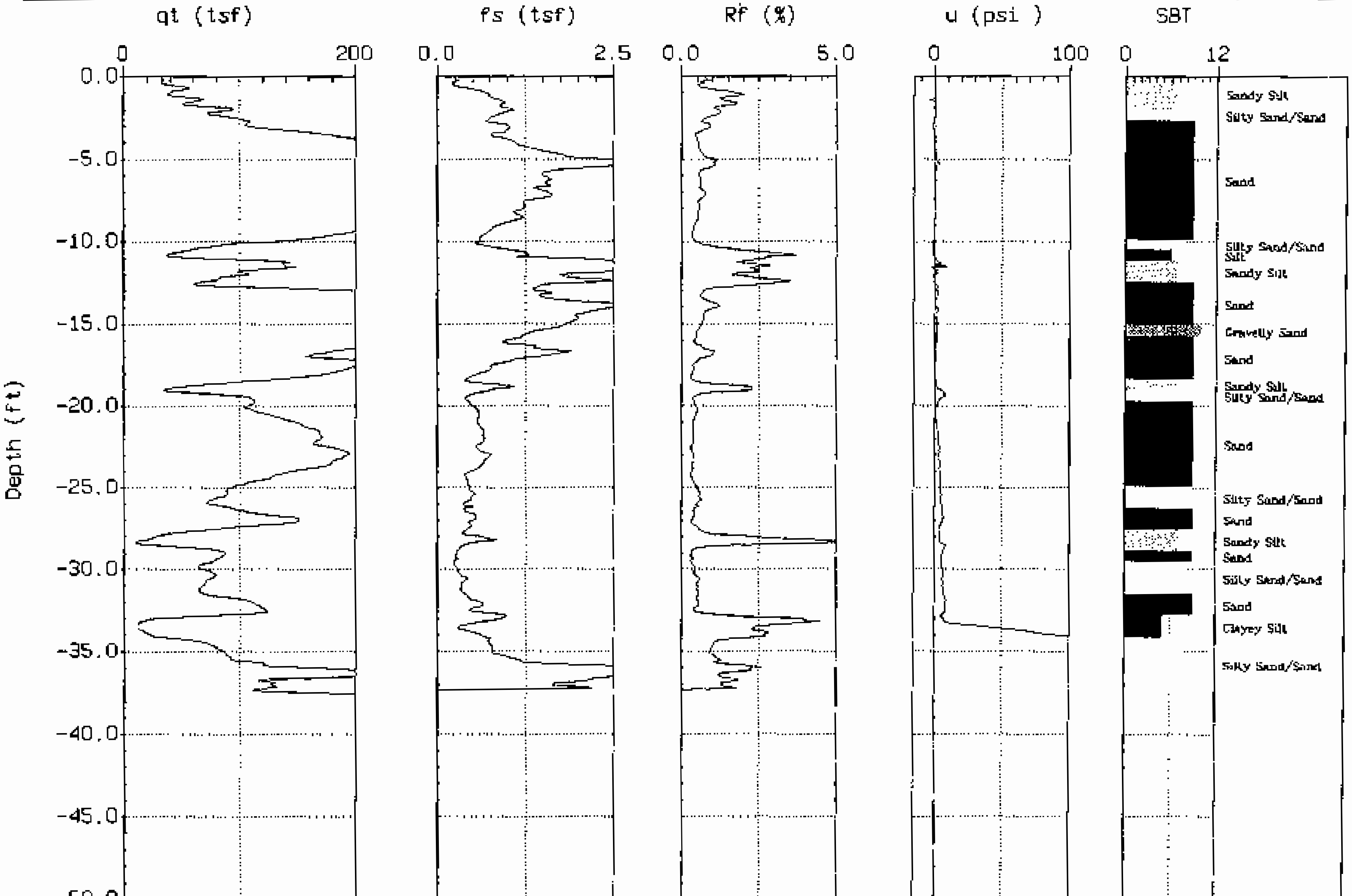
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-14A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 10:34



Max. Depth: 37.57 (ft)

Depth Inc: 0.082 (ft)

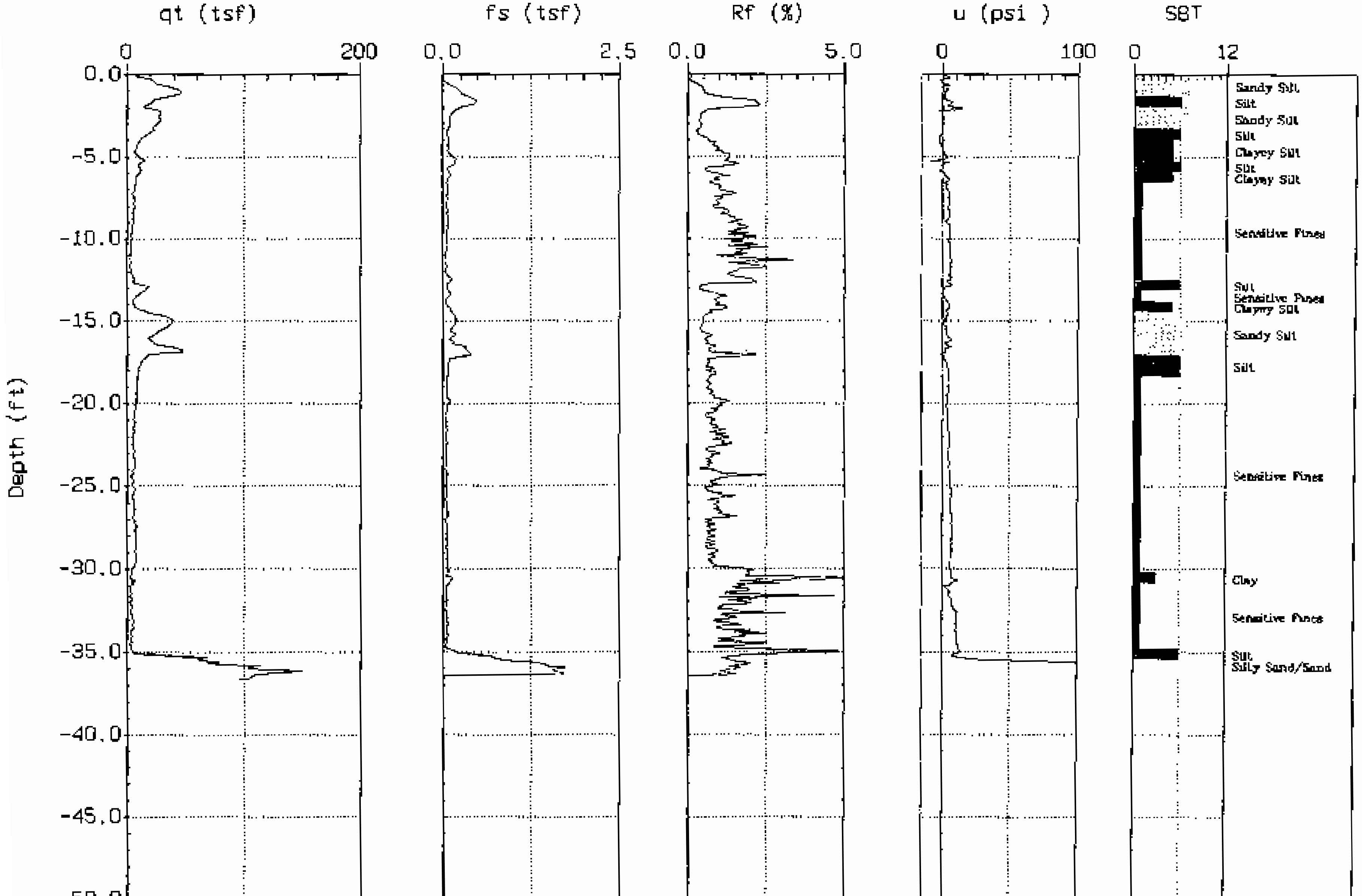
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-15
Location: Canadys, SC

Oversite: S. Bray
Date: 03:28:03 09:36



Max. Depth: 36.66 (ft)

Depth Inc.: 0.082 (ft)

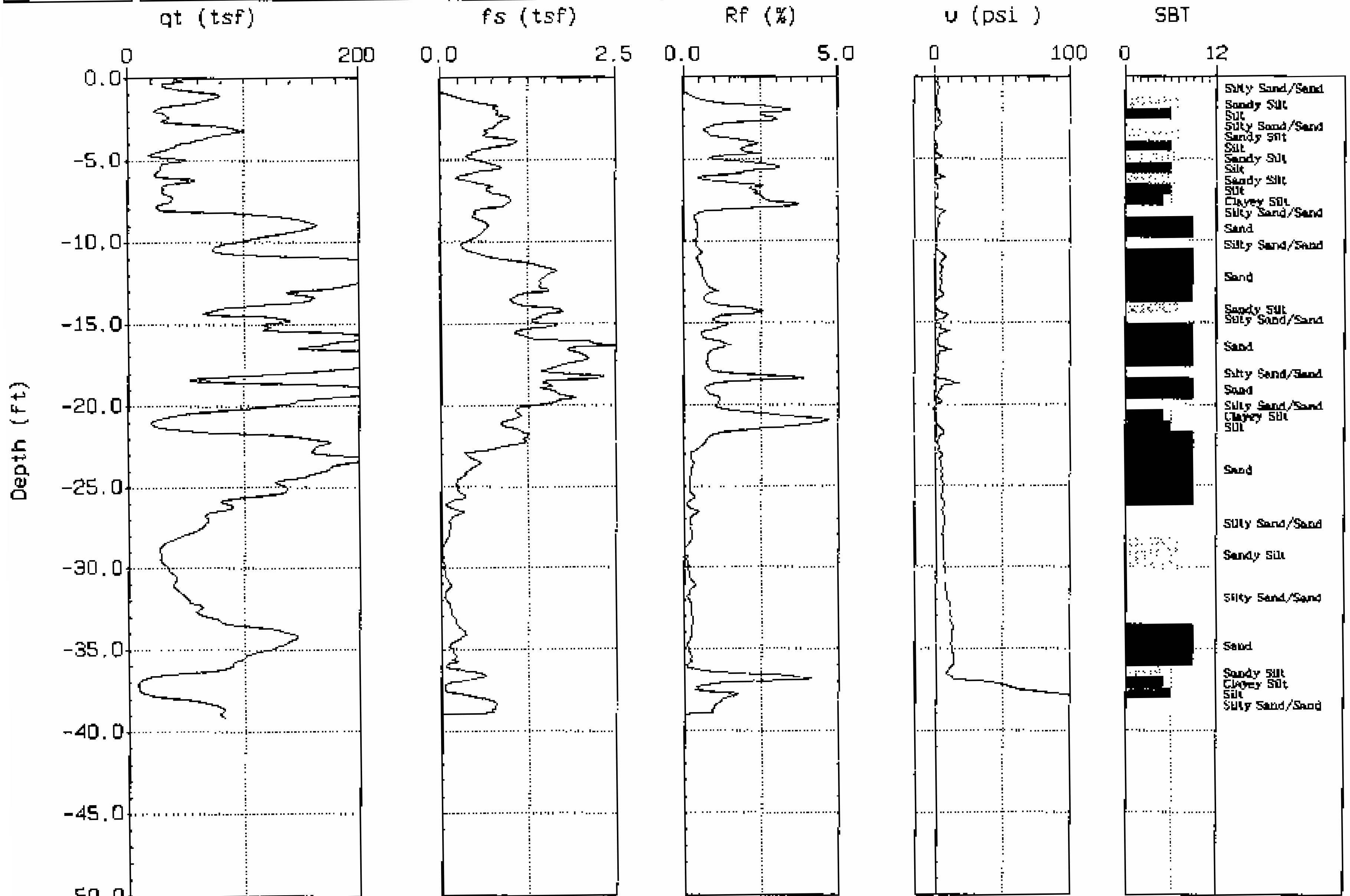
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-16
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 13:56



Max. Depth: 39.21 (ft)

Depth Inc: 0.082 (ft)

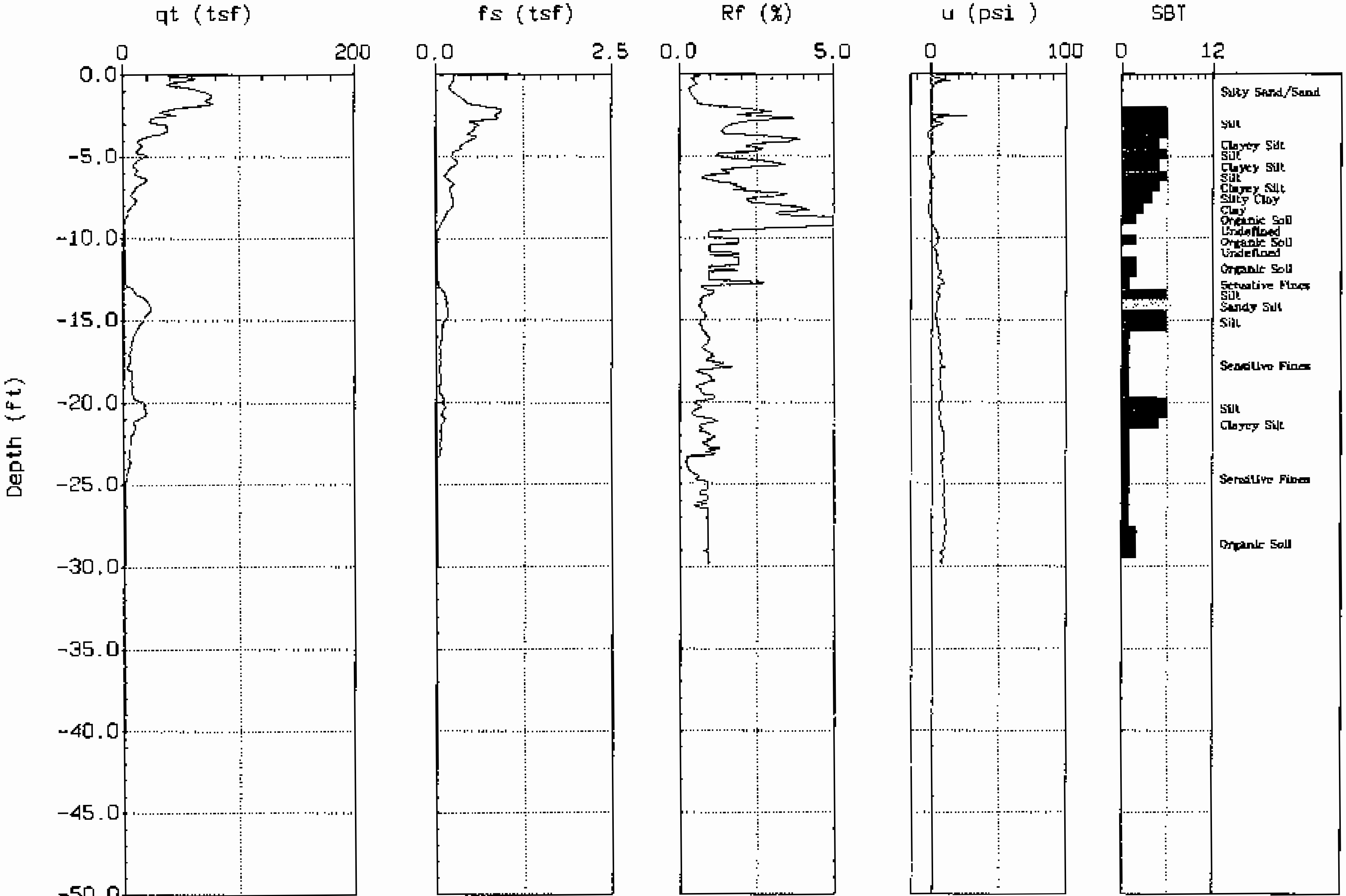
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-17
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 11:37



Max. Depth: 29.86 (ft)
Depth Inc.: 0.082 (ft)

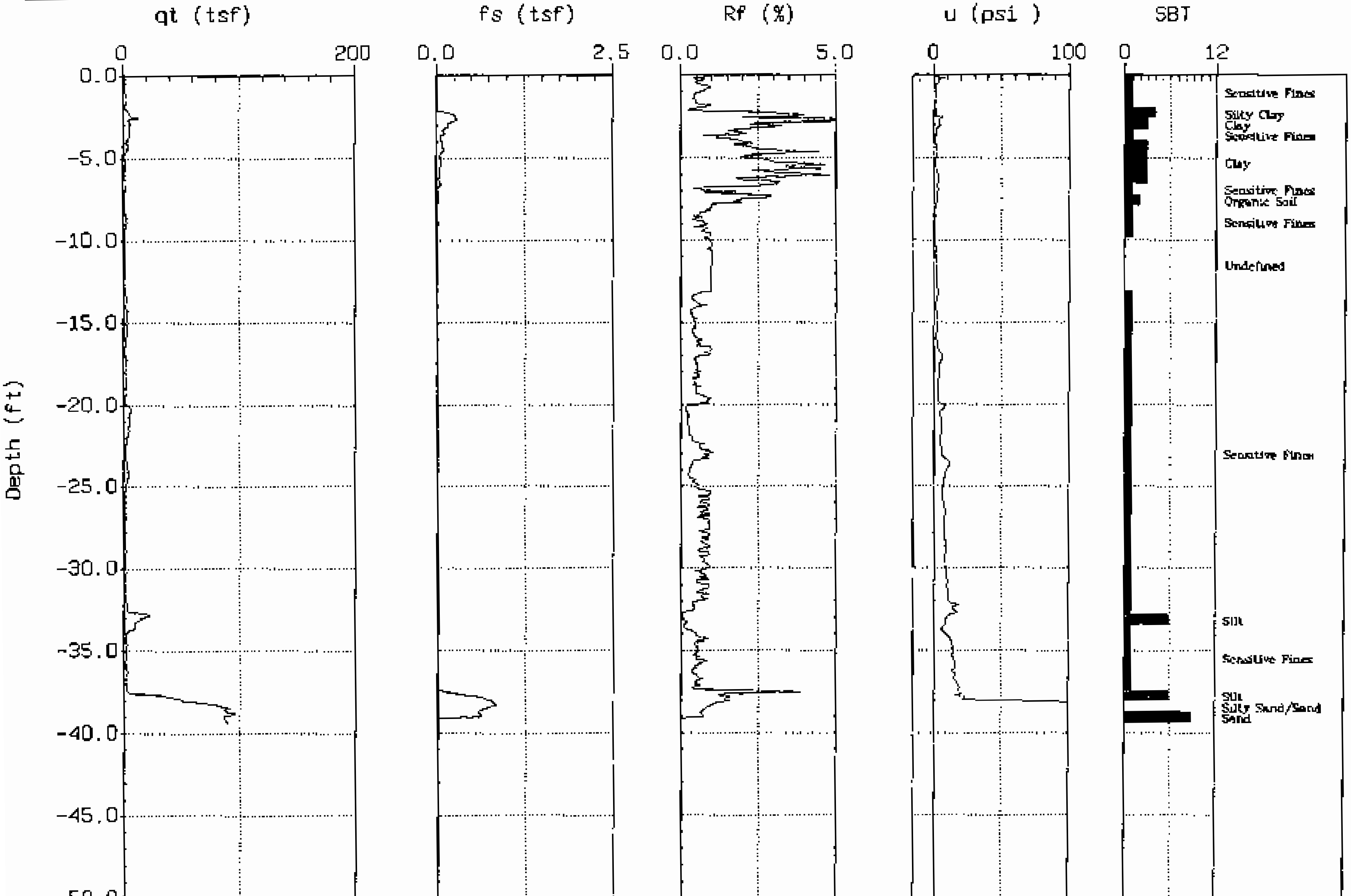
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

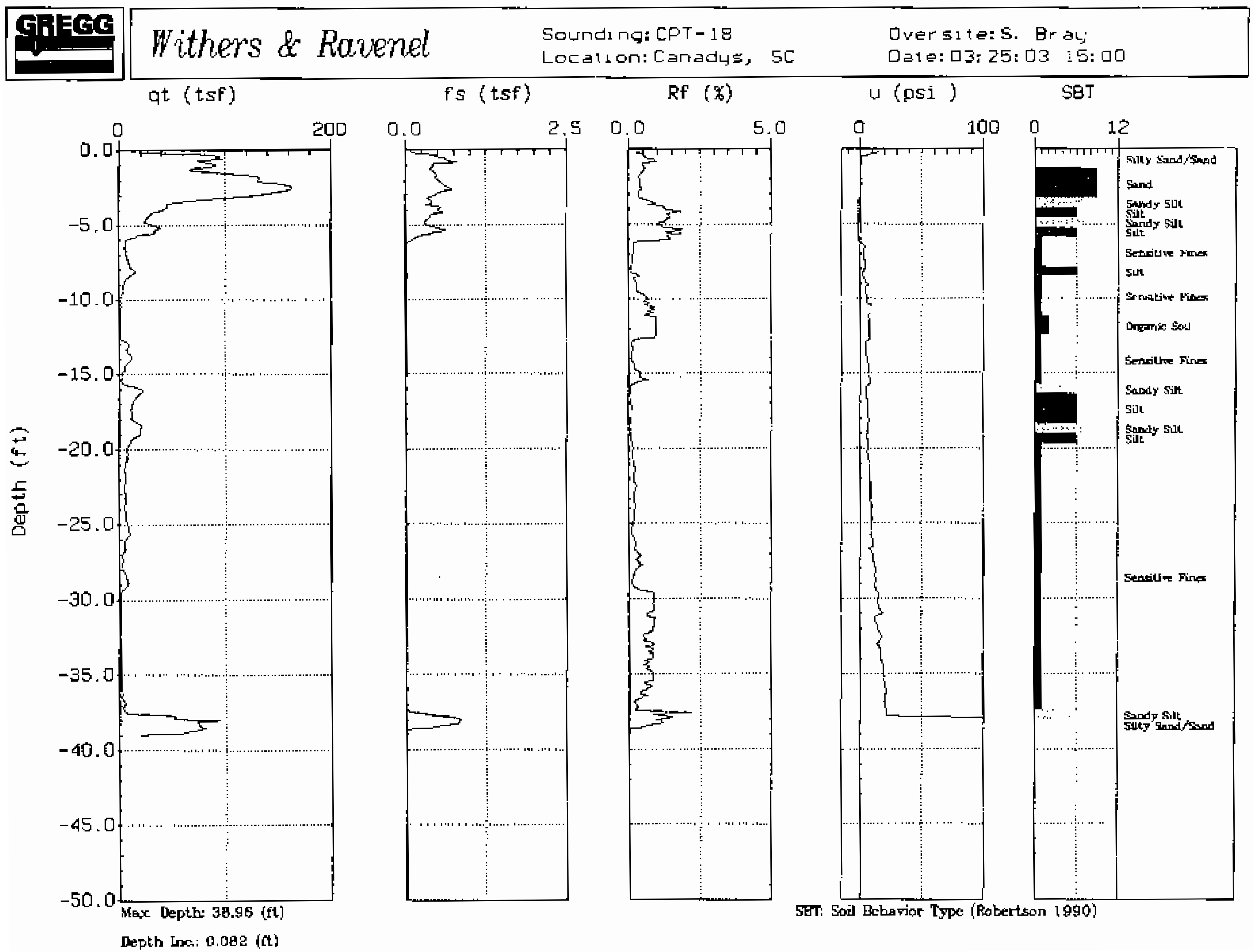
Sounding: CPT-17A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:25:03 13:00



Max. Depth: 39.37 (ft)
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

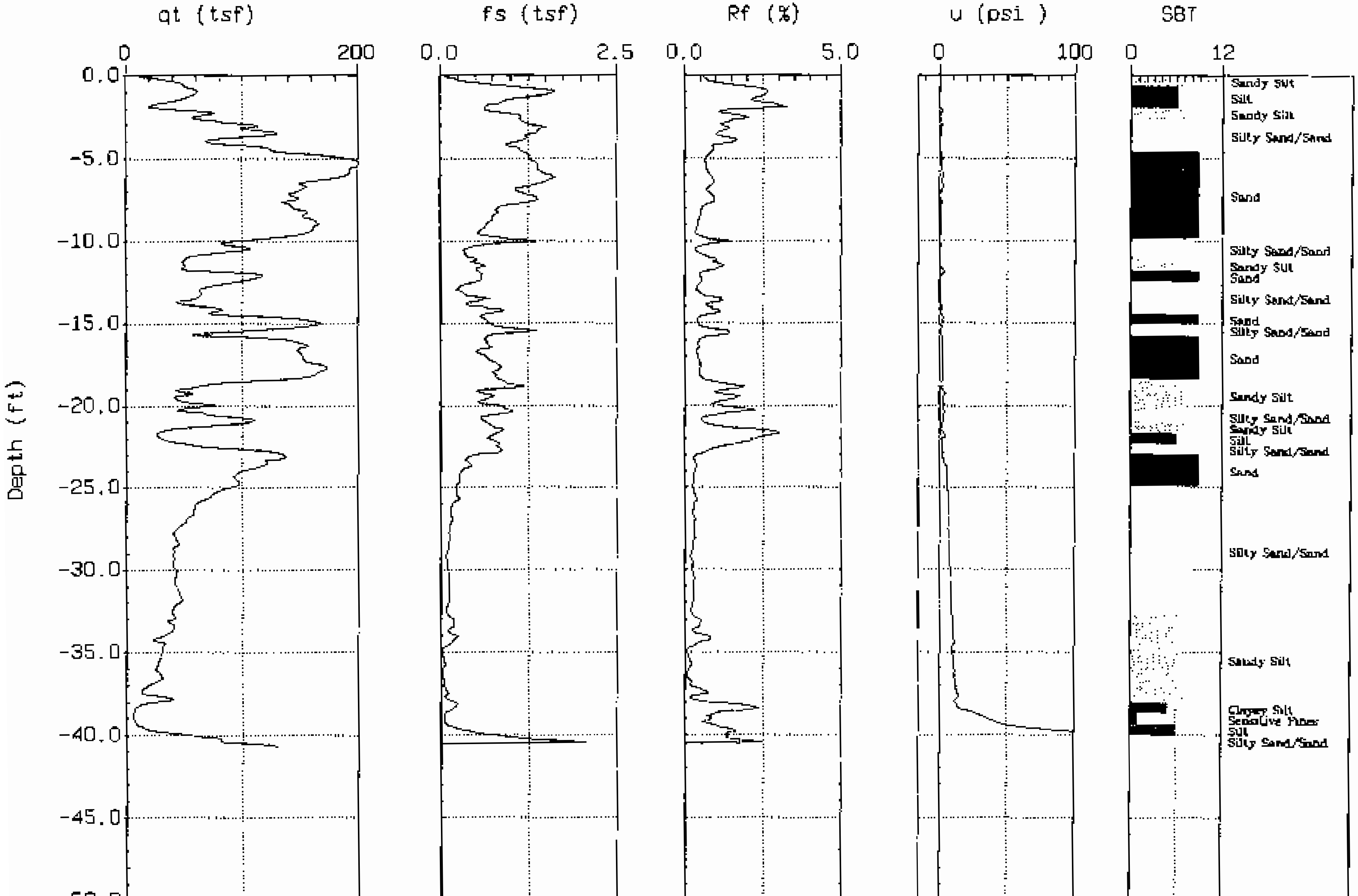

GREGG
Withers & Ravenel
Sounding: CPT-18
Location: Canadys, SC
Oversite: S. Bray
Date: 03:25:03 15:00
qt (tsf)
fs (tsf)
Rf (%)
u (psi)
SBT
0
200
0.0
2.5
0.0
5.0
0
100
0
12
Depth (ft)
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
Silty Sand/Sand
Sand
Sandy Silt
Silt
Sandy Silt
Silt
Sensitive Fines
Silt
Sensitive Fines
Organic Soil
Sensitive Fines
Sandy Silt
Silt
Sandy Silt
Silt
Sensitive Fines
Sandy Silt
Silty Sand/Sand
Max Depth: 38.96 (ft)
Depth Inc: 0.082 (ft)
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-19
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 10:03



Max Depth: 40.76 (ft)

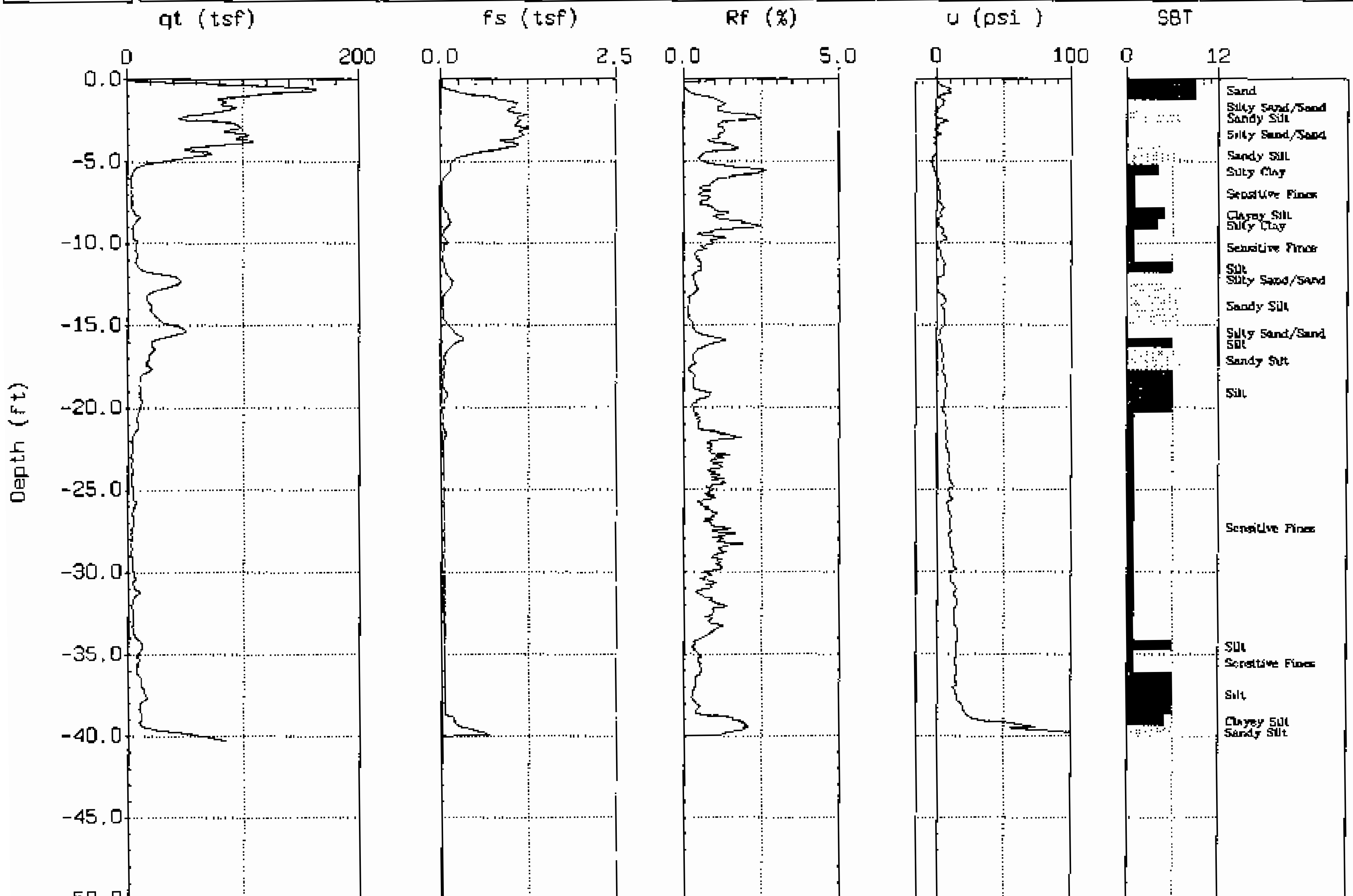
Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-20
Location: Canadys, SC

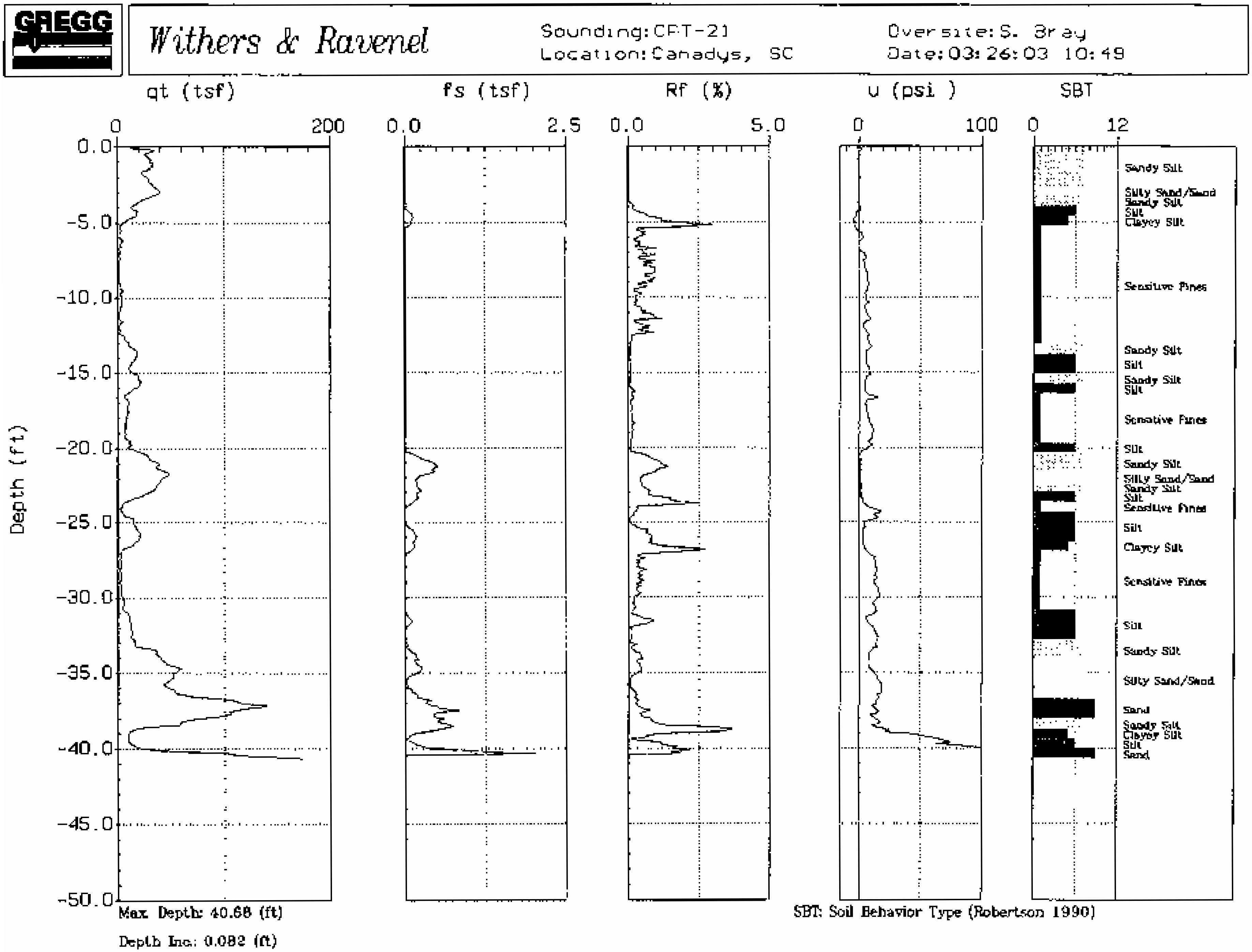
Oversite: S. Bray
Date: 03:26:03 08:27



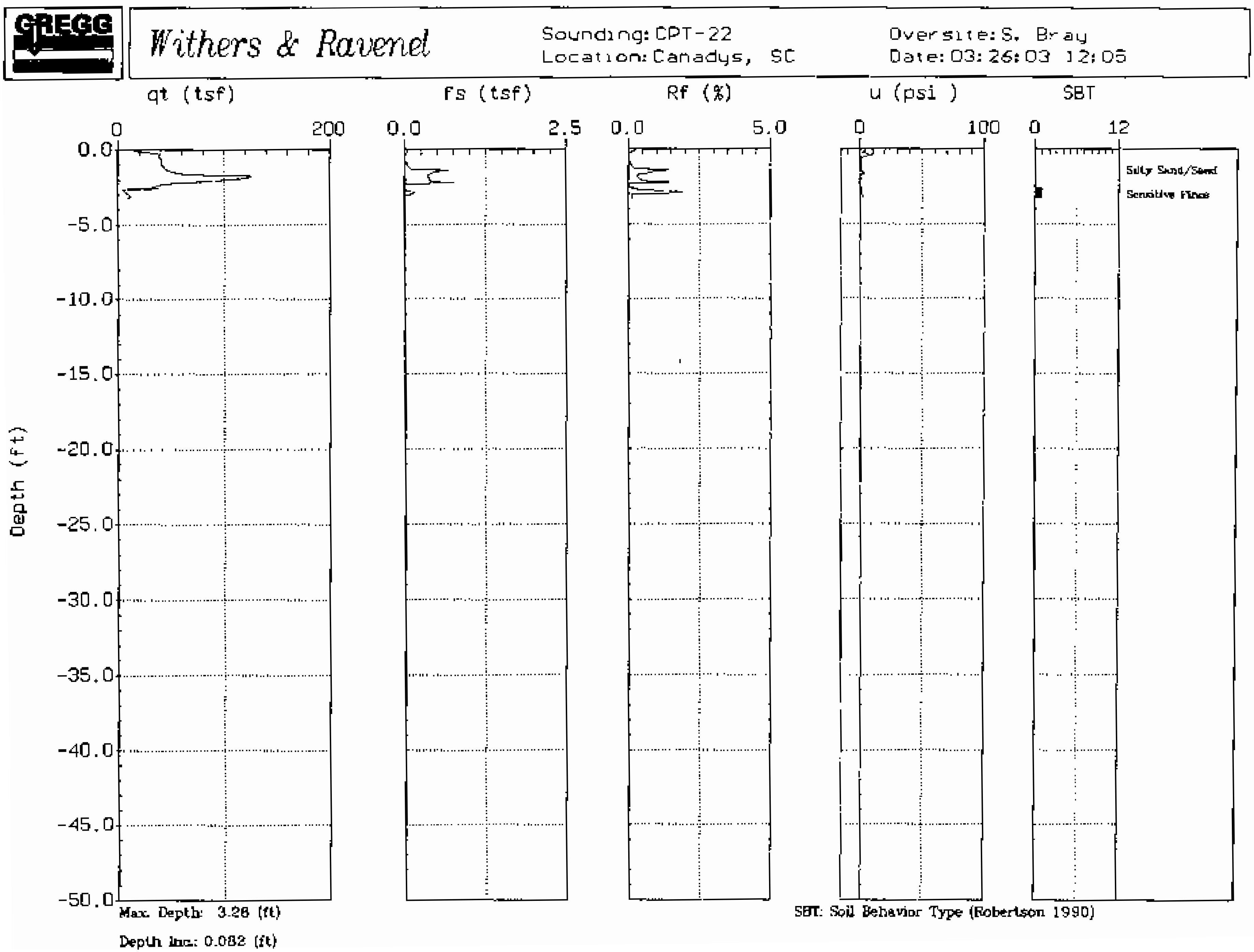
Max. Depth: 40.27 (ft)

