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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

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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 by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is **to evaluate the condition and potential of residue release from management units 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 by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

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

LIMITATIONS

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

DRAFT

Table of Contents

Page

DRAFT

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

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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

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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)[1]	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

[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 Very Small Size 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 Less Than Low Hazard Potential, 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

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

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

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	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.
Low Hazard Potential	Dams 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.
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)[1]	1.0	12.8	79.0
Current Storage Volume (cubic yards)	Varies	37,107	1,263,240
Current Storage Volume (acre-feet)[1]	Varies[2]	23	783
Total Storage Capacity (cubic yards)	9,680	371,067	1,868,240
Total Storage Capacity (acre-feet)[1]	6	230	1,158
Crest Elevation (feet)	85.81	95.31	91.00
Normal Pond Level (feet)	83.50	88.0	88.0

[1] *From Santee Cooper response to EPA's RFI dated March 17, 2009.*
[2] *Continuous maintenance excavation occurs to remove gypsum to a permitted on-site landfill.*

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 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 1is 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

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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.

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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.

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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 off-site 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 pseudo-static 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

Material	Total Unit Wt. (pcf)	Undrained Strength Parameters Cases 1 & 2		Drained Strength Parameters 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		Avg. Drained & Undrained Strength Parameters	
		C (psf)	Ø (deg)	C (psf)	Ø (deg)
<u>New Dike East Side</u>:					
Embankment (0-13')	125	-	0	675	33
Foundation (13'-23')	124.5	1000	0	-	-
Foundation (23'-33')	100.5	400	0	-	-
<u>Original Dike:</u>					
Embankment (0-20')	125	1000	0	-	-
Foundation (20'-35')	124.5	750	0	-	-
Foundation (35'-45')	100.5	300	0	-	-
<u>Pond Contents:</u>					
Ash	80 Alt. 100.5	0 100	10 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)		
Type of Analysis	**Height of Embankment (feet)**	**Calculated Factor of Safety (FS)**
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 (pseudo-static) 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)			
Location	Horizontal Seismic Coefficient (g)	Calculated Minimum Factor of Safety (FS)	
		Inside Slope	Outside Slope
New Dike - East Side @ Original Dike	0 (static)	3.388	2.261
	0.15 outside/ 0.10 inside	1.833	1.208
	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 pseudo-static 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

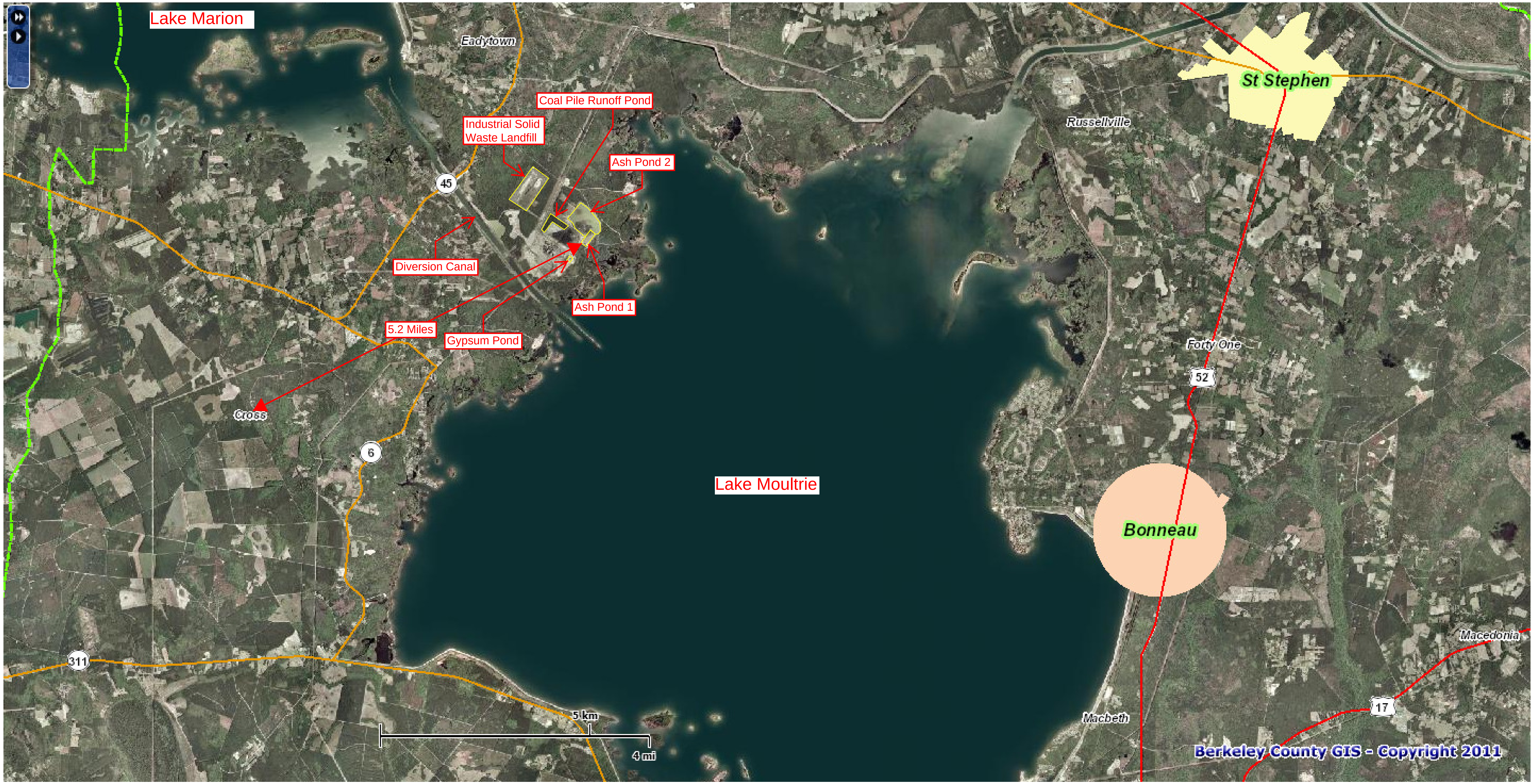
There is no dedicated dam performance monitoring instrumentation in place in the ash pond dikes and gypsum pond dike, although useful groundwater level information is obtained from monitoring wells installed on the ash pond dikes for sampling and analysis of groundwater. No problem or suspect condition, 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

