US ERA ARCHIVE DOCUMENT

# Coal Combustion Residue Impoundment Round 9 - Dam Assessment Report

**Cross Generation Station** 

Santee Cooper
Pineville, 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

**April 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 Cross Generation Station coal combustion residue (CCR) management units are based on a review of available documents and on the site assessment conducted by Dewberry personnel on February 23, 2011. We found the supporting technical documentation to be generally adequate (Section 1.1.3). As detailed in Section 1.2.5, there are two recommendations based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Cross Generation Station CCR management units (Gypsum Pond, Bottom Ash Pond 1, and Bottom Ash Pond 2) are generally SATISFACTORY for continued safe and reliable operation, with no recognized existing or potential management unit safety deficiencies within the parameters of design and operation considered appropriate for their low hazard potential classifications.

#### 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 a 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 byproducts 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 for hazard potential classification**. 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.

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or byproducts 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.

#### **Table of Contents**

	<u>Page</u>
INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS	II
PURPOSE AND SCOPE	II
1.0 CONCLUSIONS AND RECOMMENDATIONS	1-1
1.1 CONCLUSIONS	1-1
1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)	1-1
1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)	1-1
1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation	1-1
1.1.4 Conclusions Regarding the Description of the Management Unit(s)	1-2
1.1.5 Conclusions Regarding the Field Observations	1-2
1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation	1-2
1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program	1-2
1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation	1-3
1.2 RECOMMENDATIONS	1-3
1.2.1 Recommendations Regarding Maintenance	1-3
1.2.2 Recommendations Regarding Continued Safe and Reliable Operation	1-3
1.3 PARTICIPANTS AND ACKNOWLEDGEMENT	1-3
1.3.1 List of Participants	1-3
1.3.2 Acknowledgement and Signature	1-4
2.0 DESCRIPTION OF THE COAL COMBUSTION RESIDUE MANAGEMENT UNIT(S)	2-1
2.1 LOCATION AND GENERAL DESCRIPTION	2-1
2.2 COAL COMBUSTION RESIDUE HANDLING	2-1
2.2.1 Fly Ash	2-1
2.2.2 Bottom Ash	2-2
2.2.3 Boiler Slag	2-2
2.2.4 Flue Gas Desulfurization Sludge	2-2
2.3 Size and Hazard Classification	2-2
2.4 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY	2-5
2.5 Principal Project Structures	2-5
2.5.1 Earth Embankment	2-5
2.5.2 Outlet Structures	2-6
2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT	2-7
3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS	3-1
3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT	3-1
3.2 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS	3-1
3.3 SUMMARY OF SPILL/RELEASE INCIDENTS	3-1
4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION	4-2
4.1 Summary of Construction History	4-2
4.1.1 Original Construction	4-2

4.1.2	Significant Changes/Modifications in Design since Original Construction	4-3
4.1.3	Significant Repairs/Rehabilitation since Original Construction	4-3
4.2	SUMMARY OF OPERATIONAL PROCEDURES	4-3
4.2.1	Original Operational Procedures	4-3
4.2.2	Significant Changes in Operational Procedures and Original Startup	4-4
4.2.3	Current Operational Procedures	4-4
4.2.4	Other Notable Events since Original Startup	4-4
5.0 FIE	D OBSERVATIONS	5-1
5.1 F	PROJECT OVERVIEW AND SIGNIFICANT FINDINGS	5-1
5.2 E	ARTH EMBANKMENT - BOTTOM ASH POND 1	5-1
5.2.1	Crest	5-1
5.2.2	Upstream/Inside Slope	5-2
5.2.3	Downstream/Outside Slope and Toe	5-3
5.2.4	Abutments and Groin Areas	5-4
5.3 E	ARTH EMBANKMENT – BOTTOM ASH POND 2	5-5
5.3.1	Crest	5-5
5.3.2	Upstream/Inside Slope	5-5
5.3.3	Downstream/Outside Slope and Toe	5-6
5.4 E	ARTH EMBANKMENT - GYPSUM POND	5-8
5.4.1	Crest	5-8
5.4.2	Upstream/Inside Slope	5-9
5.4.3	Downstream/Outside Slope and Toe	5-10
5.4.4	Abutments and Groin Areas	5-11
5.5	OUTLET STRUCTURES — BOTTOM ASH POND 1	5-11
5.5.1	Overflow Structure	5-11
5.5.2	Emergency Spillway (Emergency Outfall Structure)	5-11
5.5.3	Low Level Outlet	5-13
5.5.4	Pump Structures	5-13
5.6	OUTLET STRUCTURES — BOTTOM ASH POND 2	5-14
5.6.1	Overflow Structure	5-14
Water	flows from Bottom Ash Pond 2 to Bottom Ash Pond 1 through a trapezoidal notch weir (spi	Ilway). A
view c	f the notch weir is shown in Photograph 5.14. The Fabriform-armored notch appeared to b	e in overall
satisfo	ictory condition with no major depressions, displacements, or deterioration. It was observe	d that some
veget	ation has become established on the Fabriform revetment, particularly along the seams	5-14
5.6.2	Outlet Conduit	5-15
5.6.3	Emergency Spillway	5-15
5.6.4	Low Level Outlet	5-15
5.7	OUTLET STRUCTURES — GYPSUM POND	5-15
5.7.1	Overflow Structure	5-15
5.7.2	Outlet Conduit	5-15
5.7.3	Emergency Spillway (Emergency Outfall Structure)	5-15
The er	nergency outfall structure and the access footbridge (in part) is shown in Photograph 5.15;	it is of the
same	design as the emergency outfall for the ash ponds. The galvanized steel-frame footbridge a	ppeared to

	sound condition with no significant rust. The reinforced concrete box with overflow v	
	tisfactory condition with no major cracks, spalls, or other deterioration	
5.7.4		
5.7.5	5 Pump Structure	5-17
6.0 H	YDROLOGIC/HYDRAULIC SAFETY	6-1
6.1	Supporting Technical Documentation	6-1
6.1.1	I Flood of Record	6-1
6.1.2	2 Inflow Design Flood	6-1
6.1.3	3 Spillway Rating	6-2
6.1.4	Downstream Flood Analysis	6-3
6.2	ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION	6-4
6.3	ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY	6-4
7.0 ST	FRUCTURAL STABILITY	7-1
7.1	Supporting Technical Documentation	7-1
7.1.1	Stability Analyses and Load Cases Analyzed	7-1
7.1.2	Posign Parameters and Dam Materials	7-3
7.1.3	B Uplift and/or Phreatic Surface Assumptions	7-5
7.1.4	Factors of Safety and Base Stresses	7-5
7.1.5	5 Liquefaction Potential	7-7
7.1.6	6 Critical Geological Conditions	7-8
7.2	ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION	7-10
7.3	ASSESSMENT OF STRUCTURAL STABILITY	7-10
8.0 AI	DEQUACY OF MAINTENANCE AND METHODS OF OPERATION	8-1
8.1	OPERATING PROCEDURES	8-1
8.2	MAINTENANCE OF THE DAM AND PROJECT FACILITIES	8-2
8.3	ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS	8-3
8.3.1	Adequacy of Operating Procedures	8-3
8.3.2	? Adequacy of Maintenance	8-3
9.0 AI	DEQUACY OF SURVEILLANCE AND MONITORING PROGRAM	9-1
9.1	Surveillance Procedures	9-1
9.2	Instrumentation Monitoring	9-1
9.3	ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM	9-2
9.3.1	Adequacy of Inspection Program	9-2
9.3.2	2 Adequacy of Instrumentation Monitorina Program	9-2

#### APPENDIX A – REFERENCE DOCUMENTS

Doc 01: Cross Generation Station Vicinity Map

Doc 02: Ash Management Flow Chart

Doc 03: Cross GS Pond Construction Drawings

Doc 04: Cross GS Regional Map Showing the Management Units in Relationship to

Critical Infrastructure

Doc 05: NPDES Violation Report

Doc 06: Cross GS Final Report Appendices to Volume 2 and Profiles
Doc 07: Cross GS Volume 2 Appendices – Unit 2 Subsurface Investigation

Doc 08: Bottom Ash Pond Extension and Stability Computations

Doc 09: Santee Cooper BMP Plan

Doc 10: Cross GS Dike Inspection Reports

Doc 11: Monitoring Well Location Map and Readings

#### APPENDIX B - FIELD OBSERVATION CHECKLISTS

Doc 12: Dam Inspection Check List Forms

#### 1.0 CONCLUSIONS AND RECOMMENDATIONS

#### 1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit, February 23, 2011, and review of technical documentation provided by Santee Cooper.

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

Based on a review of the engineering data provided by the owner's technical staff and Dewberry engineers' observations during the site visit, the dike embankments and emergency outlets appear to be structurally sound under static loading conditions. With respect to seismic stability and liquefaction potential, it appears that the dike embankments probably would safely withstand a low to moderate intensity earthquake with short duration, but they probably would not withstand the strong earthquake for which the main plant structures are designed. The level of stability with respect to seismic loading appears to be commensurate with the low hazard potential rating of the dikes.

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

No hydrologic/hydraulic analyses have been provided for the ash ponds or gypsum pond. However, for purposes of this assessment rigorous analyses are not needed for evaluation of hydrologic safety of the ash ponds and gypsum pond, which are totally contained within perimeter dike systems and do not receive uncontrolled off-site drainage. By inspection, the ash ponds and gypsum pond currently have adequate hydrologic safety for at least the 50-year "design" precipitation depth of 8.40 inches (0.70 foot), since there currently is more than sufficient flood storage volume between the normal operating water levels and the lowest crest elevations on the impounding dikes.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is generally adequate for these dikes of low hazard potential. Engineering documentation reviewed is contained in Appendix A (Doc 06 and Doc 08). The documentation did not include hydrologic/hydraulic analyses, but as noted above, hydrologic

safety can be assessed simply on the basis of inspection of the ring-dike systems, which do not receive uncontrolled off-site drainage. The documentation included both static and seismic stability analyses. The static stability analyses are sufficient. The seismic stability analyses were performed by the pseudo-static method. There is a question as to the validity of using this method when there is the potential for some soils in the foundation to lose shear strength during strong earthquake shaking (see discussion in Section 7.3). The documentation did not include liquefaction potential analysis of very loose to loose silty sands or excess deformation potential analysis of very soft to soft clays in the foundation soil profile under the dikes. Because of the generally low consequences of failure of these dikes, performing detailed liquefaction/deformation studies and additional seismic stability analyses does not appear to be warranted at this time.

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

The descriptions of the management units provided by the owner were an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management units required to conduct a thorough filed observation. The visible parts of the embankment dikes and emergency outlet structures were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability. Embankments appear structurally sound. There are no apparent indications of unsafe conditions or conditions needing emergency remedial action. Some minor maintenance is needed (see Subsection 1.2.5).

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 CCR management units. There was no evidence of significant embankment repairs or prior releases observed during the field inspection.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. The management unit dikes do not have dedicated dam performance instrumentation, although groundwater levels are measured semi-annually in groundwater quality monitoring wells located on the crest of the ash pond dikes. Based on the size of the dikes, the history of satisfactory performance, the current inspection program, and in the absence of problem or suspect conditions, there is no need for installation of performance monitoring instrumentation at this time

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility is generally SATISFACTORY for continued safe and reliable operation. No existing or potential management unit safety deficiencies are recognized. Although some engineering documentation is marginal, acceptable performance is expected under all applicable loading conditions (static, hydrologic, limited seismic) in accordance with the applicable criteria commensurate with low hazard potential classification.

#### 1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding Maintenance

It is recommended that routine maintenance pay particular attention to:

- a. Re-establishing good grass cover in areas of sparse grass growth and in areas eroded by surface runoff;
- b. Removing or otherwise controlling vegetation growing on (or in thin sediment on) the Fabriform revetment on the interior slopes of the ash pond dikes.
- 1.2.2 Recommendations Regarding Continued Safe and Reliable Operation

No recommendations appear warranted at this time.

#### 1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

\*Fred Tucker, Dewberry

\*Anne Lee, Dewberry

Levon Strickland, Santee Cooper



- \*Denise Bunte-Bisnett, Santee Cooper
- \*Jane Hood, Santee Cooper
- \*Billy Dixon Jr., Santee Cooper
- \*John Fondren III, Santee Cooper
- \*Participated in field observations.

#### 1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on February 23, 2011.

Fred Tucker, P.E. Registered, SC 6836

Anne Lee, Civil Engineer

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

#### 2.1 LOCATION AND GENERAL DESCRIPTION

The Cross Generation Station (Cross GS) is physically located on the east bank of the Diversion Canal in Berkeley County, South Carolina, approximately 5.2 miles northeast of Cross, South Carolina. Cross GS is located on Cross Station Road, Pineville, South Carolina 29468. Lake Marion is northwest of the Cross GS, and Lake Moultrie is southeast of Cross GS. See Doc 01 in Appendix A for location of the Cross GS on an aerial map.

The Cross GS has three CCR management units, Bottom Ash Pond 1, Bottom Ash Pond 2, and Gypsum Pond. Bottom Ash Pond 1 and Bottom Ash Pond 2 function as one pond at normal operating water level. Bottom Ash Pond 2 is connected to Bottom Ash Pond 1 with a trapezoidal notch cut through the original northeast side dike of Bottom Ash Pond 1. Table 2.1 shows the summary of the size and dimensions of the CCR management unit dikes.

Table 2.1: Summary of Dam Dimensions and Size			
	Gypsum Pond	Bottom Ash Pond 1	Bottom Ash Pond 2
Dam Height (ft) <sup>1</sup>	6	18	14
Crest Width (ft)	15	15 & 30	15 & 24
Length (ft)	1075	2293	6899
Side Slopes (upstream) H:V	3:1	3:1	3:1
Side Slopes (downstream) H:V	3:1	3:1	3:1

From Santee Cooper response to EPA's RFI dated March 17, 2009.

#### 2.2 COAL COMBUSTION RESIDUE HANDLING

#### 2.2.1 Fly Ash

Fly ash is dry-handled and sold for use in cement production or transported by truck to a nearby landfill. See Doc 02 in Appendix A for Ash Handling Flow Path and Section 8.1 for more detailed description of the ash handling operations.

#### 2.2.2 Bottom Ash

Bottom ash from the steam generator is collected in the bottom ash hoppers. The bottom ash is sluiced to the Bottom Ash Pond 2 via a closed system process.

#### 2.2.3 Boiler Slag

Boiler slag conveyance follows the bottom ash flow path from the boiler and sluiced to Bottom Ash Pond 2.

#### 2.2.4 Flue Gas Desulfurization Sludge

Gypsum from the flue gas desulfurization systems is dewatered and is sold, landfilled, or stored onsite. There are two gypsum dewatering processes, general gypsum dewatering and wallboard gypsum dewatering. Wallboard gypsum is sold to the market or stored onsite. Gypsum produced for other uses is sold to the market or transported to the landfill. All gypsum is transported by truck. Filtrate from the dewatering process is pumped to the Gypsum Pond. Filtrate from the wallboard gypsum dewatering process is pumped to Bottom Ash Pond 2. See Doc 02 in Appendix A for Flue Gas Desulfurization Systems and Gypsum Handling Flow Path. Further description of the gypsum handling operation is included in Section 8.1.

#### 2.3 SIZE AND HAZARD CLASSIFICATION

The Cross GS CCR impoundment dikes are not regulated by a federal or state agency and currently do not have federal or state hazard classifications. Dams owned by the South Carolina Public Service Authority (Santee Cooper) are specifically exempted from state regulation in Section 72-2 Dam Classifications and Exemptions of the South Carolina Dams and Reservoirs Safety Act Regulations. Santee Cooper created an internal multi-disciplined team composed of professional engineers with backgrounds specializing in dam safety, environmental services, plant operations, and facility maintenance to evaluate the structural integrity and safety of the impoundments. This task force established formal hazard ratings for each impoundment using nationally recognized criteria.

For reference, the South Carolina Department of Health and Environmental Control (SCDHEC) Size Classification and Hazard Potential Classification criteria are shown in Table 2.2a and Table 2.2b, respectively; the Hazard Potential Classification adopted by the EPA is shown in Table 2.2c.

Based on data summarized in Tables 2.1 and 2.3, Bottom Ash Pond 1 and 2 combined has a Small Size classification per the SCDHEC Size Classification criteria shown in Table 2.2a. Although the combined total storage capacity of Bottom Ash Pond 1 and 2 is 1,388 acre-feet, the liquid (water) portion currently is on the order of 582 acre-feet and will shrink as the ponds fill with bottom ash. The bulk of the bottom ash stored in the ash ponds is not expected to "flow" far through a postulated breach in the perimeter dike. Failure of the embankment would release water and CCR onto surrounding flat wooded and swampy land owned by Santee Cooper. Some of the CCR carried by the water may potentially reach Lake Moultrie or possibly the Diversion Canal (see discussion in Subsection 6.1.4). Failure would not likely cause loss of life but would cause some onsite environmental damage. On the basis of the hazard potential classification criteria used by the EPA (see Table 2.2c), Santee Cooper has given Bottom Ash Ponds 1 and 2 combined a Low Hazard Potential classification. Dewberry concurs with this hazard potential classification.

Based on data summarized in Tables 2.1 and 2.3, the Gypsum Pond has a <u>Very Small Size</u> classification per the SCDHEC Size Classification criteria shown in Table 2.2a. Failure of the low dike impounding the 1-acre Gypsum Pond would discharge a small volume of water and CCR onto flat surrounding land owned by Santee Cooper. The failure would not likely cause loss of life but would cause minor onsite environmental damage. Santee Cooper has given the Gypsum Pond a "Less than Low" Hazard Potential classification (see Table 2.2c). Dewberry concurs the classification should be <u>Less Than Low Hazard Potential</u>, since no or minimal environmental damage is likely.

Table 2.2a: SC Size Classification*			
Category	Impoundment Storage (Acre- Feet)	Dam Height (Feet)	
Very Small	Less than 50	Less than 25	
Small	Less than 1,000 but equal to or greater than 50	Less than 40 but equal to or greater than 25	
Intermediate	Less than 50,000 but equal to or greater than 1,000	Less than 100 but equal to or greater than 40	
Large	Equal to or less than 50,000	Equal to or less than 100	

<sup>\*</sup> Size classification may be determined by either storage or height of structure, whichever gives the higher category.

Table 2.2b: SC Hazard Potential Classification		
Category	Hazard Potential	
High	Dams located where failure will likely cause loss of life or serious	
Hazard	damage to home(s), industrial and commercial facilities, important	
(Class I)	public utilities, main highway(s) or railroad(s).	
Significant	Dams located where failure will not likely cause loss of life but may	
Hazard	damage home(s), industrial and commercial facilities, secondary	
(Class II)	highway(s) or railroad(s) or cause interruption of use or service of relatively important public utilities.	
Low	Dams located where failure may cause minimal property damage to	
Hazard	others. Loss of life is not expected.	
(Class III)		

Table 2.2c: Dam Hazard Potential Classification			
Used by EPA			
Category	Hazard Potential Description		
High Hazard Potential	Dams where failure or misoperation will probably cause loss of human life.		
Significant Hazard Potential  Low Hazard	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.  Dams where failure or misoperation results in no probable		
Potential	loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.		
Less Than Low Hazard Potential	Dams where failure or misoperation results in no probable loss of human life or economic or environmental losses.		

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

The amount of CCRs currently stored in the units and maximum capacities are summarized in Table 2.3. The Gypsum Pond is designed to contain flue gas emission control residuals. Bottom Ash Ponds 1 and 2 are designed to contain bottom ash and boiler slag. The bottom ash ponds also receive economizer ash and water pumped from the Gypsum Pond, the coal pile runoff retention basin, and plant drainage sumps. Water from the bottom ash ponds is recycled for use as ash seal and ash sluice water, using a series of pumps at Bottom Ash Pond 1.

Table 2.3: Amount of Residuals and Maximum Capacity of Unit			
Ash Pond Name	Gypsum Pond	Bottom Ash Pond 1	Bottom Ash Pond 2
Surface Area (acre) <sup>1</sup>	1.0	12.8	79.0
<b>Current Storage</b>	Varies	37,107	1,263,240
Volume (cubic yards)			
<b>Current Storage</b>	Varies <sup>2</sup>	23	783
Volume (acre-feet) <sup>1</sup>			
<b>Total Storage Capacity</b>	9,680	371,067	1,868,240
(cubic yards)			
<b>Total Storage Capacity</b>	6	230	1,158
(acre-feet) <sup>1</sup>			
Crest Elevation (feet)	85.81	95.31	91.00
Normal Pond Level	83.50	88.0	88.0
(feet)			

From Santee Cooper response to EPA's RFI dated March 17, 2009.

#### 2.5 PRINCIPAL PROJECT STRUCTURES

#### 2.5.1 Earth Embankment

Bottom Ash Ponds 1 and 2 have perimeter dike embankments that have geometric features and crest elevations as shown above in Tables 2.1 and 2.3. The dimensions and elevations are from construction drawings shown in Doc 03 in Appendix A. The wider crests occur on the embankments along the northwest side of Bottom Ash Pond 1 (30 feet wide) and the southwest side of Bottom Ash Pond 2 (24 feet wide), apparently to accommodate layout of various pipelines. The original northeast side dike of Ash Pond 1 was breached with the 10-foot bottom width trapezoidal notch (spillway) when the Bottom Ash Pond dike was constructed, so that

<sup>&</sup>lt;sup>2</sup>Continuous maintenance excavation occurs to remove gypsum to a permitted on-site landfill.

the two ponds function as one pond at normal operating water level, which is several feet above the bottom elevation of the notch. Bottom Ash Pond 1 is lined with a 6-inch thick soil bentonite layer and the inside slopes were originally armored with riprap. When Bottom Ash Pond 2 was constructed, Fabriform (grout-filled cellular fabric form) revetment was placed on top of the original riprap. Bottom Ash Pond 2 is lined with Bentomat, which is a thin geocomposite of bentonite sandwiched between and contained by fabric layers; the inside slopes are armored with Fabriform to protect the liner and slope from wave erosion and exposure (see Subsection 7.1.2 for dike design parameters and dam materials). No internal drainage blankets or toe drains for seepage control were included in the design of the dikes, but such seepage control features would not be warranted or expected for low perimeter dikes impounding lined ponds.

The Gypsum Pond has a diked perimeter embankment that has geometric features and crest elevation shown in Tables 2.1 and 2.3, based on construction drawings shown in Doc 03 in Appendix A. The material used in the construction of the dike is unknown, but believed to be similar to that used in the ash pond dikes. The pond is lined with a 6-inch thick soil bentonite layer and the inside slopes are armored with riprap. No internal drainage blankets or toe drains for seepage control were included in the design of the low dike.

#### 2.5.2 Outlet Structures

Bottom Ash Pond 1 – There is a pump structure located on the southwest end of the pond. Water is pumped back to the plant through two systems, the ash sluice system and the ash seal system. An emergency overflow structure is also located at the southwest end of the pond. The overflow structure consists of a 4-ft by 4-ft (interior opening dimensions) reinforced concrete box with an overflow weir elevation originally at 94.0 feet, but the weir was lowered to elevation 89.0 feet when Ash Pond 2 was constructed. There is a handwheel that formerly controlled a sluice gate for the structure, but the gate and handwheel are no longer operational, since the level of ash in the pond is above the gate (i.e., the gate is buried). The top of the structure is at elevation 95.0 feet. Emergency overflow discharges from the bottom of the overflow structure through an 18-inch diameter conduit. According to drawings issued in 1982 for construction of Ash Pond 1, the outlet conduit is indicated to be concrete pipe; however, a plan issued in 2004 for construction of modifications at the

pump platform shows the outlet conduit to be an 18-inch diameter steel pipe. The entrance invert elevation of the outlet pipe is at 78.0 feet according to original construction drawings (see Doc 03, Appendix A).

Bottom Ash Pond 2 – There is a 10-foot bottom width trapezoidal notch (spillway weir) with 3 horizontal (H) to 1 vertical (V) side slopes located through the original northeast side dike of Bottom Ash Pond 1. The trapezoidal notch is armored with Fabriform revetment. The crest elevation of the trapezoidal weir is at 85.0 feet (see Doc 03, Appendix A). Water from Bottom Ash Pond 2 flows through the notch into Bottom Ash Pond 1.

Gypsum Pond – There is a pump structure located on the northeast end of the pond. Water is pumped from the pond to Bottom Ash Pond 2. An emergency overflow structure is located at the southwest end of the pond. The overflow structure consists of a 4-ft by 4-ft (interior opening dimensions) reinforced concrete box with an overflow weir elevation at 84.5 feet. The top of the overflow structure is at elevation 85.5 feet. According to construction drawings, emergency overflow discharges from the bottom of the overflow structure through an 18-inch diameter concrete pipe to a receiving channel. The invert elevation of the outlet pipe is at 78.5 feet (see Doc 03, Appendix A).

#### 2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

A regional map showing Cross GS and the CCR ponds in relationship to "critical" infrastructure within a 5-mile radius was provided by Santee Cooper as shown in Doc 04 in Appendix A of this report. "Critical" infrastructure includes facilities such as schools and hospitals. There is one school within the 5-mile radius across the Diversion Canal.

#### 3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

#### 3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT

Furnished reports of quarterly inspections, conducted by Santee Cooper for the period December 2009 through February 2011 indicated no major structural or operational problems. No significant deterioration was indicated in the documentation reviewed. No other reports on the safety of the management units were provided.

# 3.2 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS

Discharge from the impoundment is regulated by the South Carolina Department of Health and Environmental Control (SCDHEC) and the impoundment has been issued a National Pollutant Discharge Elimination System Permit. Permit No. SC0037401 was issued November 3, 2006.

#### 3.3 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted releases, or other performance-related problems with the dikes over the last 10 years. The data did identify a bypass incident (unpermitted release) related to the maintenance of the pH Trim system. The release was not related to the performance of the dike or the emergency outlet structure.

#### 4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

#### 4.1 SUMMARY OF CONSTRUCTION HISTORY

#### 4.1.1 Original Construction

Original construction included Bottom Ash Pond 1 and the Gypsum Pond. The ponds were constructed by Burns and Roe, Inc. and their subcontractor, Ruscon Construction. Santee Cooper provided inspection and monitoring of construction. Construction was started in 1982 and the ponds were commissioned for service in 1983, when Unit 2 (the first unit completed) came into service. The construction drawings for these ponds are included in Doc 03 in Appendix A and appear to be the record drawings.

Both ponds were formed on flat land with perimeter dike embankments constructed of onsite materials. It appears that the pond areas were incised several feet below the original ground surface.

The ash pond was significantly expanded to the northeast and northwest by the construction of Bottom Ash Pond 2. The expansion created by Bottom Ash Pond 2 was constructed by Gilbert/Commonwealth. Santee Cooper provided inspection and monitoring of construction. The Bottom Ash Pond area was commissioned for service in 1995, when Unit 2 came into service. Construction drawings for the expansion are included in Doc 03 in Appendix A; it is not clear if they represent record drawings, since they are not sealed by a professional engineer.

The expansion area was enclosed with a perimeter dike embankment that ties-in to Bottom Ash Pond 1 at the east corner of the pond at one end and at the northwest side dike of the pond at the other end. The new dike embankments were constructed of onsite materials obtained primarily from excavation within the Bottom Ash Pond 2 area, which generally incised the pond bottom area several feet below the original ground surface, except in low areas of the pond where it appears that fill was required to prepare the subgrade for the Bentomat liner. The liner was covered with a protective 1-foot thick layer of ash over the pond bottom and a 1-foot thick layer of structural fill or sand under the Fabriform revetment on the inside slopes of the new dike embankment.

The trapezoidal notch spillway was excavated through the original northeast side dike of Bottom Ash Pond 1 and lined with the Bentomat, which was protected with soil cushion and Fabriform revetment as described above. Since the new dike around Bottom Ash Pond 2 was lower than the dike at Bottom Ash Pond 1 by more than 4 feet, the weir elevation at the emergency overflow structure was lowered 5 feet to elevation 89.0 feet.

The pump structure at Ash Pond 1 was expanded to incorporate additional pumps and service structures for Unit 3. The improvements included a new bulkhead system to retain the expanded platform for the new Unit 3 pumps and structures. A drawing for the expansion, issued by Parsons Energy & Chemicals Group Inc. in 2004 for construction, is included in Doc 03 in Appendix A; it is not clear if this drawing represents a record drawing, since a note on the drawing indicates that "this media should not be considered a certified document."

No other records of original construction are available.

#### 4.1.2 Significant Changes/Modifications in Design since Original Construction

The only changes/modifications in design since original construction are those to the Bottom Ash Pond 1 structures to accommodate the expansion created by Bottom Ash Pond 2. These changes are discussed in Section 4.1.1 above. There appear to have been no other significant changes or modifications in design since original construction.

#### 4.1.3 Significant Repairs/Rehabilitation since Original Construction

There appear to have been no significant repairs/rehabilitation since the original construction of the CCR ponds.

#### 4.2 SUMMARY OF OPERATIONAL PROCEDURES

#### 4.2.1 Original Operational Procedures

Furnished documents do not include the original operational procedures. Originally only Bottom Ash Pond 1 and the Gypsum Pond were in place. It is presumed that original operating procedures were similar to current procedures, as described in Section 8.1. Ash from Unit 2 is sluiced directly into Bottom Ash Pond 1 where the suspended particles settle out and the water recycled back to the plant through separate ash sluice and ash seal water systems. The sluice pipe was supported on a timber trestle

extending to the center of pond near the northeast end. The original operating water level in the pond was at elevation 93.0 feet. It is further presumed that filtrate from gypsum dewatering processes of the flue gas desulfurization systems was pumped into the Gypsum Pond, with water in this pond pumped to Bottom Ash Pond 1 and accumulated sediment (gypsum) excavated and removed to a permitted onsite landfill as needed to maintain storage capacity. The water level in the Gypsum Pond was (and still is) maintained at or below 83.5 feet.

4.2.2 Significant Changes in Operational Procedures and Original Startup

After construction of the expansion created by Bottom Ash Pond 2, the sluice and wastewater flows, as well as discharge from the Gypsum Pond, were directed into that part of the combined ponds which are in series and function as one pond. The operating water level in the combined ponds was lowered to elevation 88.0 feet from the original 93.0 feet in Bottom Ash Pond 1. Originally, pyrite-containing economizer ash from the back of the boilers was deposited in the ash ponds, most notably in the northwest part of Bottom Ash Pond 2. The pyrite is now removed and no pyrite-containing ash is deposited in the ash ponds.

4.2.3 Current Operational Procedures

See Section 8.1 for current operational procedures.

4.2.4 Other Notable Events since Original Startup

There are no other notable events since original startup.

#### 5.0 FIELD OBSERVATIONS

#### 5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Fred Tucker, P.E. and Anne Lee performed a site visit on Wednesday, February 23, 2011 in company with the participants listed in Section 1.3.1.

The site visit began mid-morning. The weather conditions during the visit were 62 degrees Fahrenheit, sunny, and dry. Photographs were taken of conditions observed. Please refer to the Dam Inspection Checklist in Appendix B for additional site visit 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 CCR impoundment dikes was that they were in satisfactory condition and no significant findings were noted.

#### 5.2 EARTH EMBANKMENT - BOTTOM ASH POND 1

#### 5.2.1 Crest

A typical view of the perimeter dike embankment crest of Bottom Ash Pond 1 is shown in Photograph 5.1. The limerock-surfaced crest appeared to be in satisfactory condition with no major sags, depressions, or other signs of significant settlement. No tension cracks which might suggest soil shear failure were observed in the crest or along the edge of the crest. The crest of the dike on the northeast side of Bottom Ash Pond 1 is shown in Photograph 5.2, as viewed from the southeast end toward the location of the notch spillway through this dike. A sparse grass cover has become established on this part of the crest, apparently due to low traffic on this dead-end section. The grass appeared to be maintained.



Photograph 5.1. View of crest and inside slope, southeast side looking northeast.



Photograph 5.2. View of crest and inside slope of Bottom Ash Pond 1 northeast dike, looking northwest.

#### 5.2.2 Upstream/Inside Slope

A typical view of the upstream slope of Bottom Ash Pond 1 is shown in Photograph 5.3. (Note the wider crest with pipelines on the northwest side of Bottom Ash Pond 1.) The Fabriform revetment that overlies the original riprap on the upstream slope was observed to have slight unevenness in its surface, but it appeared to be sound and generally free of

deterioration. Patches of vegetation (primarily the reed, Phragmites) were observed on the upstream slopes, generally along and just above the water line or ash sediment line. No slumps, slides, or other signs of shear failure were observed in the visible parts of the slopes above the water surface or ash surface.



Photograph 5.3. Typical view of inside slope, northwest side looking southwest.

#### 5.2.3 Downstream/Outside Slope and Toe

A typical view of the outside slope of Bottom Ash Pond 1 is shown in Photograph 5.4. As shown, the grass was observed to be maintained in relatively good condition. Minor erosion from mowing equipment was observed on the slope. No areas of significant erosion were observed. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed

The area along the outside toe of the dike on the southeast side was observed to be covered in woody vegetation (Photograph 5.4). The outside slope of the dike on the northwest side was observed to be covered with mowed grass; however, some erosion was observed along the outside toe of this section of the dike, as shown in Photograph 5.5. There were no indications of seepage.



Photograph 5.4. Typical view of outside slope, southeast side looking northeast.



Photograph 5.5. View of outside slope and toe, northwest side looking southwest.

#### 5.2.4 Abutments and Groin Areas

There are no abutments or groins in the dike embankment. No erosion or displacements were observed where the Bottom Ash Pond 2 dike ties into the Bottom Ash Pond 1 dike.

#### 5.3 EARTH EMBANKMENT – BOTTOM ASH POND 2

#### 5.3.1 Crest

Typical views of the perimeter dike embankment crest of Bottom Ash Pond 2 are shown in Photographs 5.6a and 5.6b. The ash finger dike in the pond is visible in Photographs 5.6a. The limerock-surfaced crest was observed to be in satisfactory condition. No major sags, depressions, or other signs of significant settlement were observed in the crest. No tension cracks or other signs of insipient mass soil movement were observed in the crest or along the edge of the crest.



Photograph 5.6a. Typical view of crest and inside slope, northeast side looking northwest.

#### 5.3.2 Upstream/Inside Slope

A typical view of the inside slope of Bottom Ash Pond 2 is shown in Photograph 5.6b (see also Photograph 5.6a). The Fabriform revetment on the upstream inside slopes appeared to be serviceable and in generally satisfactory condition with no major depressions and no significant areas of deterioration. Patches of vegetation (primarily Phragmites) were observed on the upstream slopes, generally along and just above the water line or ash sediment line, as shown in Photograph 5.6c. No slumps, slides, or other signs of shear failure were observed in the visible parts of the slopes above the water surface or ash surface.



Photograph 5.6b. Typical view of inside slope and crest, east side looking north.



Photograph 5.6c. View of reeds (Phragmites) growing on inside slope, northwest side looking south.

#### 5.3.3 Downstream/Outside Slope and Toe

A typical view of the outside slope of Bottom Ash Pond 2 is shown in Photograph 5.7a. As shown, the grass on the outside slope was typically observed to be maintained in satisfactory condition. Minor erosion from

surface runoff or disturbance of mowing equipment was observed at a number of locations, typically along the toe, as shown by a typical view in Photograph 5.7b. Santee Cooper personnel indicated that topsoil was not used on the outside slope for vegetation establishment. No areas of major erosion were observed. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed on the outside slope.



Photograph 5.7a. Typical view of outside slope and toe, east side looking north.



Photograph 5.7b. View of outside slope and toe, northwest side looking southwest.

A water-filled perimeter ditch is located along the outside toe, which restricts access of mowers. Therefore, tall grass was observed to typically occur along the toe (see Photograph 5.7b). There were no obvious signs of seepage from the toe.

#### 5.4 EARTH EMBANKMENT - GYPSUM POND

#### 5.4.1 Crest

A typical view of the perimeter dike embankment crest of the Gypsum Pond is shown in Photograph 5.8. The finger dike embankment used for excavating/hauling equipment access is shown in Photograph 5.9a. The crest was observed to be in satisfactory condition. It appeared to be somewhat wider than the 15-foot design width. No major sags, depressions, or other signs of significant settlement were observed in the crest. No tension cracks were observed in the crest or along the edge of the crest.



Photograph 5.8. Typical view of crest, southwest side looking southeast.



Photograph 5.9a. View of crest, inside slope, finger dike, and emergency overflow structure, northwest side looking southwest.

#### 5.4.2 Upstream/Inside Slope

Typical views of the inside slope of the Gypsum Pond are shown in Photographs 5.9a and 5.9b. Riprap was observed to cover the inside slope of the dike embankment.

The slope of the riprap above the water level appeared steeper than the 3H to 1V design slope of the embankment. The slopes of the finger dike within the pond were observed to be bare earth. No slumps, slides, or other signs of shear failure were observed in the visible parts of the slopes above the water surface.



Photograph 5.9b. Typical view of inside slope, southeast side looking northeast.

#### 5.4.3 Downstream/Outside Slope and Toe

A typical view of the outside slope and toe of the Gypsum Pond dike embankment is shown in Photograph 5.10. As shown, the grass on the outside slope was typically observed to be maintained in satisfactory condition. No areas of significant erosion were observed. No obvious signs of slumps, slides, bulges, tension cracks, seepage, or animal holes were observed.

A drainage ditch along the outside toe of the pond conveys runoff to a ditch downstream of the emergency overflow outfall. There were no obvious signs of seepage from the toe.



Photograph 5.10. View of outside slope and toe, southwest side looking southeast.

#### 5.4.4 Abutments and Groin Areas

There are no abutments or groins in the dike embankment. However, no erosion or displacements were observed where the finger dike ties into the perimeter dike.

#### 5.5 OUTLET STRUCTURES – BOTTOM ASH POND 1

#### 5.5.1 Overflow Structure

Bottom Ash Pond 1 has an emergency outfall structure, see Section 5.5.3.

#### 5.5.2 Emergency Spillway (Emergency Outfall Structure)

Photograph 5.11a shows the emergency overflow structure and the access footbridge to the structure. The galvanized steel-frame footbridge had some rust but appeared sound. The reinforced concrete box with overflow weir appeared to be in satisfactory condition with no major cracks, spalls, or other deterioration. A view of the weir on the front side of the overflow structure is shown in Photograph 5.11b. It was observed that the overflow structure was buried with ash almost to the elevation of the weir. A handwheel that accesses the sluice gate was observed to be rusted but sound; however, the handwheel is not used since the sluice gate is buried with ash and inoperable.



Photograph 5.11a. Emergency overflow structure.

The emergency overflow structure has bottom discharge into an 18-inch diameter conduit through the dike. The discharge end of the emergency outlet conduit, shown in Photograph 5.12, appeared to be steel pipe with a smooth PVC liner. The visible part of the emergency outlet conduit appeared to be sound. It appeared that discharges from the pipe would flow into a wetland area and ultimately into the Diversion Canal.



Photograph 5.11b. View (from above) down toward weir in emergency overflow structure.



Photograph 5.12. Discharge end of emergency outlet conduit.

#### 5.5.3 Low Level Outlet

There is no low level outlet.

#### 5.5.4 Pump Structures

Pump structures are located on the southeast side dike of the pond. Water is pumped from Bottom Ash Pond 1 through two systems back to the plant for reuse. One system is the ash sluice system and the other is the ash seal system. Photograph 5.13 shows several ash sluice system pipes from the pond. The pipes and equipment appeared to be well maintained. It appeared that one pump (of many) had been removed for service. The visible part of the bulkhead around the pump platform appeared to be in sound condition.



Photograph 5.13. Ash sluice lines to plant.

### 5.6 OUTLET STRUCTURES – BOTTOM ASH POND 2

#### 5.6.1 Overflow Structure

Water flows from Bottom Ash Pond 2 to Bottom Ash Pond 1 through a trapezoidal notch weir (spillway). A view of the notch weir is shown in Photograph 5.14. The Fabriform-armored notch appeared to be in overall satisfactory condition with no major depressions, displacements, or deterioration. It was observed that some vegetation has become established on the Fabriform revetment, particularly along the seams.



Photograph 5.14. Trapezoidal notch weir.

#### 5.6.2 Outlet Conduit

There is no outlet conduit.

### 5.6.3 Emergency Spillway

There is no emergency spillway.

#### 5.6.4 Low Level Outlet

There is no low level outlet.

#### 5.7 OUTLET STRUCTURES – GYPSUM POND

#### 5.7.1 Overflow Structure

The Gypsum Pond has an emergency outfall structure. Observations of the overflow structure associated with the emergency outfall structure are included in Subsection 5.7.3.

### 5.7.2 Outlet Conduit

Observations of the outlet conduit associated with the emergency outfall structure are included in Subsection 5.7.3.

### 5.7.3 Emergency Spillway (Emergency Outfall Structure)

The emergency outfall structure and the access footbridge (in part) is shown in Photograph 5.15; it is of the same design as the emergency outfall for the ash ponds. The galvanized steel-frame footbridge appeared to be in sound condition with no significant rust. The reinforced concrete box with overflow weir appeared to be in satisfactory condition with no major cracks, spalls, or other deterioration.



Photograph 5.15. Emergency overflow structure.

As at the ash ponds, the emergency overflow structure has bottom discharge into an 18-inch diameter conduit through the dike. The discharge end of the emergency outlet conduit, shown in Photograph 5.16, appeared to be the same kind of pipe as observed at the ash ponds, i.e., steel pipe with a smooth PVC liner. The visible part of the emergency outlet conduit appeared to be sound. Discharges from the pipe flow into a drainage ditch at the outside toe.



Photograph 5.16. Emergency outlet conduit.

#### 5.7.4 Low Level Outlet

There is no low level outlet.

### 5.7.5 Pump Structure

There is a pump structure that conveys water from the Gypsum Pond to Bottom Ash Pond 2. The pump is triggered once the water surface elevation reaches a set elevation. An auxiliary pump is located adjacent to the permanent pump structure. A view of the pump platform is shown in Photograph 5.17. The pump structure and associated equipment appeared to be in satisfactory condition. The pipe outlet conduits from the pump system at the Gypsum Pond are shown in Photograph 5.18. The pipes convey water from the Gypsum Pond to Bottom Ash Pond 2.



Photograph 5.17. View of discharge pump structure and auxiliary pump, looking northeast.



Photograph 5.18. View of pipes conveying water from Gypsum Pond to Bottom Ash Pond 2.

#### 6.0 HYDROLOGIC/HYDRAULIC SAFETY

### 6.1 SUPPORTING TECHNICAL DOCUMENTATION

#### 6.1.1 Flood of Record

The historical maximum water surface elevation in the ash ponds was slightly above 89.2 feet, which is the actual elevation of the weir at the emergency overflow structure at the southwest end of Bottom Ash Pond 1, causing water to flow through the emergency outflow structure. This maximum water surface elevation was not due to any particularly severe flood condition, but due to a mishap in January 2009, when all water was returned to the ash ponds during and just after the pH Trim system was taken out of service for several days to repair a leak (i.e., there was no outflow through the treatment system for several days). With the water surface at the emergency overflow weir elevation the freeboard in Bottom Ash Pond 1 was approximately 6.1 feet and the freeboard in Bottom Ash Pond 2 was approximately 1.8 feet.

No documentation has been provided about the maximum water surface elevation in the gypsum pond. Since there have been no reported flows through the emergency overflow structure, the water surface presumably has always been below the emergency overflow weir elevation of 84.5 feet (according to design drawings), leaving more than 1.3 feet of freeboard.

#### 6.1.2 Inflow Design Flood

The ash ponds and gypsum pond at the Cross Generating Station do not receive uncontrolled inflows from off-site. Santee Cooper representatives indicated that drainage structures at the station are designed for the 25-year frequency, 24-hour duration rainfall event. Presumably, the emergency outlet structures at the ash ponds and gypsum pond are designed for at least this event.

For ponds that are totally contained within a perimeter dike system, such as the ash ponds and gypsum pond at the Cross Generating Station, safe containment of water within the basins is provided by maintaining sufficient freeboard to contain 100 percent of design precipitation over the pond areas.

As previously mentioned, the SCDHEC Dams and Reservoirs Safety Act Regulations specifically exclude state regulation of dams owned and

operated by the South Carolina Public Service Authority (Santee Cooper). The state recognizes Santee Cooper's jurisdiction over its own dams; therefore safety of those dams comes under Santee Cooper's purview, and Santee Cooper has the authority to set the safety standard. Santee Cooper has set up a task force to evaluate the structural integrity and safety of its impoundments and to establish hazard potential ratings for each impoundment using nationally recognized criteria. This task force is expected to set the safety standard for impounding structures such as those at the Cross Generating Station. If Santee Cooper's hazard potential ratings and safety standards closely follow those given in the South Carolina dam safety regulations, the Cross ash ponds and gypsum pond would have spillway design floods as indicated below:

Bottom Ash Pond 1/Bottom Ash Pond 2 – Based on Small Size Classification and Low Hazard Potential Classification, the spillway design flood (SDF) criterion is 50- to 100-year frequency. The state requires new dams to be designed for the upper end of this range. Presumably, existing impoundments should be satisfactory for at least the lower end of this range. The precipitation depths at the Cross Generating Station ash pond coordinates, assuming 24-hour duration, are 8.40 inches and 9.59 inches for 50-year frequency and 100-year frequency, respectively, from the National Weather Service's on-line Precipitation Frequency Data Server, which gives point precipitation frequency estimates from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3, 2004.

Gypsum Pond – Because of the very low storage capacity of the gypsum pond (< 50 acre feet), very low height of the impounding dike (< 25 feet), and very low consequences of failure, the gypsum pond dike would be exempt from state regulation even if it did not come under Santee Cooper's authority. Therefore, the state would have no SDF criterion for the gypsum pond dike. The 25-year frequency, 24-hour duration storm event used for drainage design at Cross appears to be the appropriate design requirement for gypsum pond. From the above noted reference the precipitation depth for this frequency and duration is 7.29 inches.

### 6.1.3 Spillway Rating

No spillway rating was provided for the emergency outlet works at the ash ponds and the gypsum pond. However, no outfall is assumed in the assessment in Section 6.3

### 6.1.4 Downstream Flood Analysis

No downstream flood analysis has been provided for the ash ponds and gypsum pond. A qualitative analysis based on field observations and review of available data is as follows:

Bottom Ash Pond 1/Bottom Ash Pond 2 - Failure of the perimeter dike around the ash ponds would release water and coal combustion residue (CCR) carried by the water onto flat surrounding wooded and swampy land owned by Santee Cooper. The failure would not likely cause loss of life but would cause some onsite environmental damage.

An overtopping breach would most likely occur over the lower dike that impounds Bottom Ash Pond 2 and probably over the dike sections along the southeast, east, northeast, and north sides of the pond, where CCR sediment has not yet built up to the operating water level in the pond. With a breach through this portion of the perimeter dike some coal combustion residue could potentially be carried along slight-graded drainage features to reach Lake Moultrie approximately ½ mile away, where several dozen or more lake homes are located on lots leased from Santee Cooper. Because of the low head above outside toe elevations and flat topography, flood water from a postulated dam breach is expected to have low flow velocity and low flow depth when it reaches Lake Moultrie. In addition, most of the bottom ash would likely be deposited on the flat ground before reaching the lake.

A less-likely breach through the higher perimeter dike around Bottom Ash Pond 1 would release water carrying eroded CCR into wooded, swampy land and slight-graded drainage features to the Diversion Canal approximately 1 mile away or to Lake Moultrie; again, most of the bottom ash would likely be deposited on the flat land before reaching the Diversion Canal or the lake. A breach through the dike around Bottom Ash Pond 1 would release less water than a breach through the dike around Bottom Ash Pond 2, because the control section of the spillway notch between the two ponds would prevent water below elevation 85 feet from leaving the much larger Bottom Ash Pond 2.

Gypsum Pond - Failure of the low dike impounding the 1-acre Gypsum Pond would discharge coal combustion residue onto flat surrounding land owned by Santee Cooper. The failure would not likely cause loss of life but would cause minor onsite environmental damage. Due to the low head

above outside grade and low volume of water and coal combustion residue, the water and material released would most likely be entirely contained within the plant boundaries and likely would not reach Lake Moultrie or the Diversion Canal.

### 6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

No hydrologic/hydraulic analyses have been provided for the ash ponds or gypsum pond. However, for purposes of this assessment rigorous analyses are not needed for evaluation of hydrologic safety of the ash ponds and gypsum pond, which are totally contained within perimeter dike systems and do not receive uncontrolled offsite drainage. A simple assessment as discussed in the following section is sufficient.

#### 6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

By inspection, the ash ponds and gypsum pond currently have adequate hydrologic safety for the "design" precipitation depths given in Subsection 6.1.2, since there currently is more than sufficient flood storage volume between the normal operating water levels and the lowest crest elevations on the impounding dikes. The ash ponds will continue to have adequate hydrologic safety unless the average surface elevation of ash builds up to less than the design precipitation depths (0.70 foot for the 50-year design storm or about 0.8 foot for a 100-year design storm, both of 24-hour duration) below the top of the Bottom Ash Pond 2 Dike. Even then, the volume of water that could potentially be released would be quite small (approximately 64 acre feet for the 50-year design storm) and the consequences of overtopping would be relatively minor.

Likewise, the gypsum pond will continue to have adequate hydrologic safety unless the average surface elevation of sediment builds up to less than the design precipitation depth (0.61 foot for the 25-year, 24-hour duration design storm) below the top of the Gypsum Pond Dike. However, because of the periodic maintenance cleaning of sediment in the gypsum pond, the sediment level should never reach such a high level and most likely will always be maintained below the emergency overflow weir, which is 1.31 feet below the top of the dike.

This assessment conservatively assumes no outflow through the emergency overflow structures and no rainfall infiltration into the bottom ash that lies above the normal operating water level in the ash ponds.

#### 7.0 STRUCTURAL STABILITY

#### 7.1 SUPPORTING TECHNICAL DOCUMENTATION

#### 7.1.1 Stability Analyses and Load Cases Analyzed

The designer of record for Bottom Ash Pond 1 and the Gypsum Pond was Lockwood Greene (LG), Spartanburg, SC, working with Burns and Roe (B&R), Paramus, NJ. The designer of record for the ash pond expansion, which includes Bottom Ash Pond 2, was Gilbert/Commonwealth (G/C), Reading, PA. Law Engineering Testing Company (Law), Charlotte, NC, working for B&R, performed preliminary stability analyses as part of subsurface investigations of the Cross Generating Station site in the late 1970s, before specific locations and alignments of the CCR impoundment dikes had been established. The findings and results that pertained to the proposed waste disposal areas (CCR impoundments) are included in Law's Final Report, Volume 2 dated February 9, 1979; Volume 2 included the Phase 2 Report, which covered those structures and support facilities outside the main plant area. Selected test boring records, profiles, and laboratory data from this report were provided by Santee Cooper (Appendix A Doc 06).

Detailed subsurface investigations for Unit 2, the first unit to be built, and associated structures, among them the ash pond (Bottom Ash Pond 1), were performed by Woodward-Clyde Consultants (W-C), working for B&R. W-C performed stability analyses of the dike embankment for Bottom Ash Pond 1. The stability analyses, as well as findings and recommendations, are presented in W-C's Unit 2 Subsurface Investigation report dated January 1981; selected parts of this report were provided by Santee Cooper (see Appendix A, Doc 07). Static stability was calculated using both total and effective stress analyses. The cases analyzed were:

- 1. 19-ft High Dike, Undrained Strength (pond full @ El. 93)
- 2. 24-ft High Dike, Undrained Strength (pond full @ El. 93)
- 3. 24-ft High Dike, Drained Strength w/ Seepage (pond full @ El. 93)

According to the W-C report, Case 1 assumed 5 feet of excavation below original ground surface within the pond area. Cases 1 and 2 (total stress analyses) assumed no seepage through the embankment, since the pond was designed to have a low permeability liner. Case 3 (effective stress

analysis) was a check of stability in case the liner should leak and develop a line of seepage (phreatic line) through the embankment, in which case drained shear strength and steady-state seepage conditions were assumed. From the discussion and illustrations in the W-C report it is not clear which slope was analyzed (inside or outside or both) and why 5 feet of excavation of the interior of the pond is associated with the 19-foot high dike slope, rather than the 24-foot high sections. In addition, the inside and outside slopes are not indicated but are presumed to be 3 H to 1 V, based on furnished design drawings. The crest width is shown as 15 feet. Rapid drawdown was not analyzed as it was considered not to be a condition that the ash pond would experience. Seismic loading also was not analyzed.

G/C performed stability analyses of the dike embankment for the expansion (Bottom Ash Pond 2). Selected parts of the stability calculations identified as S-SL173-4, approved March 4, 1992 were provided by Santee Cooper (see Appendix A Doc 08). The stated purposes of the calculations were to "Evaluate stability of the proposed new dike with respect to earthquake coefficient (acceleration) and also compare it with the stability of the existing dike." Thus, the case of loading was seismic stability, which appears to have used the pseudostatic method. The pseudo static analysis assumes that the soils will not lose shear strengths (liquefy) under the shear strains produced by the cyclic loading of the seismic forces. Factors of safety were computed for various assumed seismic coefficients ranging from 0.00g (static case) up to as much as 0.45g for a couple of sections, using the computer program STABR/G. Two sections of the dike expansion (Bottom Ash Pond 2), west side and east side, and one section of the existing dike (Bottom Ash Pond 1) near the juncture with the new dike on the east side were analyzed. Different foundation soil stratification was used for the east side versus the west side. Both inside and outside slopes at 3H to 1V were analyzed. The outside slopes of the new dike were assumed to be 13 feet high, relative to 19 feet high for the existing dike; the inside slopes of the new dike were assumed to be 15 feet high, relative to 20 feet high for the existing dike (due to interior being incised).

No specific stability analysis appears to have been performed for the Gypsum Pond Dike. However, because this dike is lower than the ash pond dikes and has similar design, its stability presumably was judged to

be equivalent to or better than indicated by analyses of stability of the ash pond dikes.

### 7.1.2 Design Parameters and Dam Materials

The soil design properties and parameters used in Woodward-Clyde's stability analysis of the original dike (Bottom Ash Pond 1) are shown in Table 7.1. The predominant borrow soil available for construction of this dike embankment from excavation within the pond appears to have been assumed to consist of predominantly silty sandy clay and clayey sand. The upper foundation layer was assumed to be clayey sand and sandy clay and the lower foundation layer was assumed to be silty clay with fine sand lenses. A limestone layer (Santee formation) was assumed to occur at the base of the lower foundation layer.

Table 7.1: Design Properties and Parameters of Materials Used in W-C's Analyses					
	Total Unit Wt. (pcf)	Undrained		Drained	
Material		Strength Parameters		Strength Parameters	
		Cases 1 & 2		Case 3	
		C (psf)	Ø (deg)	C'(psf)	Ø´(deg)
				,	
Embankment (0-19')	120	800	0	0	26
Foundation (19'-29')	115	1000	0	0	26
Foundation (29'-44')	100	300	0	0	22

See Doc 07 in Appendix A for source of information in this table.

The soil design properties and parameters used in Gilbert Commonwealth's stability analysis of the newer dike (Bottom Ash Pond 2) are shown in Table 7.2. The embankment fill was assumed to consist of predominantly clayey sand (Unified Soil Classification of SC). It appears that the strength parameters used for the fill of the newer dike were taken as the average of estimated drained and undrained strength parameters, whereas the strength parameters for the original dike were taken as the undrained strength parameters. The more critical foundation soil stratification apparently occurred at the analysis section on the east side of the pond near the juncture with the original dike; thus only the soil properties and parameters of the foundation layers for the east side dike are shown in Table 7.2. The upper foundation layer was assumed to be clayey sand/ sandy clay (SC-CL) and the lower foundation layer was

assumed to be soft high plasticity clay (CH). Similar foundation soil stratification was assumed under the original dike, although the upper foundation soil layer was thicker and the lower foundation soil layer was very soft. Undrained strength parameters were assumed for all the foundation soil layers under both the newer on the dike east side and the original dike. The Santee Limestone was assumed to occur at the base of the lower foundation layers. It appears that ash deposits in the ponds were assumed to have shear strength with alternative parameters as indicated in Table 7.2. It is not entirely clear from the documentation, but it appears that the ash strength was taken into consideration only in additional analyses of the outside slopes, to check any beneficial effect of the presence of the ash on outside slope stability. The assumed level of ash in the pond was not specifically stated, but presumably it was set at the operating water level.

Table 7.2: Design Properties and Parameters of Materials Used in G/C's Analyses					
Material	Total Unit Wt. (pcf)	Undrained Strength Parameters C (psf) Ø (deg)		Avg. Drained & Undrained Strength Parameters C (psf) Ø (deg)	
New Dike East Side:					
Embankment (0-13')	125	-	0	675	33
Foundation (13'-23')	124.5	1000	0	-	-
Foundation (23'-33')	100.5	400	0	-	-
Original Dike:					
Embankment (0-20')	125	1000	0	-	-
Foundation (20'-35')	124.5	750	0	-	-
Foundation (35'-45')	100.5	300	0	-	-
Pond Contents:					
Ash	80	0	10		·
	Alt. 100.5	100	15	-	-

See Doc 08 in Appendix A for source of information in this table.

### 7.1.3 Uplift and/or Phreatic Surface Assumptions

In Woodward-Clydes's total stress analyses (Cases 1 and 2) of stability of the dike embankment (Bottom Ash Pond 1) no phreatic surface or line was assumed to develop in the embankment; the pond maximum operating water surface elevation was assumed to be at elevation 93 feet. In W-C's effective stress analysis (Case 3), which assumed failure of the liner and development of seepage through the dike embankment, the phreatic line was assumed to extend linearly through the embankment section from the maximum operating water surface elevation of 93 feet at the interior slope to a crop-out point on the exterior slope located 8 vertical feet above the outside toe of the embankment. In Gilbert/Commonwealth's seismic stability analyses of the newer dike (Bottom Ash Pond 2) and the original dike (Bottom Ash Pond 1) phreatic lines were conservatively assumed to develop through the embankment analysis sections, extending linearly from the maximum operating water surface elevation (88 feet on the newer dike and 93 feet, as well as 88 feet, on the original dike) at the interior slope to the outside toes of the embankments.

From visual observations in the field and review of monitoring well water level readings, there is no evidence of seepage outcrops on the outside slopes of any of the CCR impoundment dikes and no indications that a phreatic surface has developed through dike embankments.

#### 7.1.4 Factors of Safety and Base Stresses

The computed factors of safety for the three cases W-C analyzed for static stability of the original dike (Bottom Ash Pond 1) are shown in the Table 7.3 below. The text of the W-C report is "sketchy" and unclear as to which slopes, inside or outside, the computed factors of safety apply. Since the interior of the pond was planned to be incised by excavation to as much as 5 feet below original grade, it would appear that the indicated 24-foot high dike section referred to the inside slope, and the indicated 19-foot high dike section referred to the outer slope. However, parenthetical notes in the text indicate "5 ft of excavation in pond interior" next to the 19-foot dike, and "no excavation in pond interior" next to the 24-foot dike; it seems likely that these notes were mistakenly interchanged. W-C's analyses did not indicate what factor of safety (FS) criteria were adopted for design. The U.S. Army Corps of Engineers (USACE) recommends minimum FS criteria for dams are 1.5 (long term, steady state seepage –

consolidated drained strengths) and 1.3 (short term, i.e., end-of-construction – unconsolidated undrained strengths).

Table 7.3: Static Stability Factors of Safety from W-C's Analyses of Original Dike (Bottom Ash Pond 1)				
N Type of Analysis	Height of Embankment (feet)	Calculated Factor of Safety (FS)		
t Undrained (Case 1)	19	2.24		
Undrained (Case 2)	24	1.68		
Drained with Seepage (Case 3)	24	2.45		

See Doc 07 in Appendix A for source of information in this table.

A summary of computed factors of safety from G/C's seismic (pseudostatic) stability analyses of the more critical analysis section (east side) of the newer dike (Bottom Ash Pond 2), as well as analysis sections of the original dike (Bottom Ash Pond 1) at the juncture with the newer dike and at the location of worst foundation soil conditions, is presented in Table 7.4 below. G/C's analyses calculated factors of safety for various assumed seismic coefficients, but did not indicate which seismic coefficient was adopted for design. Factors of safety versus earthquake (seismic) coefficient plots were developed for each of the analysis sections, but the design criterion was not indicated. The usual minimum FS criterion adopted when using pseudo-static analysis is 1.00, but 1.10 or higher is sometimes used, depending on designer's preference or confidence level in assumptions made in the analysis. Using this criterion and plots of FS versus seismic coefficient, the seismic coefficients corresponding to FS = 1.00 are approximately as follows for the more critical (outside) slope of the analysis sections:

New Pond-East Dike @ Original Dike	0.20g
Original Dike @ New Pond-East Dike	0.17g
Original Dike with Worst Foundation Conditions	0.12g

Table 7.4: Seismic (Pseudo-Static) Stability Factors of Safety from G/C's Analyses of New Dike (Bottom Ash Pond 2) & Original Dike (Bottom Ash Pond 1)

	Horizontal	Calculated Minimum Factor of Safety (FS)		
Location Seismic Coefficient (g)		Inside Slope 3.388	Outside Slope 2.261	
New Dike - East Side @	0 (static) 0.15 outside/	1.833	1.208	
Original Dike	0.10 inside 0.25	0.954	0.872	
Original Dike @ New Pond – East Dike	0 (static)	2.370	1.892	
	0.15 outside/ 0.10 inside	1.452	1.126	
	0.25	0.840	0.769	
Original Dike - Worst Foundation Condition	0 (static)	2.369	1.557	
	0.10	1.302	1.056	
	0.25	0.670	0.597	

See Doc 08 in Appendix A for source of information in this table.

### 7.1.5 Liquefaction Potential

No liquefaction potential analyses appear to have been performed specifically for the dikes that impound the CCR ponds at the Cross Generating Station. Available subsurface information, discussed below in Subsection 7.1.6, indicate that the foundation soils under the dikes typically include layers of soft to very soft silty clay and some layers of loose to very loose sands/silty sands within the upper 20 to 25 feet of the Pleistocene soil profile above the Santee Limestone. Depending on their

relative densities and intensity of earthquake shaking, the silty sands could be susceptible to liquefaction, and the very soft clay could also be susceptible to large displacements during strong earthquake shaking. The 1979 Law report included discussions of liquefaction of cohesion-less soils (e.g., sands and silty sands) and earthquake behavior of soft to very soft clays as they pertain to such soils that exist in the Pleistocene Sediments at the Cross site. Based on their work, it was Law's opinion that "the sands and silty sands at the Cross site will become liquefied during the design earthquake. Therefore, important structures, including embankments, that are designed to withstand the design earthquake, should not have foundation support from these sands and silty sands." Law's discussion of earthquake behavior of the soft clay led to "the overall impression that the soft fine grained soils at depth would fail or deform excessively under the shaking of a major earthquake....On a judgmental basis, therefore, important structures, including embankments, that have as a design criterion to withstand strong earthquake shaking without collapse or serious damage, should not have foundation support that is dependent on the performance of soft, fine-grained soils."

#### 7.1.6 Critical Geological Conditions

The subsurface conditions at Cross site were extensively investigated prior to construction of the first unit (Unit 2) and associated structures, and W-C made numerous borings and test pits during final subsurface investigation of the original ash pond (Bottom Ash Pond 1). Furnished selected data from Law's investigation are included in Appendix A Doc 06, and W-C's subsurface investigation report is included in Appendix A Doc 07.

From Law's 1979 report the site stratigraphy within the depths explored includes in order of increasing depth:

- 1. Relatively unconsolidated sediments of Pleistocene age
- 2. Santee Limestone of Eocene age
- 3. Black Mingo Formation of Eocene age

Typically, in the area of the ash ponds the depths of the Pleistocene sediments to the Santee Limestone are on the order of 20 to 25 feet, although they range shallower and deeper, depending on location. The Pleistocene sediments include:

1. Clays and silts of high plasticity (CH & MH)

- 2. Clays and silts with low plasticity (CL & ML)
- 3. Clayey Sands
- 4. Silty sands and slightly clayey silty sands (SM & SM-SC)

The 1979 Law report indicated that "in very general terms the Pleistocence soil profile at the site may be characterized as consisting of a relatively 'firm' layer overlying much 'weaker' more compressible layers." The geologic hazards associated with the Pleistocene sediments relative to the CCR pond dikes are as previously discussed: potential for liquefaction of the loose silty sands and/or excessive deformation of soft to very soft silty clay during strong earthquake.

The Santee Limestone thickness typically was in the range of 30 to 50 feet in Law's Phase 2 borings that completely penetrated the formation. A number of Law's borings and W-C's borings encountered drilling rod drops and losses of drilling water within the limestone, suggesting possible voids in the limestone. Most of the rod drops were in the range of less than 0.2 foot to 3.5 feet. The most significant rod drop in W-C's borings was 8.5 feet in boring B-632 (near east-side juncture of original dike with newer dike) between depths of 48 and 56.5 feet, and the most significant rod drop in Law's borings was 9.0 feet in boring B-244 (near north side of Bottom ash Pond 2) between depths of 29 and 38 feet with a void filling of blue green silty clay noted. A furnished map showing the original topography indicates a relatively broad surface depression in the vicinity of boring B-244. Thus, the geologic hazard associated with the Santee Limestone is potential collapse of a void in the limestone under the impounding dikes or ponds.

The Black Mingo Formation was encountered at depths ranging from 44 to 87 feet in Law's Phase 2 borings that were made deep enough to encounter it. The upper part of the Black Mingo consists of firm to very dense silty sand and clayey sand, and the lower part consists of hard to very hard clayey silt and silty clay. There appear to be no significant geologic hazards associated with the Black Mingo Formation relative to the CCR pond dikes.

Seismicity – The Cross Generating Station is in an area of high seismic hazard. Based on USGS Seismic-Hazard Maps for Central and Eastern United States, dated 2008, the Cross Generating Station, including the ash

ponds and gypsum pond, is located in an area anticipated to experience about 0.98g peak (horizontal) ground acceleration with a 2-percent probability of exceedance in 50 years, assuming uniform firm-rock site conditions, i.e., a site with average shear wave velocity of 2500 feet per second in the upper 100 feet below the ground surface. The relatively unconsolidated Pleistocene sediments that overlie the Santee Limestone would be expected to have much lower shear wave velocity; therefore, the expected horizontal ground acceleration at the dikes, derived from a site response analysis, would be higher than the indicated map value. In the 1979 Law report it was noted that designers established the design earthquake for the Cross project as that specified in the Uniform Building Code, 1976 Edition, which was "a base rock excitation representative of horizontal motions of a Magnitude 7 earthquake and producing a peak rock acceleration of 0.3g." It was further noted that "This acceleration value is less than would be obtained by moving the Charleston Earthquake of 1886 to the site."

#### 7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation for the CCR pond dikes at the Cross Generating Station is adequate with respect to static stability but is not clear-cut with respect to seismic stability and liquefaction potential. The pseudo-static method of analysis used to check seismic stability may not be appropriate in view of the soft to very soft clays and loose to very loose sands that underlie the dikes, although they typically occur at appreciable depths. These poor soils, which are below the water table, could potentially develop excess pore pressures during strong earthquake shaking and experience loss of shear strength, causing deformations in the very soft clays or even liquefaction of the very loose sands. As previously noted, the pseudostatic method of analysis is valid only when the embankment and foundation soils will not experience significant loss of shear strength during earthquake shaking. In addition, the design basis earthquake (or corresponding design seismic coefficient) for the dikes is not stated in the calculations. It is noted, however, that for low dikes with low consequences of failure, such as the Cross dikes, the standard of practice, particularly of the time, usually did not include state-of-the-art seismic stability analyses or liquefaction potential analyses.

#### 7.3 ASSESSMENT OF STRUCTURAL STABILITY

On the basis of the furnished static slope stability analyses and visual observations in the field, the dikes impounding the ash ponds, as well as the gypsum pond (by analogy), have adequate stability under static loading conditions.

Assessment of seismic stability of the CCR pond dikes on the basis of the furnished pseudo-static stability analysis is less straightforward, because the validity of the pseudo-static method of analysis used is questionable when soils, such as some of those that exist under the dikes at the Cross site, could potentially lose shear strength under strong seismic shaking. If it is assumed that the suspect foundation soils do not lose shear strength during a seismic event, the analyses results indicate that the Bottom Ash Pond 1 Dike is generally satisfactory for seismic coefficients of at least 0.17g, except where the worst foundation soil conditions occur, where the FS criterion is met at a lower seismic coefficient of 0.12g; the Bottom Ash Pond 2 Dike is satisfactory for seismic coefficients of at least 0.20g. It is important to note that the seismic coefficient is not equivalent to peak horizontal ground acceleration, but is an empirical factor that is taken as some fraction of the peak acceleration, depending on earthquake magnitude; the critical seismic coefficient is the one that yields FS of 1.0 by the pseudo-static method and results in acceptably small displacements by the Newmark Method.

Assuming a Magnitude 7 earthquake, noted in Law's 1979 report, and using acceleration ratio (seismic coefficient/peak acceleration) of 0.25 for Magnitude 7 earthquake from the literature, the peak acceleration implied by the lowest seismic coefficient, 0.12g, from the analyses is 0.48g; this is lower than the peak ground acceleration (0.98g) from the USGS seismic hazard map for 2 percent probability of exceedence in 50 years (or 1 in 2500 years probability of occurrence), which does not include site response due the mantle of relatively unconsolidated Pleistocene sediments.

However, the peak ground acceleration, not including site response, is 0.16g from the USGS seismic hazard map for 10 percent probability of exceedence in 50 years (or 1 in 500 years probability of occurrence). Though the site response is not known, it appears that the dikes could safely withstand ground motions expected at this lower hazard level, assuming there is no liquefaction of the loose to very loose sands or severe loss of shear strength in the very soft clays in the foundation under widespread areas of the dikes. In addition, the poor soils generally occur deeper in the Pleistocene soil profile and localized liquefaction or displacements in them possibly would not be reflected through the firmer and stiffer overlying soils in sufficient magnitude to create unacceptable displacements in the dike embankments.

The dike embankments do not appear to be constructed of materials that would be susceptible to liquefaction, even if they were saturated, but as previously noted some foundation layers of loose to very loose sands and silty sands could be

susceptible to liquefaction, although the extent of these soils under the dikes does not appear to be widespread, not as much so as the soft to very soft clays at depth. As previously noted, Law's opinion was that the sands and silty sands at the site will become liquefied during the design earthquake (i.e., Magnitude 7 with peak rock acceleration of 0.30g).

From review and evaluation of the available analyses and site subsurface data, it appears that with respect to seismic stability and liquefaction potential the CCR Pond dikes probably would safely withstand a low to moderate intensity earthquake with short duration; they probably would not withstand the strong earthquake for which the main plant structures are designed.

The emergency outlet structures appeared to be in generally sound and stable condition with no evidence of significant deterioration of the limited visible parts of the structure that could be seen at the riser and at the outfall.

### 8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

#### 8.1 OPERATING PROCEDURES

Bottom Ash Pond 1/Bottom Ash Pond 2 –The two ponds are connected by a trapezoidal spillway (notch) cut through the former northeast side dike of Bottom Ash Pond 1 (see Photograph 5.14). The two ponds generally function as one pond used for disposal and storage of primarily bottom ash and economizer ash and secondarily boiler slag. However, the bottom elevation of the trapezoidal spillway is approximately 9 feet above the bottoms of ponds at the original dike toes and 3 feet below the normal operating water level in the ponds; sedimentation of most of the ash currently is within the area of Bottom Ash Pond 2. Formerly, economizer ash, which contained pyrite, was deposited in the northwest part of Bottom Ash Pond 2, but currently pyrite is removed before depositing coal combustion residuals in the ash ponds. Some of the ash in the ponds is mined and sold for use in the manufacture of concrete blocks; the pyrite was an undesirable component in the ash because of staining that would be caused by weathered pyrite. The ash is excavated and placed in stockpiles to allow the material to drain prior to loading and transport offsite.

A finger dike constructed of ash separates the northwest half of Bottom Ash Pond 2 from the southeast half. Ash material currently is sluiced from the southwest side of the pond into the northwest half to force sedimentation in the northern part of the pond as the water circulates clockwise around the northeast end of the finger dike to the southeast half of Bottom Ash Pond 2 and further on to the southwest. Water flows through the spillway notch into Bottom Ash Pond 1 where water is pumped back to the plant through two systems.

One system is the ash sluice system where the water is re-circulated to enclosed troughs under the bottom ash hoppers of the boiler furnaces. Water and ash discharged from the hoppers pass through clinker grinders to the ash sluice system, which collects and transports the bottom ash slurry to Bottom Ash Pond 2.

The other system is the ash seal system where the water is re-circulated to troughs around the periphery of the hoppers to serve as seals against outside atmospheric pressure, so that negative pressure (- 0.5 psi) can be maintained inside the boiler furnaces. The seal water spills to the ash sluice system and is conveyed back to the ash ponds via discharge into Bottom Ash Pond 2. In this fashion the water in the ash ponds is continuously recycled. The bottom ash is totally contained until it is discharged into the ash ponds.

All plant island and yard drains, including water from the coal pile runoff retention basin, are collected and pumped into Bottom Ash Pond 2. Water (~ 475 gpm) from the Gypsum Pond and filtrate (~ 300 gpm) from dewatering of gypsum from Units 3 & 4 flue gas desulfurization systems also are pumped into Bottom Ash Pond 2. Dewatered gypsum that is not immediately trucked to market is placed in covered storage on-site. Excess water in the ash ponds is released by opening a valve on the ash seal system to a line that feeds excess water to the treatment plant, where the water is discharged after treatment to the Diversion Canal between Lake Marion and Lake Moultrie in accordance with NPDES permit requirements. The recycling and water treatment discharge operations are balanced together with service water inputs to maintain the operating water level in the ash ponds at elevation 88.0 feet, providing minimum freeboard of 3.0 feet along the Bottom Ash Pond 2 Dike.

Fly ash is dry-handled and sold for use in cement production or trucked to a nearby landfill. Therefore, no fly ash is/has been deposited in the ash ponds. The dry fly ash from the electrostatic precipitators is collected in fly ash hoppers, and from the hoppers the dry fly ash is pneumatically transported to storage silos. The dry fly ash from the silos is loaded into tanker trucks and transported to market. The fly ash from the Units 1 & 2 silos, not transported to market, is landfilled. This fly ash is transferred to a pug mill for conditioning with moisture and pebble lime for better handling, and then transferred by screw conveyors to concrete storage pads. The conditioned fly ash is loaded onto hauling trucks, covered, and transported to the landfill; some moisture conditioned fly ash is trucked to market.

Gypsum Pond – This small pond receives filtrate (~ 475 gpm) from dewatering of gypsum from Units 1 & 2 flue gas desulfurization (FGD) systems; the dewatered gypsum is trucked to market or to a nearby landfill. The filtrate is discharged into the pond from overhead piping supported on a steel frame over the dike near the north corner. Wash water and some gypsum from the FGD systems, as well as water from storm drains and sumps, also are pumped into the pond. When needed, the Gypsum Pond is cleaned of sediment to restore storage volume for settling of suspended solids in the influent. A finger dike extending into the pond from the northwest side is used to facilitate access of excavators and hauling trucks used for cleaning the pond. The excavated sediment is loaded onto hauling trucks and transported to a permitted industrial waste landfill onsite.

#### 8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance of the impounding embankments and emergency outlet works of the ash ponds and gypsum pond, and essential operating equipment, such as the piping (ash sluice, ash seal, and wastewater lines) and the recirculation pumps at the

ponds, is performed as needed, based on routine inspections performed by operating personnel. Vegetation on the embankment slopes is generally mowed or cut twice a year or whenever it becomes necessary, by maintenance personnel at the station.

#### 8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

#### 8.3.1 Adequacy of Operating Procedures

Based on field observations and review of operations pertaining to CCR containment, operating procedures at the ash ponds and gypsum pond appear to be adequate.

### 8.3.2 Adequacy of Maintenance

Overall, maintenance of the impounding embankments and emergency outlet works of the ash ponds and the gypsum pond appears to be adequate. No major maintenance issues were noted from review of dike inspection reports. Based on field observations, some minor maintenance of eroded areas on the outside slope of the perimeter dikes around the ash ponds is needed. In addition, vegetation growing in places directly on the Fabriform revetment on the inside slope of the perimeter dike around the ash ponds should be removed to minimize deterioration of revetment.

### 9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

#### 9.1 SURVEILLANCE PROCEDURES

Santee Cooper personnel inspect the ash pond and gypsum pond embankments following dike inspection procedures in Section 4.9 of Santee Cooper's BMP plan, which is included as Doc 09 in Appendix A. Santee Cooper has indicated that the intent of the BMP plan is to train operating personnel to conduct routine, periodic inspections of the impoundment dikes and have qualified dam safety personnel assist operating personnel with the quarterly inspections as requested. The quarterly inspections are documented on Dike Inspection Reports in checklist format (see Appendix A, Doc .10).

Miscellaneous Inspections – Santee Cooper operating personnel and security guards are trained in making daily observations of the ash pond embankments. Engineers accompany the operating personnel during the quarterly inspections when requested.

#### 9.2 INSTRUMENTATION MONITORING

There is no dedicated dam performance monitoring instrumentation in place in the impounding embankments of the ash ponds and gypsum pond. However, groundwater monitoring wells are in place at various locations on the crest of the ash ponds perimeter dike and around the ash ponds for monitoring of groundwater quality. The locations of the monitoring wells are shown on an aerial photo in Doc 11 in Appendix A. Groundwater levels are measured as part of the water quality monitoring program. The groundwater elevations for the period of record from January 1996 to July 2010 are tabulated and plotted in Doc 11 in Appendix A. The semi-annual measurements of groundwater levels in the monitoring wells located on the crest of the perimeter dike around the ash ponds show that the water levels have fluctuated some 4 to 6.5 feet over the period of record but have remained below the original ground line and have not risen up into the dike embankment. In fact, over the period of record there appears to have been a slight downward trend averaging on the whole around 0.10 to 0.15 foot per year, suggesting that the lined ash ponds have locally retarded recharge to the groundwater regime. A staff gauge mounted on the bulkhead of the pump platform on the southwest side of Bottom Ash Pond 1 is used for monitoring the water surface elevation in ash ponds.

#### 9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

#### 9.3.1 Adequacy of Inspection Program

The inspection program is generally adequate based on field observations and review of Santee Cooper's written inspection procedures.