Depth Inc: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)



GREGG
Withers & Ravenel
Sounding: CPT-21
Location: Canadys, SC
Oversite: S. Bray
Date: 03:26:03 10:49
qt (tsf)
fs (tsf)
Rf (%)
u (psi)
SBT
Depth (ft)
Sandy Silt
Silty Sand/Sand
Sandy Silt
Silt
Clayey Silt
Sensitive Fines
Sandy Silt
Silt
Sandy Silt
Silt
Sensitive Fines
Silt
Sandy Silt
Silty Sand/Sand
Sandy Silt
Silt
Sensitive Fines
Silt
Clayey Silt
Sensitive Fines
Silt
Sandy Silt
Silty Sand/Sand
Sand
Sandy Silt
Clayey Silt
Silt
Sand
Max. Depth: 40.68 (ft)
Depth Inc.: 0.082 (ft)
SBT: Soil Behavior Type (Robertson 1990)

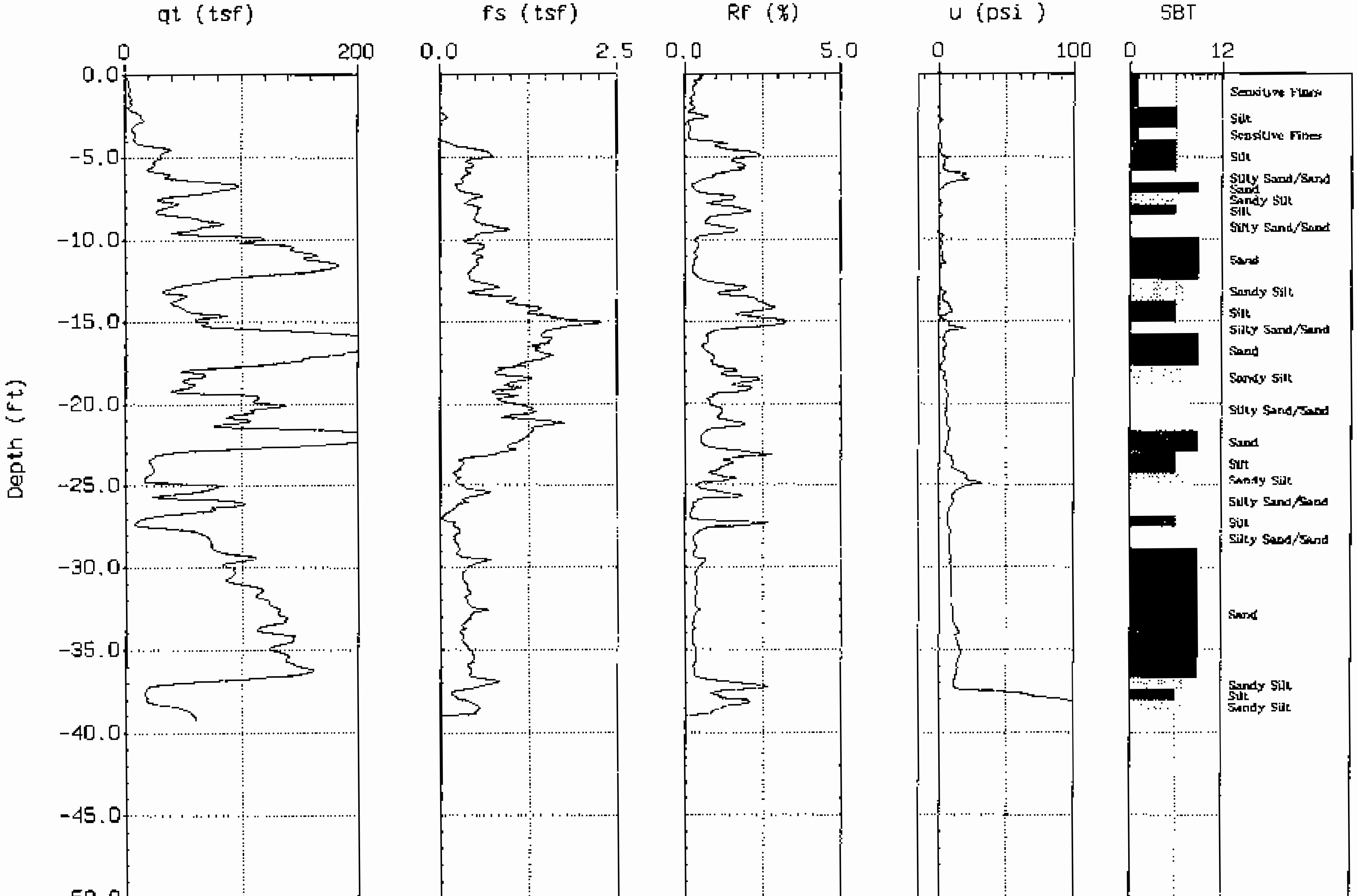

GREGG
Withers & Ravenel
Sounding: CPT-22
Location: Canadys, SC
Oversite: S. Bray
Date: 03:26:03 12:05
qt (tsf)
fs (tsf)
Rf (%)
u (psi)
SBT
0
200
0.0
2.5
0.0
5.0
0
100
0
12
Silty Sand/Sand
Sensitive Fines
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
Depth (ft)
Max. Depth: 3.28 (ft)
Depth Inc: 0.082 (ft)
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-22A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 12:12



Max. Depth: 39.21 (ft)

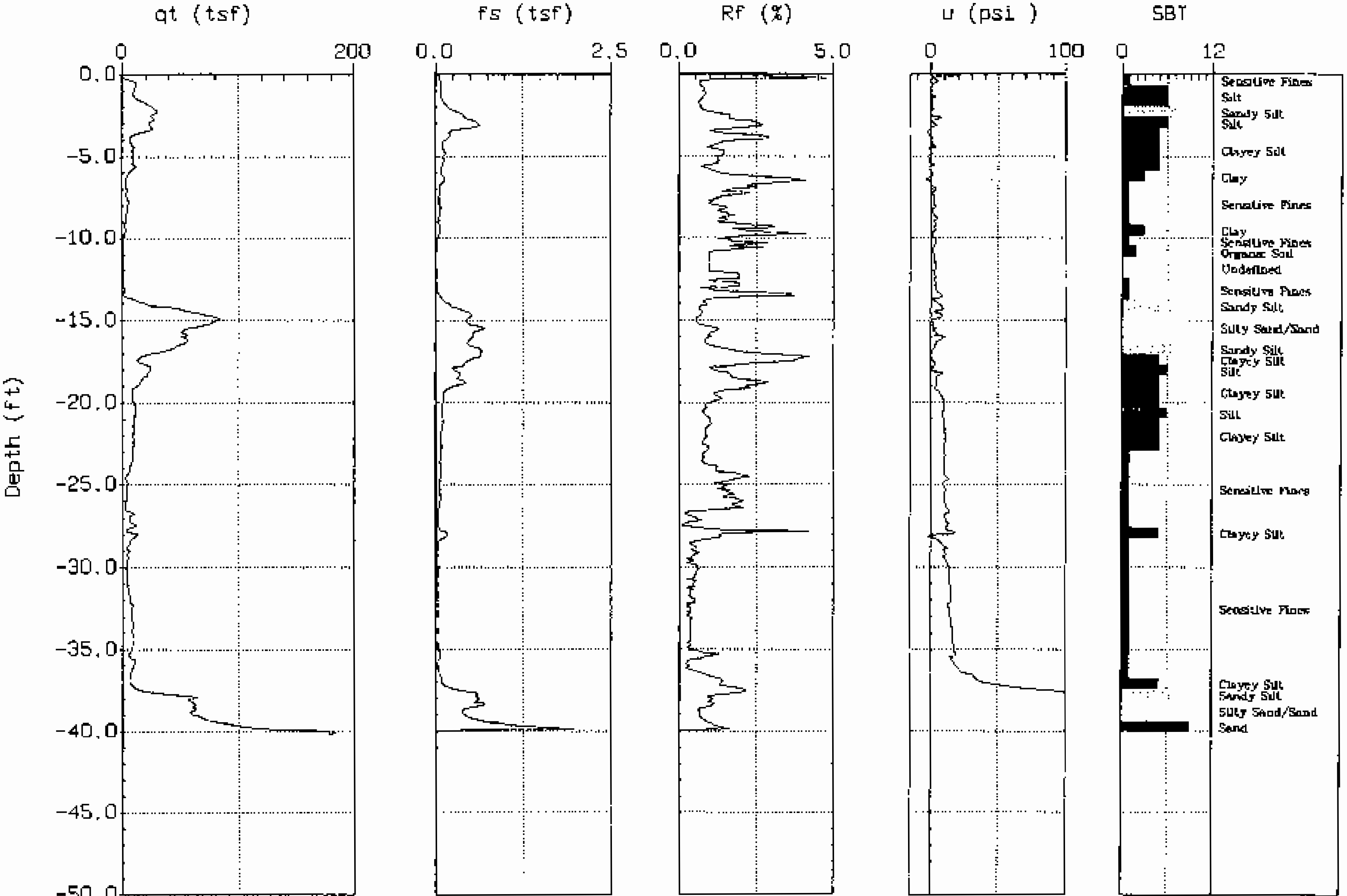
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Withers & Ravenel

Sounding: CPT-23
Location: Canadys, SC

Oversite: S. Bray
Date: 03:28:03 11:13



Max. Depth: 40.19 (ft)

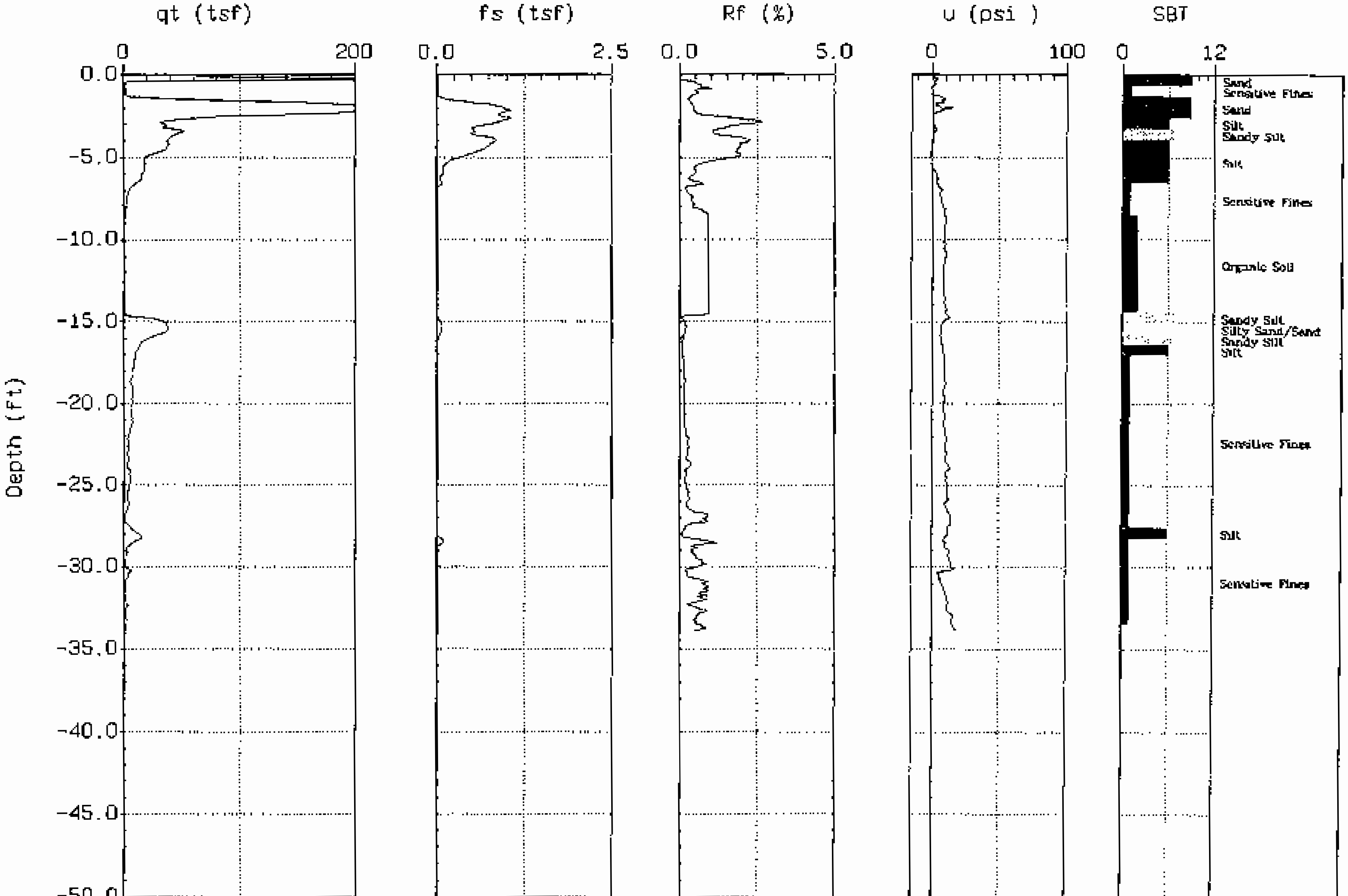
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG | *Withers & Ravenel*

Sounding: CPT-24
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 14:0:



Max. Depth: 33.87 (ft)

Depth Inc: 0.082 (ft)

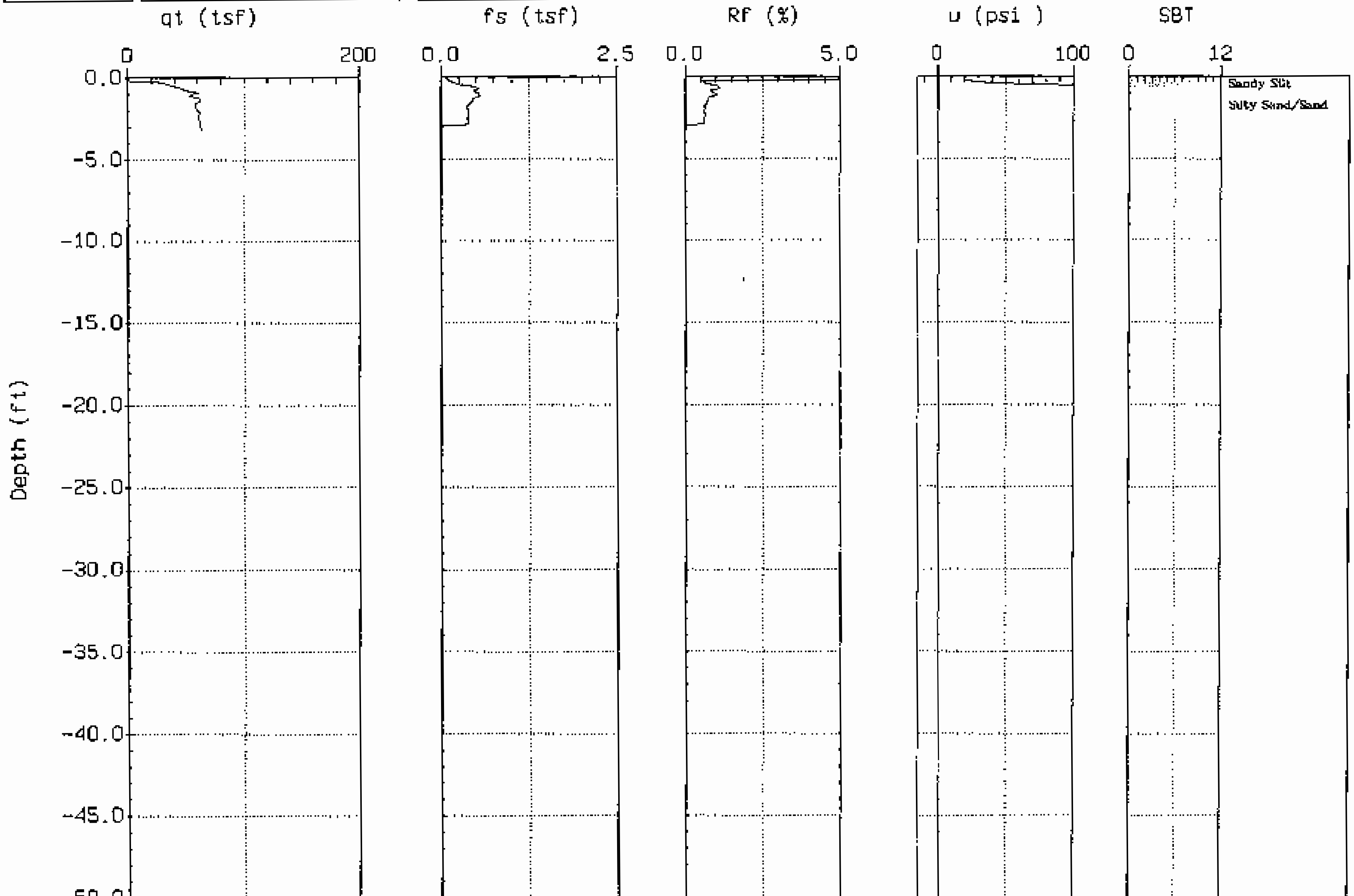
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-24A
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 15:41



Max. Depth: 3.20 (ft)
Depth Inc.: 0.082 (ft)

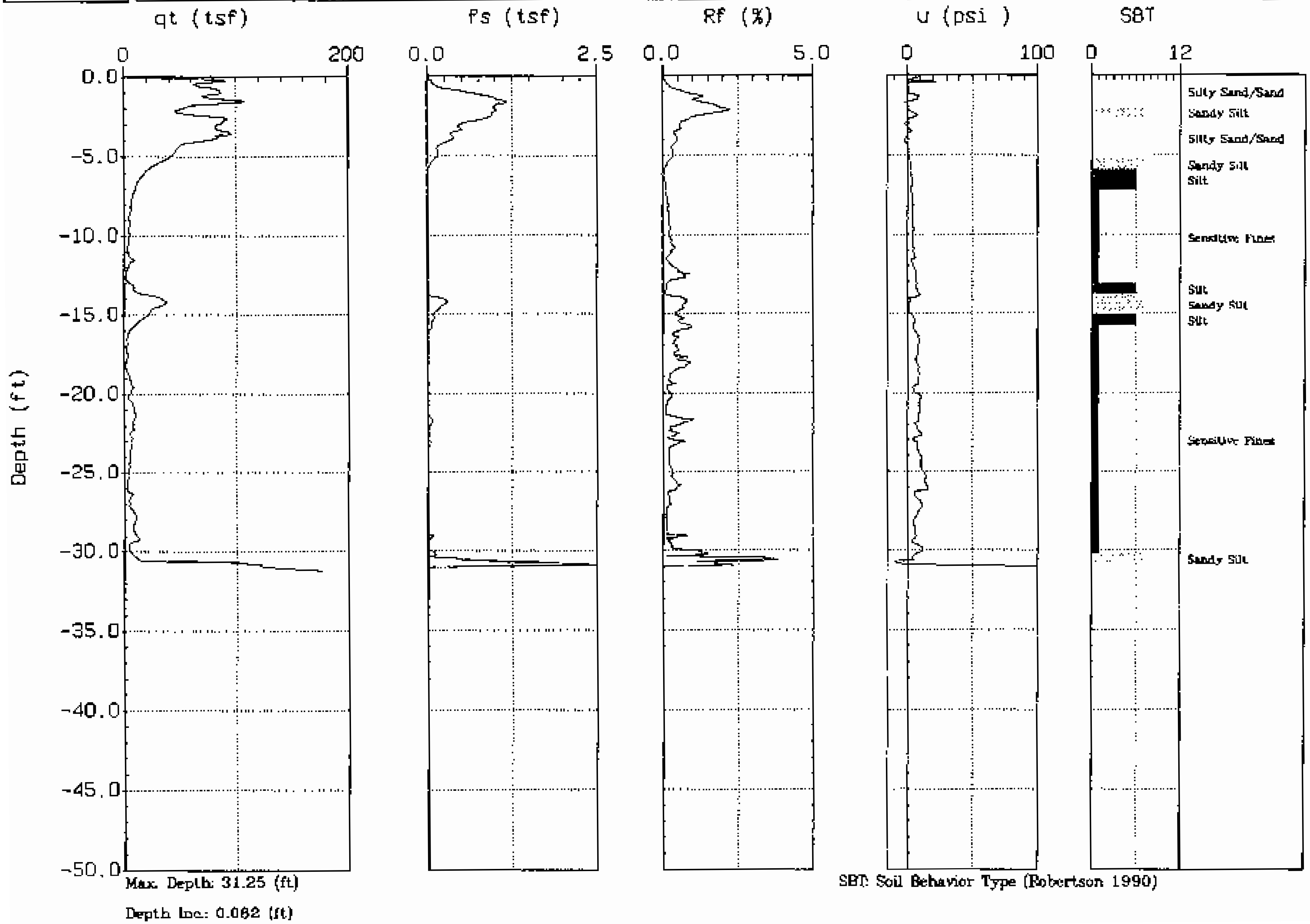
SBT: Soil Behavior Type (Robertson 1990)

GREGG

Withers & Ravenel

Sounding: CPT-25
Location: Canadys, SC

Oversite: S. Bray
Date: 03:26:03 16:02

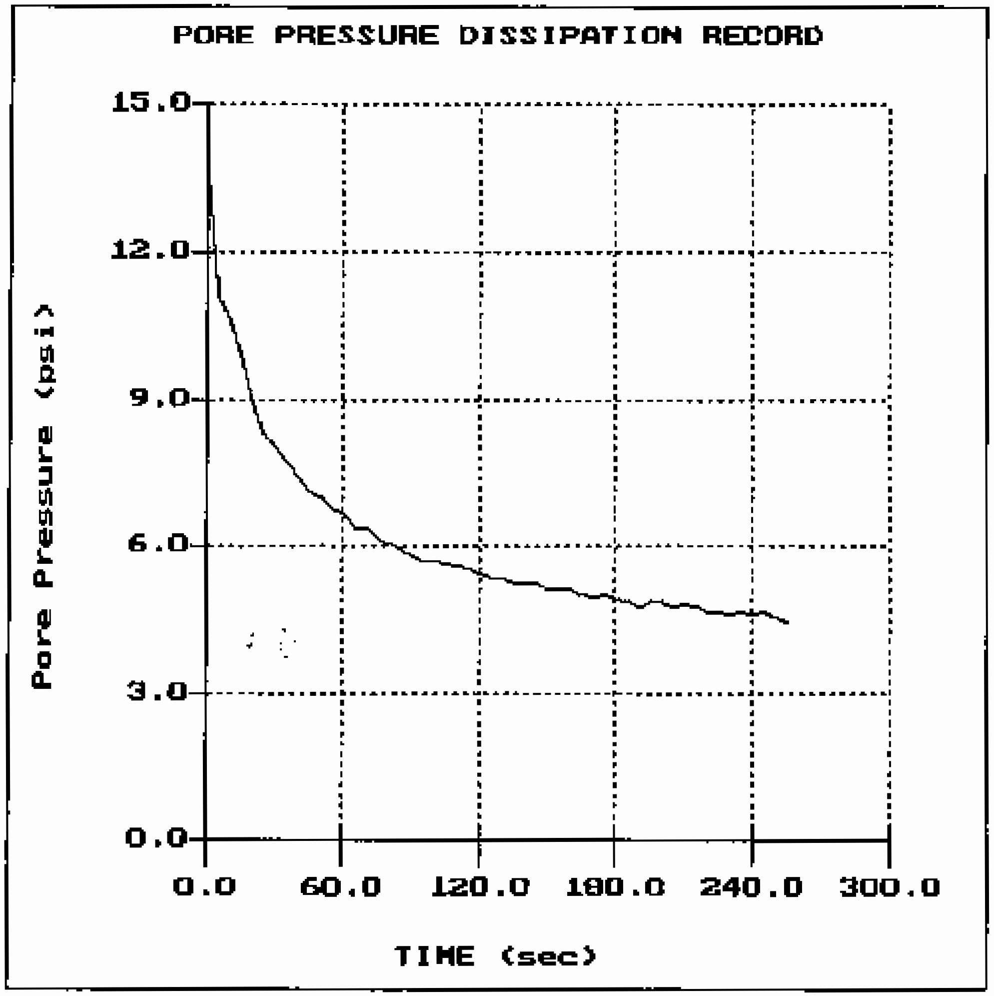


APPENDIX B

PORE PRESSURE DISSIPATIONS

GREGG

W & R — Sounding:CPT-01 — Location:Canadys, SC — Oversight:S. Bray — Date:03:28:03 13:15



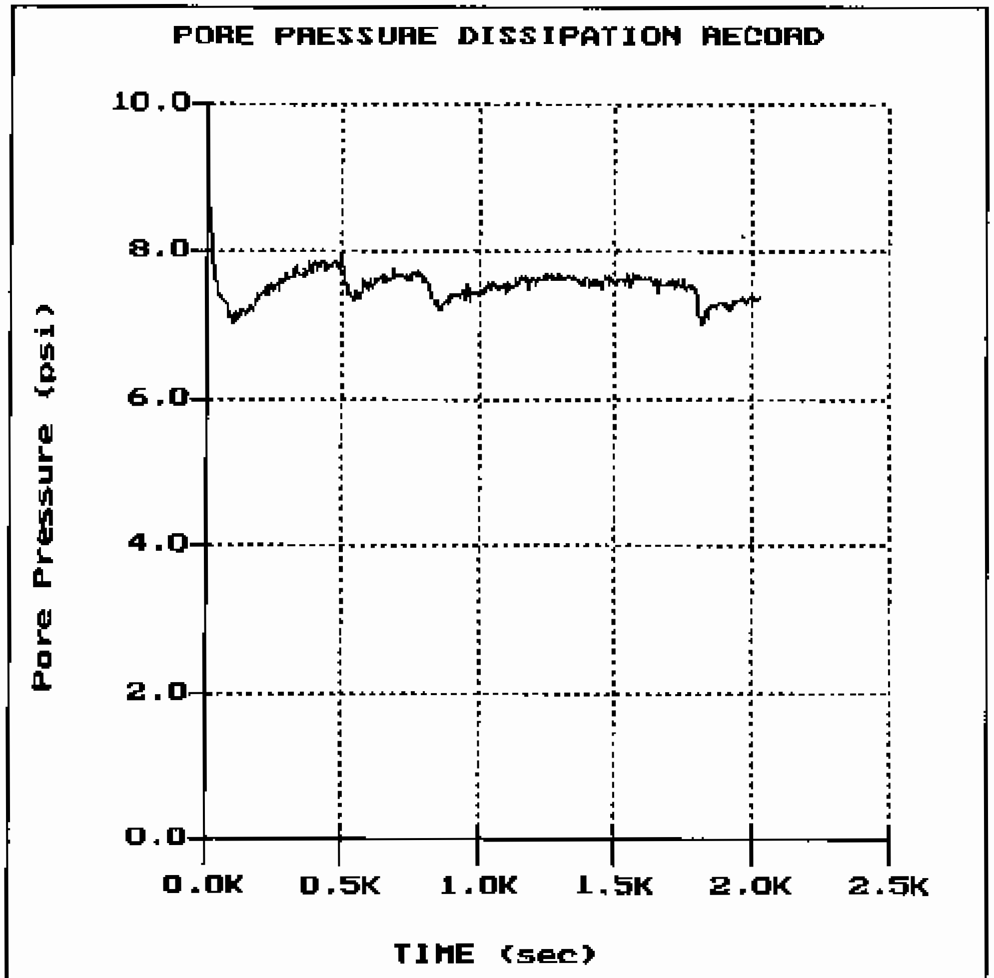
File: 044CP01.PPD
Depth (m): 4.93
(ft): 16.17
Duration : 255.0s
U-min: 4.41 255.0s
U-max: 13.71 0.0s
U-eq.: 3.80
U-50 : 8.75 21.1s
ch : 33.911 cm^2/min
%Ut: 0.94

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 300.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.26 m
7.41 ft

W & R

Sounding:CPT-01
Location:Canadys, SC

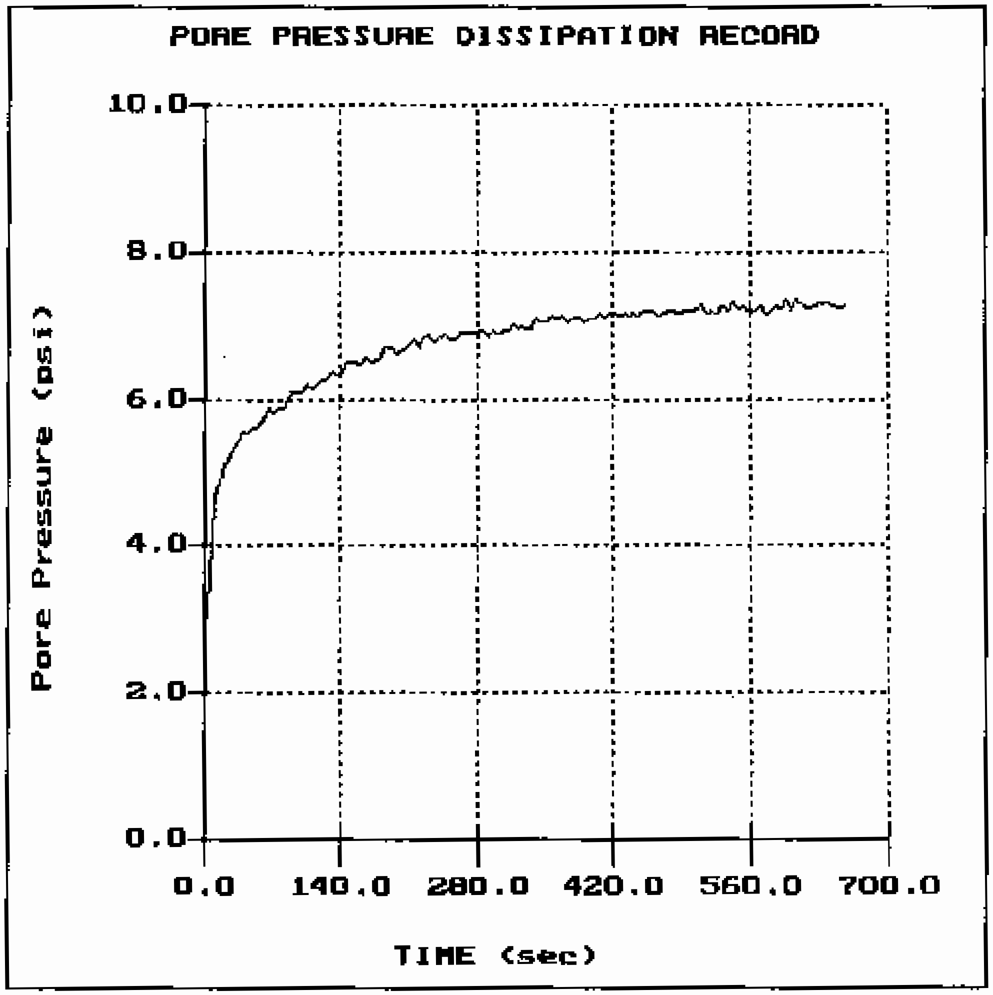
Oversight:S. Bray
Date:03:28:03 13:15



File: 044CP01.PPD
Depth (m): 7.33
(ft): 24.05
Duration : 2020.0s
U-min: 7.00 1810.0s
U-max: 8.57 5.0s
U-eq.: 7.49
U-50 : 8.03 16.6s
ch : 43.049 cm^2/min
%Ut: 1.46

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 2500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.06 m
6.76 ft

W & R | Sounding:CPT-028 | Oversight:S. Bray
Location:Canadys, SC | Date:03:28:03 14:20



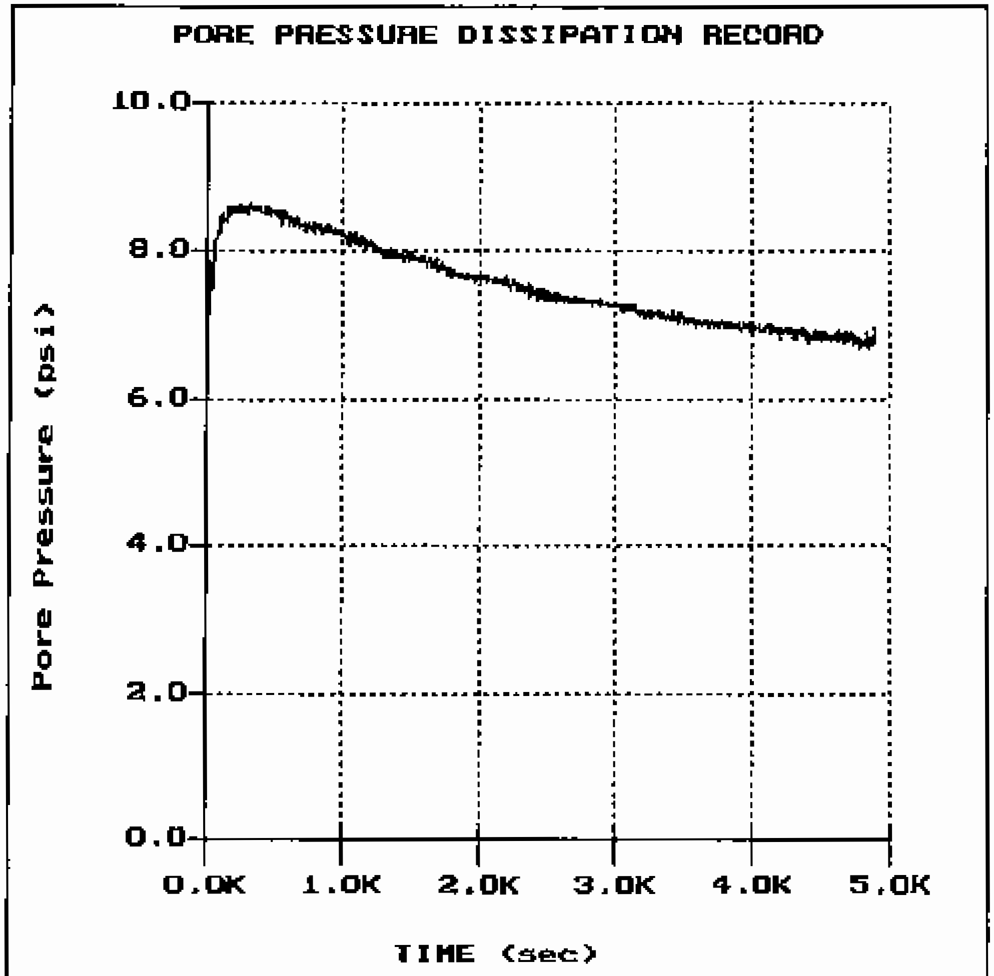
File: 044CP028.PPD
Depth (m): 7.33
(ft): 24.05
Duration : 655.0s
U-min: 2.81 0.0s
U-max: 7.34 605.0s
U-eq.: 7.27
U-50 : 5.04 18.9s
ch : 37.946 cm^2/min
%Ut: 1.02

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 700.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.22 m
7.28 ft

W & R

Sounding:CPT-03
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 09:38



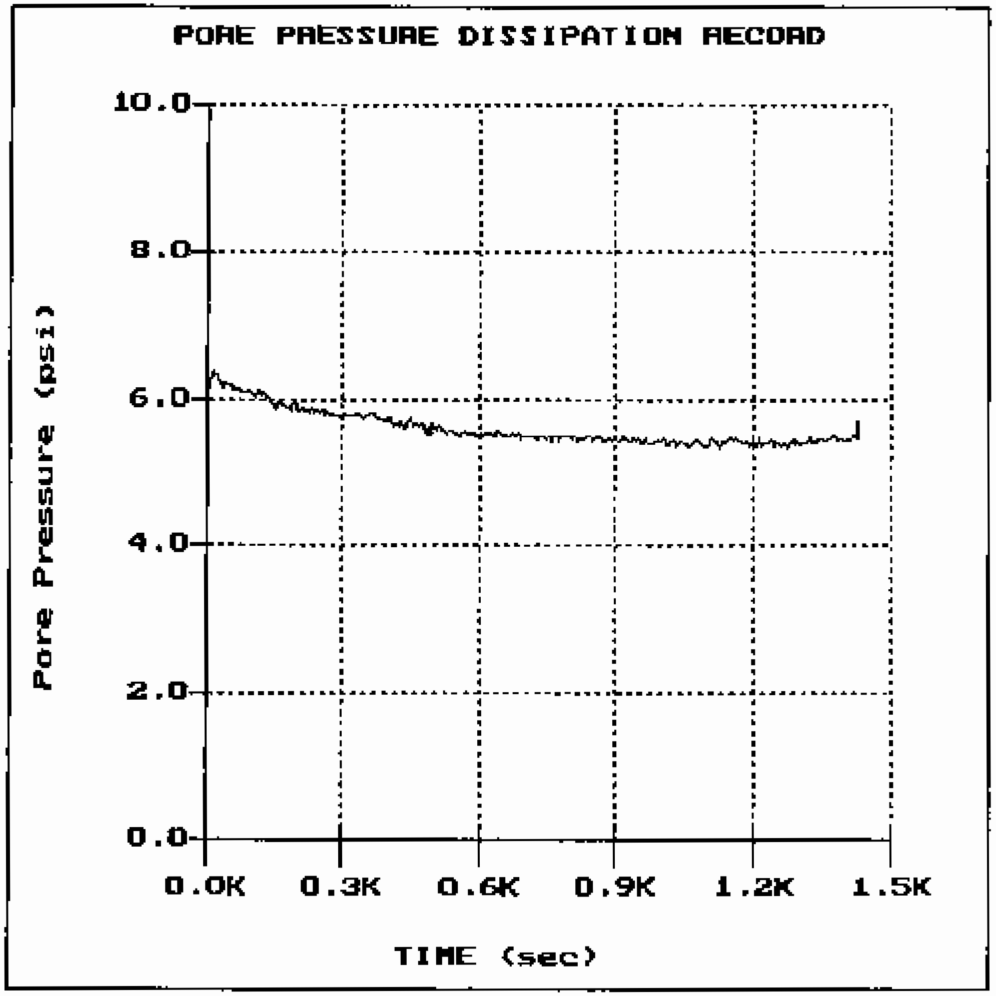
File: 044CP03.PPD
Depth (m): 6.22
(ft): 20.41
Duration : 4885.0s
U-min: 6.65 4850.0s
U-max: 10.52 0.0s
U-eq.: 6.26
U-50 : 8.39 4.3s
ch : 166.651 cm^2/min
%Ut: 0.91

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 5000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 1.82 m
5.97 ft