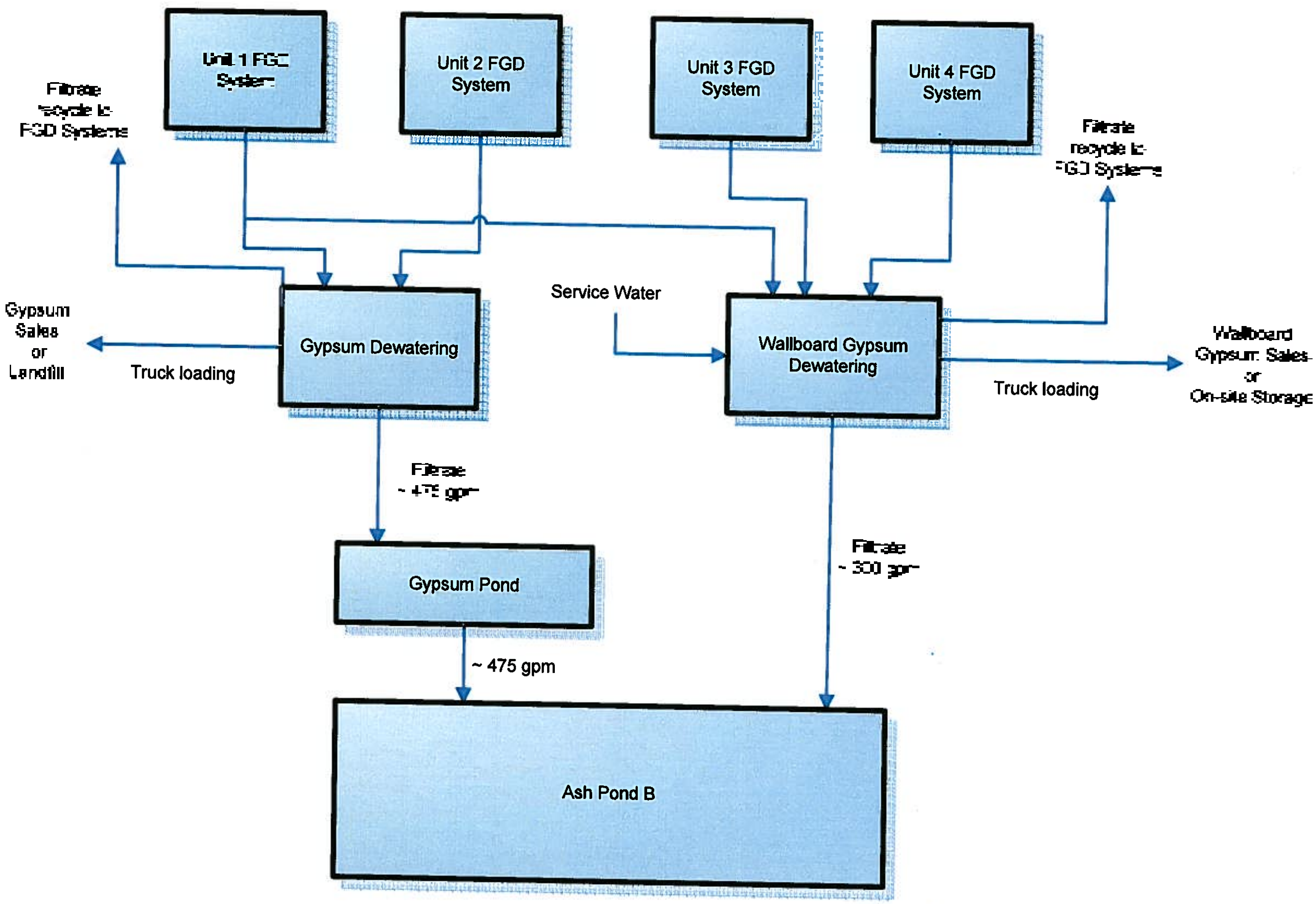
Appendix A Doc 01: Cross Generation Station Vicinity Map