### 9.3.2 Adequacy of Instrumentation Monitoring Program

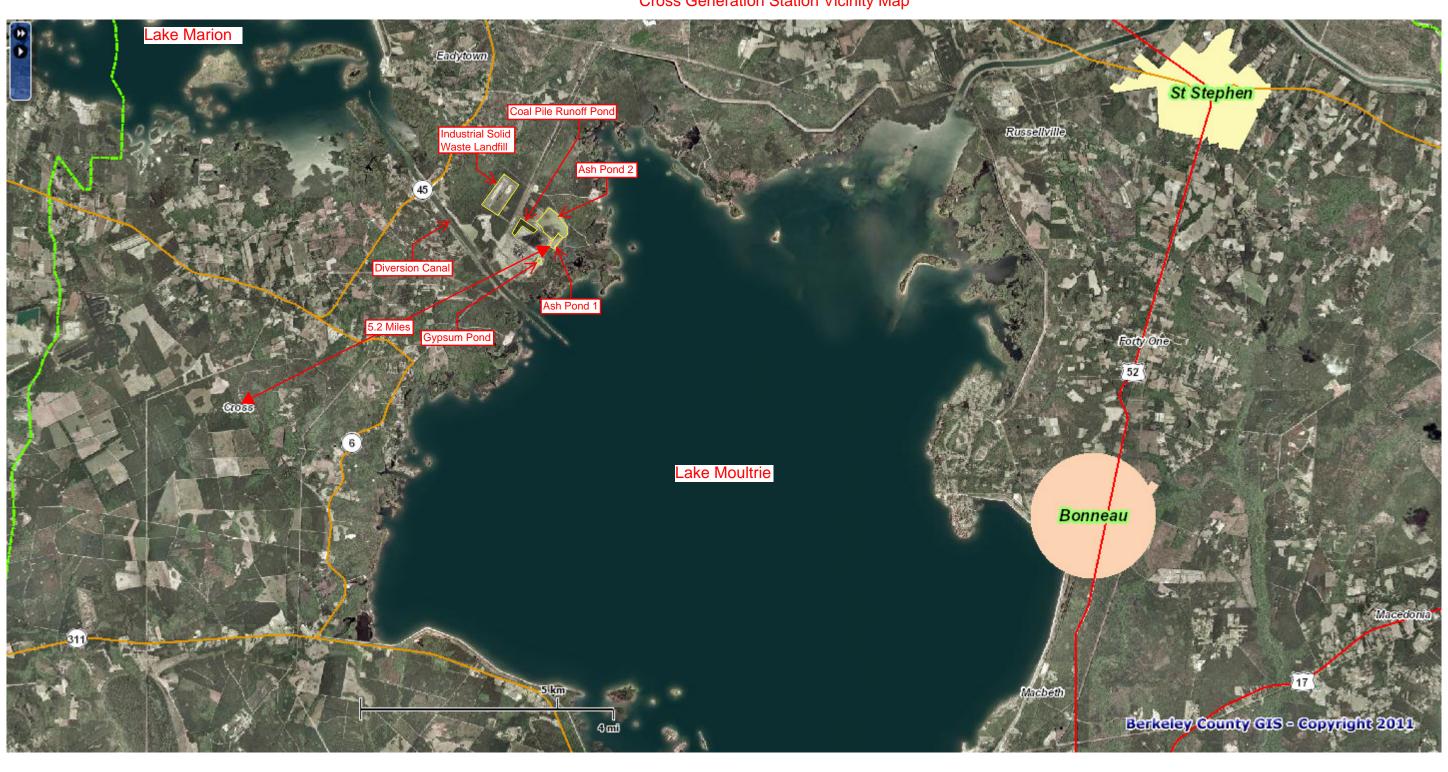
There is no dedicated dam performance monitoring instrumentation in place in the ash pond dikes and gypsum pond dike, although useful groundwater level information is obtained from monitoring wells installed on the ash pond dikes for sampling and analysis of groundwater. No problem or suspect condition, such as excessive settlement, major seepage, shear failure, or displacement was observed in the field that might be reason for installation of additional instrumentation. In the absence of stability problems or major seepage issues, and considering that the impounding embankments are low and the ponds are lined with very low permeability materials, there is no need for performance monitoring instrumentation at this time.

### APPENDIX A

### REFERENCE DOCUMENTS

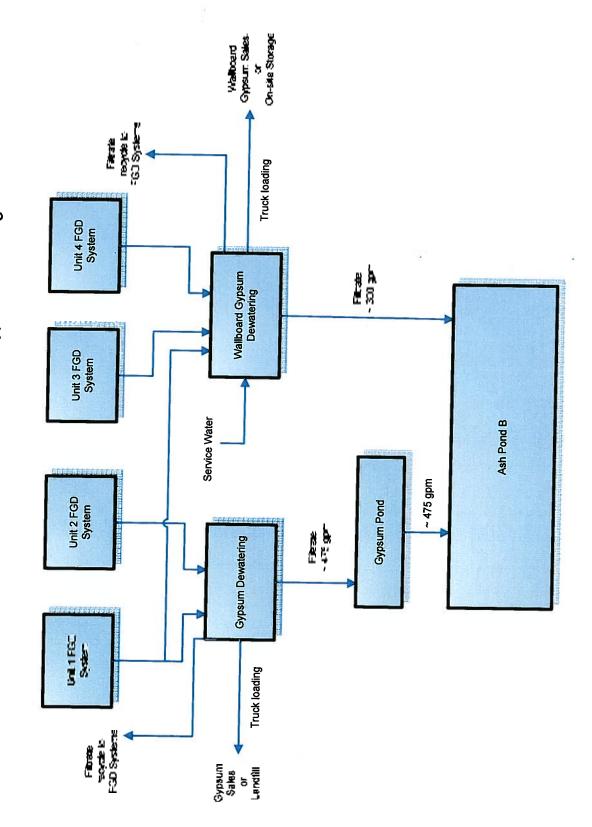
Appendix A Doc 01: Cross Generation Station Vicinity Map

### Cross Generation Station Vicinity Map



Appendix A Doc 02: Ash Management Flow Chart

Santee Cooper Cross Generating Station Flue Gas Desulfurization Systems and Gypsum Handling



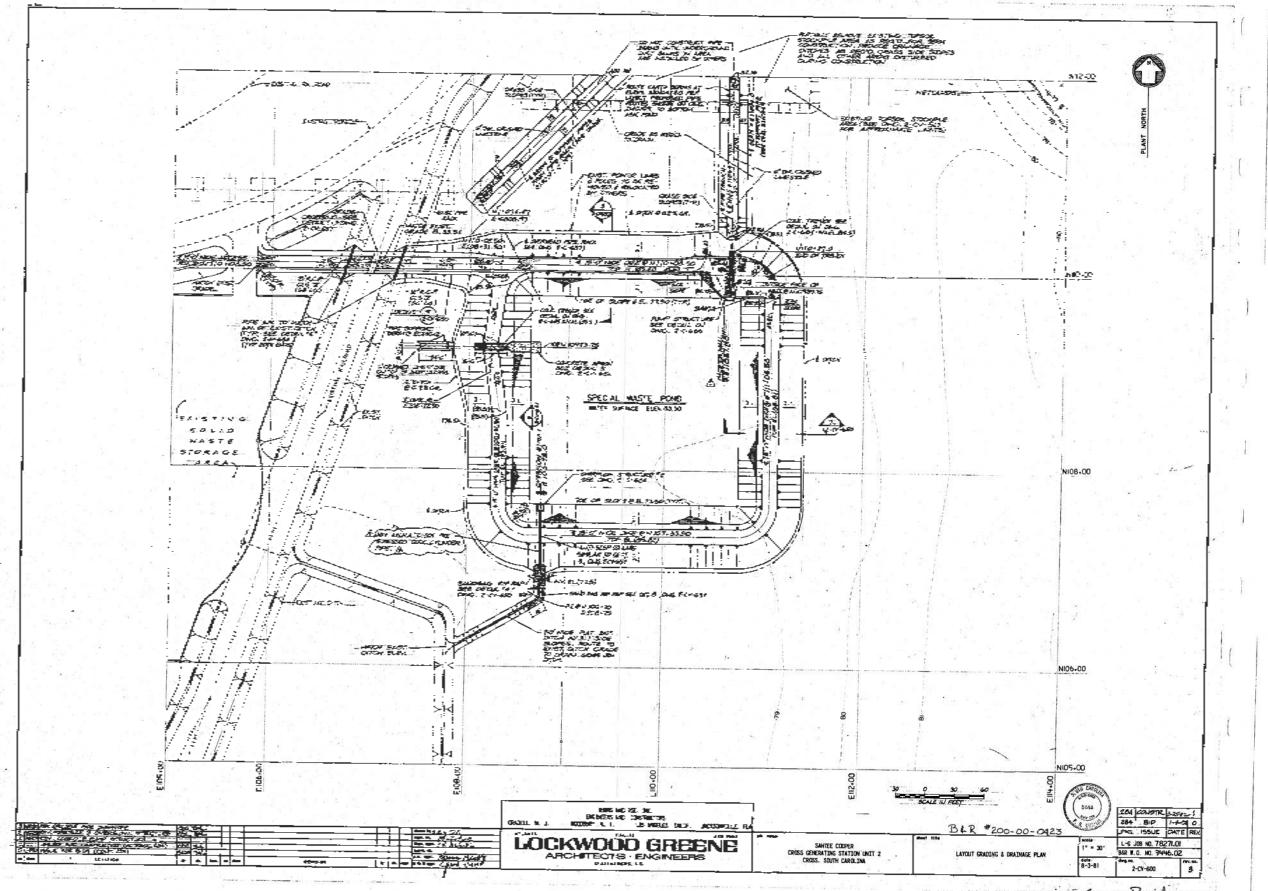
# (for conditioning) Water and Lime Screw conveyors Pug Trucked Unit 1 & 2 Silo To Market Unit 3 & 4 Silo Fly Ash Hoppers Precipitator Transport Air Blower Air Heater/ SCR Inlet Sept. 1 Ash Handling Boiler Area Sumps (Typical for 4 units) Ast: Suce rises 45: Sea X Economizer Ash Hoppers Suding Tee Economizer Ash Tank Tanks Ash Stuice Water Bottom Ash Hoppers Steam Generator Ash Seal Water Recycled Ash Seal & Ash Sluice Ash Pond A Water / Ash Pond B Discharge through pH trim to Outfall 002 to Diversion Canal

Cross Generating Station

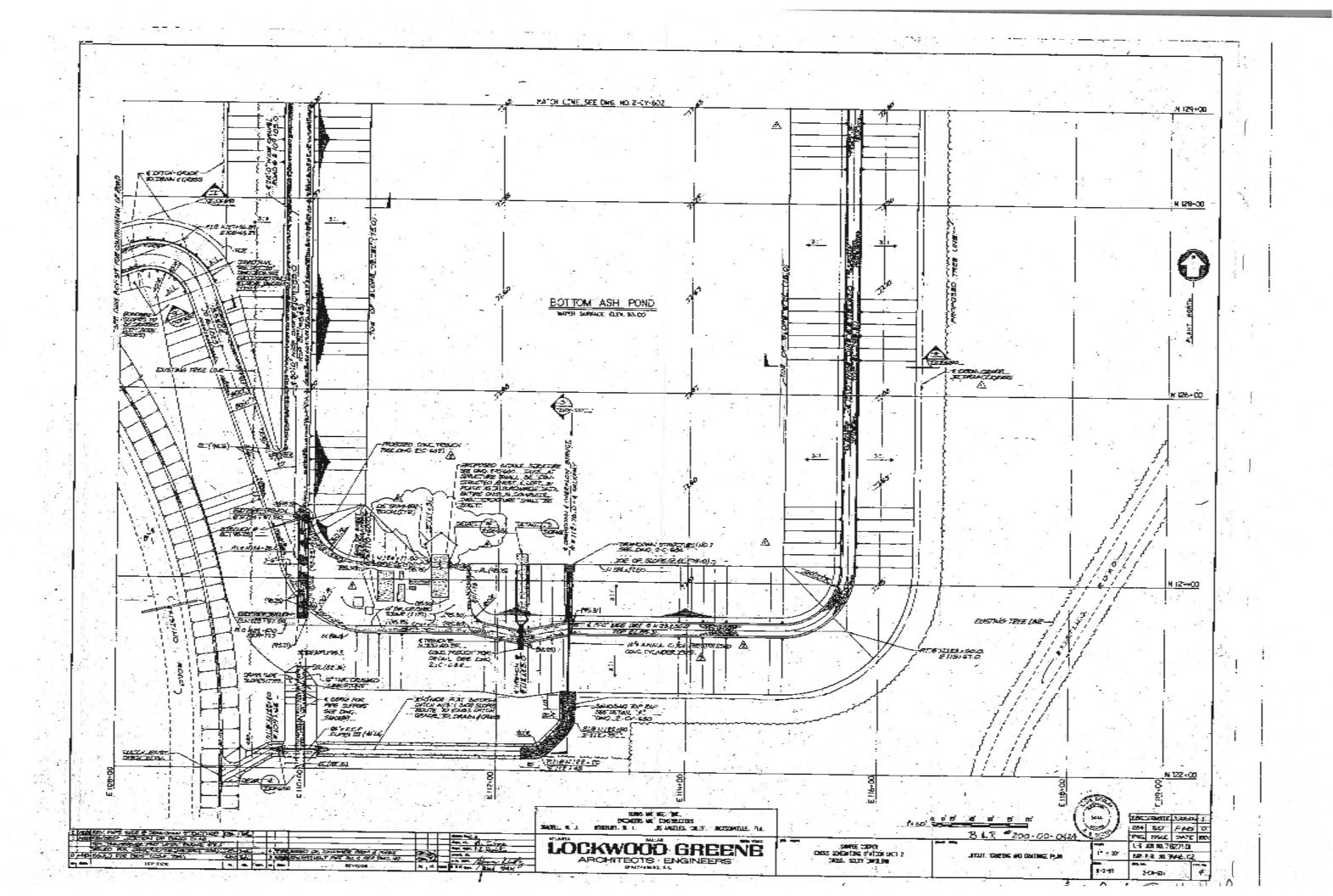
Santee Cooper

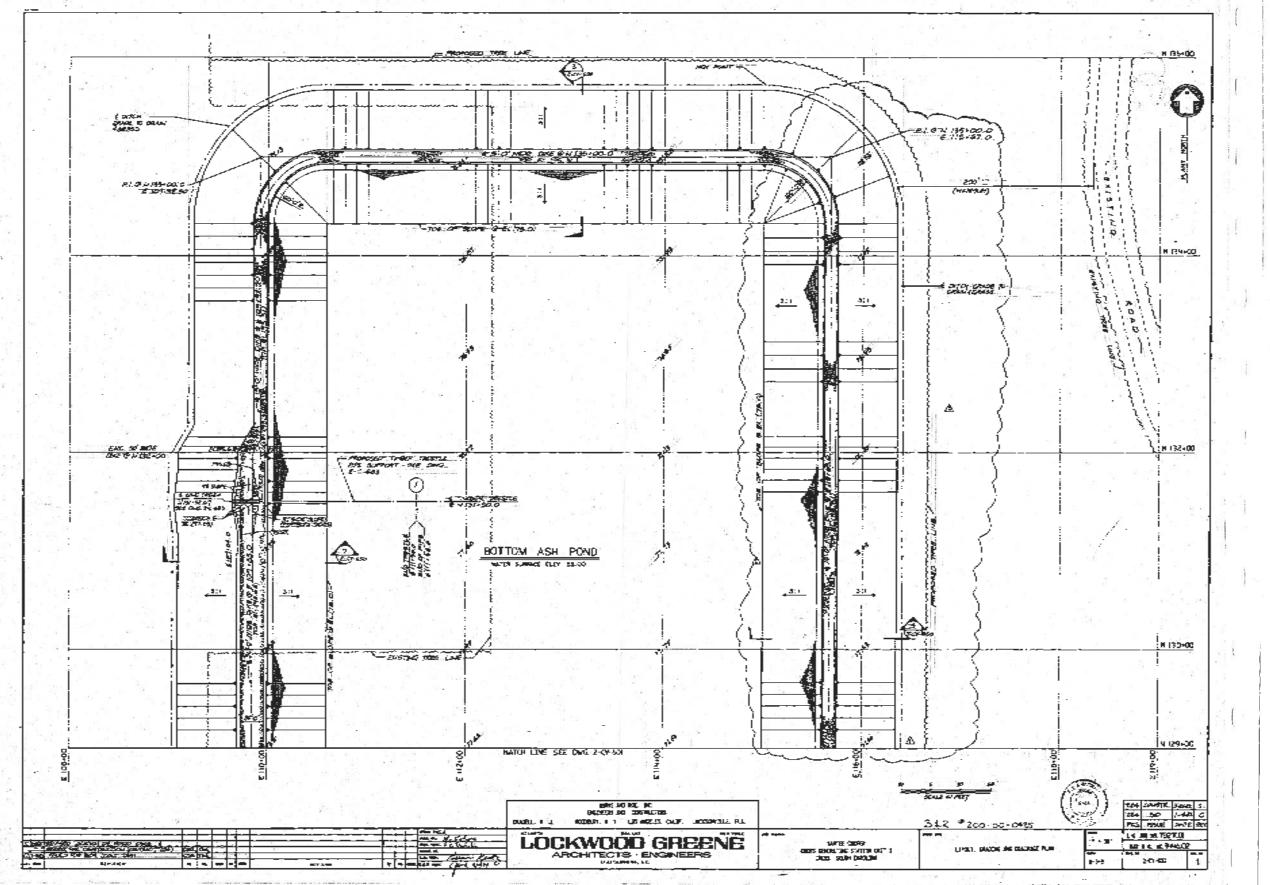
To Landfill

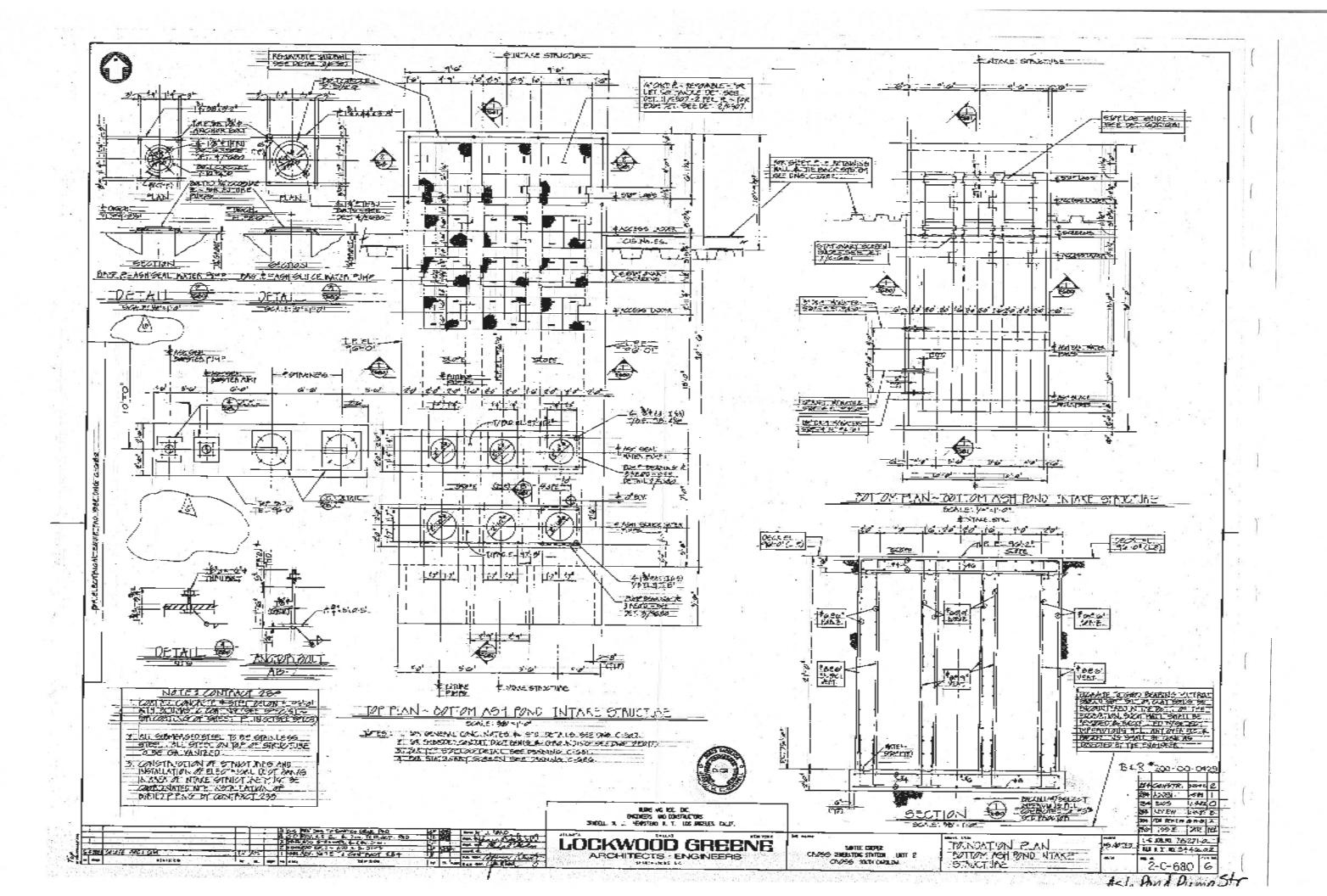
Appendix A Doc 03: Cross GS Pond Construction Plans

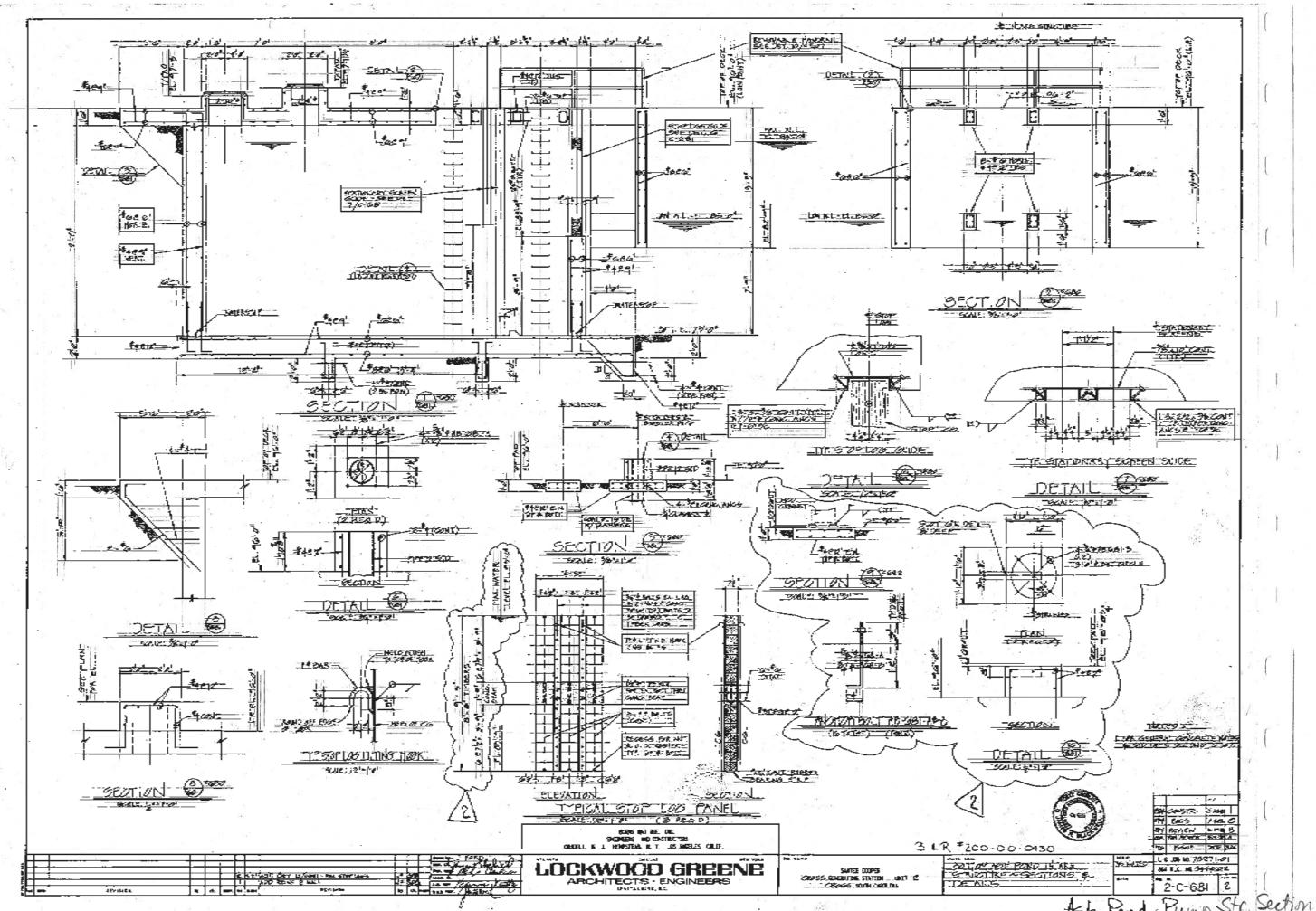


Gyp Pord

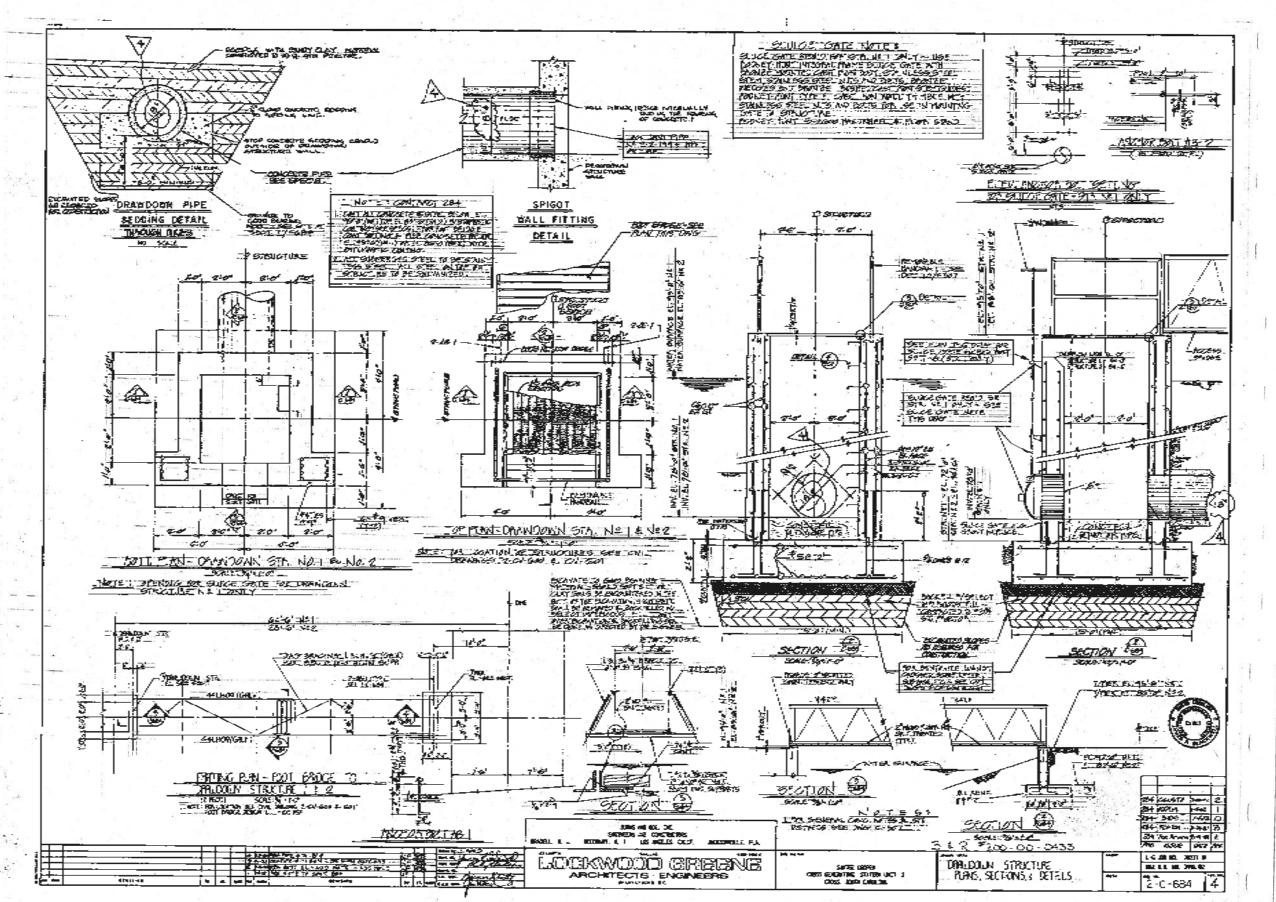


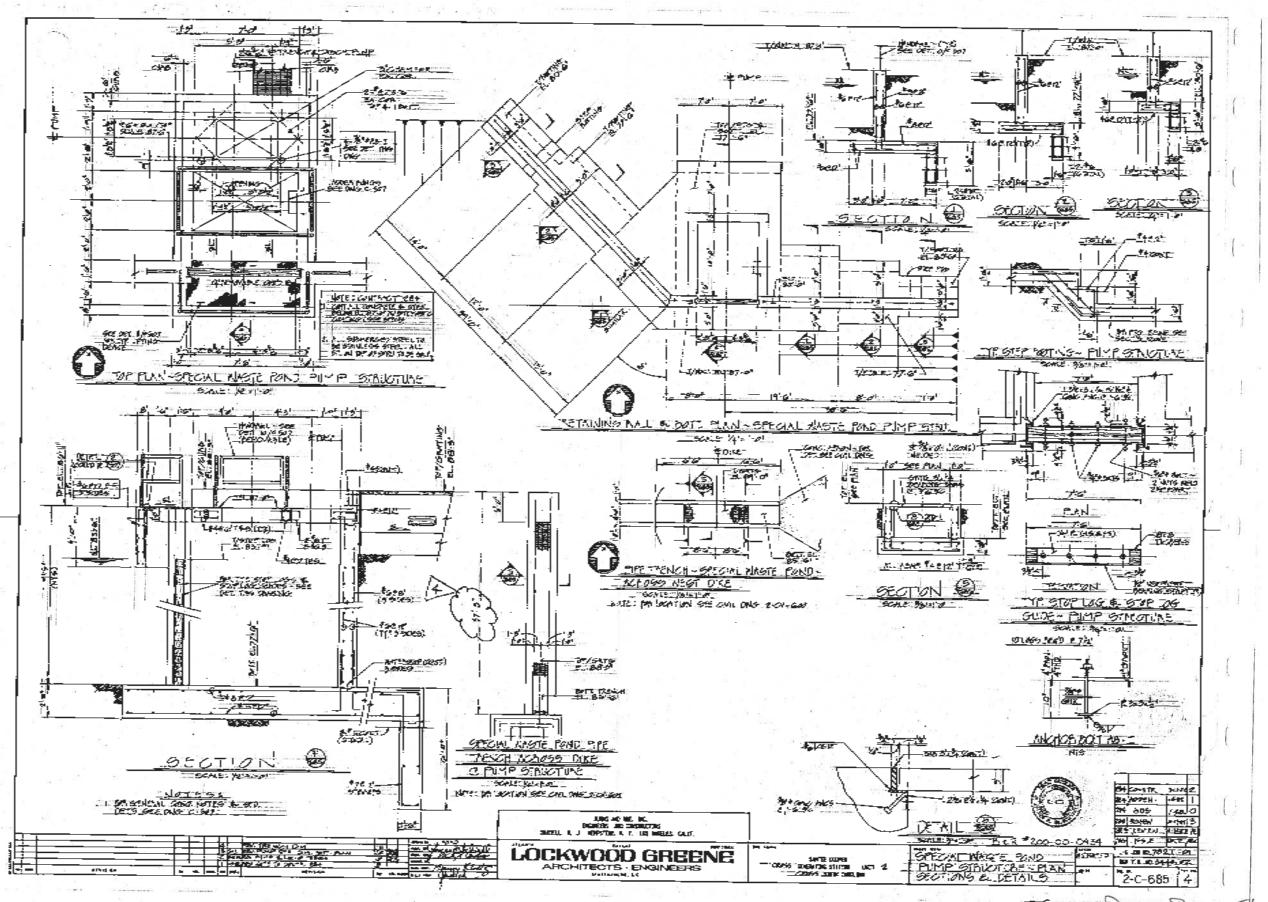




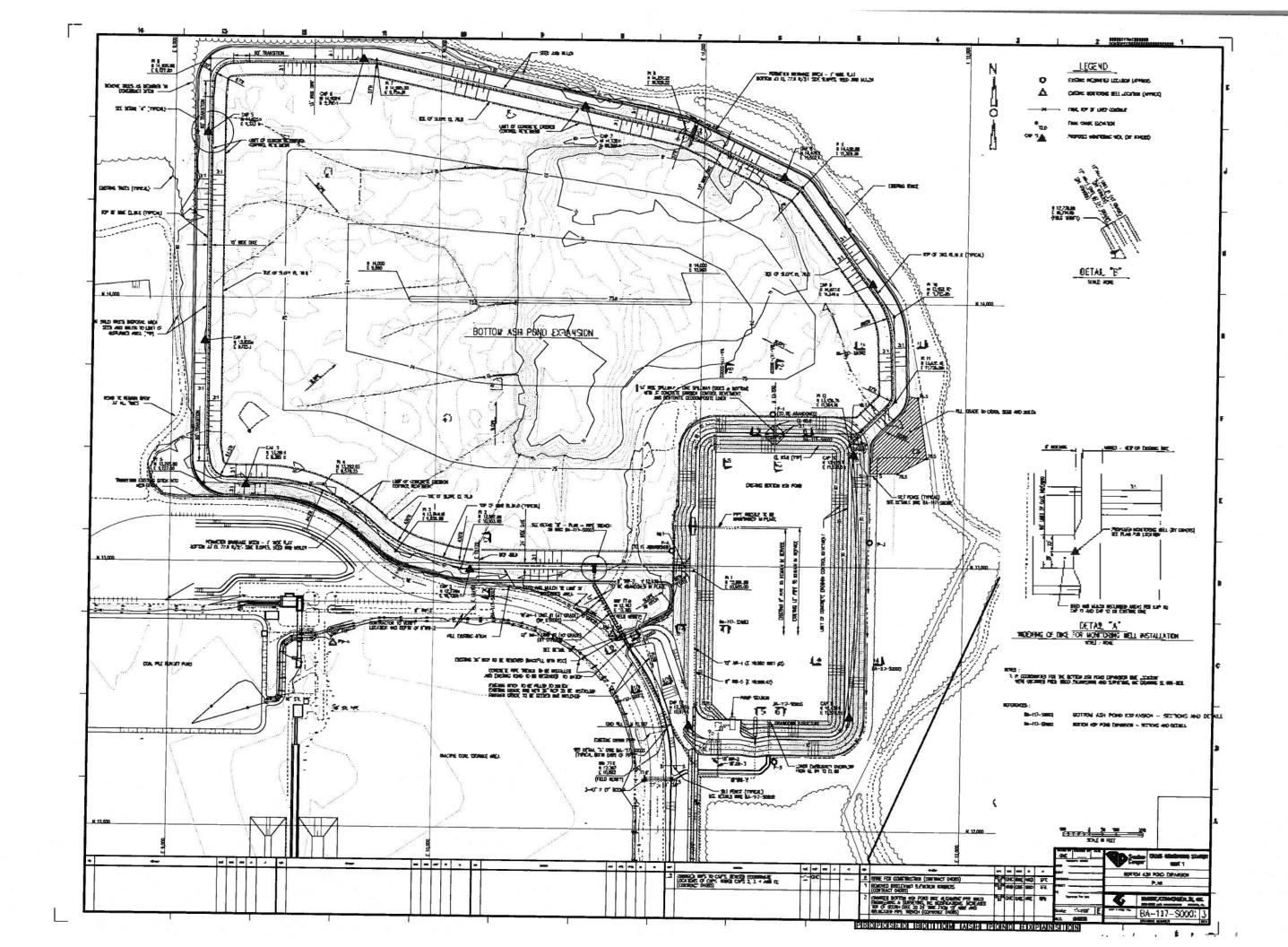


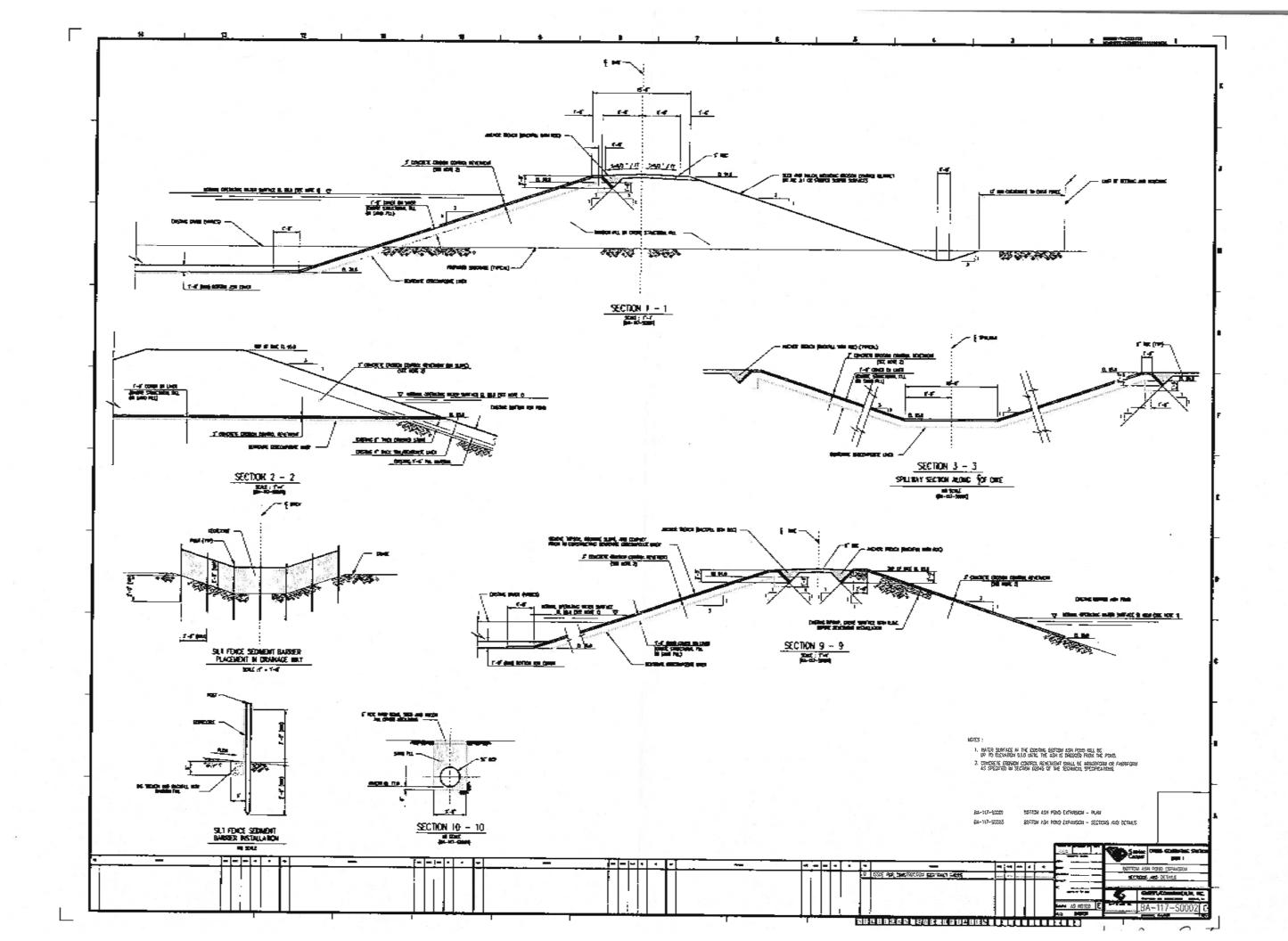
Ash Pond Pump Str Sections

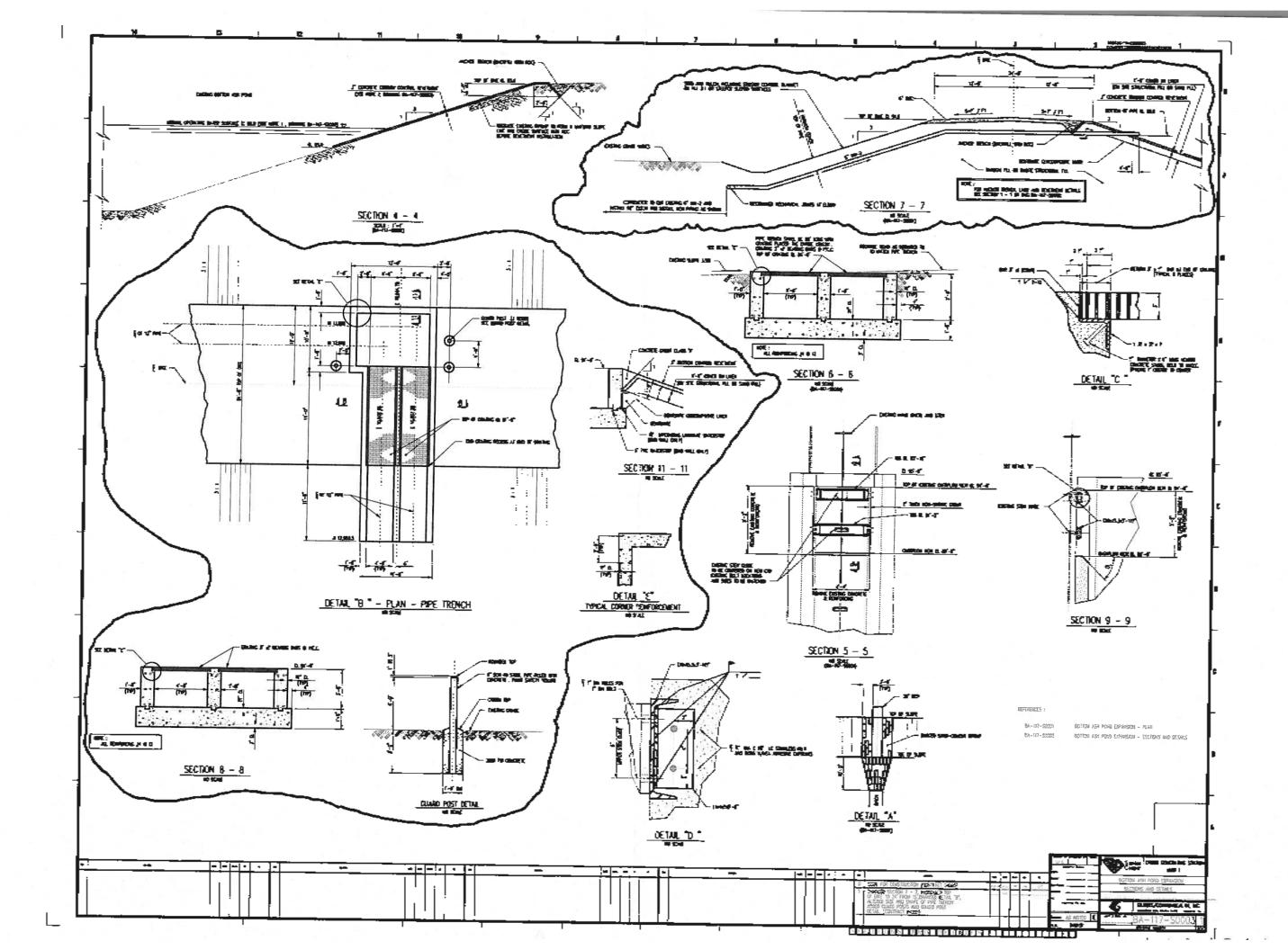


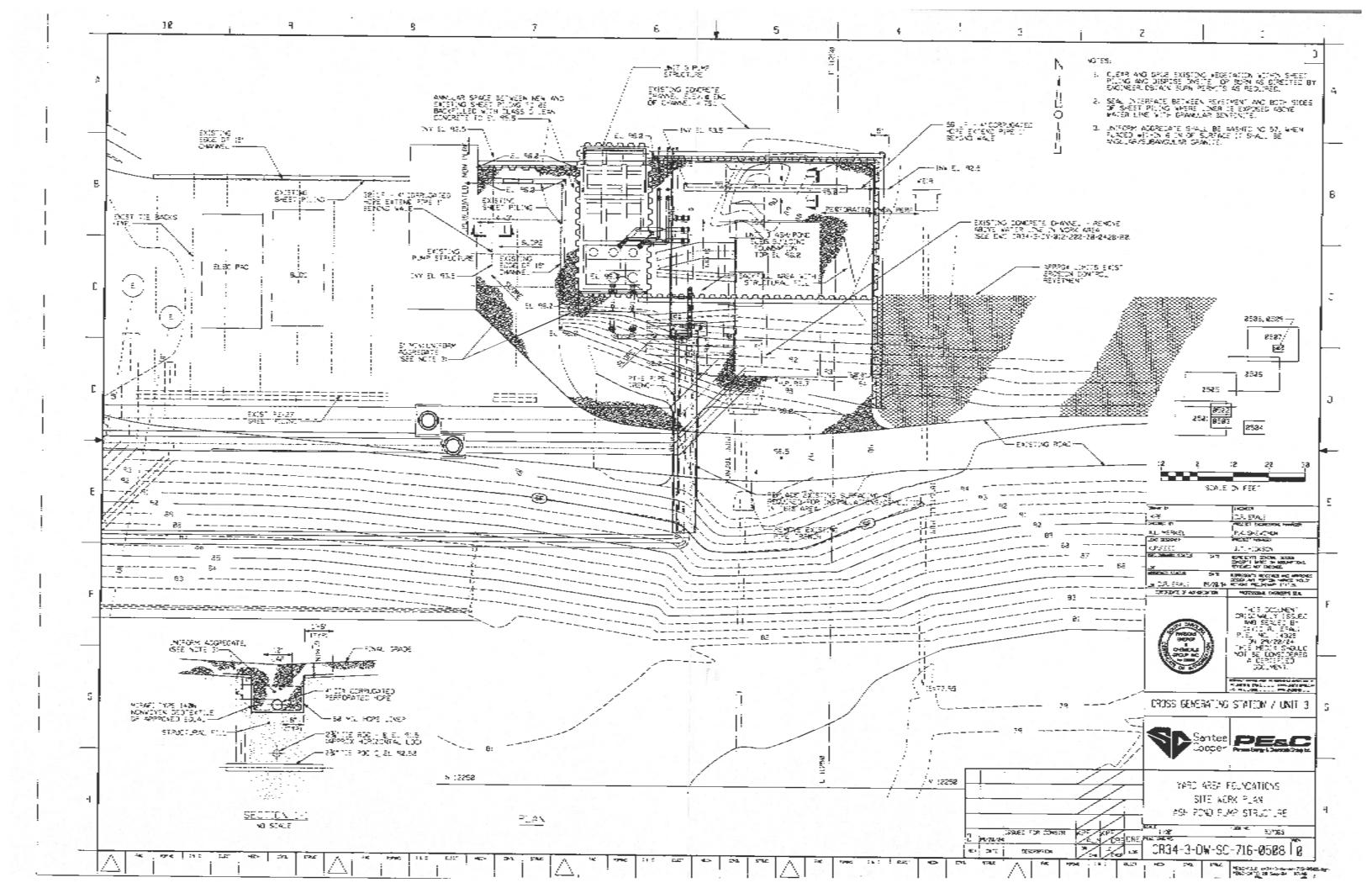


Gyp Pond Pump Str

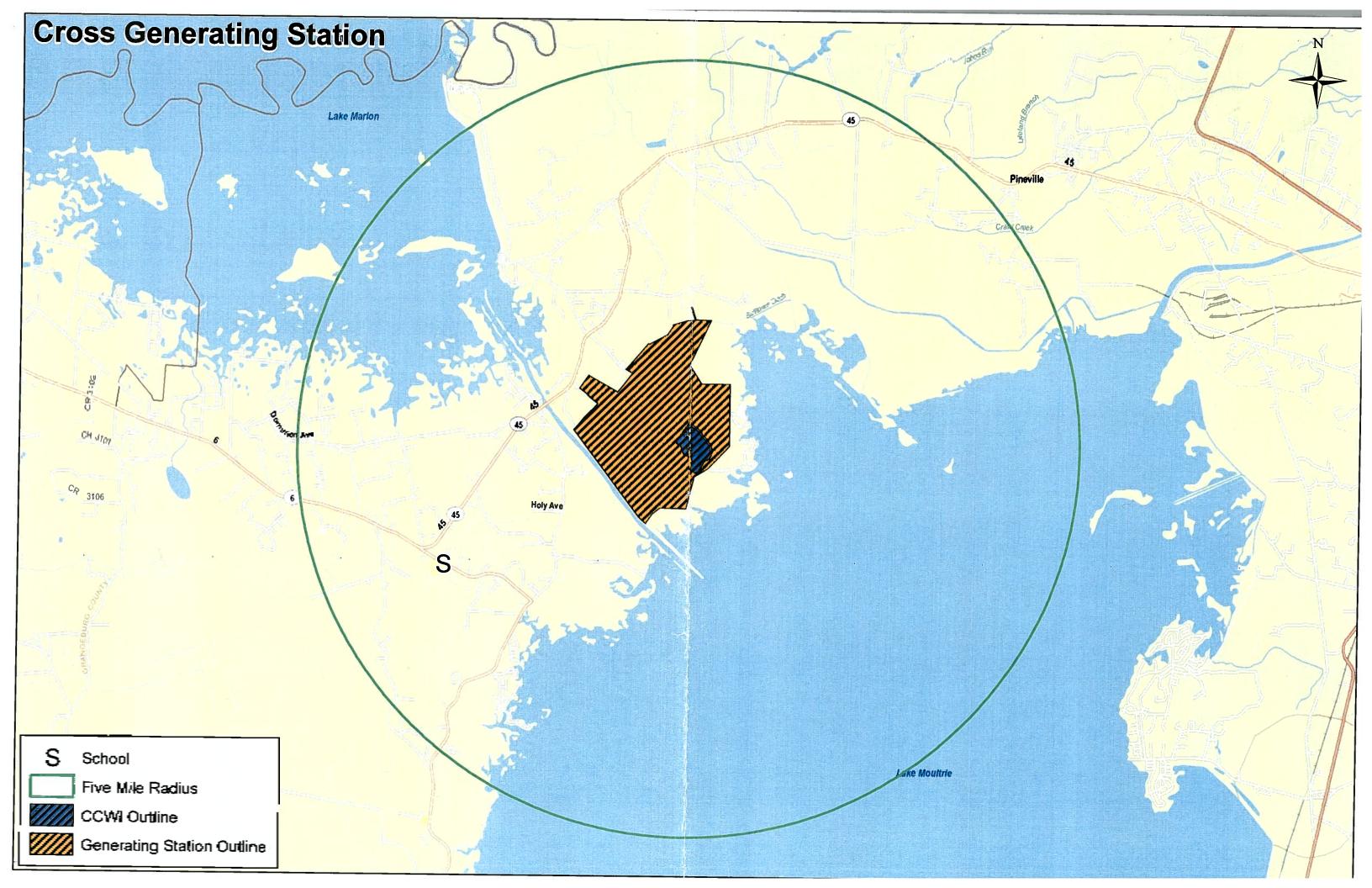








Appendix A Doc 04: Cross GS Regional Map Showing the Management Units in Relationship to Critical Infrastructure



Appendix A Doc 05: NPDES Violation Report

## NPDES VIOLATION REPORT FORM

· · · · · · · · · · · · · · · · · · ·	
SANTEE COOPER FACILITY:	
NPDES PERMIT #:	SC0037401
NPDES OUTFALL/DESCRIPTION:	Lake Moultrie - Diversion Canal
PARAMETER:	pH
STARTING DATE & TIME:	1/12/09 - ~10:00 am
ENDING DATE & TIME:	1/12/09 - 1:00 pm
TOTAL # SAMPLES ANALYZED:	7
AVERAGE VALUE (LIMIT):	6.88 (6.48, 6.78, 7.02, 7.05, 7.05, 6.92, 6.86)
LOWEST VALUE (LIMIT):	6.48
HIGHEST VALUE (LIMIT):	7.05
CAUSE OF VIOLATION:	pH Trim System taken out of service for Maintenance.
ACTION TAKEN TO ELIMINATE OF REPUBLICANT AND ACTION OF SERVICE TO MAINTENANCE,	

Action taken to eliminate or reduce violation and steps taken to prevent future occurrence:

Ash Pond levels will be recorded and weir examined daily by the Results Lab. If level exceeds 88 feet (actual overflow is 89.2 feet) above mean sea level actions will be taken to reduce inflow or to increase discharge. Lab personnel will assume sole responsibility for operating the system and will report any deficiencies to Station management. Standard Operating Procedures have been modified to reflect these changes as well as Station Best Management Training course.

## COMMENTS:

The Ash Pond Bypass incident occurred as a result of taking the pH Trim system out of service for maintenance. An underground leak occurred during the weekend of January 2, 2009 and a temporary patch made. After parts were procured, the system was taken out of service by the Operations group on Friday, January 9<sup>th</sup>. Repairs took longer than anticipated (3 days) as Operations had isolation difficulty. The Ash Pond level is monitored once per day by the Results lab. On Sunday, January 11<sup>th</sup>, the system was placed in service, however, the pH probe had been placed in a buffer solution which caused all water to be returned to the ash pond. This was discovered at 9:00 am on Monday January 12 and corrected by Results Lab Personnel. The pond level when checked the morning of January 12<sup>th</sup> was within the overflow. The Pond was discovered overflowing some time around 10:00 am. Susan Jackson and Mike Davis were promptly notified and they advised a courtesy call to SCDHEC was appropriate. The call was placed to SCDHEC's Mike Hiott on Tuesday, January 13 by Tim Swicord and a plant visit occurred that afternoon.

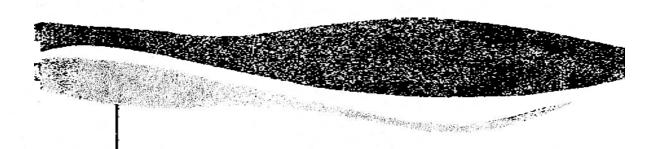
SIGNATURE RESULTS SUPERVISOR:	Mat A. W Klan
DATE: SIGNATURE OF PLANT MANAGER:	(1)23109
DATE:	

n. La

Appendix A Doc 06: Cross GS Final Report Appendices to Volume 2 and Profiles

MANTE STATE SONT STATE OF THE SAME STATE OF THE

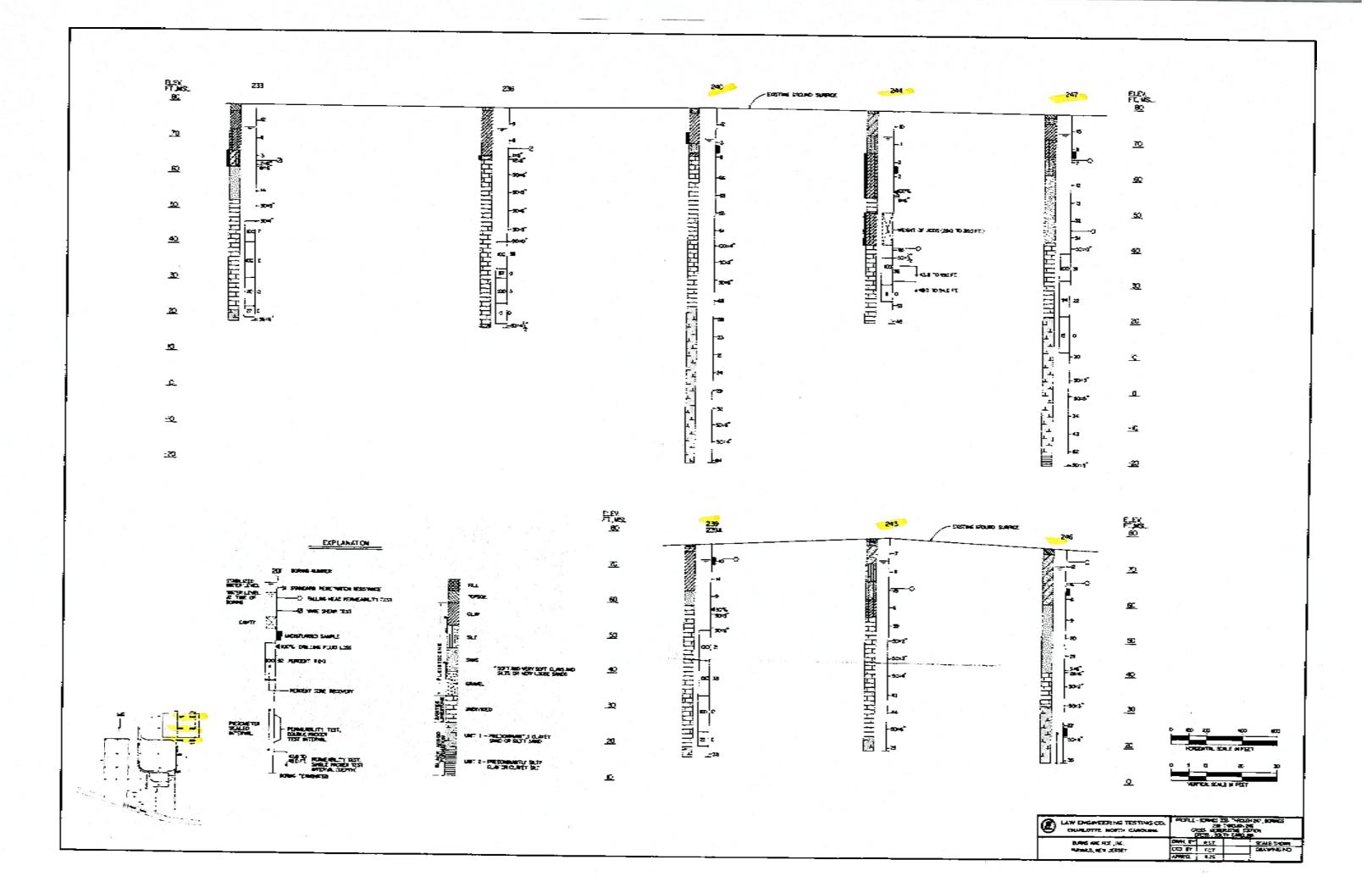
CR34-3-LI-CS-0003-R0

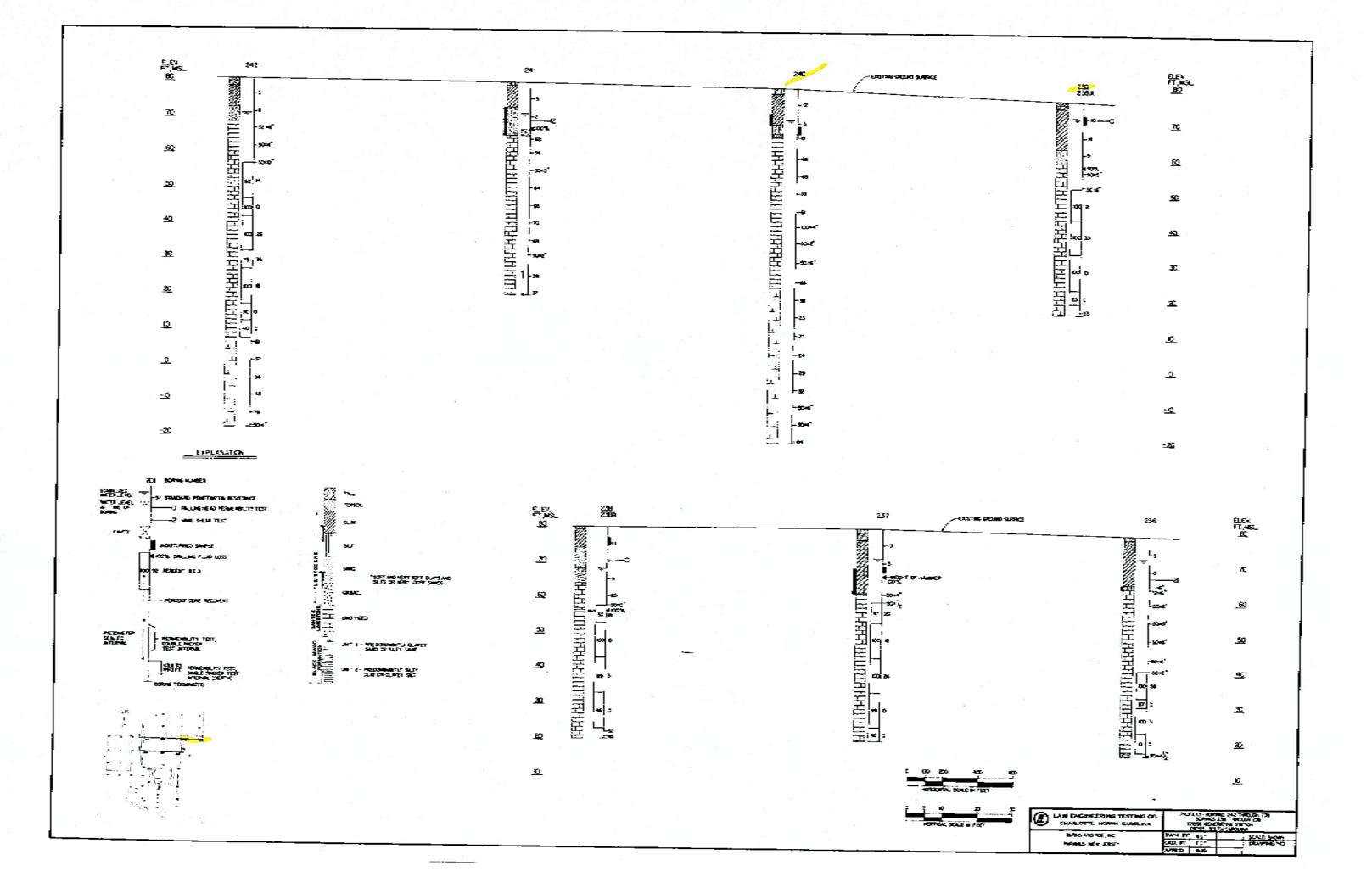


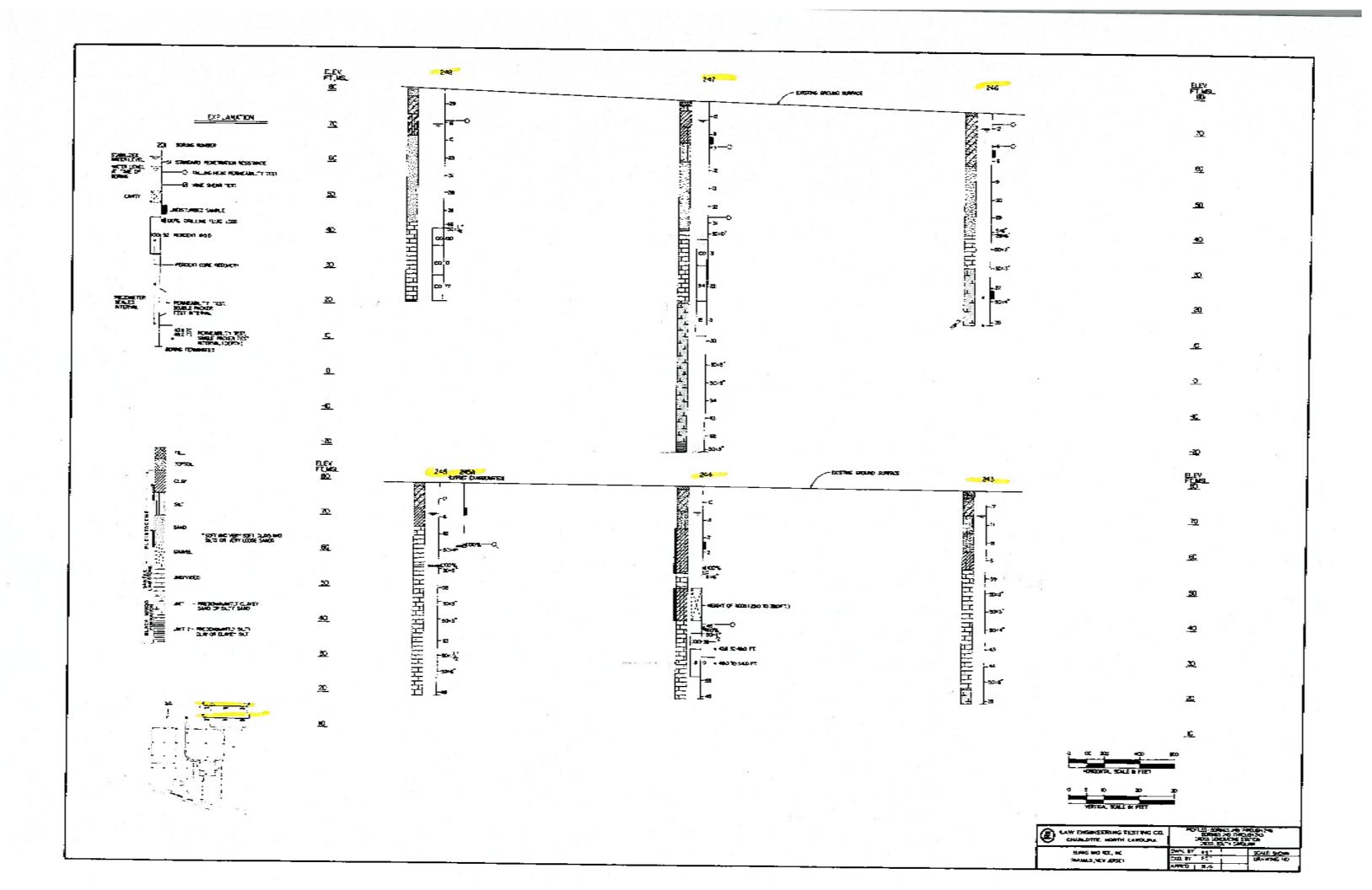
FINAL REPORT
CROSS GENERATING STATION
CROSS, SOUTH CAROLINA
LETCO, JOB NO. CH 4193

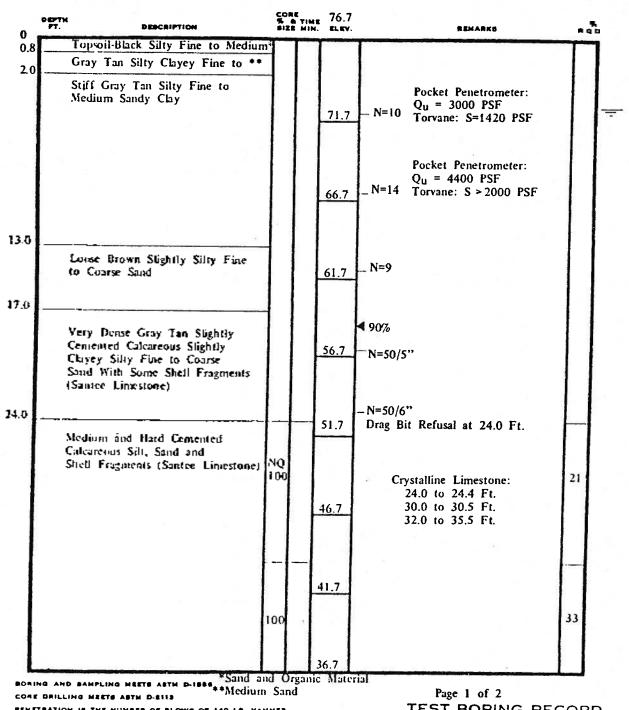
APPENDICES TO VOLUME 2 AND PROFILES

Law Engineering Testing Company









BORING AND SAMPLING MEETS ASTM D-1886 \*\*Medium Sand

CORE DRILLING MEETS ASTM D-2113

PAGE 1 of 2

TEST BORING RECORD

PALLING SO IN. REQUIRED TO DRIVE 1-4 IN. 1.D. SAMPLER 1 PT.

UNDISTURBED SAMPLE WATER TABLE, 24 HR

WATER TABLE, 24 HR

A ROCK JOINT:

DATE DRILLED 12-18-78

DATE DRILLED 12-18-78

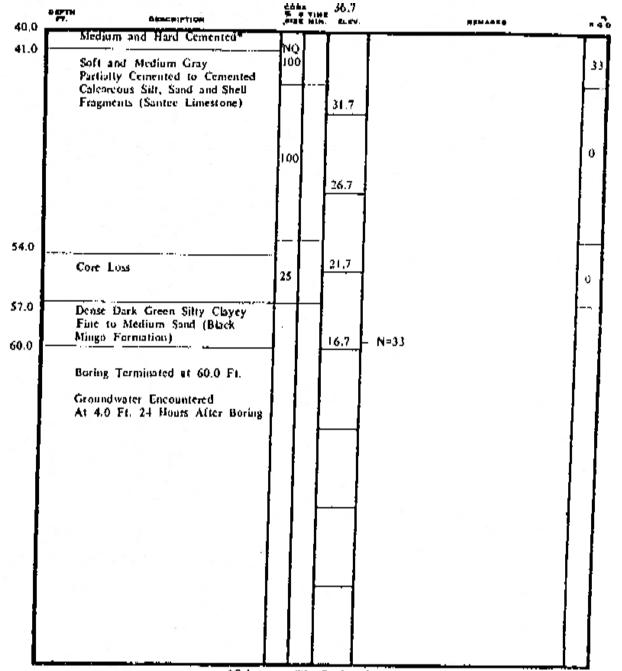
LE LOW DIP 0-30"

N - STANDARD PENETRATION LOSS OF DRILLING WATER

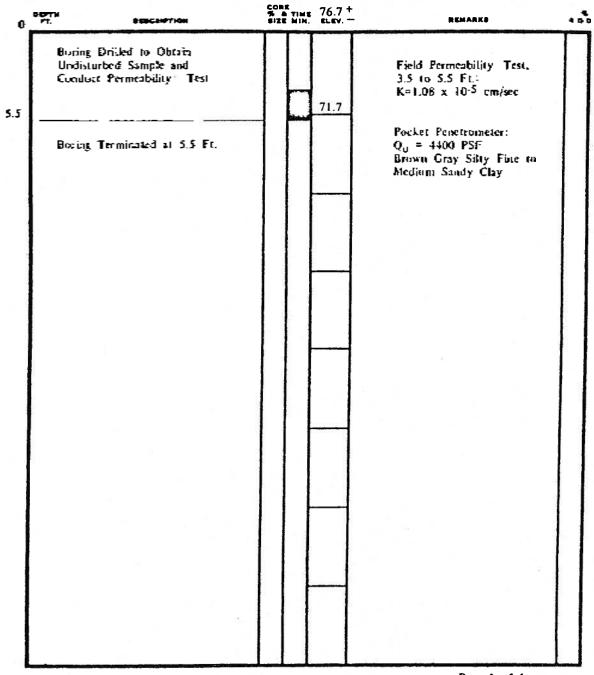
R.Q. D. ROCK QUALITY DESIGNATION

\*\*SETTEP DIP 60'-80"

LAW ENGINEERING TESTING CO



SORING AND SAMPLING MARTH ARTH DATES \*Calcordous Sift, Said and Page 2 of 2 Shell Fragments (Sautee Limestone) COME DELLING WESTS ASTM BISTS TEST BORING RECORD PENETRATION IS THE HUMBER OF SLOWE OF SEC LE. HAMMER FALLING TO IN. SEQUIRED TO DRIVE 1-4 IN. I.G. SAMPLES 1 PT. BORING 40 \_\_ 239 4 MOCK JOINT DATE DATELED 12-18-75 [4] " HOCK CONS BROOVERY THESE WATER TABLE. . HE --- HO CH 4193 M - BTANDARD PENETRATION - LOSS OF DECLINE WATER LAW ENGINEERING TESTING CO. R.Q.D. ROCK GUALITY DEFIGNATION



BORING AND SAMPLING MEETS ASTM D-1886 CORE DRILLING MEETS ASTM D-2115 PENETRATION IS THE NUMBER OF SLOWE OF 140 LB. HAMMER FALLING SO IN, REQUIRED TO DRIVE 1-4 IN. I.D. SAMPLER 1 FT. UNDISTURSED SAMPLE WATER TABLE, 24 HR

N . STANDARD PENETRATION LOSS OF DRILLING WATER

R Q D. ROCK QUALITY DESIGNATION

Page 1 of 1 TEST BORING RECORD

BORING NO. 239A DATE DRILLED 12-18-78 JOB NO. CH 4193 LAW ENGINEERING TESTING CO.

A ROCK JOINTS

L= LOW DIP 0-30"

M = MED. DIP 30'-60"

\$ = STEEP DIP 60'-80"

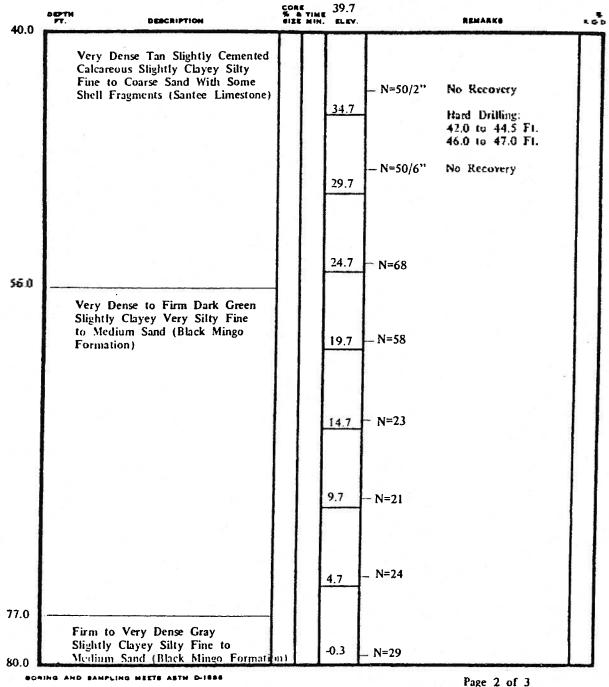
CORE 79.7 ... REMARKS DESCRIPTION Black Fine to Medium Sandy Stiff Gray Slightly Micaceous Pocket Penetrometer: Fine Sandy Clay  $Q_u = 6000 PSF$ 74.7 - N=12 Soft Gray Tan Silty Fine Very Sandy Clay 69.7 N=3 10.0 Loose Tan Gray Slightly Clayey Silty Fine Sand With Clay Lenses Torvane 12.5 Ft.: 12.5 13.5 S=720 PSF Firm Tan Gray Fine Very Sandy\* N=8 Loose Yellow Tan Slightly Cemented 64.7 Calcarenes Slightly Clayey Silty Fine to Medium Sand (Santee\*\* 16.5 Very Dense Tan Slightly Cemented Calcareous Slightly Chyey Sitty Fine to Coarse 59.7 - N=66 Sand With Some Shell Fragments (Santce Liniestone) 54.7 - N=69 49.7 N=53 \_ N=61 44.7 Hard Drilling (37.0 to 41.0 Ft.) N=100/4" No Recovery \*Clay
\*\*Limestone) BORING AND SAMPLING MEETS ASTM D-1556 Page 1 of 3 CORE DRILLING HEETS ASTM D-8113 TEST BORING RECORD PENETRATION IS THE NUMBER OF SLOWS OF 140 LR. HAMMER PALLING TO IN. REQUIRED TO DRIVE 1-4 IN. I.D. BAMPLER 1 PT-DATE DRILLED 12'16-17:78 A ROCK JOINT. UNDISTURBED BAMPLE WATER TABLE, B4 HR

MATER TABLE. 1 HA N . STANDARD PENETRATION LOSS OF DRILLING WATER

R.Q.D. ROCK QUALITY DESIGNATION

700 NO CH 4193

M = MED DIP 301-60" LAW ENGINEERING TESTING CO \$ m STEEP DIP 60'-60'



CORE DRILLING MEETS ASTM D-2113 PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING SO IN REQUIRED TO DRIVE 1-4 IN. I.D. SAMPLER I FT.

UNDISTURBED BAMPLE WATER TABLE, 24 HR. 190 TO ROCK CORE RECOVERY THE WATER TABLE. 1 HR N - STANDARD PENETRATION LOSS OF DRILLING WATER

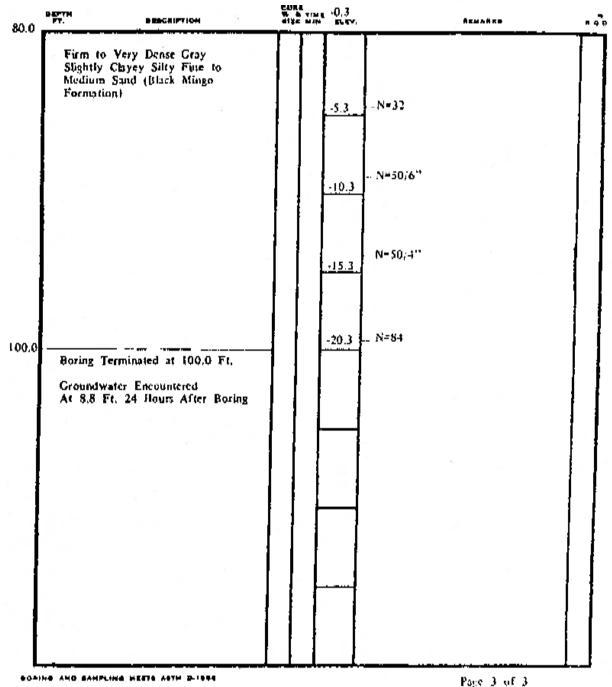
R Q.D ROCK QUALITY DESIGNATION

TEST BORING RECORD BORING NO 240

A ROCK JOINT!

\$ = STEEP DIP 80'-90"

DATE DRILLED 12/16-17/78 JOH NO. CH 4193 LAW ENGINEERING TESTING CO



-----COME OFILLING MEETS ASTH D.S.S.S. PARETHATION IS THE MUMBER OF SLOWS OF 140 LB. HAMMER

MA HOCK CORE RECOVERY THE WATER TABLE. I HE N - STANDARD PENETRATION LOVE OF BRILLING WATER TEST BORING RECORD

MATE DAVILLED 12"16-17" 5 d noch Joint 104 NO. \_ CH 4193 M - MED DIS 30.-49. LAW ENGINEERING TESTING CC

# - erer- Dir 40"----R.G.D. BOCK QUALITY DISIDNATION

COME 1.0 - ~ --80.0 Very Dense to Dense Dark Green to Gray Silty Fine to Medium Sand With Thin Interbedded Cby Seams (Black Mingo Formation) \_N=36 4.0 \_N=45 -9.0 ...N≈78 -14.0 Thin Interhedded Cemented Sand Seams (89.5 to 98.6 Ft.) 98.6 N=50/t" -19.0Boring Terminated at 98.6 Ft. Groundwater Encountered At 9.9 Ft. 24 Hours After Boring NW Casing Set to 24.0 Ft.

----COME DRILLING HERYS ASTM TATELL PARATELYING IS THE MUNICIPED OF SLOWE OF ICE LE. HAMMES PALLING SO IN. BEQUIEFO TO DRIVE 1.6 IN. 1.8. SAMPLES I PT.

UMDISTURSTO SAMPLE WATER TABLE, 24 HR IN THE COLL COME ASCOVERY THE WATER TABLE. & HE N . STANGARD PERSTRATION LOSS OF DAILLING WATER

C BOCK JOINT L r LOW DIF 0-00" M P HED DIP \$0'-40"

5 - STAGE GIF 80'-80'

TEST BORING RECORD DATE SHILLING 12/11:12/78 104 HB. C11 4193 LAW ENDINEERING TESTING CO

Page 3 of 3

Topsoil-Black Sitty Fine to Medium Tan Silty Fine Sand 2.0 Firm Brown Gray Silty Very Clayey Fine to Medium Sand 73.8 -N=17 7.0 Pocket Penetrometer: Stiff Gray Chycy Fine Qu = 3600 PSF Torvane: S-1700 PSF Sandy Silt 68.8 -N=11 12.0 Field Permeability Test, Firm Tan Gray Slightly Clayey 13.5 to 15.0 Ft.: Silty Fine to Coarse Sand 63.8 N=19 K=2.82 x 10.6 cm/sec 17,0 Pocket Penetrometers Firm Blue Gray Silty Clay  $Q_0 = 3000 \text{ PSF}$ 58.8 ..N=6 ("Laminated") Torvane: S=540 PSF 22.0 Very Dense to Dense Cray Slightly Cemented Calcargous 53.8 \_N=59 Silty Fine to Coasse Sand With Some Shell Fragments (Santce Limestone) -N=\$0/2" No Recovery Hard Drilling (28.0 to 31.0 Ft.) 48 8 N=50/3" No Recovery Hard Drilling (33.5 to 41.0 Ft.) 43.8 .N-50/4" Page 1 of 2

WA TIME 78.8

& BACK PTION

BOAING AND GAMPLING MEETS ASTM 0-1004 \*Sand and Organic Material CORT DRILLING MESTS ANTH D-6119 PENETRATION IS THE HUMBER OF BLOWN OF 149 CR. HAMMER

TEST BORING RECORD 

MADIETURBED SAMPLE --- WATER TABLE, 24 HA MA NOCK CORE ASCOVERY THE WATER YABLE, I WA N - STANDARD PENETRATION - LOSS OF DRILLING WATER

FALLING SO IN. EXQUISED TO BRIVE 1-4 IN. 1.D. SAMPLES 1 FT.

C BOCK JOINT L # LÓW DIF #-10-M - MED DIE 10,-40.