W & R

Sounding:CPT-04
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 11:47



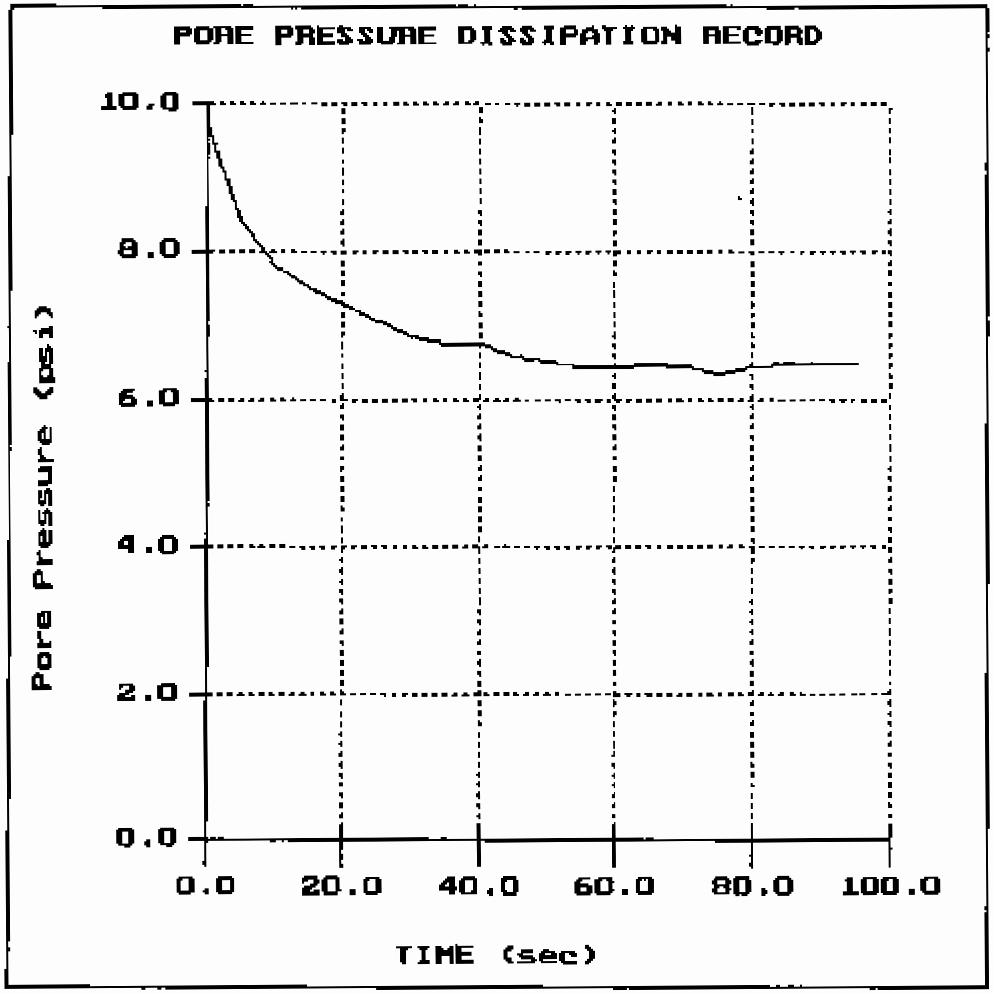
File: 044CP04.PPD
Depth (m): 5.20
(ft): 17.06
Duration : 1430.0s
U-min: 5.31 1270.0s
U-max: 6.37 10.0s
U-eq.: 5.38
U-50 : 5.87 176.9s
ch : 4.050 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 1500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 1.42 m
4.66 ft

W & R

Sounding:CPT-04
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 11:47



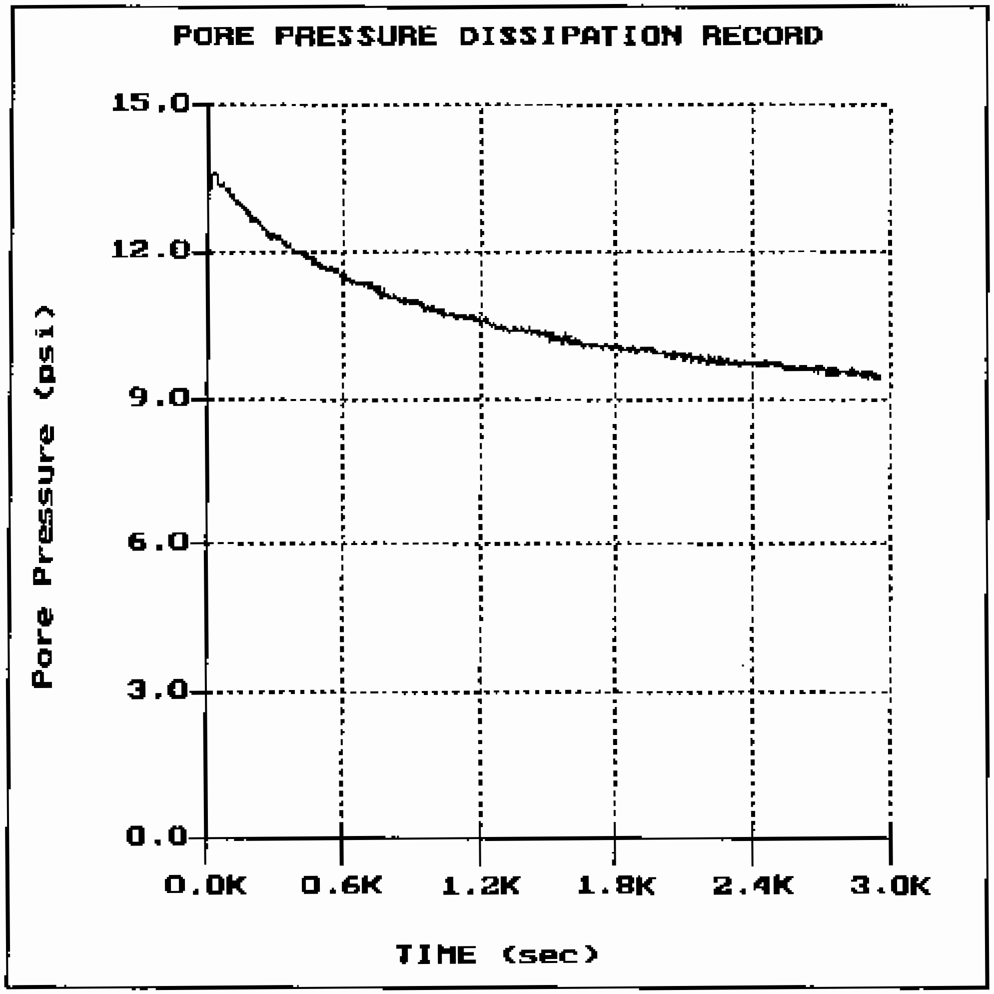
File: 044CP04.PPD
Depth (m): 7.08
(ft): 23.23
Duration : 95.0s
U-min: 6.31 75.0s
U-max: 9.72 0.0s
U-eq.: 6.43
U-50 : 8.07 7.7s
ch : 93.323 cm^2/min
%Ut: 1.04

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 100.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.56 m
8.40 ft

W & R

Sounding:CPT-04
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 11:47



File: 044CP04.PPD
Depth (m): 8.55
(ft): 28.05
Duration : 2955.0s
U-min: 9.38 2935.0s
U-max: 13.61 20.0s
U-eq.: 8.43
U-50 : 11.02 837.2s
ch : 0.855 cm^2/min
%Ut: 0.82

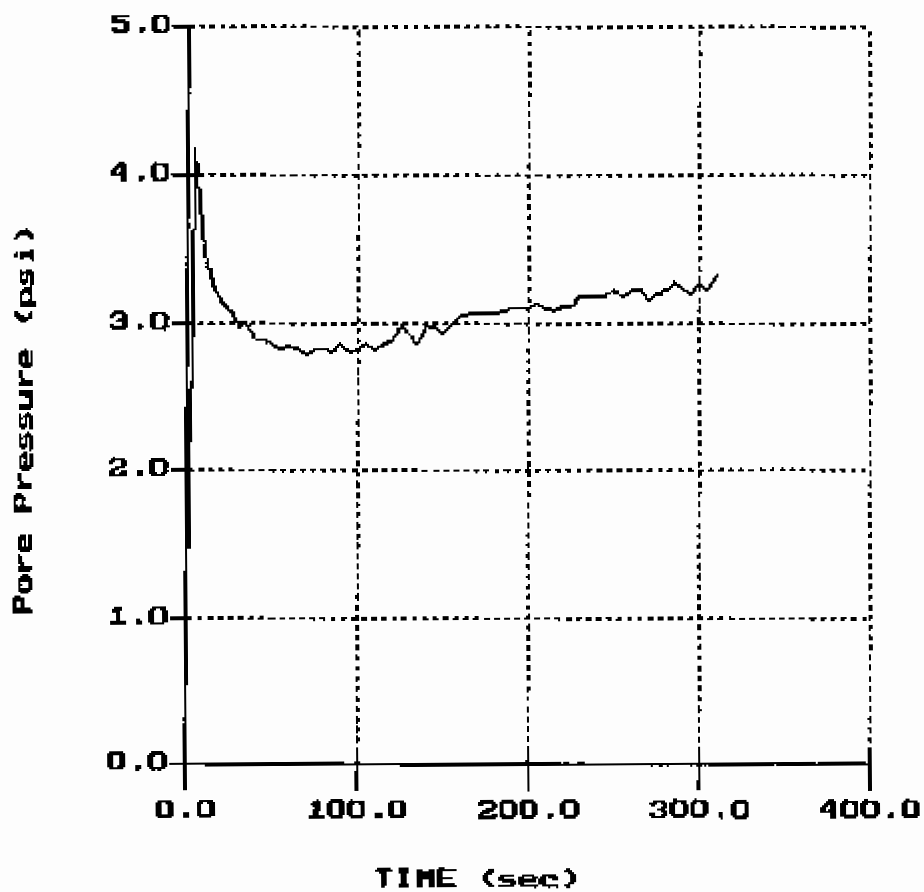
Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 3000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.62 m
8.60 ft

W & R

Sounding:CPT-05
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 14:02

PORE PRESSURE DISSIPATION RECORD



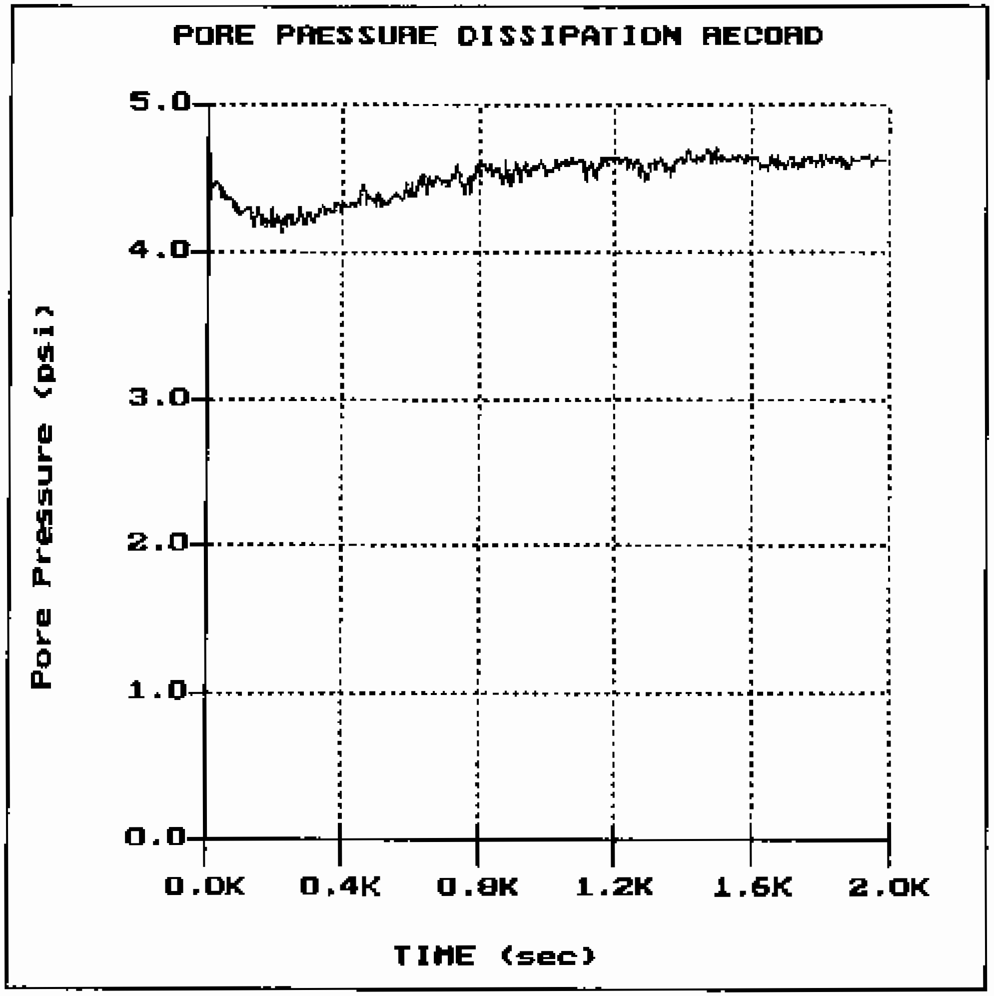
File: 044CP05.PPD
Depth (m): 7.90
(ft): 25.92
Duration : 310.0s
U-min: 0.92 0.0s
U-max: 4.17 5.0s
U-eq.: 3.24
U-50 : 2.08 1.8s
ch : 400.944 cm^2/min
%Ut: 1.40

Plot u-min: 0.00
u-max: 5.00
t-min: 0.00
t-max: 400.0
# of TicksX: 4
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 5.62 m
18.44 ft

W & R

Sounding:CPT-06
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 14:51



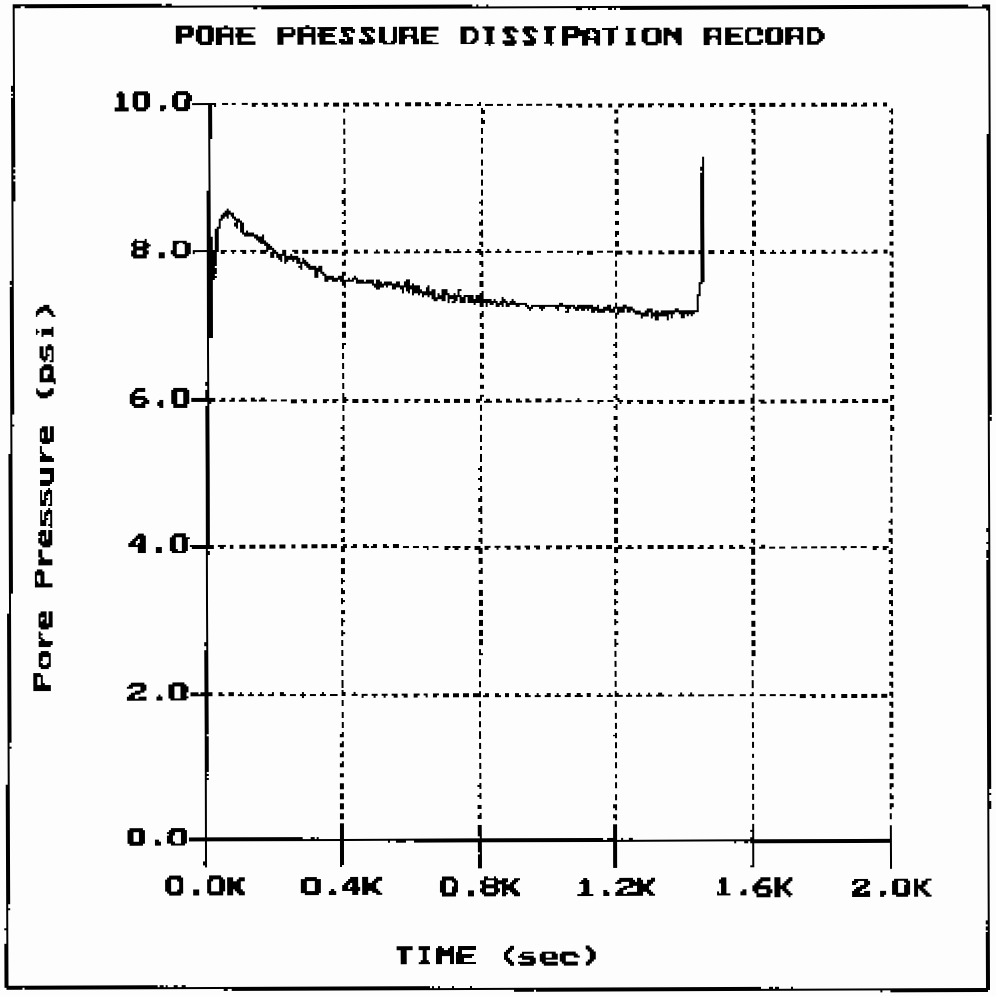
File: 044CP06.PPD
Depth (m): 4.88
(ft): 16.01
Duration : 1985.0s
U-min: 4.13 220.0s
U-max: 4.96 0.0s
U-eq.: 4.64
U-50 : 4.80 1.3s
ch : 538.093 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 5.00
t-min: 0.00
t-max:2000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir:100.0
Water table: 1.62 m
5.31 ft

W & R

Sounding:CPT-06
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 14:51

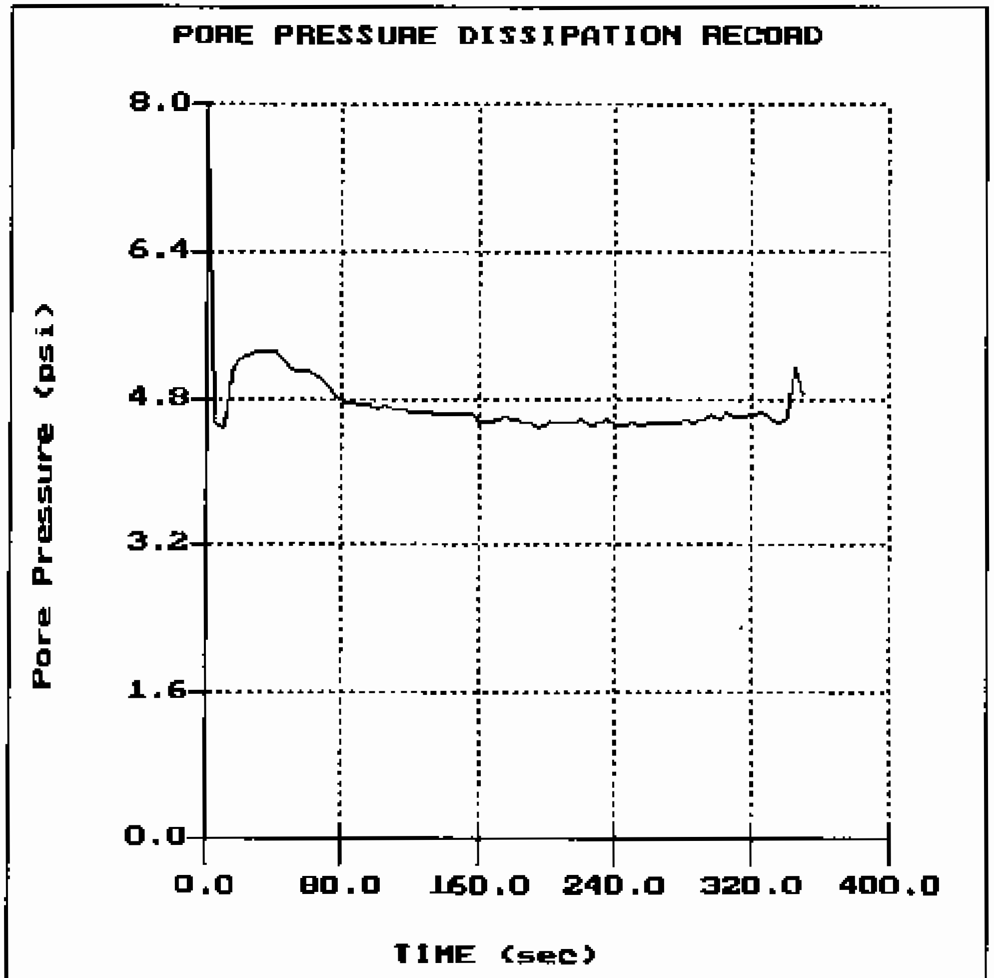


File:	044CP06.PPD	
Depth (m):	7.03	
(ft):	23.06	
Duration :	1450.0s	
U-min:	6.84	5.0s
U-max:	9.48	0.0s
U-eq.:	7.12	
U-50 :	8.30	2.2s
ch :	321.042	cm^2/min
%Ut:	1.12	
Plot u-min:	0.00	
u-max:	10.00	
t-min:	0.00	
t-max:	2000.0	
# of TicksX:	5	
# of TicksY:	5	
Rigidity Ir:	100.0	
Water table:	2.02 m	
	6.63 ft	

W & R

Sounding:CPT-07
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 16:35



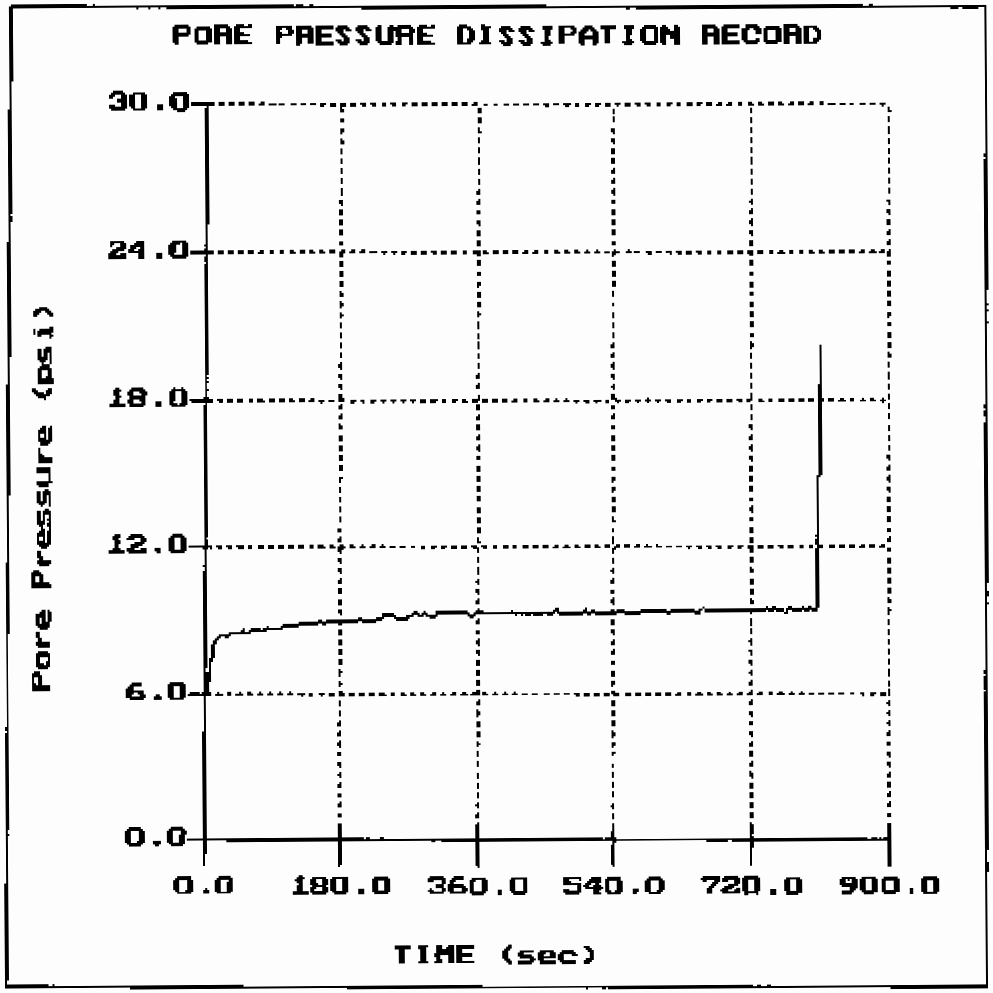

```
File: 044CP07.PPD
Depth (m):   5.08
      (ft):  16.67
Duration :  350.0s
U-min:    4.48 195.0s
U-max:    7.83   0.0s
U-eq.:    4.55
U-50 :    6.19   2.5s
ch  : 289.135 cm^2/min
%Ut:   1.02

Plot    u-min:   0.00
        u-max:   8.00
        t-min:   0.00
        t-max:400.0
# of TicksX:     5
# of TicksY:     5
Rigidity Ir:100.0
Water table:    1.88 m
                6.17 ft
```

W & R

Sounding:CPT-07
Location:Canadys, SC

Oversight:S. Bray
Date:03:27:03 16:35



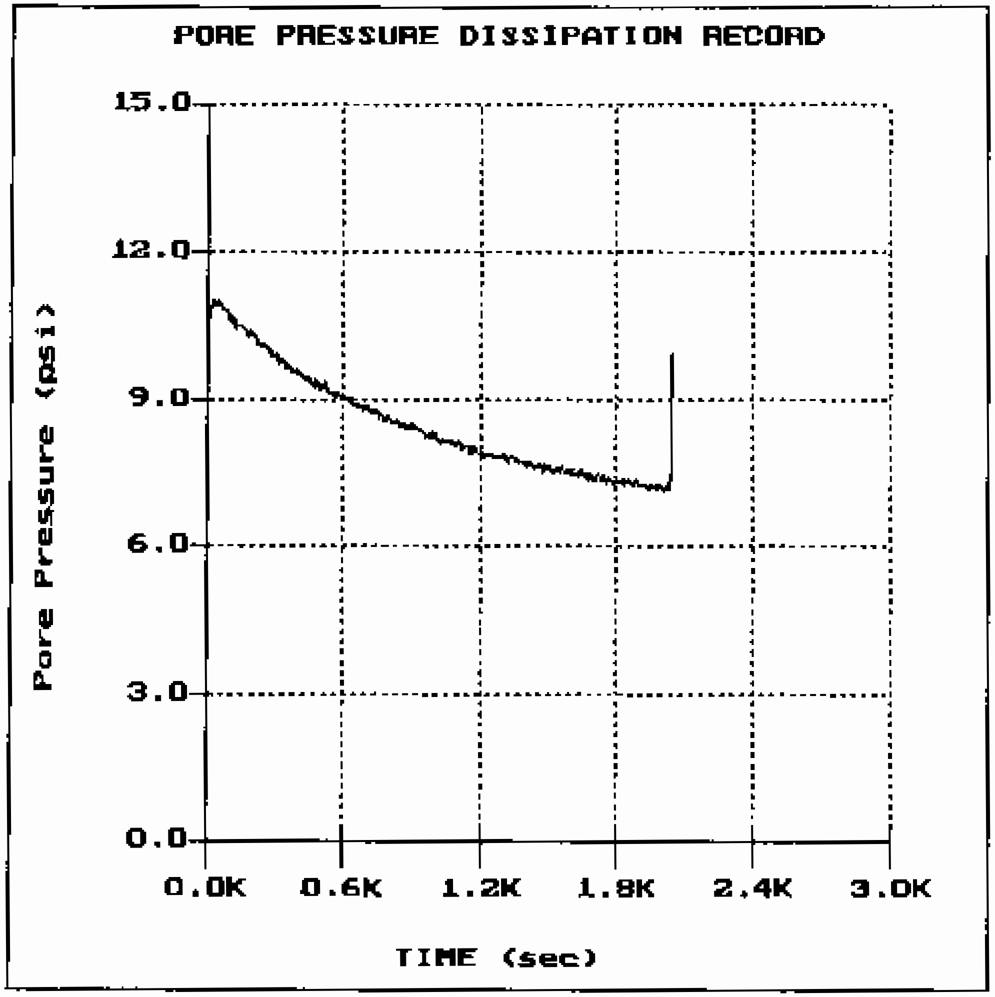
File: 044CP07.PPD
Depth (m): 9.15
(ft): 30.02
Duration : 810.0s
U-min: 6.02 5.0s
U-max: 20.08 810.0s
U-eq.: 9.37
U-50 : 7.70 10.3s
ch : 69.558 cm^2/min
%Ut: 4.20

Plot u-min: 0.00
u-max: 30.00
t-min: 0.00
t-max: 900.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.56 m
8.40 ft

W & R

Sounding:CPT-07A
Location:Canadys, SC

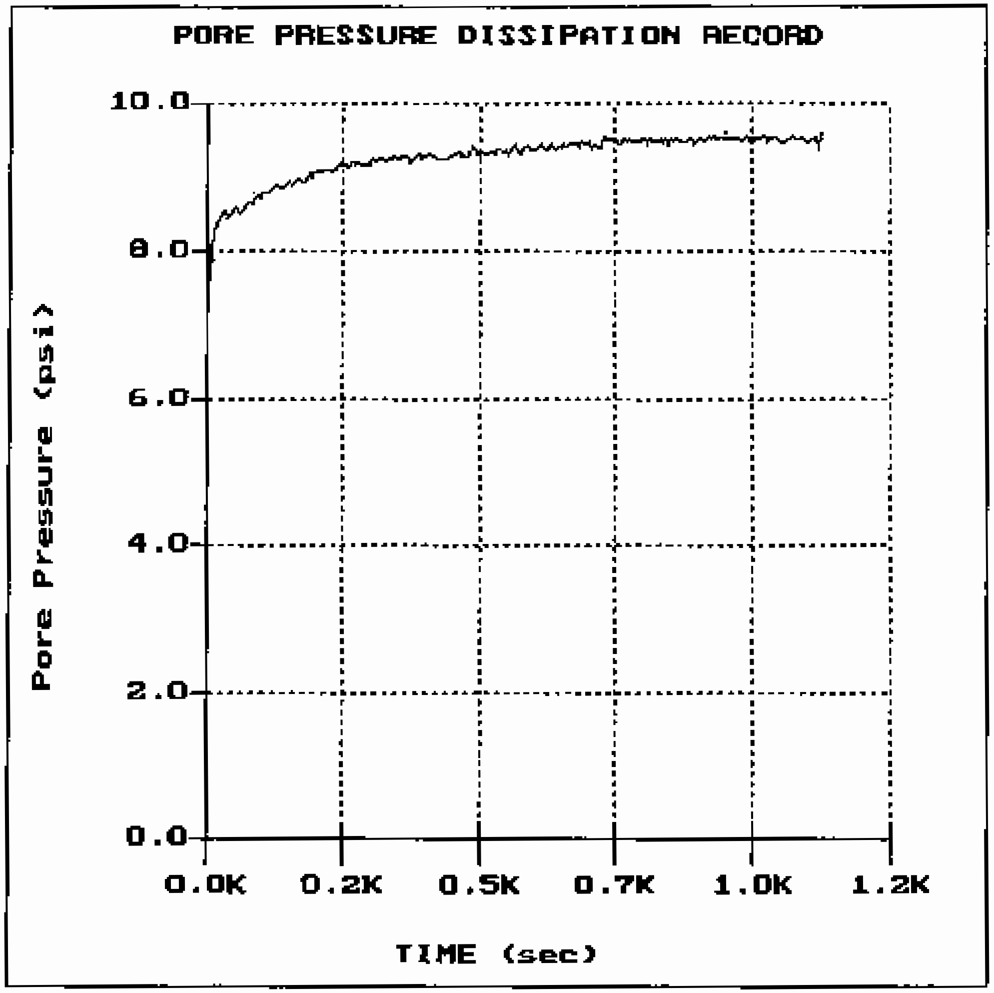
Oversight:S. Bray
Date:03:28:03 08:20



File: 044CP07A.PPD
Depth (m): 9.07
(ft): 29.76
Duration : 2040.0s
U-min: 7.10 2005.0s
U-max: 10.99 40.0s
U-eq.: 6.56
U-50 : 8.77 679.7s
ch : 1.054 cm^2/min
%Ut: 0.88

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 3000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 4.46 m
14.63 ft

W & R | Sounding:CPT-08 | Oversight:S. Bray
Location:Canadys, SC | Date:03:27:03 17:20



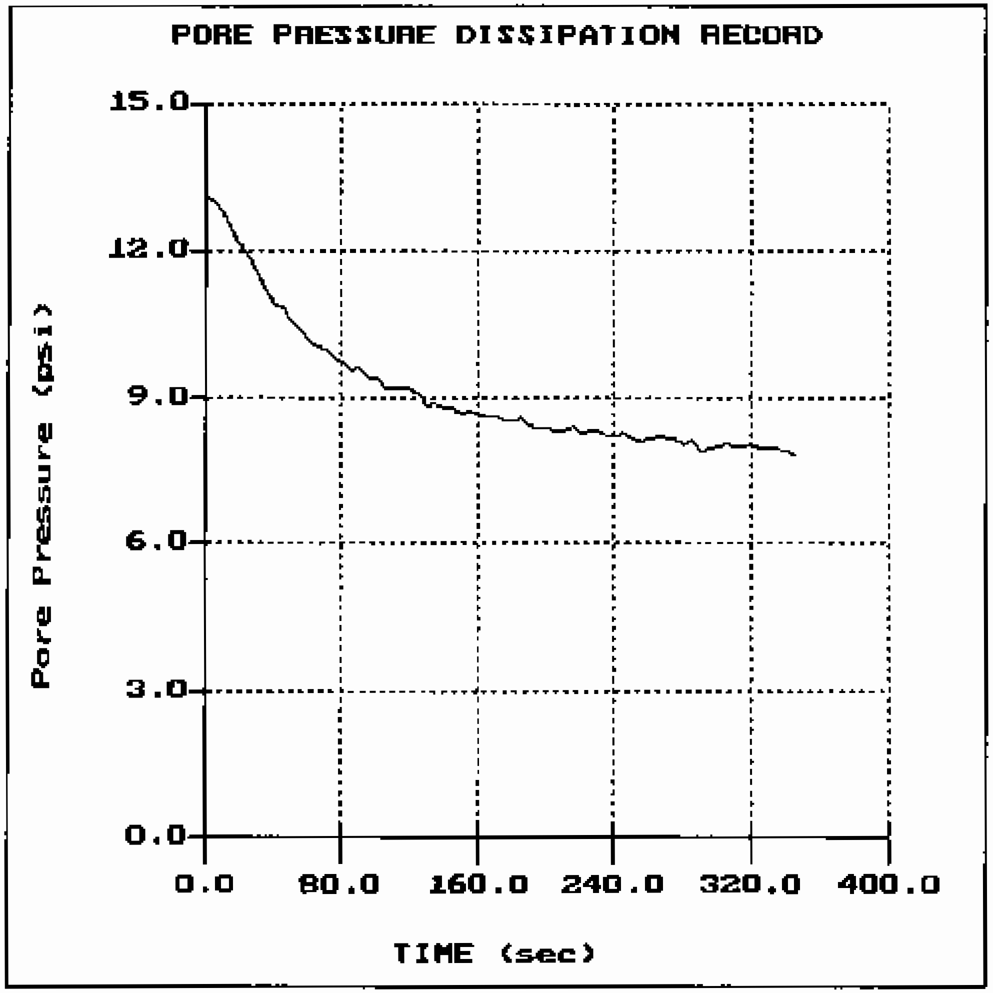

```
File: 044CP08.PPD
Depth (m):   9.15
      (ft):  30.02
Duration  :  1080.0s
U-min:    7.59    5.0s
U-max:    9.58 1080.0s
U-eq.:    9.51
U-50  :   8.55   48.7s
ch  :  14.711 cm^2/min
%Ut:   1.03

Plot   u-min:   0.00
       u-max:10.00
       t-min: 0.00
       t-max:1200.0
# of TicksX:    5
# of TicksY:    5
Rigidity Ir:100.0
Water table:   2.46 m
               8.07 ft
```

W & R

Sounding:CPT-09
Location:Canadys, SC

Oversight:S. Bray
Date:03:24:03 13:55



File: 044CPD9.PPD
Depth (m): 8.10
(ft): 26.57
Duration : 345.0s
U-min: 7.83 345.0s
U-max: 13.08 0.0s
U-eq.: 7.49
U-50 : 10.29 57.2s
ch : 12.518 cm^2/min
%Ut: 0.94

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 400.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.83 m
9.28 ft

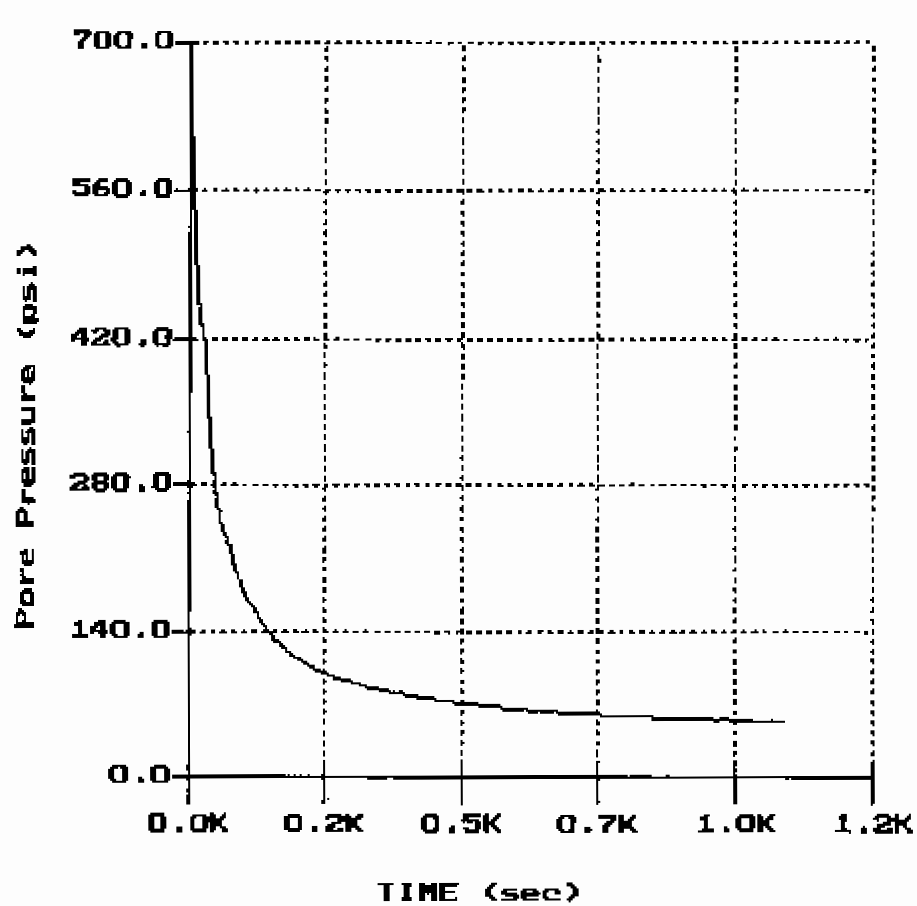
W & R

Sounding:CPT-09
Location:Canadys, SC

Oversight:S. Bray
Date:03:24:03 13:55

File: 044CP09.PPD
Depth (m): 12.05
(ft): 39.53
Duration : 1045.0s
U-min: 52.98 1040.0s
U-max: 654.56 0.0s