Cross Generation Station Vicinity Map

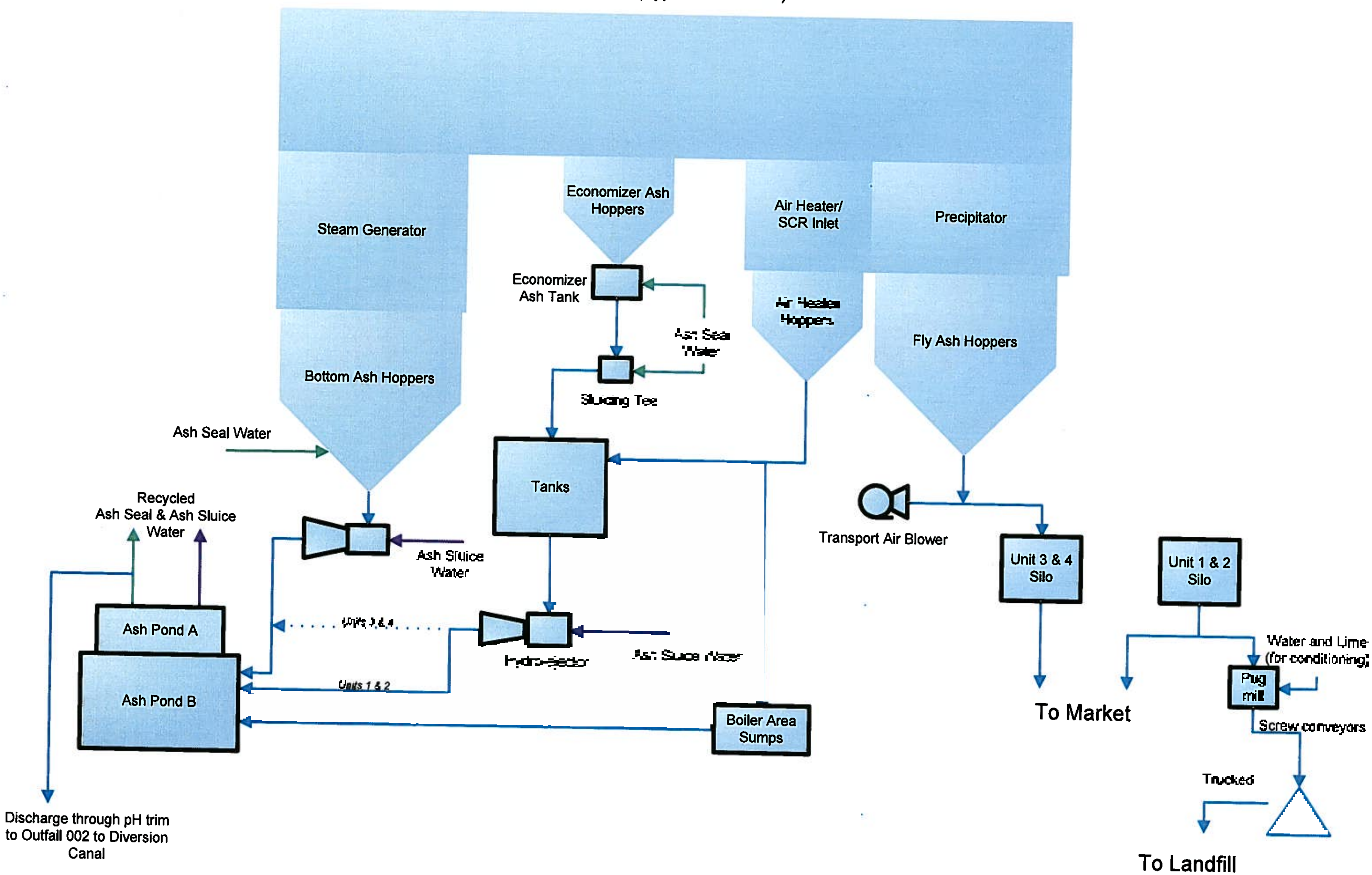


Appendix A Doc 02: Ash Management Flow Chart