\* - #7 FEF DIP 40"-#4"

DATE DEICLES 12-18-78 лов мо. <u>СП 4193</u> LAW ENGINEERING TESTING CC

r a 0

\*\*\*\*

R.G.D. BOCK QUALITY DESIGNATION

ROD BOCK QUALITY GENERATION

CORE 38.8 % & TIME SIZE MIN. ELEV. 46: BXRAMER DESCRIPTION 40.0 Very Dense to Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments 33.8 N=43 (Santee Limestone) 28.8 -N=44 \_N=50/6" 23.8 56. C Fren Dark Green Stellich Chyey Silly Fire to Hadium Sand (Black Mirgo Formation) 18.8 N=25 Boning Terminated at &C.D Ft. Groundwater Encouplemed At 8.5 Ft. 14 Hours After Berfra. Page 2 of 2

BORING AND BAMPLING MEETS ASTM D-1896 CORE DRILLING MEETS ABOM D-ESIS PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN REQUIRED TO DRIVE 1-4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE WATER TABLE, 24 HR 34 % ROCK CORE RECOVERY THE WATER TABLE, 1 NA N STANDARD PENETRATION LOSS OF DRILLING WAYER

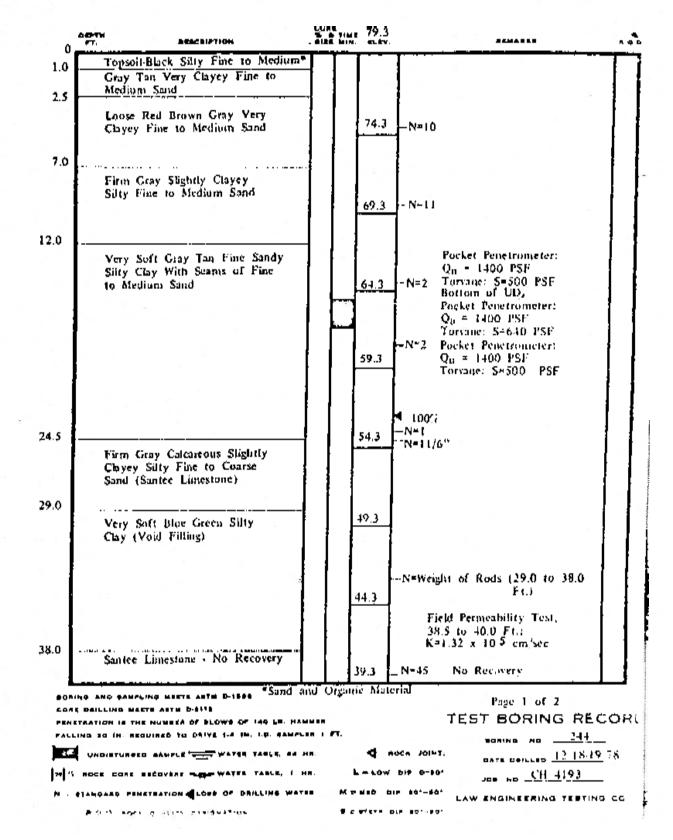
AOCK JOINT:

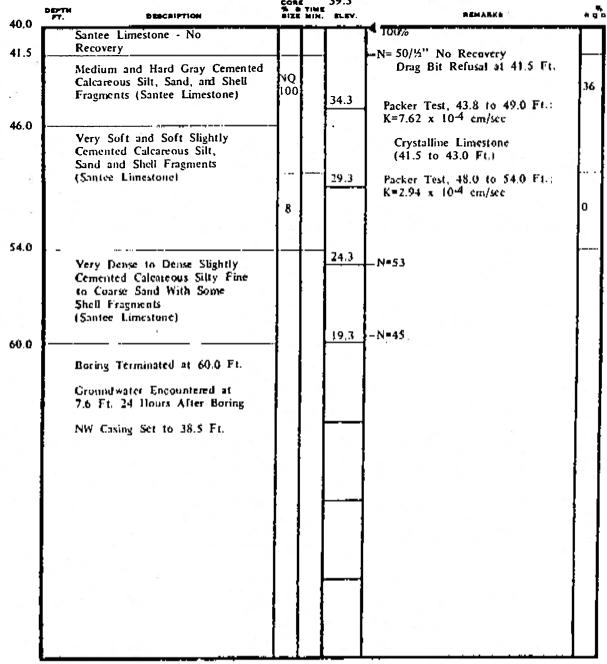
M = MED OIP 30"-60"

8 - #1424 2 # 201-80.

TEST BORING RECORD

SORING NO 243 DAYE DRILLED 12-18-78 JOB NO CH 4193 LAW ENGINEERING TESTING CO





----CORE BAILLING HEEVE ASTH P-4118 PERSTRATION IN THE HUMBER OF GLOWB OF 140 LB. HAMMER PALLING SO IM. PEQUIPED TO DRIVE 1-6 IN. I.G. SAMPLES 1 PT.

UNDISTURSED SAMPLE TANK WAYER TANKE, BA HE MIN HOCK CORE RECOVERY THE WATER TABLE. I HE M . STANDARD PENELBATION LOSS OF BRILLING WATER

AOCH JOHT M . MEP DIE \$0"+40"

# m erase die sa'....

TEST BORING RECORD \*gaing No. \_\_244 BATE BRILLED 12/18-19/78 400 Mg. CH 4193 LAW ENGINEERING TESTING CO

Page 2 of 2

Topsoil-Black Siky Fine to Medium\* 1.0 Gray Tan Clayey Fine to Medium 3.0 Firm Gray Brown Very Clayey 74.7 N=17 Fine to Medium Sand 7.0 Pocket Penetrometer: Firm Gray Slightly Micaceous  $Q_{II} = 1800 \text{ PSF}$ Fine Sandy Clay With Thin Fine Torvane: S=1000 PSF 69.7 N=6 5ex: 5ees 123 Very Desse to Desse Gray to Light Green Gray Slightly 64.7 N=62 Cesested Calcarrais Silly Fire to Course Sand With Some Shell Figures (Spite Linesloy) N=50/4" 59.7 100℃ -N=50/5" Void (23.2 to 23.5 49.7 - N=55 N=50/5" No Recovery 44.7 N=50/3" No Recovery Hard Drilling (38.7 to 40.3 Ft.)

SORE 79.7

\*Sand and Organic Material BORING AND SAMPLING MEETS ASTN D-1886 CORE DRILLING HEETS ASTH D-3113 PENETRATION IS THE NUMBER OF SLOWS OF 140 LB. HAMMER FALLING SO IN. REQUIRED TO DRIVE 1-4 IN. 1.D. SAMPLER I PT.

DESCRIPTION

UNDISTURBED SAMPLE WATER TABLE, 24 HR 30 % ROCK CORE RECOVERY TOP WATER TABLE. 1 HR N . STANDARD PENETRATION LOSS OF DRILLING WATER

A ROCK JOINT L = LOW DIP 0-30

M = MED DIP 30"-60"

\$ = STEEP DIP 60'-60"

DATE DRILLED 12 17-18 78 JOD NO \_\_\_\_\_СН 4193 LAW ENGINEERING TESTING CC

Page 1 of 2

TEST BORING RECORD

440

BEMARKS

R.Q.D. ROCK QUALITY DESIGNATION

R G.D. BOCK GUALITY DESIGNATION

CORE 39.7 S & TIME SIZE MIN. BLEV. LQD DESCRIPTION REMARKS 40.0 Very Dense to Dense Gray to Light Gray Green Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone) 34.7 -N=63 Hard Drilling (46.3 to 51.1 Ft.) \_N=50/11/2" No Recovery 29.7 Hard Drilling (51.3 to 52.7 Ft.) No Recovery - N=50/6" 24.7 19.7 - N=48 60.0 Boring Terminated at 60.0 Ft. Groundwater Encountered At 9.0 Ft. 24 Hours After Boring NW Casing Set to 28.0 Ft. Page 2 of 2

BORING AND SAMPLING MEETS ASTM D-1886 CORE DRILLING MEETS ASTM D-RITS PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IM, REQUIRED TO DRIVE 1-4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE WATER TABLE, 14 HR

S AOCK CORE RECOVERY -WATER TABLE, I HR. N . STANDARD PENETRATION LOSS OF DRILLING WATER

A ROCK JOINT: L = LOW DIP 0-30.

# = STEEP DIP 60'-80"

BORING NO. 245 DATE DRILLED 12/17-18/78 JON NO. CH 4193 LAW ENGINEERING TESTING CO

TEST BORING RECORD

CORE 79.7± SIZE MIN. BLEV. 449 REMARKS DESCRIPTION Boring Drilled to Obtain Undisturbed Sample and Conduct Permeability Test 74.7 Tan Gray Slighto Micaceous Very Chyey Fine to Medium Sar.d Pocket Penetrometer, 9.0 Ft. 69.7  $Q_u = 2800 PSF$ Turvarie, 90 Ft. S=1100 ESF 81.7 18.0 100% Field Permeability Test, 16.5 to 18.0 Ft.: No Return Boring Terminated at 18.0 Ft. 59.7 (150 Gallons/2 Minutes) this till tills betand On I kind Page 1 of 1 COME PRESENT MEDITAL PARTY OFFICE TEST BORING RECORD PERCENCIA TO MAND OF MARK OF HALL, MANDE

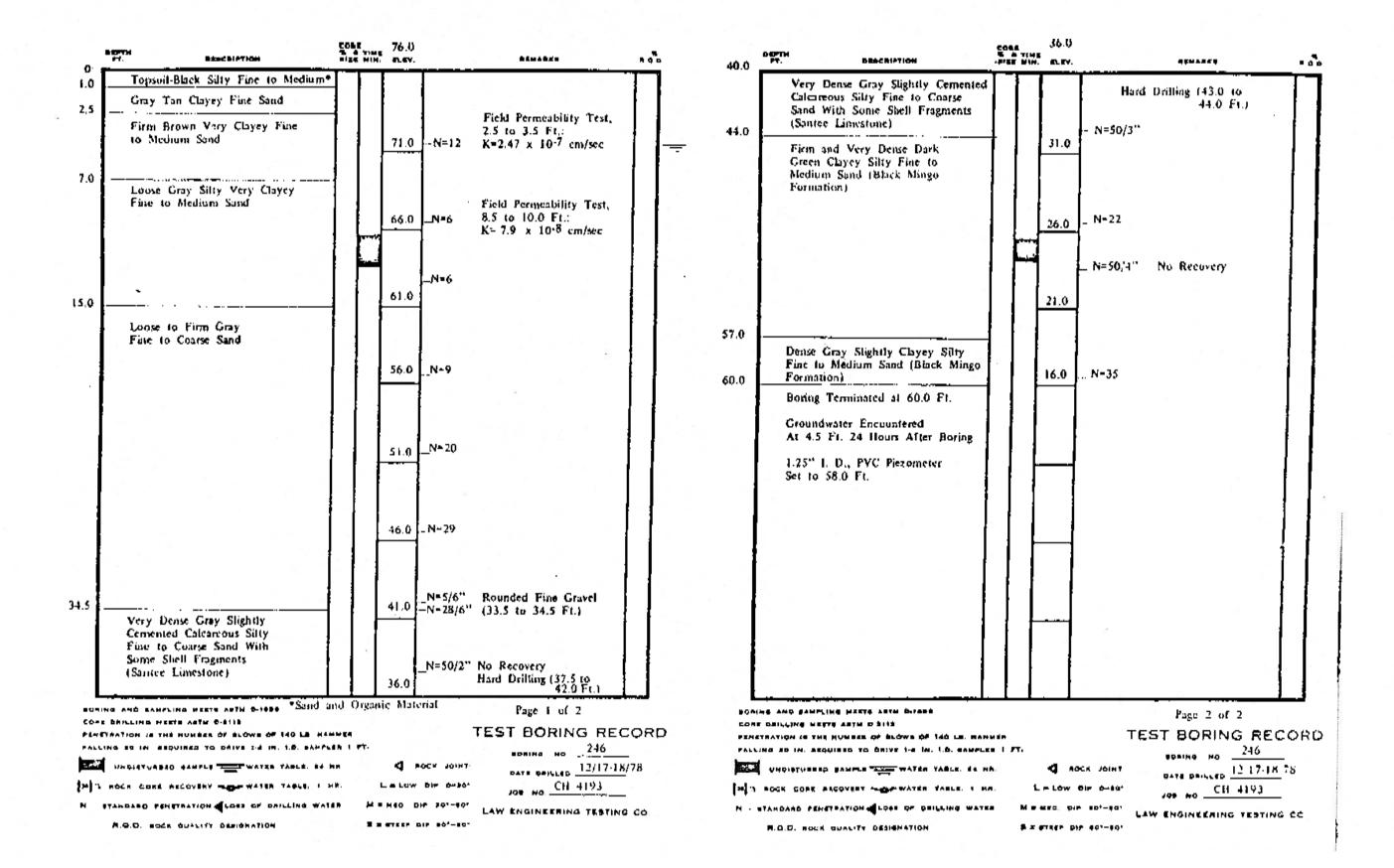
120 to 1354

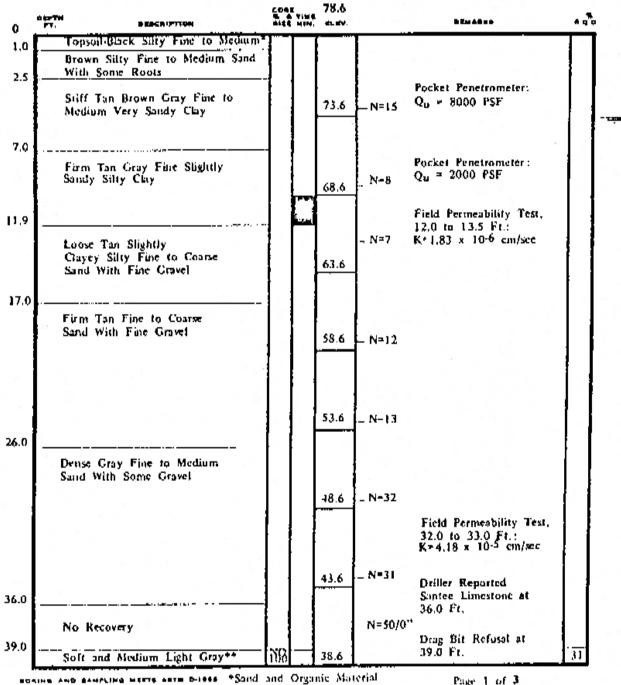
tem telatin <u>1245-</u>3 (E 419) LAW ENGINEERING TESTING CO

ROD BOOK WALLS ESSABILISM

Bearing as Miner

R Q.D. ROCK QUALITY DESIGNATION





Page 1 of 3

COME DANCEING METTS ARTH DISES \*Sond and Organic Material Page 1 of 3

COME DANCEING METTS ARTH DISES \*\*COREN Connected Calegrams Sill, Sand

PERMITANTION IS THE MUMBER OF BLOWE OF 140 LE. HAMBER and Shell Fragments TEST BORING RECORD

FACCING SO IN ARQUIRED TO DAIVE 14 IN. 1.0. FAMPLEX 1 FT. (Santee Linestone)

ON ORDINATIONS DISEMBLE WATER TABLE, I HA. LE LOW DIR DISEMBLE DATE DELLES CH. 4193

M. STANDARD PERMITANTION LOSS OF DRILLING WATER MAND OIR POLICED LAW ENGINEERING TESTING CO.

R.O.D. AOC4 QUALITY DESIGNATION

S P STEE- DIP 40'-+0"

R O.D. BOCK QUALITY DESIGNATION

SONING AND BAMPLING MEETS ASTH D-1665

COSE DRILLING #2574 AST# 9-117

### PART OF HER PA

Soft and Medium Light Gray 39.0 to 41.6 Ft. Green Cemented Calcartous hool 48,9 to 50.2 Ft. Silt, Sand and Shell Fragments (Santee Limestone) 33,6 28.6 94 23.6 57.0 Very Soft Dark Green Slightly Clayey, Silty Fine to Medium 18.6 Sand (Black Mingo Formation) 13.6 66.8 \_N≃30 Firm and Very Dense Dark Green Silty Fine to Medium Sand With Traces of Organic Material (Black Mingo Formation) \_N=50/5" 3.6 -N=50/5"

TORE 38.6

# EMGAIFTION

40.0

Page 2 of 3

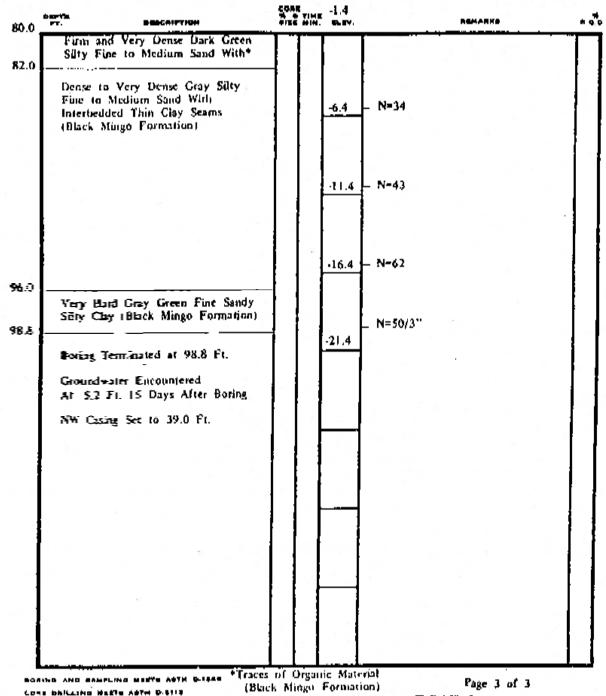
TEST BORING RECORD

. . .

BAMARKA

Crystalline Limestone:

# m mrder oip mo'-ma'



Page 3 of 3 TEST BORING RECORD FORING NO. 247

UNDIGIUSAED SAMPLE ------ WATER TABLE, SE ME **₹** #00 # 307HT. M T HOCK COME RECOVERY ------ WATER VARLE. 1 HA. M . STANDARD PENETRATION - LOSE OF BRILLING WATER

PERSTRATION (A THE HUMBER OF BLOWS OF 140 LP MANNER PALLINA SO IN. BEQUIRED TO BRIVE 1-4 IM, 1,0, SAMPLER I FT.

M.G.D. BOCK SUALITY DESIGNATION

M - MED DIF 40.--40.

PATE ONILLED 12/18-20/78 <sub>ма ма СН 4193</sub>

LAW ENGINEERING TESTING CO. B - 87824 DIP 841-40\*

CORE NINE BLEV. - - -REMARKS Gray Slightly Silty Fine Sand 2.0 Firm Red Brown Gray Very Clayey Fine to Medium Sand 76.2 N=29 Field Permeability Test, 8.5 to 10.0 Ft.: K#3.54 x 10:7 cm/sec 7.0 Very Stiff Gray Tan Slightly Torvane: S=1060 PSF Micaceous Fine Sandy Clayey Pocker Penetrameter:  $Q_{tt} = 3000 PSF$ 13.0 N=10 Loose Gray Slightly Silty Fine to Medium Sand 18.0 Firm to Dense Brown to Gray Slightly Silty Fine to Coarse Sand 61.2 N-23 56.2 - N=31 .. Nº28 51.2 N=28 37.5 Very Dense Gray Slightly Comented Drag Bit Refusal Calcareous Silty Fine to Coarse\* at 39,5 Ft. .. N≏50/¼" 39.5 Hard Gray Calcageons Comented\*\* 1100 somme and sampline weets aste minus. \*Sand (Santce Linguisone)

Page 1 of 2 goes nangular magre auto 6-2012 \*\*Silt, Sand and Shell Fragments PENETRATION IN THE NUMBER OF SLOWS OF 149 LES HAMBER (Sanice Linestone) TEST BORING RECORD PACLING SO IM. ASQUIRED TO DRIVE S.E IN. S.D. MAMPLER & FT. EGRING NO -248 -----HOCK JOHNT: BATE BRILLED 12-17-78 200 NO CH 4193 ME NOCK GORE SECONEST THE WATER TABLE. I HA F = FOM DIE 0-40. N . STANDARD PRINTERTION LOSS OF BRILLING WATER M = MEO OIF BOT-BOT LAW ENGINEERING TESTING CC R.Q.D. ACCE QUALITY BESIGNATION E M STEEP DIP 40"-10"

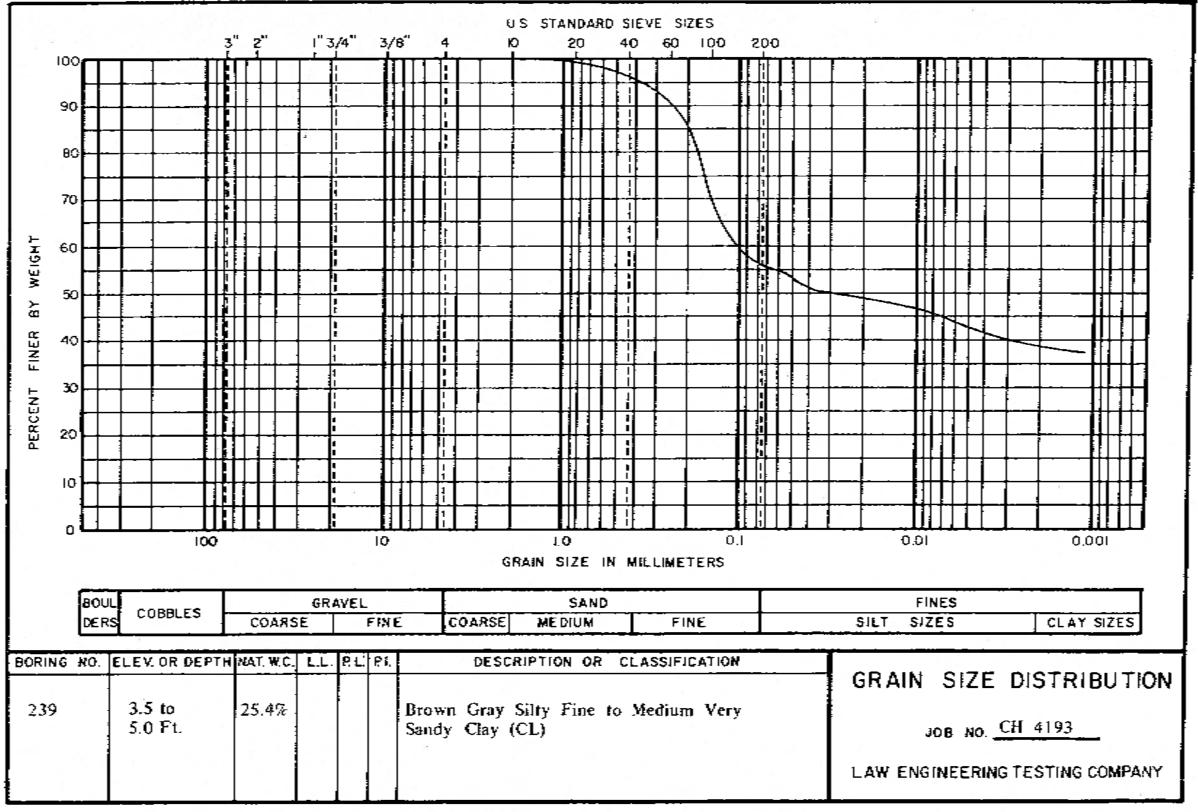
CORE 41.2 4 Q.D. SEMARKS <u> ingresidentialia</u> Hard Gray Calcureous Comented Crystalline Limestone: Sit, Sand and Shell Fragments 39.5 to 44.5 Ft. (Santee Limestone) 57.0 to \$9.5 Ft. 36.2 44.5 Soft Gray Calcareous Partially Cemented Sitt. Sand and Shell Fragments (Santee Limestone) 26.2 55.0 Hard Gray Calcureous Comented Sit, Sand and Shell Fragments (Santee Limestone) \$9.5 60.0 21.2 Boring Terminated at 60.0 Ft. Groundwater Encountered At 10.2 Ft. 24 Hours After Boring NW Casing Set to 39.5 Ft.

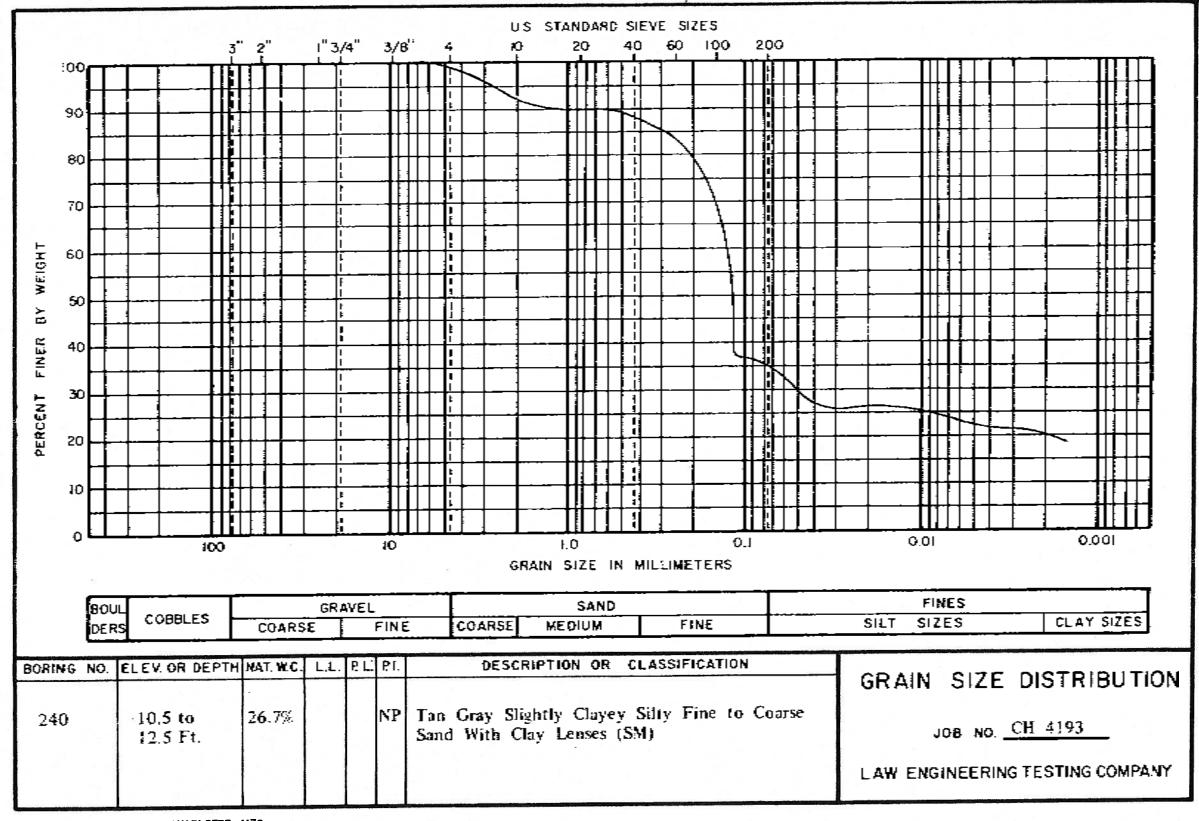
Source and sampling meets any siess \*Soft Green Slightly Clayey Silty Fine Page 2 of 2 to Medium Sand (Black Mingo CORE DRILLING MEETS SETH 6-2117 TEST BORING RECORD PRHEIMATION IN THE NUMBER OF SLOWS OF 140 LB. HAMMES ... FORMATION) #0#IN4 NO 248 PACCING BO IM. ABSUIASS TO DAIVE 1:6 IM. 1.9. SAMPLER 1 FT. BATE OFILLES 12-17-78 UMDISTURSED SAMPLE WATER TABLE, 24 HR SOCK JOINT MY BOCK COME RECOVERY THE WATER TABLE. I HE . СН 4193 PI - STANDARD PARETRATION - LODE OF GRILLING WATER M = M40 OH 30.-60. LAW ENGINEERING TESTING CO. B w #784# Dir 40"-10"

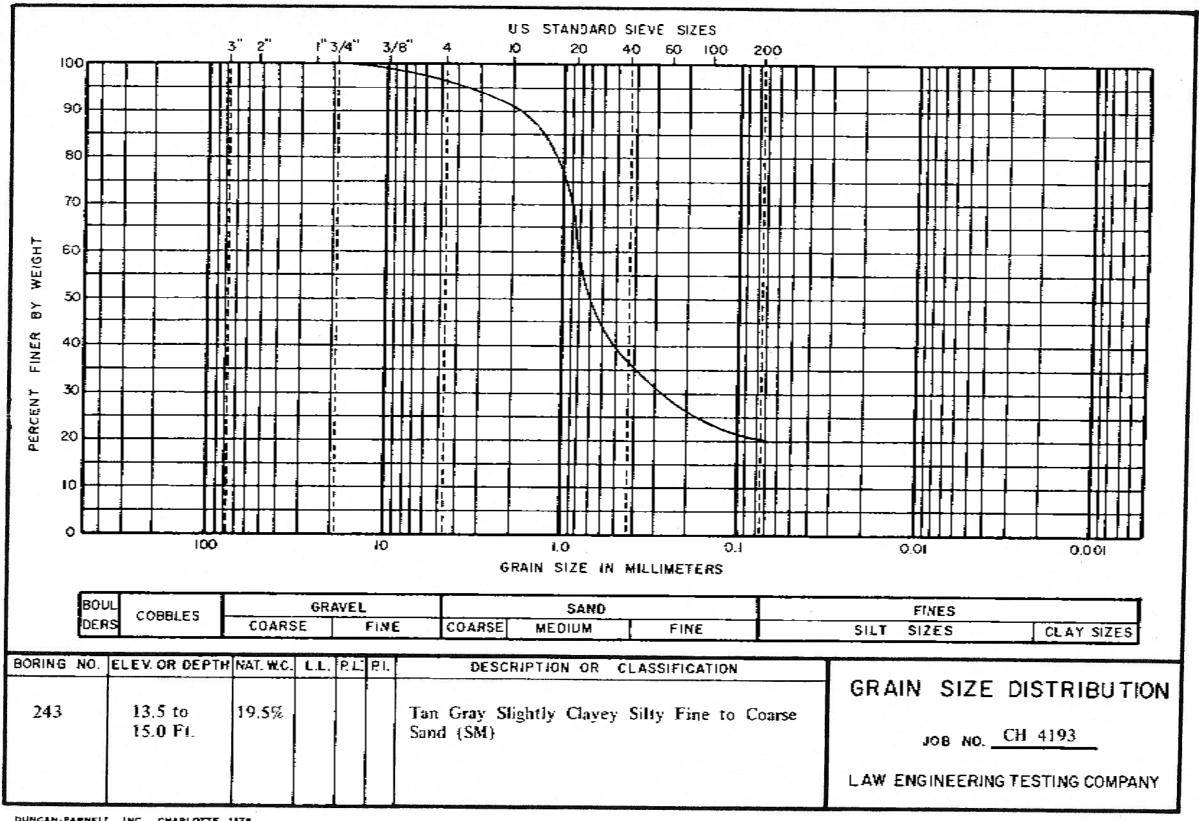
R.Q.O. BOCK QUALITY DESIGNATION

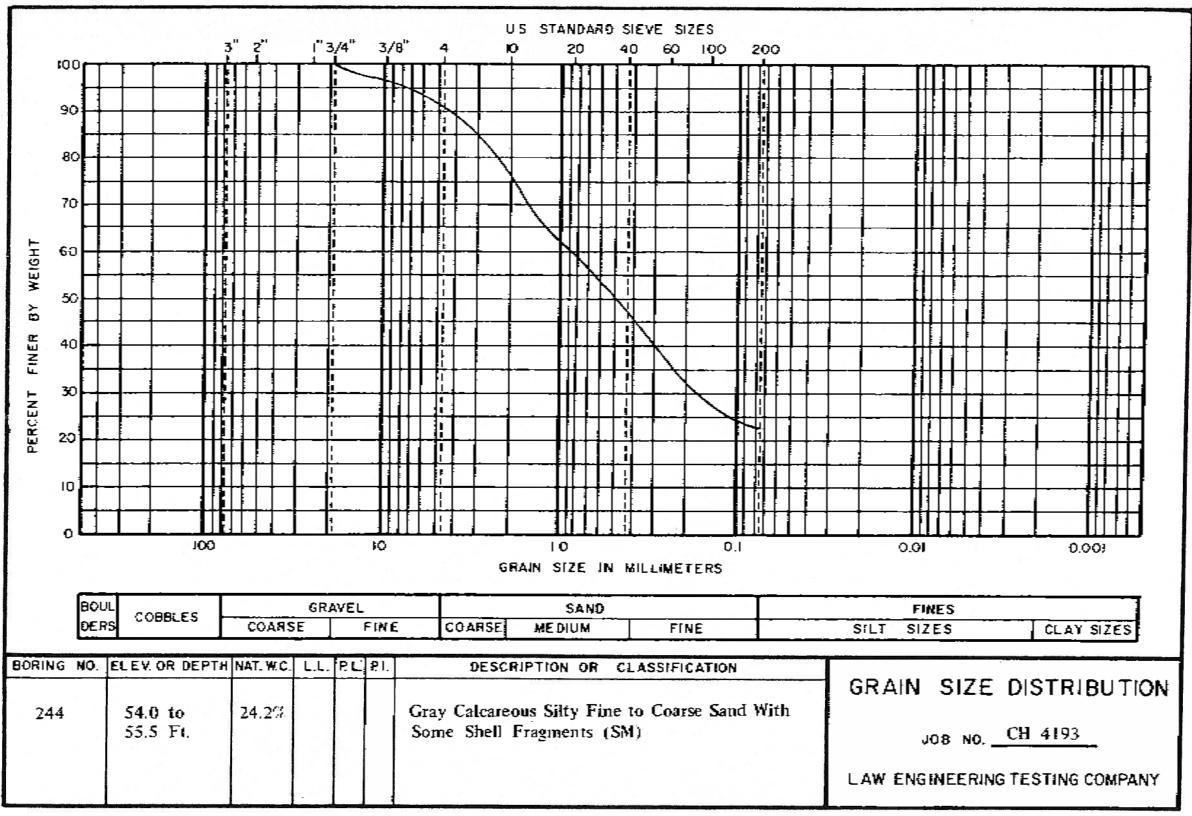
CORE 78.6 400 BEHARKE O DECEMPTION Topsoil 1.5 Black Silty Clayey Fine to Medium 3.0 Firm Gray Clayey Fine to Medium 73.6 - N=11 Sand 7.0 Soft and Very Soft Gray Green Silty 68.6 - N=4 63.6 - N=2 Firm Gray Slightly Micoceous Very Chyey Fine to Medium Sand 58.6 - N≖13 22.0 Very Dense Gray Clayey Fine to Coarse Sand 53.6 }- N≖65 27.0 Very Dense Gray Slightly Cemented Calcarcous Sitty Pine to Coarse Sand With Few Shell Fragments 48.6 - N=81 (Santee Limestone) 43.6 - N=83 38.5 50/0 Drag Bit Refusal at 38.5 Ft. Medium to Hard Gray Cemented\* souths and sampling waste astw press \*Calcorcouts Silt, Sand and Shell Page 1 of 3 Fragments (Sante Limestone) TEST BORING RECORD FALLING SO IN. REQUIRED TO DRIVE 1.4 IM, 1.0. BANGLER I FT. ADEX JOINT DATE OFFICES 12 4-5 78 лов но <u>СН 4193</u> MIN MOCK COME RECOVERY THE WATER TABLE. I HE. M . STANDARD PENETRATION LOSS OF BRILLING WATER M = MED. DIP 30'-40" LAW ENGINEERING TESTING CC H - 47444 DIF 40'-40' R Q.O. SOCE QUALITY BESISHATION

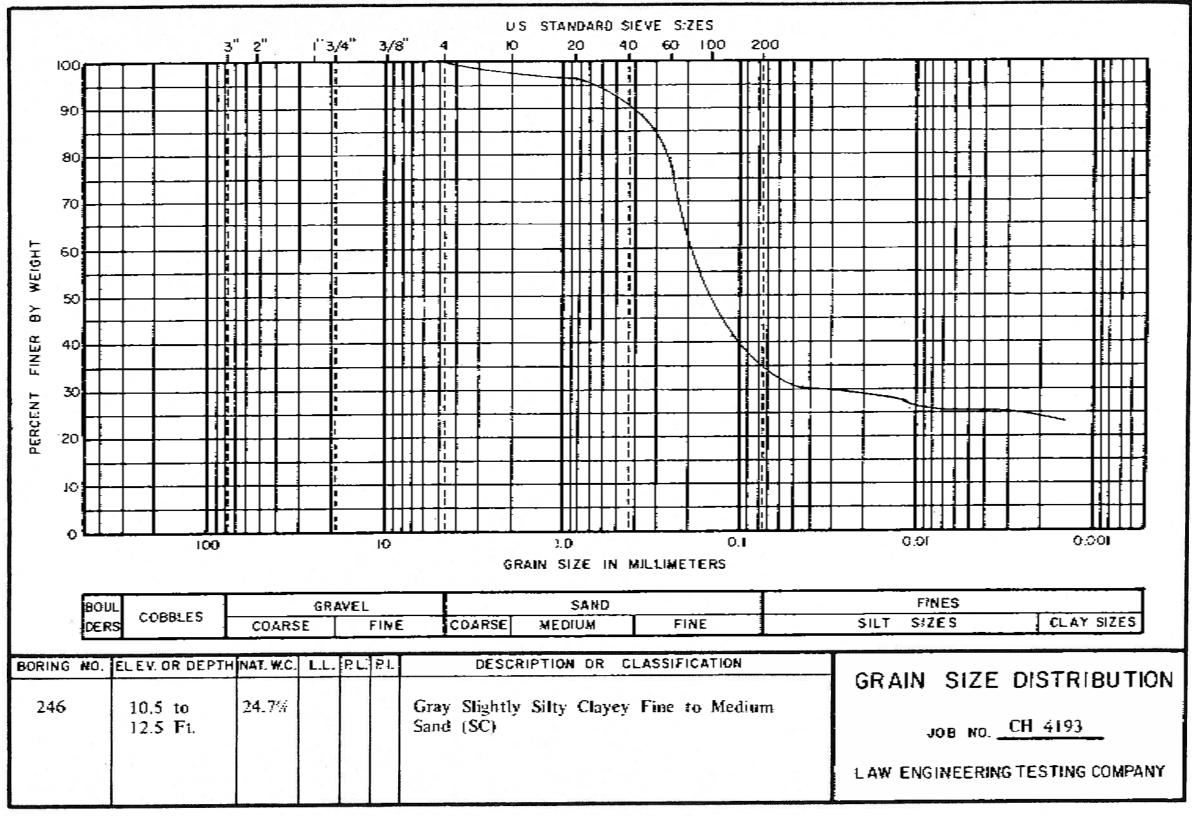
78.6

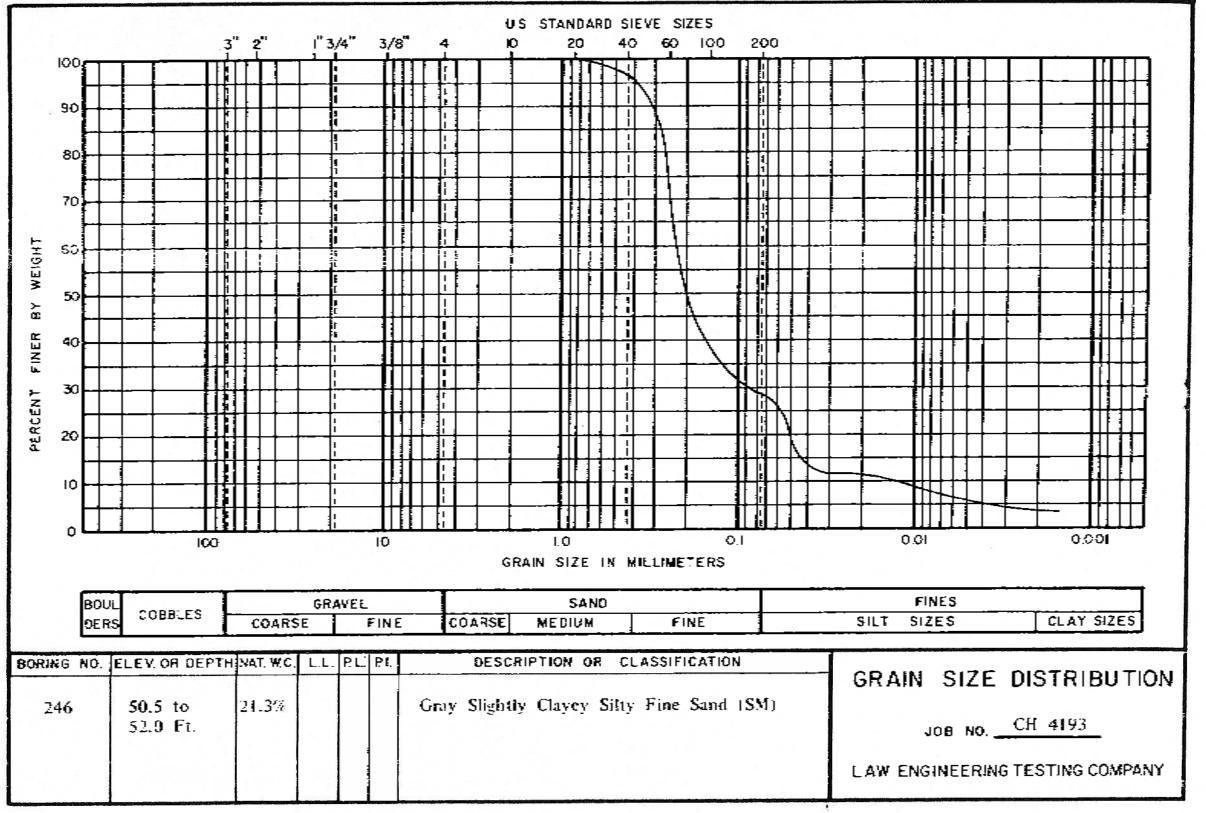


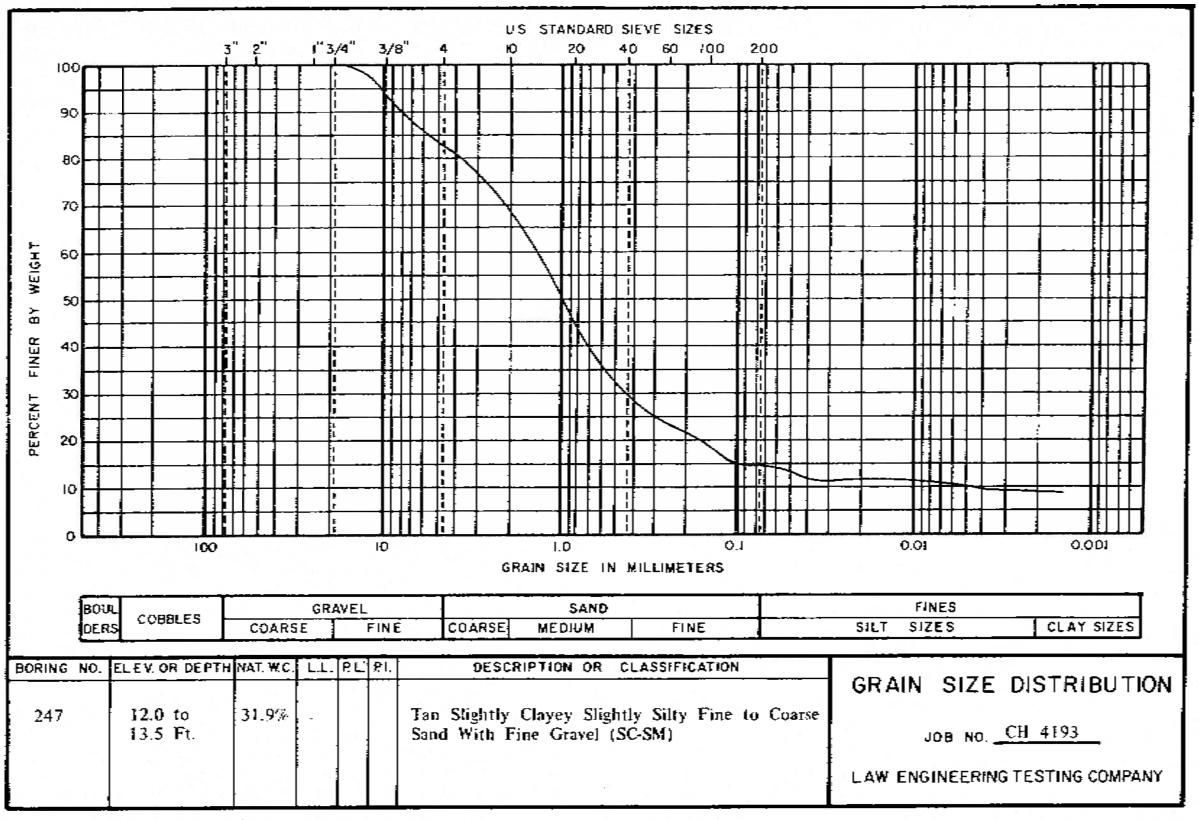


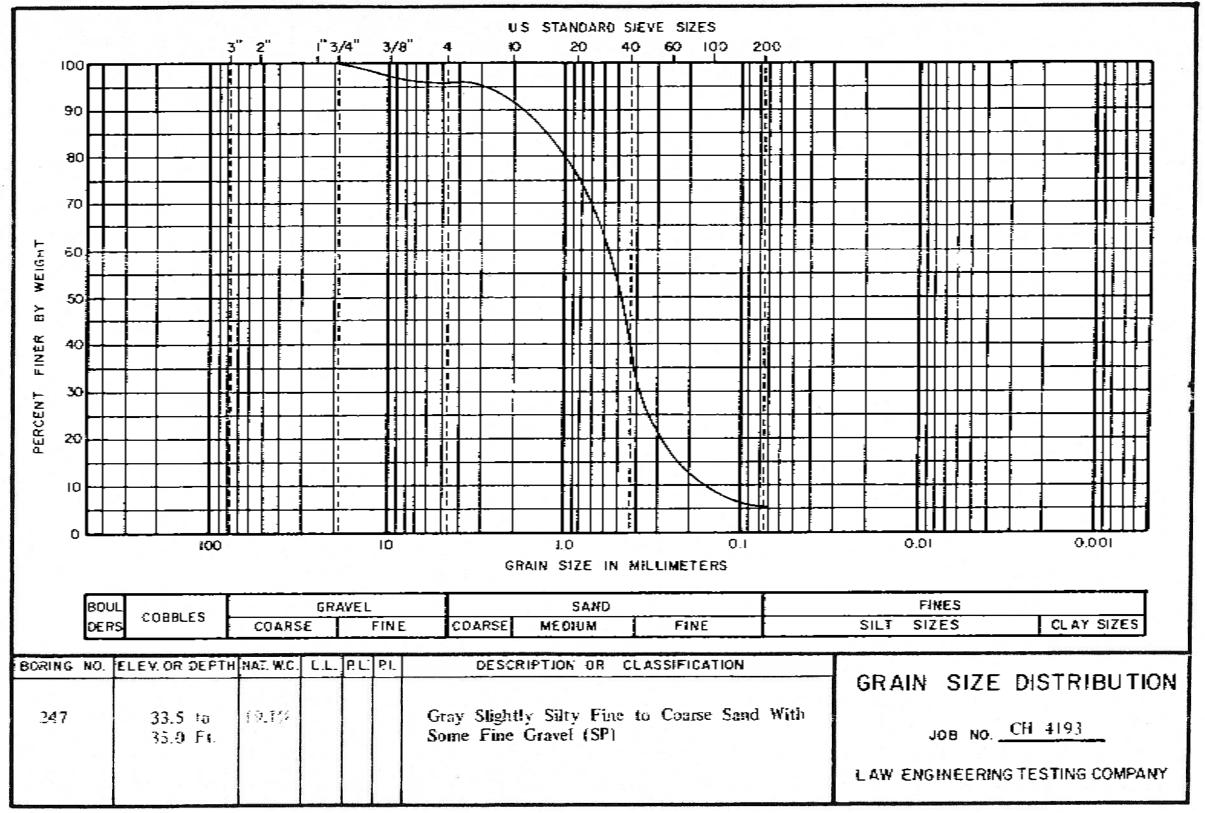


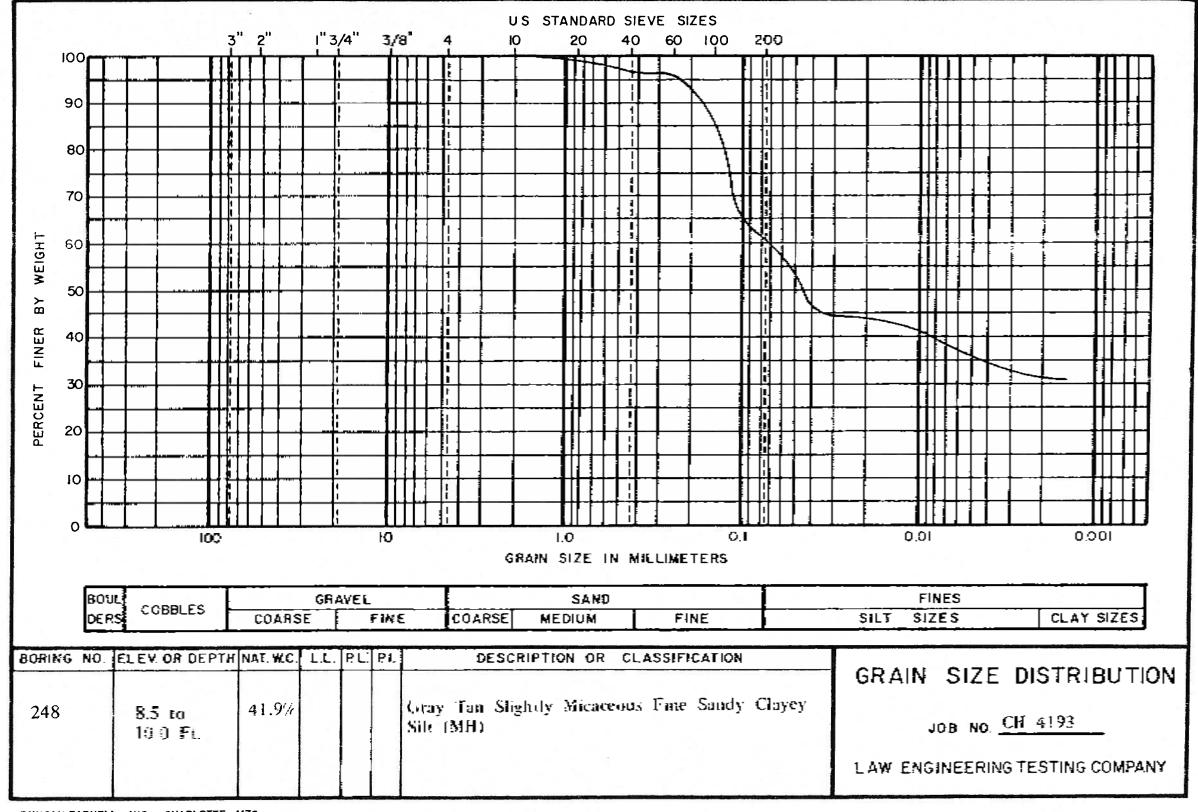


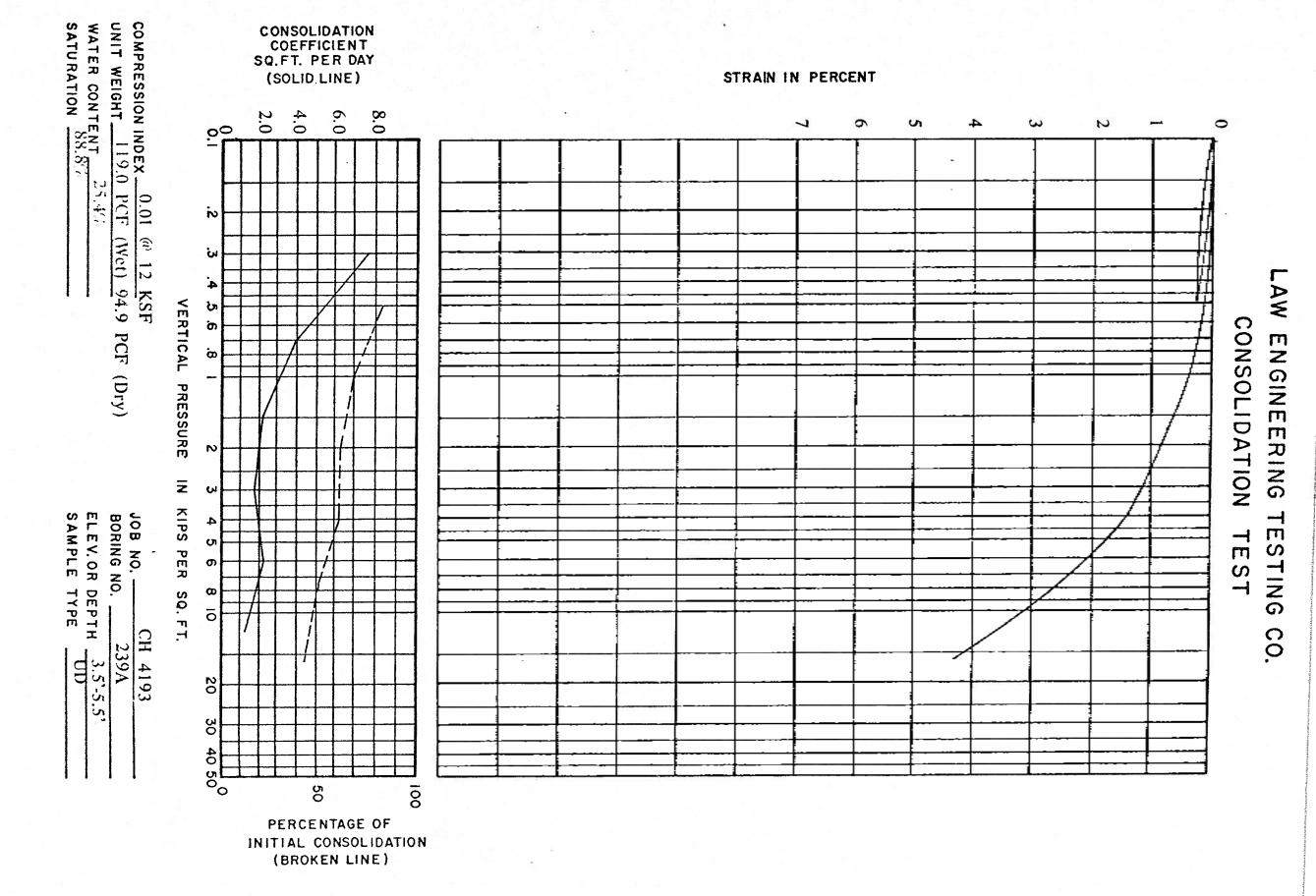


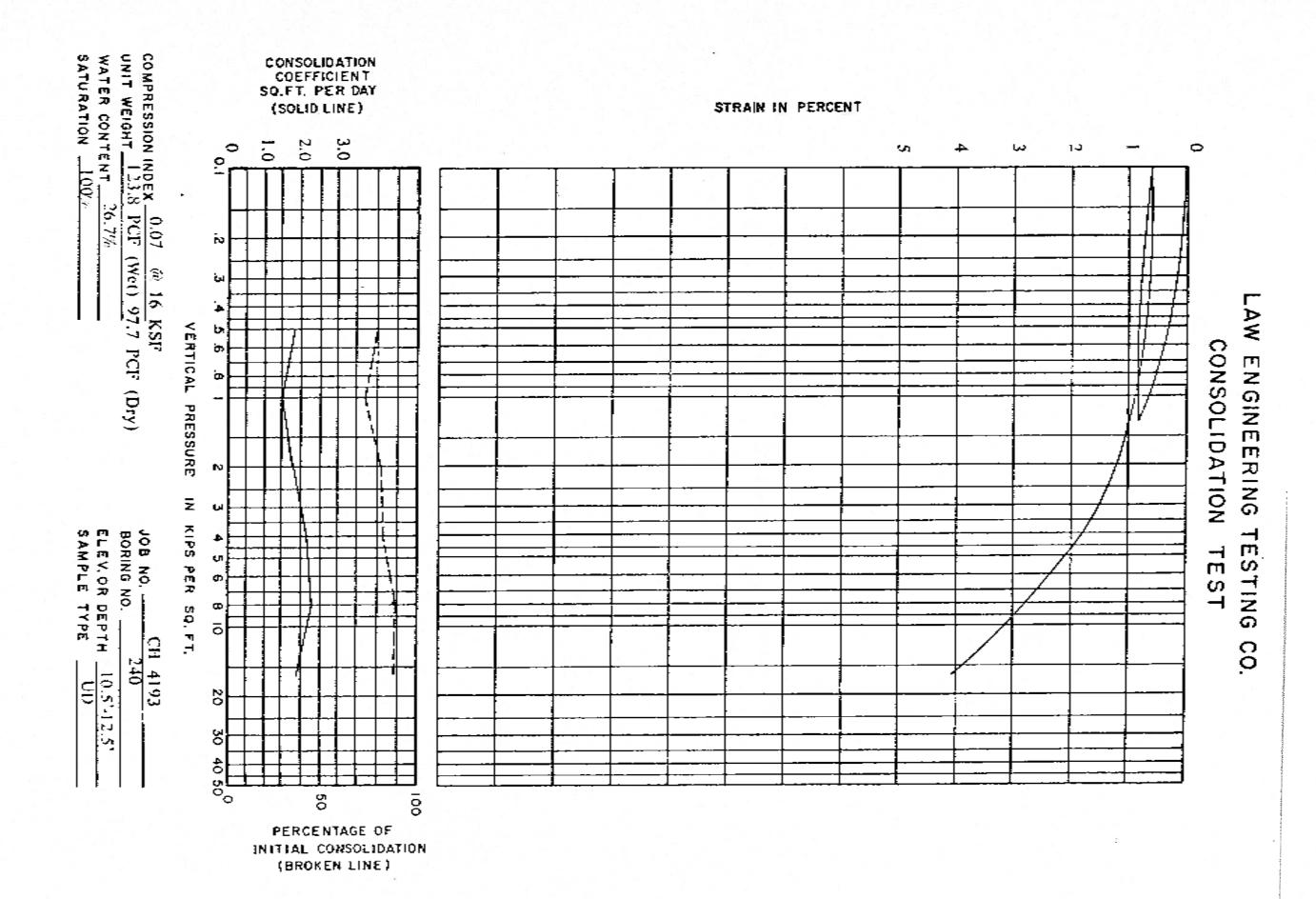


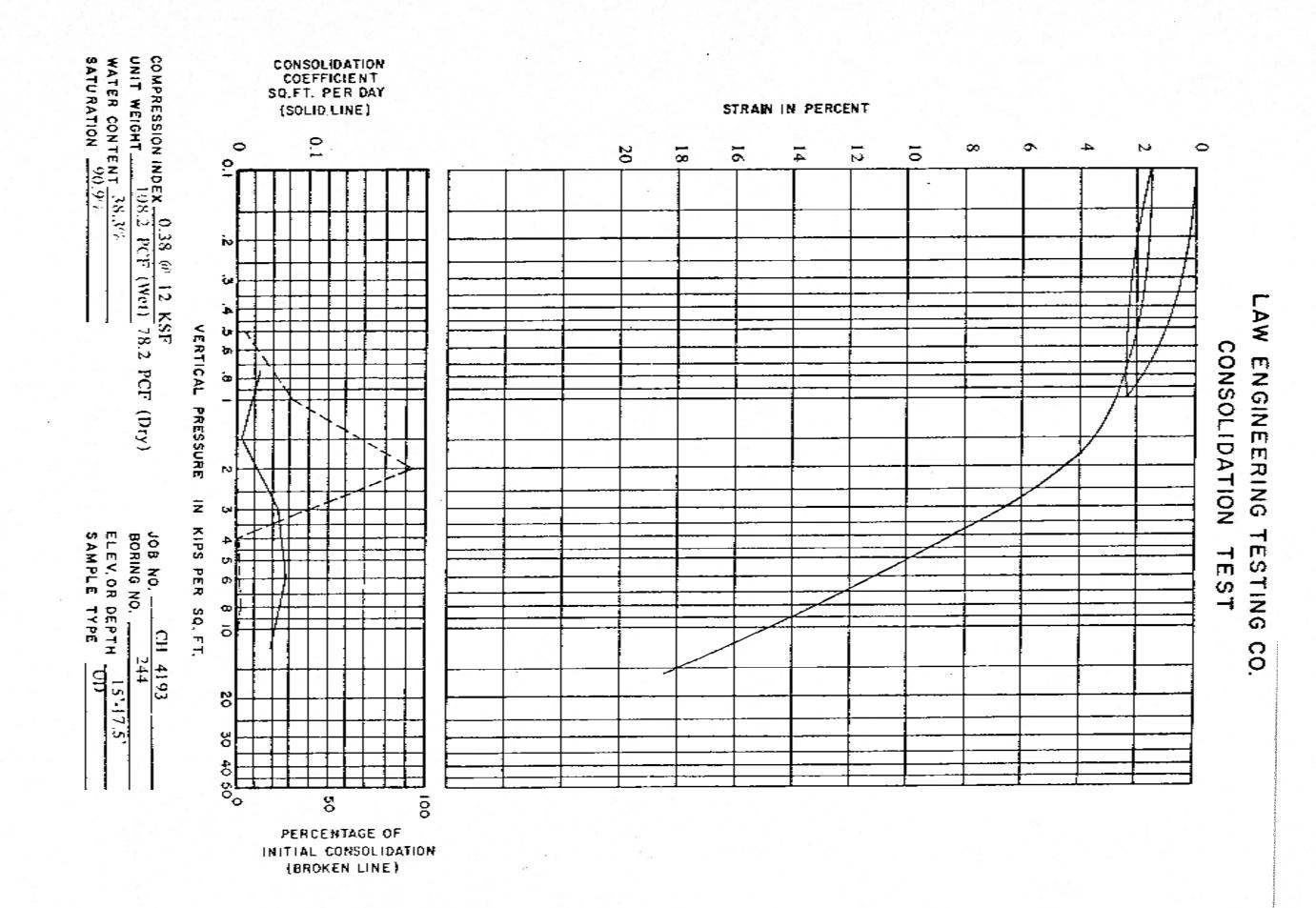


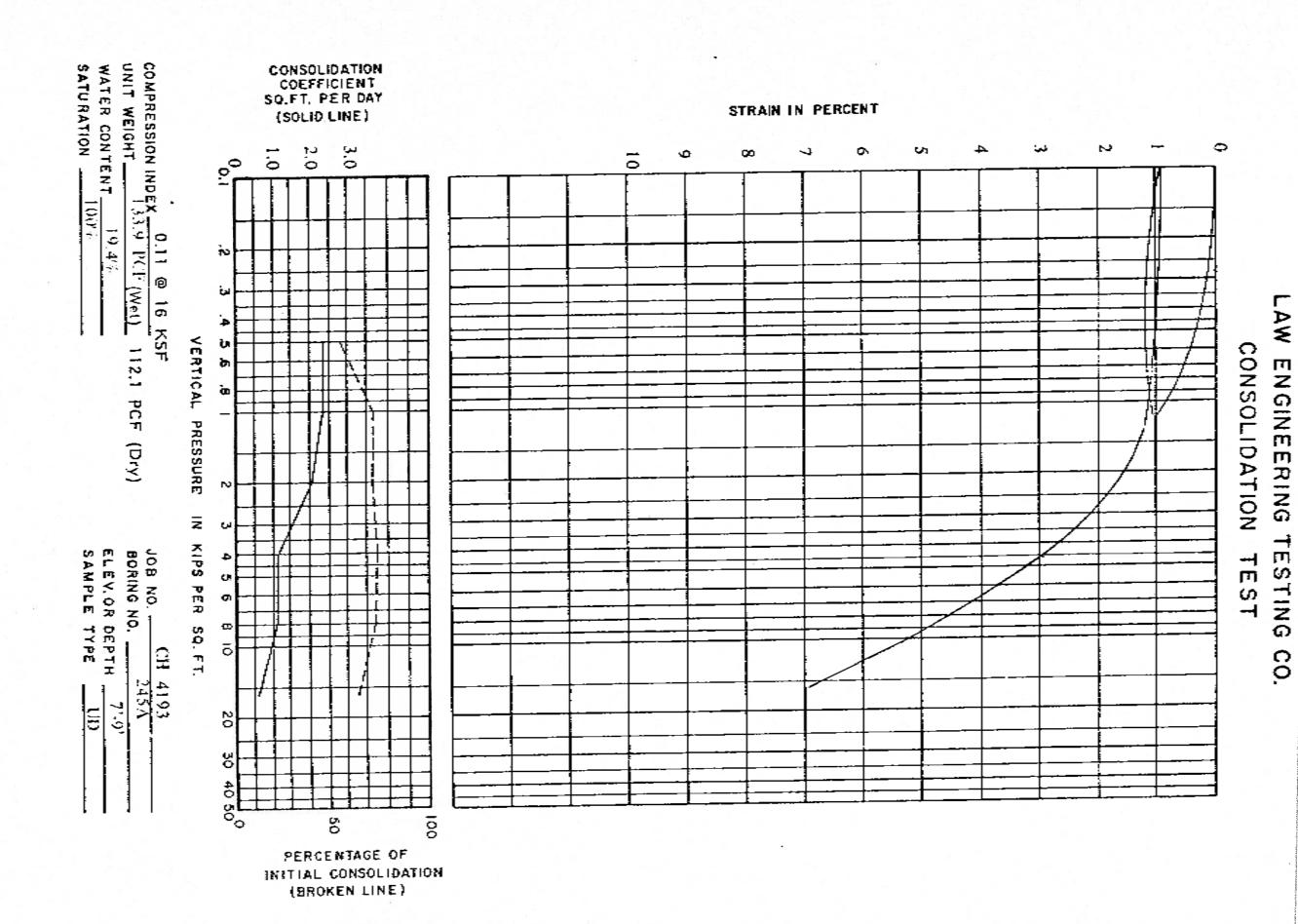




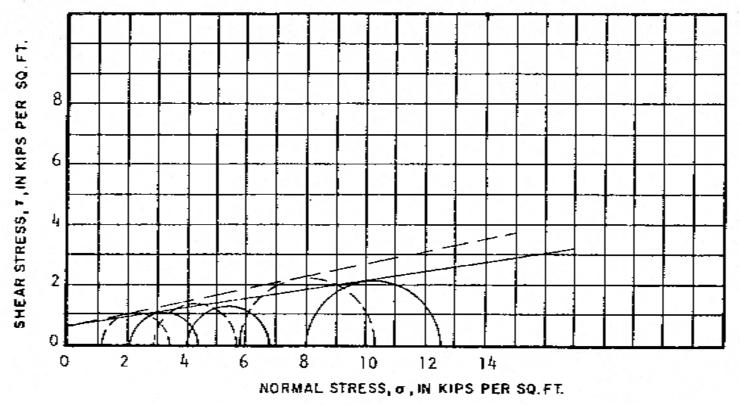


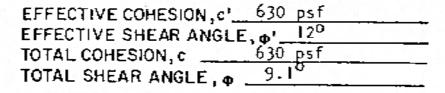






# LAW ENGINEERING TESTING COMPANY





INITIAL PROPERTIES: (1) (2) (3) AVG.

UNIT WEIGHT v. 115.9.113.0.115.6.114.8 pcf
WATER CONTENT, w. 33.0 42.2 32.1 35.8 %

VOID RATIO, e. 0.905 1.088 0.897 0.963

SATURATION, s. 97.0 100 95.1 97.4 %

FINAL PROPERTIES: (1) (2) (3) AVG.

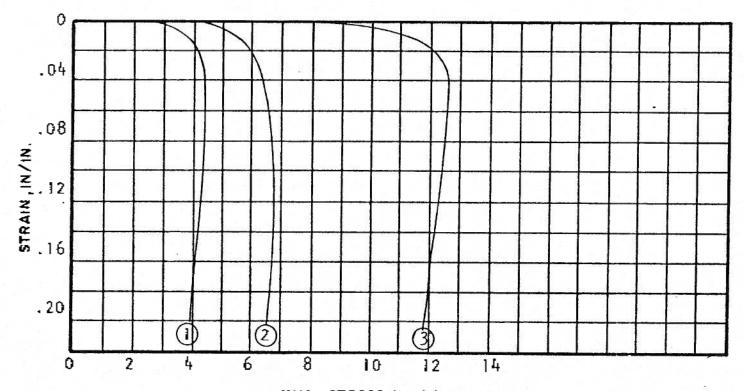
UNIT WEIGHT, Y 118.3 113.6 121.4 117.8 pcf

WATER CONTENT, w 32.1 38.4 28.5 33.0 %

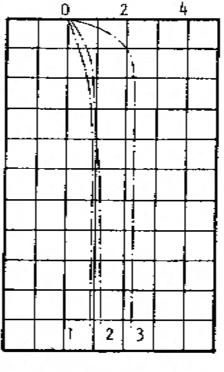
VOID RATIO, e 0.853 1.022 0.757 .877

SATURATION, s 100 100 100 %

### MOHR DIAGRAMS



EXCESS PORE PRESSURE IN KIPS PER SQ.FT.



# SAMPLE DESCRIPTION:

Very Soft Gray Tan Fine Sandy Silty Clay (CL)

TOTAL STRESSES \_\_\_\_\_\_

SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

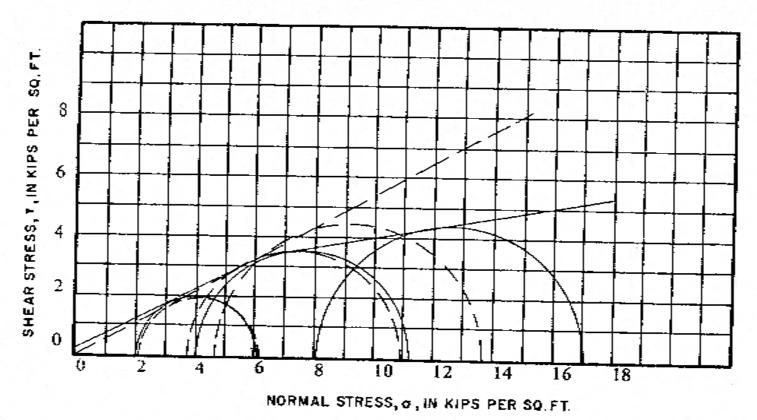
JOB NO. CH 4193 DEPTH 15.5'-17.5'

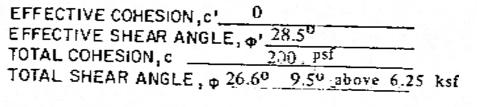
BORING NO. 244
SAMPLE TYPE\_UD

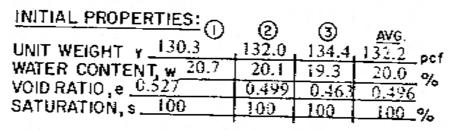
AXIAL STRESS IN KIPS PER SQ.FT.

STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

# LAW ENGINEERING TESTING COMPANY

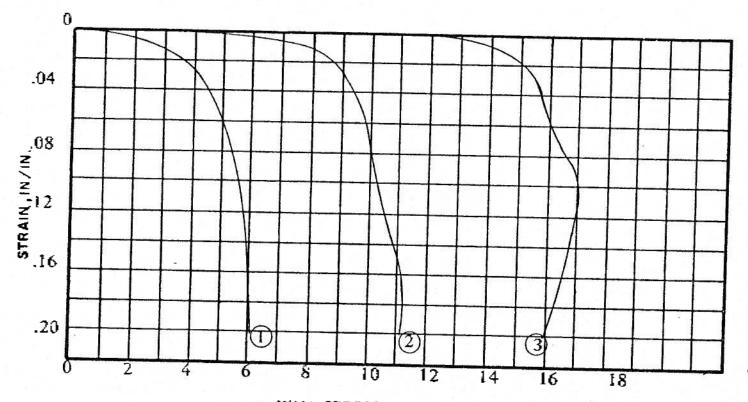




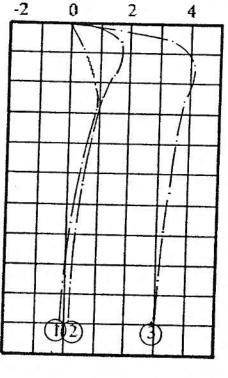


FINAL PROPERTIES:		_		
———— (I)	②	(3)	AVG.	
UNIT WEIGHT, v 130.3	<u>. 1</u> 31.7	134.8	132.3 pc	•
WATER CONTENT, w 19.2	18.0	15.6	17.6 %	
VOID RATIO, e _0.508	0.476		0.466	ı
SATURATION, s 100	100	100	100 %	

## MOHR DIAGRAMS



EXCESS PORE PRESSURE IN KIPS PER SQ.FT.



SAMPLE DESCRIPTION:

<u> Loose</u>					
Micaceo	us_Ve	rv C	avev	Fine	to
Medium	Sand	(SC)		- 1115	

TOTAL STRESSES \_ EFECTIVE STRESSES ----

> SATURATED, CONSOLIDATED, UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

JOB NO. CH 4193 BORING NO. 245-A DEPTH\_7.0-9.0

SAMPLE TYPE UD

AXIAL STRESS IN KIPS PER SQ.FT.

STRESS - STRAIN AND PORE PRESSURE-STRAIN CURVES

Appendix A Doc 07: Cross GS Volume 2 Appendices –
Unit 2 Subsurface Investigation

# **VOLUME TWO - APPENDICES**

FIRST

UNIT & SUBSURFACE INVESTIGATION
CROSS GENERATING STATION
CROSS, SOUTH CAROLINA

Prepared for

BURNS AND ROE, INC. 800 Kinderkamack Road Oradell, New Jersey

Contract 3503 - 192

January 1981 30C 6090 80C4090

Page 3 - 30

the contractor's assessment of the likelihood of encountering construction difficulties and may vary considerably from those shown in the preliminary cost estimate. These factors will have to be evaluated by Burns & Roe, Inc. and may change the apparent advantage offered by System C.

#### 3.6.4 Foundation Recommendations

Our preliminary evaluation of alternate foundation systems suggests that foundation systems more economical than grouting prior to caisson construction may be available. We recommend that these alternate foundation systems be evaluated further by Burns and Roe, Inc. to assess the potential economic advantage that can be realized.

If area grouting caissons are chosen, the caissons can be designed using the criteria developed in Section 3.2 and the "high cost" grouting program described herein. If area grouting and cast-in-place walls are chosen, the walls will require further design studies to more completely consider potential difficulties. Preliminary design envisions 30 inch wide unreinforced concrete walls oriented parallel to the short axis of the building, installed by the slurry trench method and bearing on the top of the hard layer of Santee Limestone.

# 3.7 ASH POND EMBANKMENTS AND LINING ANALYSES AND RECOMMENDATIONS

#### 3.7.1 <u>Structural Information</u>

An area of approximately 92 acres has been set aside for eventual use as an ash disposal pond. Our investigation covered

only the first stage construction. The location of the first stage Ash Pond is shown in Figure 1-1. The Ash Pond is approximately 950 by 700 ft in plan dimension, (approximately 16 acres) and is intended to store 20 ft of liquid. We understand from Mr. R. Rohr that Lockwood Greene Architects and Engineers is considering excavating the interior of the pond to provide fill material for construction of the embankment. The height of the interior embankment slope will be 20 ft plus the required free-board. The height of the exterior embankment slope above existing grade will depend on the depth of excavation in the pond interior.

A pump structure is to be located in the southwest corner of the Ash Pond. The pump structure is approximately 18 ft by 40 ft in plan, 22 ft deep, and consists of three intake compartments separated by concrete partitions. The average bearing stress of the pump structure is  $1.6~\mathrm{k/ft^2}$ . Sketches provided by Lockwood Greene Architects and Engineers show the top of the pump structure at the crest of the embankment.

The Ash Pond is intended for storage of bottom ash and chemical wastes from the various plant facilities. The expected concentration of various chemicals to be discharged into the pond is available in the Project Environmental Impact Statement.

# 3.7.2 <u>Subsurface Conditions</u>

The subsurface investigation in the Ash Pond area consisted of 24 borings and 30 test pits. The locations of the borings and the test pits are shown on Figure 3-11. Twenty-two borings were terminated in the Santee Limestone and two were drilled

to the top of the Black Mingo formation. Undisturbed tube samples of the major clay strata were obtained. A piezometer was installed within the upper 15 ft of the Santee Limestone at boring B-621. Test pits were excavated using a Case 850 backhoe to a depth of 11 to 12 ft, and bag samples of the various strata were obtained. The ground surface elevation in the Ash Pond area ranged from 77.1 ft to 79.2 ft.

#### 3.7.2.1 Overburden Soils

The overburden soils in the Ash Pond area consist of two primary layers:

- 1. Gray-tan silty/sandy CLAY and clayey SAND with lenses and seams of medium to fine sand. This stratum underlies a mantle of brown silty sand and sandy silt, I to 2 ft thick, and extends to depths of between 7 and 15 ft below existing grade. The material becomes increasingly sandy with depth. Sand lenses and seams were encountered primarily in the lower half of this stratum. Vertically oriented stringers of fine sand were common in the upper 4 to 5 ft of this stratum. SPT "N" values ranged from 3 to 15 but were typically 5 to 10. The liquid limit and the plasticity index varied from 45 to 86 and from 25 to 65, respectively.
- Gray-green silty CLAY with lenses and seams of medium to fine sand. This stratum varies in thickness from 2.5 to 7 ft along the western embankment and from 8 to 15 ft in other areas of the Ash Pond. Layers of

silty/clayey sand varying in thickness from 2 to 7 ft are included within the clay or at the base of the stratum within the southeast quadrant of the site and along the northern embankment. SPT "N" values in the clay portions of the stratum ranged from 0 to 9 but were typically 2 to 4. The liquid limit of this stratum varied from 94 to 118 and the plasticity index varied from 50 to 86.

#### 3.7.2.2 Santee Limestone

The Santee Limestone was generally encountered at approximate el 52 ft, which corresponds to a depth of about 26 ft. However, borings B-634 through B-641 were drilled at the western edge of the site and indicate a rock surface at about el 60 ft.

The penetration of borings into the limestone prior to coring provides an indication of the depth from top of limestone to the top of the hard layer within the limestone and varied from 6 to 10 ft over most of the site. The penetration into the limestone varied from about 9 to 20 ft along the western embankment where the limestone was encountered at about el 60 ft. These observations suggest the elevation of the top of hard limestone varies less than the elevation of top of limestone. SPT "N" values in the limestone above corable rock were typically greater than 50 but SPT "N" values near the top of the limestone were often low (1 to 6). In general, core recoveries of the hard limestone were greater than 80 percent and RQD values were greater than 60 percent but lower values were recorded occasionally.

#### 3.7.2.3 <u>Voids</u>

Geophysical probes were not drilled in this area. Consequently, information on voids is based on observations of water loss or rod drop during the drilling of borings. The observations suggesting possible voids are summarized below:

Boring No	Elevation of Top of Void, ft	Estimated Height of Void, ft	Observation
B-632	29.1	8.5	Rod drop
B-633	42.4	0.2	Rod drop
B-622	54.0	3.5	Loss of drill water
B-628	34.0	small	Loss of drill water
B-630	54.2	2.0	Loss of drill water
B-631	25.0	1.5	Loss of drill water
B-633	32.4	3.0	Loss of drill water
B-641	58.4	small	Loss of drill water
B-644	51.9	0.4	Loss of drill water

It should be noted that a loss of drilling water which is not accompanied by a rod drop is probably associated with a more porous zone and not necessarily with the presence of a void.

#### 3.7.3 Design and Construction Considerations for Embankments

#### 3.7.3.1 <u>Materials of Construction</u>

The upper layers of silty sand, silty clay, and clayey sand could be suitable for use as compacted fill. We estimate that approximately one foot of material would be removed during stripping and grubbing. The depth of soil suitable for excavation

and use as compacted fill depends on the depth to the water table. Soils excavated close to the groundwater table may be too wet to excavate, handle, place, and compact without excessive effort. Water level measurements in the Ash Pond area indicate groundwater at approximately 7 to 8 ft below the present ground surface. These measurements were made in the late summer and fall, after a long period of dry weather and the water table in the spring is probably higher. We anticipate that the depth of excavation could range from 3 to 5 ft below grade, depending on actual groundwater conditions.

The near-surface soils are plastic clays which become soft and difficult to traverse during wet periods. Consequently, construction of the embankments should be scheduled during the late spring and summer months and weather delays should be anticipated.

The plastic clays have the following typical index properties:

Liquid Limit	50-70	percent
Plasticity Index	40-50	percent
Water Content	15-25	percent

Values of liquid limit or plasticity index higher and lower than these typical values were also measured.

#### 3.7.3.2 Compaction Criterion

Compaction curves based on Standard Proctor compactive effort are shown in Appendix D for various composite samples obtained

from the test pits. Drying or wetting the fill to achieve a different field moisture content is likely to be very difficult due to the plastic nature of the site soils. Fortunately, the optimum moisture content for the cohesive soils is approximately 20 percent and is similar to the in-situ water content. Nevertheless, a Contractor must anticipate that some alteration to moisture content may be necessary.