PORE PRESSURE DISSIPATION RECORD

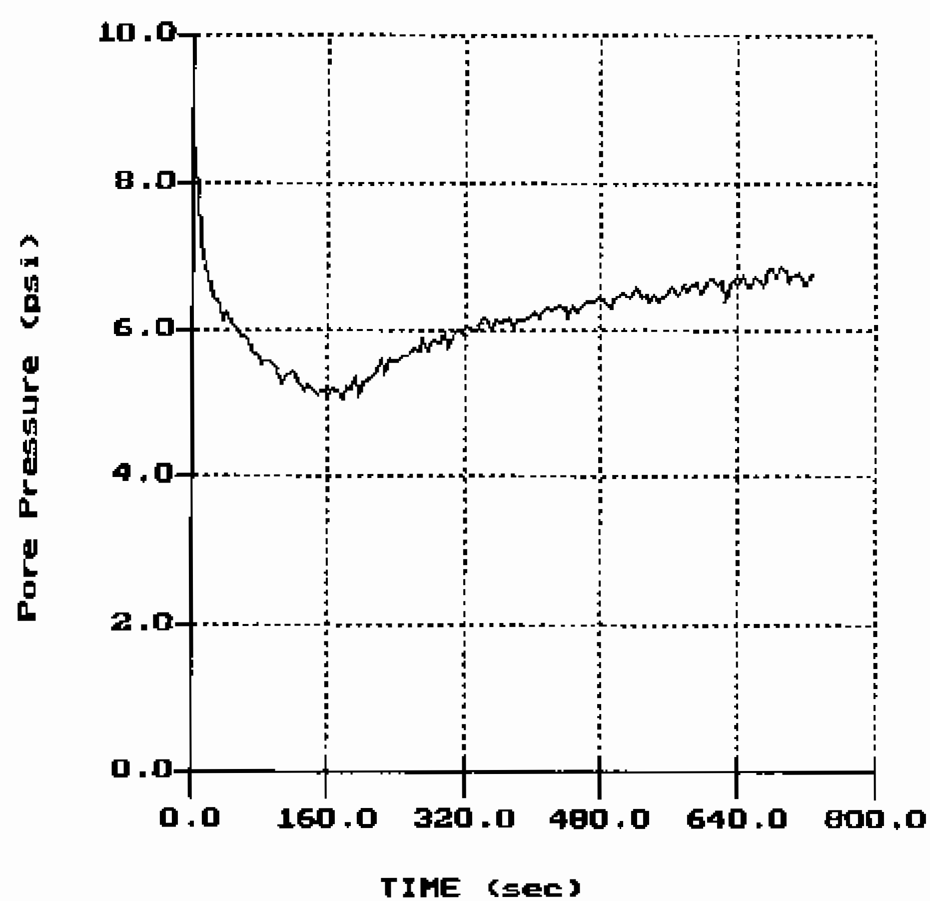


W & R

Sounding:CPT-10
Location:Canadys, SC

Oversight:S. Bray
Date:03:24:03 15:11

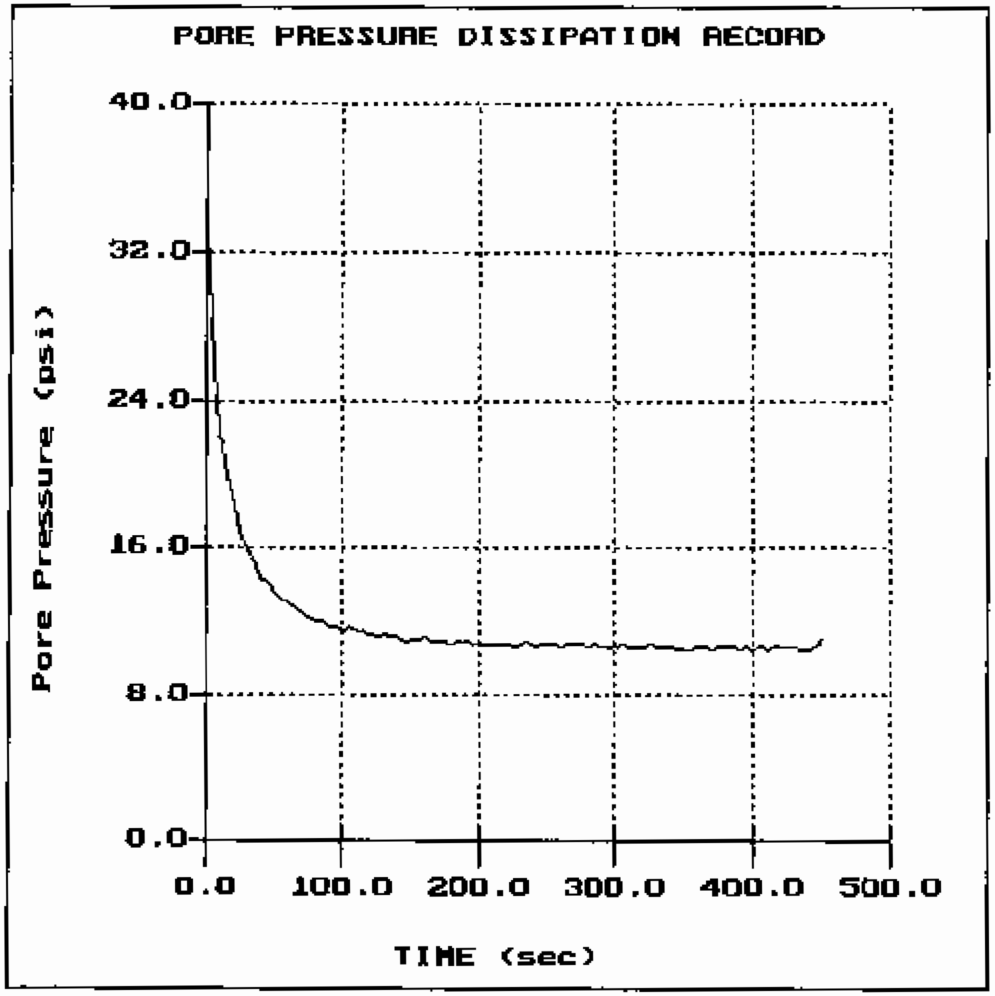
PORE PRESSURE DISSIPATION RECORD



File: 044CP10.PPD
Depth (m): 6.05
(ft): 19.85
Duration : 725.0s
U-min: 5.03 175.0s
U-max: 8.63 0.0s
U-eq.: 6.67
U-50 : 7.65 6.5s
ch : 110.259 cm^2/min
%Ut: 1.84

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 800.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 1.36 m
4.46 ft

W & R | Sounding:CPT-10 | Oversight:S. Bray
Location:Canadys, SC | Date:03:24:03 15:11



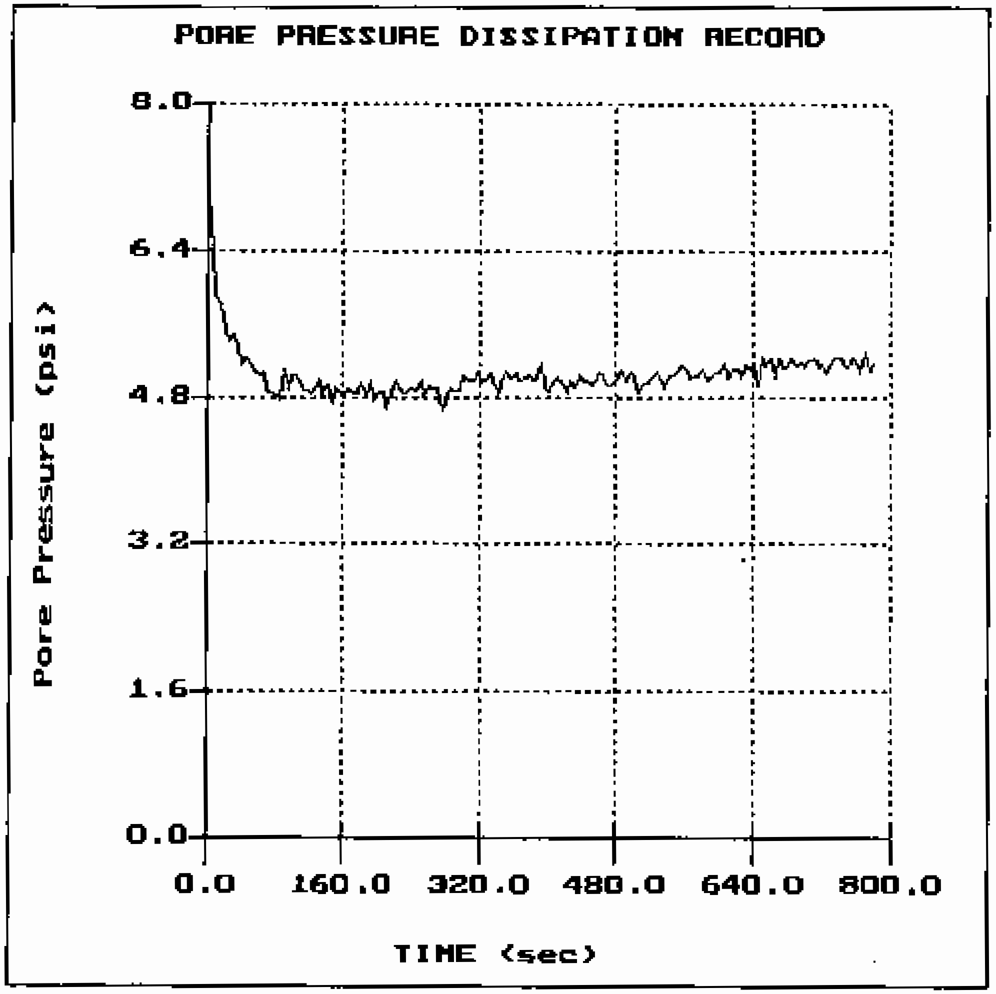
File: 044CP10.PPD
Depth (m): 10.98
(ft): 36.02
Duration : 450.0s
U-min: 10.42 370.0s
U-max: 33.45 0.0s
U-eq.: 10.42
U-50 : 21.94 10.7s
ch : 66.838 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 40.00
t-min: 0.00
t-max: 500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 3.65 m
11.98 ft

W & R

Sounding:CPT-12
Location:Canadys, SC

Oversight:S. Bray
Date:03:25:03 08:20



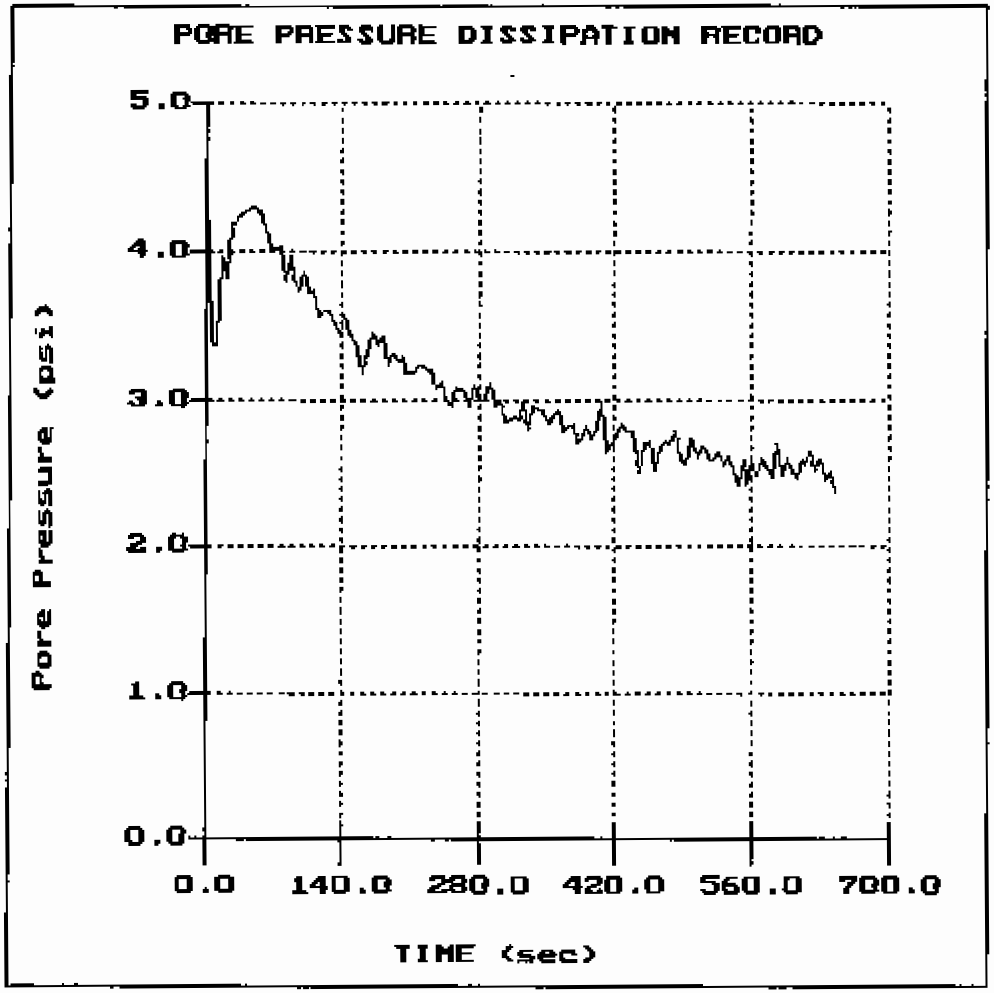
File: 044CP12.PPD
Depth (m): 6.95
(ft): 22.80
Duration : 780.0s
U-min: 4.64 275.0s
U-max: 7.02 0.0s
U-eq.: 5.22
U-50 : 6.12 7.8s
ch : 92.275 cm^2/min
%Ut: 1.32

Plot u-min: 0.00
u-max: 8.00
t-min: 0.00
t-max: 800.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 3.28 m
10.76 ft

W & R

Sounding:CPT-12
Location:Canadys, SC

Oversight:S. Bray
Date:03:25:03 08:20



File: 044CP12.PPD
Depth (m): 4.12
(ft): 13.52
Duration : 645.0s
U-min: 2.36 645.0s
U-max: 4.48 0.0s
U-eq.: 2.33
U-50 : 3.41 4.9s
ch : 146.713 cm^2/min
%Ut: 0.99

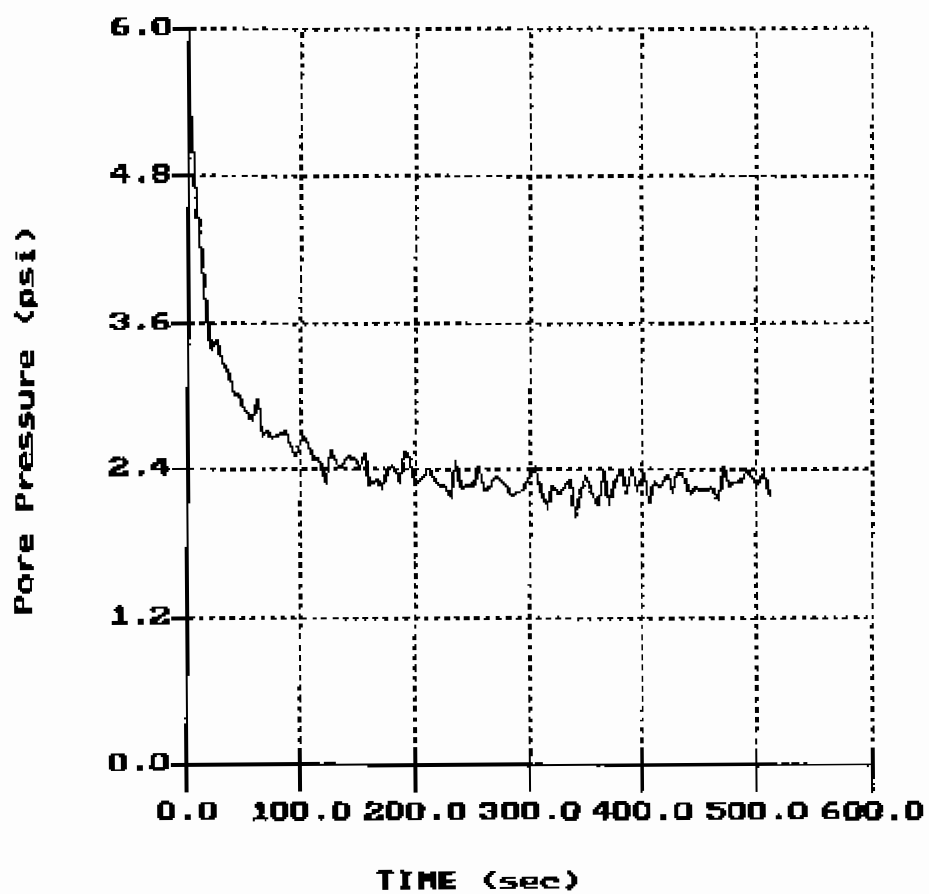
Plot u-min: 0.00
u-max: 5.00
t-min: 0.00
t-max: 700.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.48 m
8.14 ft

W & R

Sounding:CPT-13
Location:Canadys, SC

Oversight:S. Bray
Date:03:25:03 09:22

PORE PRESSURE DISSIPATION RECORD



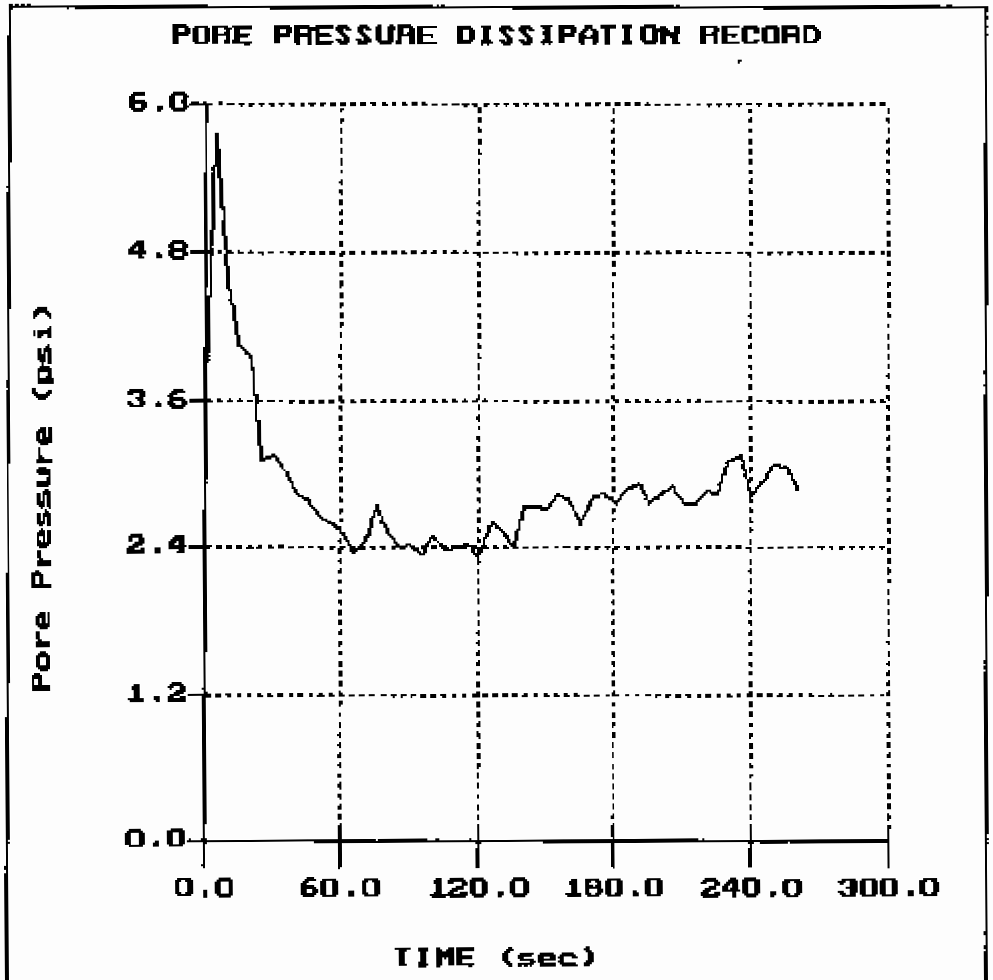
File: 044CP13.PPD
Depth (m): 5.08
(ft): 16.67
Duration : 510.0s
U-min: 2.03 340.0s
U-max: 5.41 0.0s
U-eq.: 2.33
U-50 : 3.87 13.4s
ch : 53.541 cm^2/min
%Ut : 1.10

Plot u-min: 0.00
u-max: 6.00
t-min: 0.00
t-max: 600.0
# of TicksX: 6
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 3.44 m
11.29 ft

W & R

Sounding:CPT-14A
Location:Canadys, SC

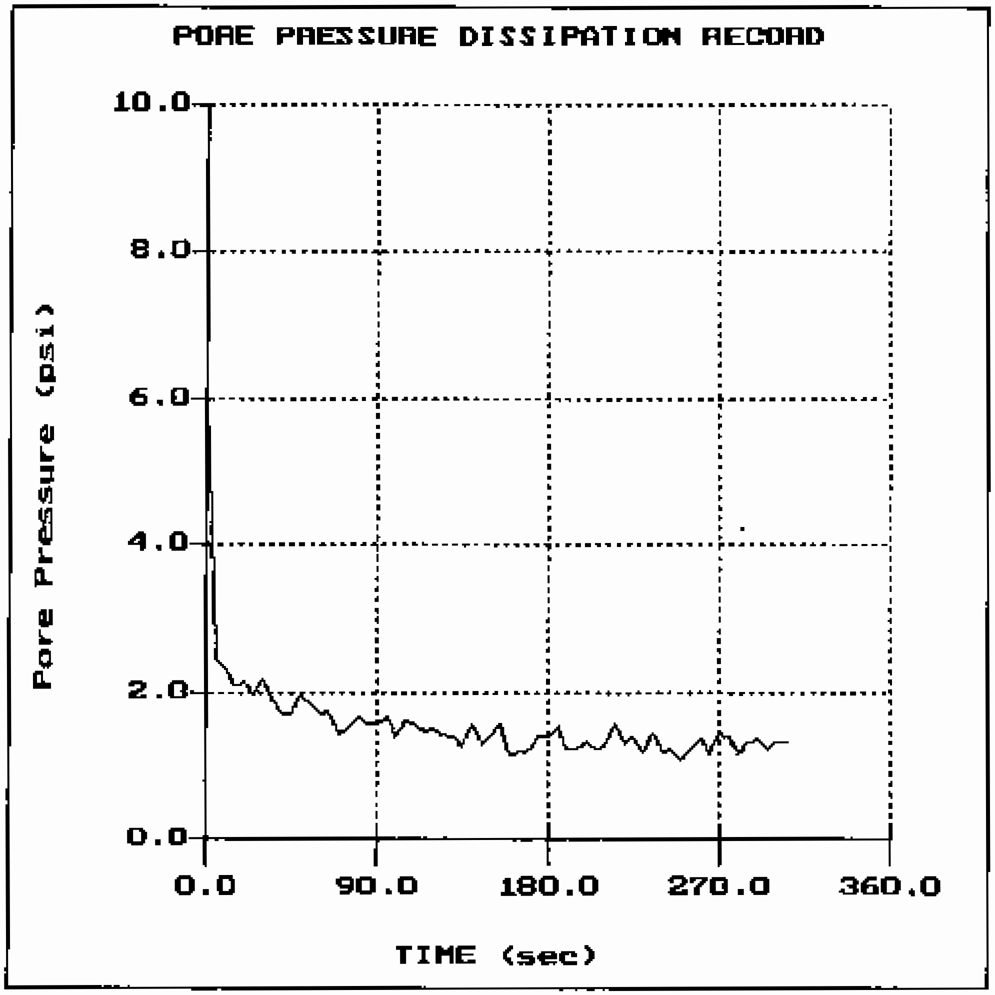
Oversight:S. Bray
Date:03:25:03 10:34



File: 044CP14A.PPD
Depth (m): 7.08
(ft): 23.23
Duration : 260.0s
U-min: 2.32 120.0s
U-max: 5.74 5.0s
U-eq.: 3.00
U-50 : 4.37 11.9s
ch : 60.384 cm^2/min
%Ut: 1.25

Plot u-min: 0.00
u-max: 6.00
t-min: 0.00
t-max:300.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir:100.0
Water table: 4.97 m
16.31 ft

W & R | Sounding:CPT-15 | Oversight:S. Bray
Location:Canadys, SC | Date:03:28:03 09:36



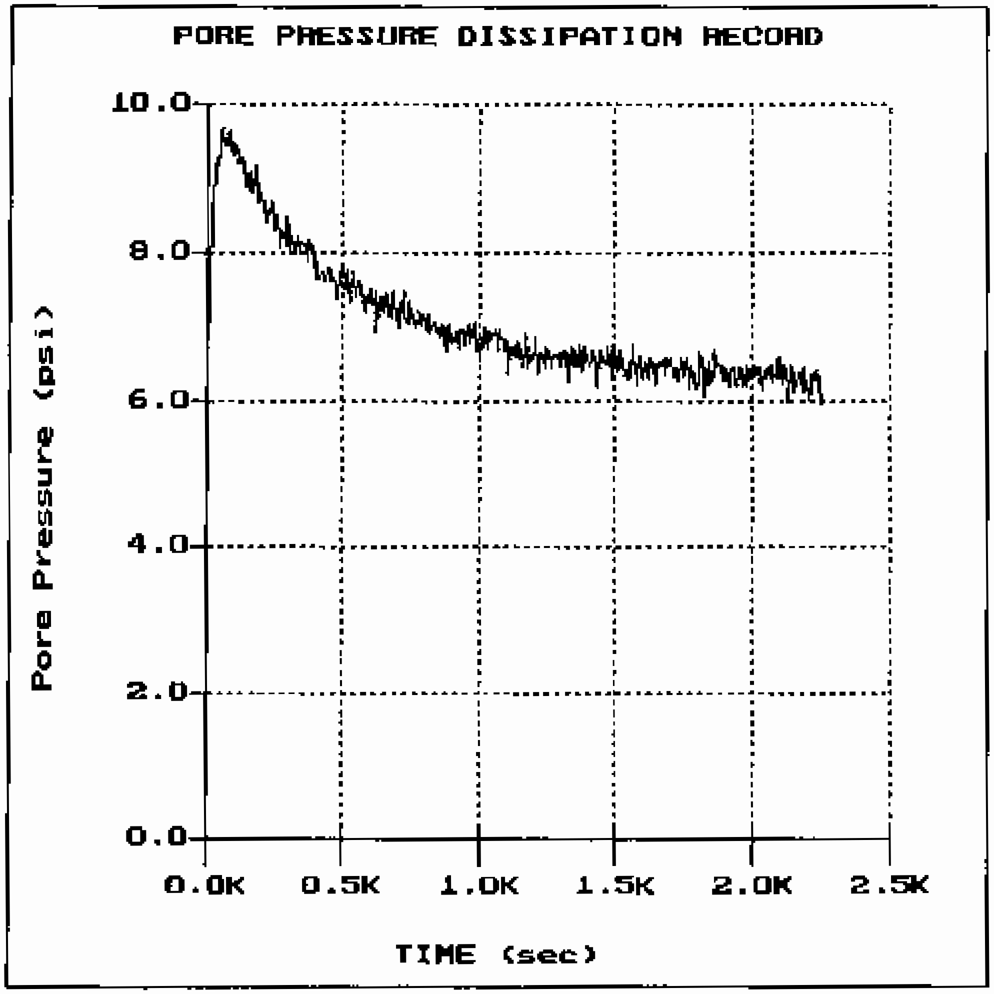
File: 044CP15.PPD
Depth (m): 5.15
(ft): 16.90
Duration : 305.0s
U-min: 1.08 250.0s
U-max: 6.04 0.0s
U-eq.: 1.32
U-50 : 3.68 3.3s
ch : 218.615 cm^2/min
%Ut: 1.05

Plot u-min: 0.00
u-max:10.00
t-min: 0.00
t-max:360.0
# of TicksX: 4
# of TicksY: 5
Rigidity Ir:100.0
Water table: 4.22 m
13.85 ft

W & R

Sounding:CPT-15
Location:Canadys, SC

Oversight:S. Bray
Date:03:28:03 09:36



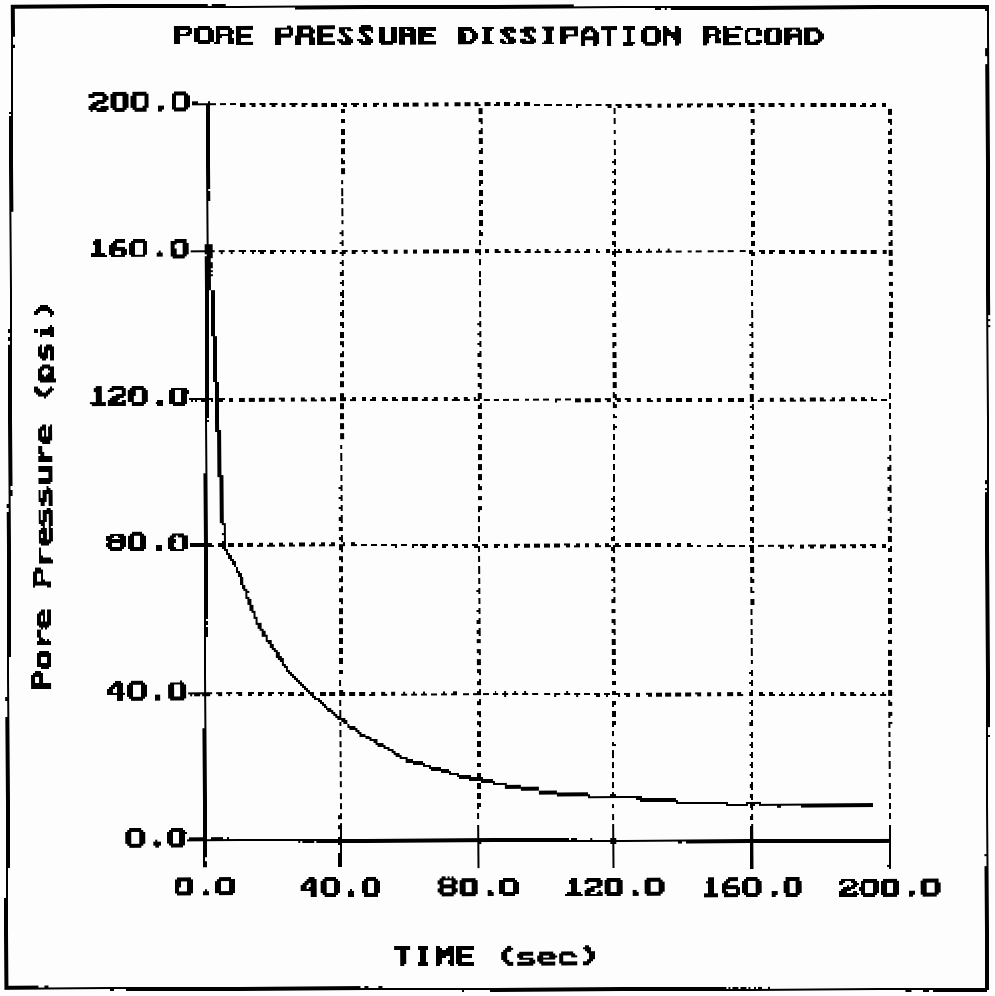
File: 044CP15.PPD
Depth (m): 9.57
(ft): 31.40
Duration : 2245.0s
U-min: 5.94 2245.0s
U-max: 9.70 55.0s
U-eq.: 6.29
U-50 : 7.99 334.6s
ch : 2.140 cm^2/min
%Ut: 1.10

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 2500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 5.15 m
16.90 ft

W & R

Sounding:CPT-15
Location:Canadys, SC

Oversight:S. Bray
Date:03:28:03 09:36



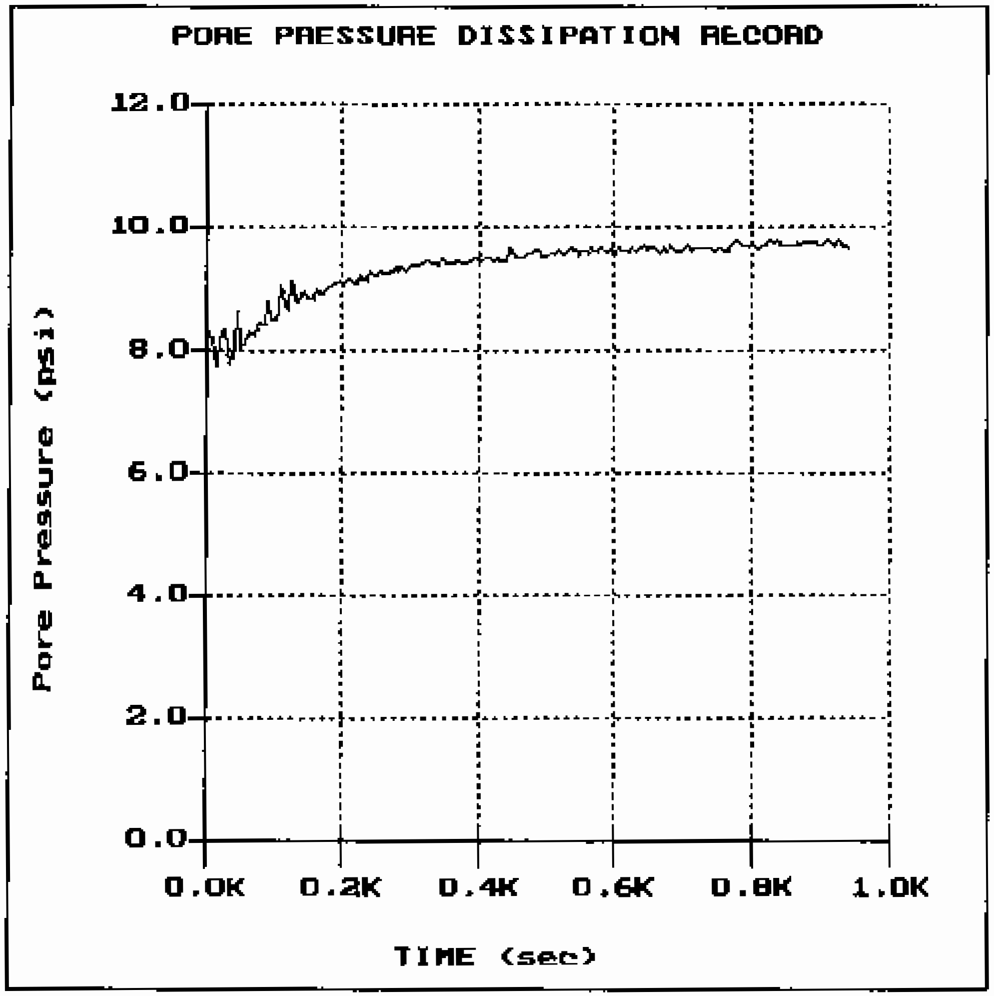
File: 044CP15.PPD
Depth (m): 10.90
(ft): 35.76
Duration : 195.0s
U-min: 9.56 180.0s
U-max: 167.89 0.0s
U-eq.: 9.73
U-50 : 88.81 4.5s
ch : 160.190 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max:200.00
t-min: 0.00
t-max:200.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir:100.0
Water table: 4.06 m
13.32 ft

W & R

Sounding:CPT-16
Location:Canadys, SC

Oversight:S. Bray
Date:03:25:03 13:56



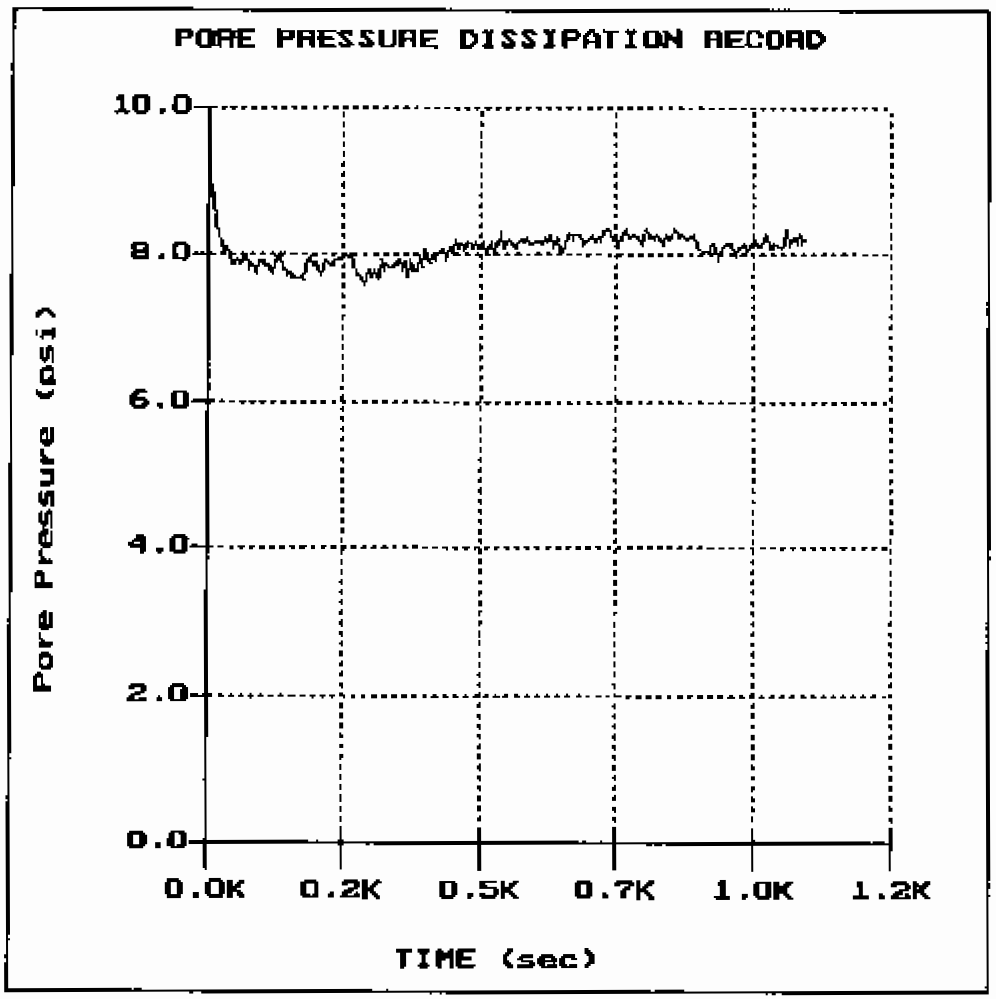
File: 044CP16.PPD
Depth (m): 9.75
(ft): 31.99
Duration : 940.0s
U-min: 7.77 15.0s
U-max: 9.81 910.0s
U-eq.: 9.75
U-50 : 8.76 89.6s
ch : 7.991 cm^2/min
%Ut: 1.03

Plot u-min: 0.00
u-max: 12.00
t-min: 0.00
t-max: 1000.0
# of TicksX: 5
# of TicksY: 6
Rigidity Ir: 100.0
Water table: 2.89 m
9.48 ft