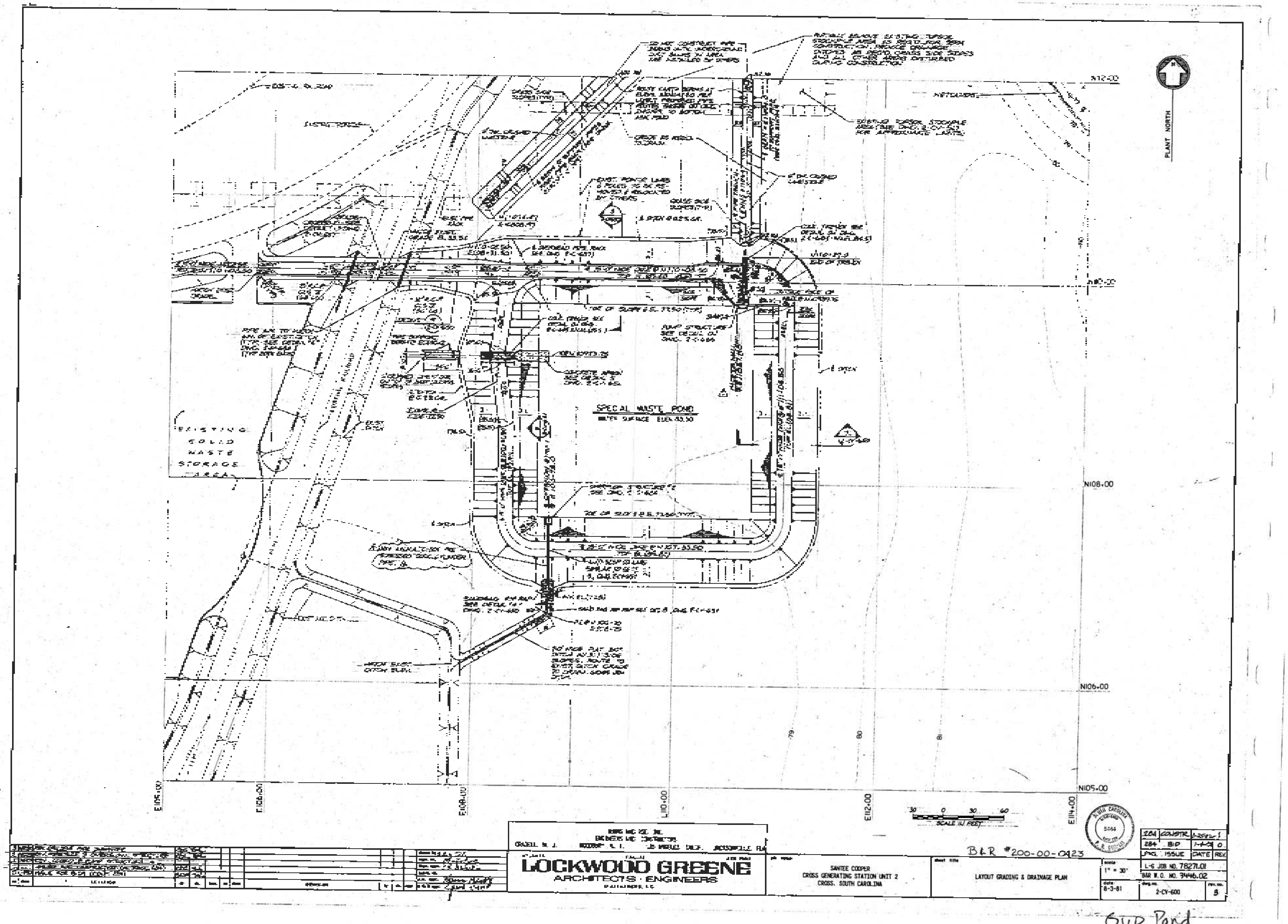
Santee Cooper
Cross Generating Station
Flue Gas Desulfurization Systems and Gypsum Handling