We recommend using "standard energy" as the standard for control of field compaction. Fill should be placed at a water content that is at least 1 percent greater than the optimum water content to reduce the permeability of the fill and to provide a more ductile material capable of accommodating potential settlements of several inches. A minimum of 95 percent of the optimum dry density measured in the laboratory test designated as ASTM 698-70 should be specified.

#### 3.7.3.3. Embankment Details

#### Slopes

Embankments constructed of clay soils, particularly if compacted wet of optimum, typically require relatively flat slopes to minimize the likelihood of shallow sloughing. We recommend a maximum slope of 3H:1V.

#### Crest Width

Determination of crest width is generally based on considerations of seepage, crest erosion, and access requirement for

vehicular traffic. A minimum crest width of 15 ft would be required for a one lane road with shoulders. This minimum width would be sufficient from a seepage point of view.

#### Freeboard

The height of the embankment above maximum pond level is provided as protection against wave action and wave run-up and is based on consideration of maximum anticipated wind velocity and maximum fetch. We recommend a minimum freeboard of 4 ft. This freeboard height is approximately equal to the average height of voids in the Cooling Tower Area and will probably be sufficient to protect the dam from overtopping in the event of collapse of deep voids.

#### Erosion and Slope Protection

Those portions of the embankment exposed to rainfall should be protected from erosion by a permanent ground cover. Slope protection should also be considered in the splash zone from 2 ft below normal pool to the dam crest. The proper amount of slope protection requires a balance between initial cost and maintenance costs. It is likely that a 6 inch thick layer of 1-1/2 inch crushed stone would provide moderate slope protection and require little maintenance. A filter layer should be provided between the crushed stone and the embankment fill.

### Zoning and Internal Drainage

We recommend the embankment be constructed as a random fill section.

The embankment would be built using the upper few feet of soil in the ash pond area. These soils are primarily cohesive. As discussed in Section 1.6, a likely range of field permeability for compacted samples of the near-surface cohesive site soils is  $1.7 \times 10^{-8}$  cm/sec to  $8.7 \times 10^{-9}$  cm/sec. Thus, the available site soils provide a relatively impervious embankment material. Pockets or layers of sandy material are present and are located randomly throughout the site.

It is likely that granular inclusions within the embankment would be contained within a matrix of clay soils and would have little effect on the overall permeability of the embankment. Separation of materials for use in zoned construction is likely to be difficult to implement in the field because the sandy soils are randomly distributed. Sandier materials, if identified in the field, should be placed at the downstream side of the embankment. Our stability analysis suggests that internal drainage is not necessary for embankment stability for the side slopes recommended above. The downstream erosion protection described above should be sufficient to prevent erosion if seeps on the downstream face develop. Local minor repairs, such as placement of inverted filters in problem areas, could be handled as a maintenance item.

#### 3.7.3.4 Control of Seepage from the Ash Pond

The main concern about pond seepage is potential environmental damage caused by seepage of pond fluid into the groundwater.

Seepage can occur either through the embankment or through the pond bottom. Commonly used methods of controlling seepage

include providing a relatively impervious embankment and placing a relatively impervious lining over the upstrem face of the embankment and the entire pond interior. A relatively impervious embankment would be provided. The following paragraphs discuss the need for a lining and alternate liner methods.

#### Need for Pond Lining

The site soils have a low permeability and are a natural seal for the fluids in the pond. However, the presence of sandy layers makes it doubtful that this natural seal is continuous over large areas, such as the bottom of the pond. Covering the existing soils with a compacted soil lining or with a membrane would provide two levels of protection against seepage. The primary line of defense is the constructed liner. The secondary line of defense is the overburden soils which generally have a very low permeability. Similarly, covering the embankment with a lining would provide two levels of protection against seepage.

#### Soil Linings

Choice of an appropriate lining (soil or membrane) should consider the properties of the various liner types, the likelihood of and mechanism of liner failure, and the impact of voids in the Santee Limestone on overall pond liner performance. Compacted on-site soils can be considered as a construction material for a liner. Commonly used imported liner materials include bentonite soil mixtures and plastic or rubber liners. These liners are discussed in the following paragraphs.

A thick layer of compacted on-site soils would provide an economical liner. Granular zones are present throughout the site but construction of the liner in 8 inch thick lifts to a total thickness of 4 ft would essentially preclude the formation of vertically continuous granular inclusions ("windows"). However, an unresolved question concerning the suitability of on-site soils as a liner material is the behavior of these soils when exposed to the pond water chemical environment. A laboratory testing program consisting of permeability and strength tests on compacted samples subjected to percolation of water with a chemical makeup similar to that anticipated in the ash pond would be required to address this problem. An estimate of the scope and cost of such a program could be developed if Burns and Roe, Inc. is interested in pursuing this alternate further.

A mixture of imported bentonite in a dry powder form and available site soils provide another possible lining material. Bentonite seals are usually constructed by spreading bentonite on the ground surface, mixing the bentonite with the upper 4 to 6 inches of soil by discing or rototilling and compacting the mixture. A grade of bentonite resistant to deterioration under the pond chemical environment would have to be chosen. Complete coverage with bentonite and uniform mixing of bentonite with the soil are essential. These requirements are difficult to achieve and necessitate careful inspection in the field.

Cracking of soil liners is a potential problem of both compacted natural soils and bentonite-soil liners. The danger of desiccation cracking is clear. We have also observed cracking of soil liners which remain submerged or are protected from drying

80C4090

Page 3 - 41

but have no simple explanation for the cause of this problem. This bizarre problem is not common but deserves consideration. Methods for protection against cracking are discussed in a later paragraph.

#### Membranes

Commercially available plastic liner materials such as PVC, reinforced chlorinated polyethylene (CPER), or HYPALON have been used sucessfully as waste pond liners. Special solvents are used to join the strips of liner and to seal the liner around concrete structures such as the pump structure. The chemical makeup of the pond water should be made available to the liner manufacturer so that a liner material providing durability under the pond water chemical environment is chosen. Based on preliminary discussions with liner manufacturers, it appears that CPER or HYPALON will be required. The influence of settlement on liner performance should be evaluated by the Vendor.

#### Protection of Liners

We recommend that soil cover be placed over the liner to protect it prior to first filling of the pond and during excavation operations which might be required for future removal of ash by dragline or other methods. This recommended depth of soil cover for bentonite-soil liners or plastic liners is 4 ft. For the compacted natural soil liner, the cover depth could be reduced to 2 ft.

#### Performance and Cost of Alternate Liners

The estimated rate of seepage under a 20 ft head is shown below for three alternate liners.

<u>Liner Material</u>	Estimated Maximum Rate of Seepage	Remarks
natural soil	$4x10^{-4}$ gpm/ft	4 ft thick liner
bentonite - soil mixtures	6x10 <sup>-5</sup> gpm/ft	6 in. thick liner
membranes	zero	minor leakage at joints or undetected minor tears might be expected

The estimated seepage losses are all relatively small. Evaluation of allowable seepage losses was not part of our scope of services. We would be pleased to develop a scope for this new work item if requested by Burns and Roe, Inc.

Table 3-5 summarizes a preliminary cost comparison for the three liner materials. The lining constructed using a thick layer of compacted on-site soils offers an apparent cost saving of about \$0.55/ft<sup>2</sup> over a membrane, and an apparent savings of about \$0.40/ft<sup>2</sup> over a bentonite-soil mixture. These cost advantages are substantial because of the large areas involved. The presently proposed pond covers about 665,000 ft<sup>2</sup> and the future pond area would total about 4,000,000 ft<sup>2</sup>. A savings of \$.50/ft<sup>2</sup> converts to about \$330,000 for the present pond and \$2,000,000 for the future ponds.

#### Summary of Liner Options

The optimum liner will give acceptable performance at minimum cost. We have not evaluated what estimated seepage rates are acceptable from an environmental view point. Consequently, all we can say now is that membranes which ideally allow zero seepage are acceptable and that the other liners might be acceptable.

A further unresolved technical issue is the behavior of the onsite soils in the presence of the various chemicals that could be introduced into the pond.

In summary, chemical-resistant plastic liners would provide adequate protection against pond leakage and associated environmental damage. Thin bentonite-soil liners and thick liners of compacted on-site soils may provide adequate protection and offer a substantial savings in construction cost, but will require further evaluation.

#### 3.7.3.5 Impact of Voids on Pond Performance

Most of the borings in the Ash Pond Area were terminated after 20 to 30 ft of penetration into the Santee Limestone (about el 25 ft). The one boring which did penetrate to the Black Mingo encountered an 8.5 ft high void. The void was encountered within the same range of elevations as were the Cooling Tower voids, suggesting that similar foundation conditions may be present in the Ash Pond area.

Construction of the embankments will result in some increase in stress on the voids. Filling of the pond will also result in a stress increase. Collapse of voids 5 to 10 ft in height is possible and would probably result in a few feet of surface subsidence. The unknown is the size of the area in which voids might collapse. Such subsidence could result in rupture of the lining and development of a flow path down into the Santee Limestone. Leakage of pond fluid into the Santee Limestone would be difficult to contain without construction of a prohibitively

costly soil bentonite cutoff wall extending into the Black Mingo formation. Construction of a shallow perimeter cutoff wall extending only into the gray green silty clay would be ineffective if a seepage path to the Santee Limestone developed somewhere in the pond interior.

This potential problem would only develop if a chain of events occurred: 1) void collapse, 2) significant surface subsidence, 3) liner rupture, and 4) liner rupture at a location where predominantly granular soils are present, or liner rupture combined with sufficient subsidence to cause cracking of the clay strata at that location. The likelihood of all of the above occurring and resulting in pond leakage is difficult to assess. In our opinion, a prudent approach would be to provide safeguards wherever possible to strengthen each of the potential weak links. The following measures could be taken:

 Preload the Foundation: Preloading could be used prior to construction to induce any void collapses that may occur under the embankment loading.

The preload should impose a load equal to 1.5\* times the anticipated embankment and/or water loading and should be of sufficient size plan dimensions to make sure the preload stress is not dissipated above the elevation of the voids. A minimum preload width of 150 ft should be specified with the crest of the preload extending at least 50 ft beyond the exterior crest of the Ash Pond embankment. Each square foot of pond area should be preloaded for a minimum of one month.

<sup>\*</sup>Preloading at 2 times the average building load was considered for the "T-Beam" solution at the Cooling Tower because the consequences of void collapse at the Cooling Tower were more severe.

We believe a rolling-preload, i.e. reuse of the same material in successive areas of the pond, could be constructed for \$1/ft<sup>2</sup> to \$2/ft<sup>2</sup>.

The mechanism of void collapse is not well understood. Undoubtedly, there are time related effects such as ravelling or creep type failure which would be accellerated by an increase in stress. Consequently, a higher stress increase or a larger period of stress application will increase the effectiveness of the preload. Foundation preloading does not rule out the possibility of future void collapse associated with time dependent effects or with changes in groundwater chemistry or flow patterns. Quantification of these concepts is beyond the state-of-the-art. The important point is that a preload provides a positive approach to dealing with the void problem but does not preclude the possibility of future void collapse. The recommended preload height and preload period represents, in our opinion, a reasonably effective but not prohibitively expensive compromise.

2. Provide More Durable Liner: If bentonite soil mixtures or compacted natural soils are used it would be desirable to make them as ductile and self healing as possible. Plastic liners could be reinforced. These measures would provide protection against minor ground movements but not against local sink holes several feet deep.

3. Compartmentalize Pond: Division of the pond into separate compartments would allow continued operation of the pond system while portions were drained for inspection and repairs, if required. There would be additional cost associated with construction of internal partition dikes and backup pumping capacity.

Each of the above measures add cost to the project. These costs must be weighed against the level of uncertainty the Project Owners are willing to accept.

#### 3.7.3.6 Estimated Settlements

Construction of the Ash Pond embankments will impose a stress of apprximately 2.7 k/ft2 on the Pleistocene overburden soils. The Pleistocene soils are very plastic, particularly the lower gray green silty clay, and exhibit a relatively high compressibility even upon reloading. Thus, even though consolidation tests indicate the site soils to be overconsolidated, significant settlements are likely. We estimate that settlements could vary from 4 to 10 inches. The range of settlement is based on the variation in thickness of compressible strata and the presence of layers or pockets of silty sand. The areas in which differential settlements should be anticipated are near the southwest corner (in the area of the pump structure) where the compressible strata increase in thickness from about 15 ft to 30 ft over a distance of approximately 150 ft, and along the northern dike where sand layers of varying thickness were encountered. influence of these settlements on the operation of the pond will have to be evaluated by Lockwood Greene Architects and Engineers.

It may be necessary to build the embankment to an elevation higher than the final design elevation to accommodate anticipated settlement and maintain the desired freeboard. A 6 and 12 inch increase in crest elevation is recommended for the west embankment and the north, east, and south embankments, respectively. The influence of this settlement on liner performance also needs to be considered by the liner vendor.

The soils have a low coefficient of consolidation,  $c_v$ , despite the fact that they are somewhat overconsolidated. Values of  $c_v$  in the reloading portion of the consolidation test were 0.5 to 4 x  $10^{-3}$  cm<sup>2</sup>/sec. We estimate that 4 to 8 months would be required for realization of the estimated settlements. This estimate allows for the presence of sand seams and, considering our experience, that the rate of field consolidation is generally more rapid than that indicated by consolidation test results.

#### 3.7.3.7 Pump Structure

The pump structure is a relatively rigid concrete box. This structure will move as the embankment deforms to accommodate foundation settlement due to the embankment loading or foundation settlement associated with the pond loading of water and/or ash.

Reduction of pump structure settlement by pile support could result in development of a void (seepage path) beneath the structure as the embankment settles away from the pump structure. In addition, differential settlement between the embankment and the pump structure could also result in rupture of the impervious seal around the structure. Consequently, we recommend that the pump structure not be pile supported.

804090 Page 3 - 48

We understand from Mr. R. Rohr of Lockwood Greene Architects and Engineers that the pump structure itself is not particularly sensitive to settlement. The main areas of concern are: 1) the connection between the pumps and the piping distribution network, and 2) differential settlements between the crest and the toe of the embankment which could cause tilting of the pump structure.

Two sequences for construction of the pump structure can be considered for minimizing the settlement of the pump house associated with the embankment loading:

- 1. Construct the embankment, allow it to settle, excavate and construct the pump house, and backfill. Settlement of the pump structure is minimized with this sequence but double handling of the material is required. In addition, adequate compaction of the backfill will be difficult to achieve unless the excavation is wide enough to accommodate proper compaction equipment. The time required for settlement could be reduced by placing a surcharge in the pump area to accelerate the rate of settlement.
- 2. Construct the pump structure, build up the embankment around the structure, and delay hook-up of piping connections until sufficient settlement has occurred so that remaining settlement is considered to be acceptable. With this sequence it will probably be easier to achieve adequate compaction. However, the presence of the pump structure will hamper the contractor's progress somewhat. The ability of the concrete structure to tolerate the estimated settlements would have to be evaluated.

In either case the pump structure will experience deformation during pond filling. Furthermore, the contact between the embankment and the structure represents a potential seepage path. We recommend that two concrete seepage collars be constructed around the walls and floor of each structure. Each collar should extend out a minimum of two feet from the structure and should be enclosed in a layer of bentonite a minimum of 6 inches thick on each face of the collar. The bentonite layer is intended to provide a compliant layer which will accommodate the expected movement of the structure.

#### 3.7.3.8 Embankment Stability

Our analyses of embankment stability was made using undrained shear strengths and calculated using drained shear strengths with steady state seepage conditions. Undrained shear strenghs used for the natural soils were based on results of laboratory torvane and triaxial tests. The strength of the compacted clay embankment was estimated from consolidated undrained triaxial tests. The profile analyzed, and the strengths used for each soil layer are shown on Figure 3-12. The strengths chosen were lower than those recommended for design in Section 1.7 and represent the lowest strengths reported for other areas of the site. The results of the initial analyses assuming the worst conditions indicated that additional analyses were unnecessary.

The analyses described above assume no seepage through the embankment. A drained analysis assuming steady state seepage was also performed as a check. A steady state seepage condition may develop if a leak in the pond lining occurs.

The results of both analyses are summarried below:

Reight of <u>Pabankment</u> , Ft	Calculated Pactor of Safety	Type of Analysis		
19 (5 ft of excavation in		undrained		
pond interior	2.24	strength		
24  no excavation in pond		undrained		
interior)	1.6B	strength		
24	2.45	drained strength with seepage		

#### 3.8 LIMITATIONS

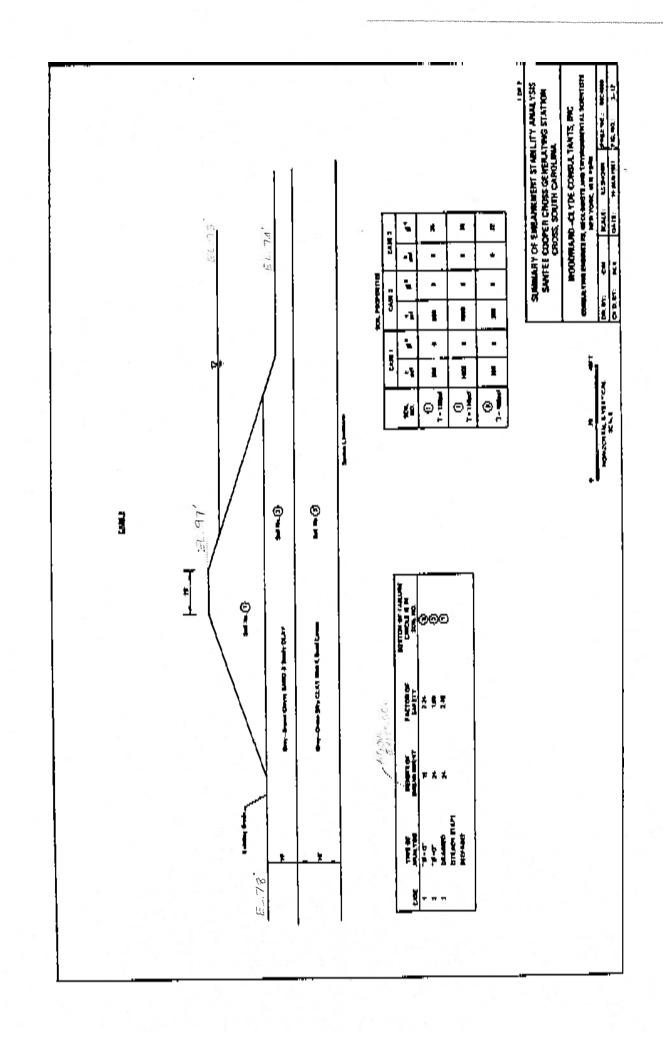
The analyses and foundation recommendations presented herein are based on our understanding of soil stratigraphy determined from the subsurface investigation program and on our evaluation of engineering properties based on laboratory and field data. Our knowledge of soil stratigraphy and engineering properties is imperfect, yet our analyses and the development of foundation recommendations must proceed based on limited data.

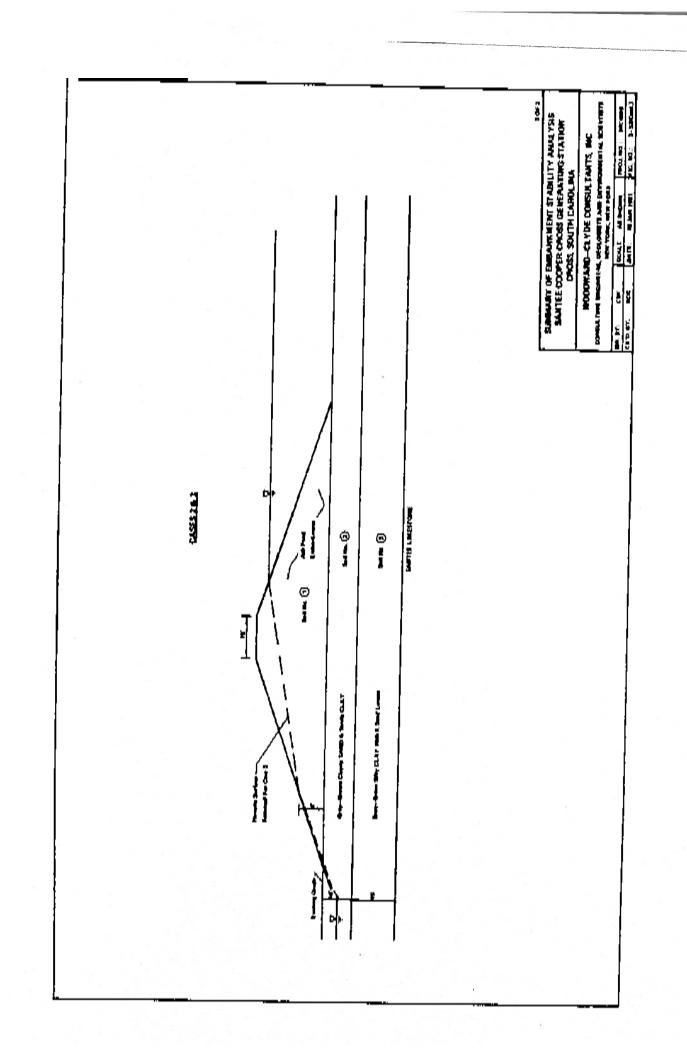
The uncertainty associated with the ability of caissons or other foundation elements to carry the imposed load is generally accounted for by the selection of prudent values of ultimate bearing and side friction and selection of a suitable factor of safety. Our predictions of expected movements for structure foundations and embankments are intended to provide a range of likely values (± 1 standard deviation) of foundation movement. Consequently, movements greater than or less than those indicated are possible.

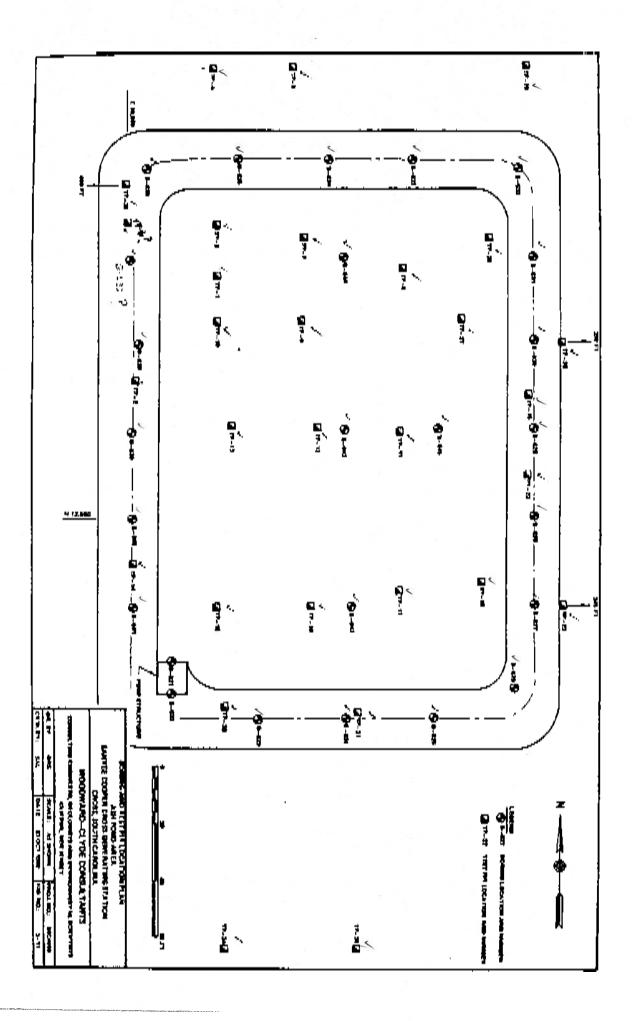
80C4090

Page 3 - 51

The analyses, opinions, and recommendations contained herein are based on the subsurface conditions exposed by the current subsurface investigation program and our understanding of the proposed construction. If conditions different from those described herein are encountered during construction, we would recommend re-evaluation of these findings in view of the changed conditions.







BORING LOGS

# WOODWARD-CLYDE CONSULTANTS CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

	roc 01	BÓRI	NG		B-62	<u>1</u>	_				EHEET	1_ OF _3	_
SANTEE COOPER CENEDATION	- er	T1011				_	ELEVA	TION A	AO OM	TUM	PROJECT NO	<u> </u>	7
SANTEE COOPER GENERATING STATION, UNIT 1				77.86 ft MSL				<b>80</b> C408					
ARDAMAN AND ASSOCIATES				FOREMAN J. Jones			14 July 1980				DATE FINISH 15 Jul	y 1980	
CME-55 Hydro Rotary						COMPLETION DEFTH ROCK BEPTH 66.5 ft 25.7 ft							
SIZE AND TYPE OF BIT	Size A	NO T	TPE COL	IC BAR	REL		NO SAM	PLEST	oist 1	7	UNDIST 1	Ç086	Ⅎ
ASING 4" "Flush Joint"	1	ם" או	ouble	Tube	" св		WATER		HS.	_ 1	COMPT	740 P EL	┪
SAMPLER Z-IN O.D. SPLIT SPOON			DROP		_		BORING	VERT	ICAL	OIAE	CTION		,
	40 LB	<u> </u>	DROP	30 -	-IN		INBFEC	TOP	м	. G	lordano		٦
		Ε.	_	AMPL			MOCK	COAL	,				┪
DESCRIPTION	ELEV.	UEPTH.	TYPE NO. LOC	RECOV.	PENETA RESIST BLJGIN,	CORE NO.	HECOV.	ROD	CORP TIME MIN/FT.		REMARI	KS	
Dk gray to lt gray f-SAND loose (dry)	1	Ŀ,,	<u>1</u> -2	0.1	2 6								٦
(2.0 ft)	75.8	ŀ	<u> </u>	<del> </del>	<u>-ā</u>	i		-	{				ſ
Gray & yellow brn f-sandy		<b>├</b> ² .	1						[				1
CLAY w/occ. lenses of	1	[ <sub>3</sub> .		m	3								ľ
silty f-sand.firm (moist)		-	<b>S-</b> 2	<del> </del>	3 2								١
+ ~ gray CLAY w/lenses of		<b>├</b> ⁴ ⁻	<del>1 -</del>										1
brn/tan sandy clay,			1	<u> </u>			]						1
Lizm (moist)	1 1	L " .		2	3		1 !						ı
•		- 6 -	တ်		, 2 3								ı
•	Į (	<u> </u>	<b>f</b> —		<u> </u>		]						I
Lt brownish gray CLAY w/	1	ļ ´,	<b>!</b> —	<b>_</b>									ı
lenses of silty f-sand,	li	- • -	Ş-Ş	٠.	2 2		[						ı
firm (moist)	1 1	١.	ψ	1	2		l						ı
Gray & brn(mottled)CLAY		_ <b></b>		ļ <u>.</u>			!		- 1				I
w/lenses of lt gray silty	lł	— 10 <del>-</del>	$\vdash$		1		i !		ŀ				Ì
f-sand,loose (moist)	li		S-5	5	3				1				ı
-	ן ו	_ '' _	<i>V</i> 2		2			- 1	- I				l
Γ	ŀ	<b>- 12</b> -			- 1			}					1
	ŀ				I				ŀ				
•		- 13 -		=[					1				l
- 1.0°.	-	14			ſ		'		- 1				ı
Dk gray CLAY w/lenses	i t	1		l				- 1	4				l
(16.2 ft)	•	֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֓֡֓֓֓֡֡֡֡			1								ŀ
	61.7	- 16 -	9-S	1,5	2 6	i							l
	61.1	4	<b>-</b> "			- 1							l
(16.8 ft) (16.8 ft)	1	. '' ]				j		- 1					1
plastic,soft(moist)	┟	- 18 -	GD-1	v)	높								
***************************************	ŀ		5	7	PUSH	- 1			Í				
- Dk gray CLAY w/frequent	t	**-										= =	
y, <b>y</b>	1	20	5-/	4.5(	1	- 1	ı	vI					

	1	LOG OF	BORIN	e	B-6:	21	_			SHEET Z OF 3
	1	FT		AMPL				CORE		
DESCRIPTION	ELEV. FT.	DEPTH,	TYPE NO. LOC	RECOV. FT.	PENETR RESIST BL/GIN.	CORE NO.	AECOV.	ROD	CORE TIME WINJET.	PEMARKS
scams of it gray silty f. SAND, soft. (moist)		- zı -	8-7	1.5	2			<u> </u>		<del>" .</del>
• •		- 22 <b>-</b>								=
		- 23  - 24				=				_
Top 2":Dk gray f-c sandy -CLAY.gome 1t gray limeston rock fragments.tr silt (we (25.7 ft)	) 52.2	- 25 -			1 31				=	14 July 1980 15 July 1980
Bottom 4":Lt gray f-c cal- careous clayey 5AND, same limestone rock fragments,	J-15.	— 26 — -	-S		43					
tr silt,v.dense,(wet) (decomposed rock)		- 1 - 28 -								
. t gray clayey calcareous		29-								
-SAND, some coarse sand tr limestone rock frag- monts, v.dense (moist)		- 310 - 31	8-8	1.5	30 32 41					Bottom 1": hard
(decomposed rock)		- 322 -					Ì			
		- 33 - - 34 -				Ì				
Lt gray silty,calcareous f-c 5AND,some limestone		- 38			42			2		
rock fragments, tr clay, v. dense, (decomposed rock) (moist to wet)		- * -	S-1	1.1	41 51 54					
Lt gray silty calcareous f-c SAND,some limestone		- 37 <b>-  </b> - 38 -	<u>3-11</u>	U. I	<u>Teoze</u>				- 1	
rock fragments, tr clay, v. dense (decomposed rock)		- 39 -					4			
(wet)		- 40 <del> </del>	S-12	2	41					
Lt gray silty calcareous f-SAND, some limestone rock fragments, tr clay, v. densc,	= =	-41-	٧.	ī.	63 52					
decomposed rock) (wet to woist)		- 42 - 1 - 43 -					-			
									ı	

B-621 БИЕЕТ <u>3</u> ОF <u>3</u> LOG OF BORING \_\_ ROCK CORE PENETA RESIST OCIGIN. DEPTH CORE TIME MEN/F1 CORE NO. TYPE NO. 1 RÉMARKS DESCRIPTION 55 Lt gray clayey f-m SAND & 53 limestone rock fragments 48 103 tr c-sand,tr \$ilt, v.dense, (decomposed rock) (wet) 47 49 Lt gray clayey f-m SAND, 60 some silt, tr limestone 26 rock fragments, c-sand.v. 61 34 dense (decomposed rock) (wet) 52 63 64 55 st gray clayey f-c SAND, some wilt, tr limestone 34 66 53 rock fragments, v. dense, (decomposed rock) (wet) 67 68 59. 17.9 60 SAND, Dk grayish green 32 some silt, v.dense (wet) 43 47 62 -63 Dk grayishgreen f-m silty A hard lense found SAND, some clay, tr shell\*, from approx. 64.8 ft 21 to 65.0 ft dense (wet) 26 Boring terminated at 66.5°

MOJECT AND LOCATION	106 0	F BOAT	NG		-622		_			\$HEET OF _
SANTEE COOPER GENERATIA	IĞ STA	TION	UNIT	7			CLEVA	TION /	AND D	ATUM PROJECT NO.
PRILLING AGENCY			FORE					03 ft		,
ARDAMAN AND ASSOCIATES				J. J	0 to 40 to			START		DATE FINISHED
MILLING EQUIPMENT				V. V	ones		15	JUL)	/ 198	
CME-55 Hydro Rotary							56	-1 ft	₽₽₽₹} E	POCK DEPTH
ZE 329 /8 PEPEPEPE	E(ZE A	AND YY	FE CO	RE BAR	MEL -		NO BAI			
ASING			ouble						FIRST_	20.0 £
ASING HAMMER WEIGHT			DROP	- 444		_	WATER EVEL BORING	S ANG	E AAI	OTHECTION 28MA F
AMPLER Z-IN O.D. SPLIT SPOOM	<del>,</del>		1-11-41					VERT	ICAL	UMECTION
AMPLEA HAMMER WEIGHT	140 LB	15	DROP	30 -	-IN	_	INSPEC	TOR		M. Giordano
5 - 5 - 5 - 5	1	F.		AMPL			MOCK	CORE		
DESCRIPTION	- L	¥	8	8	E = z				T _	Ī
	ELEV	DEPTH	TYPE NO. LOC	187	PERETA RESIST BL/61N.	CORC MO.	Š	_ □	# # # #	REMARKS
	_	□	1 5 3	₩.	7.5.2	Ωž	₩,	₫ <b>₽</b>	CORF	i
Top 6":Dk brn f-5AND, some	.J	ļ.,	1	$\top$	1	$\vdash$	<del>                                     </del>	_	+	<del> </del>
Veg. roots (dry)		١,-	S-1	ļ <del>.</del>	10				1	
Bottom: Lt brn-gray t-5ANt gome = 11t, tr xeg; m.dense (dry)	<b>?</b> 【	Ι,	s	<del>  -</del>	.10	!				
		<b>-</b> 2 −		.		Ì	1	1	1	
Dk gray & yell.brn(mottle CLAY,some silt,tr f.sand,	(a)	⊦ .	<b>-</b>	ļ	-		1		] ;	1
-LA:,some slit,tr f.sand, firm (dry)	1	<b>├ ३</b> -	Ņ	10	3					
rrem (dry)		-	ς,		3					
	1 1	- 4		<del></del> -	4 .				1	
k & lt gray & yellowish	1 1	┞╶┪	ŀ							
orn (mottled) silty CLAY,	1 1	<b>–</b> 5 –								
some fine sand, firm (moist	4 I	-	7	5.	2		] ]			
Pring Bend, Intilligiouse	1 1	<b>⊢</b> • →	Ş	-	3					
	1		_		3		[			
	70.5	<b>-</b> 7 -								
Lt gray to It yellow brn	<del>1′``</del>		== = ,	] [	1					
ilty CLAY, clayey SILT,	1 1	a -	•	<del> </del>	2					
some f-sand, tr roots, firm	j t	• •	S	-	3			ı		
(moist)	1 f	- 9 <b>-</b>			Ť			ļ	j	T# ##444 ===============================
	j k	• •			1			1	J	Lt gray return at approx. 9.5 ft
t gray clay	ı f	- 10 -			2				j	PPPION. 9.3 IC
4	i t		S-5	7	2				1	
t gray to tan silty CLAX	, t	-117	S	~~	3	ļ		Į	1	
clayey SILT, some f-sand		· †						1	- 1	
irm.(moist)		-12-	1						J	
	<u> </u>	1	J	- [	- [	- 1	1		1	
	64.5	-13 🕇			J	J			J	
	ightharpoonup	_, 1	-		ľ	i		]		
	-   <b> </b>	-''-'j	1		I	]	J	[1	J	
		1	إ		ľ					
k gray CLAY, tr silt, f-		"丁	·	<u>., , , , , , , , , , , , , , , , , , , </u>	2				- )	
and,plastic (moist)	' <b>[</b>	]	\$ 6	1.5	2					
	F	16 7			4	- {		1	- 1	
	Ĺ	17.		"					1	
		·-]		ĺ				- 1		
	L	٦, ٦			ı			- }		
	L	"】		1						
	L	Let			ı					
	Ľ	7				ł			1	
	1	***		- 1				- 1		

	'	.00 OF	BORIN	VÇ	<u>B−6</u>	<u>2</u> 2	_			SHEET OF3
DESCRIPTION	EV.	DZPTH, FT.	TYPE NO. LOC	RECOV. WY	PENETA M RESIST BURIN.	Щ.	_	K CORE	F	BEMAA
Dk gray & yellowish brn - silty CLAY, some f-sand,	ELEV. FT.	420	S-7 177	1.5 REC	00	COME NO.	MECOV.	윤	CORE TIME WIN/F	REMARKS
v.soft	=	- 22 -			2					
(24.0 ft)	54.0	- 23								
Lt gray silty, calcareous f.SAND, some clay, limestone rock fragments (decomposed rock) (moist)		25 26 27	8-8	1.2	2 1 1		77.1		=	WATER LOST BET. 24.0 ft & 27.5 ft
		- 28 - - 28 - - 20 -						!		
f-SAND, some limestone rock fragments, tr silt (moist) v.dense (decomposed rock)		- 30 - 31	6-8	1.0	19 21 29					
Lt gray & black clayey fine calcareous SAND, some lime- stone rock fragments, tr silt, v.dense (moist) (decomposed rock)		-34 -		-	= :					
(36.1 ft) 4	11.9	36 -	8-10	<u>.</u> 2	2B 3A		.: 10			Driving casing to 36.0 ft Changed to coring at
Gray, deeply to mod.weath- ered fossiliferous LIME- STONE, closely to intense- ly fractured.		37 -				Run-1	1004	728	1.0	16 July 1980
Gray,dccply weathered fonsiliferous LIMESTONE, mod.to closely fractured,	ŀ	40-		_	-		1			
locally crushed.		43 -				Run-2	1001	499	8/5 ft= 1.6	

		LOG OF	BDRIN	c	B-62	22	_			SHEET .	3 OF 3
		Ħ,		AMPLI			ROCK	CORE	<del>,</del>		
DESCRIPTION	ELEV. FT.	DEPTH	TYPE NO. LOC	RECOV. FT.	PENETA Resist Bujein.	CORE NO.	ACO38	1900	CDRE TIME MINJET.		REMARKS
- Gray deeply weathered fos-		- 46 -				R-2	1001	99			
siliferous LIMESTONE, mod. to closely fractured. locally intensely fractured		47 -				27					•
		48		-		Run-3	981	\$41	9.0		
		- 49 - - - 50 -	£ <sup>7</sup>			æ.					÷
.Gray-lt gray deeply weath-		- 51-									
ored to locally decomposed fossiliferous LIMESTONE		52 -	İ								
mod fractured to slightly locally intensely fractured	=	53 54				Run-4	1001	781	0.B		
		- 55					ĺ				
Boring terminated at 56.1	_	56	_				$\dashv$	25	-		
		- 57 -	ļ	-,	į				-		
		- 58 - - 59						=			
		 -60 -				İ			ĺ		
		-0,-					0		- {		
	ŀ	- 62 - 63		₹							
		64			3						
		- 65 -		j	-	7					
		-66 <del> </del>									
	Ė	67 -						100 0			
	F										
	ŀ	.70 ·									

•	.OG OF	BORN	NG	_	B-623	3	_				SHEET OF _	3
PROJECT AND LOCATION		_					ELEVA	TION A	ND DA	TUM	PROJECT NO	
SANTEE COOPER GENERATING	STAT	TION,	UNIT 1	)				66 ft			B0C4090C01	
ARDAMAN AND ASSOCIATES			FOREN					START			OATE FINISHED	_
ONILLING TOURMENT				)- Ga	ndy				y 198		16 July 1980	
CME-55 Hydro Rotary							COMPL		DEPTH	<u> </u>	HOCK DIPTH	_
Size AND TYPE OF BIT	SIZE A	NÖ TV	FE COP	LE AA	r iir A i		NO SAF	55.0			28.0 ft	
CASING 3" "Flush Joint"									FIRST_		UND/5T Z 20.0 (	C±
CASING HAMMER WEIGHT	N	,Do	DROP	Tube	" СВ		WATER	- A900			COMPL 24HP 1	E+
SAMPLER 2-IN O.D. SPLIT SPOON								VERT	ICAL			
SAMPLER HAMMER WEIGHT 1	40 LB	5	DROP	30 -	-IN		INSPEC	YOR		M.	Giordano	
•		F	- 3	AMP.		$\blacksquare$	MOCK	CORE				
DESCRIPTION	<u>خ</u> ا	Ĭ	_ Z	₹	# 5 ±	ت ا	ķ	1	<u> </u>			
÷	ELEY.	DEPTH	TYPE NO. LOC	RECOV. FT	PEMETA RESIST BL/GIN.	CORC NO.	#ECOV.	1 gg	CORF TIME MINUF		REMARKS	
	<del> </del>					D Z	a x	-	ÜΈΣ	<u> </u>		
Dk brn, silty f-SAND, tr		ł	٠,,	9.	3		ł		1			
-clay,veg.,decomposed,wood	[	<b>-</b> ' -	Ś		3	1						- 1
	1				<u> </u>	1		ĺ				
(2.5 ft)	75.2	[ " ]	1					ļ				ľ
Dk gray brn to yellowish/		- a -	١	1	3		i					1
tannish brn (mottled), f-		┡╶	S-2	1.5	4	[		i				
sandy CLAY, some silt, *tiff.	1 1	- 4 -	<u> </u>	<del> </del>	5	l	}					ı
(dry)		-	ł				Ì					_ ]
Lan to it brn & yellow brn		<b>–</b> 5 –	╌	$\vdash$	7							- 1
I (mottled) f.sandy CLAY 6		•	7	ι.	8							- [
clayey f-SAND, some silt,		- * -		1	8	l						- 1
v.stiff (dry)		[,]			1			İ	f			ı
<b>-</b>		, ,								F	requent seams o	£
-Lt grayish brn & lt brn		- 8	5-4	ις.	2		Ι.			ъ	rown silt in 5-	4 ]
silty CLAY, some f. sand,			κ'n	7	3 4			8	1			- 1
tr. decomposed wood, firm			_		3		Ħ					ı
(moist)	1	- 1	Ϋ́	47	3							- 1
-Lt greenish gray & lt brn +f.sandy CLAY, some silt,		- 10 -	-S	<b>–</b>	4							
firm (moist)	ľ	]					1 1					ŀ
-Lt green gray & lt brn CLA	. [	_"']					.		1			- 1
some f.s.tr silt (moist)		_ 12 <b>_</b>										
Bottom 12":Lt graen gray 6	55,2		9	e i	1							
It brn CLAY, freq. f. sand	ŀ	- 1a -	9-S	3.	7							
seams,occ.c-sand, seams,	ł				<u> </u>							- 1
stiff (moist)	ı h	-14-	_		`. I			i	- 1			
Top: As above	1	· •	UD-1	2.5	PUSR							1
Bottom: Dk gray CLAY, some	l	- 18 -	Ď	٠,	<u>~</u>			-				
f-sand seams (moist)		- 10 -		!					- 1			- 1
*Dh. genon-geny GTAY 54	Ţ	. '' -	7	2	1				1			1
Dk green-gray CLAY, highly		- 17 -	-5	: I	2 2							
. 18616	- F	┫		-		- 1			- 1			
	ŀ	- 18 -	2		_ I			-	ŀ			-
As above	ŀ	· -	ė	κi	PUSH	i		İ				
Ī	- t	- 10 -	5	~	4	J						
<del>-</del>	- t	· 1	- 1	i i	1			J	ı.			-1

_			L <b>O</b> G OF	BORIN	a	B-6	23				\$HEET OF 3
Ī			E		<b>≜</b> MP <u>L</u> I			ROCK	COME		
	DESCRIPTION	ELEV. FT.	DEPTH.	TYPE NO. LOC	RECOV. FT.	PENETA RESIST BL/614.	CORE NO.	FIECOV.	ROD	CORE THE MINJET.	REMARKS
	(22.5 ft)	55.2	21			-		=	,		
<del> </del>	Dk greenish gray clayey silty f-c SAND, some shell; tr f. gravel (moist)	40.7	- 25 -	8-5	1.5	0 1 2 _		В			
<u> </u>	(28.0 ft)  t gray silty f-SAND.some	49.7	- 26 - - 29 - - 30 -		-						
- - - - - -	clay,tr fossiliferous LIME STONE fragments,v.dense (mpist) -		- ; - 31 - - 22 - - 32 -	5-9	1.3	15 22 40	:			10.	
† •		42.7	33 34 35			50/0			•	5.ft	Refusal at 35.0 ft
1	Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, mod. to closely fractured, occ. sm. vugs.		- 36 - - 37				Run-1	924	728	6 min/2.5	Changed to coring at 35.0 ft  Lt gray return bet. 35.0 ft and 37.5 ft
	Lt gray, mod. to deeply weathered fossiliferous LIMESTONE mod. to closely fractured, occ. sm. vugs.		- 39 - - 39 - - 40 -				Run-2		80¢	1.4	
+	•	= =	- 41 - - 42 -	= - - -			Rut	1001	38	1.	
‡	Lt gray deeply weathered to locally decomposed fos- siliferous LIMESTONE, mod. to closely fractured.		- 43 - 44 - 45			*: :::::::::::::::::::::::::::::::::::	Run-3	1004	624	1.8	

		.00 OF	BORIN	c	B-6	<u> </u>	_			SHEET OF
1		Ħ,		AMPLE		-	1	CORE		8."
DESCRIPTION	ELEV. FT.	БЕРТИ, FT	TYPE NO. LOC	RECOV. FT.	PENETR RESIST BL/6IN.	CORE NO.	RECOV.	Aco	CORE TIME MIN/F1	RÉMARKS
† <u>†</u>		- 46 - - 47 -		_		Run-3	100\$	621	1.8	
Lt gray to gray, deeply weathered to decomposed fossiliferous LIMESTONE, closely to mod.fractured, locally crushed	8	-48 -49 -50 -51				Run-4	\$06	448	1.0	
Lt gray, decomposed to deeply weathered fossili-ferous LIMESTONE, mod. to closely fractured.		- 53 - - 54 -				Run-5	.5/25=100	.1/2.5=44	1.0	
Boring terminated @ 55.0		- 56 57 67 67 67 67								
<u> </u>		- <b>69</b>	===							

	FOG OI	- BORI	NG	В-	<u>-624</u>	_	_			5HEET OF3
SANTEE COOPER GENERATING	G STA	TION,	י דואט				ELEYÁ	73 ft	ND DA	10M PROJECT NO. 80C4090C01
ARDAMAN AND ASSOCIATES	74	_	¢oa€k D	AAN . Ga:	ndy		DATE 8	TARTE July	1980	18 July 1980
CME-55 Hydro Rotary								5 £t		AOCK DEPTH
ASING 3" "Flush Joint"	4		ble T				NO SAN WATER LEVEL		FIRST -	
SAMPLER Z-IN O.D. SPLIT SPOON			DROP				BORING		E AND	DIRECTION
	140 LB	s	DROF	30 -	-IN		INSPEC	TON		ordano
DESCRIPTION	ELEV FT	DEPTH, FT	TYPE NO. LOC	RECOV.	PENETA <sup>(0)</sup> RESIST EL/61%.	CORE.	RECOV. OO		CORE FIME MIN/FT.	REMARKS
Dk gray brown silty f.SAN tr veg,v.loose (Dry) 1.0' Rott:gray & yellow brn,f. sandy CLAY, some silt,tr. veg,firm (Dry)	76.7	<del>                                      </del>	S-1	1.5	0			_		
Gray & yellow brown, f. sandy CLAY, some silt, tr. veg., wood firm (Dry)		3 -	S-2	1.4	3 4 4					v & -
Gray & light grayish brn (mottled)f.sandy CLAY, some Veg.,roots,wood (Dry stiff	).	- 6 - - 6 - - 7 -	S-3	1,5	6 7					
Light gray & light tannish brown silty, f, sandy CLAY tr wood, firm. (Moist)			S-4	1.4	3 4					
Light gray & tannish brown - (mottled)f.sandy CLAY, some - silt,firm (Dry-Moist)		11 -	5-5	1.5	3 2 3					
Lt gray & tannish brn.f. sandy CLAY, some silt (Moist) (15.5 ft)	62,2	- 13 - - 14 - - 16 -		_	ī					
Dark greenish gray CLAY Some f.sand seams, soft, (Moist)		- 16 - - 17 -	9-8		1	j				
Thank greenish gray CLAY, some f.sand seams		- 18 - - 19 -	UD-1	2.5	PUSH					
<u> </u>	ŧ	26	+	$\rightarrow$		T <sub>1</sub>		i	-	

	L	og of	BORING		B-624	_				SHEEY _ 2 _ OF _ 3
DESCRIPTION	ELEV. FT.	DEPTH, FT.	TYPE NO. LOC	HECOV.	PENETR <sup>di</sup> Resist Bljein.	COME NO.		RQD GDR	CORE TEME MIN/FT.	REMARKS
(25.0 ft) /Light gray,silty,cal- /careous f.SAND,some lime-		- 21 - - 22 - - 23 - - 24 -								#
careous f.SAND, some lime- stone rock fragments, tr- clay, shells, v.dense (Moist)		- 26 -  - 26 -	S-7	1.0	β2 50/1°					Changed to coring at 26.0 ft
Light gray deeply weath- ered to decomposed foss- LIMESTONE, closely fractured to crushed		- 27 - - 28 -				Run-1	188	151	1.4	
‡	l	29-								
Light gray deeply weath- ered to decomposed foss LIMESTONE massive, locally crushed		- 30 - 31 - 32 33 34 36				Run-2	914	469	1.3	
Light gray mod. to deeply weathered foss. LIMESTONE, occ.small vugs, mod. to closely fractured.		36 37				Run-3	196	841	3,6	
Light gray, decomposed to deeply weathered foss. LIMESTONE, closely fractived to crushed.		40-				Run-4				
<u>‡</u>		- 43* - 44* - 45				Run	196	404	80	

			LOG OF	BORIN	a	<u>B-62</u>	4	_			SHEET	O	F3
			FT.	- T	AMPLE		Ш		CORE				
	DESCRIPTION	ELEV. FT.	ОЕГТН,	TYPE NO. LOC	RECOV. FT.	PENETA RESIGT BL/BIN.	CORE NO.	RECOV.	ROO	CORE TIME MIN/FT.		REMARKS	
	Light gray decomposed to deeply weathered foss.LIME-			-	-				10			<del></del>	
٦	STONE closely fractured,		48				R-5	671	0	1			
_	Boring terminated at 46.5'		47 -									•••	
-			<b>-48</b> -			п	Ì	ļ					
			_40 -				94						
	-		- 50 <b>~</b>										
4	-	П	-51-							ŀ			
325		н П	82 -				(9			Ì			
7	_	=	- 53				i						
+	•		- 64				ĺ	ŀ					
7			- 55 -	'						H			
4			- 1 -86 -	=				-					Ì
1	-		- <del>-</del> -	ĺ									
-	:	15					ļ	-					
1								ſ					
+			- 1						]	ı			ľ
$\frac{1}{2}$	-			Ì									
7			-57			- 1				- 1			
#		Ì	- 62 -										İ
7		-	-63 -			- 1							
‡		- 1	- <b>"</b> -	İ		Ī	ĺ		-	- 1			
‡		ļ	-45 -			1							
‡		ł	<b>™</b> ┤										
+		ŀ	- 07 -			Į							
+		ł		Ì	]								
+		F	- 69 <b>-</b>					=					
t		t	70 1										

Ļ	0G OF	BORIN	Ç	B-6	25					\$HEET _ 1 _ OF _ 3
SANTEE COOPER GENERATING	STAT	ION, U	NIT 1			•		ION A		TUM PROJECT NO. 80C4090C01
ARDAMAN AND ASSOCIATES			OREM				DATE \$	TARTE	_	18 July 1980
CME-55 Hydro Rotary				. Jo	1100		COMPLE	TION		ROCK DEPTH
							51-5 <u>Wae on</u>			26.5 ft
CABING 3" "Flush Joint"		NO TYP Double		•			WATEH LEVEL		777 9	-   20.0 IE
CASING HAMMER WEIGHT	14/4		DADP	· •			BOM: 40	VERT	CAL	DIRECTION 5 A
SAMPLER 2-IN O.D. SPLIT SPOON SAMPLER HAMMER WEIGHT 14	O LBS	e le	DROP	30 -	-IN	_	INSPEC			Giordano
	3	1	5.	AMPLE	ş		ĕOCK.	COBE		·
DESCRIPTION	ELEV. FT.	ОЕРТН,	TYPE MO. LOC	RECOV. FT	PENETA Resist Bugin.	CORC NO.	RECOV.	Rob	CORF THAE MIN/FT.	REMARKS
Light gray-brown to dark			s-1	٦.	2 5					
gray silty SAND, tr. veg. - loose (2.0 ft)	76.0	[ ' ]	c)i	F.	4					
I		- 2 -						Ì		
Grayish & yellowish brown (mottled) CLAY, some f-sard		- 3 -	S-2	1.0	41 51					
lenses, tr.silt, veg.,		- 4 -		· · ·	6					
stiff (Dry)										
		_ 6 -	ņ	5	3					
brown (mottled), f. sandy		- 6 -	Ġ	4	5	ŀ		İ		
CLAY, tr milt (stiff) (dry)		L , 1								
+		-			2					
Light gray & tannish brn. (mottled), f. sandy CLAY &		<b>-</b> • -]	<b>∳-</b> \$	1.3	3		1			
clayey f.SAND, some silt,		- 9 -	s	1	. 4					
firm (Moist)		- ,,							-	
Tannish brn.f-m sandy,		- "	-5		2		-			
silty CLAY, firm (Moist)		-11-	Ş-		4					
Ŧ		12								
+		-				10				
1		- 13 T			=					
+	:	-14-								
	63. O	- 16		<u>.</u> .						
Dark greenish grayish CLAY, some milty f.sand			S-6		1		.			
geams, highly plastic, soft		, ie 1			2				= ="	
I (Moist)	-1	- 17 -								
Dark greenish gray CLAY		- 10 -							5	
tr veg. (Moist)	- c	- <u>-</u> -	uD-1		PUSH					
I		F " <b>"</b> -			32					

	Ł	OG DF	BORING		B-62	5		=		SHEET 2 DF 3
		FT.		AMPLE		_ ,	AOGK I	CORE		
DESCRIPTION	ELEV. FT.	0EP1H,	7.7 PE NO. LOC	RECOV. FT.	PENETRI Resist Blæin.	CORE NO.	MECOV	нар	CORE TIME MIM/F 1	REMARKS
Dark green gray CLAY some f.sand & silt seams,highly plastic,soft (Moist)		_ 21 _	5-3	1.5	2 2					
plastic, soit (Molet)		_ 22	Ā				^			
		23 -			l 					
(25.0 ft)	55.0	24 							= !	-
Dark green-bluish gray clayey, silty f-c SAND, tr rock fragments, soft (Moist)		- 25 - 26 -	8-8	1,4	0					
		27		ļ	<u> </u>					
		_ ze -								_
t gray, silty fine calcare-		- 29 - - - 30 -	_		3I					
us SAND, some foss, limeston rock frags, tr clay, v. dense (Moist) (31.5 ft)	46.5	- 27 -	S-9	1.3	42 70					
		32.	Γ							Changed to coring a 31.5 ft
Light gray deeply weathered to decomposed foss. LIME- STONE, bottom 1.7 ft mod.		33 - - 34 -	•			Run-1	\$86	106	1.0	
weathered, massive locally intensely fractured.		35.	1			_ ₹				
_	ļ	36	<u> </u>	i i		1_		_		
-		37	┨ ゙							
Gray,deeply to mod.weath- Lered foss LIMESTONE,mod.to Lolosely fractured,locally		- 38	]	14		Run-2	36.4	341	1.2	
_closely iractured.locally _crushed.occ.med.vugs, _bottom 3" - decomposed.		F.,40	1			₽	<b>(</b> *)	,		
		ţ.,	1_					<u> </u>		
Light gray decomposed to deeply weathered foss.LIME STONE, closely fractured to	5	42	1			5.5	مر ا		و	
crushed.		ļ.,	1	> -		Run-	300	8	ď	

		8HEET									
	1	FI,		AMPL			Acc.	CORE			
DESCRIPTION	ELEV. FT.	DEPTH, FT	TYPE NO. LOC	RECOV.	PENETA RESIST BUGIN.	CORE NO.	RECOV.	70 B	CORE TIME MINIET.		<b>РЕМАР</b> К∑
1		- 46 -				R-3	301	38		=	
Light gray deeply weathered to decomposed foss. LIME-	- 1 - 20	47					-				
STONE, closely to mod. fractured, locally crushed.		- 48 -  - 49 -			= =	Run-4	40	•			
<u>*</u>		- 50 - 50				Ru	88₽	564			
Boring terminated at 51.5	<u>.</u>	-51 - 52	-		$\dashv$					<u></u> -	<u> </u>
		-63									
+		- 54 -			j						
		- 546 -					ļ		-		
	ŧ	57	13				-				
-		- 50 - 50		İ							
	F	-60						,	v j		
	F	61 -						4.0			
	ŀ	63		21							
		56 -									
	ţ	•• <u> </u>									
	ŀ	57									
	E	 									
	ᆣ	70 <del>-</del>									

	LOG OF	EORIN	ıe —	<u>B</u> -	<u>-626</u>		_				\$HEET		OF <u>3</u>
PHOSECT AND LOCATION			-				ELEVA	TION A	NÓ DA	TUM	PROJECT	NO.	
SANTEE COOPER GENERATING	G STA	ΓίΟΝ, Ι	JNIT 1						MSL			4090C0	1
ARDAMAN AND ASSOCIATES			POREM				OATE S			$\neg$	DATE FI	•	
DRILLING EQUIPMENT			J	. Jes	105				1980			117 19	<b>8</b> 0
CME-55 Hydro Rotary							с <b>ёмг</b> ц. 51.	O Ét	DEPTH	- 1	₩00R DE 26.0		
SIZE AND TYPE OF BIT	SIZE	NO TY	FE COR	E BAH	MEL		NO SAL	PLEST	5)ST .		UNDIST_		<del></del>
CASING 3" Flush Joint	1	Doub.					WATER LEVEL		TRAT		COMPL	<u>-26</u>	0 ft
CASING HAMMER WEIGHT			DROP	<i></i> <u></u>			BORING	ANGL	E AND				
SAMPLER Z-IN O.D. SPLIT SPOON							INSPEC	VERT	ICAL_				
SAMPLER HAMMER WEIGHT	40 LB		DROF	30 -					M. G	ord	ano		
	1	Ē	<del></del>	<u>AMP</u> LE		<del>-</del>	ROCK	COME					
DESCRIPTION	ž	)EPTH,	ي س	Ŕ	TSIS FIST	¥	ğ	_	# w #		AEN	IARKS	
	ELEV. FT.	ä	TYPE NO. 100	RECOV.	PERETA RESIST BL/6IN.	10 π 10 π	RECOV.	908	CORF TIME	l			
Light brown silty SAND, v.	$\mathbf{T}$	t		+ -	1	<b>-</b>	+		+	<del> </del>			
loose (Dry) (1.0)	77.2		-S	1.5	2	1		1		[			
- Light gray & yellowish		ļ ' ī	L"_	1	_3_				1 1				
- brown (mottled) f.sandy	Į.	<b>-</b> ≱ -	ł			l		Į	1 1	ĺ			
+ CLAY	1	. "	_	<del>                                     </del>						ĺ			
•		<b>⊢</b> з -	S-2	→	55					ĺ			
<u>_</u>		L '	ď	-	7					ĺ			
I		<b>[</b> ' ]								!			
	j			<u></u>	1								
ight gray & tannish-yel-	1				4								
+ low brown (mottled) f.		<b>⊢</b> 6 ~	S-3	10	4				1 1				
<ul><li>sandy,silty CLAY,tr.veg.,</li></ul>	!	- 4		-	6		1						
- stiff (Moist)	1	- 7 -											
t		T . 1			3		1 = 1		1				
Light gray & tannish brn	Į I	["]	S-4	1.5	4								1
silty CLAY, some f. sand	1 1	$\square$		<u> </u>	4		1		1				
I seams, firm (Moist)	l i						i i						
-		10-			<u>-</u>				1				
r .	1	- 4	Ϋ́	₹.	2								. !
+ Light gray & tannish brn		-11-	S.	1	3		1		•				- 1
f.sandy CLAY, some Bilt		· 1											- 1
tr veg, firm (Moist)		-12-					-		- 1				1
L		_,,]							1				ľ
-		. ".			ı		:		<b>'</b>				
+		-14-		1			i 1						
+									1				- 1
Light tannish brown silty		<b>– 15</b> –			2		<b> </b>	J	ŀ				8
ine SAND, tr veg.v.loose.		٠٦	9-e	1.0	2			- 1					ı
(Dry)		- 16 -	, va	-i	3								
(17.0 *+)	61.2	17							- 1				ŀ
· management					- 1			ſ					- }
		- 18 -		1 (	- 1		]						
	9-			}	1				* H				
Ť.	l	- 19						j					
The second secon		20 1	2.2		- 1			- 1					- 1

		<b>БНЕЕТ</b> <u>2</u> ОF <u>3</u>								
DESCRIPTION	ELEV. FT.	DEPTH. FT.	TYPE NO. LOC	RECOV. M	PENETA Resist 9 Jein.	CORE NO.		CORC	CORE TIME MINST.	REMARK\$
Dark greenish gray CLAY, occ. f.sand seams, very soft (Moist)		30 7	S-7 NO	1.5 Re	1 1 3 8 1 1	CO	H€	ROD	00 E #	
		- 22 23	=				=			×
Dark greenish gray clayey, m-c SAND, some f. sand, tr. si loose (wet)(26.0 )	52.2	- 24 - - 25 - - 26 -	8-8	r.	1					
Lt gray silty calcareous f. SAND.some clay, tr limestone rock fragments (Decomposed Rock) (wet)		- 27 - - 28 -	S	-	4	_			2	_
Lt gray silty calcareous  ""m SAND, some clay tr lime"  one rock fragments v.  qense (Decomposed Rock)		- 29 - - 30 -	S-5	1.4	80 90					Change to coring at 31.0 ft
(wet) (31.0 ft)  Light gray deeply weathered	47.2	- 32 -							<u>4</u>	
fotsiliferous LIMESTONE, bottom 1.25 ft hard slight- ly to mod. weathered.	1	- 33 - - 34 - - 35 -	п			Run-1	1004	761	3.4	
Light gray deeply weathered		- 35 - - 36 -								
fossiliferous LIMESTONE, top 1.0 ft mod.weathered, massive to locally crushed.		- 37 - - - 38 - - 39 -				Run-2	\$06	928	1.2	
		405		3		Ę,	<u></u>	6	1	
Gray deeply weathered fos- siliferous LIMESTONE close 'y fractured,occ.small vug	1	- 43 -				Run-3	924	\$8£	1.5	
		- 44				Ř	6	ιά	Ţ	

LOG OF BORING \_\_\_ B-626 SHEET \_\_\_\_\_\_ OF \_\_\_\_3 ROCK CORE SAMPLES DEPTH. FT. PENETR RESIST BUGN, TYPE NO. LOC CORE NO. DESCRIPTION REMARKS Light gray decomposed fossiliferous LIMESTONE crushed 10 ő 60 Boring terminated at 51.0 **5**5 67 59 40 62 -

LOG OF BORING \_\_\_\_\_\_ B-627 BHEET \_\_1\_ OF \_\_3\_ MOJECT AND LOCATION ELEVATION AND DATUM PHOJECT NO. SANTEE COOPER GENERATING STATION, UNIT 1 77.94 ft MSL 80C4090C01 DRILLING AGENCY DATE STARTED DATE FINISHED ARDAMAN AND ASSOCIATES J. Jones 17 July 1980 17 July 1980 DEILLING EQUIPMENT COMPLETION DEPTH ADCK DEPTH CME-55 Hydro Rotary 51.5 ft 25.5 ft SIZE AND TYPE OF BUTTE" NO SAMPLES DIST 9 SIZE AND TYPE COME BARREL UNDIST 1 2000 ft CASING NX "Double Tube" CB THET COMPL CASING HAMMER WEIGHT BORING ANGLE AND DIRECTION DROP SAMPLER 2-IN O.D. SPLIT SPOON VERTICAL NSPECTOR SAMPLER HAMMER WEIGHT 140 LBS DROP 30 -IN M. Giordano NOCK COAL PENETA RESIST BL/BIN. RECOV. FT RECOV. DESCRIPTION ELEV. FT. CORF TIME MINJE TYPE NO. L REMARKS COHIC **H**30 Light gray silty SAND, locks  $\overline{1}$ (Dry) (1.0 ft) 76.9 2 Light gray & yellow brown f. sandy CLAY, firm. (Dry) 4 Dark grayish brown & yel-5 low brown f.sandy CLAY, tr 6 wilt, veg. (Dry) Gray to light brown & yel-3 low brown (mottled) f.sandy 5 #1lty CLAY, tr veg. (Moist) 5 7 Light gray & tannish brn, 4 fine sandy, silty CLAY 4 tr.veg (Moist) Light tannish brn silty, 2 clayey f-m SAND, some 2 coarse sand (Wet) 3 12 Dark greenish gray silty 2 CLAY, some lenses of silty 1 \_f.sand (Moist) wek greenish gray CLAY ome silt (Moist) PUSH

·		.00 OF	BORIN	G		SHEET OF3				
	1	FT		AMPLE				CORE		
DESCRIPTION	ELEV. FT.	БЕРТН.	TYPE NO. LOC	RECOV.	PENETA RESIST BL/GIN.	CORE ND.	RECOV.	AGD A	CORE TIME MIN/FT	REMARKS
‡		- <del>2</del> 1	_::							Attempted vane shear test at 20.0 ft and not successful. Pushe
Dk greenish-gray CLAY.some lenses silty f. sand.soft (Moist)		- 22 - -	S-7	1,5	0 1 3					vane 18" and would not fail
Dk greenish gray f. sandy		24 -	-	=						
CLAY (25.5 ft) Light gray clayey calcameous f.SAND,some silt,tr lime-		- 25 - - 26 -	S-B	1.3	1 6 15	= =				
stone rock fragments. (Moist	,	_ 27 _ _ 28 _				Ì		8	<i>3</i>	-
Light gray silty f.SAND, some limestone rock frag- nts,tr.shells,clay,v.	m	- 29 - - 30 -		2	44	-				
Light gray mod.weathered	16.4	- 31 - - - 32 -	2-5	_: I	51 114					Change to coring at 31.5 ft
foss.LIMESTONE, top 1.5 ft deeply weathered to decom- posed		- 33 -		8		7			5 ft	
<u> </u>		- 34 -  - 35 -			= = //2	Run-1	928	944	15 min/5	
Light gray, mod. to deeply		37		-		-				
_weathered foss. LIMESTONE, _occ.small vugs.	ŀ	- 328 -		ĺ		22			ft	
‡		- 39 - - 40 -		e e		Run-2	1001	648	min/5 f	
<del>-</del>	ļ			-	_			- 2	5.5	
Light gray, deeply weathered oss. LIMESTONE. Massive to ,od.fractured.		- 42 - 43				Run-3	1004	68\$	min/5 ft	
<u> </u>		45				Æ	ĭ	- 1	6.5 m	

	- 1	LOG OF	BORIN	Ġ	B-627	,	-			SHEET	<u>:</u>	OF3
	-	FT.	;	AMPL (				CORE				
DESCRIPTION	EL EV. FT.	DEPTH, FT.	TYPE NO. LOC	RECOV.	PENETA RESIST OCJÓIN,	CORE NO.	RECOV.	аов	CORE TIME MIN/FT		REMARI	c\$
Light gray to gray deeply wcathered to locally decom-		46 -				R-3	100%	488				
posed foss.LIMESTONE, massive to mod.fractured, occ.small vugs	-	47		-								
		-40-							5 ft			
		- 49 - 50				Run-4	98₺	94%	min/5			
		- 51 -							₩			
Boring terminated at 51.5'		- 52 -							v.			
		- 63 <u> </u>			¥			1	-			
		- 54 -			=			_				
		- 66 -				=						
		-57-	4					i i		<		
		58-						_				
		59-	=	_		54 2	= =	5				
		60										
		62 -					= =			E .		
		63 -										
	= = "	- 84 -										
		- <b>65</b>						2	1			
		- se										
		- 60 -										

	ı	.∆G QF	BORIA	·G	В-	-628_		_				SHE	ET _	<u> </u>	3
POJECT AND LOCATION								ELEVA	TION A	ND DA	TUM	PROJE	CT NO	<b>5</b> .	
SANTEE COOPER GE	NERATING	3 STAT	TION, I	UNIT 1				1	61 <b>f</b> t					90C01	
TORILLING AGENCY				FOREM	ΔŅ			DATE S	TAATE	D		DATE	FINIS	нев "	
ARDAMAN AND ASSO	DCIATES				D. (	Gandy			Ĵuly					y 1980	Ö
1			**					COMPLI	Etion Oft	DEFTH		₽ŏčκ 2	<b>DEPT</b> 5.0		
CME-55 Hydro Rot	ary	HITE A	ND TV	PE COA	E BAB			NO SAM				L .			
NYE 3 WY KAP TELCONE	W	1								7/51 1 7/65T_	0	COMPL	. 1	¢γg€.	
CASING 3" "Flush Jo1	NEIGHT	N/		uble OAO₽	Tube	CB		POPING						ZaryA	5 ft
SAMPLER 2-IN O.D. SPL				Olio.				1	VERT	ICAL					
		40 LB	S	DROP	30 -	-IN		INSPEC	TÇR		м. (	iord	ano		
		1	FT		AMPLI			POCK	COAt		1				
DESCRIPTION		ELEV. FT	DEPTH	TYPE NO. LOG	RECOV.	PENETA RESIST BL/GIN.	CC RE	RECOV.	ROD	CORF TIME MIN/FT		F	EMAI	RKS	
Li grayish brn,si	îtv f⇒	┿╌	Ë	-	-	2	<del>  •</del>	+	<u> </u>	J. 1	<b>!</b>		-		
_ SAND, tr.veg., v.lo		1	-	17	1.2	3	ł				4 '	west	of.	stake	
_			<b>.</b> ' '	<b>L</b>	[ ]	1 2									
			Ĺ,.			}	1								
	<u>.5</u> ft)	75.1	L * .		ļ	<u> </u>					ı				
Grayish brn & yel		ŀ	- 3 -	77	5	4	1		}		ſ				
brn CLAY, some f-s			┡	8	[	6		_	1		ł				
L silt,vcg,stiff (	Φ£Ã.)	1 '	- 4 -	<del>-</del>	<del> </del>	+	ſ	1							
(	5.0 ft).	72.6	•	1			l								
Lt grayish brn &		1	- 5 -		1	6	1		•						
f-sandy CLAY, some			Ĺ.:	S-3	2	6									
stiff (dry) (7	.5 ft)		Γ".	S	<u> </u>	<u> </u>									
L			7 -			1				:					
'_		1	١,	—	-						i				
	. / - \ \		┝ # -	7	₽.	2		Ì							
Lt gray brn & tan sandy CLAY, some &		1		Ċ	m	3 2									
_ (moist) firm	iit,		- 0 -	┢	+−	-			ļ						
- (MOX26) = 111m			•	1											
F		i i	-10-	S	5	2		1 :	ł						
Lt brn fine sandy	CLAY		[_,,_	ŝ	1	1		i i							
_ w/pockets of m-f		l _	_ '' .		<u> </u>	2		1							
⊥ sand, er lenses of			<b>— 12</b> —	l											
<u>clavev f-sand, sof</u>	t (moist	•	- 1 -	1											
Lt grayish brn &	2.5 ft)	i I	13			3	ŀ								
silty f-SAND, some	lense.	63.2		S-6	47	3									
_ <del>dreen clay tr m-</del> e	and (14.4	( )	- 14 -	Ġ		4									
Greenish gray f-s			- 15 <del>-</del>												
CLAY			_ "° -												
_ Dk green clay, son		4	16-	7	L										
<pre>_ w/silt,highly pla</pre>	istic		-	슼	0.5										-4
•			- 17 -												
		1		_	٠,	1				5					
- Dk green gray CL	Y.tr	-	18 ~	S-7	1.5	ō									
pockets of dark (				"		1									
silty fine sand,			- 19 -		-					. ]					-
plastic.			20	-				J . J		_ 1					

	LOG OF BORING B-628													
	<u> </u>	<b>.</b>		AMPLE				CORE	s					
DESCRIPTION	ELEV. FT.	рертн.	170 JON 1905	RECOV. FT.	PENETR RESIST BL/61M.	CORE NO.	RECOV.	#QD	CORE TIME MINZET.	<b>A</b> ÉMARKS				
Greenish gray CLAY.some silt.tr f-sand,v.soft-soft, (moist),highly plastic		21 —	8-8	1.5	0 0		=			V				
‡ <b>‡</b>		- 23 - 23 - 24 -												
(26.0 ft)  Lt greenish gray silty to SAND-f.sandy silt, some	51.6	- 20 -	8-8	1.4	2 1 5									
clay,tr.limestone rock fragments,shalls,loose(wet- moist)(decomposed rock)		- 27 - - 28 - - 29 -								Driller reports hard material 27.5 ft - 28.5 ft				
Lt greenish gray silty, calcareous f-SAND.some limestone rock fragmonts.		- 30 - - 31 -	S-10	1.5	30 50 50/5'					R S				
tr clay,shells.v.dense (moist) (decomposed rock)(33.5 ft)		- 32 - - 33 -		:		-				Casing to 32.0 ft				
(35.5 <b>f</b> 5)	44.1	- 34 - - 36 -		_	P					Change to coring at 33.5 ft				
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, massive to slightly fractured, freq.		- 36 - - 37 -		<del>-</del>	50/0	Run-1	\$86	\$86	7.5					
medium vugs (%"- 1")  Lt gray, mod. weathered  fossiliferous LIMESTONE,  Bottom 1.9': deeply weath-		38 -		e <sup>2</sup>			=	0.2	3					
fractured, freq. large vugs		40-				Run-2	1004	75\$	3.8	<b>,</b>				
Lt gray, doeply weathered to decomposed fossiliferous LIMESTONE closely to		43-	1		2	3			_	Lost circulation at 43.0 ft				
intensely fractured, occ.		44-				Run-3	196	64.8	-					

	LOG OF BORING													
		ī												
DESCRIPTION	ELEY. FT.	DEPTH,	TYPE NO. LOC	RECOV. FT.	PENETR AESIST BL/61K.	COME NO.	RECOV.	용	CORE TIME MIN/FT		REMAR	KS		
		- 48 - - 47 - 47	1			Run-3	196=0.5/81	3.2/5.0=64%	1,4				=	
Lt gray deeply weathered to decomposed fossilifer- ous LIMESTONE, closely to intensely fractured, freq. tm. vugs( 'i")		- 48 49 50 51 62 -				Run-4	824	20%						
Boring terminated at 53.0'		53 - - - - - - - - - - - - - -				-								
		- 56 - - 57 - - 68 -	1											
		- 59 - - 60 - - 61 -			<b>*</b> =									
		- 62 - 53 - 64												
‡ <u>‡</u>		66												
1		69	1											

<u> </u>	.00	BOHIN	<b>4</b> 0		945					#HEFT OF _3
SANTEE COOPER GENERATING	2 STA	CION I	UBUT 1							TUM PROJECT NO
SHILLING AGENCY	, 01M	TON,	FOREN				DATE 6		ft M	
ARDAMAN AND ASSOCIATES				p. 6.	andv				у 198	PATE FINISHED 0 22 July 1980
SAILLING EQUIPMENT							COMPL			
CME-55 Hydro Rotary								53-5		27.0 ft
HEE AND TYPE OF BIT	SIZEA		PE COP				NO SAA		D181	10 UNDIST 120.0 ft
FASING 3" "Flush Joint"			<u> Роир</u> 1	e Tul	∍¢"¢	В	WATER		FIRST.	COMP: 15748
CASING HAMMER WEIGHT SAMPLER 2-IN Q.D. SPLIT SPOON			DROP				BONING	VERT	CAL	DIMECTION -
	40 LB	ź.	DROP	30 -	-IN		INSPEC			И О:
	1	ĬĘ,		AMPL	5		NOCK	CORE		M. Giordano
- DEPORTURAL	١	Ŧ	<b>"</b> 3	ž.	E to z		نج		J. F	
DESCRIPTION	EL EV. FT.	DEPTH.	TYPE NO. L	RECOV.	PESIST BLJGIN,	COM NO.	я Есоу.	8	CORF TIME MING	REMARKS
		L <u>-</u> _	- ž	E 1	<u> 7 E E</u>	ΰĪ	<u> </u>	č	ŬFΞ	
L Top 7":Dk brn, silty f SA	NP	┞	S-1	₹.	1			''	} _	"•
. some vog,loose (dry)	į.	<b>Ի</b> ነ -	S	-i	3				i .	
T Dk brn silty f-SAND	1	t '	<b>t-</b>	†	<del>                                     </del>	1				
(2.5 ft )	75.1	[		L	}	- 2		Ì		
Dk gray to light grayish		- 3 -		Γ_	3					
brn & yellow brn,f-sandy		<b>Ļ</b> ⁻ ,	S-2	1:5	4					
CLAY, some silt, stiff		- 4	<u> </u>	<del> </del> -	5					
(dry)		┞ -	1					i	!	
<b>f</b>		- s -		6	6.					¥
Lt gray & lt brn (mottled)			ŝ	1 5	50					
f.sandy CLAY, some silt, T stiff (dry)		_ ° _		$L^ $	5		1	ĺ		
T stiff (dry)		- 7 -								-
`	<del> </del>								=	
, Lt gray & tannish to yel-	1	<b>-</b> • -	S-4	ις.	2					
low_brn(mottled),fine	<b>!</b>		S	7	2					
* sandy, \$11ty CLAY, soft (dry	1 1	- ° -			-		l .		1	
T 15		L 10 -								
Lt gray a tan,f-sandy silty CLAY (11.0 ft)	66.1	ַ יי	ķ	Δ,	2					
	00.1	-11-	4	-;	2 2					
Lt greenish gray & tan										
tr.c.sand veg, loose		12-					l . i			_
(moist)	1	٠ ٦					1			
	641	- 13 -								
Lt grayish brn,f-sandy		- 14 -	5-6	.5	2				7.	
SILT, some clay, soft			Ś	1.	$\frac{2}{1}$					
(moist-wet) (15.0 ft)	62.6	— 16 —			1					qu=0.75(pocket pen-
+		- 1	ş-7	۸ž	ī					etrometer)
<ul> <li>Gray CLAY w/frequent</li> <li>pockets of f-sandy silt,</li> </ul>		- 16 -	Ġ	1,	i [					
soft (wet)		_ 17 _					]		= 1	Vane shear test 17.0
!		- 4							,	ft-18.5 ft
		- 10 -	- 1		J					Disturbed:1.09 tsf
t					ŀ				1	Remolded :0.78 tsf
<b>-</b>		19-		1				Ì	ı	Vane shear test 19.0 fr-20.0 ft
		1						5 = 1		Wasterbed: R.93 taf

	L	06 <b>0</b> 7	BORING	<u> </u>	B-62	9				SHEET OF3
<del></del>	- 7	FT.		AMPLE			40CK	CORE		
DESCRIPTION	ELEY. FT.	DEPTH. F	TYPE NO. LOC	9EC0V. FT.	PENETH RESIST BL/GIN.	COXE NO	RECOV.	BOD	CORE TIME MINIET,	REMARKS
		- 21 -								Vane shear 20.5 ft- 21.5 ft Disturbed: 1.25 tsf
Dk gray silty CLAY,some silty f-sand seams (moist) v.soft	- - 	22 -	8-8	1.5	1 1					Remolded : 0.85 tsf qu=0.75 (pocket penetrometer)
(25,0 ft)	\$2.6	24 - 24 -	_				-			
Dk greenish gray clayey f-m SAND, some silty (wet) v.loose (27.0 ft)	50.6	- 26-	S-9	1.5	2 1				2	
	30.0	- 27 - - - 28 -								
		20 - 30 -			25"					
Lt gray clayey, calcareous f-SAND, some limestone rock fragments, tr.silt.v.		- 31 ·	s-1	1.2	45 50					
dense,(decomposed rock) (moist) (33.5 ft)	44.	<b>+</b>		ļ			<u> </u>		-	Change to coring 33.5 ft
Lt gray,slightly weathered locally deeply weathered fossiliferous LIMESTONE	1	-35	1			Run-1	938	883	6.3	
Top 2.0:hard occ.sm.vugs Bottom:glauconitic		36	- - -			~	- 2			
Lt greenish gray,deeply weathered fossiliferous LIMESTONE,freq.sm.vugs,		38	1		u u	1				
locally decomposed glau- conite abundant.		40	ł			Run-2	156	513	1:3	
ŧ .		- 42	1		3"	"				
t greenish gray deeply weathered to decomposed fossiliferous LIMESTONE closely to mod.fractured		- #  - #	,- <del> </del> - 			B. 1	1001	50%	2.2	

	ı	.0G OF			\$HEET	3 0	)F3_				
DESCRIPTION	ELEV. FT.	DEPTH. FT.	 RECOV. 61	PENETR W RESIST BLJGIN,		RECOV. 0	CONT	CORE TIME MINZET.	•	<b>ÉMARKS</b>	
		- 48 - 47			Run-3	100%	50%	1.2	* 1	,	
Lt gray,desply weathered to decomposed LIMESTONE closely fractured,locally crushed		- 49 50 51 52 53 -			Run-4	1004	458	1.1			
Boring terminated at 53.5		- 54 - 65 - 66 - 67									
		- 62 -							a a		
		- 64 - - 65 - - 66 -				v 					
‡		- 69 -				8	75 A				

Lr	OG OF	BORIN	NG	B-	630	_	_			SHEET1_ OF _3
PROJECT AND LOCATION						—		. –	-	TÚM PROJECT NO.
SANTEE COOPER GENERATING	STA								t MSL	1
ARDAMAN AND ASSOCIATES		_ '	FOREM/ ј.	AN . Joi		<b>-</b> ,	DATE 81	STARTE July		DATE FINISHED 21 July 1980
DAILLING EQUIPMENT			<del>-</del>		16.5			-	DEPTH	. 1
CME-55 Hydro Rotary							5	31.5 f	ft	22-0 ft
SIZE AND TXPE OF BIT			PE CON			_	NO SAM	MPCES	0157 10	O UNDIST 1 28AL ft
casing 3" "Flush Joint"	N		ouble	Tube	3" CB		WATER	· •	FIRST	COMPL - 24 0 ft
CASING HAMMER WEIGHT	_		DROP				BONING	S ANGL VERT		DIMECTION
SAMPLER 2-IN O.D. SPLIT SPOON SAMPLER HAMMER WEIGHT 14	40 LBS	-	DROP	30 -			INSPECT		Non-	
SAMPLER HAMMER JITELSON	10		5.4	AMPLE	€5.	_	ASEK	CONE		·-·
DESCRIPTION	ELEV. FT.		TYPE NO LOC			CORE NO.			CORF TIME MIN/FT.	REMARKS
Dk brn,fine SAND,some Veg roots,tr silt,loose (dry)			\$-1	9.7	1 4 4					
- Gray & yellowish-light brn - f sandy,silty CLAY,tr veg - roots, stiff (dry)		2 7	5-2	1.0	3 4 5					
Gray & yellowiwh-lt brn f-sandy CLAY,some silt, stiff,dry		5 - 6 -	S-3	8.0	3 5 6					
Lt gray & tannish brn f- - sandy CLAY & clayey f- - SAND some silt, firm		- ' - - " - - " -	S-4	1.0	3 4 4					
- moist - Lt greenish gray & tan - silty,f-sandy CLAY,tr veg - firm,moist		-11-	\$-5	1.5	2 2 4					
(13.0 ft)	64.2	-12 → -13 -								Driller reports v.soft material 13.0 ft
Dk greenish gray CLAX,		-14- - 15-	-	_						
some fine sand, tr 511t		- 16 ~ - 17 ~ - 17 ~	1-GN	2.5	HISH 1			5	= 1	
Dk greenish gray CLAY w/ frequent f-sand seams, some silt,tr veg.		- 18 - - 19 -	S-6	1.5	2					

	L	OG OF	BORIN	a	B-63	Ō				SHEET OF 3
<u> </u>		Ę.		AMPLE			HOCK			
DESCRIPTION	ELEV. FT.	DEPTH, I	TYPE NO. LOC	RECOV.	PENETR AESIŜT BLJGIN.	CORE NO.	HECOV.	ВОБ	CORE TIME MINJET.	REMARKS
_pk greenish gray silty CLAY _some f-sand pockets,v.soft (moist). (21.5 ft)	55.7	21 —	£-\$	1.5	000					
Gray, clayey silt 6 lt gray f-SAND (22.0)	55.2	_ 22 <i>_</i>	8-8	0.5	0 4					Slight water loss
Lt gray silty calcareous  f-c SAND, some gray silt, tr.	54.7	-23- -								Lost 10.09 gals bet. 23.0 ft & 25.0 ft
limestone rock fragments, loose (moist)(decomposed rock)	<b>3</b>	- 24 -				=				priller reports hard material 23.5 ft
Lt gray, silty calcareous f-c SAND, some limestone rock fragments, tr clay, v. dense		25 26	\$-9	1.5	53 48 76	=				
(decomposed rock) (wet)	50.7					=				Still losing water (slight)
		— 28 - - — 29 -								Ī
t gray,silty,calcarcous		30 -	<u> </u>	14	41					Driving casing change coring to 31.
fine SAND, some limestone rock fragments, tr clay, v. dense (decomp.rock) (wet-moist (31.5 ft)	45.7	<u> </u>	1 1	1	69 163	_	<u> </u>	- 1 11	-	ft
		- 32 - - - 33 -	1							
Light gray,slightly to mod weathered fossiliferous LIMESTONE		34-	1			Run-1	843	82\$	3.4	
Top 3.2 ft v. hard, massive Bottom: frequent small to med vugs, glauconite noted.		25		G.	-	1		Ì		
Light gray, deeply to mod.	40.7	37	<del>                                     </del>	-		-		-		
weathered, locally decom- posed fossiliferous LIME- STONE, slightly to mod. frac		- 38	-							
tured, locally crushed, fre- quent sm. vugs		39	-			Hun-2	1001	74.	2.2	
‡		40	1					7		
Lt gray deeply weathered fossiliferous LIMESTONE,	35.	7 - 42	1		+-		-		+-	
mod.fractured.frequent sm.		43	-			Run-3	100\$	78.	2.2	1
1		F 44	1							

	L	00 DF	BORING		BHEET 3 OF 3					
		- <del>L</del>	3	AMPLE			_	ÇĢRL		
DESCRIPTION	ELEV. FT.	ОЕРТН, І	77. LDC	RECOV. FT.	PENETA RESIGT BUGIN.	CORE NO.	HECOV.	RQ0	CORE TIME MIN/FT.	REMARKS
		- 46				R-3	1001	78%	2.2	
Lt gray,deeply weathered	- 1	47 -								
to decomposed, fossiliferous LIMESTONE, frequent small vugs, massive to mod. frac-	= -	48 - 49 -				Run-4	\$G01	824	6.0	
tured		<b>-</b> ∞-				2	07			
Boring terminated at 51.5'		-51- - 62-	┝		-	-	_		-	
<b>T</b>		F 62 -	1			1				
I		- 55 -	1						1	
7		56	}							
‡		- <sub>57</sub>	}						=	
‡		59	1							
‡	1	-e0	-							
<u>‡</u>		62	3							
<u>‡</u>		F 63	1					-		c
‡		- 64 - 65	1							
		80	-							
		67	1					7	-	
‡		- 69	4							

	LOG DI	FOR P	4G	I	3-631		_				SHEET1_ Or _3.		
PROJECT AND LOCATION										TUM	PROJECT NO.		
SANTEE COOPER GENERAL	TING STA	HON,	FORTM		20		77.5				80C4090C01		
ARDAMAN AND ASSOCIAT	ES		· ·	. Jor	1 A B	,		uly 1			23 July 1980		
DAILLING EQUIPMENT					163		COMPLE	TION	DEPTH	AOCK DEPTH			
CME-55 Hydro Rotary							54.	.0 <b>f</b> t	:	20.5 ft			
\$126 AND TYPE OF BIY			PE COM				NO SAM				UNDIST 28.0 ft		
CASING 3" "Flush Joint"			uble '	. CR		LEVEL		(RST	_	COMPL - ZAHR ET			
SAMPLER 2-IN O.D. SPLIT SPO			DKOP		-	1	VERT		Vir	EGTION			
SAMPLER HAMMER WEIGHT		5	DROP	30 -	-IN		INSPEC	TOR		M,	Giordano		
1		Ξ.		SAMPLES			воск	CORE	$\overline{}$		· · · · · · · · · · · · · · · · · · ·		
. DESCRIPTION	, j	Ĕ	" 8	8	ET F	ω.	8	l _	# W ±		REMARKS		
	E E	DEPTH,	A 0	RECOV.	PENETR RESIST BL/61N.	CORE NO.	# X	90	CORF TIME WINJE				
Dk brn silty f-SAND true			₩	+	2	··	+	<u> </u>	-	⊢	·-		
Grayish 6 yellowish bun		ţ.,	7 ·	42.	ī	- 1			li	ı			
fine-sandy, silty CLAY, t	:r	-	-S-	<del></del>	; 2								
veg.soft (dry-moist)		- 2 -	-	1		ŀ		ĺ					
<u> </u>		<b>.</b> .	╂┈	<del>                                     </del>	2	1							
Grayish & yellowish brn	,	L 3 .	2-S	ω	3								
fine sandy CLAY, some si			s	7	4	ı		ĺ	1- 1				
<u>veg,firm (dry-moi</u> st)	4.5 73.0	4	ł		:	1							
Dk gray & yellowish bro		B	╂		<del>                                     </del>	Į	j						
Lclayey f-SAND, some silt		···	S-3	1.3	3 5	l	_						
stiff (moist)	"	- 6 -	1 "	ļ	6	11							
I (7.0 ±	(t) 70.5	Ι,				1				ľ			
		Γ΄.		ļ	$\vdash$		i .						
Dk to lt grayish to yel	Now	<b>–</b> 8 –	4	<u>د</u>	3								
brn, f-sandy silty CLAY,		ŀ .	Ϋ́	∹	4				1. 1				
stiff (moist)		<b>- •</b> -	-	┿	-								
Ţ		10-	1										
Lt gray & tannish brn i		L	ر ک	2	2		2						
sandy CLAY w/freq lense of silty f-sand(soft-fi		11-	S	;;	2								
_ or silty i sand(solt-i)		r ,			2								
<b>†</b> '3'		<b></b> 12	1	Į									
		L	1	l	=								
<b>-</b>		. ' .					1 1						
Lt gray f-sandy clay		14 ·	ш		, -								
Lit gray 1- sandy clay									ĺ				
(15,5 <u>f</u> t)	) 62.0	15	_		1	100							
Gray CLAY w/thin lenses	8	L ,,, -	9-S	1.5	2					- 5			
of silty f-wand, (soft-	firmD	- `` -			2_								
<pre>r.veg.,highly plastic</pre>		<b>–</b> 17 –	—		┝─┤				3				
,		· '	[-	0									
Greenish gray CLAY, high	hly	T 18 -	] ⊜	2.0	PUSH				-, 4				
plastic (moist)		Ĺ .a.	<u> </u>		4	14			- 5				
		F			T.		Į.		> 1				
		20		•			, .						