W & R

Sounding:CPT-17
Location:Canadys, SC

Oversight:S. Bray
Date:03:25:03 11:37



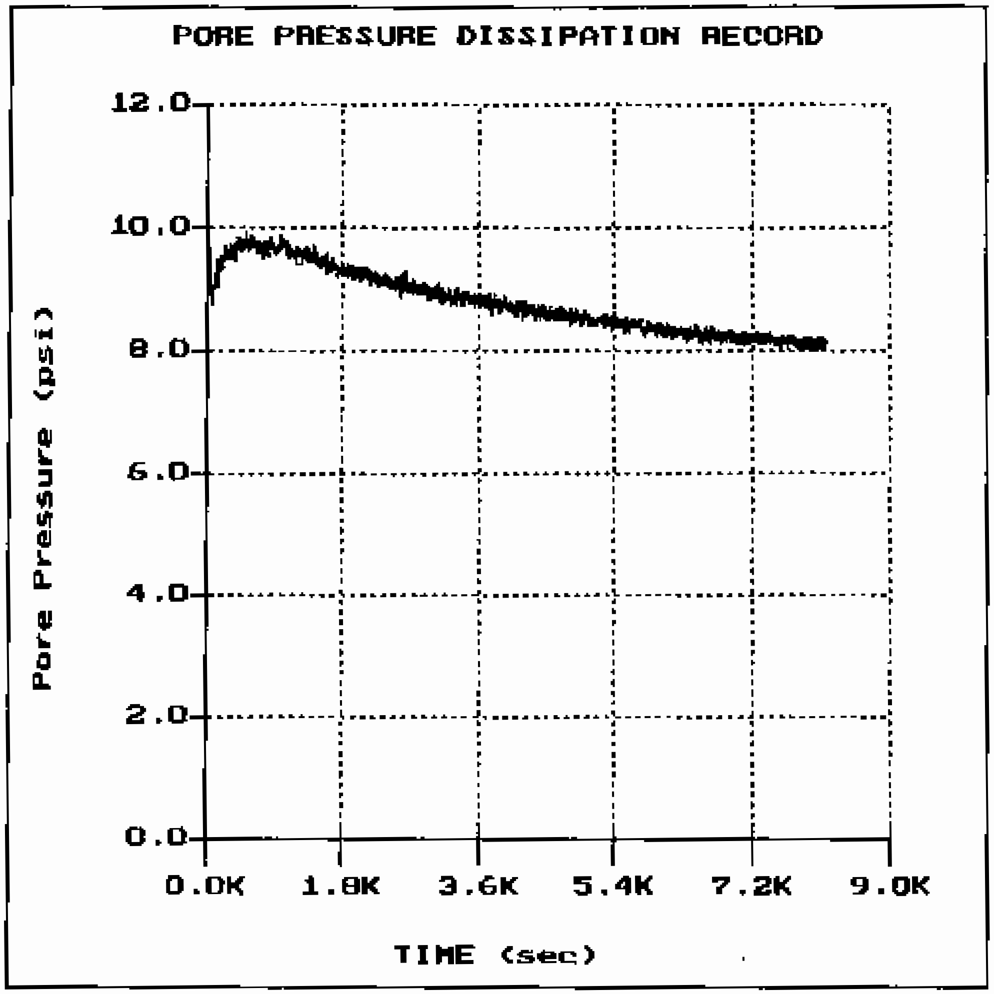
File: 044CP17.PPD
Depth (m): 7.18
(ft): 23.56
Duration : 1050.0s
U-min: 7.57 275.0s
U-max: 8.93 5.0s
U-eq.: 8.05
U-50 : 8.49 14.1s
ch : 50.838 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 10.00
t-min: 0.00
t-max: 1200.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 1.52 m
4.99 ft

W & R

Sounding:CPT-18
Location:Canadys, SC

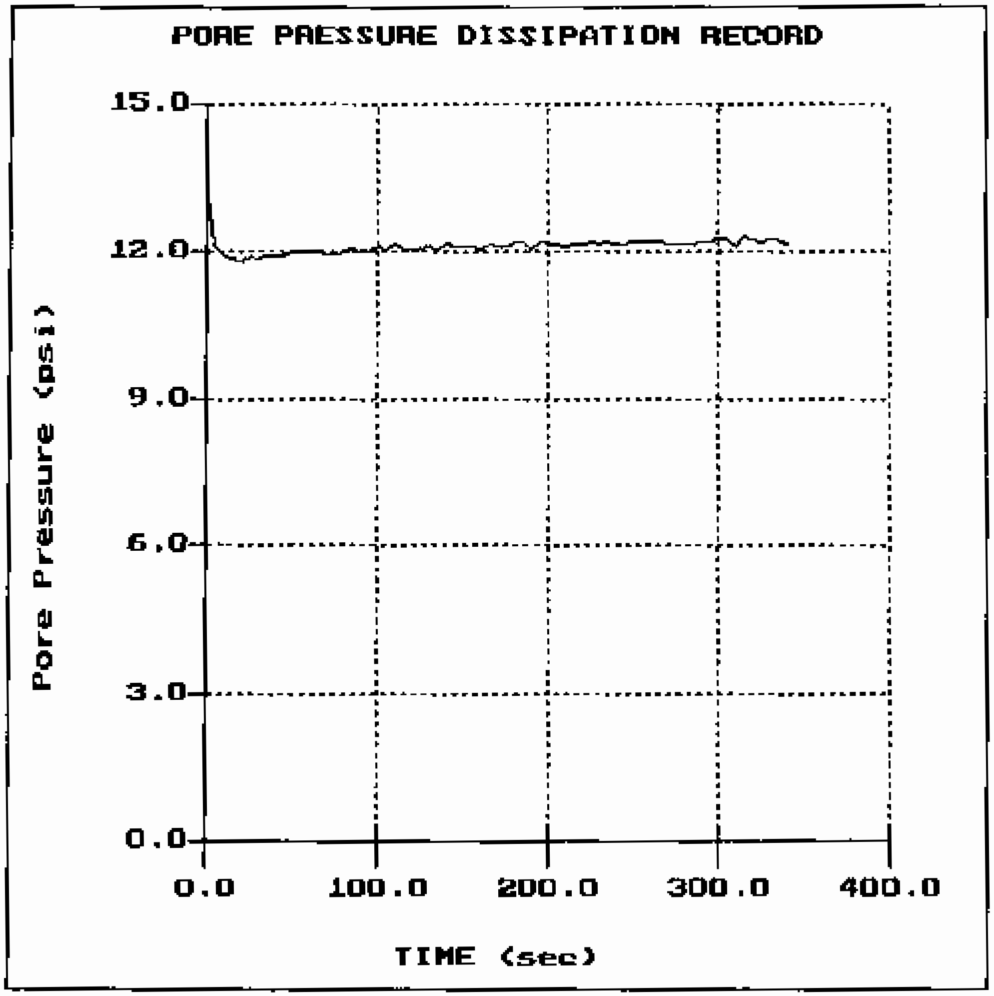
Oversight:S. Bray
Date:03:25:03 15:00



File: 044CP18.PPD
Depth (m): 8.10
(ft): 26.57
Duration : 8150.0s
U-min: 8.00 8030.0s
U-max: 11.11 0.0s
U-eq.: 7.88
U-50 : 9.49 22.9s
ch : 31.212 cm^2/min
%Ut: 0.96

Plot u-min: 0.00
u-max: 12.00
t-min: 0.00
t-max: 9000.0
# of TicksX: 5
# of TicksY: 6
Rigidity Ir: 100.0
Water table: 2.56 m
8.40 ft

W & R | Sounding:CPT-19 | Oversight:S. Bray
Location:Canadys, SC | Date:03:26:03 10:03



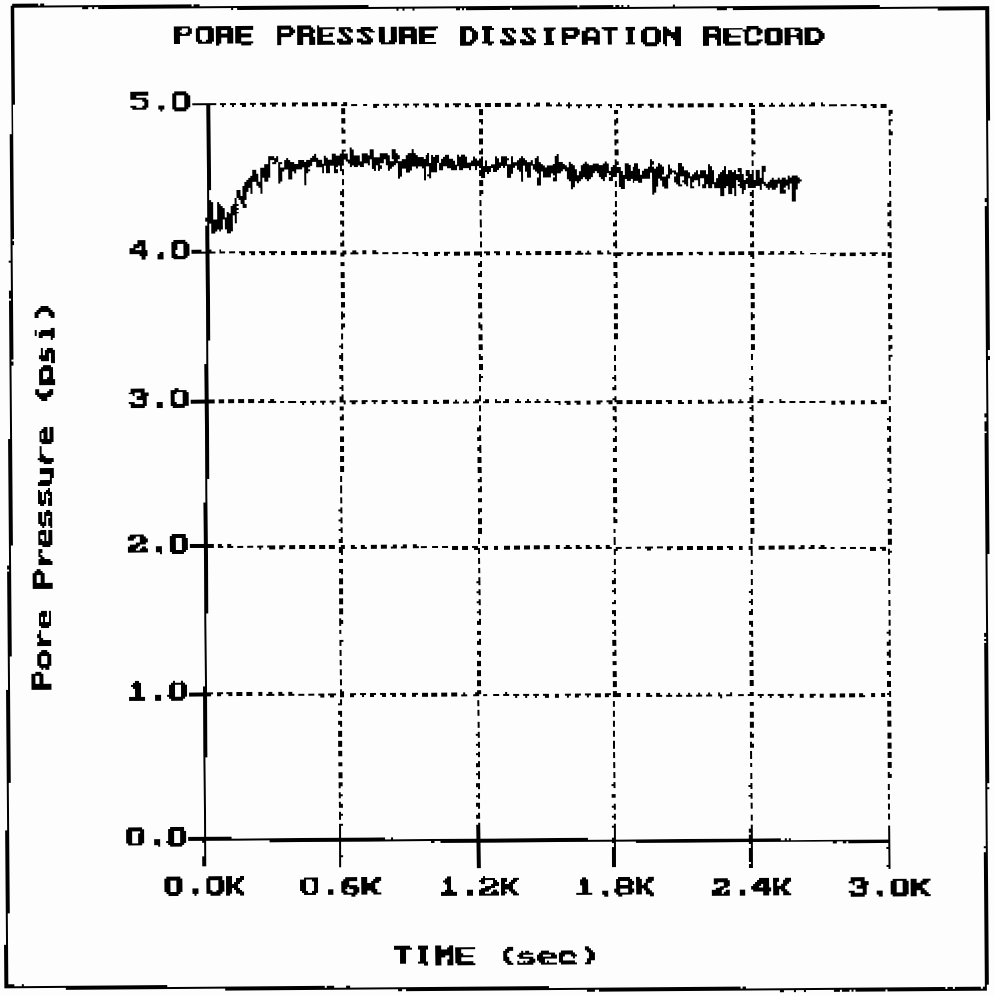
File: 044CP19.PPD
Depth (m): 11.32
(ft): 37.14
Duration : 340.0s
U-min: 11.78 20.0s
U-max: 13.14 0.0s
U-eq.: 12.24
U-50 : 12.69 2.1s
ch : 345.086 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 400.0
# of TicksX: 4
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.71 m
8.89 ft

W & R

Sounding:CPT-20
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 08:27



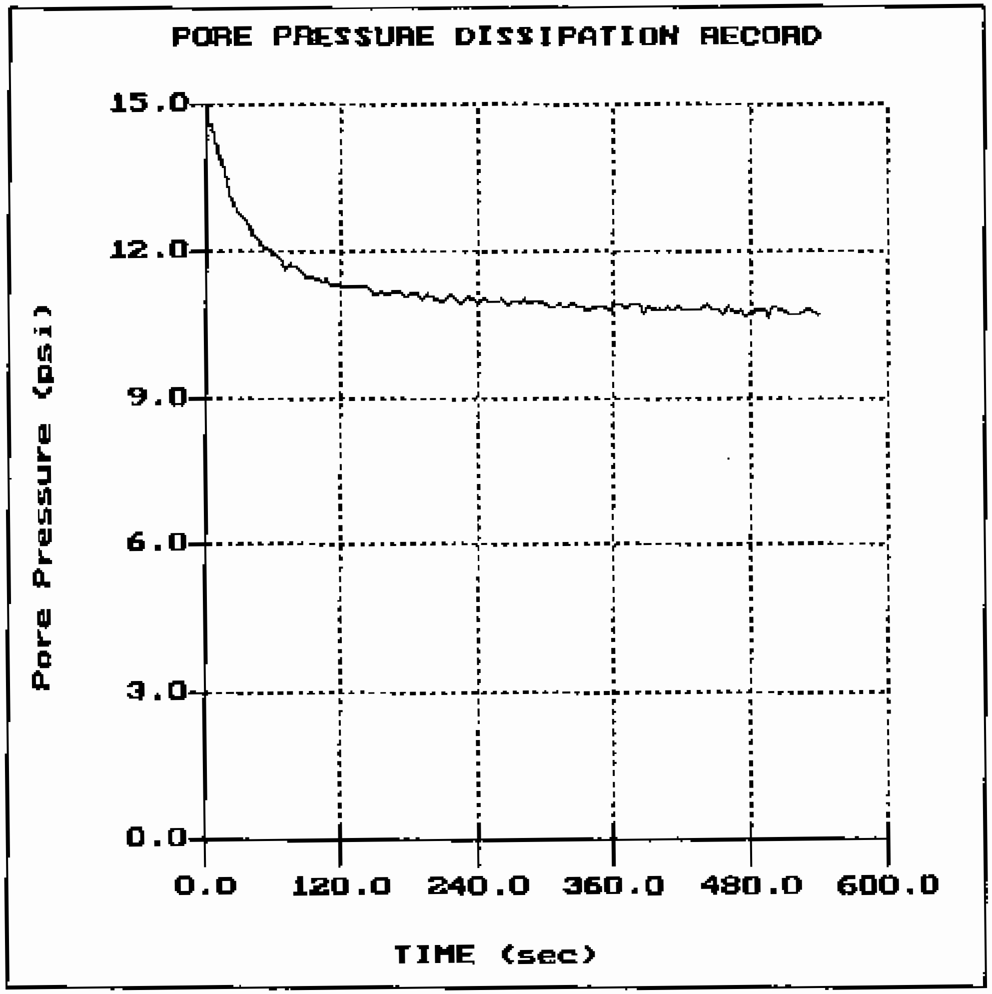
File: 044CP20.PPD
Depth (m): 6.10
(ft): 20.01
Duration : 2595.0s
U-min: 4.07 5.0s
U-max: 4.68 890.0s
U-eq.: 4.48
U-50 : 4.27 8.9s
ch : 80.151 cm^2/min
%Ut: 1.49

Plot u-min: 0.00
u-max: 5.00
t-min: 0.00
t-max: 3000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 2.95 m
9.68 ft

W & R

Sounding:CPT-20
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 08:27



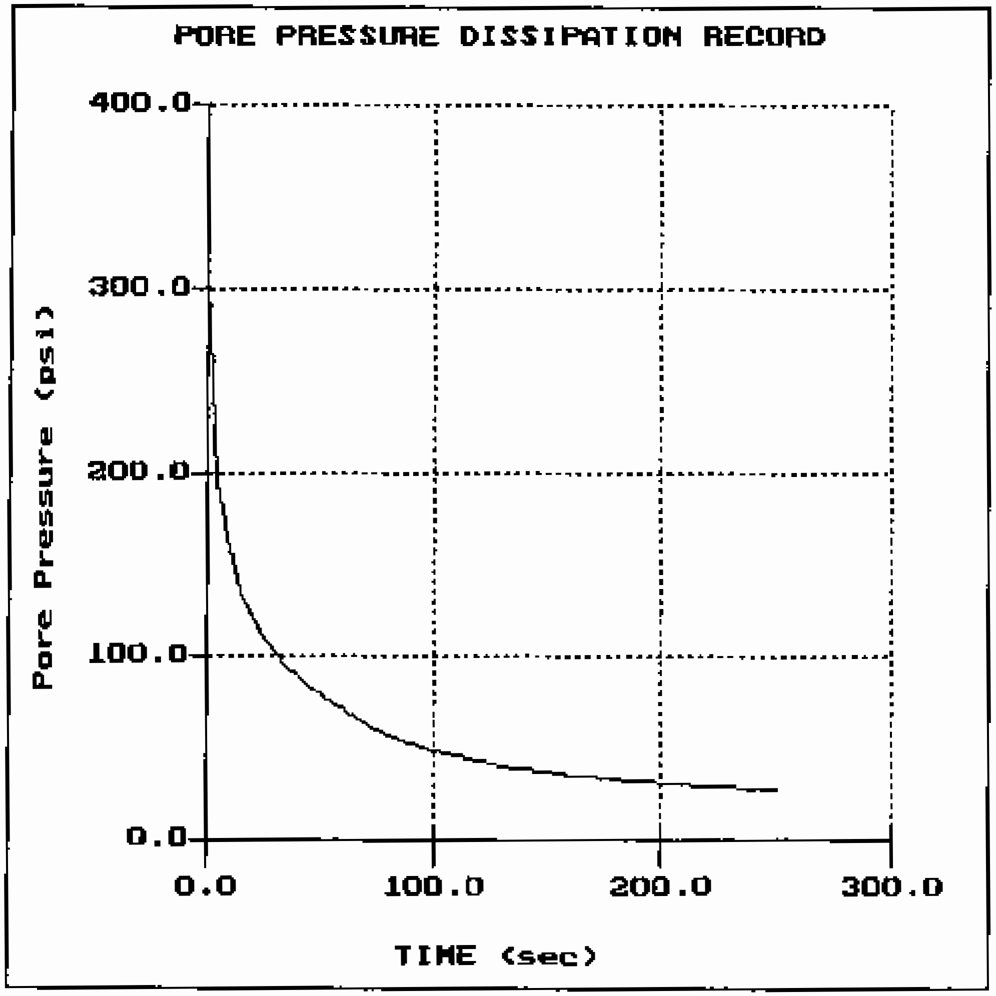
File: 044CP20.PPD
Depth (m): 11.25
(ft): 36.91
Duration : 540.0s
U-min: 10.62 475.0s
U-max: 14.59 5.0s
U-eq.: 10.62
U-50 : 12.61 34.5s
ch : 20.745 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 600.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 3.78 m
12.40 ft

W & R

Sounding:CPT-20
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 08:27



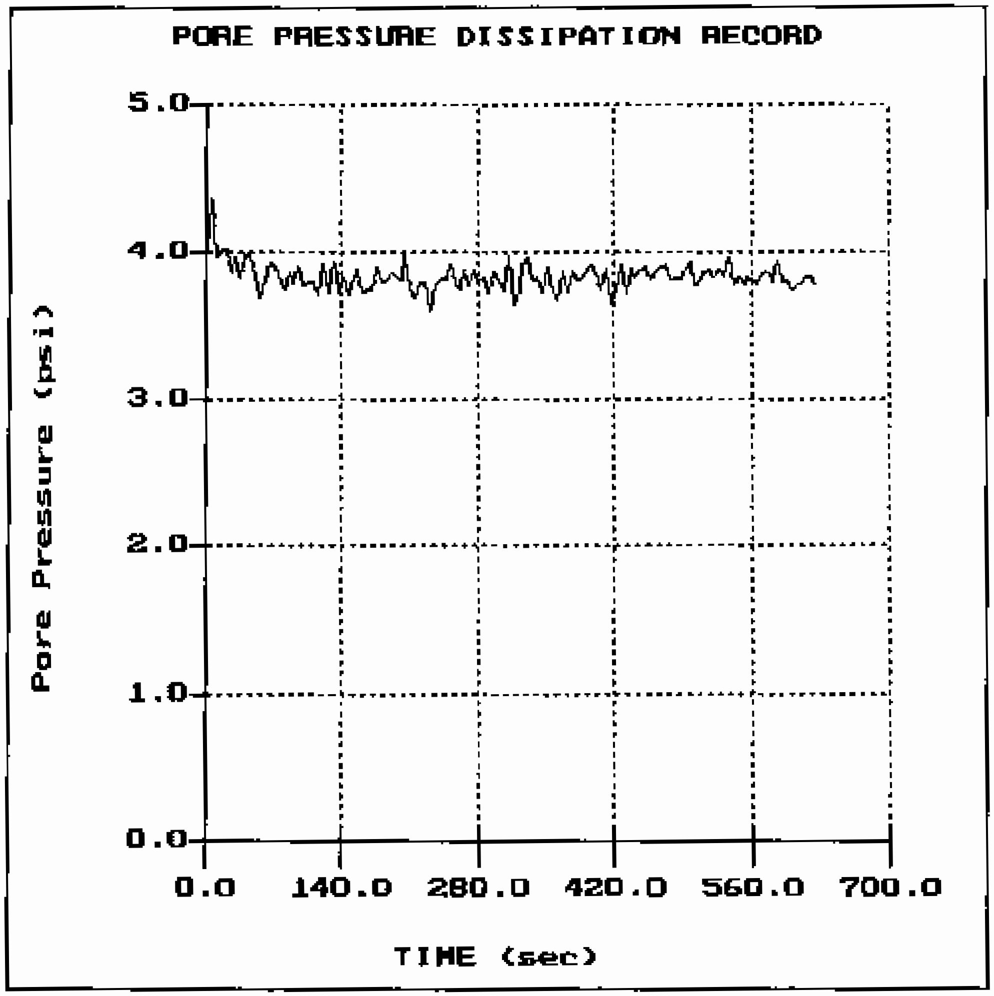
File: 044CP20.PPD
Depth (m): 12.28
(ft): 40.29
Duration : 250.0s
U-min: 27.55 250.0s
U-max: 307.13 0.0s
U-eq.: 13.89
U-50 : 160.51 9.7s
ch : 73.470 cm^2/min
%Ut: 0.95

Plot u-min: 0.00
u-max:400.00
t-min: 0.00
t-max:300.0
# of TicksX: 3
# of TicksY: 4
Rigidity Ir:100.0
Water table: 2.51 m
8.23 ft

W & R

Sounding:CPT-21
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 10:49



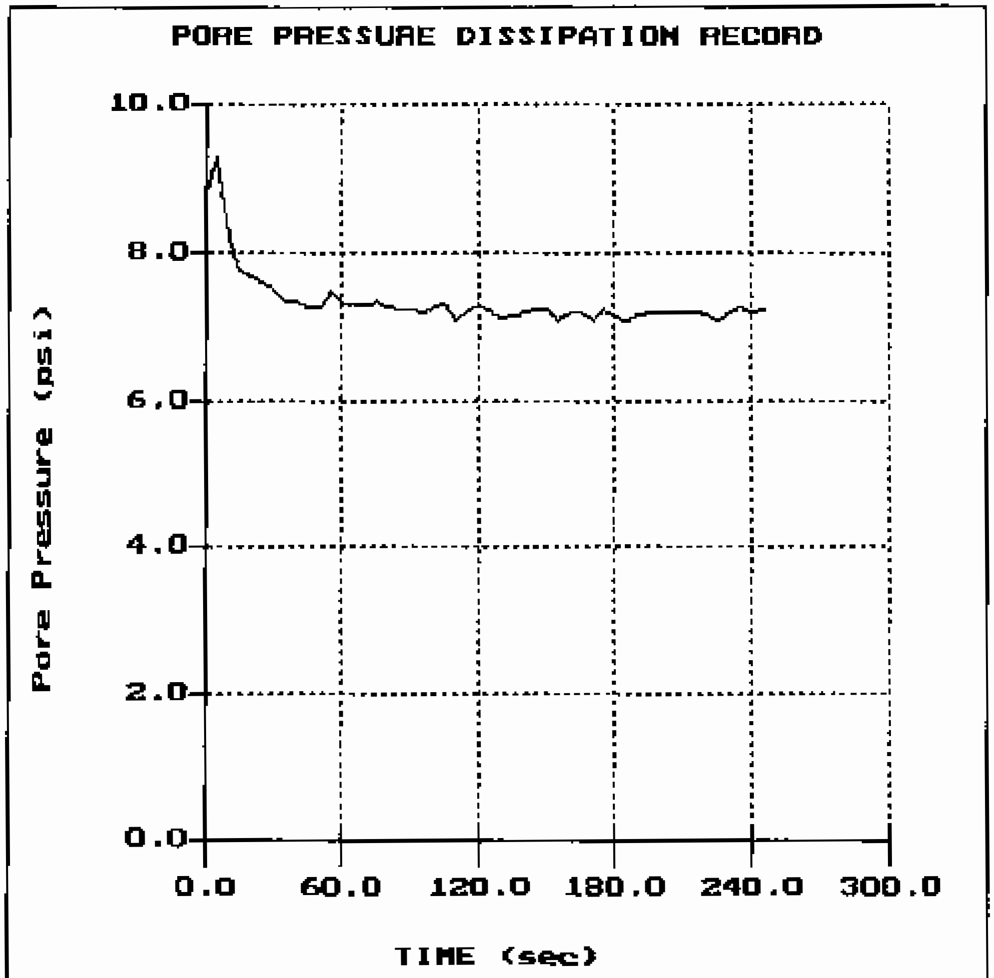
File: 044CP21.PPD
Depth (m): 8.10
(ft): 26.57
Duration : 625.0s
U-min: 3.60 230.0s
U-max: 4.35 5.0s
U-eq.: 3.85
U-50 : 4.10 8.1s
ch : 88.394 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 5.00
t-min: 0.00
t-max: 700.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 5.39 m
17.68 ft

W & R

Sounding:CPT-21
Location:Canadys, SC

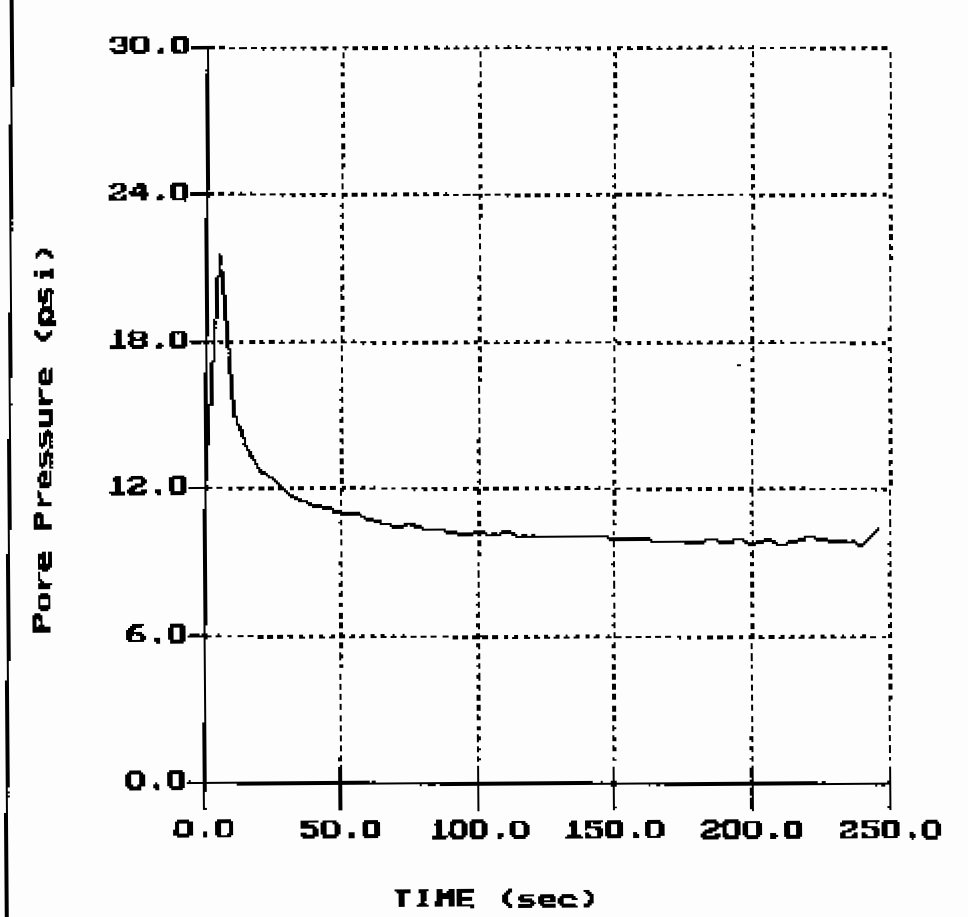
Oversight:S. Bray
Date:03:26:03 10:49




```
File: 044CP21.PPD
Depth (m): 10.50
     (ft): 34.45
Duration : 245.0s
U-min:   7.08 225.0s
U-max:   9.28   5.0s
U-eq.:   7.22
U-50 :   8.25   9.8s
ch : 73.382 cm^2/min
%Ut:   1.07

Plot   u-min:  0.00
       u-max:10.00
       t-min: 0.00
       t-max:300.0
# of TicksX:    5
# of TicksY:    5
Rigidity Ir:100.0
Water table:  5.42 m
             17.78 ft
```

W & R	Sounding:CPT-21 Location:Canadys, SC	Oversight:S. Bray Date:03:26:03 10:49



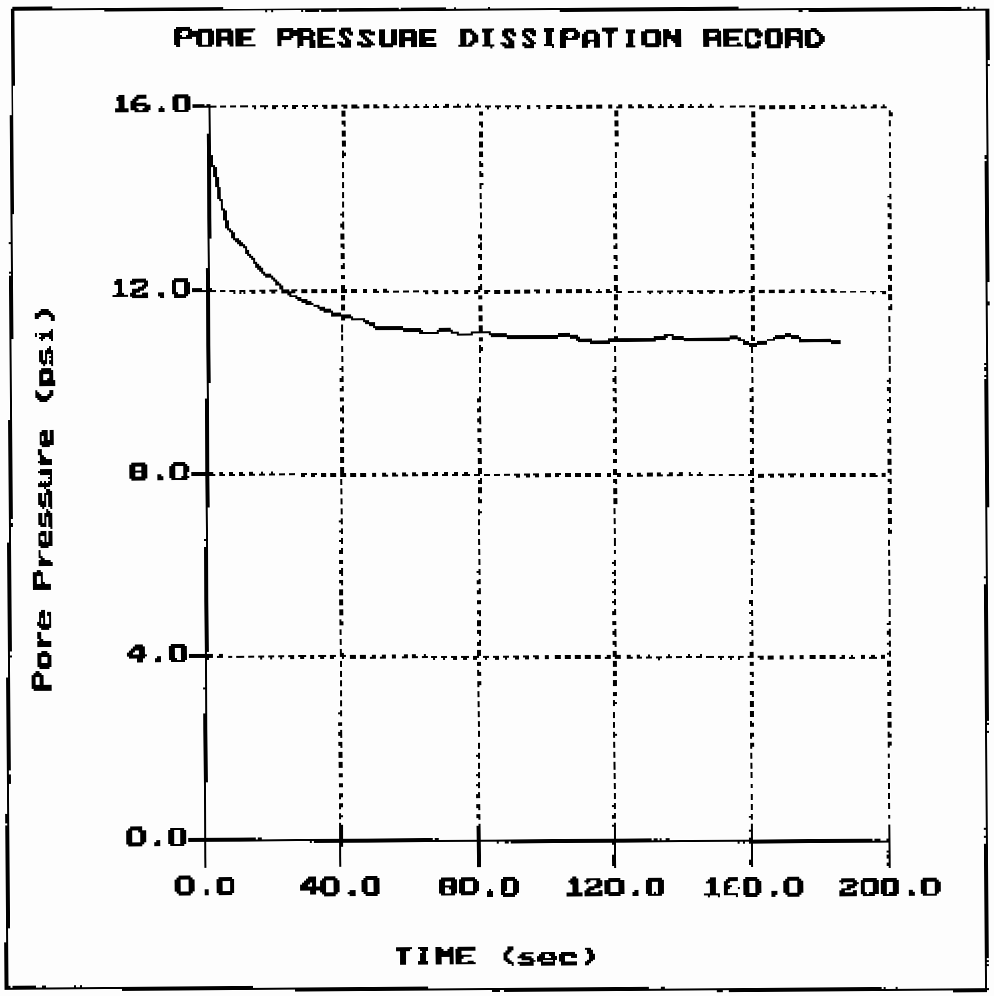
File: 044CP21.PPD
Depth (m): 11.50
(ft): 37.73
Duration : 245.0s
U-min: 9.70 210.0s
U-max: 21.48 5.0s
U-eq.: 9.68
U-50 : 15.58 9.5s
ch : 75.042 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max:30.00
t-min: 0.00
t-max:250.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir:100.0
Water table: 4.69 m
15.39 ft

W & R

Sounding:CPT-22A
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 12:12



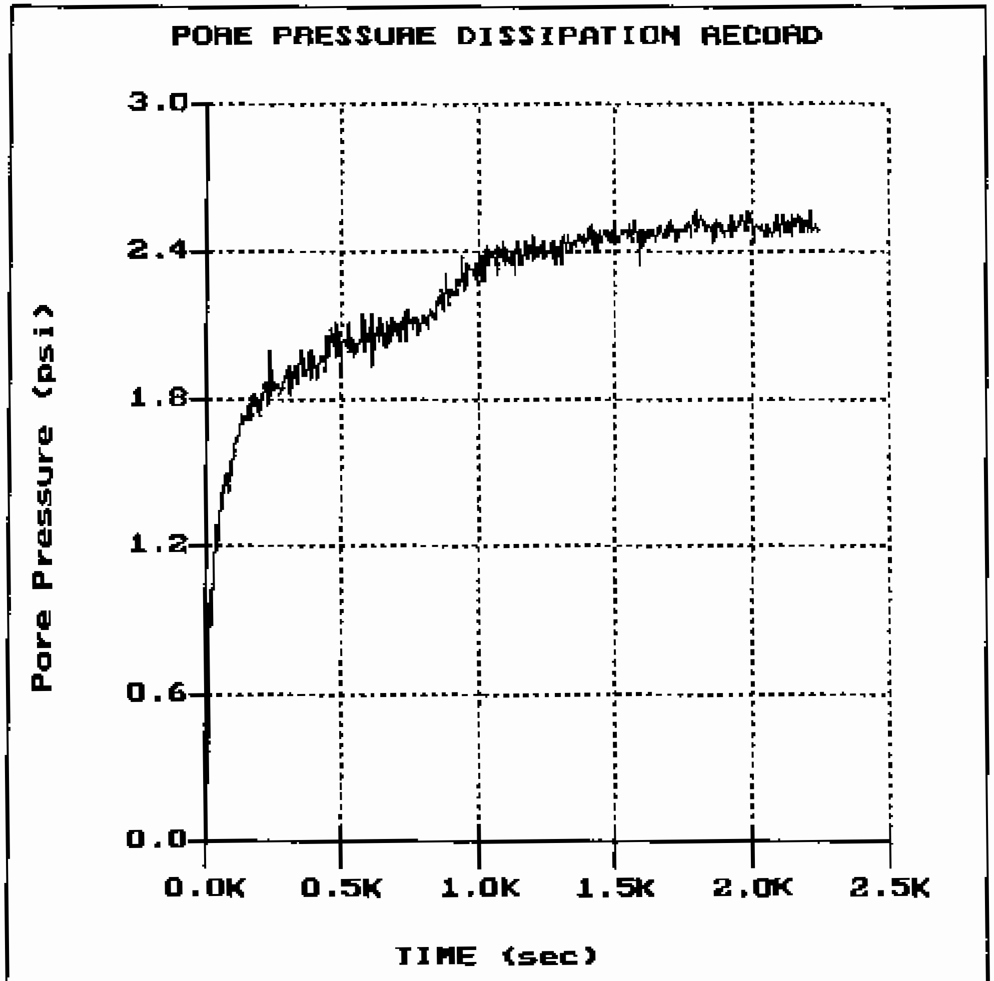
File: 044CP22A.PPD
Depth (m): 10.38
(ft): 34.06
Duration : 185.0s
U-min: 10.84 160.0s
U-max: 15.03 0.0s
U-eq.: 10.89
U-50 : 12.96 10.4s
ch : 68.999 cm^2/min
%Ut: 1.01

Plot u-min: 0.00
u-max: 16.00
t-min: 0.00
t-max: 200.0
# of TicksX: 5
# of TicksY: 4
Rigidity Ir: 100.0
Water table: 2.72 m
8.92 ft

W & R

Sounding:CPT-23
Location:Canadys, SC

Oversight:S. Bray
Date:03:28:03 11:13



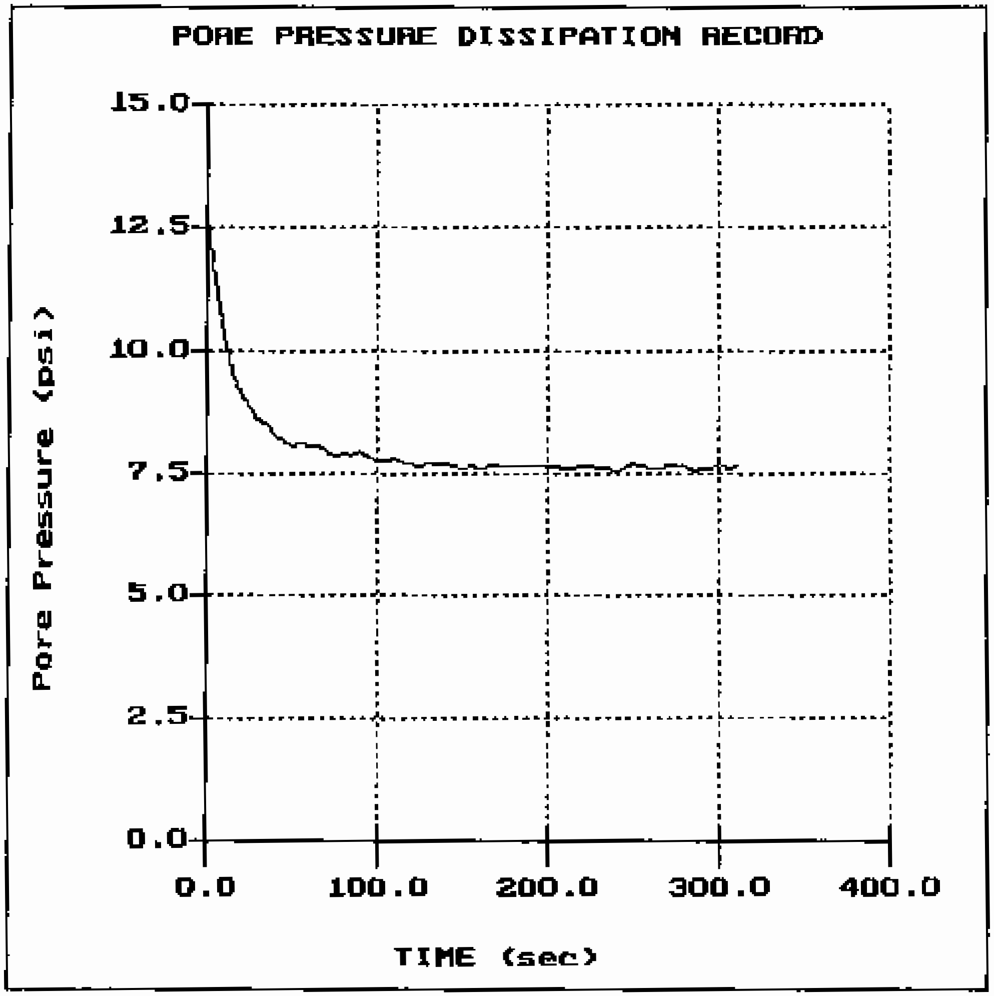
File: 044CP23.PPD
Depth (m): 5.53
(ft): 18.14
Duration : 2235.0s
U-min: 0.24 5.0s
U-max: 2.56 2210.0s
U-eq.: 2.52
U-50 : 1.38 58.2s
ch : 12.305 cm^2/min
%Ut: 1.02