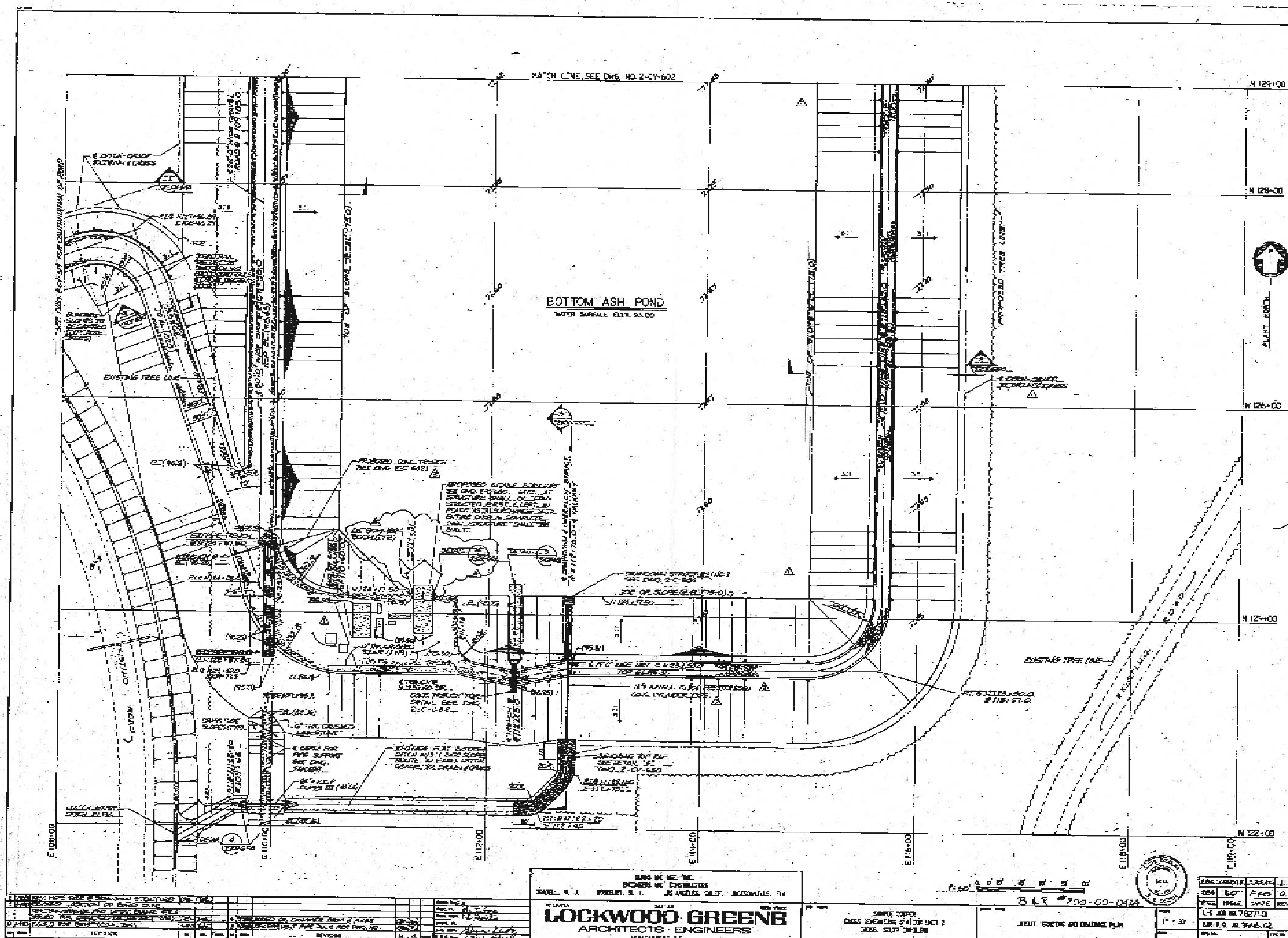
Santee Cooper
Cross Generating Station
Ash Handling
(Typical for 4 units)