	LOG OF BOAING R-A31									SHEET 3 OF 3
		FT.		AMPLE				COAL		
DESCRIPTION	61.6V. FT.	13 'HL43Q	TYPE NO. LOC	RECOV.	PENETA RESIST BUSIN.	CORE NO.	RECOU.	400	CORE TIME MINUFT.	REMARKS
fossiliferous LIMESTONE -mod.to closely fractured, locally intensely fractured freq. sm. to med.vugs		- 46				Run-3	100%	868	1.5	
Lt gray deeply weathered fossiliferous LIMESTONE closely fractured locally decomposed freq.sm. vugs		49 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -				Run∼4	161	19	ac l	Lost circulation at 52.5 ft Driller reports 52.5 ft-soft material
ring terminated at 54.0°										

		OG OF							БНЕЕТ <u>2</u> ОF <u>3</u>	
	'	Ξ.		AMPLE		<b></b>		CORE		1 1 2
DESCRIPTION	ELEV. FT.	DEPTH.	TYPE NO. LOC	RECOV. FT.	PENETA RESIST BL/GIN,	CORE NO.	RECOV.	нор	CORE TIME MIN/FT	REMARKS
Grn gray CLAY w/pockets v. Sense sand		21 —	S-7	5	3 2					
		- 22 -	S	1,	1				_	
(23 ft)	54.5	 - 23								
		24								
t gray silty calcareous f-c SAND,some limestone		25 -			1			-		=
cock fragments,m.dense moist (decomposed rock)		— 26 — -	5-8	1.0	9 21	-				
		_ 27 _  _ 28 _						-		
		- 29 -								
gray,silty,clayey,cal-		357			44					
areous f-SAND, some limc- stone rock fragments		31 -	6~\$	1.4	51 78			= "		
(decomposed rock)	-	32			3					Driven casing to
(34 ft)	43.5	<b>- 33 -</b>					ø			34.0 ft
ot gray, slightly weathered to fresh, locally moderately		- 34 -								Change to coring 34.5 ft
veathered,fossiliferous LIMESTONE.occ.sm.vugs		—35 — -	77			5 1				-
Fop 1.8 ft: fresh,slightly fossiliferous,hard,mas≠ive		_ 37 _				Run-1	988	928	7.0	
·		 - 328 -				521				
Lt gray, mod weathered fos- siliferous LIMESTONE, freq.	=	- as -				7.			11	
ned. to large vugs, massive locally closely fractured.		40 <b></b>		i .	2 1					
	= =	<b>-</b> 41 -			3 - 1	2				
		- 42 - 43 -				Run-2	963	781	5.0	
		44						Ā		22 July 1890
Lt gray mod, weathered		[							with r	23 July 1980

L	OG OF	BORIN	·		<u> </u>		-				BHEET	1 0F3
PROJECT AND LOCATION	PYAT	TON I	INUT 1								PROJECT NO	
SANTEE COOPER GENERATING	MIM.							<u>11 ft</u>			800405	
PAILLING AGENCY ARDAMAN AND ASSOCIATES		]	FOREM				DATE S				DATE FINISH	
ORILLING EQUIPMENT				D	Jandy	$\longrightarrow$	COMPLE	July	198 <u>0</u>	$\rightarrow$	23 July	1980
CME-55 Hydro Rotary							66.5	5 ft			39.0 ft	
	SIZE A	ND TY	PE CORI	5 9 <b>≜</b> R	AEL	$\overline{}$	NO BAM	PLEBIE	18T 1			CORE
CASING 3" "Flush Joint"			bl≢ Tu				WATER LEVEL	-	TRET	<del>"                                    </del>		₹₩.5 fe
CASING HAMMER WEIGHT	<u> N</u>		DI# XI	))))	CD	$\overline{}$	BORING	ANGL	E AND	DINE	CTION	413 16
SAMPLEM Z-IN O.D. SPLIT SPOON		<del></del> -	D 1-14.					VERT	ICAL			
	40 LB:	5	DROP	30 -	-IN		INSPECT			М.	Giordano	
		-		AMPLE			ROCK (	CORE			· · ·	
DESCRIPTION	ELEY. FT.	DEPTH	TYFE NO. LOC	RECOV. FT	PEHETR RESIST BL/61/AL	COAT NO.	RECOV.	Вар	CORF TIME MINJET.		HEMAH	K\$
-bk brn silty f-SAND,some -veg.,v.loose (dry)(1.5 ft)	75.e	, -	S-1	1.4	1 2 2					23	July 198	٥
- -Dk grayish a yellowish		- 2 - - 3 -	2.	m	3							
thrn f-sand y CLAY, some silt tm (dry) (5.0 ft)	72.1	•	- %	1	4	-		- 1				
No recovery	<u> </u>	- 8 - - 8 -	Œ	0.0	6 6 7					N≎	sample	
Gray & yellowish brn clay- ey,f-SAND (8.0 ft) Lt gray & yellowish brn f-sandy CLAY,freq.silty f- sand lenses,firm (moist)	697	- 7 -	8-3	1.5	2 3 4							
Lt yellowish brn f-sandy	66 3 64 &	-11-	S-4	1.5	2 1 2	**						
<u> </u>	<u> </u>	-13	5-5	1.1	1 2 1	1						
_Lt tannish brn f-sandy _CLAY,some silt,v.soft (moist)	61.6	Т Т						11		14	ne shear 1.0 ft - 1 disturbed	.6.5 <b>f</b> t l:1.17 ts:
reenish gray silty CLAY frequent lenses of silty		- 18 -  - 17 -	S-6	1.5	WH 1							1:1.09 ts:
Greenish gray silty CLAY  w/frequent lenses of ailty		18 -	<u> </u>		1					17	ne shear 7.5 ft - 1 ndisturbed Remo)ded	9.0 ft
I feetend w soft (moist)			(V)		!		1 1	1	1 1	1		

7	LOG OF ECRING B-632									SHEET OF3
		FT.		MPLE				CORE	]	
DESCRIPTION	ELEV. FT.	БЕРТН,	TYPE NO. LOC	HECOV. FT.	PENETR RESIST BL/GIN.	CORE NO.	НЕСОУ.	ROD	CORE TIME WIN/FT	REMARKS
			s-7	1.5	2 ,					yane shear 21.0 ft -
-		21 <b>–</b>								22.4 ft Undisturbed:1.09 tsf
(22.4 ft)	54.7	<b>– 22</b> –								Remolded:0.82 tsf
	72	23-				1	n#			
<u> </u>		24 -	1			•				
}	1	L 26 -	<u> </u>			1				
Gray, silty c-f 5AND, some	-	<b>.</b>	8-2	0.7	3 5		-			
-clay (m.dense-loose)(wet)		- 25 	<u>~</u>	0	5	ł				
†		- 27 -	1							
F		<u> </u>	•			1	ļ			1
‡	l	29-								
, up 6":Lt gray, silty f-SAM	k	- 30-	ႃ—	ļ	5	$\mathbf{I}$				İ
(30.5 ft) Gray clay, some f-m SAND,		L 31 -	- S-S	1:3	3					
tr milt, veg., firm (moist)		L 32.	<u> </u>	<del> </del>	+	1				
‡		ł	1			-				
<u>‡</u>		- 33-	7			-				
†	1	- M-	1			ı				
Top 6":Gray clay, some f-m SAND, tr silt	Į,	_ as -	01	\ <u>\</u>	+ 3	1				
It gray f-SAND, some silt,	1	- 36	- L		4 3	]	1			Λ =
tr clay, loose (moist)		37	$\top$	1			ļ			3.
+		L 328	1	-		1				
(39.0 ft)	38.	<u>1</u> 39	_	1						
-		ŀ	1							
Lt greenish gray, f-c, cal- careous SAND & limestone		<b>-</b> "	S-11	1.3	17		1			
Trock fragments, tr silt		<b>⊢</b> 41	<b>1</b> *	1 -	50/		8 1			Lost drilling fluid at 40.0 ft
v.dense (moist)  decomposed rock)		47	1							
+		43	4							
<b>1</b>	æ	-	-			1				
		F 40	<u> </u>	<u></u>	e e	-		112		

* <u>* * * * * * * * * * * * * * * * * * </u>		OG OF		#HEET 3 OF 3						
		12		AMPLE				ÇORE	ا	
DESCRIPTION	ELEV. FT.	БЕРТН, І	TYPE NO. LOC	RECOV.	PENETA AESIST 8L/6PH.	CORE NO.	RECOV.	900	CORE TIME MBN/FT.	REMARKS
Lt gray, silty, calcareous f-m SAND, some limestone		48			35 50 50/3*					Casing to 47.5 ft still no circulation
rock fragments, shells, v. dense (moist) (decomposed rock)		47	_	-						
(deponiposed 100m)		<b>- 48 -</b>			=					Possible void:
		- 49 -								49.0 ft to 56.5 ft
		- 61-					}			
		52								Drill rods fell to 56.5 ft
		- 63 -			8					
		54								
		56 -								Casing to 58.0 ft
Lt greenish gray,silty f-c SAND,tr limestone rock		57-	s-13	1.5	15 28 38					Circulation return from SB.O ft
fragments, shells, clay, m. dense-v.dense, (wet)		- 58- - - 50-			35					
(decomposed rock) (60.0 ft)  Dk greenish gray silty f-	17.		-	<u> </u>	1 21					
SAND phosphate abundant, v.dense (wet)		-01-	S-14	1.5	31 41	1				
		62-	1		>		- 5			
		- 63	1	-						
- - - - naanish sway silty f-		68	<u> </u>		30					
Dk greenish gray, silty f- SAND, some clay, phosphate abundant, m.dense, (moist)		<b>_</b>	S-1:	2.5	21 19					
Boring terminated at 66-5		- 67	1			1				
		- 68	1							
		F 70	1							

	OG OF	OOHI	vG		-033		_				BHEET	OF	3	
MOJECT AND LOCATION				_			ELE VA	TION A	ND DA	TUM	PROJECT NO.		_	
SANTEE COOPER GENERATING	STAT	rion,					77.	39 £	t MSL		<b>8</b> 0C40B			
MAILLING AGENCY			FOREM				DATE \$	TART	E D		DATÉ FINISM	ED		
ARDAMAN AND ASSOCIATES			•	<del>j.</del> J	ones		24	July	1980	_	25 July 1980			
							COMPLI				ROCK BEFTH			
CME-55 Hydro Rotary	C+76 A	NA VV	PE CON				NG SYN	59.0	N A.L.	—	30.0 ft			
3-7/8" Tricone"											UNDIST <sub>2</sub>	<u>88</u> 00	ft	
CASING 3" "Flush Joint"			<u>прје.</u>	Twbe '	. <u>СВ</u>		WATER		FIRST		COMPL_ 74HR			
SAMPLER 2-IN O.D. SPLIT SPOON			DHOP				VERTICAL							
	40 LBS   DROP 30 -IN						M. Giordano							
	Т	1 -		ДМ#11	<u> </u>		AOCK	COME			•			
A S A A A A A A A A A A A A A A A A A A		Ŧ.	, Š	<u>\</u>	E 5 보		ž			i				
DESCRIPTION	ELEV	DEP TH.	TYPE NO. LOC	RECOV.	PENETH RESIST BL/GIM.	CORE No.	RECOV.	8	CORE	ŀ	REMARKS			
	<u> </u>	4	<b>⊢</b> 2	E 12	2 4 9	ΰz	i ä ≭	_ <del>Ĕ</del>	NE 포					
Top 12":Dk brn f-sandy	I	.=	1 _	5 -	1									
-CLAY, tr. veg., soft (dry)	76, 4			=	2	ľ								
		ŀ	<del>-</del> -	<del>                                     </del>	<del>2</del>		1	,	1 1	ŀ				
Gray & yellowish brn CLAY some f-sand, tr silt	,	- 2 -	ł		ļ		1	-						
(dry to moist)	ł	f '	•	<del> </del>	2	ł	1		1					
	l	- 2 -	<u>ښ</u>	₩.	2									
Gray & yellowish brn CLAY		۱ <u> </u>	Ġ		4	i .								
ome f-sand, tr.silt, firm	l	<b>-</b> • -	1		<u> </u>	7.				1				
(moist)		I . 1	1						= =					
Gray to it gray CLAY, soft		F 8 -	1		1									
- Gray to it gray CLAY, Boft		L.:	7	Ö	1									
- (moist)		$L_{\mathfrak{s}}$	Ŷ		3		€		1 1					
Ĺ		[]	<b></b>				1							
- Lt gray CLAY w/froquent	[ ]	Γ΄.	L		<u>.</u>					ĺ				
- pockets of lt brownish		- : -	I _		Z		- i		:	ĺ				
gray f-sandy wilty, firm		٠.	S-4	0.9	2					ĺ				
(moist)		_ 9 _	۳,	٧	3									
-	67.9	- · "	ł	1						ĺ				
The greenish gray silty	_	-10-			-		1 1			1				
CLAY w/frequent silty,			ιs	2	1									
- f-Sand Seams,firm		-11-	S-5	i i	3		1 1							
- (moist)		}	ऻ—			1 7			I				,	
<b>†</b>	1	- 12 ···	<b>S</b>											
·		•												
		13 <del></del>				1	i I		=					
(14.0 ft)	63.4	t 1							1 1					
		- 14 -							1 6				i	
Lt gray clayey f. SAND	_ =	<u> </u>		L					l					
w/ frequent thick lenses		ר"ים		_	2				1 -					
of grn clay, soft, firm		- 10 -	S-6		2		1							
(moist) (17.0 ft)	60.4	∟‴]		1	2									
	50.4	<b>– 17</b> –			ابا									
uk greenish gray CLAY,		<b>-</b> -	Γ~		1								- 1	
some silty f-sand seams,		<b>– 18</b> →	'n		1									
v.soft (moist)							Į į	Y						
- Dk greenish gray CLAY,		- 19 <del>-</del>	UD-1	2.0	PUSH									
highly plastic (moist)		┝╻┑	ij	~	P.								- 1	

	Ł	.OG OF			<u>P-63</u>	.3	-		27	#HÉET OF
F 10. 2		FT.		AMPLI				CORE		
DÉSCRIPTION	ELEV. FT.	'нцаза	77PE NO. LOC	RECOV. FT.	PENETA Resist Oljein.	CORE NO.	RECOV.	P00	CORE TIME MINJET.	REMARKS
Dk greenish gray CLAY w/			מַט	2.5	PUŞH					
frequent fine sand seams	1	_ 21 <u>_</u>	Б.	2	WH					I
v.soft, (moist)	i		S-6	<u> </u>	WH		1	1		i e
Dk greenish gray CLAY,	<b>i</b>	22 <del></del> -	<u> </u>	ļ-,	1					
highly plastic (23.5 ft)	53.9	┞ •						1	100	
		— 2 <b>3 —</b>	Ņ	_	뇶		j :	1		Change of soil in to
	· · · · · ·	¹ ¹	횽	2.0	PUSK		1			
Dk gray clayey silty f-m 5AND,tr.c-sand,loose	1	<b>– 24</b> –		l.''	"		Į			
(moist-wet)		25 -			2	•	1	1		
(morat-wer)		[ * · ·	S-9	1.5	l l			1		
		<b>— 26</b> —	5		8		:			
		L " -					1			
		<b>– 27</b> –		ĺ						
						1	'			
		— 2B —			=					-
				ŀ		_		1		
	i	29					:			
(30.0 ft)	47.4		1						Y	
Lt gray, clayey, silty f-5ANG		- 3D			1	5				
some limestone rock frag-	1	` `	s-10	1.5	ī					
ments, v. loose (moist)		- 31 -	s	_	3		-			
(decomposed rock)		_ <b>32</b> _					'	1		Losing water slowly
		. ~ .								at 31.5 ft
. : '		<b>— 33</b> —						1		
						1		1		
94	i	— 34 —								
9	1	-						1	'	Snoon Avenned at
		_35-			<b>!</b>		<b>l</b> .		Ι,	Spoon dropped at 35.0 ft, about 24",
		ŀ ·						]		no recovery
		- JR			1	V			}	(probable void)
		T _ T								
Lt gray,clayey,silty,f-c		- 37 -								
SAND, some limestone rock fragments (moist), v.dense		_ <b>35</b> 3 –	Ţ		11					
(decomposed rock) (39.0 ft)			s-11	1.5	23			ł	i :	Change to coring at
	38.4	39-	٠,		37					39.0_ft
Lt gray, mod to slightly		-	. =		Ē		:	1		
weathered fossiliferous		40-			ii .			1		145 Y
LIMESTONE, hard, closely fractured, glauconite noted		t '			al 2					Partial water loss
Tracemed, gradeomice notes	.	- 41 -			- "	7	_		2	LME OTHY AGEET TOOR
	1		=			Run-1	269	221	2.2	
		<b>- 42</b> -			V=	PK.				casing to 44.0 ft
		[ <sup>.</sup>		7			] = _			
		<b>-</b> "፣			62 12		- 2		1	
	-	[ ]								24 July 1980
			= 1,0					70		25 July 1980
•	1	45	1			100				2 - 2 - 10 - 10 - 10 - 10 - 10 - 10 - 10

	'	-00 OF	BORIN	° —	B-633		_			<b>EME</b>	T <u>3</u> OF <u>3</u>
	'-	FT.		AMPLE				COME	<b>,</b>		
DESCRIPTION	ELEV. FT.	DEPTH, FT.	TYPE NO. LOC	RECOV. FT.	PENETA RESIST BUSIN,	CORE NO.	RECOV.	90	CORE TIME MIN/FT.	7	REMARKS
Lt gray moderately to deep- ly weathered fossiliferous - LIMESTONE closely fractured glauconite noted		46 -				Run-2	501	26%	3.0	Lost bet.	200 gals, water 45.0 ft-48.0 ft
Lt gray, deeply weathered fossiliferous LIMESTONE,	1 1	45 45					=				
ken, glauconite noted		- 50 - - 61 -				7			و		
<del>-</del>		- 52 - - 52 - - 53 -			- 1 - A	Run-3	104	<b>\$</b> 0	1.6		
Lt gray deeply weathered to decomposed fossiliferous IMPSTONE, glauconite noted. Moderately to closely		- 64 -	.								
fractured.		- 56 - 57 - 57		İ		Run-4	764	621	0.5		
Boring terminated at 59.0'		- 68					7				
		 -60 -									× *
	Ė	62 - 63 -									
		- M -									
	Į	-66									
<u></u>	ŀ	67 -									
		70							90 T		

	.00 01	- BOHII	₩G		3-634		_				SMEET _	OF	3
ADJECT AND LOCATION							ELEVA	TION 4	ND DA	TUM	PROJECT N	<u> </u>	
SANTEE COOPER GENERATING	STAT	TION,						37.				90C01	
OHILLING AGENCY			FOREM	4AN		-	DATE		-	<b>—</b>	DATE FINIS		
ARDAMAN AND ASSOCIATES				D. G	andy		15 J	uly	1980		16 July		
CME-55 Hydro Rotary									DEPTH	$\neg$	MOCK DEFT	·· —	_
-		1/A = 1						.5 ft			20.5 ft		
A=7/R" "hricone"			FE COR				MAR OW	_		9	ψNΦ(8Y	20 o	<i>f</i> +
ASING 4" Flush Joint	NX *	Doub.	<u>le Tu</u>	<u>be" (</u>	<u> B</u>		WAYP N	- 1	HET		COMPL	24HA 0	<del></del>
SAMPLER 2-IN O.D. SPLIT SPOON			DROP				BORING	VERT	ICAL	DIRE	CTION		
	40 LB	2	DROP	30 -	_1 B/		INSPEC	TOR		<u> </u>		-	
	T E	Ĭ	- 5	AMPL		$\overline{}$	BOCK	CORE	М.	G10	rdano		_
			TYPE NO. LOC	Τ.	1 <sub>6</sub>		_	1		l l			ļ
DESCRIPTION	ELEV FT.	DEP11H,	¥ 3	RECOV. FT	F 5 5	₩.	ĺŚ	6	# w = =	i	REMAI	9KS	
	7.7	ă	₹ 2	H 7	PENET P RESIST BL/GIN.	CO #	RECOV.	5	CORE				
Dk gr organic siltySAND	0.5		1 _	5	† i –		+	<del>                                     </del>	<del>  </del>				ᅱ
some veg (0.5 ft)	7	Ĺ, .	S	🖫	ī				1 1	l			- 1
Lt brown CLAY, Lr Veg,		. ' .		<u> </u>	1	1	J						- 1
T (Dry-Moist) plastic		- 2 -	l		[ "		ì						- 1
+			<b>-</b>	+	<del> </del>			[		1			- 1
Cray & yellow,brn CLAY,		- 3 -	2-2	νū	3		却						
tr silt, plastic (Dry)		-	ιή	<del> </del>	4 1	1	1		1				- 1
<b>+</b>		- 4			4	1				1			- 1
		•				[	1						
		- B -			8		1 ;			1			- 1
T CLAY, some silt, tr f. sand			\$-3	~	В		)			ı			- [
plastic, tr, veg. (Moist)		- 6 -	W	-	8		]			ı			- 1
		_ 1	_		<u>-</u> :								H
Ŧ		[']	=										-
Gray-lt gray (mottled)					2		1 [						-1
CLAY, some silt, tr f. Sand	1		-4	1.4	2								- [
+ veg, plastic, soft (Moist)	- 1		5	1	2		{						
102847	- 4						1 1						1
	•	- 10 <del>-</del>					l l						1
T Light gray CLAY, tr f sand	ŀ	- 4	ν̈́	т.	3		1						- 1
silt,plastic,soft (Moist)	ŀ	- 11 -	S.	~	1 2		{						Т
,	ŀ	-		-				- 1	1				Т
	r	- 12 -		[	ı								
T	ŀ	1			- 1	=	- 1						-
(13.5 ft)	ľ	- 13 <b>-</b>	- 1			i		}	- 1				1
+		1			= _ [		í						1
I_	1	- 14			- 1		!	- 1					1
		( J							- 1				1
		. "". ┪	9	Ģ	2	=	1		- 1				1
L Dark greenish gray, clayey		- 10 -	S-6	1.0	1	- 1			- 1				
silty f. SAND, loose (wet)	ŀ	· ' 4	$\rightarrow$		2								Т
	ŀ	- 17 -							- 1				1
·	ŀ	- 4						- 1					
	⊢	- 18					7.		ŀ				
	ŀ	- 4											
†	, "	19-	1										1
		20	A		. J	y		Ĺ					

<u>,</u>		.0G OF	BORIN	a	B=6	34	_			\$HEET Z OF3
		FT.		AMPLE			ROCK	CORE		
DESCRIPTION	ELEV. FT.	DEPTH,	TYPE NO. LOC	RECOV.	PENETA RESIST BL/GIN,	CORE NO.	RECOV.	Roo	CORE TIME MIN/FT.	REMARKS
Lt groenish gray clayey f.				0	2	-	- N F		-	Losing water at 20.0'
Lt gray, clayey calcareous	-	– z1 <b>–</b>	S7	7.	$\begin{bmatrix} 3 \\ 13 \end{bmatrix}$					
f-m SAND, some silt, tr lime-		22 -								
<pre>stone rock fragments,m.dense (wet)</pre>	2.0								i	
<del>I</del>		23								
± 1		24			l i					
Light gray silty,calcareous		— <del>25</del> —			13				Į į	
f.SAND & limestone rock fragments,v.dense.(wet)		- 26 -	S-B	1.0	25				1	
+		-			28				]	
<b>T</b>		_ 27 ~			i	ļ				
+ 1		— 28 <b>—</b>								
<b>‡</b>		_ 	= %							ı
7		- 36 T	8-9	1.0	20 ° 50/5			_ =		
Light gray clayey, silty cal- careous f-c.SAND, some lime-		- 31 -	- 02		307 3					
stone rock fragments, yedense		- 32		T			١_			
Light gray, deeply weathered		33								Changed to boring at
to decomposed foss.LIMESTONE closely fractured.	,		j			Run-1	1004	481	0.4	2.5 ft
T		- 3	ĺĺ		-	- ₹	1	•		, = =
<u>+</u> !		<b>-35</b> -	-							
Light gray, mod to slightly		- 386								
_weathered, foss. LIMESTONE, _massive to slightly frac-		_ 37 ~					×			
tured, hard.			1			Run-2	# 901	948	5	
<b>.</b>		- 348 - -				₽	2	g,		
+ 1		<b>- 39</b> -	i							
Light gray, al to mod. weath-		40				-0				- Y 12
ered, foss.LIMESTONE, massive					= 1		Ì			
to slightly fractured, hard.		- " -								
		_ 42 _				Run-3	<u>.</u>	<b></b>		
+		- 43-			1	<b>2</b> 00	100%	100\$		
I		_ 4,4								
+	2 1	48			2					

		LOG OF				34	_			\$HEET OF3
	1 <u> </u>	FT.	) <u>5</u>	AMPLI				CORE		
DESCRIPTION	ELEV. FT.	DEPTH,	TYPE NO. LOC	RECOV.	PENETH Resist Bljoin,	CORE NO.	RECOV.	Rao	CORE TIME MIN/FT.	REMARKS
Light gray, deeply to mod. weathered, foss.LIMESTONE, closely to mod.fractured,		- 46				<u> </u>	1	_	<u> </u>	
locally intensely fractured	_ <	-47 - - 48				Pun-4	1001	781		
‡	23	49							2	
Light gray, deeply weath- ered foss.LIMESTONE, close- ly to mod.fractured.		- 50 -  - 51 -		_	1	Run-5	<b>1</b> 6	0/2.5≒801		
Boying to-		52				Ru	1004	2.0/2.		
Boring terminated at 52.5%	= =	- 53 - - 54 -	-						# 	
<u>t</u>		- 66 -	4		-	= =				
1		- 545 - - 57 -		> 1				ĺ		
<u> </u>		- 64 - 59			-					
<u>‡</u>		-60								
‡	į	-51								
‡	Ė	63								
<u> </u>		-65								
‡	[									
	F	- 67 -								
	F	. 69								
	ţ	70 -								

	L	OG OF	BORIN	<del>ه</del>	<u> </u>	635		_			5#EET] OF
PROJECT AND LOCATION		STAT	ION, U	NIT 1				CFCONT	ION A	ND DAT	M PROJECT NO. 80C4098C01
DRILLING AGENCY				FOREM	AN			DATÉ ST	TARTE		DATE FINISHED
ARDAMAN AND	ASSOCIATES				J. Je	nes				ly 198	
DAILLING EQUIPMENT								COMPLE			AOCK OKPTH
CME-55 Hydro		CITE A	NO TYP	E COR		Ac.		NO SAM	2.0 :	tt Dist 9	18.5 ft
CIZE AND TYPE DE DE	one							WATER LEVEL		FIRST	
CASING A" "F) USh .	Joint"    WEIGHT	NX	<u>ئەم.</u>	DROP	Lups.	<u>CB</u>		BORING	ANG	E AND	THECTION
SAMPLER 2-IN O.D.				11.5				INSPECT	VERT	ICAL	<u></u>
SAMPLER HAMMER		io LB:	5	DROP	30 -					М.	Giordano
_			Ξ		AMPLE			MOCK	COMM		
DESCRIPTIO	ON	ELEV. FT.	DEPTH	TYPE NO. LOC	RECOV.	PENETA RESIST BL/GIN	CORE NO.	RECOV.	00 H	CORF TIME MIN/FT	REMARKS
Dk Gray org. f	-sandy <u>\$ILT</u>			7	4	1 3		-	-		
m, veg. tr. w			ן יון	ıs.	<u> </u>	2					
Grayish bin to			Ĺ,.			1		1			
f. sandy (0.5. veg. decompose	d wood, tr		<b>⊦</b> ˙ ⋅		┼-	3		1			
c gilt firm			- 3 -	S-2	νi	3					
Lt gray brn f.	sandy silty		ተ . <sup>•</sup>	ė,	mi	3					
(moist)	veg.,iim	_	<b>F</b> ^ 7	1			1			2	
. (moist)		ļ	[	<u> </u>	↓	<u> </u>	ı			1	
← Gray brn-tan f	.sandy CLAY	l	ļ .	m	S	2 2		<b>.</b>			
some silt,(moi			J- 6 -	S	1	4	1		,		
-			ት ፡		+	+	1	1	Ì	2 11	
- · · · · · · · · · · · · · · · · · · ·		1	<b>-</b> 7 -		-	İ				i I	
<pre></pre>			<b>L.</b> :	1		2	1			1	
= sand,firm. (F		l l	Γ'.	S-4	1.5	3	-			1	
			<b>- 9</b> -	<u> "</u>	ļ	3	1				
+			n i ,	1		14	-				
- Lt greenish gr			- 10 -	-5	+	1	1		i		
brn (mottled) CLAY,some #ilt			L	'n	1-1	2					
firm. (moist)	c,cr veg-,		<b>[</b> ]"	<u> </u>		2	1		ļ		
[ ************************************			— 12 <b>-</b>	4			ł				
<del> </del>		l l		1			1				
<del> </del>		)	<b>—</b> 13 -	1			1				
<b>†</b>	(14.0 ft)		t '	1			ĺ			G.	Gray return at
<u> </u>		П	Γ"	1						<b> </b>	approx. 14.0 ft
I	44141 #-	1	L 15-	1	Щ	+	1				
Greenish gray SAND, some clay	,allty II v.looke(Wet)	, I	<u> </u>	S-6	1:1	1 1					
SAND, SOME CIA	y , 1003E (WEL,	Ί	16 -	٠,	1	2				1 1	
+			t	-	+	<del>  -</del>	1			=	
+		1	17 -	1		1		D	-	j	
	(10.5 ft	,	18-				T.			1 I	Change at 18.5 ft.
<del></del>	(10.5 14	1	<b>+</b> ~ .	-			-				
1			<b>– 19</b> -	- 1							
+			F	1	ì		ŀ	1		177	

B-635 LOG OF BORING \_\_ SHEET 2 OF 3 MOCK CORE SAMPLES PENETR RESIST BL/61%, DEPTH. RECOV. CORE **DESCRIPTION** TYPE NO. L CORE TIME REMARKS Lt gray, silty calcareous 32 f-m SAND, some coarse sand, 21 -45 tr limestone rock fragments, clay, v.dense (wet) 22 -23 24 Lt gray, silty calcareous 25 f-c SAND, some limestone 30 rock fragments.tr clay, v. 28-64 dense (wet) 27 **Z**8 29 tt gray silty calcareous f 30 AND, some limestone rock 37 47 fragments, tr clay, v.dense 31 . 150/5 (moist) (32.0 ft) 32 Changed to coring at 32.0 ft 33 Lt gray deeply weathered fossiliferous LIMESTONE 34 closely to mod.fractured \$84 locally crushed 36 36 37 Lt gray, mod to decply weathered, fossiliferous LIMESTONE, closely to mod. fractured, locally crushed. 1004 948 40 Lt gray, deeply tp mod. weathered, fossiliferous 42 LIMESTONE, mod. to closely fractured, locally crushed 43 Run-3 1004 42%

#### WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

	•	LOG OF	BORIN	<u> </u>	₽-		-			SHEET 3 OF 3
		FŤ.	. <u>.</u>	AMPLE			_	CORE		
DESCRIPTION	ELEV. FT.	DEPTH, FT.	701 DW	RECOV. FT.	PENETR PESICT BL/GIN.	CORE NO.	RECOV.	9	CORE THME MIN/FT.	AEMARKŞ
+		- 46-				Run-3	1001	421		
Lt gray to gray deeply weathered fossiliferous		-47 ·	-							
LIMESTONE, closely to mod. fractured, locally intensely fractured.				**		Run-4	#	568		
	27	- 50				Ruf	100\$	ž		
Boxing terminated at 52.0'		- 51 - - 52 -		_						
Boxing Cemunaced at 32.0	-	- 53 -								
‡		- M -	-		1			-		- 11
Ŧ		- 545	=							
‡		57 <b></b>	=	= =						
Ŧ		- 54 - - 54					1			
‡		- <del>6</del> 0 -								1-, 7
‡	a	61 -								
‡		<b>=</b> 3 -								
‡		- 64 -								
Ī		55  66								
Ī		[  -					1			
1		- 69 -					۰	91		
	, _ '	- 70 -		9,7						resident of the second

	.0G OF	BORI	NG	H-	-6 <u>36</u>		_				SHEET OF3_
PROJECT AND LOCATION SANTEE COOPER GENERATING	STATE	ION,	UNIT 1					10 ft		TUM	FRÖJECT NO. 80C4090C01
ARDAMAN AND ASSOCIATES			FOREM		andy	_		July	1980		25 July 1980
CME-55 Hydro Rotary	SIZE A	ND TY	PE GOR	E BAR	REL.		COMPL 5 NO SAN	7.5 f	t		19.0 ft
CASING 3" "Flush Joint"	ĶΝ		uble DROP	Tube'	<u>' ⊂</u> B		WATER LEVEL BORING	ANGL	FAND	_	EOMPL 24HA
SAMPLER 2-IN O.D. SPLIT SPOON SAMPLER HAMMER WEIGHT 1	40 LB:	s	DROP	30 -	-IN		INBPEC	VERT	<u>ical</u>	м.	Giordano
DESCRIPTION	ELEY. FT.	ОЕРТИ, ЕТ	TYPE NO. LOC	#ECOV.	PENETR W RESIST BL/66N	COSE NO.	MOCK.	POU	CORF TIME WIN/FT.		REMARKS
-Top 6":Dk brn, silty f.sand loose (dry) -Int brn & yellow brn(mottled -silty f-SAND (dry) v. loose	,	- , -	S-1	0.8	3 3 4			_			
-lt brn & yellow brn silty -f=camp (3.0 ft) - Gray-brn & yellow brn - clayey fine SAND, some	76.2	- 3 -	S-2	0.5	4 6 7	-					
lt, stiff-firm (dry) Lt gray a yellow brn claye f. SAND, some ailt, firm	у	- 5 - 1 - 1 - 1	5-3	1.1	2 3						
Lt gray & yellow brn f. sandy CLAY (moist)	72.2	-	4-	5.	1 3					5e S-	ams of silt in
		, , ,	S	1	2 ,					5-	4
Lt gray & yellow brn silty CLAY,some f-sand		- 11 - - 11 -	\$-\$	1.5	1 3				3		
Green silty CLAY W/frequent	66,7	- 13 -	_		Ž				- [		
thin scams of silty f-sand firm (moist)		- 14 -	9-S	1.1	3 5						
	, 52.2	- 16 - - 16 - - 17 -	5-7	1.5	3 4						
en silty f-SAND, some in clay lenses, stiff (moist) (19.0 ft)	50.2	- 18 -	S-B	1.1	3 4 5						
	ŀ	- 18 - 20	: 0								

	-	LÓG OF	BORIN	G	<b>B</b> −6	36	_			SHEET _ 2 _ OF _ 3
		£1.	į	AMPLE			<del>-</del>	COAL		
DESCRIPTION	ELEV. FT.	DEPTH, FT	TYPE NO. LOC	RECOV.	PENETR RESIST BLJSIN.	CORE NO.	RECOV.	H 0.0	CORE TIME MINJET	REMARKS
Lt gray, silty f-calcareous SAND, some limestone rock fragments, v.dense (moist)		, 1 , 2 , 1	6-S	1.0	25 32 32				-	
(decomposed rock)	- 3	- 22 -  - 23 -	- [							
		- 24 -		===				-		-
Lt gray, silty f-calcareous SAND, some limestone rock fragments, tr.shells, v.		25  26	5-10	1.1	30 50				}	>
dense (moist) (decomposed rock)	 	27			\$0Z3"					
<u> </u>		- 2B -			_ =				×	
Lt brn f-calcarcous SAND.	= "2	- 20 - - 30 -	7		30			=		
some silt,tr rock fragment v.dense (wet) (decomposed rock)	-	-3,-	5-11	1.3	34 39			=	-	
		- 33 -	-			!				
		- 24 -								
Lt gray f-m silty,calcare- ous SAND,tr.limestone,rock		- 35 - - - 36 -	S-12	1.5	1B 24 35					
fragments, v.dense (moist)	41.7	37		_ 0	े े			= .		Change to coring at 37.5 ft
Lt gray, slightly to mod.  Weathered, fossiliferous		- 38 - - 39 -			<					Refusal
LIMESTONE, mod.fractured occ.sm.to med. vugs		- 40 - 40	T×			Run-1	896	50\$	3.6	
[ (½ "- 1½")		- 41 -				-		- [1]		
Lt gray, deeply weathered		43		- 1	7	79				
fossiliferous LIMESTONE. frequent sm. vugs (24")mod. fractured		- **-				Run-2	1004	704	1.4	

LC	G OF	BÓRIN	<u>.</u>	B-6	37		_			\$HEET1_ OF _3_
SANTEE COOPER GENERATING	\$TAT	ION, L	NIT 1				78.5	l <u>f</u> t	MSL	80C4090C01
DRILLING AGENCY		··· J	FOREMA				DATE ST			DATE FINISHED
ARDAMAN AND ASSOCIATES		i	<u>J</u>	. Man	У			uly		19 July 1980
DAILLING FOURMENT	-	7. 7.					COMPLE.		PEFTH .	AOCK DEPTH
CME-45 Hydro Rotary				<u> </u>			50.5 No sami			18.0 ft
SIZE AND TAPE OF BIT			L CORE						4	0  20,0 ft
CASING 3" Flush Joint	N		<u>uble=1</u>	ube"	CB		WATER LEVEL	A 4/2	IRSY	AECTION 124 15 ft
CASING HAMMER WEIGHT			DROP					VERTI	CAL	
SAMPLER 2-IN O.D. SPLIT SPOON SAMPLER HAMMER INCIGHT 14	10 LBS	, 1	DROP	30	ĪN	_	INSFECT	OA.	м	Giordano
SAMPLER HAMMER WEIGHT 14	O LOS	, <del>-</del>		MPLE			AOCK C	ORE		4101 (191)(4
DESCRIPTION	ELEV. FT.	OEPTH, F	TYPE NO. LOC	RECOV.	PENETH RESIST BL/BIN.	CORE NO.	L	ROD	CORF TIME MIN/FT.	REMARKS
Top 6":Dk gray f- SAND some roots (dry) -Gray & yellow brn f-sandy -CLAY,tr veg.,stiff (dry)	76.2	1 -	S-1	1.5	1 1 .1		12			
Dk gray & yellow brn f- sandy CLAY, tr.veg., stiff. (Dry) (4.5 ft)	74.0		S-2	1.5	6 7					
ght gray, clayey fine SAND, tr.silt, stiff (moist)	71.5 59:2	- 5 - - 8 -	\$-3	1.5	4 6 7					
Lt gray & tannish brn Lailty CLAY & f -SAND, stiff (moist)		- 8 - - 8 -	S-4	1.5	6 6 4	A				
(10.0 ft)  Gray & lt brn,f-sandy CLAY  & clayoy f-SAND firm,tr  veg. (moist)		10  11 12 13	\$s	1.5	2 2 3		3			
(15.5 ft)  Dk gray silty CLAY w/freq f-sand partings, (wet to moist)	63.0	- 14 · - 15 · - 16 · - 17 · - 17	9-6	1.5	1 1 1					
soft (18.0 ft)	60.5	18		A						

	ı	.0G OF	BORING	<u> </u>	<b>B-6</b> 3					BHEET	3 OF3
The state of the s		ŧ.		AMPLE				COME	, ·		
DESCRIPTION	ELEV. FT.	ревти,	TYPE NO. LOC	RECOV. FT.	PENETR RESIST BL/61N,	CORE NO.	HECOV.	8	CORE TIME MIN/FT,		REMARKS
		- 46			_	Run-2	100%	70%	1.4		
Lt gray deeply weathered to decomposed fossilifer- ous LIMESTONE, closely fractured to crushed, occ. sm. vugs (2)")		- 48 - - 49 - - 60 -				Run≁3	761	161	2.4	:	
Lt gray, dosply weathered to decomposed fossilifer-	-	- 52 -		-		2	-			=	
ous LIMESTONE, closely fractured to crushed.		55				Run-4	221	99	1.0	a.	
Boring terminated at 57.5	+	- 57 58	-			-		-		-	
		-60 -61									
		F3	1								
		- 4.5 - 66 - 67	1								
1		E 61	1								

	<u> </u>	.00 OF			B-63	<u>′</u>		-6		SHEET
1		₹1.		AMF L				K COME		
DESCRIPTION	ELEV. FT.	оветн,	TYPE NO. LOC	RECOV. FT.	PENETR Resist Bl/Gin.	CORE NO.	RECOV.	90	CORE TIME MIN/FT.	REMARKS
Lt gray silty f-c SAND, E				m	25				<del> </del> -	
limestone rock fragments, tr.shells (Wet) v.dense		21 -	S-7	1	28 40				-	
		- 22 -								
	İ	<b>–23</b> –								
		- 24 -					]			
Lt gray silty f-c SAND &		- - 25 -			27			-		= =
limestone rock fragments, tr. shells,very dense,(wet)	-	26	8-5	1.0	31 50/5		ĺ			=
- - Lt gray Bilty f-c SAND,		- 77			50/3		1			
- some limestone rock frag- - ments,tr.shells,v.dense		- - 28 -	_				-			-
(wet) (30.5 ft)	= IF	29 -								
	-	- 30								
Slightly to mod.weathered	48.0		S-9	13	50/3					Begin to core at 30
fossiliferous LIMESTONE;		- 31 -					:			ft
closely to mod.fractured, light gray		- 32 -				-1				
		- 33 -				Run-1	924	581	1.3	, ,
		-34						Ţ		
		_ 35 <del>_</del>	İ						5 1	
Slightly Weathered, v. hard		-36-								Very hard drilling
fossiliferous LIMESTONE; slightly fractured, lt gray.		37								
-		- 34				· 7	·	= مو	9	
						Run-2	1004	196	4.4	
		- 4								
		- <b>4</b> 6-			ł					Driller reports 6"
Deeply weathered, closely fractured fossiliferous		- 41 <b>-</b>								clay lense at 41.5 ft & at 43.5 ft
sandy LIMESTONE; lt gray		- 42 - -				_				
		- 43 <del>-</del>				Run-3	401	0.03	3.4	
	10	- 44-	ı			_		181		
	_ 6	45	- 1						- 1	

		.OG OF	BORIN	œ	B-63	7	_			SHEET OF3
		1		AMP L				CORE		
DESCRIPTION	ELEV. FT.	DEFTH,	TYPE MO. LOC	RECOV. FT.	PENETR RESIST BL/GIN.	CORE NO.	RECOV.	800	CORE TIME MINUFT,	REMARKS
Moderately to deeply		- 46								
weathered,mod.fractured shelly LIMESTONE,lt gray		- -47 -			=					
-		48-				Run-4	1001	304	1.4	
		<u>-</u> 49−			.	æ	07			
		50 -			-					
Boring terminated at 50.5'		Б1-								
		52	1						16	
		-63-	3							•
		[-#-]			]					
•		- 65	ł					ŀ		15
		500	]		-					
		57 -								
		- 68								
	=	555						1		
		<b>├</b> ••-								
	-	- 67 -								7
_		62-					=			-
		F**-	4							
		- 64 -						=		
-		- 68 -				١.				
		- 00 -								
		67 -			1			Y		
+		- 85	1				Ø.	is a		
t		- 69 - - 70 -	1					5		

	L	.OG OF	BORIN	.c	<u>B</u> -	<u>-638</u>		_				5MEET	0	,F <u>3</u>
PROJECT AND LOCATION				*****	v =							PROJECT		
SANTEE COOPER	GENERATING	/ SIA		UNIT 1 FOREMA					3.03 1				4090C01	
ARDAMAN AND A	SSOCIATES		j	D	. Ga⊔	ndy			July			DATE FIN	uskeo July 19	980
CME-55 Hydro A			_					COMPLI 55	EYION	<mark>Бёр</mark> тн L		17.	7н 5 £t	
SIZE AND BY A Dricon			4NO TY			E.		NO SAN			9	UNDIST .	<u>(</u> 18°.	5 ft
CASING 3" "Flush 3			NX Do		Тире	. CB		WEVEL		INST	1	COMPL		7 ft
CASING HAMMER SAMPLER 2-IN O.D. S	WEIGHT			DRÓP				BORING	VERT	E AND	DIME	CTION		
SAMPLER MAMMER		40 LB:	<u>s</u>	DROP	30 -	-IN		INSPEC	TOR	,	М,	Giorda		
			<u> </u>	54	<b>≜MPL</b> E	5		ROCK	cont			7-2-	-	
DESCRIPTIO	N	ELEV. FT.		TYPE NO. LOC	RECOV.	PENETA RESIST BL/6IN.	CORT.	RECOV.	Rap	CORF TIME MIN/FT.		REM	ARKS	
- Dk brown, silty				1-s	٠.	1	Г	$\top$		1-				
- some veg.,wood, - (	v-loose (dry)	i '	<b>!</b> ' !			2								
		7 <b>5</b> 3.	2 -											
Lt grayish & ye			- 3 -	-5	+√.	2 "								
_ brn, silty, f~s _ fi <sub>r</sub> m	sandy CLAY, (moist)		<u> </u>	· s		3								
	Anna	1	[']				l				į			
5 tenni			<u> </u>	<del>                                     </del>	<del> </del>	2					l			
_ Lt gray & tanni _ f-sandy,silty C		.]	L	7	٠.	1			Į					
	(mpist)		<b>[</b> °]	Ş		2	e de la companya de l	71						
-		1	<b>-</b> 7 - √	4		] -								
			<b>┟</b> _ <u>ॗ</u>		$\vdash$	2								
Lt gray & tan s some f-sand,sof		.] /	[ 7	S-4	4.	2								
f-sandy, silty C  Lt gray & tan s  some f-sand, sof  tr.veg.	t (mores	1 /	LJ	0,1	-	1								
2		1	<b>├</b>			==					Ì			
9			<u>-</u> 10-		<u> </u>	1								
-	- I	1	$\Box_{n} \Box$	5-5	1.3	1			1	}				
-	<u> </u>	1 1	<b>h</b>		<u> </u>	2.								
		1 . 1	L"7			i I								
		55.0	$L_{13}J$											
			F 1		}		=							
		1 1	一"丁											
– – Dk greenish gra	av Bilty	1 /	[- 15 ]	Щ		-								
CLAY, some f-sar	nd seams	1 1	h 1	S-6	ν,	0 0				]				
v.soft.tr.veg.	(moist)	1 1	ተ።ታ	γ	1.	1	<u> 2</u> 11							
		1. 1	17-				П	100						
	(17.5 ft)	60.3	H 1								H			
		1 1	Ľ"J											
		1 1	- 10-				-							
-		1 1	<u>⊦                                 </u>	6					[					

	•	.0G OF	# #ORING							SHEET 2 DF 3
		FT		AMPLE			_	COME		
DESCRIPTION	EL EV. FT.	назо	TYPE NO. LOC	RECOV. FT.	PENETR RESIST 8L/GIN.	CORE NO.	MECOV.	RGD	COSE TIME MIN/FT.	REMARKS
Lt gray, silty, calcareous f-c SAND, some limestone rock fragments, tr_clay, v. dense (wet) (decomposed rock)		- 21 - - 22 - - 23 -	1-S	1.0	27 48 50/3					
Lt gray silty, calcareous		24			50					
f-c SAND, some limestone rock fragments, tr. shells, clay, v. dense (wst) (docomposed rock)	>	26 27	8~8	1.5	30 50					
		- 28 - - 29 -		-						
<del>`</del> ‡		- 30 - - 31 - - 32 -	6-S	1.2	12 25 37	-	-	-		
		- 33 - - 34 -					,			
(no recovery)  Lt gray, slightly weathered	42.4	- 35 - - 35 - - 36		0.0	50 50/2"			-		Changed to coring
to mod.weathered fossili- ferous LIMESTONE, mod. fractured to slightly fre- quent sm.vugs, v.hard		- 37 - - 38 -				Run-1	\$16	87%	3.6	at 35.6 ft
Lt gray, mod. woathered fos-		- 38 - - 40 - - 41 -								
siliferous LIMESTONE, close- ly fractured to broken, locally massive, frequent sm. vugs.		- 42 - 43				Run-2	94%	364	5.0	
‡		- 44 - 45								

		ī	.00 OF	BORIN	Ġ	B-63	88	_			\$HEET	3 OF _	3
× = = =			FT	<u>\$</u>	AMPLE			_	CORE		¥.		
DESCRIP	TION	ELEV. FT.	DEPTH	TYPE NO. COC	RECOV. FT.	PENETR Resist Bl/6in.	CORE NO.	RECOV.	900	CORE TIME MIN/FT.	AI	MARKS	
Lt gray, deeple locally decome ferous LIMES1 to intensely	posed fossili- ONE closely		46		c							ь	
locally crust	ed,occ. sm.		48 —			= ""	Run-3	#O#	141	2.2			
<u>‡</u>			- 50 -		i 				_				
LIMESTONE clo	fossiliferous		61 52				ų,	on.	d				
crushed.			- 53 - - 64 -				Run-4	2B\$	£1)	1.0			
Boring termin	ated at 55.1'	Ē	- 66 -	-		-							
‡			- 57 -										
‡			- 60				#1 == %						
<del>-</del>			-60 - - - 61 - 			-							
‡			- 62 - 63 -						- E				
<u>‡</u>			-64 - -65 -						-				- 1
Ŧ			66 -						١.				
1			- 68						- "				
<u> </u>		_]	70							HJK-			· , , -

T , L	.OQ OF	ВОВІХ	4G	В-	<u>-63</u> 9		_				SHEET	OF	3
PROJECT AND LOCATION SANTEE COOPER GENERATING	STAT	ION 1	IINIT 1	_	_		ELEVA'		NO DA		PROJECT NO.		-
ORILLING AGENCY	417.		FOREM	A N			DATE S				BOC409		
ARDAMAN AND ASSOCIATES			, GILLIA		Jones				198	o,	19 July		
DRILLING COUPMENT							COMPLI				MOCK DEPTH	_	_
CME-55 Mydro Rotary								-0 ft			16.5	ft	
3-7/8 17160UG	SIZE A	ND TY	PE COM	( BAR	MEL		NO SAM	PLES	DIST	в	UNDIST 1	C58€0 +	F +
CASING 3" "Flush Joint"		NX	"Doub	<u>ie Tu</u>	ıbe" (	СВ	WATER	1	FIRST		COMPL	24 15 P. O. 1	Ēŧ.
CASING HAMMER WEIGHT			DROP				BORING	VERT	E AND	DIRE	CTION	-,,-	
SAMPLER 2-IN O.D. SPLIT SPOON SAMPLER HAMMER WEIGHT 1	40 LB:		DROP	30 -	161		INSPEC	TOR	10.10		Giordano		_
SAMPLEN TANIMEN   ITCION	T LB.	֓֓֞֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֡֡֡֡֡֡֡֡		AMPLO		_	AOÇK	CORE		F1.	GIOFMANO		_
DESCRIPTION	ELEV. FT.	DEPTH, R	TYPE NO. LOC	RECOV. FT	PENETA Aesist Bljgim.	CORE NO.	$T_{i}$	900	CORF TIME MIN/FT.		REMAR	₹\$	
Dk grayish brn silty f-SAN			1		1	<u> </u>	$\dagger$			•	,		_
some clay, tr.veg., wood, dry		L, .	17	5	2	!							
v.loose (1.5 ft)	76.6		ĽĎ.	ļ <b>-</b>	1					ŀ			
Lt gray & yellowish brn		- 2 -	-			=							
silty,f-sandy CLAY,tr.veg.		ŀ ¹	ŧ –	$\vdash$	2								
firm (moist)		- 3 -	S-2	1.2	2			,					
		<b>L</b> . '	1 "	-	.3								
	1 - 1	Γ'.	]		-		i i	i					
				l						ľ			
(no recovery)					2	l					но выпр	le	
- (no recovery)		<b>–</b> 5 –	ž	0.0	2								
_		⊦ .	<u> </u>	_	3								
	l :	- , -											
	f i	٠. ١		-	i		]		- 11-				
Lt gray & tannish brn,f-	1	-•-	S-3	1.5	2								,
sandy CLAY, some silt, firm	1	· . •	1 ~	_	3		!						,
(taiom)	58.6	[".											
		- 10 -		<u> </u>			[ [						
.Dk greenish gray & tannish		ļ .	7	₹.	1				[ 1				
-brn silty CLAY, some f-sand		<b>-11</b> -	Ġ	ij	2 2								
_seam\$,soft-firm(moist)		٠ -	$\vdash$		4								
		— 12 —	1 -		=								
The amount of the		• •							=				
.Dk greenish gray CLAY, .some f-sand scams (moi≄t)	1 1	- 12 -					j						
- Sound I - Saild acoms (Moxac)		1,41		2	ェ								
		_ '•-	<u>-</u>	6.5	PUSH		11						
Dk greenish gray silty		15-			ъ								
-CLAY,frequent f-sand		- " -		100									
-pockets, soft (moist) (16.5 ft)	61.6	16-	2	2	2				-				
Bottom 6": Lt gray silty	07.0		S-	1.	3								
alcarcous f-SAND, some	-	-17-							2.7				i
imestone rock fragments,		F 1						_ = _					
v.loose (wet-moist)		_ 1# <u>_</u>	210		90								ŀ
		$[ \ , \ ]$					] [		- 1				-1
	1	""		. 1									- [
	1	20	<b>■</b>		E		1 - 1	•					- 1

				AMPLE	5		POCK	CORE	_	
DESCRIPTION	ELEV. FT.	DEPTH, FT	TYPE NO. LOC	RECOV. FT.	PENETR RESIST BLJGIN.	CORE NO.	RECOV.		CORE TIME MIN/FT.	REMARKS
Lt gray,clayey-\$ilty,cal- careous f-SAND,some fossil- iferous limestone fragments v.dense (moist) (decomposed rock)		21 - 22 23 -	9-5	1.3	23 31 33					
Lt gray, silty calcareous f-SAND, some feasiliferous limestone fragments, v.dense (moist) (decomposed rock)		24 25 26	S-7	1.4	42 44 40			10		
Lt gray silty calcareous f-SAND, some fossiliferous		- 28 29 30 -		-5	22					
limestone rock fragments, v.dense (decomposed rock) (moist)		- 31 - - 32 - - 33 -	8-8	1.1	101					
(36.0 ft) Lt gray, slightly weathered fossiliferous LIMESTONE, v.	42.1	- 34 - - 35 - - 36 -		9-	100/	_				Change to coring a 36.0 ft
hard, massive to mod. frac- tured, occ. sm. to med. vugs		37 38 39				Run-1	106	<b>\$</b> 06	5.0	
Lt gray, slightly to mod.  weathered, hard fostili- lerous LIMESTONE slightly weathered, occ. med. vugs,		- 40 - - 41 - - 42 - - 43 -				Run-2	**	924	7.0	
glauconite noted.		44.				Rur	1008	6	7.	

		k	LOG OF BORINGB-639							SHEET OF	
1			- <del>,</del> ;	. s	4MPL1	15		ROCK	CORE		
	DESCRIPTION	ELEV. FT.	DEPTH. P	TYPE NG. LOG	RECOV. FT.	PENETR RESIST BL/GIN,	CORE ND.	RECDV.	ROD	CORE TIME MIN/FT.	#EMARKS
	Lt gray deeply weathered : locally mod. fossiliferous LIMESTONE, closely fractured to mod.		- 45 - - 47 - 48				Run-3	308	26%	3.0	-36.0 ft-46.5 ft hard slightly weathered limestone
=	Lt gray, deeply weathered		49 50					1	-		
_	Lt gray, deeply weathered locally decomposed fossili- ferous LIMESTONE glauconi- tic slightly fractured to locally intensely fractured	W.	- 53 - - 53 -		7		Run-4			min/5 ft	
<u>-</u>	Boring terminated at 56.0'	_	- 55 -					72		9	
		-	- 67 - - 58 - - 59						_		
-			-62 -								
	† † † †		- 63 -								
-	Ŧ Ţ		- 67				1.		2		
	‡		- 68 - - 69 -			-21 1 2 1 2	# H				

	LOG OF	BORI	vc	<u> </u>	-540		_			SHEETOF
PROJECY AND LOCATION							ELEVA	TION A	ND DAT	UM PROJECT NO.
SANTEE COOPER GENERATIN	G STAT	FION,					77	.99 :	Ft M\$L	80C4090C01
ARDAMAN AND ASSOCIATES			FOREM				DATE 5			DATE FINISHED
DRILLING FOUIPMENT			<u> </u>	J. 3	Jones				y 1980	
CME-55 Hydro Rotary								.5 f	t	NOCK DEPTH 15.5 ft
size and given detalline"			PE COR				NO SAM		g	UNDIBT COME 20.0 f
CASING			олр) е				WATER		FIRST	DIRECTION ZAFA 4 F
CASING HAMMER WEIGHT	140	LDS	DROP	30-3	Lnch		BORING	VERT	LE AND (	DIRECTION
FAMPLER 2-IN Ö.D. SPLIT \$POON FAMPLER HAMMER WEIGHT	140 LB		DROP	30 -	1 hi		INSPEC			Giordano
MEISH!	140 CB	<u>,                                    </u>		AMP()		_	NOCK.	CORE		GIOZGANO
		≒	Ŗ				"T.\"		<u>, , , , , , , , , , , , , , , , , , , </u>	
DESCRIPTION	EL EV.	DEFTH,	TYPE NO. 10	RECOV.	138	CORC NO.	10 V.	ء ا	##2	REMARKS
	급분	20	₹ 2	## <b>!</b>	PENETH RESIST BL/GIN.	유유	₩,	F06	CORF TIME MINA	
ot brn silty-sand (0.5 ft)	77.5		1	Νį	2	Н	<del>                                     </del>	_	<del>   </del>	•
Dx gray & yellowish brn		L.	S-1		2	Į .		1		
f-sandy CLAY, some Silt, t	¥	<b>!</b> ' '	$\vdash$		3	1		ĺ		
veg.,firm (moist)		L 2 .	4							
bk. gray & yellowish brn	1	- v	╂	-	2	Į			1	
CLAY, some M-c sand, tr.		- 3 -	· ?	**	4				[	
gravel,stiff, tr.veg. (moist)		ŀ	Ś	1	4				F	
(MOISC)		<b>├</b> ⁴ ⁻	1-	<del>                                     </del>	┿	•	1			
	1 -	<b>.</b>	1	İ	}					
Lt gray & grayish brn	1	- 5 -	_	w	2	1			1 1	
f-sandyCLAY, some silt,	1	L		,	2					
plastic	1	Γ"~	1 "		4				1	
		E							1	
		Γ΄,	1				1 1			
		<b>⊢</b> a -	. →	-0	1					
. Lt gray & yellowish brn	ł i		\$-\$	-:	3					
silty CLAY, some f-sand	1 !	- ه ا	₽		3					
(moist) firm	1 1		1				1 1			
Top 12":Same as 5-4		<b>- 10</b> -	<del>-</del>							
(11.0 ft)		·	S5	.5	2		fil			
Lt gray & tannish brn	\$7.0	— 11 –	1 º	¬	2	[				
. clayey f-SAND, some silt,	× =		1	_	-				[	
tr.m.sand,loose(moist-wet	-)	- 12 -	1						^_	
(13.0 ft)	65.0		1	ŀ	- v				1 1	
	1 "		j .	-						
		_ 14 _	J				1 1			
			l	111						
Dk greenish gray CLAY		<b>–</b> 16 –		<b>.</b>						
some f and seams (15.5')		-	3-6	1.4	10					
Lt gray silty f=calcare-		- 76 -	ο,	7	25		1 1			
_ fragments (wet)v.dense	1	<u> </u>			J. 3				1	
- Lindweiter theritanisa		- 17 -	1				]		) <b>I</b>	
		Ĺ :'								
		_ '8 <u>-</u>								
		Ĺ 10.								
					7.5					
							, .			