Plot u-min: 0.00
u-max: 3.00
t-min: 0.00
t-max:2500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir:100.0
Water table: 3.76 m
12.34 ft

W & R

Sounding:CPT-23
Location:Canadys, SC

Oversight:S. Bray
Date:03:28:03 11:13



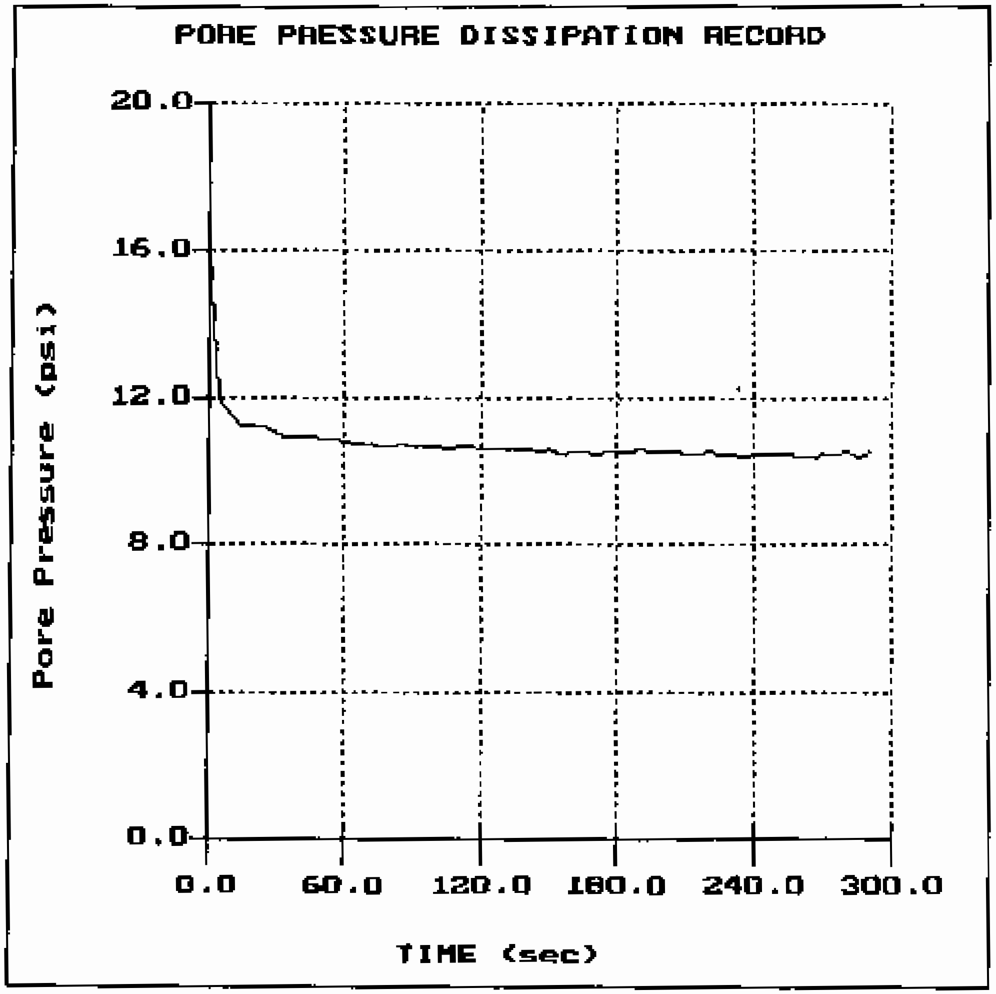
File: 044CP23.PPD
Depth (m): 8.93
(ft): 29.30
Duration : 310.0s
U-min: 7.53 285.0s
U-max: 12.65 0.0s
U-eq.: 7.61
U-50 : 10.13 11.2s
ch : 63.902 cm^2/min
%Ut: 1.02

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 400.0
# of TicksX: 4
# of TicksY: 6
Rigidity Ir: 100.0
Water table: 3.58 m
11.75 ft

W & R

Sounding:CPT-23
Location:Canadys, SC

Oversight:S. Bray
Date:03:28:03 11:13



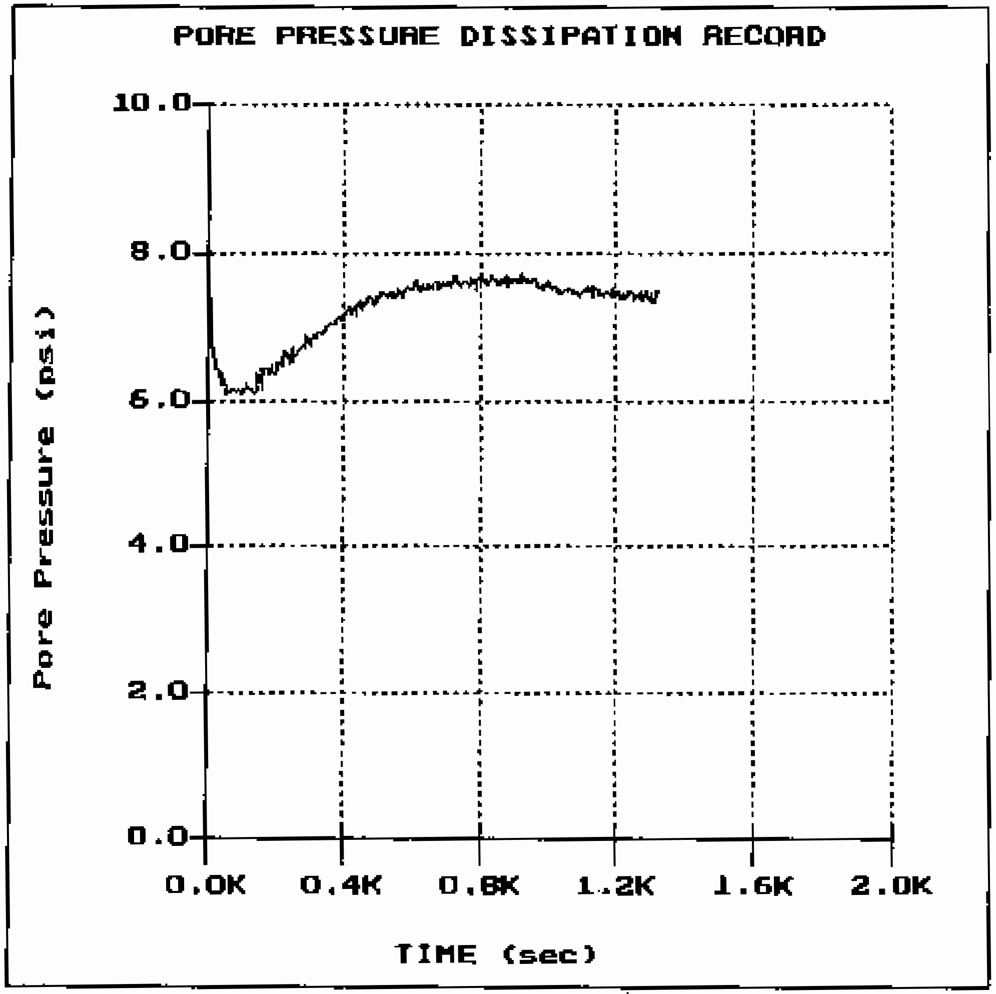
File: 044CP23.PPD
Depth (m): 10.82
(ft): 35.50
Duration : 290.0s
U-min: 10.34 265.0s
U-max: 16.03 0.0s
U-eq.: 10.42
U-50 : 13.23 3.4s
ch : 208.981 cm^2/min
%Ut: 1.01

Plot u-min: 0.00
u-max: 20.00
t-min: 0.00
t-max: 300.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 3.49 m
11.45 ft

W & R

Sounding:CPT-24
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 14:01

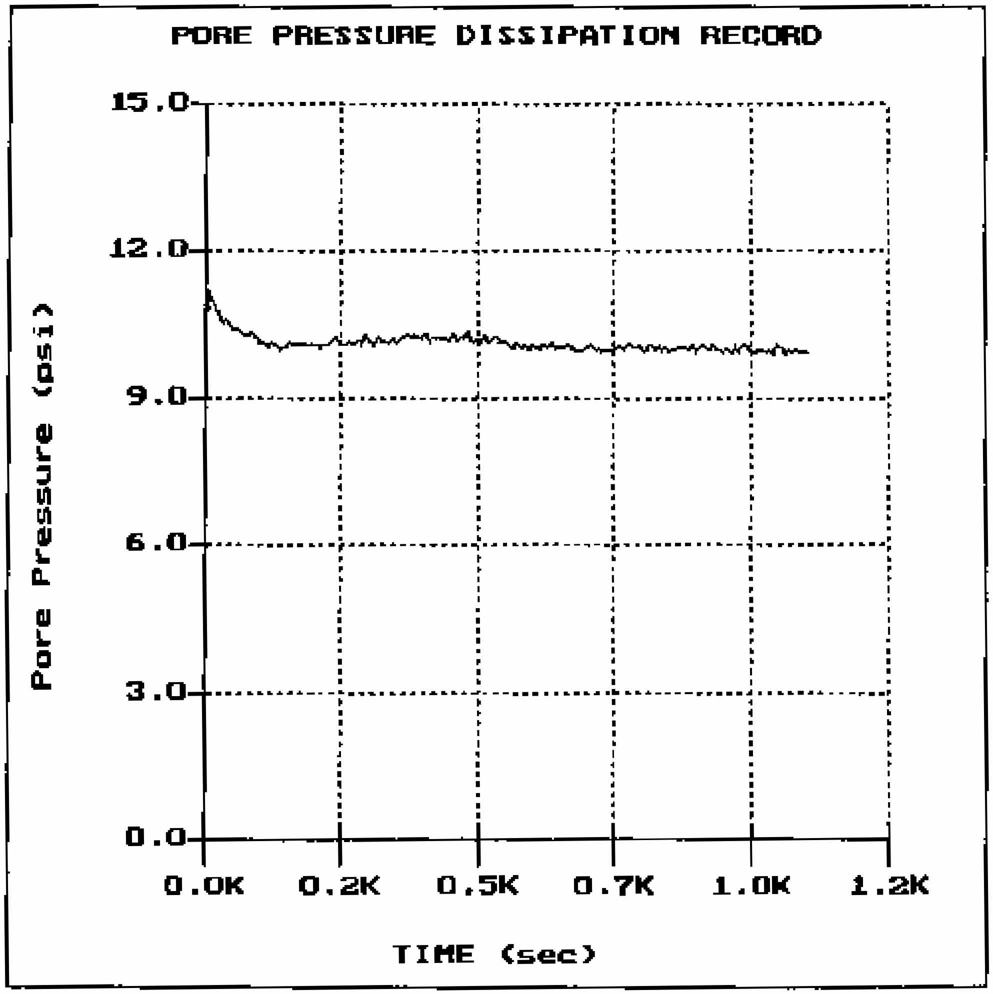


File: 044CP24.PPD
Depth (m): 2.45
(ft): 8.04
Duration : 1320.0s
U-min: 6.08 135.0s
U-max: 7.73 0.0s

W & R

Sounding:CPT-24
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 14:01



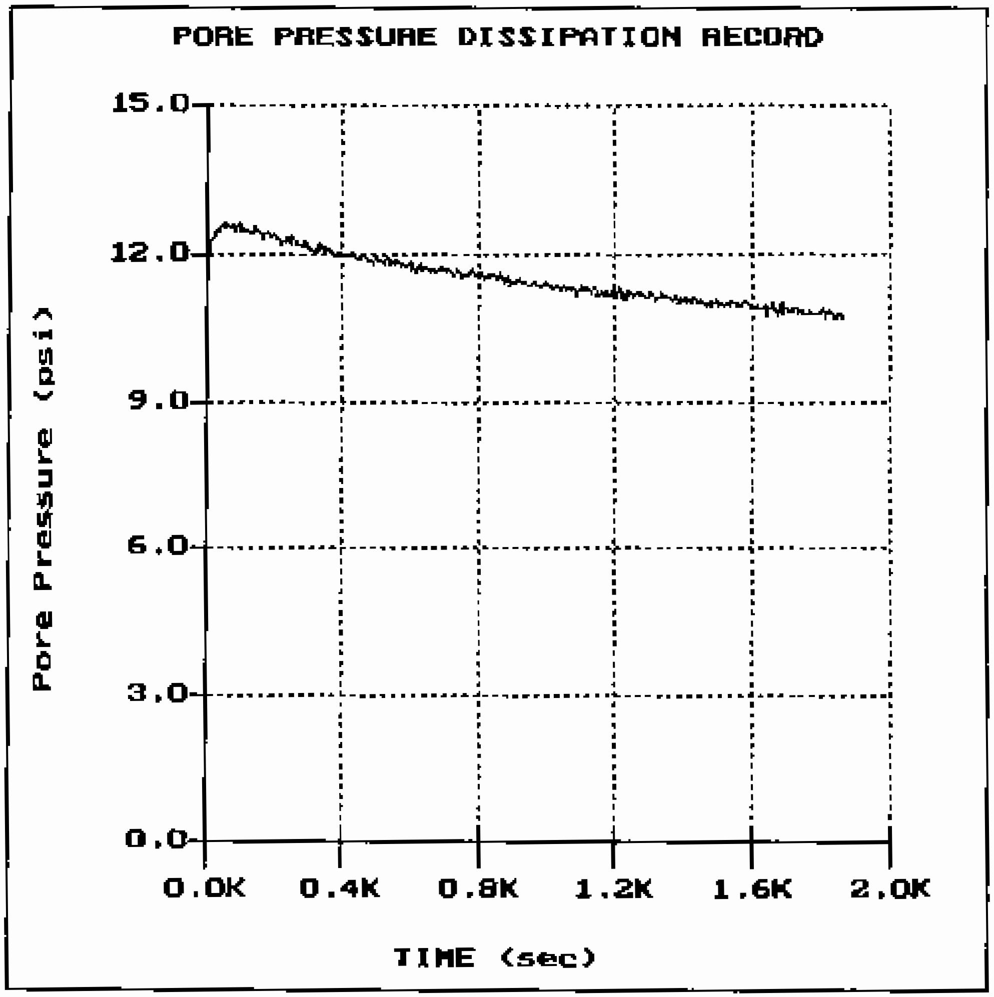
File: 044CP24.PPD
Depth (m): 7.35
(ft): 24.11
Duration : 1055.0s
U-min: 9.83 1020.0s
U-max: 11.15 5.0s
U-eq.: 9.84
U-50 : 10.50 29.5s
ch : 24.255 cm^2/min
%Ut: 1.00

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 1200.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 0.43 m
1.41 ft

W & R

Sounding:CPT-24
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 14:01



File: 044CP24.PPD
Depth (m): 7.93
(ft): 26.02
Duration : 1860.0s
U-min: 10.66 1860.0s
U-max: 12.59 100.0s
U-eq.: 10.15
U-50 : 11.37 884.9s
ch : 0.809 cm^2/min
%Ut: 0.79

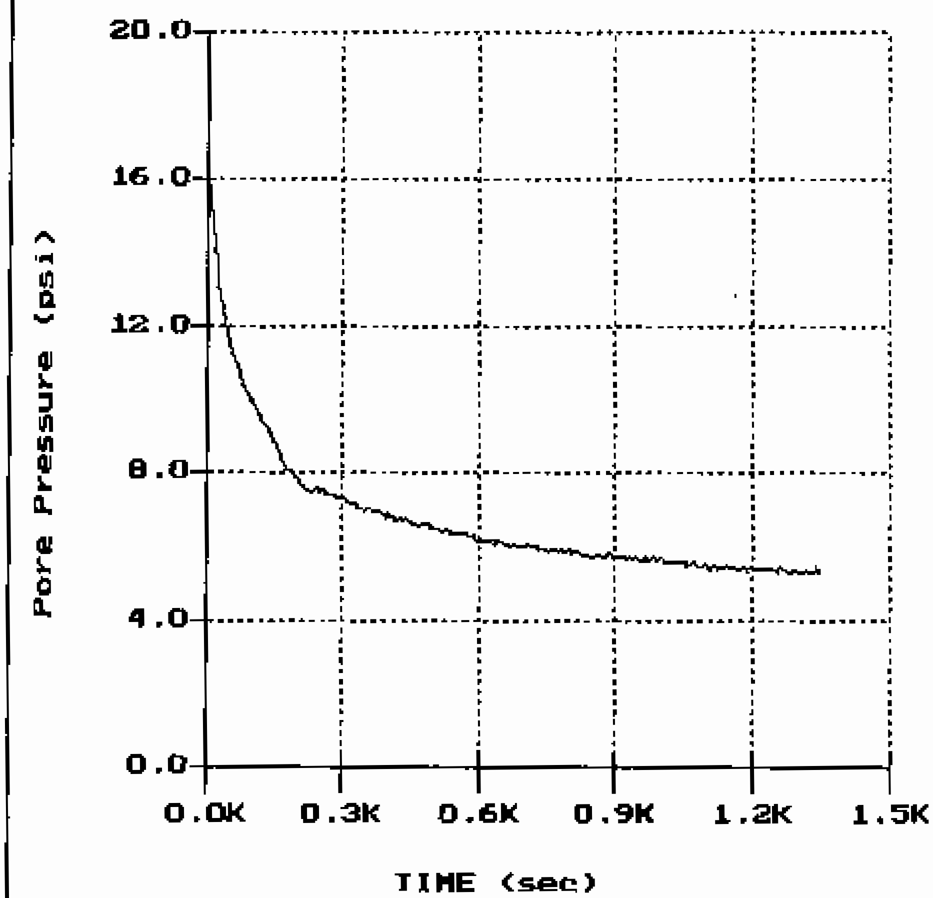
Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 2000.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 0.79 m
2.59 ft

W & R

Sounding:CPT-25
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 16:02

PORE PRESSURE DISSIPATION RECORD



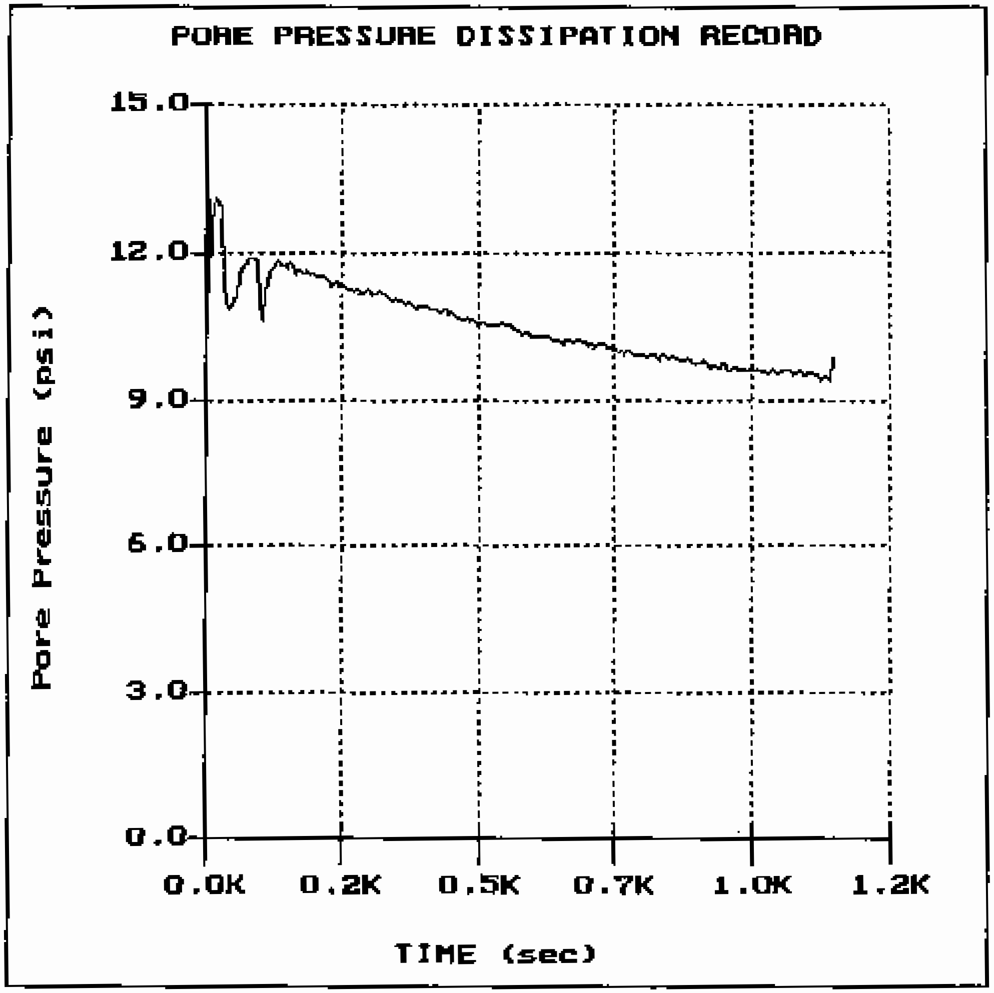
File: 044CP25.PPD
Depth (m): 7.97
(ft): 26.15
Duration : 1345.0s
U-min: 5.27 1275.0s
U-max: 16.11 0.0s
U-eq.: 5.01
U-50 : 10.56 75.1s
ch : 9.537 cm^2/min
%Ut: 0.98

Plot u-min: 0.00
u-max: 20.00
t-min: 0.00
t-max: 1500.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 4.45 m
14.60 ft

W & R

Sounding:CPT-25
Location:Canadys, SC

Oversight:S. Bray
Date:03:26:03 16:02



File: 044CP25.PPD
Depth (m): 9.32
(ft): 30.58
Duration : 1100.0s
U-min: 9.40 1095.0s
U-max: 15.06 0.0s
U-eq.: 7.14
U-50 : 11.10 33.2s
ch : 21.557 cm^2/min
%Ut: 0.71

Plot u-min: 0.00
u-max: 15.00
t-min: 0.00
t-max: 1200.0
# of TicksX: 5
# of TicksY: 5
Rigidity Ir: 100.0
Water table: 4.30 m
14.11 ft

APPENDIX C

INTERPRETATION METHODS AND REFERENCES

GREGG

GREGG IN SITU CPT Interpretations as of July 31, 2002 (Release 1.20c)

GREGG IN SITU's interpretation routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended. GREGG IN SITU, Inc. and GREGG DRILLING & TESTING Inc. do not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the program and can not assume liability for any use of the results in any design or review. Representative hand calculations should be made for any parameter that is critical for design purposes. The end user of the interpreted output should also be fully aware of the techniques and the limitations of any method used in this program. The purpose of this document is to inform the user as to which methods were used and what the appropriate papers and/or publications are for further reference.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (e.g. 0.20m). Note that q_t is the recorded tip value, q_c, corrected for pore pressure effects. Since all GREGG IN SITU cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, Fs, are not required.

The tip correction is: $q_t = q_c + (1\text{-}a) \bullet u_2$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.85 for GREGG IN SITU cones)

The total stress calculations are based on soil unit weights that have been assigned to the Soil Behavior Type zones, from a user defined unit weight profile or by using a single value throughout the profile. Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). For over water projects the effects of the column of water have been taken in to account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at mud line).

Details regarding the interpretation methods for all of the interpreted parameters are provided in Table 1. The appropriate references cited in Table 1 are listed in Table 2. Where methods are based on charts or techniques that are too complex to describe in this summary the user should reference to the cited references.

The estimated Soil Behavior Types (normalized and non-normalized) are based on the charts developed by Robertson and Campanella shown in Figures 1 and 2.

Where the results of a calculation/interpretation are declared *'invalid'* the value will be represented by the text strings "-9999" or "-9999.0". Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).
2. Where the interpretation method is inappropriate, for example, drained parameters in an undrained material (and vice versa).
3. Where interpretation input values are beyond the range of the referenced charts or specified limitations of the interpretation method.
4. Where pre-requisite or intermediate interpretation calculations are invalid.

CPT Interpretations

The parameters selected for output from the program are often specific to a particular project. As such, not all of the interpreted parameters listed in Table 1 may be included in the output files delivered with this report.

Table 1
CPT Interpretation Methods

Interpreted Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where interpretations are done at each point then Mid Layer Depth = Recorded Depth)*	*Depth (Layer Top) + Depth (Layer Bottom) / 2.0*	
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client	Elevation = Collar Elevation - Depth	
Avgqc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when interpretations are done at each point*	
Avgqt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \cdot u$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when interpretations are done at each point*	
Avgfs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when interpretations are done at each point*	
AvgRf	Averaged friction ratio (Rf) where friction ratio is defined as: $Rf = 100\% \cdot \frac{fs}{qt}$	$AvgRf = 100\% \cdot \frac{Avgfs}{Avgqt}$ *n=1 when interpretations are done at each point*	
Avgu	Averaged dynamic pore pressure (*u*)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when interpretations are done at each point*	
AvgRes	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} RESISTIVITY_i$ *n=1 when interpretations are done at each point*	
AvgUVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when interpretations are done at each point*	
AvgTemp	Averaged Temperature (this data is not always available since it is a specialized test)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} TEMPERATURE_i$ *n=1 when interpretations are done at each point*	
AvgGamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$Avgu = \frac{1}{n}\sum_{i=1}^{n} GAMMA_i$ *n=1 when interpretations are done at each point*	
SBT	Soil Behavior Type as defined by Robertson and Campanella	See Figure 1	2, 5
U.Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) user supplied unit weight profile	See references	5
T. Stress σ_v	Total vertical overburden stress at Mid Layer Depth. *A layer is defined as the averaging interval specified by the user. For data interpreted at each point the Mid Layer Depth is the same as the recorded depth.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	

GREGG

CPT Interpretations

Interpreted Parameter	Description	Equation	Ref
E. Stress σ_v	Effective vertical overburden stress at Mid Layer Depth	*Estress = Tstress - u_{eq}*	
Ueq	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic from water table depth 2) user supplied profile	For hydrostatic option: $u_{eq} = \gamma_w \cdot (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	
Cn	SPT N_{60} overburden correction factor	$Cn = (\sigma_v')^{0.5}$ where σ_v' is in tsf $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from qt/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	4, 5
N_{60} (Ic)	SPT N Value at 60% energy. This method is a slight modification of the Jefferies and Davies technique whereby the qt/N ratio varies across soil classification zones based on the Ic parameter. This techniques is limited to zones 2 through 7 on the normalized Soil Behavior Type Chart	*See Figure 1*	5, 8
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = Cn \cdot N_{60}$	4
$\Delta(N_1)_{60}$	Equivalent Clean Sand Correction to $(N_1)_{60}$	$\Delta(N_1)_{60} = \frac{K_{SPT}}{1 - K_{SPT}} \cdot (N_1)_{60}$ Where: K_{SPT} is defined as: 0.0 for FC < 5% 0.0167 • (FC - 5) for 5% < FC < 35% 0.5 for FC > 35% FC - Fines Content in %	4
$(N_1)_{60cs}$	Equivalent Clean Sand $(N_1)_{60}$	$(N1)_{60cs} = (N1)_{60} + \Delta(N1)_{60}$	4
Su	Undrained shear strength - N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
k	Coefficient of permeability (assigned to each SBT zone)		5
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 5
Q_t	Normalized q_t for Soil Behavior Type classification as defined by Robertson, 1990	$Qt = \frac{qt - \sigma_v}{\sigma_v'}$	2, 5
F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson, 1990	$Fr = 100\% \cdot \frac{fs}{qt - \sigma_v}$	2, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson and Campanella	See Figure 2	2, 5

CPT Interpretations

Interpreted Parameter	Description	Equation	Ref
q_{c1}	q_t normalized for overburden stress used for seismic analysis	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atm. Pressure q_t is in MPa	3
q_{c1N}	q_{c1} in dimensionless form used for seismic analysis	$q_{c1N} = q_{c1} / Pa$ where: Pa = atm. pressure	3
K_c	Equivalent clean sand correction for q_{c1N}	$K_c = 1.0$ for $I_c \le 1.64$ $K_c = f(I_c)$ for $I_c > 1.64$ (see reference) $K_c = 1.0$ for $1.64 < I_c < 2.36$ and $Fc < 0.5\%$	3
q_{c1Ncs}	Clean Sand equivalent q_{c1N}	$q_{c1Ncs} = q_{c1N} \cdot K_c$	3
I_c	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ Where: $Q = \left(\frac{qt - \sigma_v}{P_{a2}}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ And Fr is in percent P_a = atmospheric pressure P_{a2} = atmospheric pressure n varies from 0.5 to 1.0 and is selected in an iterative manner based on the resulting I_c	3, 8
FC	Apparent fines content (%)	$FC=1.75(Ic^{3.25}) - 3.7$ $FC=100$ for $Ic > 3.5$ $FC=0$ for $Ic < 1.26$ $FC = 5\%$ if $1.64 < Ic < 2.6$ AND $F_r<0.5$	3
Ic Zone	This parameter is the Soil Behavior Type zone based on the Ic parameter (valid for zones 2 through 7 on SBTn chart)	Ic < 1.31 Zone = 7 1.31 < Ic < 2.05 Zone = 6 2.05 < Ic < 2.60 Zone = 5 2.60 < Ic < 2.95 Zone = 4 2.95 < Ic < 3.60 Zone = 3 Ic > 3.60 Zone = 2	3
PHI ϕ	Friction Angle determined from one of the following user selectable options: a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu	See reference	5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann 1976 d) Jamiolkowski - All Sands	See reference	5
OCR	Over Consolidation Ratio – 2 methods available	a) Based on Schmertmann's method involving a plot of S_u/σ_v' / $(S_u/\sigma_v')_{NC}$ and OCR b) Based on $OCR = K \cdot \left(\frac{qt - \sigma_v}{\sigma_v}\right)$ where an average value of k=0.3 is used	5
State Parameter	The state parameter is used to describe whether a soil is contractive (SP is positive) or dilative (SP is negative) at large strains based on the work by Been and Jefferies	See reference	9, 7, 5

GREGG

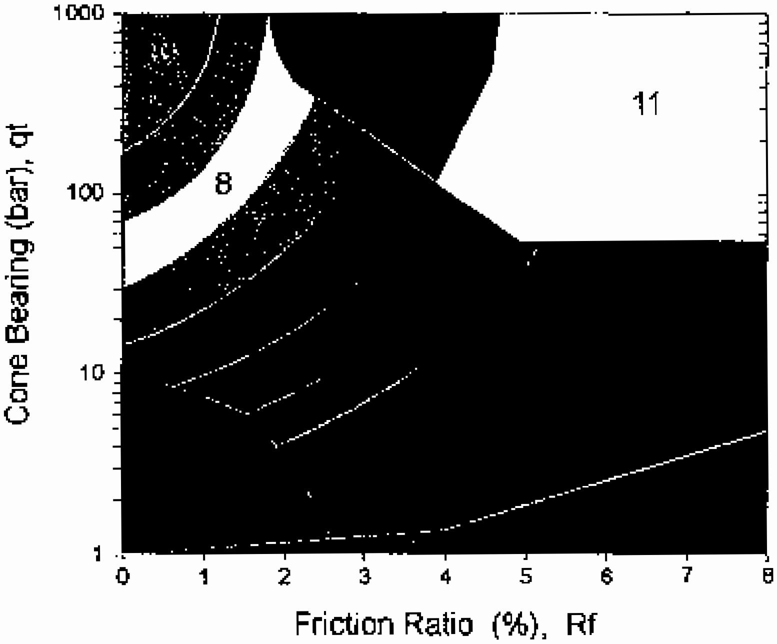
CPT Interpretations

Interpreted Parameter	Description	Equation	Ref
CRR	Cyclic Resistance Ratio (for M=7.5)	*For* $(q_{c1N})_{cs}$ < 160: $CRR = 93 \cdot \left(\frac{(q_{c1N})_{cs}}{1000}\right)^3 + 0.08$ *For* $(q_{c1N})_{cs}$ < 50: $CRR = 0.833 \cdot \left(\frac{(q_{c1N})_{cs}}{1000}\right)^1 + 0.05$	5
Youngs Modulus E	Youngs Modulus based on the work by Baldi. There are three types of sands considered in this technique. The user selects the approriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in Baldi's chart.	Mean normal stress is evaluated from: $\sigma'_m = \frac{1}{3} \cdot (\sigma'_v + \sigma'_h + \sigma'_h)$ where σ_v' = vertical effective stress σ_h' = horizontal effective stress and $\sigma_h = K_o \cdot \sigma_v'$ with Ko assumed to be 0.5	5
K_o	Coefficient of lateral earth pressure at rest.	$K_o = 0.1 \cdot \left(\frac{q_t - \sigma_{vo}}{\sigma_v}\right)$	5

Savannah River Site Specific Parameters

Interpreted Parameter	Description	Equation	Ref
Ic	Ic based on normalized data at the Savannah River Site; developed by Frank Syms and SGS	$Ic = [(1.95 - \log_{10}Q)^2 + (\log_{10} Fr + 1.78)^2]^{0.5}$ *Where: Q is the normalized tip resistance* *And Fr is the normalized friction ratio*	10
FC	Fines content based on the normalized Savannah River Site Ic parameter; developed by Frank Syms and SGS	$FC = (5.31 \cdot (I_c)^{2.31}) + 9.61$ For FC > 100 and q_t < 15 tsf the material is flagged as a soft zone	10
FC	Fines Content directly from non-normalized data at the Savannah River Site; developed by Frank Syms and SGS	$FC = [(3.56 - \log_{10}(qtsf))^2 + (1.43 + \log_{10}(Rf))^2]^{1.0}$ For FC > 100 and q_t < 15 tsf the material is flagged as a soft zone *Where:* *qtsf is the non-normalized tip resistance in tsf* *Rf is the non-normalized friction ratio*	11

Figure 1
Non-Normalized Behavior Type Classification Chart



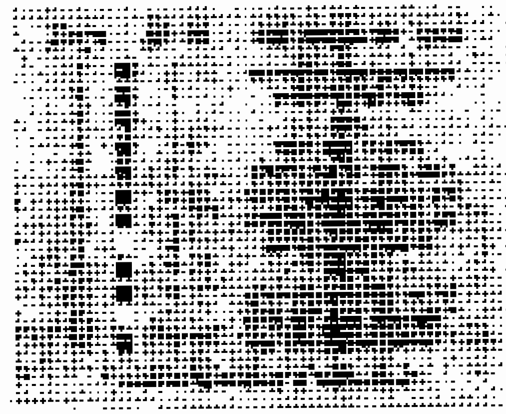
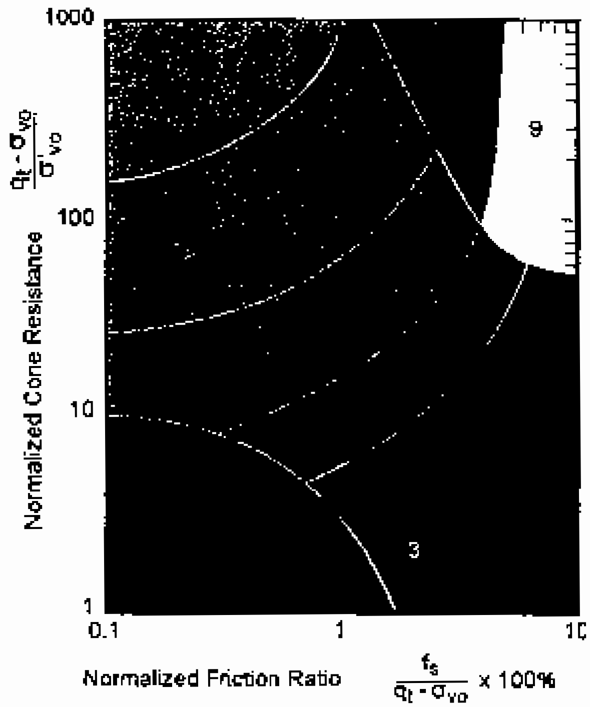
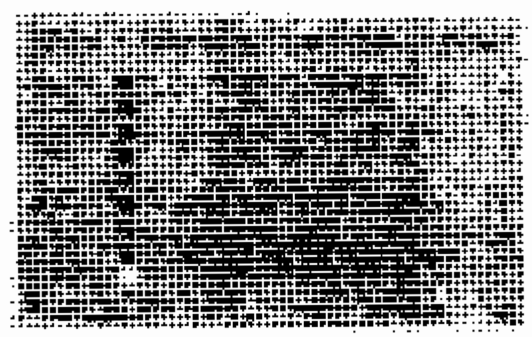


Figure 2
Normalized Behavior Type Classification Chart





GREGG

Table 2
References

No.	References
1	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
2	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
3	Robertson, P.K. and Fear, C.E., 1998, "Evaluating cyclic liquefaction potential using the cone penetration test", Canadian Geotechnical Journal, 35: 442-459.
4	Robertson, P.K. and Wride, C.E., 1998, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
5	Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, " Cone Penetration Testing in Geotechnical Practice," Blackie Academic and Professional.
6	GREGG IN SITU Internal Report
7	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.
8	Jefferies, M.G. and Davies, M.P., 1993. "Use of CPTu to Estimate equivalent N_{60}", Geotechnical Testing Journal, 16(4): 458-467.
9	Been, K. and Jefferies, M.P., 1985, "A state parameter for sands", Geotechnique, 35(2), 99-112.
10	Frank Syms, Bechtel Corp (Savannah River Site), 2001, "CPTU Fines Content Determination", Calculation No. K-CLC-G-00065 Revision 0.
11	Frank Syms, Bechtel Corp (Savannah River Site) – personal communication

Attachment D

Previous Monitoring Well Records

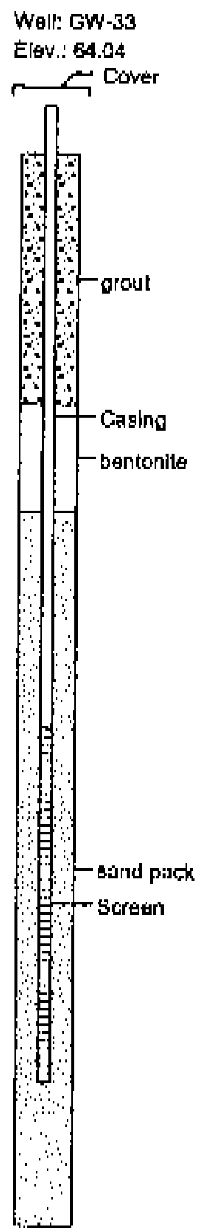
WITHERS & RAVENEL
Engineering & Surveying, Inc.
111 MacKenan Drive · Cary, N.C. 27511

LOG OF BORING GW-33

Canady's Station
Project No. 99076.18

Date Started	: 5/6/03	Drilling Company	: Geo-Technologies
Date Completed	: 5/6/03	Northing Coord.	: 450,138.7801
Hole Diameter	: 4.25 in.	Easting Coord.	: 2,118,888.1718
Drilling Method	: Hollow Stem Auger	Survey By	: W & R
Sampling Method	: Split Spoon	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION	Blow Count
0–2.5	SP	Sand with organics; FN-MD, soft, very moist to very wet, black.	
2.5–7	SP	Sand with Trace Clay; Soft, very wet, gray	7, 10, 10
7–13.5	SW	Sand; FN-CS, Soft, Very Wet, Beige	4, 5, 7
13.5–15.2	SM	Silt with FN sand; stiff, very wet, olive gray	16, 32, 50/2



Well Construction Information

WELL CONSTRUCTION
Date Compl. : 5/6/03
Hole Dia. : 4.25 in.
Drill. Method : Hollow Stem Auger
Company Rep. : Geo-Technologies

WELL CASING
Material : Sch 40 PVC
Diameter : 2 in.
Joints : threaded

WELL SCREEN
Material : Sch 40 PVC
Diameter : 2 in.
Joints : threaded
Opening : .010 slot

SAND PACK : medium

SEAL : bentonite

NOTES

07-15-2003

WITHERS & RAVENEL
Engineering & Surveying, Inc.
111 MacKenan Drive - Cary, N.C. 27511

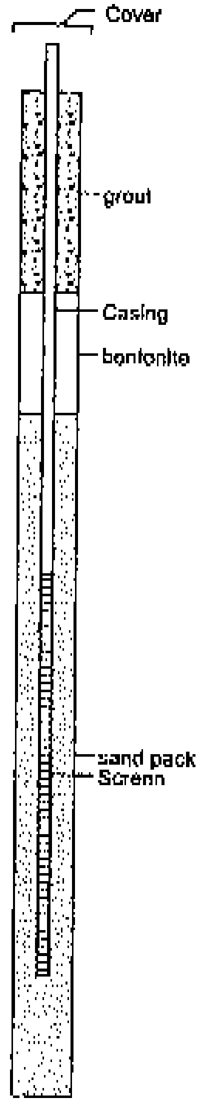
LOG OF BORING GW-34

Canady's Station
Project No. 09076.18

Date Started	: 5/6/03	Drilling Company	: Geo-Technologies
Date Completed	: 5/7/03	Northing Coord.	449,886.3177
Hole Diameter	: 4.25 in.	Easting Coord.	: 2,117,242.8790
Drilling Method	Hollow Stem Auger	Survey By	: W&R
Sampling Method	: Split Spoon	Logged By	: John Palmer

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Blow Count
0–2	SP		Sand with organic; FN-MD, Soft, V-Moist to Very Wet, Black	
2–6	SP		Sand with trace Clay; soft, Very Wet, Gray	10, 12, 9
6–11.6	SW		Sand: FN-CS, soft, very wet, beige	5, 6, 6, 6
11.6–14	SP		Silty with FN-sand; stiff, very wet, olive gray	10, 15, 30

Well: GW-34
Elev.: 32.86



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 5/7/03
Hole Dia.	: 4.25 in.
Drill. Method	: Hollow Stem Auger
Company Rep.	: Geo-Technologies

WELL CASING

Material	Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded
Opening	: .010 slot

SAND PACK	: medium
SEAL	: bentonite

NOTES

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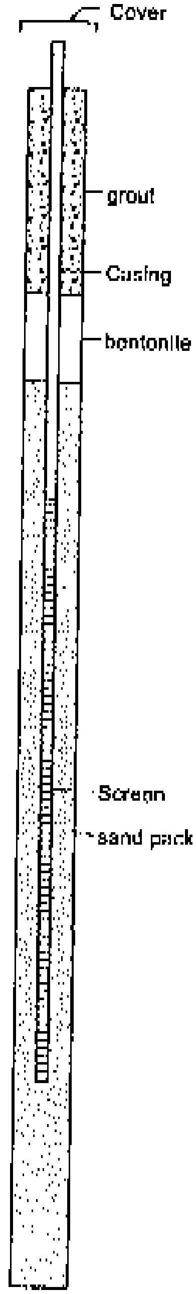
LOG OF BORING GW-35

Canady's Station
Project No. 99076.18

Date Started	: 5/7/03
Date Completed	: 5/7/03
Hole Diameter	: 4.25 in.
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon
Drilling Company	: Geo-Technologies
Northing Coord.	: 449,823.9205
Easting Coord.	: 2,117,795.7787
Survey By	: W&R
Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION	Blow Count
0–1.5	SP	Sand with organics; FN-MD, soft, Very moist,to very wet, black	
1.5–3.5	SP	Sand with trace clay;soft, very wet, gray	
3.5–10.5	SW	Sand:FN-CS, soft, very wet, beige	5, 7, 10; 3, 3, 5
10.5–11.5	SP	Silt with FN Sand;somewhat soft, very west olive gray	
11.5–14.5	SW	Sand; FN-CS, soft, very wet, beige	8, 10, 14
14.5–16.5	SP	Silty sand; FN-MD,soft, very wet, gray	18, 14, 9
16.5–20.5	SP	Silt with FN sand; stiff,very wet, olive gray	14, 24, 39

Well: GW-35
Elev.: 62.27



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 5/7/03
Hole Dia.	: 4.25 in
Drill Method	: Hollow Stem Auger
Company Rep.	: Geo-Technologies

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded
Opening	: .010 slot
SAND PACK	: medium
SEAL	: bentonite

NOTES

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WITHERS & RAVENEL
Engineering & Surveying, Inc.
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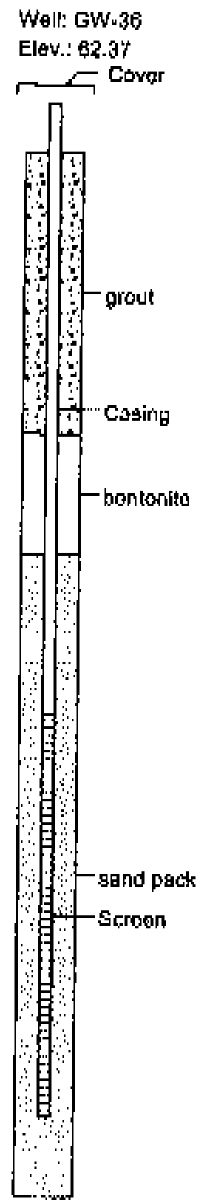
LOG OF BORING GW-36

Canady's Station
Project No. 99076.18

Date Started	: 5/7/03	Drilling Company	: Geo-Technologies
Date Completed	: 5/7/03	Northing Coord.	: 449,405.6937
Hole Diameter	: 4.25 in.	Easting Coord.	: 2,118,242.5328
Drilling Method	: Hollow Stem Auger	Survey By	: W & R
Sampling Method	: Split Spoon	Logged By	: John Palmer

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Blow Count
0–3.5	SP		Clayey silt with sand; somewhat soft, very moist to very wet, gray	
3.5–11	SW		Sand; FN-CS, soft, very wet, gray to beige	4, 6, 8; 5, 7, 8
11–13	SP		Sandy silt; somewhat stiff to stiff, very wet, olive gray	
13	SL		Silt stone	50/2



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 5/7/03
Hole Dia.	: 4.25 in.
Drill. Method	: Hollow Stem Augar
Company Rep.	: Geo-Technologies

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2 in
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded
Opening	: .010 slot
SAND PACK	: medium
SEAL	: bentonite

NOTES

WITHERS & RAVENEL
Engineering & Surveying, Inc.
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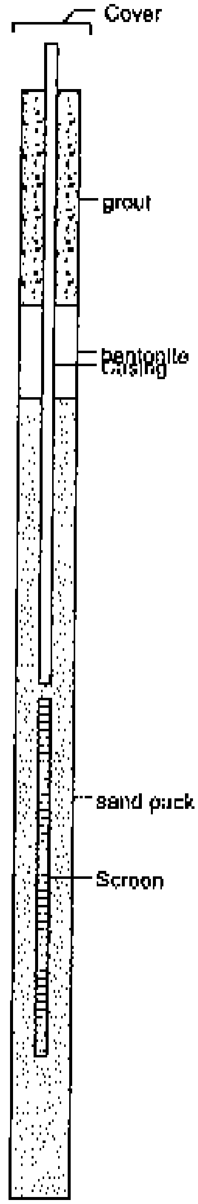
LOG OF BORING GW-37

Canady's Station
Project No. 99076.18

Date Started	: 5/7/03	Drilling Company	: Geo-Technologies
Date Completed	: 5/7/03	Northing Coord.	: 450,012.1731
Hole Diameter	: 4.25 in.	Easting Coord.	: 2,119,088.4600
Drilling Method	: Hollow Stem Auger	Survey By	: W & R
Sampling Method	: Split Spoon	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION	Blow Count
0	SP	Sand with organics, VFN-FN, soft, very moist to wet, black	
1	SP	Clayey sand;VFN-FN, soft, wet to very wet, gray	
2.5	SW	Sand; VFN-FN, soft, very wet, beige	8, 7, 7
6.5	SW	Sand; FN-CS, soft, very wet, beige	9, 9, 10
14	SP	Silt with FN sand; stiff, very wet, olive gray	1, 2, 7

Well: GW-37
Elev.: 62.46



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 5/7/03
Hole Dia.	: 4.25 in.
Drill. Method	: Hollow Stem Auger
Company Rep.	: Geo-Technologies

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded

WELL SCREEN

Material	Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded
Opening	: .010 slot

SAND PACK	: medium
SEAL	: bentonite

NOTES

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WITHERS & RAVENEL
Engineering & Surveying, Inc.
111 MacKenan Drive · Cary, N.C. 27511

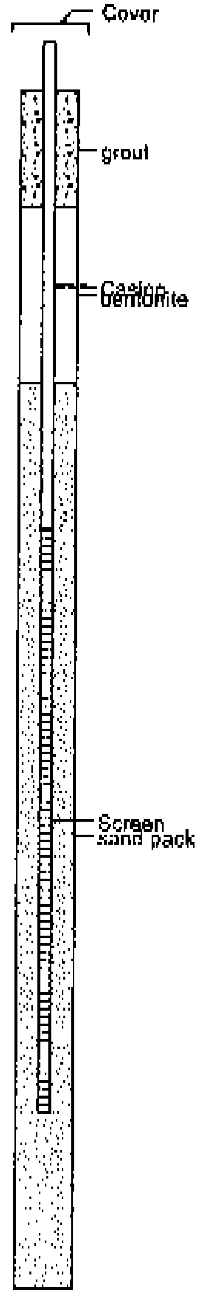
LOG OF BORING GW-38

Canady's Station
Project No. 99076.18

Date Started	: 5/7/03	Drilling Company	: Geo-Technologies
Date Completed	: 5/7/03	Northing Coord.	: 450,433.0578
Hole Diameter	: 4.25 in.	Easting Coord.	: 2,119,220.8500
Drilling Method	: Hollow Stem Auger	Survey By	: W & R
Sampling Method	: Split Spoon	Logged By	: John Palmer

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Blow Count
0–2.5	SP		Sand with organics; VFN-MD, soft, very moist to very wet, black	
2.5–6.5	SP		Sand;VFN-MD,soft, very wet, gray	6 6 7
6.5–18	SP		Sand; FN-CS, soft, very wet, gray	8 7 6 / 10 14 16
18–20.5	SM		Silt with sand;stiff, very wet, olive gray	8 15 18

Well: GW-38
Elev.: 63.11



Well Construction Information

WELL CONSTRUCTION

Date Compl	: 5/7/03
Hole Dia.	: 4.25 in.
Drill. Method	: Hollow Stem Auger
Company Rep.	: Geo-Technologies

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
Diameter	: 2 in.
Joints	: threaded
Opening	: .010 slot
SAND PACK	: medium
SEAL	: bentonite

NOTES

07-5-2003 ...99076.18\Boring Logs\GW-38.bor

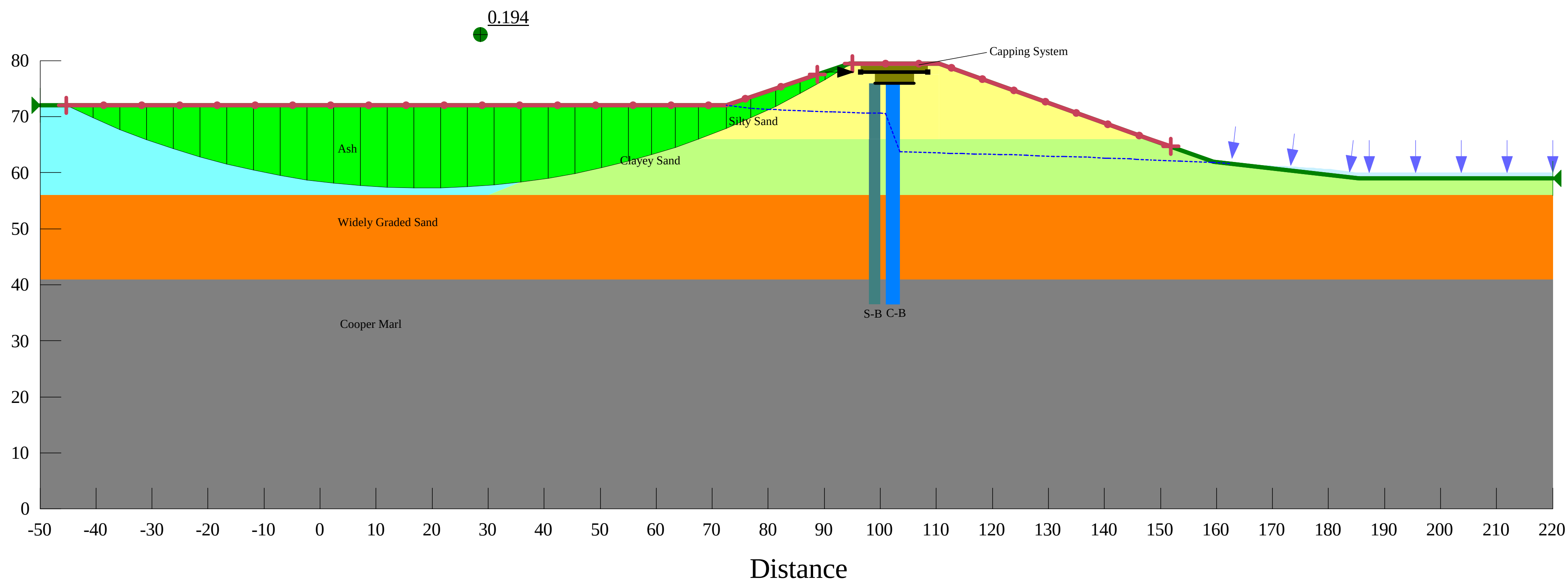
Attachment E

Output Plots from SLOPE/W

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24

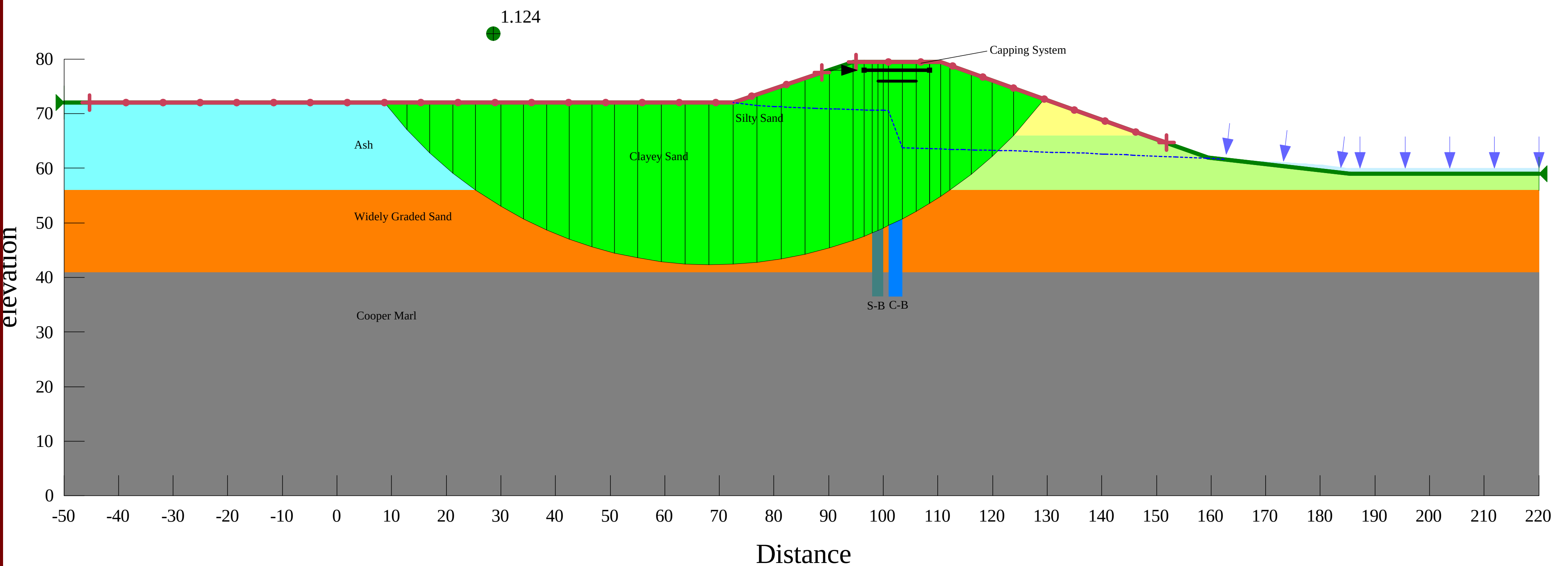


Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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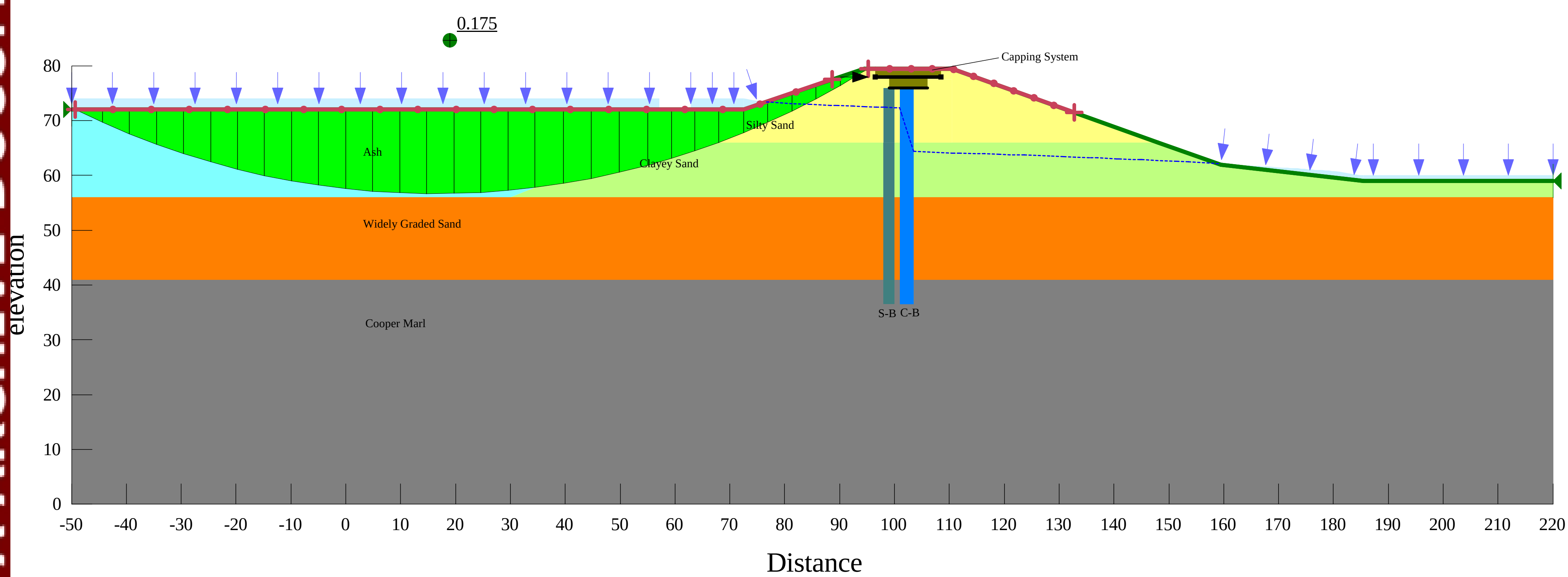
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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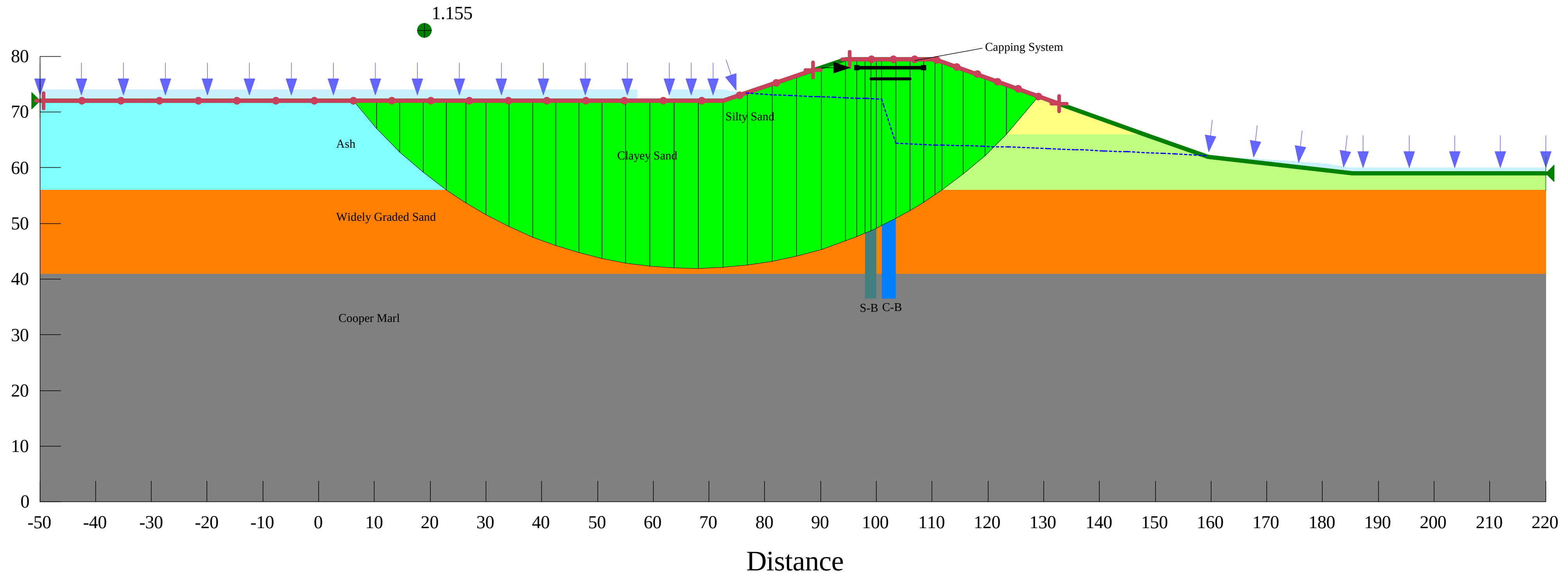
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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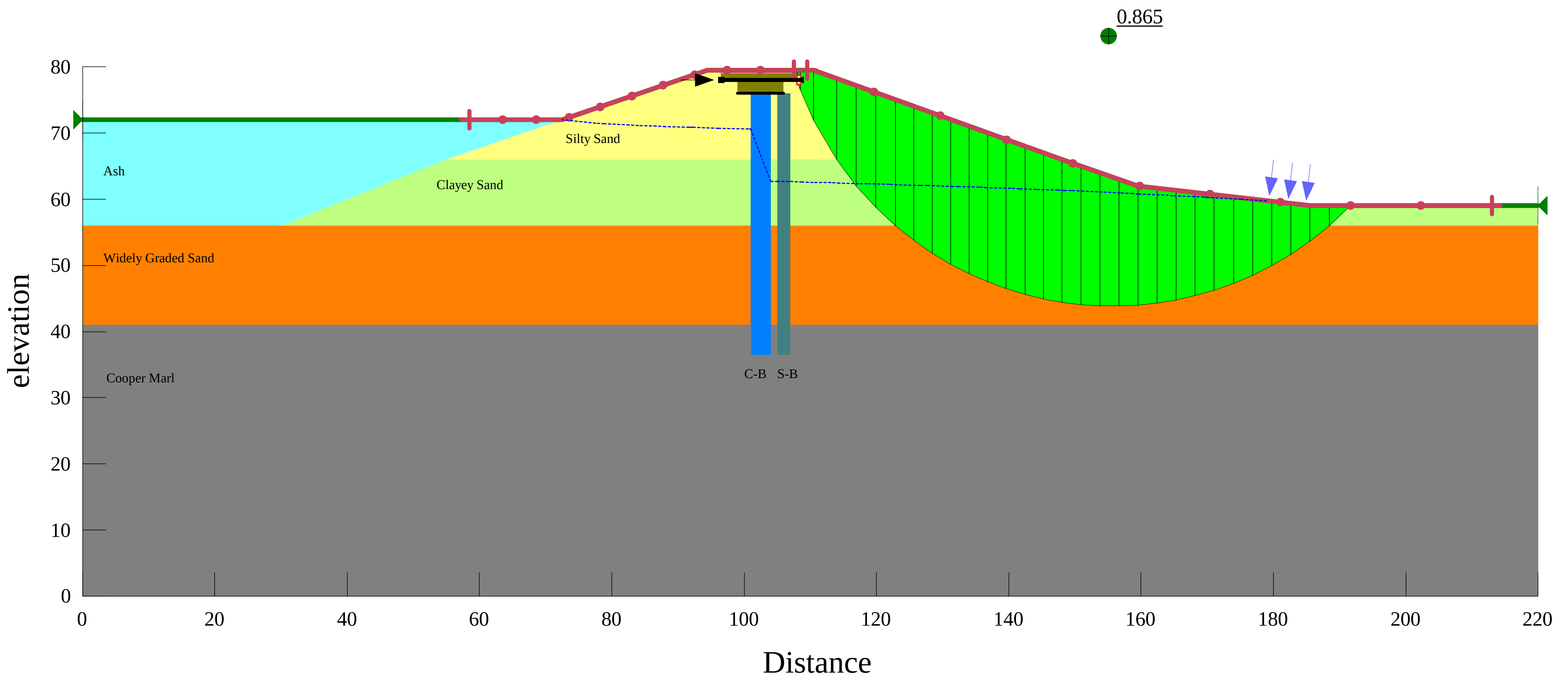
Name: Clayey sand   Model: Mohr-Coulomb   Unit Weight: 110   Cohesion: 0   Phi: 30
Name: Widely graded sand   Model: Mohr-Coulomb   Unit Weight: 125   Cohesion: 550   Phi: 0
Name: Cooper Marl   Model: Mohr-Coulomb   Unit Weight: 110   Cohesion: 4000   Phi: 0
Name: Ash   Model: Mohr-Coulomb   Unit Weight: 80   Cohesion: 1   Phi: 0
Name: C-B wall   Model: Mohr-Coulomb   Unit Weight: 80   Cohesion: 10000   Phi: 0
Name: Common fill   Model: Mohr-Coulomb   Unit Weight: 120   Cohesion: 0   Phi: 32
Name: GABC   Model: Mohr-Coulomb   Unit Weight: 125   Cohesion: 0   Phi: 38
Name: Soil-Bentonite   Model: Mohr-Coulomb   Unit Weight: 130   Cohesion: 1   Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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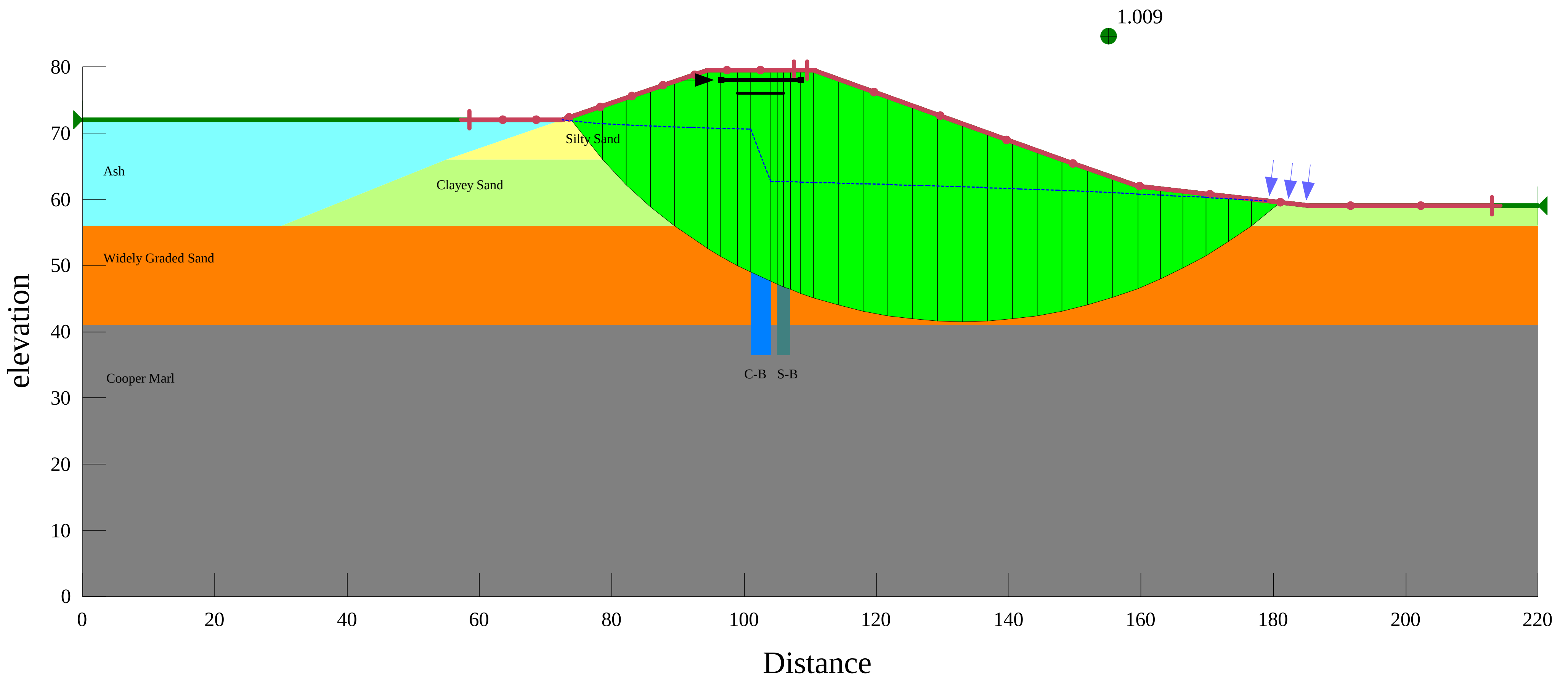
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 115 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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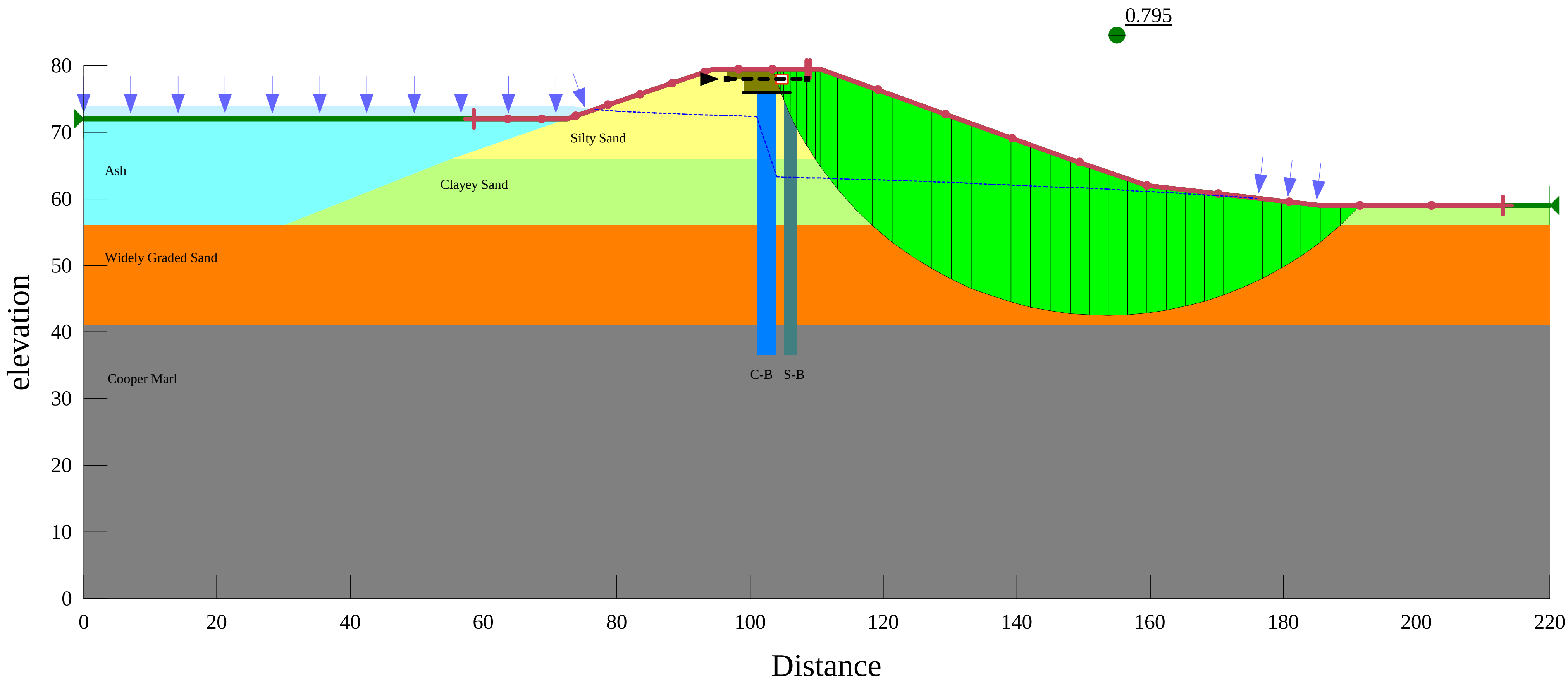
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 115 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



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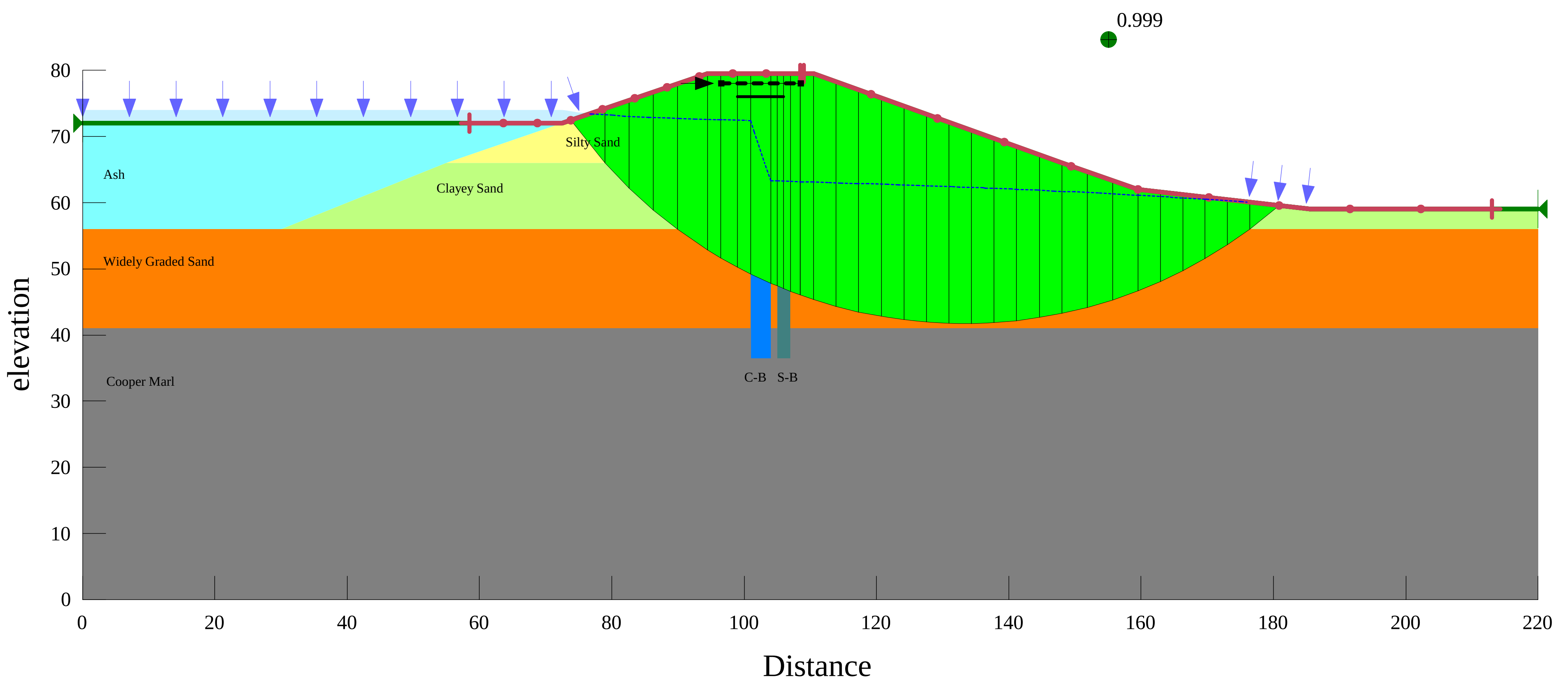
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 115 Cohesion: 1 Phi: 0

Seismic Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

Seismic coefficient: k=0.24



Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 550 Phi: 0
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 115 Cohesion: 1 Phi: 0

CDM

Memorandum

FRANCOIS G. BERNARDEAU
LIC No 038339
COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER
5/17/11

To: *Jean-Claude Younan*

From: *François Bernardeau*

Date: *May 17, 2011*

Subject: *Static Slope Stability Analysis, South Carolina Electric & Gas Ash Storage Pond – Canadys Power Station, Canadys, South Carolina*

Background

This memorandum summarizes the review of the previous static slope stability analyses and our updated static slope stability analyses results on current dike conditions for the Ash Storage Pond dike at the Canadys Power Station in Canadys, South Carolina for South Carolina Electric & Gas (SCE&G). The updated analyses were conducted under my supervision by Camp Dresser & McKee Inc. (CDM) in the Falls Church, Virginia office during the seismic slope stability evaluations. This memorandum supplements CDM's slope seismic stability analyses memorandum dated March 16, 2011.

Elevations (El.) herein are in feet and referenced to the North America Vertical Datum (NAVD) of 1988.

Review of Previous Static Stability Analyses

The following previous dike stability analyses were reviewed.

1. Slope Stability Analyses, Canadys Station Ash Pond Dike, GEI Consultants, dated December 8, 2005.

2. Slope Stability Analyses, South Carolina Electric & Gas Ash Storage Pond – Canadys Power Station Project, Canadys, South Carolina, CDM, dated April 3, 2007.