	L	OG OF	BORING	<b>.</b> t		SHEET OF3				
		FT.		AMPLE			AOCK.	CORE		
DESCRIPTION	ELEV. FT.	DEPTH,	TYPE NO. LOC	RECOV. FT.	PENETA RESIST BUSIN.	CORE NO.	RECOV.	200	CORE TIME MIN/FT.	REMARKS
Lt gray silty calcareous  - f-c SAND, some limestone  - rock fragments, tr.clay,  - shells, v.densc (moist-wet)		21 - 27 - 27 - 27 - 27 - 27 - 27 - 27 -	S-3	1.0	27 35 38					V.
(decomposed rock)  Lt gray silty, calcareous  f-c SAND, some limestone		- 1 23 - 24	_			-				
rock frags., some clay, tr. shells, y dense (desomp, tock  Lt gray, deeply weathered	52.5	Γ -	8=2	0.5	140					Change to coring at 25.5'
to decomposed fossilifer- ous LIMESTONE closely fractured to crushed.		- 26 - 27 - - 28 -			 	-1		م ا	2	
<del>-</del>		- 29 - 30				Run-1	284	<b>*0</b> •	1	
to decomposed fossilifer- ous LIMESTONE, closely fractured to crushed.		31 32		_						Barrel plugged off, recovered 2.0 in 2nd attempt
1		- 33 - - 34 -				Run-2	64%	*9	8.0	
Top 12":Lt gray deeply		35-	_					_		
weathered to decomposed fossiliferous LIMESTONE Bottom: Slightly to mod. weathered, fossiliferous LIMESTONE, closely to mod. fractured.		- 36 - - 37 - - 38 -				Run-3	196	261	4.0	
		- 39 - - - 40 -		ļ						
Lt gray decomposed to deeply weathered, fossili-ferous LIMESTONE, intensel fractured to crushed.	У	43				Run-4	301	\$0	2.2	
<u> </u>		F 44	1	7142						

		.00 OF	BORIN		<u>_</u> B-6	40				SHEET OF 3
		-£		AMPLI				CORE		
DESCRIPTION	ELEV.	DEPTH, FT.	TYPE NO. LOC	RECOV.	PENETA RESIST BL/68M.	COME NO.	RECOV.	go e	CORE TIME MIN/FT.	REMARKŞ
		Ι.				R-4		<u> </u>		
Boring terminated at 45.5	Į į	46			'				1	
		L 1	1	ĺ	1 1					
	ł	-47 -	l	<u> </u>	]					- ·
		<b>-48</b> -	1							
		· ·	1							
		- 49 - -	1			-				
		<del>-</del> 50 -			]					
		-			]					
		_51 —								
		— <b>6</b> 2 —								
		-					1			
	1	— 63 —							1	
							- [			
		- 55 -					. !			
		- 54 -								
							7-		ŀ	
	i	- 67 -								
							ŀ			
		- 55		1			ĺ			
	1	- 69	li			ļ				
	1 1					- 1		×		
		-60				- 1				
	1	-61-				Ì	-		1	
		1							ı	
		- <del>6</del> 2 -				-				
		<b>— 63 —</b>								
							Į		o .	
	-	_64 -			[		[		- 1	
		- 65			- 5		į		- 1	
			j							
	- 1	-66 -			==	h =			ļ	
			1000				l			
	<27	- 87 - -			-V =	- 1				
	- W=	<b>- 65 -</b>						100	Y P	
							NI,		. 7	
		- 69 -				ł				
		7.0		123	_0					

	L	DG OF	BORING	· —	H-1	<b>(341</b>					SHEET OF
PHUJECT AND LOCATIO		_					_				UM PROJECT NO
SANTEE COOPER	GENERATING	5TAT	ION, U	NIT 1						ft MS	
DAILLING AGENCY		11	ľ	OPEM	AN .			DATE ST			DAYE FINISHED
ARDAMAN AND	ASSOCIATES		<u>l</u>	D,	. Gan	дy		LOMPLE COMPLE	Jul	y 198	30 19 July 1980
DRILLING EQUIPMENT								1	5.1 f		17.5 ft
CME-55 Hydro				E CORI				NO SAM			UNDIST 20.5 It
NIZE JAMPJENFAPE 1828.	ne -									IAST_	20.0 1t
CASING 3" "Flush .		NX		ible :	Г/тре	CB		WATER	ANG	EAND	DIACCTION
SASING HAMMER	WEIGHT			DIK OA.					<u>vert</u>		
SAMPLER 2-IN O.D.		40 LB		DROP	30 -	IN		INSPECT	- NO	N	M. Giordano
SAMPLER HAMMER	MEIGHT	T			AMPLE	8		ROCK	CORE		
		l l	<u>.</u>	ö	Š.	<u> </u>		Υ.		Ħ	2
DESCRIPTION	DN	EL EV.	DEPTH,	TYPE NO. L	8	돌았음	COME NO.	RECOV.	90	CORE TIME MIN/F	REMARKS
•		37	ä	# ₽	11	PERETR Resist Blubin.	85	£ # #	ĕ	ਹਿੰ∓ <b>ਡ</b>	
			H		$\vdash$	1	_				
Dk brn, silty f	-SAND, SOME		ľ.	2-1	s:	2					
clay,tr.veg.v.	TOORG (GTA)		[ ' ]	Ċ	7	2				} 1	
			L			==		ŀ			(4)
<u> </u>	(2.5 ft)	75.9	1 .	<b>Ļ</b> _	<u> </u>	$\vdash$					<i>y</i>
Dk grayish bro	fine sandy	4	ـ د ـ	ņ	₩.	9					·
CLAY, tr.c-sand	),.stif <b>f,d</b> ry	1	Ļ. · .	. တဲ	-	9		1	1		_
			<u> </u>	_	+	-6	1	ŀ			
<b>T</b>		1		1		'	1				
		1	L 5 -	┺	+	<del>  -</del>	ł		9		
ray & lt yell	low bin		L 4	4	٦	6	L		1		
I (mottled) fine	sandy CLAY		<u> </u> 6  −	ال ال	1:	5	1		ĺ		
t clayey t-SA		<sup>C</sup>	<b>ŀ</b>	<b>+</b> ···	-	5	1				* ·
stiff	dry		- 7 -	1	1		ı		ļ		
+		ŀ	-	┿	+	1 -	t		1		
			— в -	7	2	1 2	Į.				
Lt gray & yel	TOWIED DID		-	ę,	-	3	1				
(mottled) find	e Fandy, off (moist)	68.4	<u>,</u> - • -	-	+	12	1			1	1
SIITY CLAI, B	OTC (MOTOC)	1000		1	118	1					
_ _ Lt green & gr	eenich grav	1	10	1		2	1				
f-mandy CLAY	u/fren gilt	J	F		, m	2		1	ŀ		
+ f.sand seams,	tr.vegsof	á	<b>-11</b> -	r,	٦,	<u>-</u>	j				
_ 1,52nd secms;	, , _ , . ,		Ĺ	1			1				Vane shear tost 12.0
. MOISC			12	1			ı				ft - 13.0 ft
<b>T</b>			13				1		1		Undisturbed: 0.54 tsf
		1	L '3'	9	5	2		ļ			Romolded :0.41 tsf
Dk greenish g	ray CLAY W/	′	L.,	S-6		2	1	Ì			
frequent silt	y f-sand		L	<b>L</b> _		1 3					Vane shear test 16.0
peams, tr.m-sa	ınd,firm		- 16						1		ft - 17.0 ft
(moist)		1	+ "	4			1 -				Undisturbed:0.11 tsf
+ Dk grn gray	HAY w/freq		16	-			1			- 175	Remolded :0.08 tsf
silty f.sand	seams (Mois)	Ę	-	4		1	1				-
		1	J- 17	+	+	~ 1	1		1		
	(17-5 ft)	60.	4	r r-	4	32					
ottom 18":	Lt gray,	av 3	- 10	S-7	1,4	50/6	1				
silty,calcar	60/r r=0	_]	ł.	+			-				
SAND,limesto	ne rock ira	٦	- 19	-			L				
F ments (wet)v			- 20	1				ا ع	Į.		1
	K. I	- h	4 V		4		_		_	_	

	LOG OF BORING									SHEET 2 OF 3
	V	, FT.		AMPLE	<del></del>	$\overline{}$		COME		
DESCRIPTION	FT. FT.	нь в	TYPE NO. LOC	RECOV. FT	PENETA RESICT BL/GIN.	CORE NO.	RECOV.	R.000	CORE TIME MINIF	REMARK\$
Lt gray,silty,calcareous f-c SAND,limestone rock		- 21 -	8-8	1.5	32 35			-		starting to lose water @ 20.0 ft
fragments, tr.clay, v.dense		- 22 -			5Q					2 1 1
(decomposed rock) (wet)		23							a	
‡		-								
‡		_ 24 _			= 1					
(26.1 ft)	52.3	- 25 - 	6-S	1.0	2D\JT-2, 30 42					
Lt gray deeply weathered to decomposed fossilifer-	V.	F ** -				V A				Change to coring at 26.1 ft
ous LIMESTONE, occ. med. vugs mod. fractured, locally	ŀ	rr 27 – -								
crushed.		- 26 -				Run-1	941	741	9	
<u>†</u>		- 29 -	- 1			H.	φ	"		
		30-	-				- 2	=		
Lt gray, deeply weathered fossiliferous LIMESTONE,	٠, -	- 31 -								
massive locally closely fractured to crushed.		- 32 - -	Į							
110000000000000000000000000000000000000		— 33 <del></del>	1			Run-2	1004	92\$	5.0	
‡	X	-34-  -	1			표	)ī	Ŭ.	"	
		<b> 35</b>								
Top 1.9': Lt gray deeply weathered	, -	— 36 — -				200				Top 1.9 ft soft Bottom 3.1 ft hard
fossiliferous LIMESTONE, mod.fractured	- 1	- 37 - -	1			1				1
Bottom 3.1: Lt gray,slightly weathered		- 30 -	1	ļ		Run-3	100%	9B\$	3.2	
to mod., hard, fossiliferous		39-	1			五	ĭ	, ,	] ''	
vugs, glauconite noted.	1.0	40-	1							
Lt greenish gray mod.		-41-	1	-	-	Т				
weathered, fossiliferous LIMESTONE, massive glauco-	Ì	42 -	1			- T				
4 nitic		- 43-	1			Run-4	96	944	3.6	
		<u>۱</u> 4.	1			-				
<u> </u>		<u> </u>	1		1	<u> </u>	L	ـــــ	Д.,.	1

		LOG OF BORING B-641  - SAMPLES ROCK CORE								5HEET3 OF3		
DESCRIPTION	EL EV. FT.	ОВРТИ, ЕТ	TYPE NO. LOC		PENETH " HESIST BL/GIN.	ON 3HOO	RECOV.		CORE TIME MIN/FT.	ŘÉMARKS		
<del></del>		-				þ-8	<b>\$</b> 96	<b>8</b> þ6	3.6			
Boring terminated at 46.1 ft		- 46 -										
		- -48-	1		۸		-		.			
		_48 -	1									
		50 -		=				v				
			1									
		- 52 - - 53 -	}									
		- <u></u>										
		- 65 -								9		
		54	1					 		- -		
		_ s7 -	1		= 1		."		-			
		- 58-	1									
		- 59	}			1		-				
		- 61 -	}									
		6.2 -	1			-						
		63 -	1							ν -		
		-	}									
		- 65 -	1					1,,				
		- 56	-	= 1					v			
		67 - 68 -		:								
		69 -	<u> </u>									

L	0G OF	BORIN	د <u> </u>	B-6	42		_			SHEET OF _3
PROJECT AND LOCATION SANTEE COOPER GENERATING	STAT	ION I	INIT 1							TUM PROJECT NO. 8004090001
ORILLING AGENCY	*****		POREM.	ÀN			DATES	8 ft		DATE FINISHED
ARDAMAN AND ASSOCIATES				. Ma	ıy			uly		17 July 1980
CME-55 Hydro Rotary							сом <b>г</b> ца 47.5		DEFTH	ROCK DEFTH
SIZE AND TYPE OF BIT	SIZE A	NĎ TÝ	PE COR	EAAA	REL		NO SAM	PLES	JIST	UNDIST CORE 2 20.0 ft
CASING Hollowstem Auger	N	x "taca	ble I	"אַרוניי	'C'R		WATEP LEVEL	-	IMST C	2 COMPL - 24/14 FA
CASING HAMMER WEIGHT			DRQ#				SORING	VERT	LAND	SIRECTION
SAMPLER 2-IN O.D. SPLIT SPOON		,					INSPEC			
SAMPLER HAMMER WEIGHT 1	40 L8:	<u> </u>	DROP	30 -			#DÇK	CORE	- 1	. Giordano
DESCRIPTION	ELEV. FT.	ОЕРТИ, FI	TYPE NO. LOC	RECOV.	PENETR RESIST BUGIN.	CORE NO.	T,-	Đ.	CORF TIME VIN/FT.	REMARKS
Dark gray,f.SAND,loose(dry)			$\vdash$		4		+			·- · · · · · · · · · · · · · · · · · ·
(1.0 ft)	76.2	<b>[</b> . ]	1		6					
Dark gray ben.& SAND, some		[ ' ]	S-1	1.5	6			i		
clay, tr. milt, roots, veg.	l I	<b>-</b> ₂ -	٧٧	~	1 :					
<u>loose (2.5 ft)</u>	74.7	┡ .	▙	<b></b> -	10	1				
Dark gray & yellow, brown &	i	- 2 -	-2	7/	8			}		
_lt.brown(mottled) f-sandy _CLAY.some #ilt. Stiff;(dry)	ł	┢	ø,		7	1		ł		
CDAY, some sile. Sciii; (GIY)	l I	<b>-</b> ⁴ -	1			1				
		' .	1		} '	1				
-Light gray brn CLAY w/fre-	1	<b>-</b>	<u></u>	5	3	1		¥	1	
-quent yellow brn clayey f	i	L	,	-	5	1			1 -	
-sand seams, some veg., stiff:	ł	LŤ.		<u> </u>	8				1	
(moist)	l	- 7 -	1	ľ						
	ŧ		₽	$\vdash$	5				1	
Light green, gray & lt tan-		<b>⊢</b> • ∸	\$-4	₹	4	ł				
nish brown CLAY, some f sand		┞ .	Ś	ι -	3	1				
tr silt, firm. (moist) (9.5 ft			<del>  -</del>		<del></del>	1				
Light green-blue gray & lt		t `	f	=	.	l		11	27	
brown f-sandy CLAY, some		10-	. 2	6	1					_
silt,tr.veg.,decomposed		L.,_	, o	1	2	1				
wood, soft (moist)					<u>l</u>					_
	65, 2	12-	₩	<b>-</b>	1					
			4							
-	1	— 13 ~	<b>₹</b> ∵ .	0	PUSH				1 1	
-bark greenish gray CLAY w/			i i	2,0	2	1			1	
~some milty mand meams.		74	1			1	1			Vane shear test ran
		٠ '	1	1	1	1				at 15.0 ft in B-642-A
		_ `° -	<u></u>	L.	0	1				qu≃ 2.0 tsf
		[ ,, ]	S-6	<b>-</b>	0	-				
-Dark greenish gray CLAY, -packets of light gray sil-		ւ".	Ľ	111	0				4.	
y f.sand.tr veg.soft.		- 17 -								
(wet/moist)	_	┡	-7	2	PUSH					
-Dark greenish gray CLAY.		<b>–</b> 18 –	CD-2	12	Ē		-	1 2		
		<b>t</b> .	1	d						
		19-	t			1				
		_	_		1					

	LO	G OF	BORING	<u> </u>	B-642					BHEET 2 OF 3
2,22.2		Ŀ		AMPLE			HOCK	CORF		
DESCRIPTION 2	<u>.</u>	DEPTH, FT	TYPE NO. LOC	ЯЕСОУ. FT.	PENETH RESIST BL/SIN.	CORE NO:	RECOV.	GDH	CORE TIME MIN/FT	REMARKS
Dark gray, silty CLAY, (Mbist) highly plastic		21 -	S-7	1.5	WR					
	F	22 -						(a)		
	Ē	- 23 - - 24								
\ <u>-</u>	), 7	- 25 <b>-</b>		5	0					
Light gray silty calcareous f.SAND & LIMESTONE ROCK FRAGMENTS, some shells (wet)49	. 7 ∍. 7	- 26 - - 27 -	8-8		25 50/4					
(27.5 ft)		- 27 - - 28 -	$\vdash$	-		-				Changed to coring at 27.5 ft
Light gray deeply weathered to decomposed foss.LIME- TONE closely fractured to	į	_ 29 _ - - 30 -				Run-1	\$0.8	384	1.0	
Jroken		- 31 -								
	١	- 32 -	<del> </del>	_		╀-	<del> </del>	igwdap		
Light gray deeply weath- ered to decomposed foss. LIMESTONE closely fractured to broken bottom 1.4 ft		— 33 - - — 34 -	1							
mod.to slightly weathered.		- 35 - -	}			Run-2	1001	36\$	2.4	Hord rock at 36.0 f
		- 35 - - 37								
Light gray, mod. to deeply -weathered foss.LIMESTONE		- - 30	1							
-mod.fractured locally -closely fractured,chlorite -noted		- 340 - 440	]			Run-3	1001	108	5.0	
		41	1			"				
m		- 42 - 43	+	+				+	-	
light greenish gray decom- posed to deeply weathered foss.LIMESTONE, closely fractured to crushed, chlor-		F	]			Run-4	72%	184	1.6	

		.00 OF	BOR)N	<u>-</u>	B-642		_			SHEET OF3
1		FT.		AMPL E	i 5			CORE	_	
DESCRIPTION	EL EV. FT.	DEPTH.	TYPE NO. LOC	RECOV. FT.	PENETA Resist Blubin,	CORE NO.	RECOV.	go <sub>F</sub>	CORE TIME MIN/FT.	REMARKS
		} -				4				
		48-				Run-4	72%	181	1.6	8
		47 -				H				
Boring terminated at 47.5		48-								
	]	49 -								
	1	-	_		_=	1				
		- <b>5</b> 0 -								
		<b>51</b>			i			=		
	1	<b>- 52 -</b>								
		- 53			1 -					
		Ŀ:								
: " " v <sub>in</sub> :		- 54								
		- 65 -					*.			
		- 546 -								
		57 ~				i				
		•							]	
		- 68	Ì						] <b> </b>	
4 544.		- 69								
	-	eo -								
	- >	61-								
		- 62 <b>-</b>				1				
		— <b>63</b> —				1				
		64 <b>-</b> -				Į	- 1		ŀi	
		- 65 -					-			
									j <b>i</b>	
		- 66					13		<u> </u>	
		— 67 —							× = = = = = = = = = = = = = = = = = = =	
		66			9					
		 			- D I					
		70 -					=			

LOC	QF	ORING		B-64	3 <u> </u>		_			SHEET1 DF2
HOJECT AND LOCATION		ON		_	_	7	LEVAT) 77	ON AN	D DATUM	80C4090C01
SANTEE COOPER GENERATING S	TATI	- J	JREM▲	N Gand	ıy	ı		July	1980	22 July 1980
CHE-55 HVdTO ROTATY		- 1	COMPLE 44 NO SAM	.0 <b>f</b> 1	t	18.0 ft				
CASING 3" "Flush Joint"		(D ТУР! Х "Do!	uble			ı	WATER	-	IRST	COMPL - 24 TO Ft
SAMPLER 2-IN O.D. SPLIT SPOON		10	ROP	30			INSPECT	VERTI	CAL	Giordano
SAMPLER HAMMER WEIGHT 14	O LBS	눈		MFLE	7		AOCK	CORE	—	
DESCRIPTION	ELEV. FT.	DEPTH, I	7 Y PE NO. LOC	RECOV.	PENETR RESIST BL/\$JN,	0096 NO.	RECOV.	7 O-0	CORF TIME MIN/FT	REMARKS
The brn silty fine SAND, some veg.,v.loose (dry)			S-1	1.3	2 3					
Dk brn to yellowish grn fine-sandy CLAY, some silt tr decomposed veg (dry) stiff  Gray & yellowish to tan- nish brn, fine sandy CLAY & clayey f-SAND (dry) stiff  Lt tannish brn & lt green ish gray, f-sandy silty CLAY, soft (moist)  Lt grosnish gray sandy silty CLAY, v. soft, tr veg (moist)	69. 67. ]		S-5 S-4 S-3 S-2	1.5 1.5 1.5	5 5 6 6 2 2					
Groenish gray CLAY w/free then silty f-sand seams Top 6" greenish gry clay w/fr silty sand seams  (18.0 ft  Lt gray silty calcareous f-SAND.tr limestone room	) 5 s	9.1	1	1.4	2 9					Vane shear test 13.  ft-14.5 ft Undisturbed-1.40 ts Remolded =1.24 ts  qu=1.25 tsf (pocket penetrometer) Vane shear test 16. ft-17.5 ft Undisturbed=0.93 ts Remolded =0.93 ts

	ı	.OG OF	BORING	ā	в-6	43				SHEET OF
DESCRIPTION	ELEV. FT,	OEPTH, FT.		RECOV. M	PENETR <sup>VI</sup> Resist Bl/6in.	CORE NO.	Ŀ	CORE CORE	CORE TIME MIN/FT.	REMARKS
Lt gray, silty f-c calcare- ous SAND, some limestone rock frags, tr clay, v.dense (wet) (24.1 ft)  Lt gray, deeply weathered to decomposed fossilifer- ous LIMESTONE crushed to intensely fractured	53.0	- 21	5-8		5071	Run-1	121	*0	1.4	Change to coring 24.1 ft
It gray, decply weathered fossiliferous LIMESTONE locally decomposed, closely to intensely fractured, locally crushed		27 - 20 - 29 - 30 - 31 - 32 - 32 - 32 - 32 - 33 - 34 - 34 - 34				Run-2	46%	19	2.4	
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, massive to mod. fractured occ.sm.vugs		- 33 34 36				Run-3	<b>\$96</b>	78%	4.8	
Lt gray, deeply weathered fossiliferous LIMESTONE closely fractured to crushed, occ. sm. vugs.		33 - 40 - 41 - 41 - 42 - 43 - 43 - 43 - 43 - 43 - 43 - 43				Run-4	39\$	#**	5.2	
Boring terminated at 44.0°		- 44 - - 45								

		LOG OF	BORN	vG ——	<u>B</u>	-644		_				SHEET	OF	3
PROJECT AND LOCATION	FA4F 6 + T-4-							ELĖVA	TÍÖN A	ND DA	TUM	PROJECT NO	5.	
SANTEE COOPER G	ENERATING	SIA	TIDN, I							t MSL		80C40		
ARDAMAN AND AS	COCIATEC			) OKEN	Д. J. J.			DATES		1980		DATE FINISHED		
DRILLING EQUIPMENT					J. J.	01163		COMPL	_		22 July 1980			
CME-55 Hydro Ro	tary							-	0 ft	DENIH	AOCK DEPTH 25.0 ft			
SIZE AND TYPE OF BIT		SIZE A	ND TY	PE COA	E BAA	AEL		NO SAN		DIST "	UNDIST	<b>6705</b> 0	-	
CASING 3" "Flush Jo	int"	NX.	"Dou	ble B	3 <i>TTO</i>	1"		WATEP	$\longrightarrow$	FIRST		COMPL	24-4-9.9	ft
	WEIGHT			DROP	4110	<u>-</u>		BORING	ANG	E AND			7 3.9	Ιţ
SAMPLER 2-IN O.D. SP								INSPEC	VERT	ICAL				
SAMPLER HAMMER	WEIGHT	140 LB	S	DAOP	30 -						М.	Giordano		
			Ŧ	<del>5</del>	AMPLI			ROCK	CONI					
DESCRIPTION		ež.	EPTH,	TYPE NO. LOC	9	PENETA RESIST BL/6IN.	ا يا ا	AECOV.	_			REMAI	aks	
		ELEV.	끃	ŽÝ	7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.7.	F. F. S	CORE NO.	پر کے ا	92	CORE TIME MIN/F	ľ	•	=	
Dk grayish brn.f-	Sandv	+	←	_	+	<del>-</del>	∺	+	<del>  -</del>					
CLAY some silt, tr		<u>.</u>		3-1	1.4	2	l		ĺ					
dry			[ ]	<u>"</u>	<u> </u>	1 2	1			}				
			L , .							ìi	İ			
-			<b>⊦</b> ^.	₽		<del> </del> _								
- Dk grayish brn &	yellow		<b>-</b> 3 -	5-2	ις.	2 2				-				
-brn (mottled) CLA			<b>Ͱ</b> ′	ம்		3								
sand, tr silt, veg		1	<b>∱</b> ^ -	•		<u> </u>		i						
	(moist)		T _ T	1					İ	1 }				
L			<b>[</b>	<u> </u>	0	2								
			<u>-</u> ه ـا	nc.	۱ <u>۵</u>	3		!						
		l ,	ĻŤ.	Z	<u> </u>	5			<u></u>					
			L 7-											
			٠ .	<b>!</b>	┿	1		1		-				
- Lt greenish gray		1 - 1	- * -	S-3	! -:	3		i		l i				
to lt brn (mottle		1	† -	S	7	4								
sandy CLAY, some s	x1t,I1Fm (moi\$t)—	67, 9	<b>- ₽</b> -											
	(MOX = C)		- 10 -	<u> </u>										
- Lt green CLAY w/f	requent	1		#	5									
- thin f-sand seams	,tr.veg.,	,	-11-	5-4	i i	2 2		1						
- \$ilt,\$oft			├ -		-	*					ı			
- Lt green CLAY w/f		l Ì	— 12 ~		_	1								
<ul> <li>thin silty f-sand tr veg.</li> </ul>	<b>s¢∆</b> mB (13.0 ft)	64.4		S~5	1.5	ī								
Lt grn silty f-ms			C 13 7	. "		3								
& silty,clayey f-			ב,, ו	9	2	1		1 1		×				
_tr veg.(moist) (1	3.5 £t <b>∫</b>	1		9-s	-	3								
Lt greenish gray,	silty		- 15 -			5								
f-m SAND & f-m sa		Į l		<u>د</u> .	7,	3								
tr clay,loose,wet			16-	Ϋ́	1.	5								
Lt greenish gray,			- : -		_,	2				31				
f-SAND, some m-san	d, tr.cla	1 1	- 17	SS	1.1	Ž								
.cose (wet) - Lt greenish gray	=11+v	-	[]	."		3		[ : ]						
- Lt greenish gray - f-m SAND, some cla			[ " ]		11					f				
(wat)	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		_ tp _											
	.0 ft)	57.4	-	- 1										

#### WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

	LOG OF BORING B-644								\$HEET OF3	
DESCRIPTION	ELEV. FT.	13 'H149G	TYPE NO. LOC	RECOV. F	PENETR PRESENT BL/GIN.	CORE NO.	·	00 ADP	CORE TIME MIN/FT,	REMARKS
Dk greenish gray CLAY w/ frequent pockets of silty f-\$and,v.soft (wet-moist)		- 21 -	6-S	1.5	0					qu=0.25 tsf Vane shear test 21.1 ft-22.5 ft
(22.5 ft) Lt green silty, f-m SAND, some	54.9	_ 22 ~ - _ 23 _	_		WR	=				Undisturbed:0.39 ts Remolded :0.31 ts
clay,v.loose (w∉t)		 - 24 -	5-10	0.5	WR WR WR					Spoon fell 2.0 ft Attempted U.D. 024.
(25.0 ft) Li gray silty f-c SAND, & " limestone rock fragments,	52.4	- 25 -	s-11	0	4 5			. "		ft, hit rock at 25.
v.dense (moist)		25 - 4 27	Ġ	1	21				=	Void bet. 25.5 ft & 25.9 ft - lost wate very slowly.
		- 28 -			=				Ŧ	
		— 29 — - 30 —		5				20		
Lt gray, silty f-SAND, some clay, tr limestone rock frag ments, v-dense (moist)			-12	S.	35 40					Change to coring
Lt gray slightly to mod.	45.4	32-	-S	1	100/5			<b>.</b>		32.0 ft Top 1.3 ft soft
weathered fossiliferous LIMESTONE, Top 1.3':deeply weathered,occ.sm.vugs,mas-		33 34				4			80	
sive to slightly fractured, locally crushed.	= =	- 35			-	Run-1	\$66	74%	3.8	
		346 	2							
Lt gray mod. weathered fossiliferous LIMESTONE,		- 37 - 38 -	· -	- - - -	- - - 					
frequent sm.vugs.locally massive to mod.fractured.	L .	- 379 - - 40 -	8			Run-2	100%	<b>₹</b> 06	5.8	
		41-								
Lt gray deeply to mod.  veathered LIMESTONE, mod. to  closely fractured, frequent  sm. vugs		- 42 - 43 -	8			Run-3	\$96	\$B\$	4.0	

B-644 LOG OF BORING \_\_\_ БНЕЕТ <u>3</u> ОР <u>3</u> FAMPLES MOCK COME TYPE NO. LOC DEPTH, CORE TIME MINJET. DESCRIPTION CORE NO. REMARKS 8 45 47 Lt gray deeply weathered fossiliforous LIMESTONE freq.sm.vugs,massivo locally closely fractured. Run-4 98€ Ŋ 50 Boring terminated at 52.0' 55 -61

LO	G ÓF	BÓRIN	<u>в</u>	645			_			SHEET OF
PROJECT AND LOCATION SANTEE COOPER GENERATING S	STAT	ION, U	NIT 1				ELEVAT	_	ND DAT	UM PROJECT NO. 80C4090C01
DRILLING AGENCY		7	FOREMA	N.			DATE S		D	DATE FINISHED
ARDAMAN AND ASSOCIATES DRILLING EQUIPMENT			John	May	,		10/	7/80		10/7/80
	Failing 1500									24.0 ft
	ZE A	ND TYP	E CORE	BARE	REL		NO SAM	9 ft PLES C	DIST	UNDIST 4 CORE _
CASING 4 in. PVC		ì	N/A				WATER LEVEL		IRST _	
CASING HAMMER WEIGHT			DROP				BORING			DIRECTION
SAMPLER 2-IN O.D. SPLIT SPOON							INSPECT	VERT		
SAMPLER HAMMER WEIGHT 14	0 LBS		DROP	30 -		-	ROCK	CORE	D. F	ate
DESCRIPTION	ELEV. FT.	DEPTH, FT	TYPE NO. LOC		PENETH RESIST BL/61N.	CORE NO.	1;	Rab	CORE TIME MIN/FT.	REMARKS
-Topsoil (HUMUS,ROOTS,SILTY -SAND)		- 1 -								PVC Casing set to 4.5 ft Drilling with water
wark brown silty CLAY, tr fine to medium sand; moist stiff	69.8	- 4 - 6 - 6 - 7 - 7	t-00	2.0	PUSHED					Driller reports change at 7.5 ft
Light Buff to Gray sandy CLAY, trace silt, moist	6 <b>5.8</b> 64.3	- 0 - - 10 - - 11 - - 12 - - 13 -	up-2	2.0	PUSHED			0 -		Driller reports change at 13 ft
Dark gray tilty CLAY, some fine sand; moist, soft		- 14	UD-3	2.0	OSHSOA					change at 13 It

			3.	AMPLE						
DESCRIPTION	ELEV. FT.	DEPTH, FT.			PENETA RESIST BL/61N.			COME	CORE TIME MIN/FT.	REMARKS
Dark gray silty CLAY, moist, firm	55.8	-21-	to-4	2.0	PUSHED			1		
Dark gray clayey medium to fine SAND, trace silt, shells, wet, stiff		-22 - - 4 -23 -								
	52.3	<b>-24</b> -25	S-1	0	35 50/5	,				Driller reports rock at 24 ft
Boring terminated at 24.9'				ď			_			
<u>‡</u>	- '-	- - - -	J7							
<b>+</b>		,   								
‡ ‡									= = =	
‡		-	11							
<del>-</del>			2.0		=		-			
‡					2					
1										
					10 2					
τ -										
‡								.,		

LOG OF BORING B-646 SHEET 1 OF 2

	STAT	ion.	UNIT 1						NO DAT	FUM PROJECT NO. 80C4080C01
DRILLING AGENCY	_		FOREM	AN	-				D	DATE PINISHED
ARDAMAN AND ASSOCIATES		-	Gand	У			10/2	/80		10/2/80
BRILLING EQUIPMENT							COMPLE	TION	OFFTH	
DRILLING AGENCY DATE PINISHED										
SANTIE COOPER GENERATING STATION. UNIT 1  B1.10  B0.100  B0.C080C01  DATE FINANTED  DATE FINANTE										
SANTEE COOPER GENERATING STATION, UNIT 1  ARDAMAN AND ASSOCIATES  FOREMAN Condy 10/2/80  ONLETTO OFFT  COMPTSO  COMPTSO  ONLETTO OFFT  COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY COMPTSO  ONDESTING PARTY ONDEST COMPTSO  ONDESTING PARTY ONDEST COMPTSO  ONDEST										
SANTEE COOPER GENERATING STATION. UNIT 1  B1.10  B0CABBOOLD  ARDAMAN AND ASSOCIATES  Candy  10/2/80  COMPLETION DEFTH  10/2/80  C										
							INSPECT	QΗ		
SANTEE COOPER GENERATING STATION, UNIT 1  ### SPARKAN ARDAMAN AND ASSOCIATES    Candy										
			<u> </u>			_		-0.5	1 2	
DESCRIPTION	ELEV. FT.	06914	TYPE 90. LQ	RECOV FT	PENET RESIST BLJGIN	PORE NO.	PECO.	900	CORF TIME KIN/FI	REMARKS
Tan/Yellow, vory plastic silty moist CLAY  Grey, Flastic Silty CLAY	71.)	- 6 - 7 - 8 - 10 · - 12 · - 13 · - 15	up-2	2.0"	PUSHED					Boring drilled to obtain UD samples

LOG OF BORING B-646 MOCK COME SAMPLLS CORE TIME MIN/FT. TYPE NO. LOC OEPTH. HECOV. CORE REMARKS DESCRIPTION 900 Pushed easy first 60.8 Dark, grey, plastic silty 1.5', harder last 21. 7 CLAY with pockets of fine 0.5' sand, moist, firm 22 23 24 25-Pushed very easy, no recovery. Tried 26 0.0 over-pushing to 29.0 and still no re-27covery 28 29, ō 2 2 Dark gray, moist, very \*Pushed very #ASY 31soft, CLAY, with a trace until rock at 32.0' of silt and sand Top of Rock @ 32-0' Boring terminated at 32.0

TEST PIT LOGS

	LOG OF TEST	PIT <u>TP-1</u>			<u>1</u> 0F <u>1</u>	
DECT AND LOCATION SANTEE	COORER	ELEVATION AND DATE	# PRO	JECT NO.		-
	S E11055.0	78.0 M		C4090C02		
CORDINATES N13079.	TORMAN	COMPLETION DEPTH	, PT AFF	MOX.DIMENSIO	N\$, FT	
R, Lewis	R. Le	17.12 elwi	· <u> </u>	5 ft x 3	ft	
ACAYATION EQUIPMENT		NO. OF SAMPLES	0187. O P	UNDIST,		
Case 580C		WATER LEVEL, FT	FIRST	COMP.	_	
ATE STARTED	DATE FINISHED	INSPECTOR				
	9/10/60	R. Blickv	vedel			_
9/10/80	37 207 00			BEPTH. NO	BAMPLES	_
	DESCRIPTION			Y 75. VOI	TYPE S	HZI
Silty LLAY: Gray, t	an, quartz, dzy, hard	, stidutiv bigging	•	Ł 1	1	
8		USC = 3		F. 7		
				F 1 7		
Silty CLAY: Gray, 1 slight:	red-brown, trace fine ly damp, firm, blocky	to medium quartz 5/		2 1		
75		000 - 210	•	F   F   F   F   F   F   F   F   F   F		
				F 7		
		ues <b>- 2.</b> 5		1 - 4 - 1	1	
					1 1	
				<b> -</b>   -	1	
- <b></b> -				F " F		
Inters	dy CLAY: Yellowiah gralightly damp becoming 7.0 ft.  layered light brown CL piscontinuous thin land quartz SAND, slightly SAND and sandy CLAY: lue-green, moist, some	WSC = 1.  WSC = 1.  WSC = 1.  WSC = 1.	silty ofine	The sale of the sa		
F. F. F. F. F. F. F. F. F. F. F. F. F. F	1.2 ft water after 20	hours		Trajerry printers		

LOG OF TEST PIT \_\_ TP-2 SHEET TOF 1 PROJECT NO. ELEVATION AND DATUM PROJECT AND LOCATION SANTEE COOPER 8004090002 £10915.0 N1289.0 76.1 MSL DINATES COMPLÉTION DEPTM, FT APPROXIDINENSIONS, FT AVATION CONTRACTOR FORMAN 10 ft x 4 ft R. Lewis R. Lewis 12.0 ft UNDIST. \_ NO. OF SAMPLES DIST. EXCAVATION COMPMENT WATER LEVEL, PT PIRST COMP Case 580C IMSPECTOR DATE FINISHED DATE STARTED R. Blickwedel 9/10/80 9/10/80 DEPTH. DESCRIPTION HD. TYPE SIZ L Silty SAND: Dark gray, organics, numerous roots, dry, loose, silty CLAY with some sand from 0.5 ft = 1.0 ft Silty CLAY: Red-brown, gray, some quartz sand, damp, roots common, mottled UCS - 1.0 UCS - 2.0 Silty SAND: White-tan, predominately fine grained, quartz, some clay lenses trades to interlayered light brown CLAY and light green silty SAND: Thin discontinuous bedding, flightly moist, occ. wood fragments UCS - 1.5 As above, but moist, blue-green, more clayey UCS=2.25-• 0.1 ft water after 1 hour 0.6 ft water after 6 hours 0.8 ft water after 20 hours 1.4 ft water after 44 hours

LOG OF TEST PIT TP-3

ACJECT AND LOCATION SANTEE C	COPER	ELEVATION AND DATUM	-+01667	#0	
	E11055.0	78,3 MSL		4090¢02	
AVATION CONTRACTOR	FORMAN	COMPLETION DEPTH. FT	•	DIMENSIONS	
R. Levis	R. Lewis	12.0 ft	10 f	t x 4 1	t
YEAVATION EQUIPMENT		HO. OF SAMPLES DIST.	<u> </u>	UNDIST.	
		WATER LEVEL FT FIRST		COMP.	
CASE 580C	DATE FINITHED	INSPECTOR			
9/10/80	9/10/80	R. Blickwedel			
3/10/00					AH+L13
	DESCRIPTION		[E] ~~	T. HOC.	TYPE BIZ
Silty CLAY: Red-brown, sand decrea damp, abund damp, abund damp, abund damp, sand decrea damp, abund damp, sand decrea d	vod custty em med-coats	med grained silty wards, very slightly ttled  pcs = 2.5  ghtly damp, 1 in. CLAY  pcs = 1.25  cy SAND and green-brown e grained quartz, ase, firm, moist  pcs = 1.75		1 2 3 4 5 6 7 B 9 0 11 12 12 14 14 14 14 14 14 14 14 14 14 14 14 14	TTPL 302

TP-4 SHEET\_1 OF 1 LOG OF TEST PIT .... ELEVATION AND DATUM PROJECT NO JECT AND LOCATION SANTEE COOPER N13439.5 E11095 78.5 M\$I. 60C4090C0Z ADINATES. ESCAVATION CONTRACTOR FORMAN COMPLETION DEPTH, FT AFF#DX.DIMERSIONS, FT R. Lewis R. Lewis 11.5 ft 10 ft x 4 ft MG. OF SAMPLES DIST. EXCAVATION EQUIPMENT UNDIST. WATER LEVEL, PT COMP FIRST Case 580C INSPECTOR DATE FINISHED OATE STARTED 9/10/80 9/10/80 R, Blickwedel DEPTH, DESCRIPTION HO TYPE SIZE **₹**₹. Sandy CLAY: Organics, fine grained, dry, slightly plastic SAND: Clean, fine grained, quartz, dry Clayey SAND grading to sandy CLAY: Rod-brown, gray, silty, fine-med grained quartz, mottled, damp UCS - 2.3 Silty SAND and CLAY: Yellow-gray, fine grained, quartz, 0.5"-1.0" clay lenses common, dry to slightly damp, wet at 8.0 ft. USC - 2.0 USC - 1.4 USC - 1.6 Silty-clayey SAND: Usually very fine grain, occ beds of med-coarse grained quartz sand, interlayed with light brown-green irregular \*eams of clay

	TO(	G OF TEST PIT	<u>P-5</u>			8H	EET_1	_ OF	<u> </u>
PROJECT AND LOCATION SANTE	E COOPER		ELEVATION AND DATU	<u> </u>	**01	LCT NO.	_	_	
DIMATES N1343	7.5 £11187.5		78.3 ft		6.0C	40900	202		
AVATION CONTRACTOR		FORMAN	COMPLETION DEFTH,	FT		OK.OIME			
R. Lewis		R. Lewis	12.0 ft		10	ft x	_	<u> </u>	
EXCAVATION EQUIPMENT			NO. OF SAMPLES	DIST. O	4	_	P14 7.	_	
			WATER LEVEL, PT	P1927 -	10	ĊD	4F.		
DATE STARTED	DATE FINISHED		INSPECTOR						
9/10/80	9/10/80		R. Blic	(wedel				<u> </u>	
	DESCR	IPTION			122	PT,		TYPE	#IZE
Sandy SILT: Organic plasti		mp, some clay,	loose, sligh UCS = 1.3						
CLAY: Light green-o fine g	Mark gray, red- rained silty sa			• o•		2			
			UCS-1.25			3 -			
			υ <b>¢5 = 1.75</b>			4			
						5 3			
Silty SAND: Yellow- thin c	lay stams comm		inea, quarte,			- 61			
						7-1			
						- 8-			
						<u>, , , , , , , , , , , , , , , , , , , </u>			
Interlayored groen grained	silty SAND and 1 quartz, irreg					-10-1 -11-1		ë e	
	nitial water in ft water after					ייייייייייייייייייייייייייייייייייייי			
					111111111111111111111111111111111111111	Junitari			

LOG OF TEST PIT TP-6

SAN	TEE COOPER		ELEVATION AND DATO	4	eno.	ECT NO.	83	
	3169.0 E10903	FORMAN	78.8 ft MSL		80	C4090	CO2	
R. Lewis		R. Lewis	12.0 ft				4 It	'
EXCAVATION EQUIPMENT				онят. 3	+			
Case 580C			WATER LEVEL, FT	FIEST -	<del></del>	co	MP.	
047E STAWTED 9/11/80	BATE PINISH	9/11/80	(MSPECTOR D	Blickwe	dal			
		37 117 00					EA W	
	DE	SCRIPTION				DЕРТН. ₽Т.	NO. TV	
		s, some clay, da			十			$\top$
Ary.	slightly damp		UC5 - 1.	25 —	⊨ :	╞ , =		
Clavev SAND and	clavey SILT: (	Gray, red-brown,	mottled, slig	ht1v	1	F		
		illy oriented poc				E 3	}	
quar	rtz sand, fine-	med grained slig	htly damp		ij.	2 -		1
						E 3		
					Ų	<u>-</u> ر		
					- [1	- 3		
							///	
					- [	[-4-]	774	
<del>_</del>	- <del></del> -	<u> </u>	<u> </u>		-1	-		
Silty SAND: Yell	low-tan, mostly	fine-very fine	grained, quar	ts.		- 5		
		moist at base, th				- T		1
	mmon especially					1		
					- 13	6 -		
					Hi	-	777	
					Ш	_ 7 _	1/2	
					Ш	-		10
					-11			
					-11	-8-		
		<u> </u>			41	- 1		
					Н	_ 9 _		
Interlayered gre	een silty SAND	and light brown	CLAY: Thin		Ш	- :		
		s, laminated, sli			Ш	· ·		
		fine grained, be	coming		Н	_ 10-	77	
COA	rser at base				Ш			
					Ш	- 17		
					Ш			
						= =		
					۱ [-	는 <sup>12</sup> 덕		S
* ^	.2 ft water aft	er 20 minutes				; ;		-
	.5 ft water af					트 크		
	.4 ft Water aft				- [ ]	- 1		
					<u> </u>	‡ <b>‡</b>		2
					-	- 4		= 33
					- [1	_ <b></b>	1	
					$\ \ $		1	
					-11	- 4		
					11			

#### WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS LOG OF TEST PIT TP-7 SHEET 1 OF 1 SANTEE COOPER ELEVATION AND CATUM PROJECT NO. N13139.5 £11202.5 77.2 MSL BOC4090C02 FORMAN COMPLETION DEPTH, FT APPROX.GIMENSIONS, FT LECAVATION CONTRACTOR R. <u>Lewis</u> Excavation Equipment R. Lewis RO. DE SAMPLES DVS T. UNDIST. WATER LEVEL, FT FIRST COMP. Case 580C INSPECTOR DATE STARTED DATE FINISHED 9/11/80 9/11/90 R. Blickwedel DESCRIPTION TYPE BIZE sandy SILT: Dary gray, brown, organics, some clay, dry to slightly damp, mod hard, slightly plastic USC = 3.25 Silty-sandy CLAY: Gray, yellow, red-brown, silty or clayey sand pockets common, firm-mod hard UCS - 2.0 UC5 - 2.0 UCS - 2.0 Silty CLAY: Yollow-green, gray, laminated, some very fine-fine grained quartz sand UCS = 1.5 Grades to interlayered silty SAND and CLAY: Green to light brown, fine-med grained quartz sand, some coarse sand, moist, very firm UCS - 2.0 SAND: Quartz, coarse, Wet \* 0.2 ft water influx immediately 0.4 ft water after 20 min.

LOG OF TEST PIT TP-8

THOUSET AND LOCATION SANT	TEE COOPER		ELEVATION AND DAYO	· T	PRQ.	ECT NO.			_
	088.0 E11375.5		77,4 MSL			00409			
THEAVATION CONTRACTOR		M&W	COMPLETION DEPTH,			*03.0LM			_
R. Lewis	R.	Lewis	11.0 ft			ft x			
ENCAMATION CONTRMENT	- *		NO. OF SAMPLES	DIST. 1	F	UM	DIST.		
Casc 5800			WATER LEVEL, PT	FIRST _		co	w+,		
DATE STAFTED	DATE FINISHED		IMSPECTOR						
9/11/80	9/11/80		R. Blich	cwe <u>del</u>					
	DESCRIPT:	ıON.			14	OTPTK,		ահա Ք <u>լ (</u>	
	DESCRIPTO	ION			PIEE	PT.	LOC	TYPE	EIZE
Sandy CLAY: Dark	gray, with organics	. fine gra	ined sand, dr	v. hard	71		ľ —		
F	,,,,	,	,	,	П	- :			
-			ucs = 4.5	5 —	-11	1-	. 10	A	
<u></u>					-11	[ ]	}		
5ilty CLAY: Brown	n, gray, some fine q	rained wan	d, slightly			2			
					Ш	-			
<u>L</u>			UC5 = 1.	75	41	L 7_		=i	
As al	oove but reddish-bro	wn and gra	y, trace sand		Ш	1			
mott)			-			-		==	
-					П	4-1			
<u> </u>					П				
					Н	Ŀ <u>.</u>		ļ	
					П	5 5	6	1	
	<del>_</del>				11	-			
CLAY: Yellow-gray	y, some sand, moist				11	- 6-	7	0	
					11			.	
-				_	<u> </u>	_ 1	22	.	
			UCS = 1.3	-	٦ ۱	F 7			
					П			V	
Ϊ.					Н	T.	=		
<u> </u>					41	- 7			
					П				
	D and CLAY: Green, b ned sand, damp,sligh			,	4	9,7			
				. /	H	Ξ,Ξ			
			UCS = 1.3	2	П				
					П				
					41	-11		ŀ	
ţ .						= =		İ	
	initial water influ								
F 0.1	Q5 ft water after 30	) minutes							
					П			- 1	
								- 1	
t e						7		ļ	
F						7	•		
_					11		-	- {	
t					H	: 1		ł	
Ł					Ιţ				
					11	: :			
					11	: ::		1	

CONSULTING ENGINEERS, GEOLOGISTE AND ENVIRONMENTAL ECIENTISTS LOG OF TEST PIT TP-9 SHEET 1 OF 1 -- GIECT AND LOCATION ELEVATION AND DATUM PROJECT NO. SANTEE COOPER N12999.0 E11202.5 77.9 MSL 80C4090C01 23 TARIQ. EXCAVATION CONTRACTOR COMPLETION DEPTH, FT APPROX.DIMENSIONS, FT FORMAN R. Lewis R. Lewis 11.0 ft 12 ft x 4 ft EXCAVATION TOURPMENT HO. OF SAMPLES EMS T. DROIST. Case 580¢ COMP WATER LEVEL. FT FARST DATE STARTED DATE FINISHED IMSPECTOR 9/11/80 9/11/80 R. Blickwodel DEPTH. DESCRIPTION ND. LOC. TYPE BIZE FT. Sandy SILT: Abundant tree roots, some clay, very loosely held, dry, slightly plastic Silty CLAY: Reddish-brown, gray-black, some sandy patches, mottled, slightly damp UCS = 2.5 ucs = 2.25 Silty SAND: Yellowish gray-green, mostly fine grained, occ med grain, damp θ\_ UCS = 1.75 -10-Interlayered SAND and CLAY: Green, mostly very fine to fine grained sand, moist, thin discontinuous clay units UCS - 1.2 11 \* No water infiltration after 20 minutes 0.1 ft water infiltration after 24 hours

LOG OF TEST PIT TP-10 SHEET 1 OF 1 PAGIECT AND LOCATION SANTEE COOPER ELEVATION AND DATUM PROJECT NO N12990.5 E11055 HMATES <u>78.1 MŞL</u> 80C4090C02 COMPLETION DEPTH, FT AVATION CONTRACTOR FORMAN APPROX. DIMENSIONS, PT R. Lewis R. Lewis 12.0 ft 12 ft x 4 ft EXCAVATION EQUIPMENT NO. OF SAMPLES D)9 T. MÁCHST. Case 580C WATER LEVEL, FT FIRST COMP. DATE STARTED DATE FINISHED MAPECTOR 9/11/80 9/11/80 R. Blickwedel BAMPLET DEFTH DESCRIPTION HO. TYPE SIZE ₹T. Sandy SILT: Brown, porous, loosely held, roots common, some organic black clay, dry-damp, slightly plastic. Silty CLAY: Gray, red-brown, mottled, some fine grained sand, damp 2 UCS - 1.5 3 Silty CLAY: As above but silty sand layers becoming common, fine to med grained, Slightly moist, very clean sand 5 in places ucs - 1.5 silty SAND and silty CLAY: Gradational contact, yellow-gray, fine - 7 grained quartz, occ muscovite, some discontinuous light green clay seams common near base, damp, UCS = 1.0 ₿ JC5=1.5 Light green silty SAND and green-brown CLAY: Discontinuous lenses; very fine grained, quartz sand, firm-hard, damp at 11.0 ft=12.0 ft clay layers dominate with some sandy pockets \* No initial water influx 0.2 ft water after 24 hours

CONSULTING ENGINEERS, GEDLOGISTS AND ENVIRONMENTAL SCIENTISTS LOG OF TEST PLT  $\underline{\mathrm{TP-}11}$ 

SHEET 1 OF 1 ELEVATION AND DATUM JECT AND LOCATION PROJECT NO SANTEE COOPER 8004090002 N12806.0 E11368 77.0 MSL COMPLETION DEPTH, FT AF PROL.DIMENSIONS, FT ERCAMATION CONTRACTOR FORMAN R. Lewis 10 ft x 4 ft 11.1 ft R. Lewis EXCAVATION EQUIPMENT NO. OF BAMPLES DIST. PADIST. Case 580C WATER LEVEL, FT COMP. (MSPECTOR DATE PINISHED DATE BTARTED 9/11/80 R. Blickwedel 9/11/80 DEFTH, DESCRIPTION HOC. TYPE BIZE FT. Silty CLAY-Silty SAND: Dry, light gray, fine grained, occ coarse grained sand, very hard, decaying leaves and roots at top UCS > 4.5 As above but trace sandy CLAY present, black hard, dry Sandy SILT: Light gray, reddish-brown in places, occ Mica, hard, dry UCS > 4.5 Silty CLAY: Gray-dark gray, some yellowish, reddish-brown, hard, slightly damp, occ organics, occ sandy lenses υCS =3.75 Gradational contact to silty SAND: Yellow, gray, quartz, abundant mica, fine-med grained, thin clay lenses common especially near base, firm, damp, slightly moist Tannish gray Bilty SAND interlayered with green CLAY: Generally fine grained, some med grained, weak-firm, moist \* No initial water influx 0.1 ft water after 18 hours

	LOG OF	TEST PIT	P-12			SHEE	T <u>)</u> OF	1
SANTEE C			ELEVATION AND DATE		FROJ	ECT NO.		
	£11225.5		77.6 MSL			C4090C		
Excavation contractor R. Lewis	<b>*</b> DMA		COMPLETION DEPTH	.rt		OR DIMENS		
EXCAVATION EQUIPMENT	R	. Lawis	12.0 ft	<u> </u>	12	1t x 5		
çase 580C			NO. OF BAMPLES	043 T. 5	-	UNDIST		
DATE STARTED	DATE FIRISHED		INSPECTOR	FIRST _	<u> </u>	COMP.		
9/11/80	9/11/80		R. Blick	wodel				
2, 11, 00			NI BIICK	**CUE1		<u> </u>	\$AMPLE	
	DESCRIPTI	ON .				PT.	C. TYPE	\$120
DECAY MATERIAL:LCAY					<b>-1</b>	1		
Silty CLAY-silty SAND					-	· 1/2		
	k clay at base, orted, very fine				41	- 1-1/2		
, , , , , , , , , , , , , , , , , , ,	ited, very rine	co coarso	yrained quar ψ¢s > 4.5		´		_	
<u> </u>			<del></del> ,	V	<b>-</b>	_ 2	_	
CLAY and silty SAND:					- 1	: 1/	4	
	g downwards, mo				- [ ]	<b>:</b> _/_		ĺ
	indant decaying			ali	-	∵3∄//	7	
grain, qu	ase with minor	sand string	crs; rine		- 11	: 1/	<i>a</i> 1	
					11:	_ 442	2	
					_  :	: 1	ا ا	İ
·					71	: 北	21 I	i
CLAY: Yellow-dark gra	y, sandy or sil	ty, firm, s	ome mica, ucs.	4.5	-₩t	- 5 <b>-</b> 1∕	<b>7</b>	
	eddigh-prown		<del></del>		→ L	<u> </u>	4	
Grades into yellowish					LE	ا الله	1 1	
occ yello	w-green clay le	nses, mod 1	.005e		11	E E		
					11	: =77	7 I	
					_) <u> </u>	- 7 <del>-</del> 1/2	91 I	-
					١Ł	<u>-</u>	4 1	
CLAY: Green, lenses o	f very fine-fin	o grained q	wartz sand,		ΗE	<u>.</u>		
moist					H E	<u> </u>		
					16		- i	
					ΙF	- 9 <del>-1</del>	1 1	
					1 F		1 1	
			=		_   F	Ξ,,Ξ		
					ΉF	- ~ <del>-</del> -		
Interlayered green si					I F	7		
mostly ve	ry fine grained	, occ craye	y, moist		F	11-		
					۱F	<b></b> _	-	
- SAND: Yellow, coarse	grain, loose, s	ome CLAY			71	1/2	a 1	
	n =				٦F	1-2- <b>7</b>	<b>"</b> " }	
	N	4			۱F	7		
	lowing into pit t bottom - 0.6				JF			
5,468 0			er 18 hours		JF	3		
					ŢF	_ =		
					۱ħ	7 7 .		
					ΗF	- 4		
					ΙÞ	- 1		
					14	- 1		
					11	- 1		

		FO	G OF TEST PIT _	TP-13			BHI	EE1_1	L OF	<u>.                                    </u>
HEET AND LOCATION	SANTEE (	COOPER		ELEVATION AND DATE	144	PAOJE	ICT NO.			
CROWATES	N12812.0		1.0	78.0 ft M5L		_₿0C4	<b>4</b> 0900	:02		
EXCAVATION CONTRACTOR			FORMAN	COMPLETION DEPTH	. FT	APPR	OX. DIM E	MS(QM)	L, FT	
R. Lewis			R. Lewis	12.2 ft		10	£t x	4 f	t	
EXCAVATION EQUIPMENT				NO. OF BAMPLES	D)\$7. ()	┰	WHE	N S 7.		
Саве 580С				WATER LEVEL, FT		+	ço.			
A474 47487F2		DATE FINITHED		IMSPECTOR			1.4.	-	_	
9/12/80		9/12/8	10		Blickwe	đe1				
7/ 12/ 80		3/12/0			ATTCV WE	<del></del>		p.	AHFLE:	5
		DESCR	RIPTION			낡	OEFTH,			
						<u>      </u>	FT,	LOC.		4126
DECAL PATENTAL						<u>-</u> ] [	: 1			
Clayey SAND: Li		, rine grai	thea, ary, ve			<b>1</b> t	: -ታ		[	
. P.	asti⊏.			UCS > 4.5		<b> </b>	- 1 <del>-</del>			
As above with	dark gray	Y CLAY as m	major constit	tuent		-   ‡	- 7			
		<u> </u>				╛┖	: 1	j l		
	- 1				_	11	_ 2 <b>-</b>			
				n, fine quartz		Įf	- 7			
				e organics, tra	. <b>⊂ ė</b>	‡	- 1			
im _	.ca, firm	, slightly	damp			- 1 t	<u>-</u> 3			
						16	: 1			
					٥	1	: , ₹			
				ucs - 2.	ŏ <del></del>	┪╏	_ 4 _			
						_   h	: 🖠			
						J F	₹			
				<u></u> <u>-</u>		_]	- ° 🗖			
010100	<del>,</del> .					<b>7</b> E	; <b>j</b>			
				ned, micaceous,		ìF	<u>3 ۽ -</u>			
_ ує	:ITOW-GLW;	у ¢тау жеал	ಡಿದ ದಲಿಗೆಗೆಗಿ≎ು ಕಿಗ	ar Dase			. " -			
						11:	: 1			
						_ [ }	- , 🕯			
						1 1	· '¬			
						11	. 1			
		<u> </u>	<del>_</del>	<del>_</del>	<del>-</del> —	<b>-1</b> b	ر _		} {	
	een to 1	ight brown	laminated of	ith lavers of			· "i	Ι.	1	
			gaminaced w.			- 1 }	- <b>-</b>			
	»ray					<u>}</u>	تو ـ		[	
							: []		"	
As above: Clay	becomin	a blue-area	n, sandv. f	irm-mod hard		-	- 7			
120 GWOAA: CIT	K11	, 7100	,				-10-		ļ ļ	
						11	: 1	1	j l	1
						16	. 7	1	) l	ì
L =						11	_11	1	1 1	1
F and the second					-		: =	Į .		1
SAND: Light b	OWN, COA	rše, occ di	ravel size.	some silt or cl	Δу.	16	<u>.</u> 3	i		
	,	-		o trouis.		<u> </u>	-12-	l	[	1
								l	!	1
						- 1 t	<u> </u>	I	1 1	
F						8	<del>_</del> 13-	1		
t		al Water i				~ [ }	· 4	_ 1	1	
	0.1 ft w	ater after	60 minutes			- [ [	- 7			
_						16		i	j l	
						- [ [	<u> </u>		ļ l	
t - I									اعا	7
-						_ [	<u>-</u> -		į l	
<b>T</b>						_ [ F	<u>.</u> 3		j l	
						- 11				

		O OF IERI PIT	TP=12			\$H(	EET_	_ QF	<u>. 1</u>
SAN	TEE COOPER		ELEVATION AND DATU	<u> </u>	PROJE	€T MO.		_	
	2586.0 E10911.5		78_2 ft M5	L	80C	40900	CO2		
EXCAVATION CONTRACTOR		PORMAN	COMPLETION DEPTH,				HEIDNE	.77	
R. Lewis		R. Lewis	12.0 ft						
EXCAVATION EQUIPMENT		W. DEATE	NO. OF SAMPLES	DIST. ()	10		4 ft		
Case 580C				FIR87 -	<del></del>	- CO			
DATE STARTED				***** -	•	100	MF	_	
9/12/80	9/12/80		INSPECTOR	Blickwed	1_1				
3/ +4/ ₽∀	7/14/80			BIICKWCC	ıςı				
	DÉSC	RIPTION	_		ž,	FT.		- L	
				_	-	F7.	ND. LDC.	7772	2021
	SAND: White-lig	ht grey, fri		ine	1 F	7			
grai	ined, dry		UCS - 3.4		JĮ ₽	્, ‡		l	
01140 0134 000	- waddan haras	man 43 a 3	3 #1 1	a	1 =	⁺⁺┪	5 g		
	, reddish brown,				1 t	3			
Str	ingers common ne	ar top, firm	, stidutly damb		-1F	_ 7			
					1 5	-2 -			
					16	3		- 1	
				_	1.5	_ =		- 1	
			v ucs = 2.5	5 —	→ t	-3 ┧			
					۱F	4			
					11	- 1			
					ΙE	4 🚽			
					Į F	7			
					[ <u>t</u>	Ė	- 1		
					[-	. 5 🗕		-	
CLAY and SAND: I	nterbedded, yell	ow, greenish	gray; sand is .	nos-o s	ΙĖ			1	
clea	n, fine grained,	some dark g	ray clay	UC\$ <b>=</b> 2.7	VIE.	3		1	
	-	,			Ϋ́	- Б 🗖	- 1		
					→ L				
					1 F	⊣			
						. 7 <b></b>		J	
					1 E	3		- 1	
_	ow-brown, fine g	rained, trace	e to some		Ιţ	- 7		1	
clay	, damp				1 +	<u>,                                    </u>			
					15	°¬	]		
	<del></del>			. —	~  t	_ ±		J	
Interlayered CLA	Y and SAND: Ligh	t green-blue	, brown, thin		J F	੍ਰ∓	1		
	ontinuous lenses				ИĽ	3-7	- (	ļ	
	in quartz			/	<b>/</b> [F		- 1	- 1	
					Į Ė.	_ 1	1	- 1	
					ΙH	10 <b>–</b>	1		
			UCS = 1.	75 /	15	-			
			V40 - 11		t	#		- 1	
					[ <del>[</del> -	11 –			
								J	
		<del></del>			<b>-</b>   ⊦	₹		]	
SAND: Coarse, we	t, trace to some	Silt Or cla	У		⊣⋤	12 🎞		- 1	
					1 4				
					1F	-		- 1	
	1 ft water after				.IF			- 1	
	6 ft water after				1 E			- 1	
2,	O ft water after	20 hours			1 =	7		- 1	
					11	٠.			
					١F	7	- 1	V .	
					1 上	j		- 1	
		- 4 '			1F	- 3			
					15	⋾	V	1	
					1 F	<b>-</b> ₹			
					ΙĖ				

#### WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTE AND ENVIRONMENTAL SCIENTISTS LOG OF TEST PIT \_\_TP-15\_ SHEET 1 OF 1 TARGUEST AND LOGATION E L E VATION AND GATUM PROJECT NO SANTEE COOPER N12510.0 E11053.0 77.7 ft MST. 8004090002 2×C4Y4T104 CONTRACTOR FORMAN COMPLETION DEFTH, FY APPROX.DIMENSIONS.FT R. Lewis R. Lewis 12.2 ft 10 ft x 4 ft EXCAVATION EQUIPMENT HO. OF SAMPLES DIST. Q U#0151. Case 580C WATER LEVEL, FT FIRST COMP. DATE STABLED DATE FINISHED #####CTOR 9/12/80 9/12/60 R. Blickwedel DESCRIPTION DEPTH. ND. TYPE BIZE **₹** ₹. Sandy CLAY Dark brown, organics, dry, slightly plastic Silty SAND: Tan-gray, predominately fine grained, firm to hard, dry Silty SAND as above With gray, red-brown clay layers, grades to silty-sandy CLAY: Red-brown, gray, very firm, blocky, slightly damp, mottled Interbedded CLAY and silty SAND: Clay is yellow-gray; sand is fine grained, micaceous, yellow-gray UCS=3.25 -U¢\$**=**2.8. Interbedded light green silty SAND and light brown CLAY: Clay is in thin, discontinuous seams; sand is fine grained and thinly lensed. UCS = 1.75 Interbedded silty SAND and CLAY: As above but clay most abundant, sand is fine grained SAND: Med-coarse grained, some silt or clay, occ pebble size, wet, loose \* No initial water influx 0.5 ft water after 15 hours

LOG OF TEST PIT TP-16

TUECT AND LOCATION S	ANTEE CO	OPER		ELEVATION AND DATIM		aucht	CT NO.			
		E11215.0	FORMAN	77.3 ft M			4090			
R. Lewis			R. Lewis	12.0 ft	- 0	1	ft »			
EXCAVATION EQUIPMENT	-		Tr. Went	NO, OF SAMPLES	OIE7. C	+		HST.		
Case 580C					FIRST _	<del>!</del>	CON		<u>-</u>	_
DATE STARTED		BATE PINISHED	_ = =	INSPECTOR						
9/12/80		9/12/80		R. 1	Blickwed	<u>e1</u>			A =	
		DESCR	IPTION			널	EPTH.	₩D.	TYPE	3 812 E
						<del>- []</del>	<b>P</b> T, 1	LOC.	1,772	
Silty SAND-san					,	11	4			
		_	ed quartz, ha	rd, friable,		1 ‡	그	77.	7.	
As above but h	ocky, po: ard gray	CLAY is ma	jor constitue	ent UCS > 4.	5 <del>-</del>	≓₽	_ ‡	///		
						<b>⋾</b>	_ 7			
- Silty CLAY: Gr				lly damp, firm base, Vertica		1F	<sup>-2</sup> -			
			ingers common			ΙE	3			
-	Can date					1E	آ- د٠	777		
						1E	3	///		
				UCS = 2.	· —	_  E	.∡ ∃		5.	
				555 - FI	-	<b> </b>	~ ‡		ļ	
						1	7			
							·⁵ ‡			
<del>_</del>	_					<b>1</b> ‡	4	77		
	CLAY: caceous, cown clay	seams of y	. centact, fir cllow-dark g:	ne grained qua ray and red-	rtz,		د ، پور <b>ددا</b> ت			
				USC = 1.9		[[	 E. g.			
				050 - 117		-    -	~ ±			
						۱ŧ	_	2.		
-		<u>.                                     </u>	<u> </u>			F	· 9 —			
Interlayered v	white-lig	ht green, i thin disco	ine quartz Si entinuous bed	AND and green- s, firm , damp	brown		.10			
						┦┋	· 11	7		
	some med llt or cl		pebble size	, quartz, wet,	0¢¢	<u> </u>  [	1 12 12	1/2		
•		al water in ater after					أسيينانيين			
							Metana	Ì.		

#### WOODWARD-CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL ECIENTISTS LOG OF TEST PIT \_\_\_TP-17 \$HEET\_1 OF \_1 PROJECT AND LOCATION SANTEE COOPER ELEVATION AND DATUM PADJECT NO 77.5 ft MSL N12537.5 E11367.5 80C4090C02 BOHMATES ACTORTION CONTRACTOR APPROX.DIMENSIONS, FT FORMAN COMPLETION DEPTH, FT R. Lewis R. Lewis 12.0 ft 10 ft x 4 ft EXCAVATION EQUIPMENT DIST, O MO. OF SAMPLES U451\$1. Case 580C COMP. WATER LEVEL, FT FIRST -DATE STARTED DATE FINISHED INSPECTOR 9/12/80 9/12/80 R. Blickwedel PEPTH, DESCRIPTION TYPE BIZE Organic CLAY layer silty SAND: to silty CLAY: White-light gray, dry, black organic, silty clay common near base, slightly plastic. Silty CLAY and silty SAND: Orange-brown, gray, occ black organics, slightly damp, mottled, some yellow-gray clay near base, sand occurs primarily as vertical stringers. Gradational contact to silty-clayey SAND: Yellow, gray, micaceous, mostly fine grained, trace med grain, clay is yellow-green, slightly damp 8 Interlayered thick light green CLAY and thin-fine grained silty SAND: Bocomes more sandy downwards, coarse grained sand at 11.5 ft-12.0 ft with trace to some silt or clay, slightly moist \* No initial water influx 2.8 ft Water after 24 hours

		LO	OF TEST PIT	TP-18 .			SHE	ET_1	OF_	1
THET AND LOCATION	SANTEE C	6.	-	ELEVATION AND DATUM	•	PROJE	ET ND.			
JADIMATES	N12548.		.0	77.7 £t MSI	,		34090			
ACAVATION CONTRACTOR			FORMAN	COMPLETION DEFTH,	F7	APPR	OX. DIME	MSIDNE,	7	
R. Lewis			R. Lewis	12.4.55		مد ا	ft x	4 ft		
MENATION CONFMENT				HO. OF SAMPLES	DIST. O		WME	15T,		
Case 580C				MATER LEVEL, FT	F(M3T -	;	to	(F		
ATE BYARYED	ì	DATE FIRMSHED	= ,,	INSPECTOR						
9/12/80		9/12	/80	R.	Blickwe	del				
III -	, ,	DESCR	IPTION	_		110	DEPTH, FT.		,,, <u>,</u>	BIZE
<del>- Organic CLNY-</del>	1 er v :	+				=		-		
Sandy CLAY: T	an, fine g	grained, qu	artz, dry, s	lightly plastic	2	-	: :			
				ucs = 1,75			בג -		-	
							: :	}	. 1	
Silty-sandy C	LAY! Gray,	, orange-br	own, some org	ganics, loose-		l t	: :			
			minated yello	ow-green sandy		ЯŁ	<del>-</del> 2 -			
C	lay noar b	DARE			,	/1F	-			
							=			
				<b>.</b>	/	1	_ J _	i		
				UCS = 1.	75 -		<u> </u>			
				UCS = 2.0			=		100	
				ψ¢s = 2.0	-	<b>-</b> 7∤				
						- 11		1		
						- [ ]	_ 5 _	1		
						-	• •			
						- 11		1		
						{	— 6 <b>-</b>	1		
						- []		<b>}</b>	1	
5ilty SAND: Y	ellow, gr	ay, fine gr	rained, tr me	d grained, tra	Ce	- 11		1		
	lay, damp	, slightly	moist			- 11	<u>-</u> 7-	1	ļ	
						<b>⊣</b> 11	. :	1 1		
						- 1		1 1		
						- 41	- ° ,	1		
			.v + (14v	SAND: Irregul	ar /	$\angle \Box$		1		1
interlayered	green-gra	y sitty Ch	ni dod siity silty of clas	SAND: Irregul ey fine graine	ā /		9-	1		
-	Lenses, gr Sand, moi≤	edes into .	errol or cray	oy z-mo graine	_ /	1	<b>t</b> :	1	Ш	1
2	2011CL 10042	_		DCS - 1.	<b>/</b>		<b>L</b> = ≥ :	<u> </u>		
				DCS - 1.	9	أمسر	-10-	<u> </u>		
				UCS ₽ 1.	25		F .	i i		
				00-3 W II			<b>L</b> :	<b>į</b> į		1
							<u>-11</u> -	<b>ქ</b>		
SAND: Coarse	. WAT SOM	me wilt or	clay			i	E	<b>∃</b>		
- aund, coarse	, 400, 000	,,				- 1	L,,	┪╏		
							£	<b>.</b> 1		
		<del></del>					F	<b>-</b>		1
							<b>—</b> 13 <b>-</b>	7		
							Ė.	7		
l' i l'accións							t	<b>:</b>		
F							F -	- 1		l .
							F	7 I		ì
							F	<b>7</b>		1
							F -	<u> </u>		
						- 1	E	-		1
+								<b>1</b> 1		1

TP-19 SHEET 1 OF 1 LOG OF TEST PIT \_\_ ELEVATION 440 0410M PROJECT NO. TOJECT AND LOCATION SANTEE COOPER 77.4 ft MSL 8004090002 N12872.5 E11589 ADINATES COMPLETION DEPTH. PT APPROX, DIMENSIONS, FT ENCAPATION CONTRACTOR FORMAN 10 ft x 4 ft R. Lewis 12.2 ft R. Lewis UNDIST EXCAVATION EQUIPMENT NO. DE SAMPLES Case 580C COMF. WAYER LEVEL, FT PIRST \_ INSPECTOR DATE STARTED DATE PINISHED 9/12/80 R. Blickwedel 9/12/80 SAMPLES DEFTH, HO. TYPE BIES DESCRIPTION Organic CLAY layer: roots, silty dark gray, dry Silty CLAY-wandy SILT: White-light gray, fine grained, hard, dry Silty CLAY: Gray-dark gray, yellowish green, orange-brown, sand pockets of fine grained quartz common, alightly damp, firm-mod hard ucs = 4.1Silty SAND: Yellow-gray, fine grained, quartz, some mica, occ light brown clay lenses, occ decayed material, damp-moist Interlayered silty SAND and blue green-brown silty CLAY: thin irregular beds, loose-slightly firm UCS=1.1SAND: Yellow-green, coarse, wet, \* No initial water influx

LOG OF TEST PIT TP-20 SHEET 1 OF 1 JECT AND LOCATION ELEVATION AND DATUM SANTEE COOPER PROJECT NO. N12331.0 E11067.0 77.9 ft 80C4090C02 DINATES. ERCAVATION CONTRACTOR FORMAN COMPLETION DEPTH, FT PPPROX. DIMENSION E. FT R. Lewis R. Lewis 12.0 ft 15 ft x 4 ft EXCAVATION EQUIPMENT WO. OF SAMPLES DIST. UMDIST. Case 5800 WATER LEVEL, FT FIRST COMF. DATE STARTED DATE FINISHED INSPECTOR 9/13/80 9/13/80 R. Blickwedel DESCRIPTION DZPTH, NO. TYPE BIZE Organic CLAY laver: cilty, black, roots silty CLAY-silty SAND: White-gray, generally fine grained, occ coarse grained, quartz, dry, hard 1 Silty SAND: Gray, orange-brown patches, mostly fine grained some gray silty clay, abundant stringers of clasm, white, fine sand As above but sandy-silty CLAY is major constituent, gray and yellow-green laminae, mod firm, damp Silty SAND and CLAY: Yellow, gray, fine grained, occ med grain 6 demp, some thin beds of yellow-green clay, trace decayed material, micaceous -8 Interlayered light green SAND and light brown CLAY: Irregular -9 bedding, very fine-fine grained sand; clay is laminar, firm, slightly moist-moist As above but clay is blue green

LOG OF TEST PIT \_\_\_\_TP-21 SHEET\_1 OF 1 TTTTUECT AND LOCATION ELEVATION AND DATUM PROJECT NO. SANTEE COOPER N12322 77.7 ft MSL 80C4090C02 £11297.5 DINATES ENCAPATION CONTRACTOR COMPLETION DEPTH, FT APPROX. DIMENSIONS, FT FORMAN R. Lewis R. Lewis 12.0 ft 10 ft x 4 ft EXCAVATION EQUIPMENT NO. OF SAMPLES DIST. O UNDIST. Case 580C COMP. WATER LEVEL, FT FIRST \_ DATE STAPTED INSPECTOR DATE FINISHED 9/13/80 9/13/60 R. Blickwedel OEFTH. DESCRIPTION HO. TYPE BILL FT. Organic CLAY layer: Gray to black, silty, abundant roots Silty SAND-sandy SILT: Light gray, mostly fine grained, hard, dry, clayey near base, slightly plastic Silty-sandy CLAY: Gray, red-brown, mottled, slightly damp, firm UCS - 4.5 CLAY and Silty SAND: Yellow-gray, occ clean pure quartz sand stringers, light green-gray clay lenses, slightly ποist UCS - 1.75 Silty SAND: As above but less clay, yellow-brown, firm grained, slightly moist to moist Interlayered tan-light green, fine grained silty SAND and green-light brown CLAY, moist firm, some mica 12

		FOC	G OF TEST PIT _	TP-22			EH!	EET_1	OF
ECT AND LOCATION	SANTER CO	OPER		ELEVATION AND DATU		PRQ.	ECT NO.		
ADMATES	N12731.0	E11588.	0	77.5 £t, M	5L	L_B(	004090	0C02	
CAVATION CONTRAC	TOR		PORMAN	COMPLETION DEPTH.				HSIONE,	<b>7</b> T
R. Lewis			R. Lewis	12.0 ft		10	) ft :	x 4 ft	
CAVATION EQUIPMENT	<del>,</del>			NO. OF SAMPLES	DIST. O.	┰	UM	OI S 7.	_
Case 580C				WATER LEVEL, PT		<u> </u>	cor	MP.	
ATE STANTED		DATE FINISHED		INSPECTOR					_
9/13/80		9/13/80	1	R, T	Blickwed	el			
					•				PLE
		DESCR	IPTION			PHEZ,	PT,	HO. LOC.	***
sandy CLAY:				ne grained, some	,		1	-	
	med-coarse	grain, har	d, dry	UCS > 4.5		- 11	F 7		
						_	F 17	1	
							<b>L</b> 1	1	
Silty-sand				gers in clay		- 11	<u> </u>	1 1	
				gray, orange by loose where say			F * 7		
		ry, rirm wh ic material		TOORE MUGLE 291	тау,	/[[	F 7		
	Some Orden	ro waretral	•		/	<b>/</b> []	L , 1		J
				ucs - 3.5	, /		┇╸┪		ļ
						[ ]	է ન		
<b></b>	<b>5</b>		—				F 4 1		
As above: C	lay becoming	, gray to y	'ellow-green,	Silty and sand	ly	- [ ]	‡ <b>1</b>	1 1	
						$\exists 1$	t 1		
CARAM CAMPA	V-11		#: #:-			-13	<b>–</b> 5 –	-	
STICA SWID:			ery fine-fin een clay len			- 11	F 7		
	quartz, soi	ue 11duc ät	een clay len	ises		- 11	F 7	1	- 1
						- [ ]	- 6 -		- 1
	_ <del>_</del> _		— —		<del></del>	<b>⊣</b> }}	t d	i	- }
Gradational	contact to	interlayer	ed tan-light	green, fine		Ш	F _ H		
				wn CLAY, moist,		- 11	F 77	1	
	firm, irre					- [ ]	- 1		
						- 11	ь в-		
						Ш	ե ՝ ∃	•	
						- 14		i	-
						- 11	- ₃-1		
						- 11	t	1	
						- 11	- 3		
						- 11	-10-		
					_	_11	[ 1		
				υcs <b>-</b> 1.9		- 11	t - 1	ļ	
						- 13	_11-	i i	
						- [ ]	F 🕇		
						- 11	<b>: 1</b>	1	
			20 20	· · · · · · · · · · · · · · · · · · ·	8	<b>-1</b> 1	<u>_</u> 12_	1	
						- [ ]	- 7	1	
						- 11	F 7		- 1
	* No initi	al water in	filtration			- [ ]	- 1	1	
	IIICI	water in	cracton			- 11			-
						- [ ]	- 7		- 1
						- [ ]	F 7		
						- [ ]	ב ב	-	
							_ 귀		
						-			1
						- 1 !	- 1		

		LOG OF TEST PIT TP-23 SHEET												
JECT AND LOCATION	SANTEE			ELEVATION AND DATE		F=0.	PROJECT NO.							
, mpinjat ES	N12510.	O 1:11990		77.8 ft	MŞL	80C4090C02								
EXCAVATION CONTRACTOR			FORMAN	COMPLETION DEPT	i, #T		APPROX. DIMENSIONS, FT							
R. Lewis	- /	F	R. Lewis	12.2 ft		L 10	ft x		t					
CASE 5800				NO. OF SAMPLES	DIST. 2	+		DIST.						
				WATER LEVEL, #7	PIRET _	:	co	MF.						
DATE STARTED		DATE PINISHED		141920708										
9/13/80		9/13/80		R.	Blickwer	ie1		<del>-</del> -	<u></u> +€	<del>,</del>				
	MEZ,	DEPTH, FY,	MO. LOC.											
SAND and SILT:	ight greatin, irrevery fir	en silty Ci	the, hard, dr	yellow-tan, draws or ange silty SA y in places; sa z, micaceous,	MD:		1 2 3 4 5 6 7 8 9 0	15 H	TYPE	FIZE				
*	No initi	al water in	of lux	UCS = 2.2	5		12							

LOG OF TEST PIT \_TP-24

SHEET \_ OF \_1\_\_

OUECT AND LOCATION S	SANTEE COOPER	ELEVATION AND DATUM	- 7	PADJECTNO							
	N11915.0 P	11065.0	Not availabl			0C4090¢02					
EXCAVATION CONTRACTOR		FORMAN	COMPLETION DEPTH, F	<b>'</b> [	AFFROX.DIMENSIONS,FT						
R. Lewis	<u> </u>	R. Lewis	12.2 ft	i	. 1			t			
Case 580C				HET. A	+	_	DH S T.				
DATE STARTED	DATE FINE	tuf t	MATER LEVEL, FT	-	•		- <u>-</u>		_		
				lickwed	141						
9/15/80		5/80	R. E	TTEKWE				FLES			
		ESCRIPTION			231	DEPTH, ≠T.	HO. TY	PE.	P+2 (		
Organic CLAY las					#1		77		_		
	n-light gray, ightly plastic	fine-med grained	, dry, hard,			= =		- }			
- <del>2</del> 13	raucta byancic				ا ل		<i>ZZ</i> 4				
					71	= =		- 1			
		range patches, m sand stringers						}			
		roots, dry, har									
gray	and yellow-g	reen at base (sa			$\ \ $	: =	7				
_ regi	ion)				{	_ 3_					
7 1 1 1					{	: ]					
					{	<u>. ,                                   </u>	2				
					-	: "					
					11	: :					
		<del>_</del>			┨╂	- 5-		-			
Silty CLAY, Grad	lational from	above, yellow, g	ray. White		H	: :					
		ccasional fine-9									
	d. tr muscovit		4			: ":	<b>75</b> /				
						: :					
						_ 7_					
						: 1					
_			W400			_ <sub>6</sub> _[	-1				
			5.60			: ´`‡					
					Ţ	: :					
<del></del>					71	- 94	-				
						: :	722	}			
						10	Z4	}			
CLAY and milty 9	SAND, Interne	dded, thin, irre	gular lenses.			: <b>1</b>		1			
ligh	nt green, very	fine-fine grain	ed sand, occ			: _ ‡					
	a, slightly mo					- 11-					
<del></del>				<u> </u>	-	: ‡					
SAND: Med-coarse	grained, qua	rtz, wet, some c	lay or silt			- 12					
					7;	= =		- }			
* Ir	nitially dry				Ĭ	- 7					
<u> </u>						- 3					
					Ţ		- 4				
f					17						
<b>;</b>					Ţ	7					
F					11	- 7					
					11	= 1					
-					11	- 1					

LOG OF TEST PIT TP-25

PPOJECT AND LOCATION	SANTEE C		· · ·	ELEVATION AND DATE	PADJECT NO.										
JINATES	N11915.0	E11295.0		Not availab		_	80¢4090¢02								
ATTANTION CONTRACT			FORMAN	COMPLETION DEPTH	. * *		APPEDX. DIMENSIONS, FT								
R. Lewis			R. Lewis	11,5 <u>ft</u>	DIST. O	10 ft x 4 ft									
Caso 580¢				WATER LEVEL, TT		+		MP.							
DATE STARTED		DATE FINISHED	'	(#SPECTOR											
9/15/80		9/15/80	)	R.	Blickwed	lel									
•			(DTION)				ркети,		APPLE						
			SPTION			-	PT.	100	TYPE	FILE					
Organio gray	SILT: ADU	ndant tree	Yoots	\			‡ :								
5ilty CLAY~	andy CLAY; blocky, dr		Latued bow	oery, nard,		ı	<b>‡</b> . =			-					
<del>[</del> -		-1	<b>├</b> ¹ -												
						4	;		Ì						
Sandy-Filty		F 2 -	1												
E				ained, dry, hard		Ц	F :	į							
	YOOTS, FOR	o vertical	Rand bocke	ts UCS > 4.5			<b>F</b> =	{							
C Grados into	gray, yell	ow-green C	AY with mi	caccous, gray, i	ine		F. 3 -	į .	-						
314300	grained sa	nd stringer	s common,	elightly damp, f	1.xm-	- 1	‡ :			_					
	hard						4 -	ĺ							
-						- 1		1							
-							<u> </u>	1							
Ļ				UCS > 4.	75	┥	<u>-</u> 5 -	1							
					-	$\dashv$	t :	1							
Silty SAND	grained, m	icaceous,	some discon	oxange patches, tinuous clay len UCS = 4.	ece,		7 -		2.7						
F						4	<b>;</b> :	1							
Silty SAND	fine grain	ed, slight	i, light gr ly moist-mo nd is coars	een, very fine- ist, becomes blu e at base	1 <b>e</b> –		- 9 -								
E						- 1	ţ :	1	ł						
							¥;	1							
t							F	1	1						
							F :	1							
E							F 12-	1							
E	• Initial	ly dry					F :	1	8.5						
ŧ .							F :	1							
-							F	7							
L DEFI							F :	1		Ε,					
						6	- N	7		34					
							F	3	300						
<b>!</b>							F :	1	1						
+						ł	F -7	1							
E						- }	F :	3							
								7	1						

SHEET 1 OF 1 LOG OF TEST PIT \_\_\_ TP-26 CLEWATION AND DATUM PROJECT NO. THEST AND LOCATION SANTEE COOPER 8004090002 77.0 ft MSL E11995.0 N12960.0 EDIHETES. APPROX, DIMENSIONS, FT COMPLETION SEPTH, PT PORMAN EXCAVATION CONTRACTOR 10 ft x 4 ft 12.0 ft R. Lewis R. Lewis UNDIST. HO. OF BAMPLES joist. O EXCAVATION FOUNTMENT WATER LEVEL, FT FIRST \_ COMP Case 580C INSPECTOR DATE FIRMSHED DATE STARTED R. Blickwedel 9/15/80 9/15/80 DESCRIPTION TYPE s:tE Language to the Control of the Contr Silty SAND: Tan, quartz, fine grained, tr med grain, dry, clayey at basc. Silty CLAY and fine-med grained silty SAND: Gray with red-brown patches, mottled, very sandy at top, grades to more clay some thin, fine grained sand lenses interbedded with sandy-silty CLAY. Clay predominately greenish-٦ gray some red-orange patches, damp, mod firm to hard UCS > 4.5 ~~ UCS > 4.5 Grades into yellow-gray, fine grained silty 5AND: with gray CLAY seems 1-2" in thickness, sand is quartz, abundant mica flakes, slightly damp As above but sand is very fine-fine grained, becoming more clayey downwards, firm, damp-slightly moist SAND: Coarse, clayey, moist water flowing in base of pit caving walls 0.4 ft water after 30 minutes

LOG OF TEST PIT TP-27

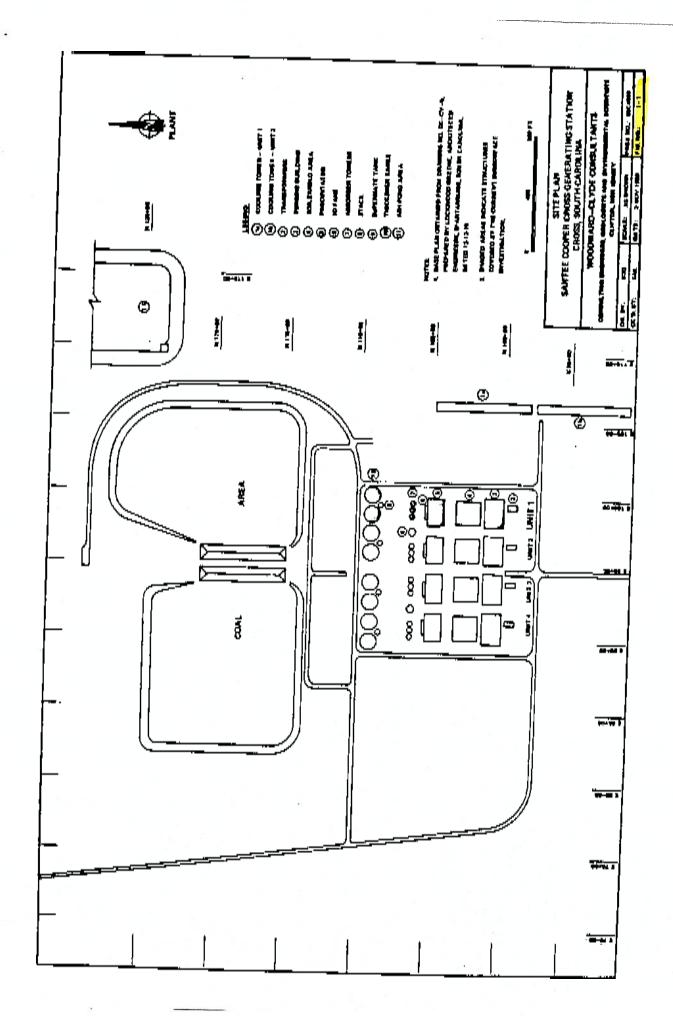
FOOLECT AND LOCATION	SANTEE COO	PER		SUEWATION AND DATUS	PROJECT NO.									
IDINATÉS	N13000.0	£11475.	5 	77.1 ft M	80C4090C02									
PECANATION CONTRACTO	DR.		FORMAN		FT	ATT	HOX.DIME	MS(0MS	, FT					
R. Lewis			R. Lewis	12.0 ft		L	O ft		t					
EXCAVATION EQUIPMENT				NO. OF SAMPLES	DART. O	+	umoist							
Case 5600				WATER LEVEL, FT	FIRST -	<u>;</u>	(co	u.F.	-					
DATE STARTED	1	DATE FINISHED		INSPECTOR	lickwede	-1								
9/15/80		9/15/	<del></del>		X T C N WE CL		1	5.	4M7LE	<u>.</u>				
		DESCI	RIPTION				DEPTH,	NO. LOC.	TYPE	#IZE				
			<u> </u>											
- 0415v 577V	Tight gray	. to fine	to med grain	od sand, hard			t :	Į I	- (					
F SIVEN CYMII	dry, blocky	, cr gra-	powdery.	UCS > 4.5		_	<u> </u>							
<b>F</b>	_1.1,		- 1	(4) × 413		- 1	<b>b</b> - :							
;						Ц	<b>t</b> :			_				
2/1/2 57774	C		mottled, root	s common, hard	١.	- 1	2 -	(		ļ				
STIFA CTWAI	druggiant	lv damp. 8	ome black org	anic clay, som	ie	- 1	<b>;</b>	1	'					
<u>}</u>	vellowish o	clay from	5.5 ft to 6.0	ft		ړ	L 3 -	1		27				
ļ.	(becoming	sandier in	this region)		,	/	ţ :	1						
<b>t</b>						j	ţ :	1						
Ŀ						1	<b>-</b> 4 -	1						
ļ.				UCS - 4,25 · /			<b>!</b> :	1		{				
‡						1	<b>L</b> 5 -	1	]	1				
<u> </u>				UCS - 4.25										
							ļ: :	1						
L ·			_ <del>_ </del> -			┪	F 6 7	1						
Silty SAND:	Yellow gra	v, very f	ine to fine gr	rained, quartz	,		‡ :	1		l				
<b>5210</b> , 33212.	occ mica,	abundant 1	inely laminat	ed layers of		l	<b>L</b> 7-	1	1	1				
<b>F</b>	yellow-gra	y CLAY, s	ightly moist			1	F :	1						
						I	F . :	1		١				
t_							F B -	4	- 1					
<b>‡</b>				UCS = 2.5		- 1	ļ :	1						
ţ.				005 - 4.5			<b>-</b> e <b>-</b>	1	==					
<u> </u>							<b>!</b>	4						
‡ <u> </u>		<u> </u>		<del></del>			<b>F</b>	7						
Cundos into	interlayer	ed sand a	s above and l	ight brown-gre	en		F10-	7		1				
Grades mice	elav becom	aing blue-	green at base				Ļ.	1						
t .			-				- 11-	‡						
				UCS = 1.5			Ė	‡						
ŧ							<b>‡</b>	7						
•					<u> </u>		12	7						
							<b>  F</b>	7		1				
<b>t</b>	* Test pit	t dry					┡ -	7	1					
<b>F</b>							<b>  F</b>	7						
t -							15	7	1					
							IE :	3						
							1 F	3						
F							I E -	-						
F							l F	3						
							l F	1_	<u> </u>					

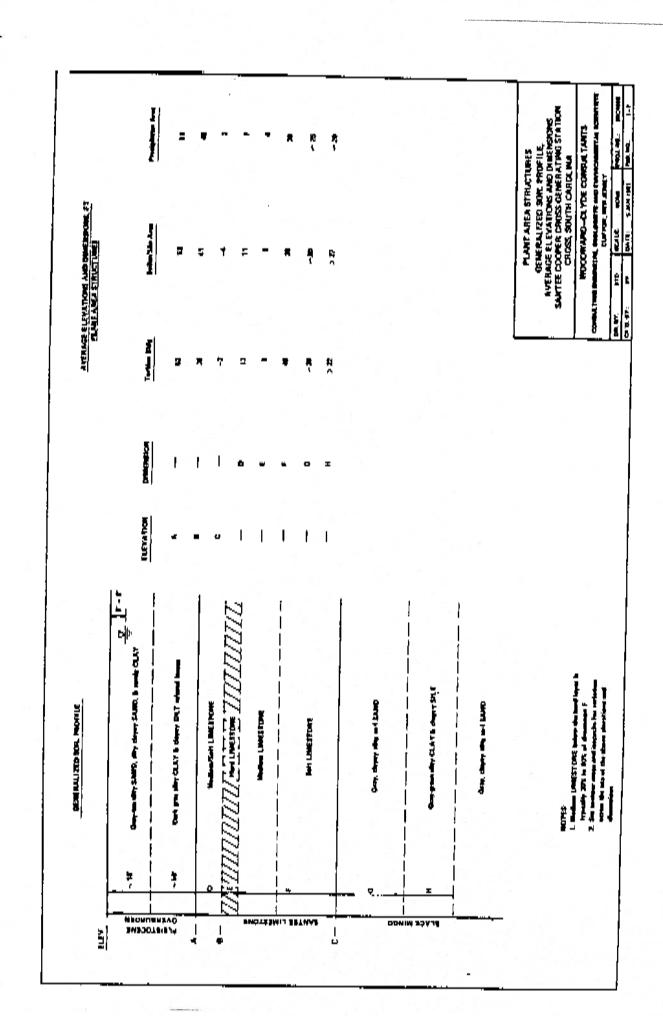
LOG OF TEST PIT \_\_TP-28 SHEET 1 OF 1 PROJECT NO. ELEVATION AND DATUM TUEST AND LOCATION SANTEE COOPER <u> </u><u>£11522.5</u> 77. 3 ft MSI B0C4090C02 N13137.5 ADINATES APPROX, DIMENSIONS, FT COMPLETION DEPTH, FT EXCAVATION CONTRACTOR 10 ft x 4 ft 12.2 ft R. Lewis R. Lewis V4 DIST. EKCAYATION EQUIPMENT HO, OF SAMPLES DUB T. Case 580 C WATER LEVEL, PT FIRST COMP INSPECTOR DATE STARTED DATE FINISHED R. Blickwedel 9/15/80 9/15/80 AAMPLE A DEFTH. DESCRIPTION LOC. TYPE BIZE Sandy CLAY: Light gray, fine grained, some med grain, trace coarse grain, dry, hard, porous, blocky, slightly plastic Silty CLAY: Occ sand stringers, gray, reddish brown, mottled, roots, some organic black clay, dryslightly damp, hard, blocky, some yellow-gray clay from 4.5 ft - 5.0 ft (sandier in this region) ひぐち= 3.5 Silty SAND: Yellow-gray, quartz, micaceous, very fine-fine grained, some yellowish green-dark gray CLAY, slightly damp Interlayered laminated CLAY and thin SAND lonses: light green, silty, very-fine grained sand, some mica, slightly moist 9 10 Interlayered fine-coarse SAND and laminated CLAY: Light greenbrown becoming blue-green near base, moist, discontinuous beds \* Initially dry 0.5 ft water after 24 hours

LOG OF TEST PIT TP-25

IEST AND LOCATION	SANTEE COOPER	. "	ELEVATION AND DATUM	FROIL	MOJECT NO.								
-DIMATES		90.0	77.1 ft MSL		80C4090C02								
EXCAVATION CONTRAC	TOR	FORMAK .	COMPLETION DEPTH, FT										
R. Lewis		R. Lewis	12.2 ft	1 10	£t >		- ·						
EXCAVATION EQUIPMENT	<u> </u>		NO. OF SAMPLES DIST. 2	+	CON	HST.	-						
Case 5800			WATER LEVEL FT FIRST _	·	100	· ·							
9/16/80	0ATE FINISA 9/10	R. Blickwe	1e l										
7/10/80	37 AS	,	NJ BIIONWO	-11		•	MPLC.	•					
	DE	SCRIPTION .			OEPTH,	HO.	tve£	BIZE					
		<u></u>		=##				_					
			same same fine fine		: 🖫								
sandy CLAY-	silty CLAY: Light g grained sand, some	ray, nard, dry,	some very fine-fine	_ <u> </u>	-, -		l						
-	grained sand, some		i t	: - =		- [							
<u> </u>													
— Sileo Clav.	Grav-dark orav. re	d-brown patches	, mottled, fine grain	ed   b	-2 -	7							
, BILLY CLAY.	clean quartz sand	stringers commo	on, slightly damp,		: :								
	hard. Clay becomes	yellow-gray wi	th depth	t		2							
-		â		E	Ξ :								
		*		<i>A</i> E	: ∃								
•				/   E	-4 -								
			UĆ\$ > 4.5 ′	1 5	: 3								
				F	_								
<del>-</del>			- 10	[	=								
			orange National	J.F	<u>-</u> 6 <del>-</del>	7							
Silty SAND:	Gradational contact spms yellow-gray (			/11	13			ĺ					
-11	grained, Slightly,			/   [ F	- , 7								
E	,-,, - <b></b> yy ,		/	18	_ ′ =								
<b>E</b>			/		=								
F			ucs = 2.75	-	_8 _	<b>!</b>	į						
F					=								
<del></del>		>			:			4					
Grades into	interlayered CLAY	and SAND: Light	t green-light brown,		<u> </u>	1							
ļ	sand coarsens and	increases in al	bundance with depth,	-11	-								
•	moist to wet with	depth	1100 = 1 - market		<u> </u>	1							
F			UC5 = 1.5	- 11		1	ŀ						
					<u> </u>	1	1						
_					-11 <b>-</b>	1							
			UCS = 0,75		<b>:</b>	1							
ţ.			005 - 0,13		-12-	1							
		<del></del>		<b>⊣</b> !		1							
						1							
-	* no water influx				<u>-13</u> -	1	<u> </u>						
ţ.	NAME AND ADDRESS OF PERSONS ASSESSED.				ļ :	1							
				- 11	<u> </u>	1							
					‡ :	1 -							
ţ.					:	1							
Ł					<u> </u>	1							
-					E :	1							
F				- 1	F ;	- F		!					