GEI (2005) performed the slope stability analyses on the dike to assess the construction impact of the new cement bentonite cutoff wall on the stability of the ash pond dike. The construction equipment surcharge was assumed to be 200 kips applied over top of dike. Two scenarios were analyzed: dike stability during construction with surcharge loading from construction equipment and impact of increasing the pond level by 3 feet.

CDM (2007) performed slope stability analyses of the dike with the new protective capping system combined with a travel surface to handle heavy construction truck activities. Five optional protective capping systems with heavy truck load on top of the dike were analyzed.

Both of the previous slope stability analyses assumed temporary construction conditions. This involved heavy equipment surcharge on top of the dike and assumed that the cement bentonite cutoff wall is under construction; therefore, it has limited strength. The cement bentonite cutoff wall was constructed in 2007. Lab testing results indicated that the unconfined compressive strength of the wall material is greater than 137 psi.

It should be noted that the updated static stability analyses summarized below are based on the current condition, under which the strength of the cement bentonite cutoff wall is largely developed and there is not construction surcharge load on top of the dike.

Basis of Evaluation

Soil properties used in the updated analyses were based on geotechnical data presented in Withers & Ravenel's report (2003).

The soil unit weight and friction angle values of the sandy soils are estimated using correlations with SPT N-values provided in NAVFAC DM-7.1 (1986) and correlations with CPT tip resistance provided by Robertson and Campanella (1983). The stability evaluation soil parameters are summarized in **Table 1**.

Table 1
Dike Soil Properties for Stability Analysis

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Remarks
Ash	80	0	0	Assume no strength
Silty Sand	120	32	0	Average N=28; average CPT tip resistance = 68 tsf
Clayey Sand	110	30	0	Average N=26; average CPT tip resistance = 80 tsf
Widely Graded Sand	125	28	0	Average N=17; average CPT tip resistance = 60 tsf
Sandy Silt (Cooper Marl)	110	0	4,000	N>50, CPT tip resistance > 100 tsf
Soil-Bentonite slurry wall[(1)]	130	25	0	N ranges from 0 to 21.
Cement-Bentonite slurry wall	80	0	10,000	Tested unconfined compressive strength >137 psi

[(1)] Lab testing data was used to estimate the unit weight of the S-B wall material that was installed in 1986. SB wall material properties have also been used in these analyses.

Static Slope Stability Analysis for Current Dike Condition

Static stability analyses for different cases were performed using the Morgenstern-Price methods in the computer program SLOPE/W (GEO-SLOPE, version 2007). Cases studied include stability for both the upstream and downstream side slopes of the dike and ash storage pond water levels (at El. 72 and 74). The static slope stability factor of safety for each analyzed case is summarized in **Table 2**.

The factor of safety for slope failures under current conditions is above 1.5 for both upstream and downstream slopes. The decrease of factor of safety due to rising of pond water level from El. 72 to 74 is not significant (within 5%).

Table 2
Factor of Safety against Slope Failure (Static Stability)

Slope	Factor of Safety Low Pond Water Level at El. 72	Factor of Safety High Pond Water Level at El. 74
Upstream	1.90	1.88
Downstream	1.64	1.60

The stability analysis results are attached in **Attachment A**.

Conclusions

Based on the results of the updated static slope stability analyses, we conclude that the dike will be stable and capable of retaining the coal ash under current working conditions.

References

NAVFAC, 1982. DM7 Design Manual 7: Volume 1 - Soil Mechanics; Volume 2 - Foundations and Earth Structures, Department of the Navy, Naval Facilities Engineering Command.

Robertson, P. K., and Campanella, R. G., 1983. Interpretation of Cone Penetration Tests; Parts I and II, Canadian Geotechnical Journal, Volume 20, No. 4, pp 718-745.

Withers & Ravenel, Inc., 2003. 95-Acre Ash Storage Pond Slurry Wall Forensic Evaluation and Hydrogeological Assessment Report, dated October 28, 2003.

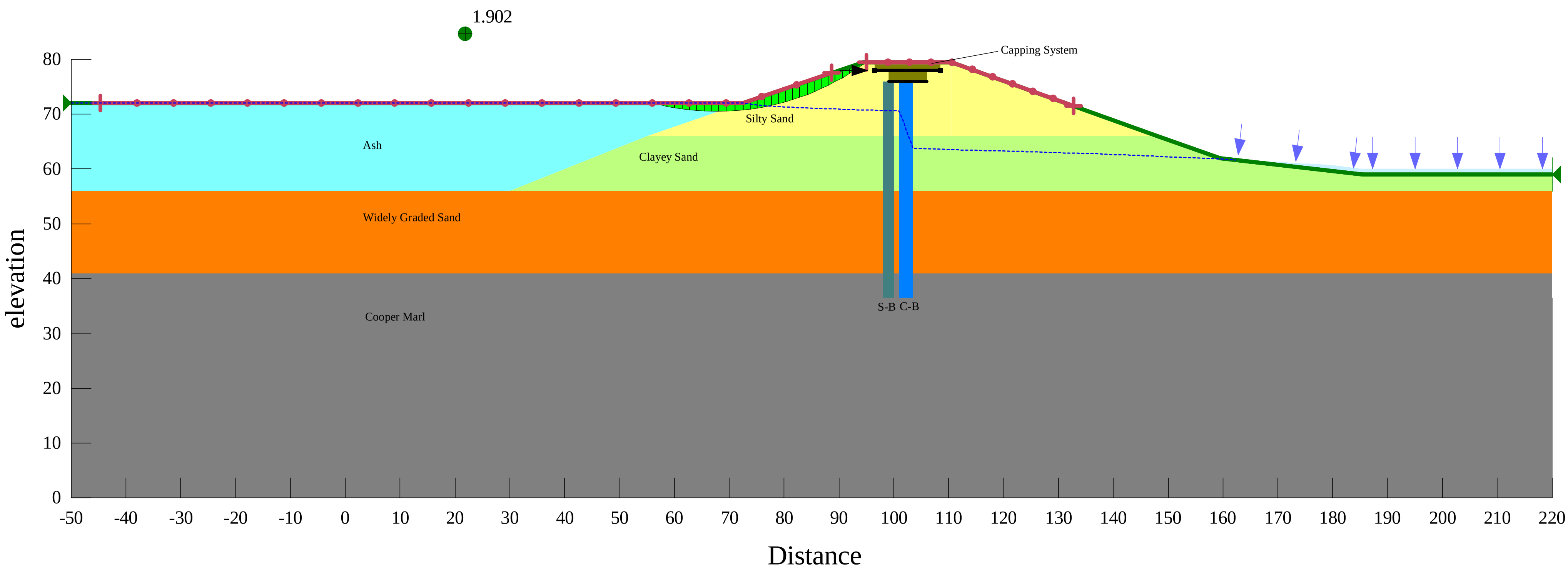
Attachment A

Stability Analysis Results

Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

Low Water Level: El. 72 ft

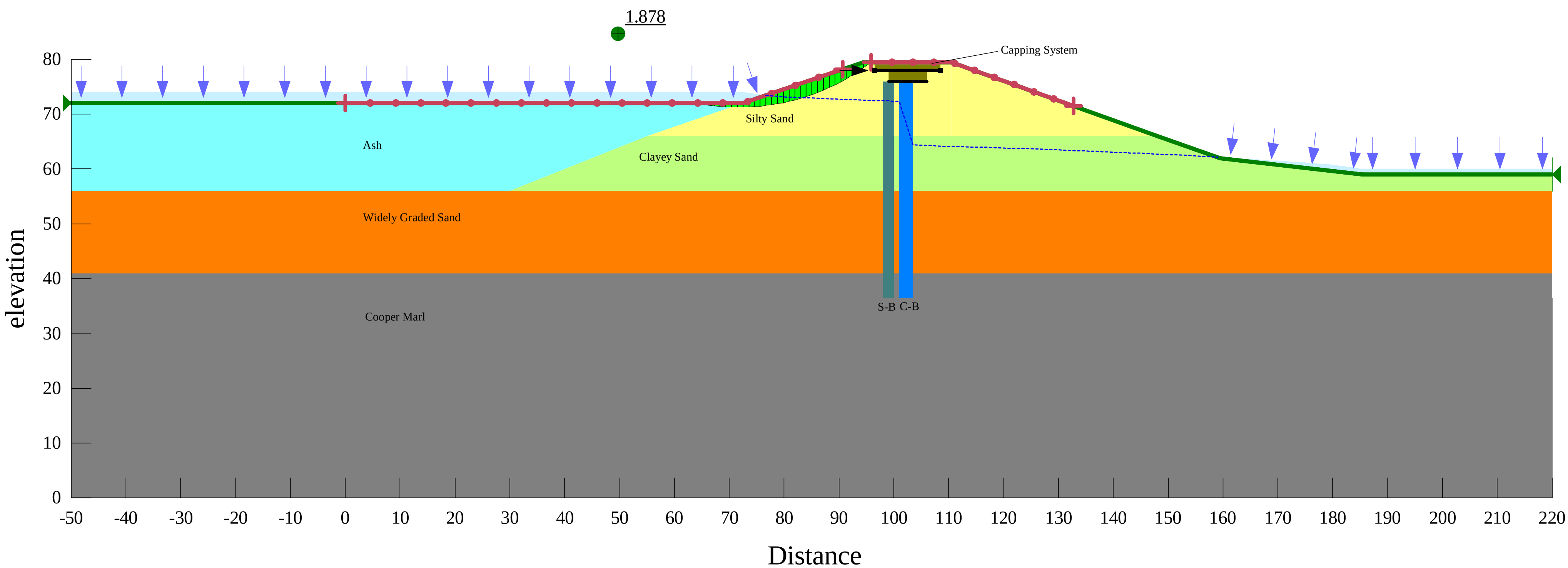


Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 28
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 0 Phi: 25

Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (upstream) and C-B wall: 1 foot

High Water Level: El. 74 ft

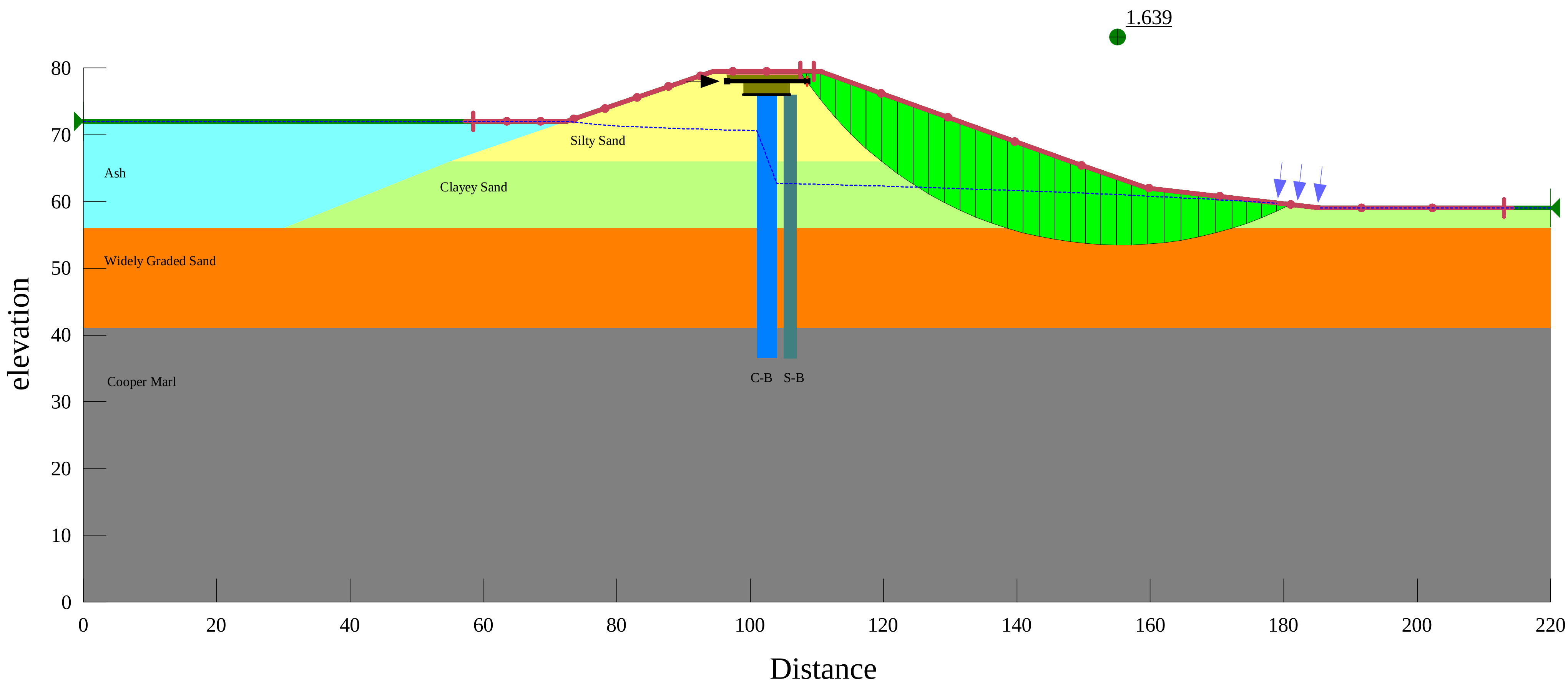


Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 28
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 0 Phi: 25

Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

Low Water Level: El. 72 ft

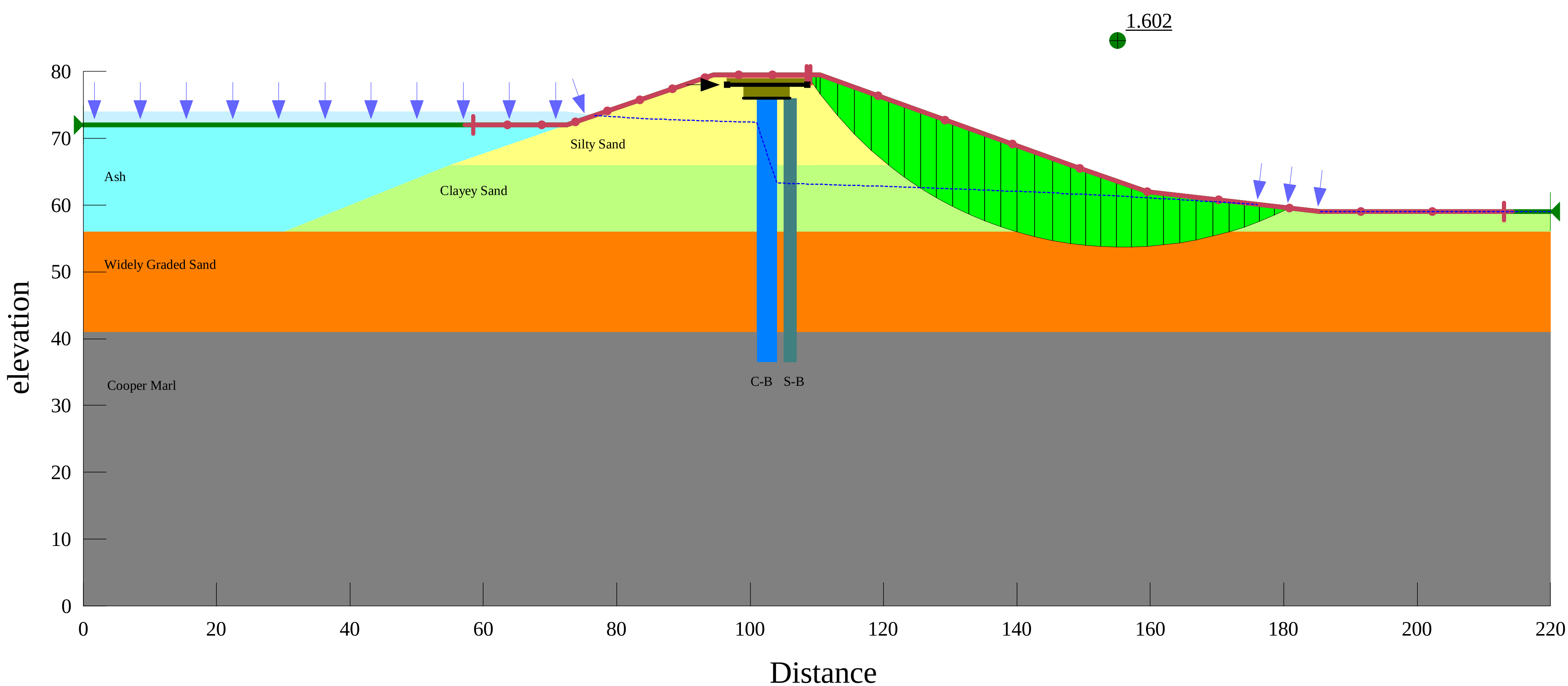


Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 28
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 0 Phi: 25

Stability Analysis - 95-Acre Ash Storage Pond, Canadys, SC

Morgenstern-Price Analysis
Distance between S-B wall (downstream) and C-B wall: 1 foot

High Water Level: El. 74 ft



Name: Silty sand Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: Clayey sand Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 0 Phi: 30
Name: Widely graded sand Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 28
Name: Cooper Marl Model: Mohr-Coulomb Unit Weight: 110 Cohesion: 4000 Phi: 0
Name: Ash Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 1 Phi: 0
Name: C-B wall Model: Mohr-Coulomb Unit Weight: 80 Cohesion: 10000 Phi: 0
Name: Common fill Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 32
Name: GABC Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 38
Name: Soil-Bentonite Model: Mohr-Coulomb Unit Weight: 130 Cohesion: 0 Phi: 25

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:

Unit Name:

Unit I.D.:

Inspector's Name:

Date:

Operator's Name:

Hazard Potential Classification: High Significant Low

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	DAILY QTRLY ANNUAL		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	72.1		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	67.5		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	80.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	N/A		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # INSPECTOR
Date

Impoundment Name
Impoundment Company
EPA Region
State Agency (Field Office) Addresss

Name of Impoundment
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New Update

	Yes	No
Is impoundment currently under construction?		
Is water or ccw currently being pumped into the impoundment?		

IMPOUNDMENT FUNCTION:

Nearest Downstream Town : Name
Distance from the impoundment
Impoundment

Location:	Longitude	Degrees	Minutes	Seconds
	Latitude	Degrees	Minutes	Seconds
	State	County		

Does a state agency regulate this impoundment? YES NO

If So Which State Agency?

HAZARD POTENTIAL. (In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

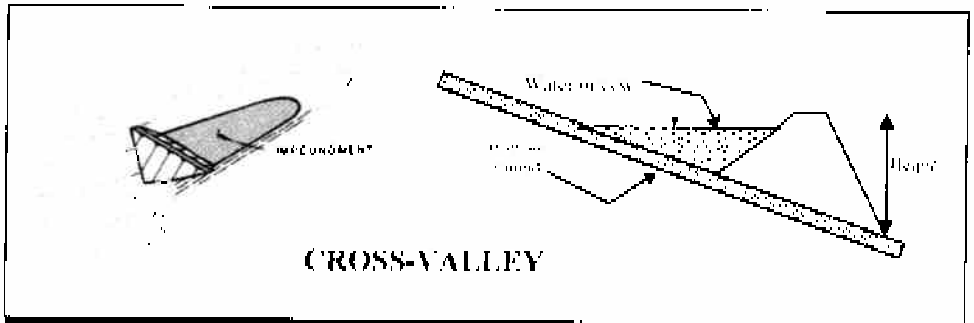
LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

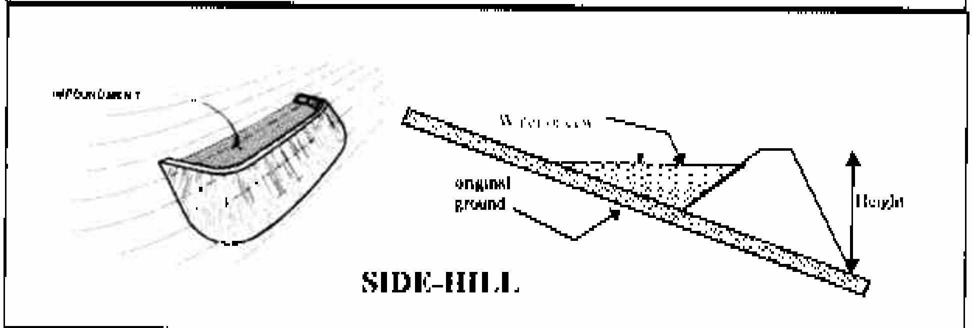
HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

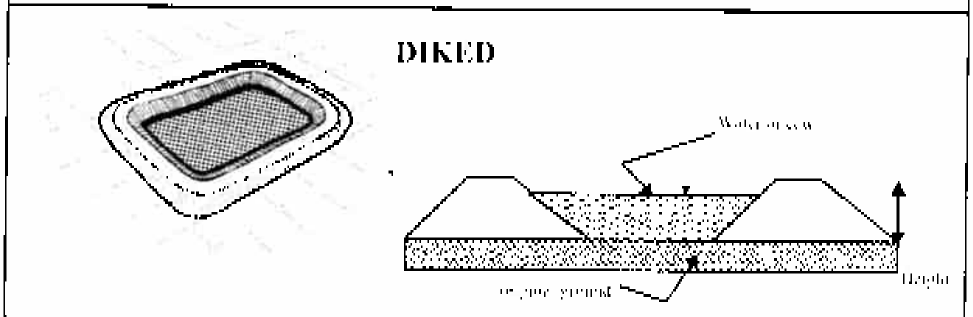
CONFIGURATION:



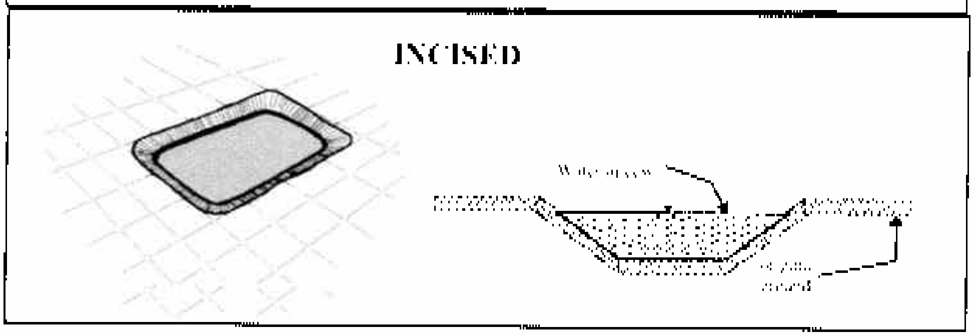
CROSS-VALLEY



SIDE-HILL



DIKED



INCISED

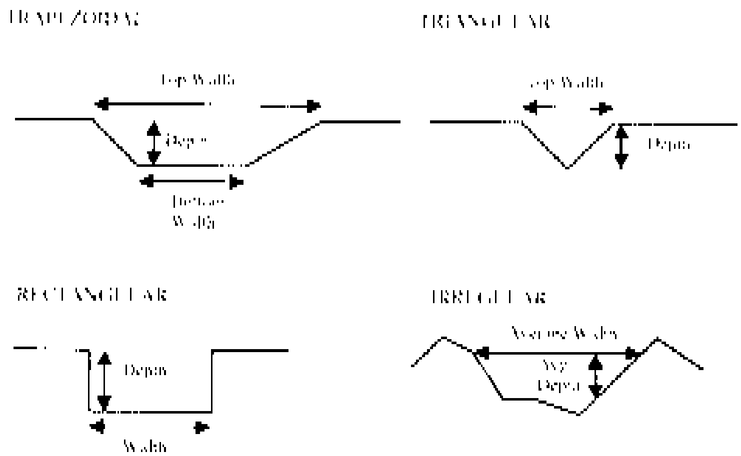
Cross-Valley
Side-Hill
Diked
Incised (form completion optional)
Combination Incised Diked

Embankment Height	feet	Embankment Material	
Pool Area	acres	Liner	
Current Freeboard	feet	Liner Permeability	

TYPE OF OUTLET (Mark all that apply)

Open Channel Spillway

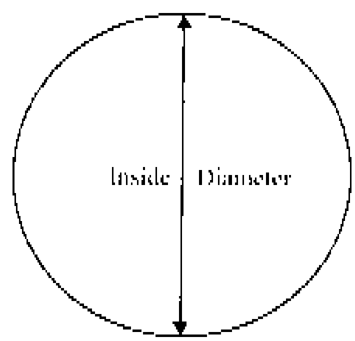
Trapezoidal
Triangular
Rectangular
Irregular



depth
bottom (or average) width
top width

Outlet

inside diameter



Material

corrugated metal
welded steel
concrete
plastic (hdpe, pvc, etc.)
other (specify)

Is water flowing through the outlet? YES NO

No Outlet

Other Type of Outlet (specify)

The Impoundment was Designed By

Has there ever been a failure at this site? YES NO

If So When?

If So Please Describe :

Has there ever been significant seepages at this site? YES NO

If So When?

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES NO

If so, which method (e.g., piezometers, gw pumping,...)?

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:

Date:

Unit Name:

Operator's Name:

Unit I.D.:

Hazard Potential Classification: High Significant Low

Inspector's Name:

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	DAILY ✓		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	NONE		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	*		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	*		Is water entering inlet, but not exiting outlet?	N/A	
5. Lowest dam crest elevation (operator records)?	69.5		Is water exiting outlet, but not entering inlet?	N/A	
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	N/A	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	N/A		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #

Comments

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # INSPECTOR

Date

Impoundment Name

Impoundment Company

EPA Region

State Agency (Field Office) Addresss

Name of Impoundment

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New Update

	Yes	No
Is impoundment currently under construction?		
Is water or ccw currently being pumped into the impoundment?		

IMPOUNDMENT FUNCTION:

Nearest Downstream Town : Name

Distance from the impoundment

Impoundment

Location: Longitude Degrees Minutes Seconds

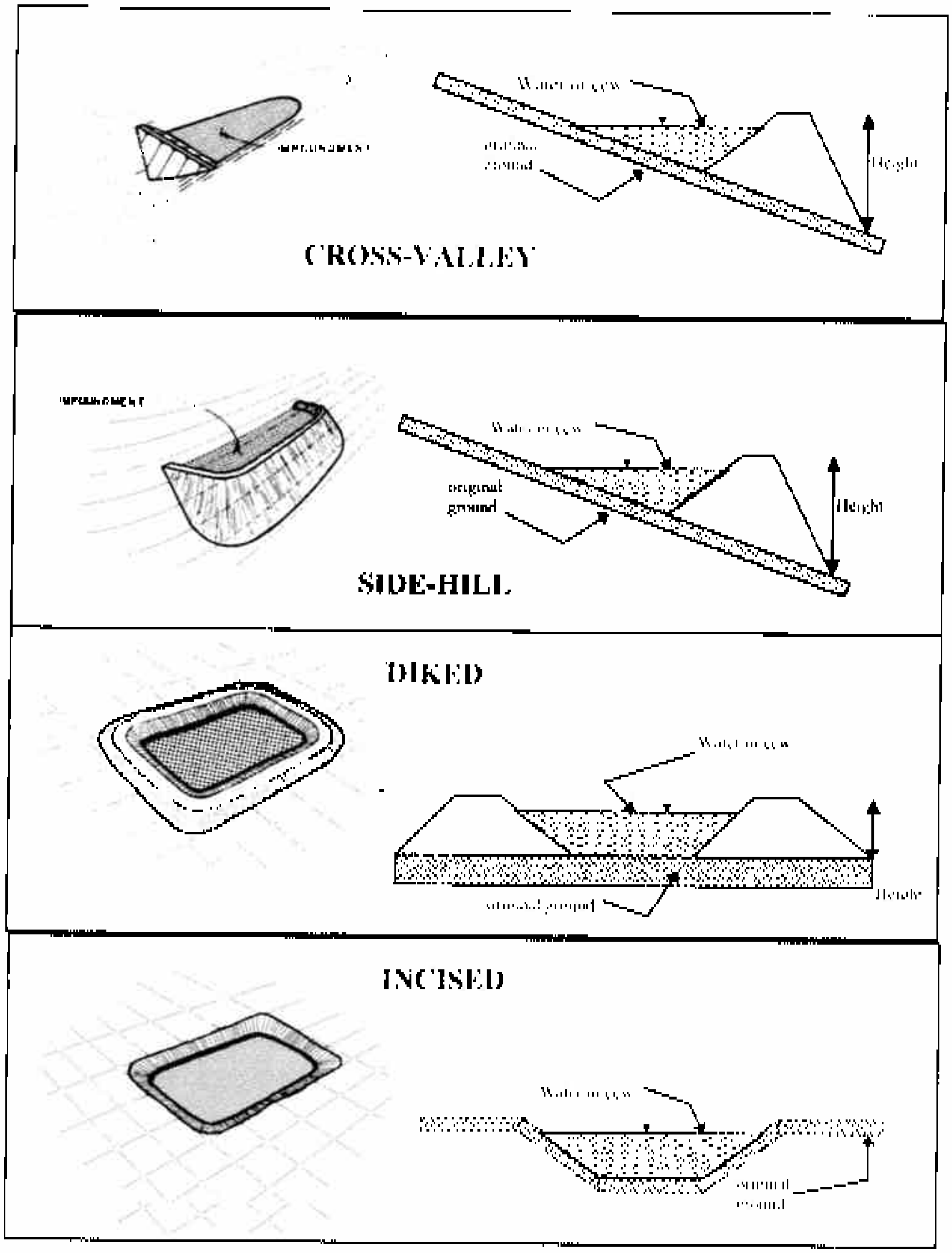
Latitude Degrees Minutes Seconds

State County

Does a state agency regulate this impoundment? YES NO

If So Which State Agency?

CONFIGURATION:



Cross-Valley
Side-Hill
Diked
Incised (form completion optional)
Combination Incised-Diked

Embankment Height	feet	Embankment Material	
Pool Area	acres	Liner	
Current Freeboard	feet	Liner Permeability	

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

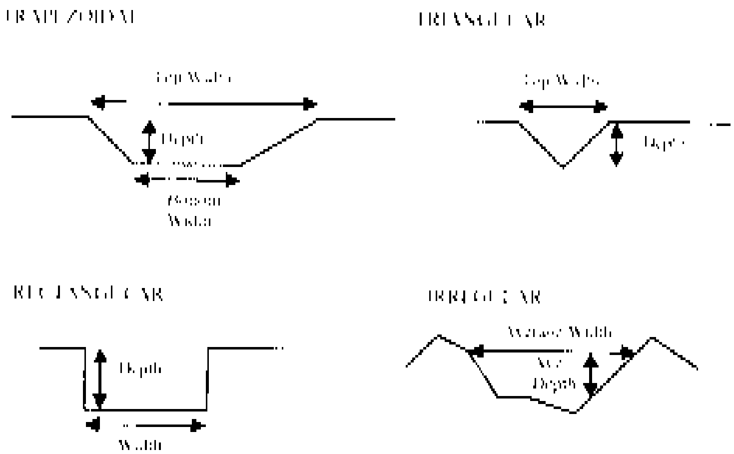
HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

TYPE OF OUTLET (Mark all that apply)

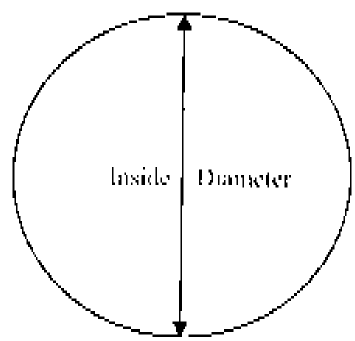
Open Channel Spillway
Trapezoidal
Triangular
Rectangular
Irregular

depth
bottom (or average) width
top width



Outlet

inside diameter



Material
corrugated metal
welded steel
concrete
plastic (hdpe, pvc, etc.)
other (specify)

Is water flowing through the outlet? YES NO

No Outlet

Other Type of Outlet (specify)

The Impoundment was Designed By

Has there ever been a failure at this site? YES NO

If So When?

If So Please Describe :

Has there ever been significant seepages at this site? YES NO

If So When?

IF So Please Describe;

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES NO

If so, which method (e.g., piezometers, gw pumping,...)?

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name:

Date:

Unit Name:

Operator's Name:

Unit I.D.:

Hazard Potential Classification: High Significant Low

Inspector's Name:

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	DAILY/ QTRLY/ ANNUAL		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	63.4		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	60.35		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?			Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	80.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?		✓
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	N/A		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # INSPECTOR
Date

Impoundment Name
Impoundment Company
EPA Region
State Agency (Field Office) Addresss

Name of Impoundment
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New Update

	Yes	No
Is impoundment currently under construction?		
Is water or ccw currently being pumped into the impoundment?		

IMPOUNDMENT FUNCTION:

Nearest Downstream Town : Name
Distance from the impoundment

Impoundment Location:	Longitude	Degrees	Minutes	Seconds
	Latitude	Degrees	Minutes	Seconds
	State	County		

Does a state agency regulate this impoundment? YES NO

If So Which State Agency?

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

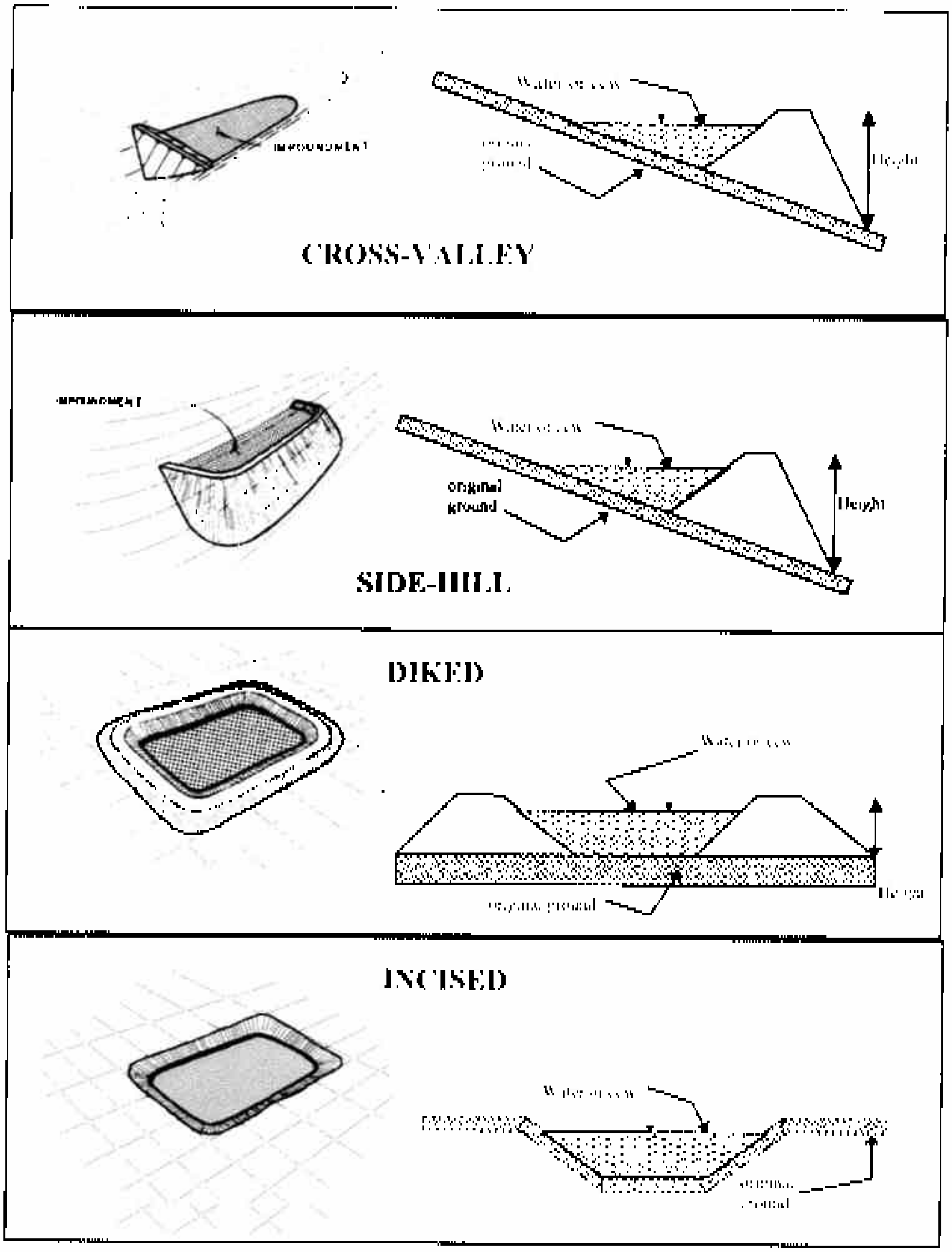
LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

CONFIGURATION:



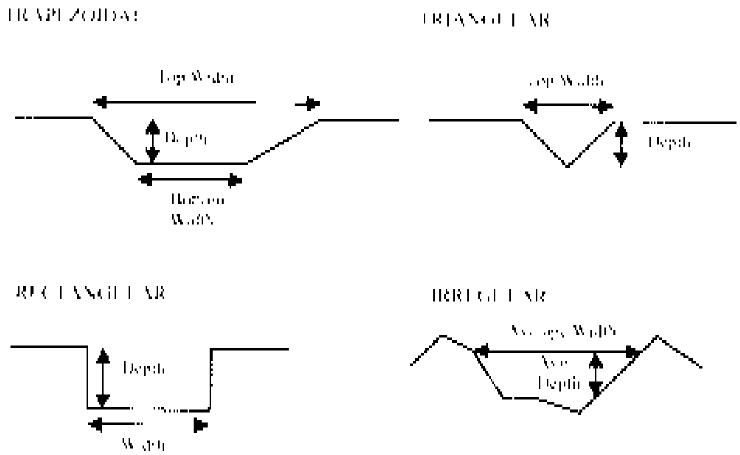
Cross-Valley
Side-Hill
Diked
Incised (form completion optional)
Combination Incised Diked

Embankment Height feet Embankment Material
Pool Area acres Liner
Current Freeboard feet Liner Permeability

TYPE OF OUTLET (Mark all that apply)

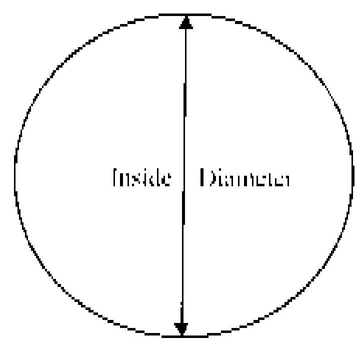
Open Channel Spillway
Trapezoidal
Triangular
Rectangular
Irregular

depth
bottom (or average) width
top width



Outlet

inside diameter



Material
corrugated metal
welded steel
concrete
plastic (hdpe, pvc, etc.)
other (specify)

Is water flowing through the outlet? YES NO

No Outlet

Other Type of Outlet (specify)

The Impoundment was Designed By

Has there ever been a failure at this site? YES NO

If So When?

If So Please Describe :

Has there ever been significant seepages at this site? YES NO

If So When?

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES NO

If so, which method (e.g., piezometers, gw pumping,...)?

If so Please Describe :