		LO	3 OF TEST PIT _	TP-30			<b>*</b> H	EET_	<u>1</u> OF	_1					
- JECT AND LOCATIO	SANTEE CO	OPER	ELEVATION AND DATE	М	***	JECT 60.			_						
4DIMATES	N13233.0	E10500.0	Not availa		80	8004090002									
EXCAMATION CONTRAC	TDA		PORMAN	COMPLETION DEFTH	, <b>e</b> T	1	PPROX. DIMENSIONS, FT								
R. Lewis			R Lewis	12.6 ft	_	<u> </u>	12 ft		£t						
Case 580C	7			MC. OF SAMPLES	C-17. O	╧	UMDIST,								
	- 12	,		MATER TEAET' LL	FIRST _	<u>'</u>		47.							
9/16/80		DATE FINISHED	/00	INSPECTOR											
9/10/80		9/16	/80	R	- Blickw	ede)	<u>.                                    </u>		1						
		DESCR	IPTION	I=		Ĩ	PEPTH, FT,	NO LOC	TYPE						
Gray organi	c root lave	c: clayey.					E :		7						
SAND: Tan,	mostly very	fine-fine	grained, som	e silt, dry, l	oose		- 1								
<del></del>				UCS = 4.0			F =	1							
_ SAND and sa	grained som	ne med-coar	se grain, dr ertical quar	-brown, sand in y with occ organizations tz sand string	anics,										
				UCS = 2.5	_	4	4-1								
					-	7									
Silty SAND	and CLAY: Y muscovite, lenses	ellowish-gr abund <b>a</b> nt <b>v</b> e	ay, fine gr ty thin li	sined, guartz a ght green-gray	ind /										
				UC\$ = 1.25	·		7 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 - 4 -		-						
Grades into	laminated (	LAY: Thin	irregular b	ed silty SAND a ed. Green-brown mica, moist			9								
				UCS - 1.25	/		_11								
SAND: Coars	e, some silt	and clay,	wet, loose	UCS " 0.5		]	-12- -								
	* O.l ft wa	ater after :	20 minutes				13								
							1								





SUMMARY OF BORING DATA (Contrard)

Nickness of Limestone Penetrated Before Caring (11)	=	).  }	97	3 0	2.3	:9	3	556	. 57	3	92	Q	9.6		12.0	13.5	2 4	12.5	12.8	5.0	10.6	35	J-1	3.4	97.	•	
Gronderger	27.9	72.6	7	***	17.72		13.0	E.	10 e	77.7	73.0	77.6	•		3.5	37		35.5	2	072	77.5		172	2	27.	•	
Elev of Top of Block	17.9		,	, ,		,				•	•	13.1	,			,	,	,	•	,	•	,	,	,		•	
Height of Void (1)	,	3.5	; '		,	,	•	Smo		ន	<u>~?</u>	3	4.2	ន				,	,			- BUG	•		0.4		
Elevo! Top of void (ft)	•	<u>.</u>			•	,	,	1	•	•	75,01	<u> </u>	42.4	12.4		•	,	•	,	•		58.4	,		<u>.</u>		
Elev of Top of Sortee Limestone (ft)	2	3.	19.7	25.52	55.0	2.5	1.23	31.6	50.6	55.2	<b>5</b>	×	4.74		27.0	990	507	£0,5	£0.3	9'1	5.5	603		- 25	7.7	53.3	
Elev of Ground Surface ([t])	77.9	Ę,	77.7	7.7	78.0	78.2	77.9	7.6	7.6	77,2	7.5	77,1	77		71.2	Ė	5,57	78,5	<b>J</b>	É	A.0	Ę	77.3	77.1	77.6	J.	
إقى س	10975.0	10975,0	0.021	1270.0	11420:0	11595.0	11525.0	11591.0	11595.0	11595.0	1595.0	11571.5	11390,0		<b>9</b> 562E		10935.0	050601	10350	109100	10910.0	0.01601	11200.0	112300	0.07511	1432.0	
z ģ	03135	13360.0	1231550	1231550	02 [2]	12365.0	1251000	12660.0	12810.0	0382	13300.0	1255.0	132700		13270.0	132700	11255.0	036061	12%00	128 0.0	126600	1251000	125 0.00	128 000	131000	1281 0.0	
Period Service	24	g G	8-63	8-62	5	<b>8</b>	£427	9	653	900	Ţ	<b>6</b> +32	63		# 107	<b>1</b> 635	400	<b>4</b> -63	8-638	603	3	<u>-</u>	<u>8</u>	8-643	\$	<b>445</b>	
Sinchre	Ash Pond																										

\* Note los

(I) Conductor elevations based on readings 24 hr of ter completion of boring unless otherwise noted (1) blo drill water return between 6.37 and 6.19

Appendix A Doc 08: Bottom Ash Pond Extension and Stability Computations

	ND INDÚSTRIAL SYSTEA CALCULATI	AS DIVISION - READS	NG PAG	et 1 ar 8
PROJECTI SANTE	e cooper Raying statu		76e	NTIFIER 5-SL_173-3
Commonwealth     SUBJECT:	OND EXTENSION		CLA	SSIFICATION
SECTION NAME AND N CIVIL / GEO	IUMBER	)4I3	W.O.	
REVISION	0	1		1-6151-006
ITEM(S) REVISED	-		2	3
DRIGINATOR	0.0		<u> </u>	
DATE	"winterfrakter			
REVIEWER/VERIFIER	10.9.90		<u> </u>	
	D.R. Esch.			
APPROVAL	10/3/90	- 2		
	Kerma	1 to 1 to 1 to 1 to 1 to 1 to 1 to 1 to		- 1
DATE	18/24/90			
ASSUMPTIONS/PRELIMINARY DATA	YES		200	
AGES REFERENCE	Py	- ×		= 0,
HE REVIEW OF THE ALCULATION INCLUDED VALUATION AGAINST THE OLLOWING QUESTIONS:	REMARKS	REMARKS	REMARKS	REMARKS
WERE INPUTS, INCLUDING COOES, STANDARDS, AND REGULATORY REQUIREMENTS, CORRECTLY SELECTED AND APPLIED?	1/E5			
ARE ASSUMPTIONS REASONABLE AND ADEQUATELY IDENTIFIED?	1257			= 1
HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCES				
	767			
BEEN CONSIDERED?  WAS AN APPROPRIATE  CALCULATION METHOD USED?	72.5 72.5			

Gilbert/Commonwealth	BOTTOM ASH POND EXTENSION	S-SL173-3	Page 2
EMDINEERS/CONSUNTARITY	REV. 0 1 2	3	PAGES 8
EXECUTATION	ORIGINATORUM terhalter		

# TABLE OF CONTENTS

TITLE	PAGE
A. PURPOSE	3
8. DESIGN INPUT	3
C. REFERENCES	4
D. ASSUMPTIONS	4
E. CALCULATIONS .	
I APP'L. STORAGE CAPACITY REQUIRED	5
2. POND CONSTRUCTION	5
3. CAPACITY OF POND SHOWN ON BA-117-CI	5
4. COMPILATION OF EXISTING PERMEABILITY DATA	6

		14 SU173-3 PAGE 3
CAL CHI A TIOM	EV. 0 L 2	PAGES 8
	RIGINATON Winterholder ATE 10-9-90	

### 1. PURPOSE

Design an extension of the existing ash pond to provide storage for a total of 35 years of bottom ash production for Unit 1 \$2. The existing ash pond is lined with bentonite. The pond extension should be similar in design to the existing pond.

#### B. DESIGN INPUT

- 1. Bottom ash production 40 acre-feet /year both units
  35-year design life. 1400 acre-feet total requirement
  Existing prond capacity = 217 ac-ft. therefore 1/83 ac.ft.
  additional strage required.
  Expand to north and west of existing fond
  Depth of new pond = 18ft. with 2 ft. freeboard
  Top of dike = elev. 95.0 ft. (max. water = 93.0 ft.)
  Was bentonite liner per existing fond
  Sideslopes shall be 3:1 (H:V). (all from Ref. 1)
- 2. Fond liner shall provide a fermesbility of 1×10-6 contineters / second or lass. From verbal request of Santie Cooper. Phone conversation with Bergotrom and Knorner.

	SUBJECT	EXTEN SION	I G-SU73-3	PAGE 1
Gilbert/Commonwealth	BOTTOM ASH FOND NEV. 0 MICROFILMED	1 2		-A9F1 8
CALCULATION	ORIGINATOR Win terhalty	<u></u>	- X	

#### C. REFERENCE'S

[ Meeting Minuter, GS-C. 0007, May 3, 1890]
2. Letter GS-L. 0025, June 20, 1880, from E.K.
Bengstrom to B.C. Rodgers, Jr. Report of study
of landfill and bottom ask pond expansion.
3. Drowing BA-117-CI, Bottom ask Pond Expansion,
Plan
4. Drawing BA-117-C2, Bottom ask Pond Expansion,
Section and Datailes
5. Law Engineering Testing Co., Final Report, Oross
Senerating Station, Volume 2, Phase II, Feb. 9, 1979
6. Woodward-Clyde Consultants, Vol. 182, Unit I
Autsurface Investigation, Cross Generating Station,
Buspace for Burns and Roe, Inc., January 1981

#### D. ASSUMPTIONS

(REF. 2)

1. In developing Option B1, it is assumed that
the layers of existing clays below the pond
would be sufficiently impermeable (as required
by applicable environmental regulations) to
setard vertical seepage. The lateral extent and
vertical distribution of the clays as well as the
degree of imperviousness considering the characteristics of the master writer would have to
be verified through additional soils investigations.
Reference 2, page 4.

		14 14 5		•
	ROTTOWN ASH POND		5- SL173-3	5
Githert/Commonwealth	MCROFILMED	2	3	PAGES 8
CALCULATION	ORIGINATOR WANTENDA LEV	2		

#### E. CALCULATIONS

I. ADDITIONAL STORAGE CAPACITY REQUIRED:

Reference 1 states that 1183 ac-ft, of additional storage la required. Reference 2 states that the usable capacity remaining in the existing pond is 150 ac-ft so an additional 1400-150 = 1250 ac-ft is required.

Use 1750 ac-ft for design.

2. POND CONSTRUCTION:

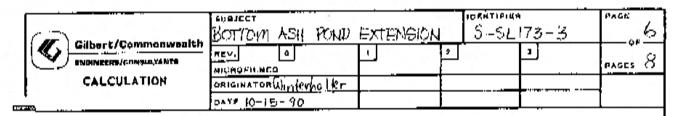
Santee Cooper has verbally agreed to the fond construction method proposed in Schame I, Option B, in Reference 2, using soil / Sentonite slurry wolls. And bottom elevation = 72.0 ft. Pef. Z, attint D Embandement side slopes = 3:1 (H:V) )
Two feat of freeboard par existing found and construct the
embandement I foot higher to allow for settlement.

3. CAPACITY OF FOND SHOWN ON BA-117-C1:

area of bottom of fond = 3,176,576 SF = 12.924 ac. And depth = 18 ft.

Capacity w/o ambaria = 92.924 × 18 = 1312.6 ac.ft.
Capacity slong remboris = 76 in × 100 11 × 9 × 94 = 3,693,600 CF = 84.8 ac.ft.

TOTAL CAPACITY PROVIDED = 1397.4 ac-ft > 1250 : OK



4. COMPILATION OF EXISTING PERMEABILITY DATA

Using References 5 and 6, LETCO and Woodward-Clyde soil reports, compile the existing fermeability dest results. See the attached table.

Type of Test - Legand

B= bailing test in piezorneter - LETCO

F= falling head field test - LETCO

L= laboratory constant head test - LETCO

P = facker field text - LETCO

L. U= laboratory test on undisturbed samples, various we we

1. R = laboratory test on composite, recomposited samples, various We - WCC

FMOH	ert/C	COMPL	/LTA	MTE	ilth	PA HE MIC OF	V. 1614	T DM 1045 1045 1045	W.v	Lev	1	(NI)		<u>. CX</u>	<u>EN</u> :			S	- Ç	3		<u>-3</u>		╀	GES	3
TYPE OF	TEST	п	_	L 1	<u>.</u>	Œ.	<b>u.</b> 1	u- 1	4. 1	<b>+</b> !	Ա.	1			L 1		ц ,	_				. 7	<u> </u>		م. م	_
PERMEABILITY	(cm/5ec)	5 OF x 977 E	מיל מיל	3.ff x 10.5	3.8i x ID 3	3,32× JO 4	2,65×10	6.92×10	7 01 x 87.1	1,04×10	3.17x 10'	3.88×10 7	1.162×10 /	4.43x10 ~	4.38×10"	0,24×10	1.28×i0 *	2.35×10	1.07 x 10	4,76×10	5,24×10	2,22xi0	5.42×10	5.08×10°	109×10	7, Yel XI U
	SITE AREA								Solin Using the Lent-	fill area							¬(		COAL PILE AREA						_	in 3.A. And
UNIPED SOIL	LASSIFICATION		ر ب ر	သွ	သွ	Sc	9.R	သွင	Sm.	ς) γγ	7	ઝ	Sm	Sm	30	25	ပ္ပ					ಶ	35'70	Sms	J)	Sm,5c
/rest	V.(FT)	i i	JZ.0- 71,U	71.7 - 70.2	65,2-63,7	76.4-75.4	70.1-61.9	76.9-74.9	71.9 - 61.9	77,6-75.6	72.6-70.6	704-68.4	78,4-774	678-66,4	78.6-76.6	73.6-71,6	73.6-72.	80.2-78.2	75.2-73.2	77.2-75.2	72.2-70,2	77.2-15.2	72,2-70,2	71,7-70.2	73.2-71,2	69.2-67.2
Semole /	~ - 1		9'0 - 0'b	8.5-10.0	15,0-15.5	3,5-4.5	9.01-0,9	3.0~5.0	8,0-10,0	3.0-5.0	80-100	0,21-0,34	1.0 - 3.0	13.5 - 15.0	3,0-5.0	8,0-10.0	8,5-10,0	3,0-5,0	0.01-0.8	3.0-5.0	8.0-15.0	3.0-5.0	8.0~10.0	8.5-10.9	3,5~5.5	10,5-R,5
, L	ביבין (דיו) בוביע (דיו)	i z	+ <u>'</u>	80.2		79.9	=	-		30.6	=	80.4		91.4	4.18 1.8	=	82.1	83.1	3	80.2	F.	88 71	=	80.2 🛨	76.71	79.7
J. J. Byco.	MUMBER		221 A	223	223	225	275	#1-215	13-225	U.b-727	14-227	229	TP-229	230	HA-231	HA-231	232	HA-234	#A-234	44-237	HA-237	HA-238	HA-238	238 A	239 A	240

 <b>(</b>	ENV	into	:/Cod	NEU	LIAN		th_	PO MEV MICH ORIG	TO TO ROFII	Med	<u>Niw</u>	herb	PD 1a.L	_	<u>-</u>	XTE	NSI	ON	S			7 <u>3</u>	<u>-3</u>		PAG	-07 -	8
6	PYPE OF	TEST		ц	l <u>i</u>	Ţ	L		. L <u>j.</u>	-			. 11	, h.	. IL_			= :	5 == 1 ==	 /	5 75 }	. F		-	; <u>~</u>		4
			- +-	2.82 × IO	1.48×105	2.44×10-5	3,22x ID-5	1.03×10+	2,47x10-7	3.9×10-8	5,440	1,08×10	1,24KP-5	1,83×106	4.18×10 5	3.54×107	8.866x10 7	9 Ur 24.7	4.2 x 10	3.2×:0	8-01x7.	5.9 110-9	8.7×10°8	8.7 x 10-	3.5x 10	6.9×10 7	1.3×to 5
		SITE AREA		Tr. of Sof Heir Porni	EXPRASION		In Sof. Ash Pour	Bot Ash	_	( N. of Sat. Asia Park								F	Bot. Asia Pane at	parter award		composite Samples	From Jest Pits in		Ash Pond		
	WHED SOIL	ELEV. (FT) CLASSIFICATION		E/S	SMISC	Sm	ઇ	SC	5 2	ည္ပ	SC	ನ	ار د	Sim	SiJ	F.	Strit	정 경 건				, 5°31	15.5	27.1	35.5	25.0	15.51
	/155/	ELEV.(FT)	1 6 L	62,5-63,8	75.8-13.8	68.9-66.8	76.3-74.3	71,3-61,3	73.5-72.5	0.3,1-6.79	65.5-63.5	73.0-71.0	680-66.0	66.6-65.	46.6-45,6	72.7-71.2	78.5-76.0	63.66	2	-	F	7.9	76.	744	74:	+ <u>}</u> -;-	Ţ!;
5 7	SAMPLE,	ELEY (FT) DEPTH (FT)	<u>1</u> 1	2001-00	30-50	10.0-12.0	3,0-5,0	8.0-10.0	2.5-3.5	8.5-10.0	6,51-6,01	3.0-5.0	8.0-10.0	120-135	32.0-33.0	8.5-10.0	2.5-5,0	0,4	14.0	040	<u>स</u>	75 	_	(C)	+1 1·Cì	. μ. γ. μ.	`  -
	GRADE	ELEV (FT)	0	<b>Δ·α</b> .,	n,	2	7.3 7.3		76.0	7	÷	0,2%	= -	78.6	1	81.2	+1 000	77.66	<u>.</u>	=	=	3 66	777	771	77.	18 <sup>7</sup>	3
	BORING	NUMBER	292	C+2	14-243	HA-243	44.24¢	HA-244	. 246	246	246	H.A.246	表した	247	247	248	TP-248	B-623	8-623	B-623	B-623	Comp. 1	Comp. i	Corp Z	Comp. 2	ار در از از از از از از از از از از از از از	

ENGINEERING (HSTRUCTION NO. 2

		CALCULATI		X 19	PAGE	1 of 100
PROJE	ct: Saute	e Cooper - Cr	oss Station U	nif 1		54173-4
SDB1E	T ASK I	Pond Dike :	tability		<u></u> Δ4νiηπ	ICATION Now - bucken mental Sogaly Pelos
360110	N NAME AND NO	WHER CIVIL/ST	ructural, No.	2141	₩.o. Ø4:	-6151-006
REVISION	1 8_	0	- P	2		3
ITEM(S) REVISED						
ORIGINATOR CY	.S.SHAH)	19-12-1				
DATE		3-3-92			2 1	-n-
REVIEWER/VERIFIER	T	DA SIN	10, =			<del></del>
DATE		3/3/72				
APPROVAL		GF Prover		<del> </del>		
DATE		8/4/192	·			· · · · · · · · · · · · · · · · · · ·
ASSUMPTIONS/PRELIMINA	RY DATA	<i>N</i> -0				
PAGES REFERENCE						25 1 2 10
THE REVIEW OF THE CALCULATION INCLUDED EVALUATION AGAINST THE		REMARKS	REMARKS	REMAR	KS	REMARKS
FOLLOWING QUESTIONS:						
WERE INPUTS, INCLUDING STANDARDS, AND REGULARDS, CORRECTED AND APPLIED	YORY TLY	203				3
ARE ASSUMPTIONS REASONABLE AND ADEQUATELY IDENTIFIED	17	76.7				
HAVE APPLICABLE CONST AND OPERATING EXPERIE BEEN CONSIDERED?		76.2		- V		
WAS AN APPROPRIATE CALCULATION METHOD US	ED?	7			:	
IS THE OUYPUT REASONAS COMPARED TO INPUTS?	II, E	· /·1				

777	
<u> </u>	

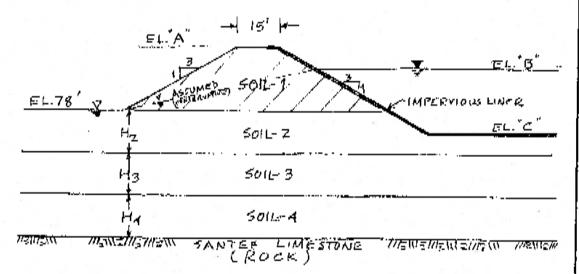
CALCULATION

ASH POND	DIKE TABILITY	S-SL173-4	PAGE 2
MEV- 6		3	PAGE*
ORIGINATOR Y. 5.5HAH DATE 2/14/42			

PURPOSE:

Evaluate stability of the proposed new dike with respect to the earthquake coefficient (acceleration) and also compare it with the stability of the existing dike. (see p. 10 thru 13 for a summary & results.)

#### DATA USED FOR ANALYSIS:



ELEV.	NEW DIKE	EXIST. DIKE
$\Gamma \Delta''$	91	95
்க"	ଓଷ	88 OR 43
<u>"ح"</u>	-76	75

- SOIL-1 Will be compacted excavated clayey soud/soudy clay (SC or SC-CL) soil. Compaction to be all mod. Proctor max. dry density, Soil-2 surface will be compacted using several passes of a large where.
- · Other sail properties and soil-profile data as determined in the following pages.
- . Assume that no solution covinies exist in the north surface below dikes.

( === )	

CALCULATION

AUDUSCT			<b>TORNTIFIE</b>		PAGE
.00			ぢ…ダレク	3-4	3
nev. o	ı	2		ž .	100
MICROFILMED				Ξ	PAGES
ONIGINATION YSS	a 8 % z		× =		
DATE 72/17/92					

#### NEW DIKE - WEST SIDE

BORING	<u> </u>	<u>≤011-7.</u> "5€ (F-M) <u>N</u>	<u>5011-3</u> ^CH"	5016-4 5M (FC)	đ. W.L. ≝lev.
701	79.9	6 455614	G 6/2-17/2	15 12/2-17/2	78.3
702	-79.6	6-65-51	5 5'- 113/4	6 113/4- 13'	78.3
70A	79.8	3 GS-44	# 4½-10½	12 10/2-13	17.1
705	79.6	8 65-51	11:56 123/4	5+ 123/-17'	78.4
708	79.9	3 6.54/2	1 4/2-10/2	10/2-207	79.1
709	77.8	$\lambda \cdot  \mathcal{Q}  \mathcal{R} = \mathcal{Z}_{\mathfrak{q}}$	11 5 5 10 ±	- 10-13'	77.8
717.	80.3	· None	5 G.S 11'	- None	78.6
7/3	80.0	7 4.5-51	6 5'-11'	11414	76.7
717	80.9	G 6-6-7'	- 7' 11'	11- 12	77.4
718	79-8	3 5.5 - 164	7 16- 22	72-250	76.8
AVE	80.0	GS - 6'	6-12	12'-17'	78,1
7, 4	I	N=5	N = 5	<u></u>	

Thus, for analysis of the west-side dike, use the following subsoil profile and the soil properties (see evaluation on p. 4 25):

_	<u>elev</u> .	. <u>н</u>	<u>YE</u> (pep)	<u>c</u> (F:f)	, <u>a</u>
501L-1(PU)	Above 78'		125.0	675	33°
501L: 2	78: 74'	4′	124.5	5'00	280
501L-3	74-68'	6'	102.5	600	0
501L- 4	68'-63'	5'	122.5	50	300
Rock	A+ 63'			\$0,000	0 · · ( 4 55 · · · · 6 .)
					V ()

	FUBJECT		ювнті 5		LYCE.	
	CALCULATION	MEV. 0	1	2	-	PAGES
		ORIGINATOR "/	25		_	<del>-</del>
<b></b>		DATE 2	117/47-		<u> </u>	

### 3011 Properties:

1. 
$$8d = 0.9 \, \text{Ndmay} \, (01557)$$
  
=  $0.9 \times 17.0$  --- \{\text{DM7.2}, p.39}  
=  $108 \, \text{pef}$ 

7. 
$$\omega = 16 \%$$
  
 $3. \chi_{\pm} = 108 \times 1.16$   
 $= 125 \text{ per}$   
 $\omega_{\text{cut}} = 29\%$   
 $\omega_{\text{cut}} = 29\%$   
 $\omega_{\text{cut}} = 29\%$ 

4. 
$$q_{ij} = 1 \text{ for, } q_{ij} = 3$$
  
 $c = 0.9 \left( \frac{1-\sin 33}{\cos 23} \right)$ 

$$A, q_{ij} = 1 \text{ for } f = --- \text{ stiff sall, } N \ge 8$$

Per W-c Rapor, App. D. Table, for similar sil,

Alternatively, 
$$C = \frac{4y}{y} \left( \frac{1 \sin \theta}{4y g} \right)$$

$$= \frac{4y}{y} \left( \frac{1 \sin \theta}{4y g} \right)$$

$$= \frac{500}{4} \text{ psf}$$

= 2.301 Sa, D. 2 - 12.

	· ·	SUBJECT	IDEMARETER	PAGE
		REV.	5-56173-4	5
	CALCULATION	MICROFILMED		100
-		DRIGINATON YSS		- 1
Ε		DATE 2/17/92-	9 "	

5011-3: CH, N=5

Qu=0.625 +sf --- (0.16. per W-c Pepul,
LAPP. D, Table D-1.

Q=625 psf --- Use 600 psf.
Qu=0

XL = 100.5 pcf --- per W-c Report,

 $Y_{t} = 100.5 \text{ pcf}$  --- per W-c Report, App D, Table

use 102.5 pcf  $\frac{1}{Y_{ns}} = \frac{40}{100} \text{ pcf}$ 

:- Use 7=40 pcf. C=600 psf. Q=0.

SOIL-4: SM SILLY F-C sand with trace clay N=7  $\longrightarrow$   $D_{\gamma}=25\%$ Use.  $Q=30^{\circ}$   $\longrightarrow$   $D_{M-7.1}$  due to C=50 for C=50  $\longrightarrow$  C=50 for C=50  $\longrightarrow$  C=50 for C=50  $\longrightarrow$  C=50 for C=50  $\longrightarrow$  C=50 for C=50  $\longrightarrow$  C=50 for C=50

	SUBJECT	10	CNT) FICE	PAGE
(m)			5-56173-4	- 6
	REV. 1	2	3	100
CALCULATION	MICROFILMED			PAGES
	ORIGINATOR YSS		2	2 - A
<b>4</b> 22.5	DATE 2/24/92	- "		11

#### NEW DIKE AT EXISTING DIKE & EAST SIDE :

BORING	<u>G.S.Elev</u>	<u>  501년: 2</u> 	<u>5011-3</u> "€H"	5 <u>01L-4</u> 5M(f-c)	<u>G.W.L.</u> <u>Elev</u>
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	80.0	6 0-131/2	13%-17	2 17-19'	78.0
719	78.6	6 0-10'	2 10-21	- 2/-284	76.6
1 - 1	78.8	7 0-10	3 10-20	None-	76.8
710	79.0	7 0-10'	3 10-20	None	77.5
월 715	77.8	7 0-7/2	- 7%-14+	14421	77.8
1 (11.6	77.5	3 0-51	5-25	None	77.72
V	76.4	]   [O · ]   (≈)	A 40 - 30 -	10.	
706	₩D.2	9 0-8%	82-12	5 12-18'	78.9
703		. 10			75
707	79.1	15- (29/2)	3 4/2-25	4 25-31/x	76.1
7711	80.2	11 0-9'	5 9-25	7 25-30	76.7-
A V ∉	79.0	5 <u>5</u> 5−11	11-21	Say None	77.0
<u></u>		N=7	N=3	<u>_</u>	

Thus, for the new dike at the existing dike, assume the following profile & parameters per the following eles:

		<u>FLEV</u>	<u>н</u>	<u>X</u> 5 (pcf)	<u>C.</u> (bsf.)	ब
I	5011-12 -	- 78'- 68'	10'	124.5	1000	0
	5011-3 -	- 68'-58'	10'	100.5	400	0
	5011-4		V¢T E×11I			ja-
	ROCK			- 1		
- [	501L-11-	<u> 59 m</u>	e 45 00	west	ride -	···

( = \)	
<b>*</b>	
V	

CALCULATION

SUBJECY	6	1056	4 Firlen	PAGE
	Y		5-5L (73 - 4	7
REV. 0 MICHOFILMED	1	z	3	100
OPIDINATON YSS				
DATE 7/24	1/92		-	<u> </u>

## Soil Properties:

5011-3: CH, 
$$N=3$$

$$S_{m}=0.375 \text{ tof, use 0.4 tof due to}$$

$$S=400 \text{ psf}$$

$$Q=0$$

$$V=38 \text{ pof}$$

$$S_{sef}=\frac{100.5}{100.5} \text{ pcf}$$

$$V=5.$$

#### POND CONTENT (ASHI+WATER):

Assume it to be silt twater, weighing  $\geq 80$  (721 for 18034 silt,  $Q = 27^{\circ}$  (721 for 1870) = 180 - 62.5 + 200 = 8.92 psf = 18.761 = 18.761 = 18.761 = 18.761 = 18.761 = 18.92 + 200 + 200 + 200 = 18.92 + 200 + 200 = 18.93 + 200 + 200 = 18.93 + 200 + 200 = 18.93 + 200 = 18

(40)		\$HBJECT I		IDENTIFIEM	**************************************
	CALCULATION	ARV. 0	1 2	2	PAGES
1	*	ONIGINATOR YSS	4		_
Y		DATE 3/12-(42	7. 22		1

Alternatively.

#### ASH

Ref: "Pulverized Coal Ash as a Structural Kill"by G.A. Leonards & B. Bailey, Jour. ASCE, GT, April 1982

Assume, based on the data presented in the

$$= Y_d \left( 1 + \frac{y_{\omega}}{y_d} - \frac{1}{\zeta_0} \right)$$

$$= 100.3$$

$$\leq_{-7} 100.5 \text{ pcf}$$

$$\zeta_0 = 62.5$$

$$\zeta_1 = 65$$

$$\zeta_1 = 2.40$$

For use in the program (where total pressure is used to compute the showing restitance),  $100.5 \times \tan Q_{R_{2}} = (100.5-62.5) \tan 35^{\circ}$   $\therefore \text{Brogram } Q = \tan \left(\frac{38}{100.5} + \tan 35^{\circ}\right)$ 

- FOR THE PROGRAM INPUT, USE



CALCULATION

	SUBJECT		10年N11×16日 ジーSと173ース								
	MEV. 0	1	2.]	3	100						
4	ORIGINATOR			= =							
	DAYF		-								

# EXISTING DIKE - WORST AREA :

- Refer to W-C Report, Fig. 3-11
  Refer to logs of borings 13621 than B-641

		501 <u>6</u> 2.	501L-3	621 424
BORING	T/L.S.	<u> </u>	<u>c</u> H	
8-621	52			
-62-2	54			
~ 623	50			
-624	<del>54</del>			
-625	52±			
-626	<i>50</i>			
- 62:7	5 (	- 91.	<b>1</b> 50	
-67.8	<b>∌</b> 0	43-63 L 7 )	63-50 (2)	
-62-9	50	G.S. 64(6)	64-50(2)	
-630	53	45-64 (8)	64-53 (3)	WARST AREA
-631	5 )	c.s 67 (6)	62-51(3)	AVL
-632	3.8 (2007)	6.5 - 62 (6)	62-5412)	<4- << 61 78-65°
.633	41 5410	Sec = 51 (5)	61-54 (2)	CH 43-53
-634	<b>ラ2</b> 主	a.i 43 (6)	63-66 (3)	
-635	58 tr	6: -64(6)	64 = 69 (8)	
_636	60	G 5 - 66 (E)	66-60631	
-637	60			29
-6.38	60			
-637	59			
-640	67-			
-641	60			

Thus, for the existing dike,

		SUBJECT	DENTIFIER	IDENTIFIEIT				
( )				5 - SL	173-4	9		
	CALCULATION	MEV. 0	, 3		-2	100		
•		UNICINATOR						
* <del>eii≐</del> 7		DATE		e ==				

Soil Properties (Exit. Dike)

$$501L-2: CL/SC, N=6, assuming to a title not compreted.$$

$$1-9 = \frac{3}{4} + sf - 200 psf$$

$$1-C = \frac{750}{8} psf$$

$$\frac{Q}{7} = \frac{0}{55 pcf} - assumed$$

$$1.7.5 pcf$$

SOIL-3:

CH N=Z

$$\frac{7u = 1/4 + sf}{1 - C} = 250 \text{ s}_{1} 300 \text{ psf}_{1} \dots \text{ distributions}_{1}$$

$$\frac{Q}{V} = \frac{0^{0}}{V} = 38 \text{ prf}_{2}$$

$$\frac{8sei}{V} = 100.5 \text{ psf}_{2}$$

THUS, FOR THE EXIST. DIKE, USE

ı	~~ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		SUBJECT
(4)		CALCULATION	REV. 0
•			0.740

SUBJECT			2 - 2 T	173-4	PAGE 10
NEV. 0		-	i ii ii	<u>.                                    </u>	100
ORIGINATOR 755	2	<u> </u>			

#### STABILITY EVALUATION

The evaluation is performed using the computer program "STABR/G," developed by Geosoft for IBM-PC and compatibles (1987 version). The program uses circular slip surface and method of slices (modified Bishop Method). It searches for the critical slip surface that passes through a given point or that is taugent to a given surface. It uses DOS operating systems. The program inputs and outputs are included in the following pages.

In the mulysis, stability of the pand-side (i.e. inner) and outer slopes of both the new and the existing dikes is investigated.

The conditions investigated are listed on p. 11 and 12.

A typical input for the program, (RUN NO.2) is given on p. 14 through 21. The outputs are on p. 21 and beyond.

The plots of F.S. variation with the earthquike coefficient variation are given on p. 13-for the outer slopes of both the existing dike (at the junction with the new dike) and the new dike (both on the west-side of the pand and at the junction with the existing dike). The F.S. /Variation of F.S. with the variation in the earthquake coefficient (ave. Effective horizontal acceleration) for all conditions investigated is tabulated on p.11 & 12.

NOTE: It is assumed that the critical slip surface for all cases investigated is tangent to the buttom surface.

Of the weaked substantiace sell layers, see Egg. 14-14 beyond.

1		zyon <b>e</b> ct		pe)	S-SLIT	3 4	11
) ,	ALCULATION		Ů	1	2 3	1	100
- 2		MICROFILMED	Y55				PAGES
		DATE	2/28/92				-
							= =
RUN	FREID	DIKE	POND W.L.	DEPTH	EARTHQUAKE	F- 5%	_
No	-	(SLOPE)	<u> </u>	TO ROCK	COEFF		
1	CR-60000	NEW-WESTSIDE	EL.88'	15 FT	0.00	3.956	.
2	CR-66010				0.10	2-154	
3	CR-44025	+ -	+	4	0.25	1.115	- 1 1
4	CRGWOUOO	NEW-WEST SIDE (OUTER)	EL.88'	15 FT	0.00	2.806	5
5	CRGWOUTO	(00.82)	- 1	*	0.10	1.929	3   K
6	CRGWOUIS				0.15	1.634	·   197
7	CRGWOU25		31		0.25	1,138	' 1 [
8	CRGWOUSS		ļ		0.35	0,89	1 I
9	CRGW0045	4	<b>‡</b>	*	0.45	0,731	1 1
10	CR-GWOOD	NEW-EAST	ይL. 88'	20Fr	0.00	3389	,
11	CR-GWOID	SIDE (INNER)			0.10	1.833	
12	CR-GW025			4	0.25	0,954	
13	CR-GWEOD	EXISTIC NEW	៤៤.ឌ៩។	ZOFT	0.00	2.37	,
14	CR-GWE10	(INNER)	- 1		0.10	1.452	
15	CR-GWE 25	+	+	₩	0.25	0.840	i I
16	CR680000	NEW- EAST	್ ⊭∟.ಕ8′	20 FT	0.00	2,26	WITH
17	GREEOUTO	SIDE (OUTER)			0.10	1.481	Ache
18	CR48-0015				0.15	1,208	- 1
19	CRGEOUZS	2			(0,25	0.872	
20	CRGEOV35	22 2			0.35	0.681	1 1
21	CRGEOV45	1 30	+	+	0.45	Q.558	
22	CRG(00ECD)	Exist & Ven	EL.88′	2.0 FT	0.00	1,892	
23	CRGOUE 10	COUTES?)			0.10	1.316	1 1
24	CREOUE 15				0.15	1,126	

PROPRIETARY INFORMATION OF GILBERT/COMMONWEALTH FOR INTERNAL USE ONLY
THIS IS A PERMANENT RECORD DO NOT DESTROY

CRGOUF.25

CRGOUESS

27 CRG00845

ax

0.35

0.45

GAI-446 11-90

0.594

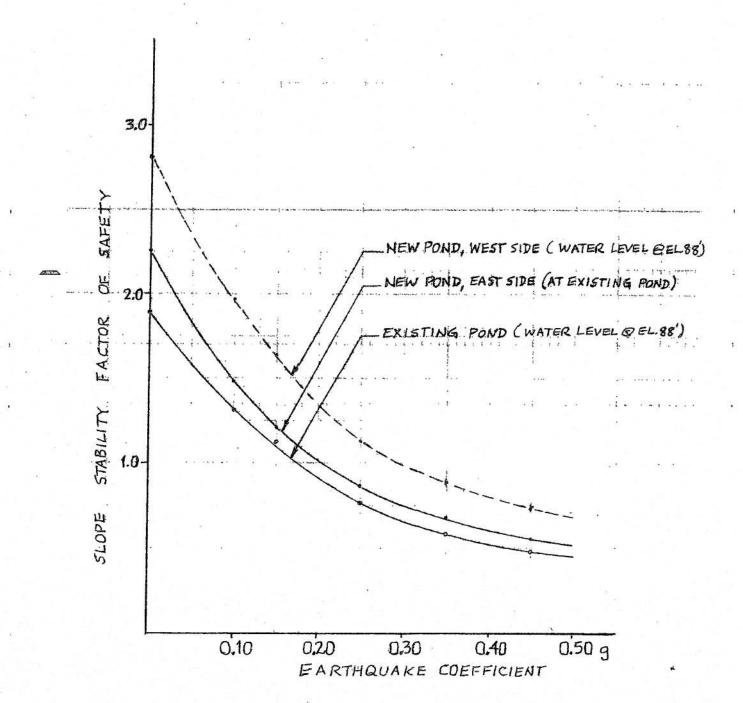
0.483

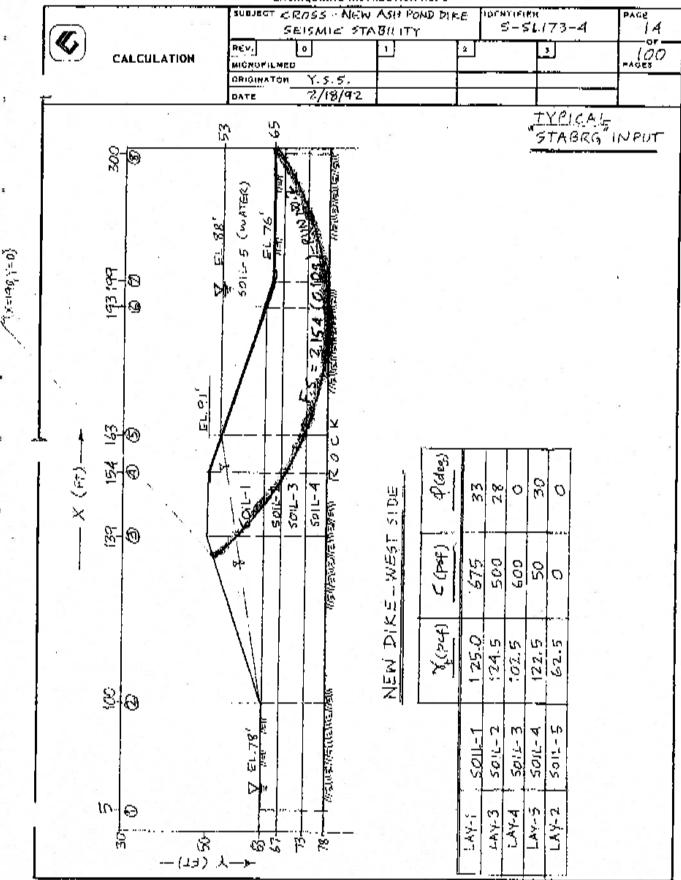
#### ENGINEERING INSTRUCTION NO. 2

		ZIII SIII ZZ RIII SIII SIII SIII SIII SI			
2:2		zonject	S-5L173-		
	CALCULATION	REV. D	2	3	PAGES
		ORIGINATOR 755			

NO.	FILE ID	DIKE(SLOPE	POND W.L.	DEPTH TO	BARHOVAKE COEFF.	<u>F. S.</u>
28	CRG0U693	EXISTICANEN CONTER)	<b>ビい</b> ろう	20 FT	0.00	1.692
24	CR-GC #00	EXIST: - NORST	EL 38'	25 Fr	0.00	2.369
30	CR-GGE10	(IMMESS)			0.10	1.302
31	CR4C5 25	*	*	r	0.25	0.670
32	ZRGCEWOO	EXISTWORST	BI. 88'	25 Fr	0.00	1.557
33	CRGCEW10	(DUTER)		^	0.10	1.056
34	CRGCEW25	= = = = = = = = = = = = = = = = = = = =	<b>†</b> :		0,25	0.597
35	CRGCEW93	*	<i>ይህ</i> . ዋ <i>ልነ</i>	•	0.00	1.558
15						

0598 -





PROPRIETARY INFORMATION OF GILD/DT/COMMONWEALTH
THIS IS A PERMANENT RECORD

FOR INTERNAL USE ONLY

<u>DO NOT DESTROY</u>

GA1-444 11-90

Appendix A Doc 09: Santee Cooper BMP Plan



# Environmental Management System Manual

April 2010

# Pollution Prevention Plan With Best Management Practices (BMPs) South Carolina Public Service Authority

2010 Revision

Appendix A Doc 10: Cross GS Dike Inspection Reports

村:103129

CROSS STATION FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES DIKE INSPECTION REPORT

BOTTOM ASH POND 1 (ORUGINAL)

DATE REVIEWED BY: Sation Manager INSPECTOR:

SIGNATURE:

Note any other issues	Inspect Concrete, Metal, and Wood #	(traces present, no grass)	Vegeta Son	Drainage Pipes	Drainage Ditches	Bois	(Flow, lush grass, clarity)	Seepage	Settement/Depression	r eeboard Adequate	Ris-rap displacement	Animal burrows	Vegetation (nees present no grass)	Sides (cracks, bulges, scarps)	Erosion guliies	Seepage (Flow, Iush grass, clarity)	Burrows or Ruts	Excessive Vegeration	Cracks (Measure Danessons)	Settlement [v]	Alignment (H)	FEA LOKE OX 4
																						LOCATION & CONNIENTS

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Sketch, Inspect, Neusure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Station Ries (original)
Found and Hydro Generation Technical Services - Jame Hood

Revised 4/15/2009

Report 6

DIKE INSPECTION REPORT FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

CROSS STATION

BOTTOM ASH POND 2

REVIEWED BY: Station Manager DATE INSPECTOR: 25.50

SIGNATURE: SIGNATURE:

Note any other issues		Drainage Pipes	Boils V	Seepage (Flow, lush grass, clarity)	Freeboard Adaquate U	Rip-rep displacement	Animal burrows	Sides (cracks, bulges, scarps)	Erosion gullies	26Sighes III Ann Crass Canivi III III III III III III III III III	Euroessive vegeration  Burious of Ruits	ersions) V	Settlement (V)	記載という。 Atgnrent (H)	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE-Sketch, Inspect, Measure, Photograph, Locale, Engage a Qualified Engineer if necessary

Cooles. Station Plats (original) Food and Hydro Generalian Technical Services - Jena Hoof

DIKE INSPECTION REPORT FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

GYPSUM POND **CROSS STATION** 

> OH TE INSPECTOR: REVIEWED BY:

Station Manager

SIGMATURE:

SIGNATURE:

Seepage Seepage (Flow, lush grass, clarity) Settlement (V) Note any other issues 3 Area Downstream Settlement/Depression Rip-rap displacement Erosion guikes Burrows or Ruts Excessive Vegetation Cracks (Measure Dimensions) Alignment (H) Drainage Pipes Drainago Ditches (Flow, itish grass, clarity) Freeboard Adequate Inspect Concrete, Metal, and Wood Vegetation Animal burrows trees present, no grass) 1 Slopes 1 CUIDO WORKS egetation (trees present, no grass) lides (cracks, bulges, scarps) FEATURE ç ~ ( STAGRANCO 2 NOUVED

S I M P L E - Skefth, l'aspect, Meesure, Photograph, Locate, Engage a Qualified Engineer if necessary NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY

States (tes (test of)

Foed and Hydro Generaldy Todasical Services - Jane Hoof

CGS 1229

BOTTOM ASH POND 1 (ORIGINAL) CROSS STATION DIKE INSPECTION REPORT FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

DATE: REVIEWED BY: Station Manager INSPECTOR:

SIGNATURE: (LL)

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED TO	Note any other issues	(trees present no grass)	Drainage Pipes Vegetation	Seepage (Flow, lush grass, clarity)	Settlement/Depression v		Vegetation (frees present to grass)		Cracks (Measure Dimensions)	FEATURE 0% ( Distributed 1997)
L ATTACHED PROMISE										LOCATION & COMMENTS

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Shetch, inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Coper: Shion Flee (on)rea)
Fossi and Hydro Generaton Technical Services - Jane Hood

BOTTOM ASH POND 2 CROSS STATION DIKE INSPECTION REPORT FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

DATE: REVIEWED BY: Station Manager INSPECTOR:

SIGNATURE:

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STIMPLE - Sketch, inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary Locate, Secondary (India)	o your all out of light and Wood	(Tees present, no grass)	Vegetation	Drainage Ditchas	Bois Carity)	Seepage	Settlement/Depression	Freeboard Adequate	Animal burrows	Vegetation (trees present no present		Burrows of Ruits	Experience Dimensions	FEATURE OX (
YOME														

Copies: Station-Plas (orginal) Posis and Hydro-Generation Technical Services - Jane Rood

DIKE INSPECTION REPORT FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

GYPSUM POND **CROSS STATION** 

> INSPECTOR: DATE REVIEWED BY: Station Manager

SIGNATURE SIGNATURE:

Note any other issues Seepage Vegetation Drainage Papes Satchic Sciented Freetoard Adequate Rip-rap displacement Sides (cracks, bulges, scarps) BLETOMS OF RUIS Settlement (v) Alignment (H) inspect Concrete, Metai, and Wood (Flow, lush grass, clarity) Settlerrent/Depression Animal burrows Vegetation (trees present no grass) xcessive Vegelation Cracks (Measure Dimensions) Sutiet Works træs present no grass) DSOI QUIES eepage (Flow, lush grass, clarity) FEATURE ž ζ ζ 7 ζ 7 ζ LOCATION & COMMENTS 

HOTE: SHOW LOCATION OF PROBLEN AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Shetch, Inspect, Massure, Photograph, Locate, Engago a Qualified Engineer if necessary

Coptes. States files (original)
Focal and Hydro Constition Technical Services - Jane Hood

FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES DIKE INSPECTION REPORT

CROSS STATION

BOTTOM ASH POND 1 (ORIGINAL)

DATES REVIEWED BY: Station Manager INSPECTOR:

SIGNATURE: SIGNATURE:

FEATURE [	Q.	LOCATION & COMMENTS
1. Crest		
Aligament (H)	,	
Settlement (V)	7	
Cracks (Measure Dimensions)	7	
Excessive Vegetation	7	
Burrows or Ruts	V	
2. Slopes		多形型 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)
Seepage (Flow, lush grass, clarity)	5	
Erosion gullies	ς	
Slides (cracks, bulges, scarps)	<	
Vegetation (trees present, no grass)	7	
Animal burrows	ς	
Rip-rap displacement	5	
Freeboard Adequate	5	
Settlement/Depression	<	
3. Area Downstream		
Seepage		
(Flow, lush grass, clarity)	,	
Boils	<	
Drainage Ditches	Υ,	
Drainage Pipes	7	
Vegetation	7	
(trees present, no grass)		
4. Outlet Works		
Inspect Concrete, Metal, and Wood	V	
5. Overall Condition		が動物が変数が動物がある
Note any other ssues	5	

NOTE: SHOW LOCATION OF PROBLEN AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Station Files (original)
Filessi and Hydro Generation Technical Services - Carle Hood

FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES DIKE INSPECTION REPORT

CROSS STATION

BOTTOM ASH POND 2

INSPECTOR: Station Manager

SIGNATURE:

WY 1 1 TO

Settlement (V) 1. Crest Seepage Frosion gul les Excessive Vegelation Cracks (Measure Dimensions) Note any other issues Settlement/Depression Rip-rap displacement Slides (cracks, bulges, scarps) Burrows ox Ruts Aligement (H) 5. Overall Condition Inspect Concrete, Metal, and Wood 4. Outlet Works (trees present, no grass) Vegetation Drainage Pipes Drainage Ditches (Flow, tush grass, clarity) Freeboard Adequate Animal burrows Seepage (Flow, lush grass, clarity) 2. Slopes regetation (trees present, no grass) . Area Downstream ş \* ζ. 7 ζ ( ζ 7 7 6 ζ LOCATION & COMMENTS

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STM PILE - Sketch, Inspect Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Station Fies (original)

Fossilend Hydro Genération Technical Services - Jane Hood

CROSS STATION

GYPSUM POND

REVIEWED BY: Station Manager INSPECTOR:

SIGNATURE:

SIGNATURE:

Boils Cracks (Measure Dimensions) Settlement (V) 1. Crest Seepage 3. Area Downstream Erosion gullies Seepage (Flow, lush grass, clarity) Burrows or Ruts Excessive Vegetation Alignment (H) Orainage Pipes Orainage Ditches (Flow, lush grass, clarity) Slides (cracks, bulges, scarps) Note any other issues Vegetation Settlement/Depression 5. Overall Condition 4. Outlet Works trees present, no grass) Rip-rap displacement Animal burrows regetation (trees present, no grass) nspect Concrete, Metal, and Wood . Slopes reeboard Adequate FEATURE 8 • 4 ٣ < ۲ K ς ۲ ςk ₹ ₹. Ç ζ LOCATION & COMMENTS

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY S IN P L E - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Section Files (original)

Fossi and Hydro Generation Technical Services - Jane Hood

FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES DIKE INSPECTION REPORT

CROSS STATION

BOTTOM ASH POND 1 (ORIGINAL)

DATE: INSPECTOR:

REVIEWED BY: Station Manager

SIGNATURE:

SIGNATURE:

Note any other lasues	5 Overall Condition III III III III III III III III III I	Inspect Concrete, Metal, and Wood	4 Outlet Works and Market Market	(trees present no grass)	Venetation	District Cives	Orainage Ditches	Bolts	(Flow, lush grass, clarity)	3 Area Downstream mala million and a second	Settlement/Depression	Freeboard Adequate	Rip-rap displacement	Animal burrows	Vogetation (troes present, no grass)	Slides (cracks, bulges, scarps)	Frosion guilles	Seepage (Flow, lush grass, clarity)	21Slopes州西州沿海湾湖湖湖湖湖河湖河湖	Burrows or Ruts	Excessive Vegetation	Cracks (Measure Dimensions)	Settlement (V)		4. Crests 经银行的 计记录记录 计图像图像图像图像图像图像图像图像图像图像图像图像图像图像图像图像图像图像图像	FEATURE
<		V		<	,		ζ	۲	<		<	۲	<		\ \ !	ς,	۲	ς,		Z,	<	Ţ	ζ	ζ		Э Х
																									的,我们是一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个一个	LOCATION & COMMENTS

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED ORAWING and DESCRIBE DEFICIENCY S J M P L E - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies. Station Files (original)
Fossil and Hydro Generation Technical Services - Jene Hood

CROSS STATION

BOTTOM ASH POND 2

DATE INSPECTOR:

REVIEWED BY: Station Manager

SIGNATURE:

SIGNATURE

	¥	Note any other issues
	多數	5回Overall Conditions 的 表情的意思
	1/	Inspect Concrete, Metal, and Wood
		4. Outlie GWork 音音集中差别音音
	۲,	(frees present, no grass)
	-	Vegetation
	ζ.	Orzinage Pipes
	<	Drainage Ditches
	<	Boils
	Υ,	(Flow, lush grass, clarity)
		Seepage
		30名(ex Downstream 发生所建筑
	Λ.	Settlement/Depression
	ς,	Freeboard Adequate
	<	Rip-rap displacement
	5	Animal burrows
	<	Vegetation (trees present no grass)
	\	Slides (cracks, bulges, scarps)
	۲	Erosion gullies
	7	Seepage (Flow, lush grass, clarity)
		2 Slopes 全是是主义。
	<	Burrows or Ruts
	7	Excessive Vegetation
	<	Cracks (Measure Dimensions)
	~	Settlement (v)
	V	Alignment (H)
LOCATION & COMPENIS	Q;	FEATURE

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY S I M P L E - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Cooles: Station Flag (orlying)

Fossif and Hydro Seneration Techniqui Services - Jane Nood

GYPSUM POND CROSS STATION ۲,

REVIEWED BY: Station Manager INSPECTOR:

DATE

SIGNATURE: SIGNATURE: ULL

	Secueira Procedites (1) (1) (1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2
	Secueiriento-barression  3:Arifa Distribution Seepaga [Flow, Lust grass, carity) Boils Drainage Ditches Drainage Pipes Vegetation (trees present no grass) 4:Outlet Works Inspect Concrete, Metal, and Wood
	Sequence Downstream  3: Anita Downstream  Seepaga (Flow, lust grass, carity)  Boils Drainage Ditches Drainage Pipes Vegetation (frees present no grass)  4: Outlet Works
	Setueinent to grass)
	Selueiræni Oepiresson  Sigarea Downstream (Flow, lush grass, carity)  Boils  Drainage Ditches  Drainage Pipes  Vegetation
	Sellement (Capression)  32Ar6a Downstream (Seepaga Seepaga (Flow, Lush grass, clarity)  Boils Drainage Disches  Drainage Pipes
	Sellement Ceptresson  32Area Downstream (1994)  Seepaga  (Flow, lush grass, carrity)  Boils  Drainage Ditches
	Sellement Osphesson  Stanes Döwnstram Sellemen  Seepaga  [Flow, lush grass, carity)  Boils
	Sellementio-apression  Seepage (Flow, lust grass, darity)
	Se uement (John Sugam )
	SEAREA DOWNSUGAM
	Sellellier: Deplession
	7.EL.
	Freetoard Adequate
	Rip-rap displacement
	Animal burrows
	Vegelation (nees present no grass)
	Sides (cracks, bulges, scaros)
	Erosion gullies
	Seepage (Flow, sist grass, ciarity)
	2. Siopes 2. 15 15 16 18 18 18 18 18 18 18 18 18 18 18 18 18
	Burrows or Ruts
	Excessive Vegetation
	Cracks (Measure Omensions)
	Settement (V)
	Algnmert(H)
14	1 Grestor (1994)
CK → LOCATION & COMMENTS	FEATURE

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Status Fles (origina.)
Face: and Hydro Generation Technical Services - Sare Hydr

CROSS STATION

DATE: INSPECTOR:

REVIEWED BY: Station Manager

SIGNATURE:

BOTTOM ASH POND 1 (ORIGINAL)

	CONTON + COMMENTS
FEATURE	DK A TOO MICH B COMMENTS
1. Crest	
Alignment (H)	
Settlement (V)	
Cracks (Measure Dimensions)	i l
Excessive Vegetation	
Burrows or Ruis	
2. Slopes	
Seepage (Flow, lush grass, clarity)	7
Erosion guillies	
Slides (cracks, bulges, scarps)	
Vegetation (trees present no grass)	
Animal burrows	
Rip-rap displacement	
Freeboard Adequate	
Settlement/Depression	V
3. Area Downstream	
Seepage	
(Flow, lush grass, clarity)	
Boils	
Drainage Ditches	
Drainage Pipes	
Vegetation	
(trees present, no grass)	
4. Outlet Works	
Inspect Concrete, Metal, and Wood	<b>V</b>
5. Overall Condition	
No!e any other issues	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY S I M P L E - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies. Station Files (origina)
Flassi and Hydra Generation Technical Sembes - Lare Hood

CROSS STATION

DATE REVIEWED BY: Station Manager INSPECTOR:

<u>5</u>

SIGNATURE:

SIGNATURE:

**BOTTOM ASH POND 2** 

	-	LOGINGUE GOVERNMENT
FEATURE	98.44	LOCATION & COMMENTS
1. Crest		
Alignment (H)	-	
Settlement (V)	V	
Cracks (Measure Dimensions)	(	
Excessive Vegetation		
Burrows or Ruts	U	
2. Slopes		
Seepage (Flow, Jush grass, clarity)	V	
Erosion gulfles	V.	
Slides (cracks, bulges, scarps)	ν,	
Vegetation (trees present, no grass)	, <	
Ammal burrows	_	
Rip-rap displacement	Z,	
Freeboard Adequate	V	
Settlement/Depression	V	
3. Area Downstream	Spirite Day of Say	
Seepage	_	
(Flow, lush grass, clarity)	,	
Bais	į	
Drainage Ditches	,,	
Drainage Pipes	6	
Vegetation	(	
(trees present no grass)		
4. Outlet Works	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	
Inspect Concrete, Metal, and Wood	,	
5. Overall Condition		
Note any other issues	,	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STM P.L.E. Sketch, Inspect Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copes: Station Fles (mg/rei)
Fissil and Hydro Generation Technical Services - Jane Hood

FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

CROSS STATION **DIKE INSPECTION REPORT** 

GYPSUM POND

REVIEWED BY: Staton Manager INSPECTOR:

1200

SIGNATURE:

SIGNATURE:

Books 2. Slopes Seepage Note any other issues 5. Overall Condition Drainage Ditches Freeboard Adequate Rip-rap displacement Slides (cracks, bulges, scarps) Seepage (Flow, lush grass, clarity) Inspect Concrete, Metal, and Wood (trees present, no grass) Vegetation Drainage Pipes (Flow: Jush grass, clarity) Settlement/Depression Animal burrows Vegetation (trees present no grass) Erosion gullies Burrows or Ruts Excessive Vegetation Cracks (Measure Dimensions) Settlement (V) Alignment (H) 1. Crest . Outlet Works . Area Downstream FEATURE 욧. ζ ζ ۲, Ç 4 C ¢. ζ ŧ, LOCATION & COMMENTS

NOTE: SHOW LOCATION OF PROBLEN AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STM P.L.E. Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copes: Station Files (original)
Floss and Pytin Generation Technical Sentices - Jans Hood

FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES

CROSS STATION DIKE INSPECTION REPORT

BOTTOM ASH POND 1 (ORIGINAL)

DATE INSPECTOR:

REVIEWED BY: Station Manager

SIGNATURE: SIGNATURE:

Note any other issues	e la la la la la la la la la la la la la	and Wood	(trees present, no grass)	Végetation	Drainage Pipes	Drainage Ditches	Boils	(Flow, lush grass, clarity)	Seepage	C. Ared Downstein L. C. Land Britain	Settlement/Depression	Freeboard Adequate	Rip-rap displacement	Animal burrows	Vegetation (trees present, no grass)	Slides (cracks, bulges, scarps)	Erasian guilles	Seapage (Flow, lush grass, clarity)	Burrows or Ruts	Excessive Vegetation	Cracks (Measure Dimensions)	Settlement (V)	CHESTER		
		HAMIBA III MA																	7					OK V COCATION & COMMENTS	ı

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY S IMPLE - Sketch, Inspect, Neasure, Photograph, Locate, Engage a Qualified Engineer If necessary

Dopler: Station E. es (original)
Fostill and Hydro Generation Technical Services - Jane Hood

CROSS STATION

BOTTOM ASH POHO 2

REVIEWED BY: Station Manager INSPECTOR: DATE

SIGNAT

SIGNAT

	URIE:
	<u></u>
B	
g	٢
H	<b>≀</b> √ *
<b>Y</b>	174

Note any other issues	2		(trees present no grass)	Vegeration	brainage Piges	Drainage Ditches	Boils	(Flow, lush grass, darity)	Seespage	Settlement/Decression /	Freeboard Adequate	Rip-rap displacement	Animal burrows	Vegetation (trees present, no grass)	Sides (cracks, bulges, scarps)	Erosion gullies V,	Seepage (Flow, Iush grass, clarity)	Burrows or Ruts	Excessive Vegetation	Cracks (Measure Dimensions)	Settlement (V)	Alignment (H)	
		是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一个人,也是一																					

MOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Sketch, Inspect, Measure, Photograph, Locate, Engaga a Qualified Engineer if necessary

Codes: Station Files (indigital)
Files and Architect School Schoo

GYPSUM POND

1

DATE: REVIEWED BY: Station Manager INSPECTOR:

SIGNATURE:

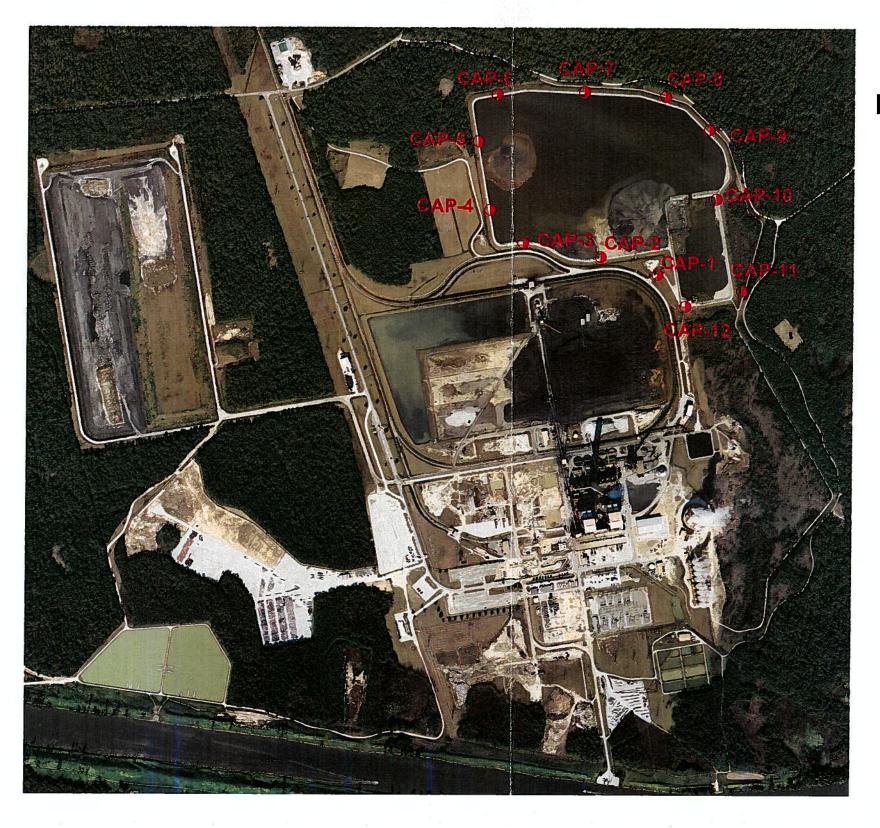
SIGNATURE:

	j	
TOAL UND	90	LOCATION & COMMENTS
Algament (H)	7	
Settlement (V)	7	
Cracks (Measure Dimensions)	5	
Expessive Vegetation	5	
Burrows or Ruts	4	
Seepage (Flow, lush grass, clarity)	7	
Eros on gulfies	\$	
Sides (cracks, buiges, scarps)	4	
Vegetation (frees present, no grass)	,	
Animal purrows	\$	
Rip-rap displacement	4	
Freezoard Adequate	۲,	
Settlement/Depression	ς,	
Spaceria		
(Flow, lush grass, clarify)	<	
Bails	5	
Drainage Ditches	.5	
Orainage Pipes	.\	
Vegetation	_	
(trees present no grass)	٠,	
Inspect Convers Males and Mood		
Note any other issues	7	
LOTE SHOW OF THE		

MOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY STMPLE - Sketch, Inspect, Measure, Photograph, Locate, Engage a Qualified Engineer if necessary

Copies: Station Faes (original)
Fissel and Physics Generation Fechnical Services - Jane Hood

Appendix A Doc 11: Monitoring Well Location Map and Readings



# Cross Generating Station NPDES Groundwater Monitoring Well Location Map

# CAP Well Location

note: PM-3 was renamed CAP-1

4

Date: 2/16/2011, MDH

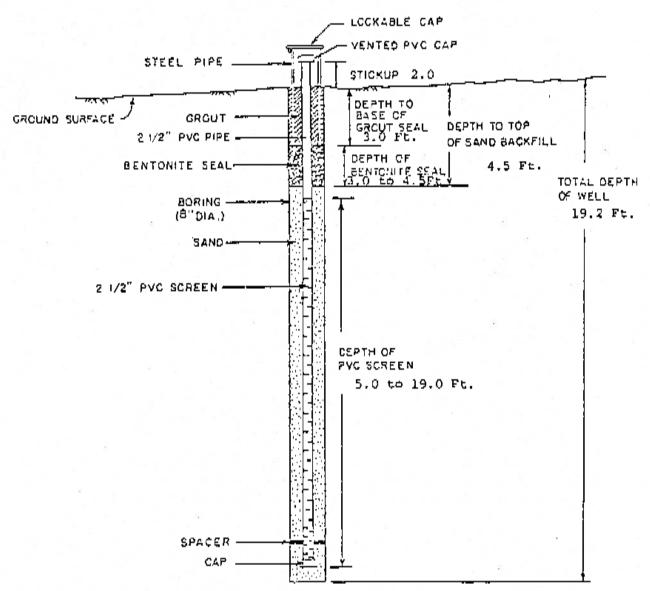
Groundwater Elevations at Cross Generating Station

			The state of the s	MI LECTOR	"aw Lectauolis at Cross Generating Station	ross Ger	erating s	Station				
Date	CAP.1	CAPLS	CTD			Well Locations	cations					
Top of pad Flowation	20,00		2	7	3	CAPS	CAP-7	CAP-8	CAP-9	CAP-10	CAP.44	C 6 D 4 3
[  <b>s</b> w]	76.70	20 13 13 13 13 13 13 13 13 13 13 13 13 13	89.62	89.77	99.80	89.83	160 St	89.70.	ROAM	20.00	72 23	2
1034906								2	25	33.07	13.01	98.61
Scheinne	78.40	78.9	75.89	78.37	78.89	78 93	70 767	1				
12.31 CO	77.87	77.9	77.4	76.81	75.69	2 2	00.00	70.77	78.38	78.69	77.85	77.38
5031350	77.57	77.56	78.43	76.47	78.20	2 6	6/0/	(3.24	76.35	74.02	76 92	76.03
6/1//199/	78.42	78.47	79.39	24.44	60.00	91.	67.73	76.05	78.55	75.54	75.69	76.24
1,67,998	79.08	79.36	79.31	78.04	10.07	76.81	7.82	76.55	77.64	75 99	77.46	78.05
5/20/**998	77.78	25	78.5C	2007	45.0	/B./6	78.67	77.54	78.39	76.91	77 68	17
8/24/1998	787	78.75	200	4 5 5	18.84	22.23	78.65	77.24	78.16	76.65	36.35	27.0
47/1959	77.43	78.81	24.7	20.7	/B.14	78.38	78.51	76.87	78.59	76.36	27.77	
513/1959	75.83	75 06	987	70.12	8 2	78.25	78.17	77.25	£5	76.17	77.77	- 27
2/23/2000	78.54	7.8 6.8	77 13	70.00	13.11	73.77	74.33	72.97	7,00	72.71	8, 51	74.4
8/9/2000	77.76	77.5		00.67	20.29	78.23	78.2	78.9	78.34	76.43	77.76	
1,23,2001	9.92	28.57	15 45	6.0	76.5	77.1	77.43	76.04	78.18	75.73	200 17	7000
7.9/2005	77.55	77.23	2 5	12.07	75.71	76.28	76.63	75.25	78.15	74 94	20.07	8 3
2,25/2082	76.14	75.75	76.95	17.3	75.39	75.9	76.28	75	77.84	74.63	17.77	0 0 1
8/19/2032	96.57	2 12	00.00	87	73.64	74.42	75.01	73.98	77.87	200	16.41	C)
242363	75.01	7.5 8.4	24.2	2.53	71.9	72.68	73.05	71.97	74.33	2 2	25.55	8
7/22/2003	95.52	74.55	13.5	692/	75.7	76.23	76.58	75.51	79 13	75 11	10.01	200
2/2/2034	74.97	73.65	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	73.03	5.56	76.67	77.03	76.25	79.6	75.77	78.33	74.42
8/16/2034	75.45	74.47	20.00	22.23	75.58	76.31	76.72	85.55	78.28	76 13	70.07	7
1/24/2005	3 42	35.55	20.00	72.41	73.22	74.5	75.44	75.62	27, 22	74.86	2 64	<b>9</b>
82222005	76.59	77.50	75.44	74.30	76.03	76.5	76.55	75.53,	78.22	75.13	2 2	g e F
19/2006	77.99	74.41	100	17.00	6.5	75.78	76.38	75.64	78.39	75.41	22.22	7 S
7/24/2008	75.71	77.18	73.78	77.77	30.5	8	77.71	76.54	78.24	76.11	77.82	28.82
1,23,2007	77.74	77.14	767	2 192	72.45	2012	74.59	74.07	76.35	74.01	76.78	74.47
7302007	77.61	74.39	13.92	78.10	26.40	z, 2	77.87	76.81	78.51	76.35	78.15	32,92
1/16/2308	75.53	75.79	73.89	20 62	13.53	800	76.72	74.82	78.28	74.69	77.93	75.05
or curants	76.51	77.36	75.34	72.83	74.00	20.5	75.12	73.23	78.09	73.28	77.31	73.04
1,222008	77.63	77.477	76.95	28.67	90.47	10.5	15.38	73.73	78.15	73.6	77.66	72
1010 SHE	77.28	76.74	76.31	75.72	74 14	75.78	7.55	76.89	78.35	75,75	77.93	76.5
7.6.00.41	77.49	77.17	77.69	78.72	74 14	28.03	20.00	76.03	-19. 14.	74.64	77.13	75.83
lower 1	76.38	75.81	75.55	74.56	74 14	12.32	3.5	75.77	공 는	75.37	77.04	78.33
					<u>.</u>	14:22	4.82	3.80	28	23.87	76.43	į

CAP-10 CAP-11 ►CAP-3 -CAP-8 CAP-9 \*-CAP-5 -CAP-6 X-CAP-4 -CAP-7 OLYM OL'UP, Com COURT Ohn 80 UES TOM Tour 90 m OUE, 50 m South \*Opp **Collection Date** to us, Coin COURT COM COUR 10/m LOUR 90/M Outer 66 M OS US 86. In 86. U.Br 16:1m To yes 96, W. 196, Ÿ ä 8 78 9/ 74 72 2 feet mean sea level

Groundwater Elevations at Cross Generating Station

# MONITORING WELL INSTALLATION RECORD



(1) Elevation Furnished by Ruscon

(2) Ref: LETCo. Job No. Ch 4781A, Report to Ruscon dated May 3, 1983.

Ruscon Corporation

Charleston, South Carolina

HAVE SCREW CONNECTORS

NOTE: ALL PYC PIPE JOINTS



LAW ENGINEERING TESTING

CM44L0778, MONTH GAMOLINA

MONITORING WELL INSTALLATION RECORD

Details of the installation are shown on the attached Monitoring Well Installation Record. The driller's observations of stratification are summarized as follows:

Well <u>Designation</u>	Ground Surface Elev. (Ft)	Depth <u>Int</u> erval (Ft)	Description
PM-3A	62.3	0 to 2.0	Fill - Sandy Clayey Silt
CAP-1		2.0 to 10.0	Sediments - Slightly Clayey Sandy Silt
- 1		10.0 to 16.0	Gray Slightly Sandy Claycy Silt
		16.0 to 19.1	Blue Green Clayey Silt
		19.1 to 19.2	Santee Limestone

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

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Neil J. Gilbert, P. E., P. G. Senior Engineering Geologist

William E. Babcock, Jr. Drilling Department Manager

Attachments

NJG/WEB: the

Ground Water Protection Division	2600 Bull Street	Columbie, S.C. 29201	(803) 734-5331	Water Well Record
	CUPS	4. OWNER OF WELL:	Ace Copper	AND THE PARTY OF T
County Property Land County System Name:		Telephone No.		
Lainute . Longkuda.		Tolephone No. 22	uched) Duce (Cyatur)	2
Cross Generaling Stufic	"	62'	11. Cata Completer	110-20-14
Crass General of 31401		MAN BOIDY	Driven Cante t	(, ) Dua 00)
Street address & City of Well Location Sketch Map: (See example on back)		7. USE:		
Horizontal Control			Public Supply Permit No  Air Conditioning	
North: 12983.9998		(¥ Ten yen	<u> </u>	
Eact: 10101.3920	,, -	B. CARING Thinacand	[] Welded   Height, Abo	ove/delow
		TVP# Mrvc G	alvaniseu   Surlaca	f1.
8		+260 Stock 42 10	Mergh Mergh	
u s v	- 2	f1		[] (4) (] (40
2. CUTTING SAMPLES YOU NO		9. SCRULN:	PVC	<u> フルッ</u>
Geophysical Loos Yes (Please enclose	e) 🔲 Na	Type; Stot/Gaute Stot/Gaute	.DID Length	<u> 28"</u>
FORMATION DESCRIPTION	THICKNESS DEPTH TO 210 OF BOTTOM OF STRATUM		المرااالاستان الماه الاستان	IOTE: MULTIPLE SCREEN! J&E SECOND SHEET
noist brown Smody Clar (GI)	13' 13'	SIEVE ANALYSIE YOU	<u>ε.</u>	
Moist Gray, brown S.IL SANGEL	8' 21'	1Z'	low land surface after 24 hours	<u> </u>
		11. POMPING LEVEL BA		
moist gray Sandy Clay	2' 23'			
most ogran Chan	- 11'   34'	Yield		<u> </u>
e wet black SANDE Clau	4' 38'	12. WATER DUALITY  Cheroical Analysis (	Yes□ No Secretial An	alyais Yes No
* SAT. black SAND	1/ 39/	Pinaya Englose Lab Res	General Parks Chicago Char	<u>ii</u>
		Installed from	39 /Z 11 to 6 Z	<u></u>
+ Soft lightyellow Chy Sard	101 11 11 11	La mellonoutena 🖼 a	• Chia	
+SAT Istit gleen Chycus lly Sand	4 6 466	Neat Coment 📝 Sant	Gement Concrete	ann D'bestuste
Fractured limestone	46" 51	Depth From O	<u> 342, "</u>	
, <u> </u>	11' 62'	15. NEAREST SOURCE OF P	OSSIGLE CONTAMINATION:	
(1 Mestone	11 62		∪pon completion ☐ No	Arnount
	, <u>.                                 </u>	16 PUMP. Date Instituted	. modet no.	not installed [
			tength of drup pips	
		TYPE Sylmianitie		Techine
Inficate water hearing somes		17. WATER WELL CONTRACT	ORBOBILED CONTROL	Centrifugal
(use a 2nd shoet if neerlest)		end this report is true to the bei	ON SOCIETY OF THE PARTY OF THE	
3. REMARKS		HUENESS TO STATE		
	14.	Skined LADVINA		N. PARECE SERVICES CONT.
-C # 1903 (10/86) COPY 1 MAIL TO: S.C. DEI	PARTMENT OF HEALTH AN	O ENVIRONMENTAL CONTR	ENTATIVE TO SECTION OF THE	115,499-105,00° - 105.

Ground Water Protection Division	2600 Bull Street	Columbia, S.C. 29201		SBBI W	IN I ROL
	CAP 3	4. OWNER OF WELL:	Soulee Con	The state of the second	atilikatia <sup>n</sup> — mesen
			No. of the State o		
1. LOCATION OF WELL		Telephone No.	The second second	147	
County System Name	11.1	Engineer Address	(2) 2020	White the beginning of the	
	Della Control	25 25 3	71 6 3 6		
		Teinphone No.		1	
Ontance And Direction from Road Intersections	SAME OF SAME O	5. WELL DEPTIMICAN	motori) Date	219-10-1 CJ - 5	<u> १</u> १-५० —
		<u> </u>	II. Cate	Completed Q = 2	22-94
cross 6 ancrating stat	-044	[ L.D. WINST - 170 III - 1	[] 10116U	JMI Boren	( ) 0 119
Street address & City of Well Location		7. USE:	Orlyan		
Sketch Map: (See example on back)		Dames (ic	Public Supply Pe	mit No	[] terminally
Horizontal Control	-	LJyraation	Air Conditioning		Carrente cal
North: 13289.517	7	W CASING Theonem	<u></u>	<del> :</del>	
East: 9274.5/39		2 Z		eight: Atjoy≠/Bei	low
		Tyne Mevc	Galvanised ¦ g,	irlaca	
	5 I=   E	+5,0,1,0 2 100, 0	Ottier W	=1qht	164.70.
		in. to		rive Shoe 7 (	) Yes   No
2. CUTTING SAMPLES Y+1 No	1: 2	8 SCHEEN.			
Geophysical Logs Yes (Please enclose)	. T 1 <sub>812</sub>	Y VDeSlot/Call/E	<u> </u>	$\frac{Z/y}{y}$	
	<u>.                                     </u>	Sot Belivery 15		5	MULTIPLE SCREENS
	THICKNESS DEPTH TO STRATUM STRATUM				COND SHEET
moist brown Sandy Clay	111 - 111	10. STATIC WATER LET		<u></u>	
		1-2'	rec olow land surface stier	34.	
moist bown Silly Chycy Sale	/2′   13′	11. PUMPING LEVEL B		74 hourt	
moist brown S. Hy SANY Clay	10'6" 23'6"			µumping	55 P M
100	106, 536	Pumping Test: Ye			
* Saturite fing limestone investig	36" 27'	Vield	<u> </u>	_	[
* sat, white fract, I mestore with Clay	-	12. WATER QUALITY			
The District of the ALACE ! House De secretarion	5   32'	Chamical Anglysis Please Enclose I als Ba	Y+1-□ №o 8±.	Irred Analysis	□**•□No
	11	Ploate Enclose Lob Re 13. ARTIFICIAL FILTE:	C (Citavel Pack)		
	- $   $	(Malaties) from	4'6" 11.10	<u>_"30'6"</u>	16.
<del></del>		Elfective size	<u> PSD voitoraria</u>	y coefficient	
<u> </u>		14. WELL GROUPED TO	H[]No		J'h
		Neat Coment 🗹 San		(C) It.	O-Sex 1141B
	-   -   <u> </u>	15, NEAREST SOURCE OF P	Type, Well disinlects	d [] Yes Yune	
	-[[		upon completi	ON DNO Amos	vn1
		18 PUMP: Quie installed	— <del>,.</del>		added
		H.P volti	inch of drop	nodel no	
• — — — —	· · · · · · · · · · · · · · · · · · ·	TYPE. Sphinersible			
		[] Jet (desp)	☐ Ageintocation	C) Canvilu	
(ficula water financing zones		T. WATER WELL CONTRACT	The state of the s	TOTAL TAXABLE PARTY	thinder my dispation
tuse a 2nd shoet of courtest)	117	FORT CORD	<b>数数据以示数数</b>	TO THE REAL PROPERTY.	Constitution of the consti
REMARKS	2006 BELF479 200	IUSINESS			200
17大量17年2日內閣共同公司美國教養				28 V	M. 1975 C. S. C. C. C. C. C. C. C. C. C. C. C. C. C.
	\$	AUTHORIZED REPAER	ENIATIVE AND ASSESSMENT		(H. Greyener) a complete.
EC 4 1903 (10/86) COPY 1 MAIL TO: \$.C. DEPA	RIMENT DE HEALTH AND	ENUINAMENTAL CONT			1

Ground Water Protection Division	2600 Bull Street	Columbia, S.C. 29201	(803) 734-8331	Water Well Record
	CAPY	4. OWNER OF WELL:	A 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	OVERNING TO LANGE
		1000 H	Sale Caser	
1. LOCATION OF WELL		Talophone No.		
Colinty System Na	THE CONTRACT OF THE PARTY OF TH	Engineer Address	A STATE OF THE STA	ENDINGS A Sign of the second second
	Market State of			
Transcription of the second se	13 N/3 / 1	5. Writt DER THICOM	TOTAL TOTAL TOTAL	
Distance And Direction from Road Intersection	· · ·	60'6"		4-27-49
Cross Generalizes	Frut ica	5. DMuri Botery	trCate Compte	
	-	Air Rolary	Oriven Can	te teol [ ] Other
Street address & City of Wall Location Sketch Map: (See example on back)		7. USE:		
Annual (San Print) die Back)		Domestic Clar	Public Supply Permit No	· Industry
Horizontal Control	- <u>i</u>	() Irrigation	Arr Conditioning	Gornales
North : 13843.38	91.	Branch (M)	<u> </u>	<del></del>
60.4	200	Bichating (V) Threming	( Identity	Above/Below
East: 9/22.23	194	7 V 20 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	I	
<i>v</i> .		+216" 51401 40C	Orther Weight	
	[ ]	766 10 10 40°C	ir, depth Drive Sho	• ? □ Y • € □ No
CUTTING SAMPLES YET NO		9 SCREEN:	fr. debili	
ECUTTING SAMPLES YAT NO			0 1/6	
Geophysical Logs Yes (Please encis	014) No	7 V D # L	PVC Diam	- <del>દાવા</del> — —
FORMATION DESCRIPTION	. 🖵	Sign/Cause Ser Between 401	11. ang _ 60 6-11	NOTE: MULTIPLE SCREEN:
	TYPICALOM: C. AIMAIUW 11 I		fs. and (t.	USE SECOND SHEET
. Moist blown to real bing sindy (1)	131 131	Stove Analysis DYs	(Please enclose)	
·	<del> •</del>	O. STATIC WATER LE	VLF	
Moistlahtyray Silly Grady Clar	1 23	II. PUMPING LEVEL B	elow land surface after 24 hou	<u> </u>
	<i>(</i> ) ——, ——,	our ma zi vije B	now Cand Surface	
is At gray Claysand with shell & s.	<u> </u>			G,P,M,
1	22111	Pumping Yest: Ye	s (Pitam englose)	[〕N••
Limestone	336 62	V (e1d)	<del></del>	
	1 1 71'	2. WATER QUALITY Chemical Analysis	<b>63</b> 4 <b>/</b> 7	
<u></u>	<del></del>	Player I notice Lab Re	[]Yes[]No (tecretia) A ruite.	na)yais Yes No
	] [] []	ARTIFICIAL FILTER	(Gravel Pack) ATT . [ No	
	T — — — (	Installed from36	16" 11.10 _ 6	<u>2'                                    </u>
	<u> </u>	Effective size	X50 uniformity coeffi	clen1
	}	4. WELL GROUTED? TY		6 . 1
	<del>                                       </del>	Nest Cement C San	d Cament 🗇 Conceste 🗩	Other     Destinate
<	1 I	Denth From Q	<u> </u>	·
(4	, <sub>1</sub>	S NEAREST SQURGE OF P	OSSIBLE CONTAMINATION:	FAM: Discoulant
	<u> </u>		Type Well disinfected [7] V	EF TURA
		E BUILD : B	upon completion 🔲 N	- Arnouni
-,- <u>-</u> .	— <del>-</del> — — — —     '°	Mit. memo		_not installed [ ]
> > >			length of drop pine	
<del></del>	——————————————————————————————————————	PE. Sobmersble		
		( ) Jet (deep)		Turbine
ficate water transing romes	1 32	WITER WELL CONTRACT		Centrifogal
(use a 2nd shoet if nearlest)	1 1 2 2	A THE LADOR OF THE PARTY PA	TO THE RESIDENCE AND A SECOND CO.	
REMARKS - WITH A CONTROL OF THE PROPERTY OF TH	REI	GISTERED ( ) CONTROL OF CONTROL O		
	A PROPERTY OF THE PARTY OF THE	MERCANCOLITICATION		
2000年1月1日 1月1日 1月1日 1月1日 1月1日 1月1日 1月1日 1月1日	(State		<b>计以外的数据</b>	ACCURATION OF THE PARTY OF THE
*** *** *** *** *** *** *** *** *** **	V - 12 1 1 - 12 1 2 1 2 1 2 1 2 1 2 1 2 1	AUTHORIZED REPRES	EN YATIVE SALESCE SALES	za na 1964 i na 1925 kwa na 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1 Na 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa 1925 kwa

<b>Ground Water Projection Division</b>	2600 Bull Street	_Columbia, S.C. 29201	(603) 734-5331	Water Well Record
	C495	4. OWNER OF WEIT		
	,1	Address	uter coper	Will have a second
		) A	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1. LOCATION OF WELL		Telephone No.		All Mary States
County Q	The service of the service	Engineer	The state of the s	t i karata da karata ing manggan panggan
DIFFERENCE		Address		ANGLE STATE
			THE REPORT OF THE PARTY OF THE	<b>数规则是在外的企业的企业</b>
		13.5		CHARLES AND AND AND AND AND AND AND AND AND AND
Lainute : Longitude	\$2556 A. T. W. A. A. A. A. A. A. A. A. A. A. A. A. A.	Totaphone No.	A STATE OF THE PARTY OF THE PAR	<b>经验</b> 的证明的
Distance And Direction from Road Intersections	or transfer was the management of the	5. WELL DEPTH (Complet	ind) Date Started: [	)~ <del>25'-4\U</del>
The state of the s	_	<u> 30'6"</u>	Completed:	
		6. [] Mud Rotary []	Jettert W Apren	() Out
				ot
Street address & City of Well Location		7. USE:		· · · · · · · · · · · · · · · · ·
Sketch Map: (See example on back)			Pullis Supply Bar is his	
Horizontal Control		())respection [7]	Public Supply Permit No	
	_	Estan Well	Air Constioning	
North: 14 625-67	120		<del></del>	<del>.</del>
		H.CASING Threaters []	Welded	
East: 9121.612	F)	DIAM ZYU!	Height: Abov	e/Below
	'	TYPA PVC Dame	annized : Surface	ti.
	i.	726" Steel 1576"	er Waight	1056,741.
		76 6 m to 15 6 16 0	topth Drive Shoe?	□ Y+1 □ N=
<u></u>	l,		leeth	,
2. CUTTING SAMPLES YET NO		9. SCHIEN:		<del></del>
		Түрү: (	1010 Dino_ 7	7 % "
Geophysical Logs Yes (Please enclose	) N= ×	Set Hajwaen 15 6	(O) 10	15-
FORMATION DESCRIPTION AND TO SAL	THICKNESS DEPTH TO	Set Halwer 15'6"	U and 30' la // U and	TE: MULTIPLE SCREENS
The Property of the Property o	O DE BOTTOM OF			E BECOND SHEET
	1 1 1	Steve Analysis   Yes (F		T-TOND BILLY
most brown Sandy any	14'   14'	10. STATIC WATER LEVEL	The	
	<del></del>	1-27		
very moist gray Silly Chysal	15, 116, 14		Jand surface after 24 hours	_
		11. PUMPING LEVEL Below	v Land Surface	
wet grantyreen Clay with Sill	1 10' 29'		hrt. pumping_	G.P.M,
	7.10 24	Pumping Test. Yes (5		
to (.)	, , , , , , , , , , , , , , , , , , , ,			•
* Sat gray Sand	<u>3'  32'  </u>		<del></del>	
, ,		2. WATER QUALITY		
			TOP Bacterial Analy	1/4 □Y+1 □ No
	1 - 1-	Plante Enclose Lab Results	<u>.                                    </u>	
		3. ARTIFICÍAL FILTER IG	(Avel Pack) WYes No.	
	· — [	Installed from 146'	rus	
		Effective size	50 uniformity coefficien	
		4. WELL GROUTED? TYAN	100	
		Ness Coment (P) Sand Co	ement 🗍 Ganerata 🗀 Oti	dibratatal
		Depth From	1117-11	Wer ( ) Qr 22 X X X X X X X X X X X X X X X X X X
	_ a   I	Organia From C		
· · · · · · · · · · · · · · · · · · ·	_ <del>_</del>	5. NEAREST SOURCE OF POSS	BBLE CONTAMINATION:	D
	1 11.	т	vpe Well dishriected 🔲 Yes	Type
			upon completion 🔲 😽	L mail n
	]   ]	S. PUMP: Date Installed	upon completion No	TATE OF THE PARTY
	·- <del>- </del>	Mfr name	madel no	
			length of drop pipet	
		YPE. Subjectible		
	]	63	<u> </u>	
odicate water bearing zones	——————————————————————————————————————	[] Jet (deep)	Reciprocetting Con	itilogal
	- J HM	WATER WELL CONTRACTOR		
(use a 2nd shapt if Apertual)			Reclarocating Cen	
INFEMARIOS VIAL SALVANOS AND AND AND AND AND AND AND AND AND AND	ON DO 1997 OF THE PROPERTY OF THE PARTY OF T	BINGSS TO TOTAL		
	CANAL CONTRACT IN	ME TO A STATE OF THE STATE OF T		
		- $        -$		
2.整个学生为5.40万亿的基础的特别。				A STATE OF MACON ASSESSMEN
COPY I MAN TO SE DESIGN		AUTHORIZED REPRESENT	ATMER TO WAY A PARTY OF THE PAR	<b>多些的影響等</b> 的影響。

Ground Water Protection Division	2600 Bull 5freet	Columbia, S.C. 29201	(803)	734-5331	Water Well Record
	CAPL	Address	14. j. 18. 12. 12. 12. 12. 12. 12. 12. 12. 12. 12		
		5	anter G	e per	
County R Day Land System Name		Telephone No.			
Administration Leading to		Address Telephons No.			
Pistance And Direction Irom Road Intersections	en var til stor ningan i men en en familier	5. WELL OFFTH (Comp.		Dote Sterien: CI -	28-44
Cress 6 enerotion Sta	fiem ]	6 [] Must Potery		Campleted: C	ን 5 <u>ዓ</u> ብ ሃ
54		153 Au Bolary	Orlyen	Capte tout	() Due
keich Map: ISse snample on back)	;	/. Dae:			
Aprizantal Control		Ligripotion	[ ) Poblic Supp [_] Ali Canditio	ly-Permit No Polog	[] 10dus ks
Nerth: 14909.118	8.4	[VT-11 Well	<u> </u>	<del></del>	
· ·	· '	III CASIMUL [V] THE PROPERTY (	Wolrter	Height: Above	/Base
4ast: 1772.064	P9	Type Drvc Dc	elvonired ;	Surface	
		176" 0 500 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1)14"	Walght	
			;	Drive Shoe?	O Y#1 □ No
CUTTING SAMPLES YOL NO		<del></del>	depth		(2)
		Type: Slot/Gaust Set Setween	_Pvc	, 2	Y4"
res (Please englos	4) No	Slot/Gausg-/s	<u>, 1010 </u>		<u>Zo'</u>
FORMATION DESCRIPTION (\$1.33)	A OF A BOTTOM OF	541841W### <u>40 6</u>	th and	0 6" II. NOT	E: MULTIPLE SCREE SECOND SHEET
mutha a Sant a	STRATUM" STRATUM"	Sieve Analysis   You	(Fleate enclose	· []	SECOND SHEET
most bown sandy am	12 2	10. STATIC WATER LEVI			·-
Moistgry Chymun (mursilt	91 21		ow land surface	efler \$6 hours	
,		11. PUMPING LEVEL 6-1			
wet gray Clay	_3'   Z4'	Pumping Test: Yes			<u> </u>
Sat Cing Soud is It	] . ]	Y leiu			
The state of the s	— <del></del>	12. WATER QUALITY			<del></del>
SAT GENZ SANDUM S.It	4' 28'		]Y #1 🔲 No	Oscierial Analysi	• □Y++□Na
Limestone	34' 62'	Please Enclose Lab Rasu	lig.	·	<u> </u>
	- <del></del>	Installed from3	3'6"	60.6"	
		Effective size	×50	prmity coefficient	
		4. WELL GROUTED! [MY44]	_}∧₀		11.
	<b>─</b> ·- <b>-</b>	Nest Coment Sand			" <u>⊡ l bgat-alt</u>
	1 1	Depth From / C	(1. 10	<u>39 6"n.</u>	
1	···	5 NEAREST SOURCE OF PO	SSIBLE CONTAM	INATION:	et Olrection
	<u>-</u>		Twee Well disk	Medied Yes T	V==
		6. PUMP* Date Invisited		mpletian ( No Ar	nstalted
		Mfi, neme		model no	
	<u> </u>	H.P	langth of a	жор рір∎+і. «	Capacitygpv
		YPE. Sylphorelible	D Per lahar		
Jicate water hearing cover		Jac (neap)			
	1 7				
tiose a 2nd sheet of needed)	AND THE RESERVE OF THE PARTY OF	GISTEREO, P. T. T. C. SHINESO	# YX YX		
	N STATE OF THE STA	une Volume		A CONTRACTOR OF THE PARTY	12.000 GH 2500 HART SAFE
			THE PARTY AND PARTY AND PARTY AND PARTY.		

Ground Water Projection Division	2600 Bull Street	Columbia, S.C. 29201	(BO3) 734.	5331 Y	Vater Well Record
	ርቀቦ7	4. OWNER OF WELL	wine Control Williams	SHIP SALES	SERGESTATION NO.
	' (		whee coop		
1. LOCATION OF WELL		Telephone No.			
County D 230 / 1 / Digital Bystom Nam	Detailed a service of the service of	Engineer	10 10 10 10 10 10 10 10 10 10 10 10 10 1		eranga jang-enggay mengunya Rabangan kelalangan
PERSONAL PROPERTY OF THE PROPE		Address	A STATE OF THE STATE OF		
					and in
		Telephone No.		1	
Distance And Direction from Road Intersection	/* 结束(6/50/2015/13/2015/15/2015/2015/2015/	S. WELL DEPTH (Cam	ptome) Date	51m (#0):   D	75 -41y
court and	011.	6. / laws press		Completed: (0	<u>-76-94</u>
cross Generating	> tation	6. Mud Rotary  Air Rotary	( ) 3011001	O Buren	עייו ר')
Street address & City of Well Location	١	7. USE:		Cahle lool	
keich Map: (See example on back)		Domestic	(_) Public Supply Fe	emit Na.	() гания пу
Ho-isabel Contro	$\mathcal{H}$	- Jronation	Air Conditioning		[**]Commerc
No. H. 14737 5		Tout Well			
1007 FX 11 13 1 3	7. 14 5	CASING Thresiend	☐ Welder		
East: 10550.	44 7 J	2. ZYu"		eight: Above/E	
	=	Tyen Mrvc 🗆			
		+216" Steel 0	U. gaoth	/#+ph/t	
<u> </u>			It. depth	rive Shoe?	□ Y •• □ No
CUTTING SAMPLES YES No		9 SCHEEN:	Ö. 4-	. , , , , _	<u> </u>
		Type:	<u> Pvc</u>	CIAN	<u> </u>
Orophytical Logs Yes (Please enclo		St. Daywoon	1.71 - 1010	/Length	7
FORMATION DESCRIPTION SELECTION	A THICKNESS DEPTH TO BOTTOM OF STRATUM	381 UB (WARK	E. Ti. Bod		: MULTIPLÉ SCREEN ECOND SHEET
		Sieva Analysis [] Ye			
Moist brown sandy Cla	ا ۱۱ ۱ ۱۱ ی	TO STATIC WATER LE	VEL		
	9 - 1 , ,		elow lend surface alte	r Zā hours	
Moist gingy-law brown Sandy	1/25 16'	11. PUMPING LEVEL B	elow Land Surface		
verymont lighthrown silly Chan	111 27	ft. af	terh/s,	pumping	G.P.M.
	<del> </del>	Pumping Test: []Ye	e (Please enclose)	. □No	
+ SATUELLUNDIFAM SAND	上 5   3z'	Y 1010	<del></del> ,		_
7.7.2		12. WATER OUALITY	— <u>-</u>		
<u> </u>	<u> </u>			cterial Analysis	
		Please Englose Leb Re	tulis. 1 (Grava) Park) - FDG.	- [3]	<u> </u>
	<del> -</del>	Installed from 14	)	321	- 1 - 0
		Effective size F	KSD Wollern	Ly coefficient	
		14. WELL GROUTEDT TO	<del></del>		54. 1
<del></del>	<u>                                     </u>	Neat Coment San	d Cymens 📑 Con	cres - Ocher	L' bentink
		Depth From	11.10	1	
·	<del>  </del>  [	I NEAREST SOURCE AS A			
		15 NEAREST SOURCE OF A	Type Well disinfects	ed 🔲 Yas Tv	00
·	├ <u>+</u>  í		upon complet	юп 🗆 No Ап	anual
		16. PUMP: Dete Installed		not in	station []
	,	Mfr nang			
	<u> </u>	H.Pvolts_	_		eoscitygpm
		TYPE. Submorsible			7 9 9
dicate water hearing tones	··  ·    ·	Jet (deep)	[] Resiprocetion	g □ ¢entri	itugaj
		7. WATER WELL CONTRACT PSI THE (epoit is true to the be			<b>建筑建设建筑</b>
(use a 2nd shoer if needed)	]	VERISTERED, & L. J. L. YCZN			
REMARKS II		ME FOR THE	AL ASSESSMENT OF THE STATE OF T	10 to 10 to	
10.12.360.44.63.36.36.36.16.36.36.36.36.36.36.36.36.36.36.36.36.36	34 A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR A CAR	AUTHORIZED REPRE	ENTATIVE ASSESSED	AND THE REAL PROPERTY.	A STATE OF S
COPY 1 MAIL TO: S.C. D.	FRA D TAARAIN OF UP ALVIE AND		CONTRACTOR PROPERTY AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSO	10 A C C C C C C C C C C C C C C C C C C	5254455 OF CENS (

COMMERCY WILL  COMMERCY MALL  COMMER	Ground Water Protection Division	2600 Bull Street	Columbia, S.C. 29201	(80:	3) 734-5331	Water Well Record
CONTINUE SAMPLES   Van   No   Compared   No   Committee   Committee   No   Committee		CAP8		Latin Commercial	+ 15 (45 Rest 59/4) - 40h	7/8/2010/03 to 7
Tapping   No.   Tapping		- 1	Address	المعالية		
Supplement   Sup			70.			
Address    Part					A STANTON TO THE STANTON	
Table   Companies   Companie	Berks SX	Emerge Advanced Company	1 1 1/2 50 10 10 10	The state of the state of	<b>与本人的企业的</b>	
District and Distriction from Road Integration  Cross Centricity Station  Cross Centricity Station  Distriction from Road Integration  Cross Centricity Station  Distriction from Road Integrat			No. 1	15.3年初便勤		
District and Distriction from Road Integration  Cross Centricity Station  Cross Centricity Station  Distriction from Road Integration  Cross Centricity Station  Distriction from Road Integrat			#13 c. (1)			384 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Committee from Road Consequences   Section   Committee   Committ	Lamusters		I S. WELL DERYLLIZES	on transfer	Care State of the Control of the Con	
By the statement of City of Well Constitution    War in training   Control		pni	(40/61	4.	10	-11-44
By the statement of City of Well Constitution    War in training   Control	Come Commenter	3 Station	8. C) Mart Boxes	<del>=:.\</del>	- Care Completed: 1	5-(2-c)4
State and City of Marit Location   Public Supply Parmy No.	FLANZ O. ON (1.01.	g structured			CB 1777 471	17 000
Commercial Control	Sittel address & City of Well Location		I L		L. Cable tool	<u>[]</u> Other
Direction   Air Constraint   Comments   Co	Sketch Med: (See example on back)		1 1 1 1	/ D		
Research		0	11 ==	_,		
Nerth   14 74 707 9	Horizontal conti	`~~(	1 ( / '		rioning	_]¢********
CUTTING SAMPLES   Ver   No	14.456	700 H	[ ] A		T	<del></del>
Type   Street   Surface				( ) Welned	i	
COUTTING SAMPLES   Ver   No	8057 11292	. 4635	Type Meye 1	)G-11		
CUTTING SAMPLES   Ver   No	Carlot Charles					
CUTTING SAMPLES   Ver   No			+Z'6" 10.10 4/3	di denti		
9. SCREEN TYPE   PVC   Diam   Z'4/1 SIGNICANTON DESCRIPTION   NO STANDARD   NO STANDAR					Drive Shoe?	□ vei [] No
Casphysical Loss	2. CUTTING SAMPLES YEL NO		O SCREEN		·	17
Mouthan Shall Clay 131 ZU ZU ZU   Sieve Analysis   Yes (Please anclose)   West of the property			Type:	PVC	2	Yu 11
Mouthan Shall Clay 131 ZU ZU ZU   Sieve Analysis   Yes (Please anclose)   West of the property	Geophysical Logs Yay (Please enc	itose) No	5191/Gauze.	1000	DiArr	·
Mouthan Shall Clay 131 ZU ZU ZU   Sieve Analysis   Yes (Please anclose)   West of the property	A STATE OF THE PARTY OF THE PAR	OF THICKNESS DEPTH TO	S=1 8+10000 40'	or trand.	60'6" IS NOTE	E MULTIPLE SCREENS
Most high Sandy Clay 1911 ZU ZU  Very mary multiple Sandy Clay 1911 W ZU  Very mary multiple Sandy Clay 1911 W ZU  Very mary multiple Sandy Clay 1911 W ZU  Limber 1912 Water Duality  Limber 1912 Water Duality  Chamical Analysis  Very mary Silly Clay 1912 Water Duality  Chamical Analysis  Very mary Silly Clay 1912 W Zu  Limber 1912 Water Duality  Chamical Analysis  Very No Beccerial Analysis   Very No Beccerial Analysis   Very No Plasse Enclose Lab Results.  13. Antificial from 391 (L. to 62) (L. Service 1912 W L. Service 1912 W	PARTIES AND THE PROPERTY OF THE PARTY OF THE	STRATUM VETRATUM			USE	SECOND SHEET
Strong   Comment   Concret   Concr	month of 1 to 194	7.1	Sieve Analysis 🔲 Y	es (Please encir		
Velymous year Silly Clay Scrit 81 341  Limes   p/1/2   1/490		H CO. 1 50	10. STATIC WATER LE	VEL		
Velymous year Silly Clay Scrit 81 341  Limes   p/1/2   1/490	Vs 12 ment white Same Clan	1 . / "	13'	selow lend surfa	ice offer 24 hours	
Vely May 5,   1	_ <u> </u>		LI. PUMPING LEVEL E	Selow Land Sur	face	···
Pumping Test:   Yes   Please encloses   No  Yield   Yes   Please encloses   No  Chemical Analysis   Yes   No   Baccerial Analysis   Yes   No    Chemical Analysis   Yes   No   Baccerial Analysis   Yes   No    Chemical Analysis   Yes   No   Baccerial Analysis   Yes   No    Chemical Analysis   Yes   No   Baccerial Analysis   Yes   No    Chemical Analysis   Yes   No   Baccerial Analysis   Yes   No    Chemical Analysis   Yes   No   Reserve   No    Installed Inc   Sept   No   No    Installed Inc   Sept   No   No    Installed Inc   Sept   No   No    Installed Inc   Sept   No   No    Installed Inc   Sept   No   No    Installed   Yes   No   No   No    I	VOLYMOS) WAY S. )) Clar With					
Viold   12. WATER QUALITY   Chemical Analysis   Ver   No   Place of Enclose Lab Results   13. ARTIFICIAL FILTER (Crew) Pack!   Ves   No   Installed from   391   (L. to   02   t.   Etractive site   EXSU uniformity coefficient   14. WELL ONDUTED?   West   No   Next Cament   Sang Coment   Concrete   Other   Dentin   Place   Concrete   Other   Dentin   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament   Sang Coment   Concrete   Other   Place   Next Cament	The state of the s	<u> </u>	Pumping Take:	. 1911444 4		G.F.M.
12. WATER OUALITY   Chemical Analysis   Yest   No   Bacterial Analysis   Yest   No   Please Enclose Lab Results.	1.00. 1.00	Janes .	1	The second second	N. □ 1/40	
Chemical Analysis   Yes   No   Place   Pach   No   Place   Pach	<del>\_\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</del>	1671 671		<del></del> =	<del></del>	_
Plaged Enclose Lab Results.  13. ARTIFICIAL FILTER (Gravel Pach)	_		12. WATER QUALITY			
13. ARTIFICIAL FILTER (Grave) Pack)		<del></del>		_	Bacterial Analysis	. []Yee[]No
Installed from 39 (L. In 62 ft.  Effective size FX5U uniformity coefficient  1a. WELL ONOUTED? (874)] No  Next Cament Send Coment Concrete Other Dentity  Denth From (L. to 34 ft.)  15. NEAREST SOURCE OF POSSIBLE CONTAMINATION:  Type West glinifected Vest Type Open Completion No Amount  Type West glinifected No Amount  10. PUMP. Date installed No Amount  Min. representation of drop pipe 11, sepecity 90m  TYPE: Submersible Jet (shallow) Turbine  [] Jet (deep) Reciprocating Camerating Strin			Planta Enclose Lab Re	Buller of Brahl	<u> </u>	
Effective site		<del> </del>	(	7/3/	/	*
14. WELL GROUTED?						
Neat Cament   Sand Cament   Concrete   Other   Devrint:	······································	<del>-</del>		<u> </u>	niformity coefficient	
Depth From						21 4. 1 4.
15 NEAREST SOURCE OF POSSIBLE CONTAMINATION:	Э.				Concrete D Othe	" De OGNITURE
Type Well disinfected   Yes Type   upon completion   No Amount			Depth From [f	ft. to	_ <u>, <del>29</del> </u>	-
Type Well disinfected   Yes Type   upon completion   No Amount	—- <u></u> -		IS NEADEST SOURCE OF	POSSIBLE FANT		
vpon completion   No Amount   No Amount   No Print   No Amount   No Print			THE MENALST SOURCE OF	Tune Well	AMINATION:	bi Oksellon
Mil. ngme		<del>-                                     </del>		upon	completion (1)	, , , , , , , , , , , , , , , , , , ,
Mil. ngive			16, PUMP. Date lostalled			netalied (T)
M.P						
TYPE   Submorsible   Jet (shallow)   Yurbine     Jet (dusp)   Reciprocating   Centrology     17. WATER WELL CONTRACTOR     end the (shall to be bet 3)     REGISTERED   A     Districts   A   A						
Jet (deep)   Reciprocating   Cantridgel     7. Weter Well Cohtput day     976 this jebolt is que to the best of the process	<del></del>	<del>                                     </del>		_		= =
## 17. WATER WELL CONTR    Use # 2nd chast if neered)    HEMARKS		1				
BLEMARKS  BLEMAR	dicare water frearing rooms	╼ <del>╎╶───┼──</del> ╶┈─╽╏			rocating [ Canin	NTO SELL.
BLEMARKS  BLEMAR			end this popul is true to the b		STANT SANTAN	
NAME Signed AUTHORIZED SERVICES SERVICES	fuce a 2nd chest if neerled)		MEGISTERED AND A COLUMN			MAN CONTRACTOR
Signed AUTHORIZED RESPECTANCE AND AUTHORIZED RES		E PROPERTURA MANAGEMENTO DE	BUSINESS Y			
Signed AUTHORIZED REDESCRIPTING CONTRACTOR AND AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING CONTRACTOR AUTHORIZED REDESCRIPTING AUTHORIZED REDESCRIPTING AUTHORIZED REDURBER AUTHORIZED REDESCRIPTING AUTHORIZED REDURBER AUTHORIZED REDURBER AUTHORIZED REDURBER AUTHORIZED REDURBER AUTHORIZ			HAME XXX DEG	HANN SHAPE		
AUTHORIZED GEORGEPHATION AND AUTHORIZED GEORGEPHATION AUTHORIZED GEORGE		於多學學是可能發送到十				
	C # 1903 (10/85) COPY I MAIL TO: E.C.	tions start in the first of	AUTHORIZED REPRE	SENTATIVE (C)		100

Ground Water Protection Division	2600 Buil Street	Columbia, S.C. 28201 (803) 734-5331 Water Well Record
	CAP9	Address
	- ( )	【1、2016年7月11日 17、7月1日 17、11日 18、11日 18日本日本日本日本日本日本日本日本日本日本日本日本日本日本日本日本日本日本日本
I. LOCATION OF WELL		Telephone No.
County Bystem Nam	Tradition California (1881)	Engineer (SEC) And Commission Commission (Section 1)
100000000000000000000000000000000000000		Address
	MANA MEDICATOR	
Talk all Samples		5. WE LL DEPTH (Completed) Date Started: 10 - 76 Gy
Distance And Direction from Road Intersections	Λ	S. WELL DEPTH (Completed)  30 6"  1. Cate Completed: 10-26-614  C. Mud Botery () Justed Deced Dove
Cross benevaling Sta	tian	6. Mud Bointy () Jetted Bored   Dug
· · · · · · · · · · · · · · · · · · ·		Air Rotary Driven Cable tool Other
Street address & City of Wall Location  Sharch Map: (See anample on back)	<del></del>	] 7. USE.
Herizantel Contro	L	Domestic () Public Supply Permit No   Industry () If gradien () Air Conditioning () Commerces
		Test Well
North: 19083.69	910	B.CANNII M Thronton [ ] Wolder
East: 11632.7	245	Diam. ZYY Height: Above/Below
C > ( ) (1) (2.32 · )	, -1 /	Type Meve Galvanired Surface,
w .		+ 216"   Signal   Other   Weight   Drive Shoe?   Cive   No
	*	Drive Shoe? Ves No
2. CUTTING SAMPLES Yet No		9. SCREEN
Genphysical Logs Yes (Please ancies		Type: 274"
	···) [] No [:]]HIÇKNESS[i DEPTH.TO:]]	Type: PVC Diam 2VL " Stot/Gause, OLD Langth 15" Set Between 15'6" 11, and 30'L 11. NOTE: MULTIPLE SCREENS
FORMATION DESCRIPTION SS	OF A REBOTTOM OF	
moist brown Sandy Clay	12' 12'	Sieve Analytis Yes (Please enclose)
	10 10	1 17'
moist blem sandy Ciny	5   17'	11. PUMPING LEVEL Below Land Surface
most blowns, ly Ciny with	<del></del>	
10.21 19.00 CALSTITUTE CONT.	<u> 4' Z1'</u>	Fumulng Test:
very must lighthan sitto	5'   26'	Vieta
		13. WATER QUALITY
very mont grays, ly chy grand	Z' Z8	Chamical Analysis (**) Yes No Baciarial Analysis (**) Yes (**) No
very ment era Club	41 321	TRANSPORTER (Gravel Pack) (No
- <del></del>	-1-32	(manelland from 14 6 4 10 10 10 10 10 10 10 10 10 10 10 10 10
	] _ [1	Effective size
	<del></del>	14. WELL GROUTED? Yes No
	<del>-                                    </del>	Nest Coment & Sand Coment Congress Coller Dentin
		Denth From O IL to 14'6" IL
		15 NEAREST SOURCE OF POSSIBLE CONTAMINATION.
	_=	Type Wall distributed 🗍 Yes Type
		upon completion D No Amount
		Mir. Darie
		H.PIvoltsIength of drop pipeIt, capacityppm
	<del>-                                     </del>	TYPE: Submersible Jel (shellow) Turbine
Ticale water hearing tones		
Section Assist Case, to & South		Jet (deep)   Reciprocating   Cantulages    7/WATER WELL CONTINUES:     Red This (eport is (r/A tr)     Reciprocating   Cantulages     Cantu
(use a 2nd shoet if nearted)	[ [ ]	HEGIT FRED (CANADA)
REMARKS	A STATE OF THE STA	Contened of the Content of the Conte
		Signad Control of the
and the second of the second o		innets
C 4 1903 (10/86) COPY 1 MAIL TO: S.C. DEP	AATMENT OF HEALTH AND	ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

Ground Water Protection Division	2600 Bull Street	Columbia, S.C. 20201	(803)	734-5331	Water Well Record
	CAPIO	4. OWNER OF WELL:	7.8 <b></b> 18.37 1.	a COO Supple Vent and	Parking Bellement (1877), and the second
	, = ·· <b>,</b> · · ·	Address	Sarte	· Copper	
			100		
1. LOCATION OF WELL		Talephone No. Engineer	The second section of		ankana je maja projecta od 2007. Gregorija
System Name		Address		3.5	
	S-Section of the behalf of		1000		
		Telephona No.	4500		
Distance And Direction from Road Intersections	SALES SERVICES SE	S. WELL DEPTH (Con		Oale Startett: (	- ' '
	, <b>,</b> , - 1			Cate Completed:	10-19- <u>414</u>
Cross Generality 5-	(+v++m	G. [_] Mud Rotary [y] Air Horary		Cable 100	
Street address & City of Wall Location	7007	7, USE:	. 15 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		
Sketch Map: (See example on back)		[] Domestic	Public Supr	Ny Parmir No.	
Horizontal Centre	0	[] (y teation			Commercia
		Tack Well			
No. M.: 13431.516	9	B. Capino Diproduce	i ∐ Metited		
Fast 11578.563	4	Diam Z'4"	10 steentred	Height: Abov	1,
112 16.36	7	+Z'Z."□S	Diber		155.//1.
The second second		4774 in. to	_ft. depth		☐ Yes ☐ No
		in. ro	_ft. depth i	<u> </u>	
2. CUTTING SAMPLES YAT NO		9. SCREEN-	OVC.	7	· V. 11
Camphytical Logs Yes (Please enclor	, No	Slov/Game	010	Dimo <u>2</u> 	707
The Market Control Land Control Land Control Land Control Land Control Land	TOTHICKNESSI DEPTH TO:	Sot Retween	3 11. and	10.3/_ 11. NO	TE: MULTIPLE SCREENS
TO MAIN OF THE PARTY OF THE PAR	BTRATUM PETRATUM	-			E SECOND SHEET
moist brown Sandy Cha	18' 18'	Slove Analysis   Y		<u>) [7</u> %-	
Lome organics	1	18		ce etter 24 hours	
very moist brown Sandy Ciny	31 211	11. PUMPING LEVEL			
most Sandy Silly Clay	9' 30'	Pumping Tast:	ntimr ,h		G.P.M.
very moist gray Clay	96" 396.	Yield		·-·	
	· -	12. WATER QUALITY		+	
Limeshore	266" 66	Chemical Analysis		Oscieriet Anal-	yais DYes No
1 7 v - 11 i		13. ARTIFICIAL FILTE	(Otolis. ÉB (Grava) Pack)	GX DN-	· <del>-</del> ··
		tour dam trans	4Z'	·~ [1/~/	
	}	Effective site	- <b>Σ</b> ΧζΩ ""	nitormity coefficien	11.
			C-17		
		Neet Coment 🕎 🌣	ineme⊅ bos	Congrete 🔲 🗘	m. Bbostunte
		Depth From	<u>D</u> 1. 10 .	42/ 1	
		15 NEAREST SOURCE OF			_ Cast Ciret tion
			Two- Well C	ileinfected 🗍 Yes	Type
	F :		upon	Companion [ No	Amount
	<u> </u>	16. PUMP: Date Installs Mir. pants		n	as merener -
	The second second				t. cepacity
		TYPE: Subineralble		hallow? [] T	urblug.
		_	☐ Nesip		entrifugal
naicate werer bearing somes		17, WHITER WELL CONTRA			
fune a 2nd share if many it					
(use a 2nd theet if nearlest)	and the second second	HEGINERS P. T. H.			
		Signed ATA			
	<b>有可以是一种的一种</b>				
The state of the s		AUTHORIZED AEM	RESENTATIVE FLET		<b>新华区区区</b>

Ground Water Protection Division	2500 Bull Street	Columbie, S.C. 29201			
		4. OWNER OF WELL:	(803)	734-5331	Water Well Record
	CAPIL	Address	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	White September 1	Control of the Contro
		<b>一种数字证明的</b>	Sollo	e Coeper	
T. LOCATION OF WELL		Telaphone No.	TANK DEALER		
Southly System Nam	at di min librata e min to mon	Engineer No.			NAME OF THE PARTY
		Address		400	<b>建</b> 基基基件 (16) 安全
			1.4	REPORT TO A SECOND	Media di di
		Telephone No.			
and the second s		5. WELL DEPTH (Care	itspan() duža¥eÿēj	Date Starter	A Property of the Control of the Con
Distance And Direction from Road Intersections		33'6"	It.		o-206-014
Cours Generally	station 1	6. Mud Rolary	Jenen –	Care Completed: 1	·
V	- , ,	Air Platery	Driven	() Core	
reet address & City of Well Location		7. USE:			
atch Map: (See example on back)		Domestic	IT Public Suci	Nie Sermir Na	
Herizalel Con	1.0	ممانعوارية []	Air Conditi	lenico	<u></u>
HALLEN TON	~\Y`r~\[	De vit Wall			Comm.
North: 12399	20 2 2 2d [	B.CASING THINGS		<u>:</u>	<del></del>
*	• ' I	21/	- 1	Height; Above	(Gala
East: 11574	.9960	Type Meve []	o Gelvanked :		
		Steel (T	Other	Surface	
		+216 % 10 (86)	it. depth	Weight	
		9. SCREEN:	L. depth	O-IVE Shoe	[] Y01 [] No
TUTTING SAMPLES YES NO		9. SCREEN:		<del></del>	<del></del>
	r	TVD#:	PYC	~ Z	Vu"
Seaphysical Logs Yes (Please enclas		Sat Between 126	1010	Diam	<del>~)</del> ·•—
FORMATION DESCRIPTION CALL	THICKNESS DEPTH TO	Sat Between 1816	10 000	3364 NOT	E: MULTIPLE SCREEN
A SHARE COUNTY OF THE THE PARTY OF THE PROPERT	6TRATUM STRATUM	· —			SECOND SHEET
moist black Sity Snoth Clar moist light Holoway Sandy Clary	31 31	Sleve Analysis ( ) Ye	n (Please enclos	e) Davie	
	31 3'	10. STATIC WATER LEV			<del>-</del>
Mars ligh Home Can Time Silly	14' 17'		alow land surface	after 26 hours	
	<u> </u>	11. PUMPING LEVEL BE	low Land Surfa	·	——————————————————————————————————————
very stiff much believed by	F 12' Zq'	tr. 4f)	ler hr	h purhatan	G.P.M,
very Stiff must felicit ( hay to H ? )	<u> </u>	Fumping Test: [] Yes			∪.r.∾ī,
+ lust ofthe Clau	5' 36' 1	Y≔id			
	O 1 9 9 11	17. WATER QUALITY	<u>-</u>		
	1 11		□Y•••□ No		
· · · · · · · · · · · · · · · · · · ·	—· <del> </del>	Please England Lab Da-	and be	Becter)el Analysis	,Y=4No
		II. ARYIFICIAL FILTER	(Grevel Pack)	Tives Class	
# 10	· <b>-</b>	Installed from	<i>( ' ) ( )</i>		
		Citactive site	``` \	ormity coefficient .	
		14. WELL GROUTED? ESY:	III NA	CONTRACTOR OF THE PROPERTY .	<b>_</b>
<u> </u>	= {	/	• • • • • • • • • • • • • • • • • • • •		I'A. I I.
		Near Cement (1) Send	> cewevi []		, 171 <u>5cnt.nhe</u>
	-	Penin From	<u></u>	17'6"	
		5 NEAREST SOURCE OF PO	OSSIBLE CONTAIN	MINATION:	
<u> </u>	[ ].		Type Welloffel	Infacted 🗔 Yes Ti	/O+
	-		upon co	mpletion D No. Ac	
		6. PUMP: Date Intralled			stalled (3
		Mir name		model no	
		H.P		drop pipe	*P*6117 " 9000
· · · · · · · · · · · · · · · · · · ·	· <del>   </del> -     <sub>7</sub>	YPE: Submeralble			
<u></u>		( ) (a) (dram)	0.		
icate water hearing comes	Jap	WALLER WELL CONTRACTOR	☐ Recipro	eting Contr	ifugal Japan (padawakan ara
		d that second is true to the best		- Life with the same of the	<b>第二个人的</b>
(vie a 2nd threat if needed)		GISTERED / 74		75 F 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
THE STATE OF THE S	ANGERO PORCHADOS PURGOS DE LOS	ISINESSO V. V. M. THORESON			
		ME -		STATE OF THE STATE	A CONTRACTOR OF THE PARTY OF TH
	MODEL BOOK OF THE STATE OF THE	ned VOV	<b>沙叶光沙里</b>	The Control of the Co	A CONTROL OF THE PROPERTY OF T
1007 LICKEL COPY I MAIL TO: 8 C TOTAL		AUTHORIZED REPRESE	ENTATIVE A WHAT	2.7	Took with Servery House

Ground Water Protection Ofvision	2000 Bull Street	Columbia, 8.C. 29201	(803) 73		Water Well Record
	CHIS		Faire Martin	Translis Machael &	ANGELER VAN DE VAN EELEN
		Address	sauter?		
1. LOCATION OF WELL		Telephone No.	AND AND ASSESSMENT		
Gouthty: Bystem Name	Andrews 1984 - Patrice - T	Engineer	The second second second		THE STATE OF THE S
	The Spice of the Spice of	Address			
THE PARTY OF THE PARTY					A DOCA TO STATE OF THE STATE OF
Linear Street	Tarrania in A	Telephone No.			
Distance And Direction from Road Intersections	A PARTY AND A SECURITY OF THE SEC	S. WELL BERTH (Com		te Sterreit: 🚧	
Cross Generali	a Stulling	6. DWOULDOWN		Lored	9-20-94
C1047 0 00 11 -017	7 )(10,000	Air Colary	Driven		
Street address & City of Well Location		). USE:		Cable 1001	Ouher
Stetch Map: (See example on back)		□ Pomestic	[] Public Supply:	Parmir No.	
Horizontal Can	$I_{c}\rho$	□ 11710ation	[1] Air Conditions		
	· · ·	Test Well	<u> </u>		
North: 12387.	5561	B. CASING Y YNVERINGE	☐ Watried		
East: 10967.		Type Proc D	Salvanira-	Height: Ahove	
	,,,,,,			Surface Weight	
	19	+2'6. 8 47	L. drøth		/bi.//i. □ No
		li 10. tm 1	I. doprh		
COTTING SAMPLES YET NO		9. SCHEN:	Pvc		
Geophysical Logs Yes (Please enclose	□ N	.,,,,,	<del></del>	_ bunZ	<u> </u>
FORMATION DESCRIPTION SELL SANS	THICKNESS LOEPTH TO:	Set Between _ H.Z	11 400 6	<u> </u>	<del>.o.</del>
ter and the second second second second second second second second second second second second second second	ATRATUM STRATUM		[1. brid	-	E: MULTIPLE BCALEN BECOND BHEET
monthoun sand Class		Stave Analysis () Ve	(Please englose)		
	13' 13	10. STATIC WATER LEV	EL		
most brown Sandy Clay	15' 28'	'Z <u>0'6''</u> 11.6•	low land surface at	er 24 hours	
- <del> </del>	<del></del>	11. PUMPING LEVEL B	V		January .
very most light given in the	5' 3z'		bre.	րդածլո <b>ց</b>	С.Р.М.
		Pemping Tast: Yes	(Please enclose)		
* wet Gray silly sort ciny	21 341	Y ie (u			
+ but are cla.	3' 37	12. WAYER QUALITY	<b>-</b> -		
- China China	· <del></del>	Planta Engines ( al. Bass		acterial Analysis	. <u> </u>
* SAF OLLAN CAMES S. D. CAND	16" 3864	J. ARTIFICIAL FILTER	(Gravel Pack)	93 (TINA	
* SAL GIAZ Clay  * SAL GIAZ Clayer S. ly SAND  * Wet GIAZ Claywith S. Ho	1171 171	installed from _ 46	· (t. 10	701	4.
- wet Gray chymny s.Ho	7/21 46	Effective sizeFX5	<u>O</u> uniforn	ity coefficient .	
Limestony	34' 70'	4. WELL GROUTED! DE	.∏No		
<del></del>	<u> </u>	Near Coment D Send	Cement 🖺 💍 Co	nergio 🗆 Oshia	Ochowhalk
4		Depth From O	<u> </u>	11.	
		5. NEARESY SOURCE OF PO	DESIBLE CONTAMINA	TION:	
	-		Thomas William Control	ded   (V Y.	. — i i
		E DIMAR DANS	upon compli	No An	nount
		Mir. carry	_ <del></del>		
		H.Pvors_,_	Inneth of deci		anarity -
		YPE: [] Submersible			
		[] Jet (deep)	□ masta	<u> </u>	
idicate water hearing zones		WATER WELL CONTRACTO I THE FEBRUARY OF THE BEST CHIEF CONTRACTOR	RS CERTIFICATION	in Cevil	CAN DE LAND
(use a 2nd shoet it needed)	[ 82	this sport is studio the bes			
HEMARKS TO A STATE OF THE STATE	PE DE LA CONTRACTOR DE	Bindes PST, IJ			W. Y. W.
		ME CONTRACTOR			
		m print	<del>以</del> 为与思	2.5	
# 1903 (10/86) COPY 1 MAIL TO: \$.C. DEPA		AUTHORIZED REPRESE			

# APPENDIX B

# FIELD OBSERVATION CHECKLISTS

Appendix B Doc 12: Dam Inspection Check List Forms

Site Name:	Cross Generating Station	Date:	23 February 2011			
Unit Name:	Bottom Ash Pond 1	Operator's Name:	Santee Cooper			
Unit I.D.:		Hazard Potential Classification:	High Significant Low			
Assessor's Name:		Frederic C. Tucker, PE; Anne Lee				
Charly the appropriate have heless. Dresside comments when appropriate. If not applicable or not available record "NI/A"						

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
Frequency of Company's Dam Inspections?	Quarterly <sup>2</sup>		18. Sloughing or bulging on slopes?		Χ
2. Pool elevation (operator records)?	88'		19. Major erosion or slope deterioration?		<b>X</b> 5
Decant inlet elevation (operator records)?	89'3		20. Decant Pipes: (Emergency Outfall Structure)		
Open channel spillway elevation (operator records)?	N/A	N/A	Is water entering inlet, but not exiting outlet?		Χ
5. Lowest dam crest elevation (operator records)?	94'		Is water exiting outlet, but not entering inlet?		Χ
If instrumentation is present, are readings recorded (operator records)?	X <sup>4</sup>		Is water exiting outlet flowing clear?	N/A <sup>6</sup>	N/A <sup>6</sup>
7. Is the embankment currently under construction?		Х	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	Х		From underdrain?	N/A <sup>7</sup>	N/A <sup>7</sup>
Trees growing on embankment? (If so, indicate largest diameter below)		Х	At isolated points on embankment slopes?		Х
10. Cracks or scarps on crest?		Χ	At natural hillside in the embankment area?		Χ
11. Is there significant settlement along the crest?		Χ	Over widespread areas?		Χ
12. Are decant trashracks clear and in place?	N/A	N/A	From downstream foundation area?		Χ
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		Х	"Boils" beneath stream or ponded water?		Х
14. Clogged spillways, groin or diversion ditches?		Χ	Around the outside of the decant pipe?		Χ
15. Are spillway or ditch linings deteriorated?		Х	22. Surface movements in valley bottom or on hillside?		Х
16. Are outlets of decant or underdrains blocked?		Х	23. Water against downstream toe?		Х
17. Cracks or scarps on slopes?		Х	24. Were Photos taken during the dam inspection?	Х	

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.

N/A = Not Applicable TBP = To Be Provided

Note #	Comments
1	Hazard potential classification is determined by Santee Cooper. The indicated "low" hazard potential classification also is Dewberry's interpretation, based on EPA criteria shown on page 3.
2	Santee Cooper conducts quarterly internal inspections by plant operating personnel with assistance of qualified dam safety personnel when requested; also informal daily inspections take place over the course of the year.
3	Top elevation of overflow riser for Emergency Outfall Structure; there is no regular overflow into outfall structure.
4	Water levels in water quality monitoring wells in crest are recorded.
5	Interior slope is protected with Fabriform (grout-filled geosynthetic blanket).



6	Water is recycled to the plant using pumps located on the southwest side of the pond; no ordinary discharge permitted thru emergency outfall structure.
7	No underdrain structures. Pond is lined with 4" thick layer of Soil-bentonite.



# **Coal Combustion Waste (CCW)**

# **Impoundment Inspection**

Impoundment I	NPDES Per	mit SC00374	101	ASSESSO	<b>R</b> Frederic C.	Tucker, PE; An	ine Lee
Date January Impoundment Name Bottom			2007 Ash Pond 1				
Impoundm	ent Comp EPA Reg	-	Cooper				
•	State Age	ress Columb	ıll Street ia, SC 29201				
Name of I	mpoundm	<b>ent</b> Bottom	Ash Pond 1				
(Report ed	ach impou	ndment on a s	eparate form u	nder the same	Impoundment	NPDES Permit	number)
New		Update					
					Yes		No
Is impoundment currently under construction?							
ІМРО	UNDMEN <sup>-</sup>	Γ FUNCTION:	Receives bott	om ash and bo	tream, in serie iler slag dischai rge from Coal P	ged directly fr	om plant
Nearest Dov	vnstream '	Town Name:	Cross, South (	Carolina			
Distance fr	om the im	poundment:	5.5 miles				
Location:							
Latitude	33	Degrees	22	Minutes	15.2	Seconds	N
Longitude	80	Degrees	06	Minutes	16.8	Seconds	w
	State	South Carolin	ıa	County B	erkeley		
					Yes		No
Does a state agency re			gulate this imp	oundment?			
			If So Which St	ate Agency?	DHEC, Bureau o		



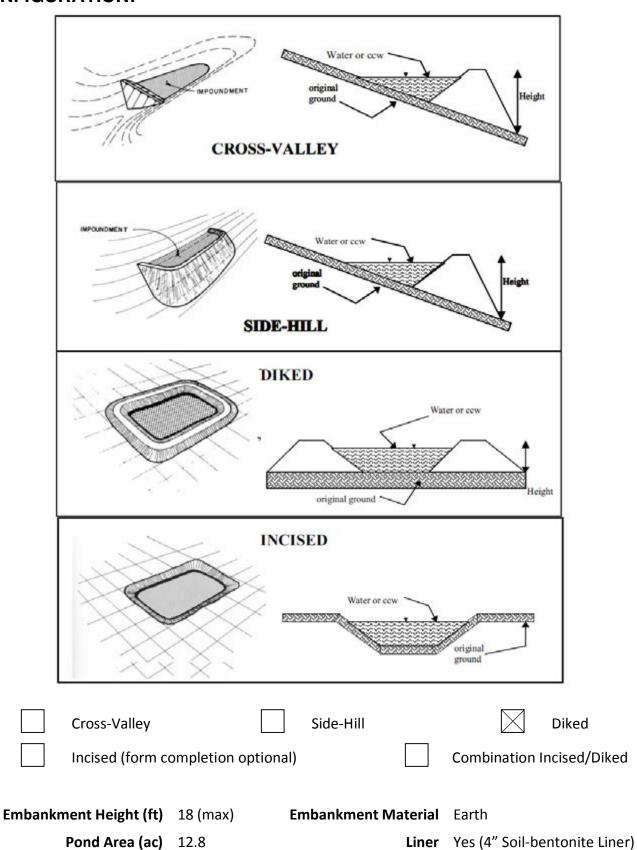
HAZARD POTEN	NTIAL (In the event the impoundment should fail, the following would occur):
	<b>LESS THAN LOW HAZARD POTENTIAL:</b> Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.
	LOW HAZARD POTENTIAL: Dams assigned the low hazard potential 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.
	<b>SIGNIFICANT HAZARD POTENTIAL:</b> 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.
	<b>HIGH HAZARD POTENTIAL:</b> 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:**

Dam failure would discharge coal combustion residue onto flat surrounding land owned by Santee Cooper. Some coal combustion residue could potentially be carried along slight-graded drainage features to reach Lake Moultrie approximately ½ mile away, where several dozen or more lake homes are located on lots leased from Santee Cooper. Because of the low head above outside toe elevations and flat topography, flood water from a postulated dam breach is expected to have low flow velocity and low flow depth when it reaches Lake Moultrie.



## **CONFIGURATION:**



, -- -- -- --

**Current Freeboard (ft)** 

Liner Permeability < 1 x 10<sup>-7</sup> cm/sec

**US** Environmental

**Protection Agency** 

# **US EPA ARCHIVE DOCUMENT**

# TYPE OF OUTLET (Mark all that apply)

	Open Channel Spillwa	ay					
	Trapezoidal	TRAPEZO	OIDAL		TRIANGULAR		
	Triangular		Top V	Vidth	Top Width		
	Rectangular	(435)	Dept	h	Depth		
	Irregular		Bot		V •		
	depth (ft)		Wio	lth			
	average bottom width (ft)	RECTA	NGULAR		IRREGULAR		
	top width (ft)		Depth Width		Average Width Avg Depth		
	Outlet (Emergency)						
18"	inside diameter (SDR 17 – smooth lined – 19.	5" OD)	/				
<u>M</u> :	aterial_			Inside Diameter			
	corrugated metal		/				
	welded steel						
	concrete						
	plastic (hdpe, pvc, etc.)						
	other (specify):						
_		. •	Yes	No			
•	s water flowing through t outl						
	No Outlet						
	Other Type of Outlet (specify):						

The Impoundment was Designed By	Burns & Greene	Roe/ L	ockwood.
		Yes	No
Has there ever been a failure at the	nis site?		$\boxtimes$
If So	When?		
If So Please Describe :			

	Yes	No
Has there ever been significant seepages at this site?		
If So When?		

	Yes	No
Has there ever been any measures undertaken to		
monitor/lower Phreatic water table levels based		
on past seepages or breaches		
at this site?		
If so, which method (e.g., piezometers, gw pumping,)?		
1 1 0, 7		

# No.

**US EPA ARCHIVE DOCUMENT** 

**ADDITIONAL INSPECTION QUESTIONS** 

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

No. However, Mr. John E. Fondren, III, PE, with Santee Cooper, who observed construction of the dikes, was present and indicated that topsoil and deleterious organic material was removed from the foundation areas (6" to 2' deep) and that extensive dewatering using ditches was required to prepare a dry foundation for placement of the dike embankment fill.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures, or patchwork on the dikes.



_	2. Pool elevation (operator rec					
		et elevation (opera				
$\boldsymbol{z}$		nel spillway elev				
	Notch bottom					
•••		n crest elevation				
1	6. If instrumentation is present					
_	(operator records)?					
		ankment currently				
$\boldsymbol{\pi}$		preparation (ren				
		where embankr				
0	largest diame	ving on embankm eter below)				
=	10. Cracks or	scarps on crest?				
	11. Is there si	ignificant settleme				
	12. Are decar	nt trashracks clea				
П		ons or sinkholes i				
	in the pool are					
<b>&gt;</b>	14. Clogged s	spillways, groin o				
Η	15. Are spillway or ditch linings					
I	16. Are outlets of decant or un					
9		scarps on slopes				
$\sim$		from erosion.				
~		se changes in th				
	normally be	described (exter				
•	N/A = Not Ap	plicable				
-	Note #	Comments				
•	INOIG #	Oomments				
℩	1	Hazard pot				
-	'	also is Dew				
•••		0				
,	2	Santee Cod				
S)		dam safety				
$\overline{}$		Bottom Ash				
_		bottom 7.5				

Site Name:	Cross Generating Station	Date:	23 February 2011
Unit Name:	Bottom Ash Pond 2	Operator's Name:	Santee Cooper
Unit I.D.:		Hazard Potential Classification:	High Significant Low 1
	Assessor's Name:	Frederic C. Tucker, PE; Anne	Lee

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?	Quarterly <sup>2</sup>		18. Sloughing or bulging on slopes?		Χ
2. Pool elevation (operator records)?	88'		19. Major erosion or slope deterioration?		<b>X</b> 5
Decant inlet elevation (operator records)?	89'3		20. Decant Pipes: (Emergency Outfall at Pond 1)		
Open channel spillway elevation (operator records)?     Notch bottom elevation.	TBP <sup>3</sup>		Is water entering inlet, but not exiting outlet?		Х
5. Lowest dam crest elevation (operator records)?	91		Is water exiting outlet, but not entering inlet?		Χ
6. If instrumentation is present, are readings recorded (operator records)?	X <sup>4</sup>		Is water exiting outlet flowing clear?	N/A <sup>3,6</sup>	N/A <sup>3,6</sup>
7. Is the embankment currently under construction?		Х	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	Х		From underdrain?	N/A <sup>7</sup>	N/A <sup>7</sup>
Trees growing on embankment? (If so, indicate largest diameter below)		Х	At isolated points on embankment slopes?		Х
10. Cracks or scarps on crest?		Х	At natural hillside in the embankment area?		Χ
11. Is there significant settlement along the crest?		Χ	Over widespread areas?		Χ
12. Are decant trashracks clear and in place?	N/A	N/A	From downstream foundation area?		Χ
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		Х	"Boils" beneath stream or ponded water?		Х
14. Clogged spillways, groin or diversion ditches?		Х	Around the outside of the decant pipe?		Х
15. Are spillway or ditch linings deteriorated?		Х	22. Surface movements in valley bottom or on hillside?		Х
16. Are outlets of decant or underdrains blocked?		X3	23. Water against downstream toe?		Х
17. Cracks or scarps on slopes? Minor remnant scarps on outside slope from erosion.	Х		24. Were Photos taken during the dam inspection?	Х	

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.

N/A = Not Applicable TBP = To Be Provided

7	INOIG #	<u>Somments</u>
	1	Hazard potential classification is determined by Santee Cooper. The indicated "low" hazard potential classification also is Dewberry's interpretation, based on EPA criteria shown on page 3.
)	2	Santee Cooper conducts quarterly internal inspections by plant operating personnel with assistance of qualified dam safety personnel when requested; also informal daily inspections take place over the course of the year.
)	3	Bottom Ash Pond 2 is upstream and in series with Bottom Ash Pond 1. Water from Bottom Ash Pond 2 is hydraulically connected to water in Ash Pond 1 through a wide trapezoidal notch through the former northeast side dike of Ash Pond 1. Thus, Ash Pond 1 and Ash Pond 2 function as one pond with an emergency outfall located through the southwest side dike of Ash Pond 1.



4	Water levels in water quality monitoring wells in crest are recorded.
5	Interior slope is protected with Fabriform (grout-filled geosynthetic blanket).
6	Water is recycled to the plant using pumps located on the southwest side of Ash Pond 1; no ordinary discharge permitted thru emergency outfall structure, which is located at Ash Pond 1.
7	No underdrain structures. Pond is lined with synthetic clay liner (Bentomat).



## **Coal Combustion Waste (CCW)**

### **Impoundment Inspection**

Impoundment N	IPDES Per	mit SC00374	101	ASSESSO	OR Frederic C.	Tucker, PE; An	ine Lee
Impound	D dment Na	<b>ate</b> January <b>me</b> Bottom	2007 Ash Pond 2				
Impoundme	ent Compa EPA Reg	-	Cooper				
	State Age fice) Addr	ess Columb	ıll Street ia, SC 29201 Ash Pond 2				
Name of in	npounum	ent Bottom	ASII POHU Z				
(Report ea	ch impour	ndment on a s	eparate form u	nder the same	Impoundment	NPDES Permit	number)
New		Update					
					Yes		No
ls water or ccr	-		ently under co				
IMPOL	JNDMENT	FUNCTION:	Receives botto	om ash and bo	eam, in series, f oiler slag discha orge from Coal F	rged directly fr	om plant
<b>Nearest Dow</b>	nstream 1	Town Name:	Cross, South C	Carolina			
	m the im	poundment:	5.4 miles				
Location: Latitude	33	Degrees	22	Minutes	25.0	Seconds	N
Longitude	80	Degrees	06	Minutes	2.6	Seconds	w
	State	South Carolin	na	County E	Berkeley		
	Does a sta	ate agency reį	gulate this imp	oundment?	Yes		No
			If So Which Sta	ate Agency?	SCDHEC, Burea Assurance Divisi		-



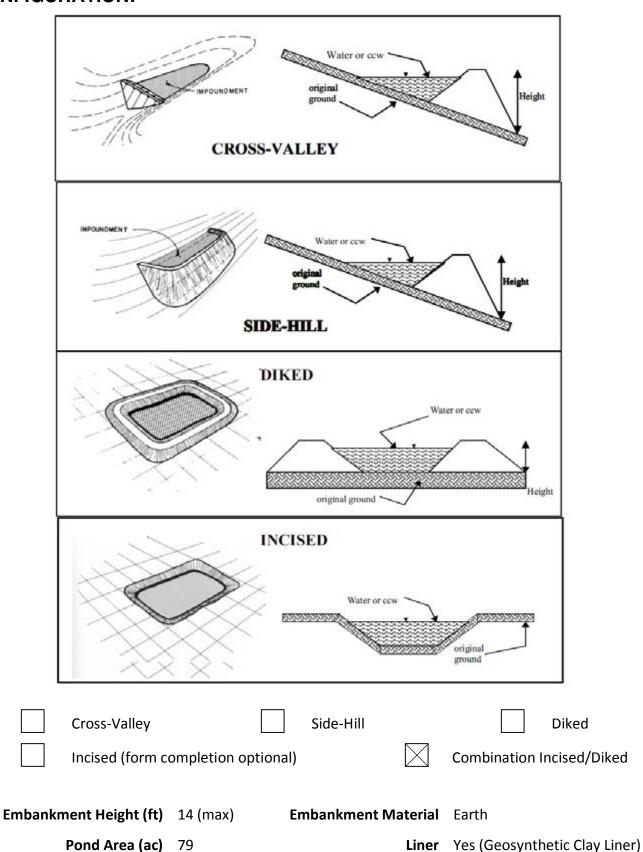
HAZARD POTEN	NTIAL (In the event the impoundment should fail, the following would occur):
	<b>LESS THAN LOW HAZARD POTENTIAL:</b> Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.
	LOW HAZARD POTENTIAL: Dams assigned the low hazard potential 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.
	<b>HIGH HAZARD POTENTIAL:</b> 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:**

Dam failure would discharge coal combustion residue onto flat surrounding land owned by Santee Cooper. Some coal combustion residue could potentially be carried along slight-graded drainage features to reach Lake Moultrie approximately ½ mile away, where several dozen or more lake homes are located on lots leased from Santee Cooper. Because of the low head above outside toe elevations and flat topography, flood water from a postulated dam breach is expected to have low flow velocity and low flow depth when it reaches Lake Moultrie.



### **CONFIGURATION:**





**Current Freeboard (ft)** 

Liner Permeability < 1 x 10-7 cm/sec



## TYPE OF OUTLET (Mark all that apply)

	<b>Open Channel Spillway</b> (Noside dike of Ash Pond 1.)	Notch through fo	ormer NE	
	Trapezoidal	TRAPEZOIDAL		TRIANGULAR
	Triangular		Top Width	Top Width
	Rectangular		Depth	Depth
	Irregular	₹	Bottom	· ,
	depth (ft) TBP		Width	
	average bottom width (ft) TBP	RECTANGULA	<u>R</u>	IRREGULAR
	top width (ft) TBP	Dep		Average Width  Avg  Depth
	Outlet (Ash Pond 2 is hydraulical through a wide trapezoidal notch i dike of Ash Pond 1. For practical p Ash Pond 2 serve as one pond, with located through the southwest side Bottom Ash Pond 1 Checklist.)	n the former no urposes, Ash Po h one emergend	ortheast side and 1 and and outfall	
<u>M</u>	aterial_			S-2-6-39
	corrugated metal			
	welded steel			Inside Diameter
	concrete			
	plastic (hdpe, pvc, etc.)			
	other (specify):			
		Yes	No	
	Is water flowing through the outlet?			

☐ No Outlet			
Other Type of Outlet (specify):			
The Impoundment was Designed By Gilbert	Comm	nonwealth	1
	Yes	No	
Has there ever been a failure at this site?			
If So When?			
If So Please Describe :			

	Yes	No
Has there ever been significant seepages at this site?		
If So When?		

	Yes	No
Has there ever been any measures undertaken to		
monitor/lower Phreatic water table levels based		
on past seepages or breaches		
at this site?		
If so, which method (e.g., piezometers, gw pumping,)?		
1 1 0, 7		

### **ADDITIONAL INSPECTION QUESTIONS**

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

No.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

No. However, Mr. John E. Fondren, III, PE, with Santee Cooper, who observed construction of the dikes, was present and indicated that topsoil and deleterious organic material was removed from the foundation areas (6" to 2' deep) and that extensive dewatering using ditches was required to prepare a dry foundation for placement of the dike embankment fill.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures, or patchwork on the dikes.

Site Name:	Cross Generating Station	Date:	23 February 2011
Unit Name:	Gypsum Pond	Operator's Name:	Santee Cooper
Unit I.D.:		Hazard Potential Classification:	High ☐ Significant ☐ LT Low ☐¹
	Assessor's Name:	Frederic C. Tucker, PE; Ann	ne Lee

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?	Quarterly <sup>2</sup>		18. Sloughing or bulging on slopes?		Χ
2. Pool elevation (operator records)?	X3		19. Major erosion or slope deterioration?		X <sup>5</sup>
Decant inlet elevation (operator records)?	TBP <sup>4</sup>		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A	N/A	Is water entering inlet, but not exiting outlet?		Χ
5. Lowest dam crest elevation (operator records)?	TBP		Is water exiting outlet, but not entering inlet?		X6
6. If instrumentation is present, are readings recorded (operator records)?		Х	Is water exiting outlet flowing clear?	N/A <sup>7</sup>	N/A <sup>7</sup>
7. Is the embankment currently under construction?		Х	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	Х		From underdrain?	N/A <sup>8</sup>	N/A <sup>8</sup>
Trees growing on embankment? (If so, indicate largest diameter below)		Х	At isolated points on embankment slopes?		Х
10. Cracks or scarps on crest?		Χ	At natural hillside in the embankment area?		Χ
11. Is there significant settlement along the crest?		Χ	Over widespread areas?		Χ
12. Are decant trashracks clear and in place?	N/A	N/A	From downstream foundation area?		Х
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		Х	"Boils" beneath stream or ponded water?		Х
14. Clogged spillways, groin or diversion ditches?		Χ	Around the outside of the decant pipe?		Х
15. Are spillway or ditch linings deteriorated?		Х	22. Surface movements in valley bottom or on hillside?		Х
16. Are outlets of decant or underdrains blocked?		Х	23. Water against downstream toe?		Х
17. Cracks or scarps on slopes?		Х	24. Were Photos taken during the dam inspection?	Х	

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.

N/A = Not Applicable TBP = To Be Provided

١	Note #	<u>Comments</u>
	1	Hazard potential classification is determined by Santee Cooper to be less than low. The indicated "less than low" hazard potential classification also is Dewberry's interpretation, based on EPA criteria shown on page 3.
	2	Santee Cooper conducts quarterly internal inspections by plant operating personnel with assistance of qualified dam safety personnel when requested; also informal daily inspections take place over the course of the year.
)	3	Water level measured 4'1" below top of emergency outfall structure at time of site visit.
	4	Appeared to be approximately 2' below dike crest elevation.



5	Inside slope is relatively steep but armored with riprap.
6	Mud noted in outlet end of discharge pipe of emergency outfall and vivid red-colored water noted in outfall ditch. (Mud possibly due to backflow of surface runoff in practically flat-graded ditch, which was designed that way for retention of surface runoff on-site, according to Santee Cooper personnel.)
7	Outlet for Gypsum Pond is an emergency outfall structure located through the southwest side dike; no ordinary discharge permitted thru emergency outfall structure. Water is pumped to Bottom Ash Ponds using pumps located on northeast side of pond.
8	No underdrain structures. Pond is lined with 4" thick layer of Soil-bentonite.



## **Coal Combustion Waste (CCW)**

### **Impoundment Inspection**

Impoundment	NPDES Per	mit SC00374	401	ASSESSO	<b>R</b> Frederic C.	Tucker, PE; An	ne Lee
Impou	D ndment Na	Date January ame Gypsum					
Impoundr	nent Comp EPA Reg	-	Cooper				
-	State Age Office) Addi Impoundm	ress Columb	ill Street ia, SC 29201 Pond				
(Report e	rach impoui	ndment on a s	eparate form u	nder the same	Impoundment	NPDES Permit	number)
New		Update			Yes		No
Is water or c	•		rently under co ed into the imp				
IMPO	DUNDMENT	FUNCTION:	Receives flue	gas emission co	ontrol residuals	i.	
Nearest Do	wnstream <sup>·</sup>	Town Name:	Cross, South (	Carolina			
Distance f	rom the im	poundment:	5.2 miles				
Location: Latitude	33	Degrees	22	Minutes	4.5	Seconds	N
Longitude	80	Degrees	06	Minutes	31.6	Seconds	w
	State	South Carolin	าล	<b>County</b> B	erkeley		
	Does a st	ate agency reį	gulate this imp		Yes		No
			If So Which St		SCDHEC, Burea Assurance Divi		



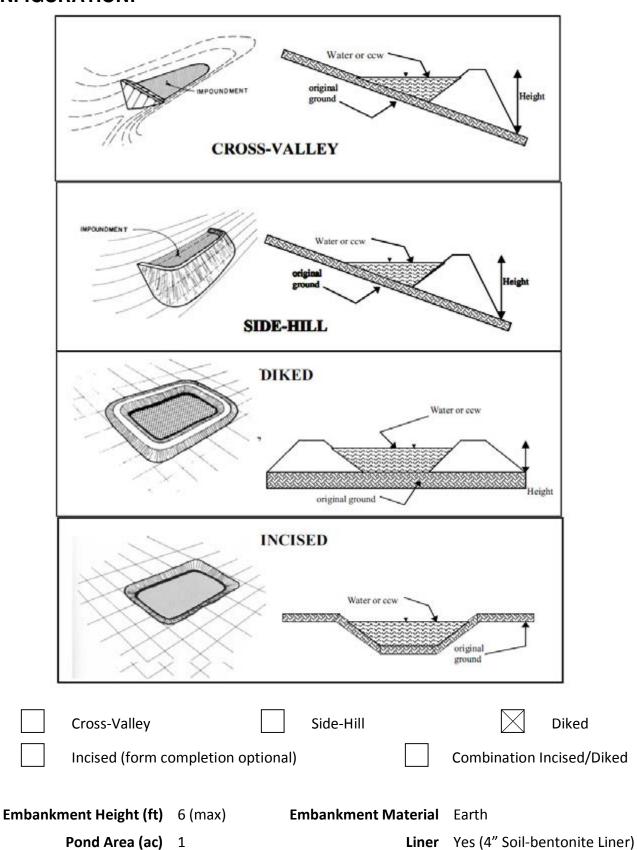
# **HAZARD POTENTIAL** (In the event the impoundment should fail, the following would occur): **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses. LOW HAZARD POTENTIAL: Dams assigned the low hazard potential 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:**

Failure of the low dike impounding the 1-acre Gypsum Pond would discharge coal combustion residue onto flat surrounding land owned by Santee Cooper. Due to the low head above outside grade and low volume of coal combustion residue and water, the water and material released would most likely be entirely contained within the plant boundaries and likely would not reach Lake Moultrie more than ½ mile away.



### **CONFIGURATION:**



**Current Freeboard (ft)** 

Liner Permeability < 1 x 10<sup>-7</sup> cm/sec



# TYPE OF OUTLET (Mark all that apply)

	Open Channel Spillwa	ay				
	Trapezoidal	TRAPEZO	OIDAL		TRIANGULAR	
	Triangular		Top V	Vidth	Top	Width
	Rectangular	(435)	Dept	h		Depth
	Irregular		Bot			V •
	depth (ft)		Wid	th		
	average bottom width (ft)	RECTA	NGULAR		IRREGULAR	
	top width (ft)	-	Depth Width		Averag Av De	- /
	Outlet					
18"	inside diameter (SDR 17 – smooth lined – 19.	5" OD)	/			
<u>M</u> :	aterial_			Inside Diameter		
	corrugated metal					
	welded steel					
	concrete					
	plastic (hdpe, pvc, etc.)					
	other (specify):					
_			Yes	No		
l	s water flowing through t outl					
	No Outlet					
	Other Type of Outlet (specify):					

The Impoundment was Designed By	Burns & Greene	Roe/ L	ockwood.
		Yes	No
Has there ever been a failure at the	nis site?		$\boxtimes$
If So	When?		
If So Please Describe :			

	Yes	No
Has there ever been significant seepages at this site?		
If So When?		

	Yes	No
Has there ever been any measures undertaken to		
monitor/lower Phreatic water table levels based		
on past seepages or breaches		
at this site?		
If so, which method (e.g., piezometers, gw pumping,)?		
1 1 0, 7		

### **ADDITIONAL INSPECTION QUESTIONS**

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

No.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

No. However, Mr. John E. Fondren, III, PE, with Santee Cooper, who observed construction of the dikes, was present and indicated that topsoil and deleterious organic material was removed from the foundation areas and that extensive dewatering using ditches was required to prepare a dry foundation for placement of the dike embankment fill.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures, or patchwork on the dikes.