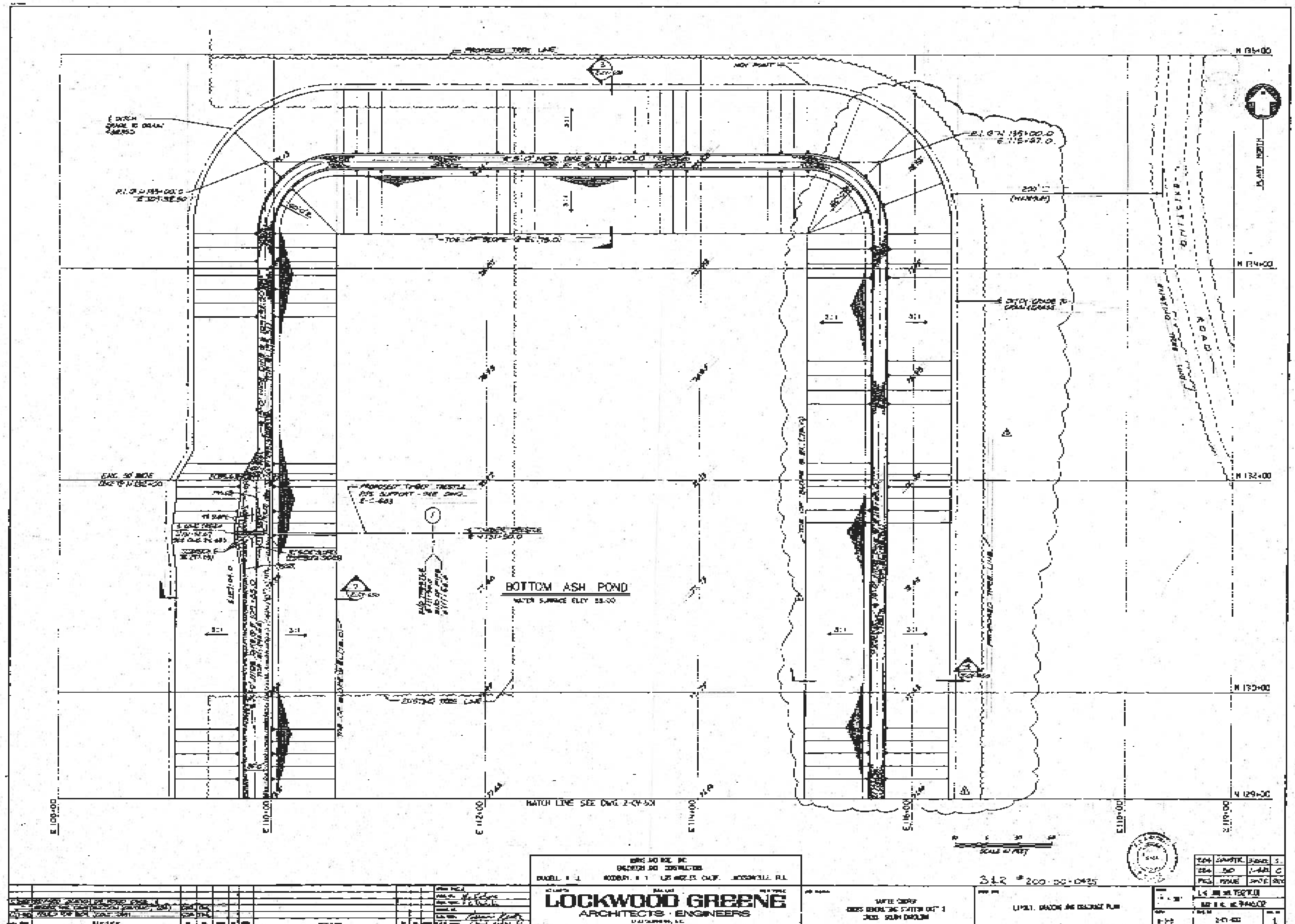


Appendix A Doc 03: Cross GS Pond Construction Plans

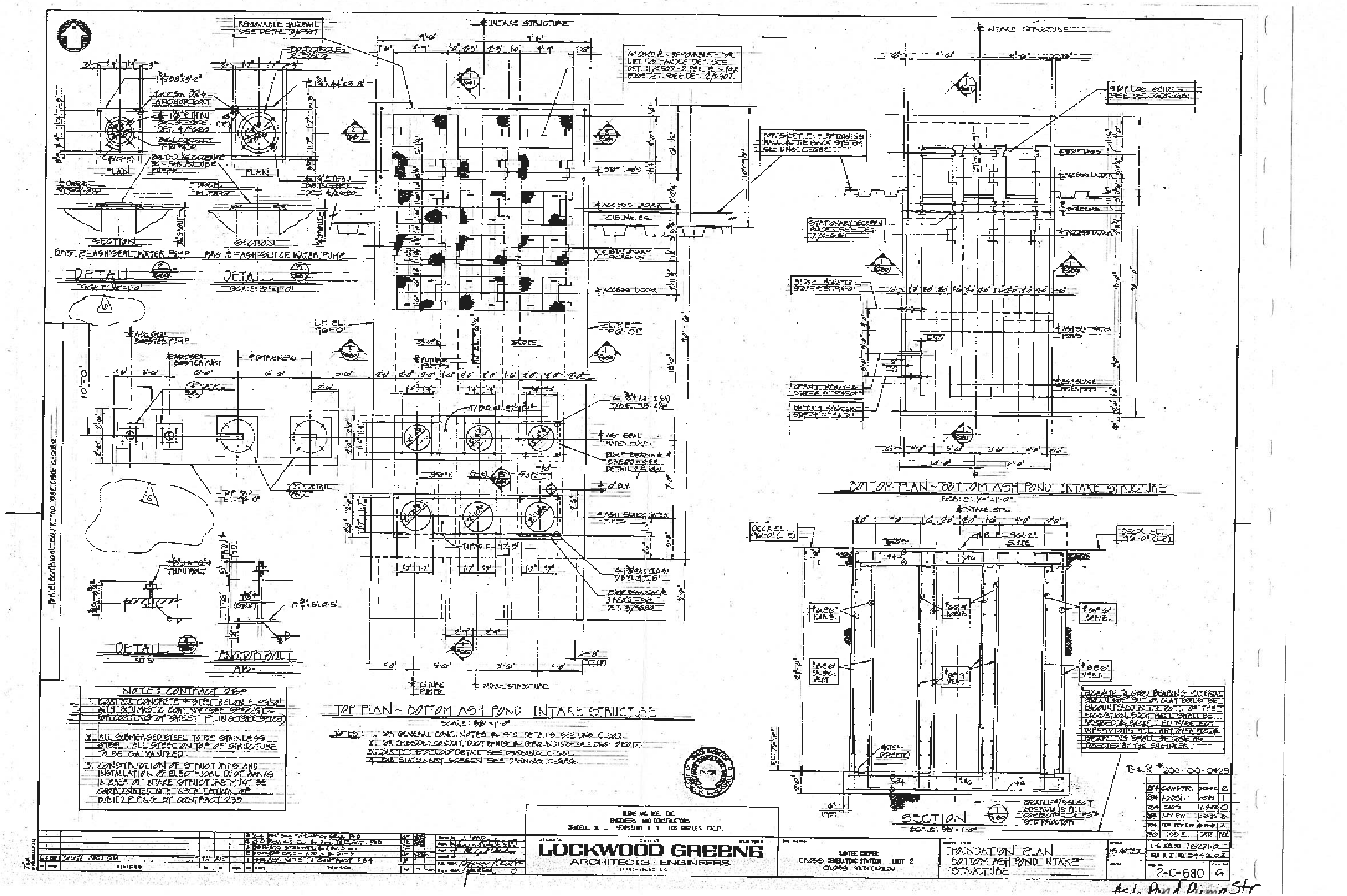


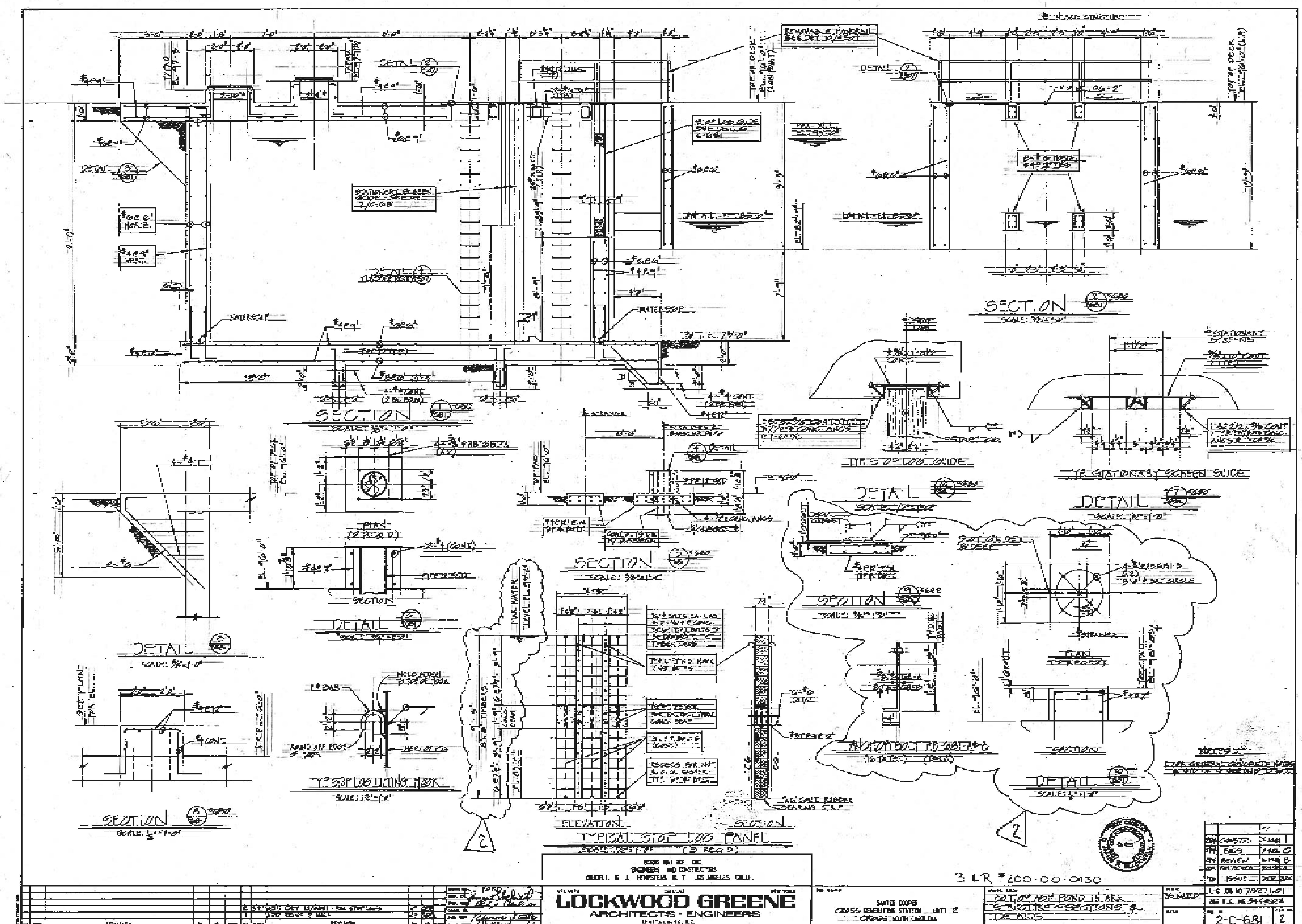
PLANT NORTH
SPECIAL WASTE POND
EXISTING SOLID WASTE STORAGE AREA
N112+00
N110+00
N108+00
N106+00
N105+00
E105+00
E106+00
E108+00
E110+00
E112+00
E114+00
30 0 30 60
SCALE IN FEET
LOCKWOOD GREENE
ARCHITECTS · ENGINEERS
SANTEE COOPER
CROSS GENERATING STATION UNIT 2
CROSS, SOUTH CAROLINA
LAYOUT GRADING & DRAINAGE PLAN
1" = 30'
8-3-81
L-G JOB NO. 78271.01
B&R W.O. NO. 3446.02
2-CV-600
3
284 CONSTR.
284 BID
PKG. ISSUE DATE REV.
B&R #200-00-0423
Gyp Pond


MATCH LINE, SEE DWG. NO. 2-CY-602
BOTTOM ASH POND
N 128+00
N 126+00
N 122+00
E 110+00
E 112+00
E 114+00
E 116+00
E 118+00
E 119+00
EXISTING TREE LINE
PROPOSED TREE LINE
PLANT NORTH
LOCKWOOD GREENE
ARCHITECTS · ENGINEERS
B&R #200-00-0424
1" = 30'

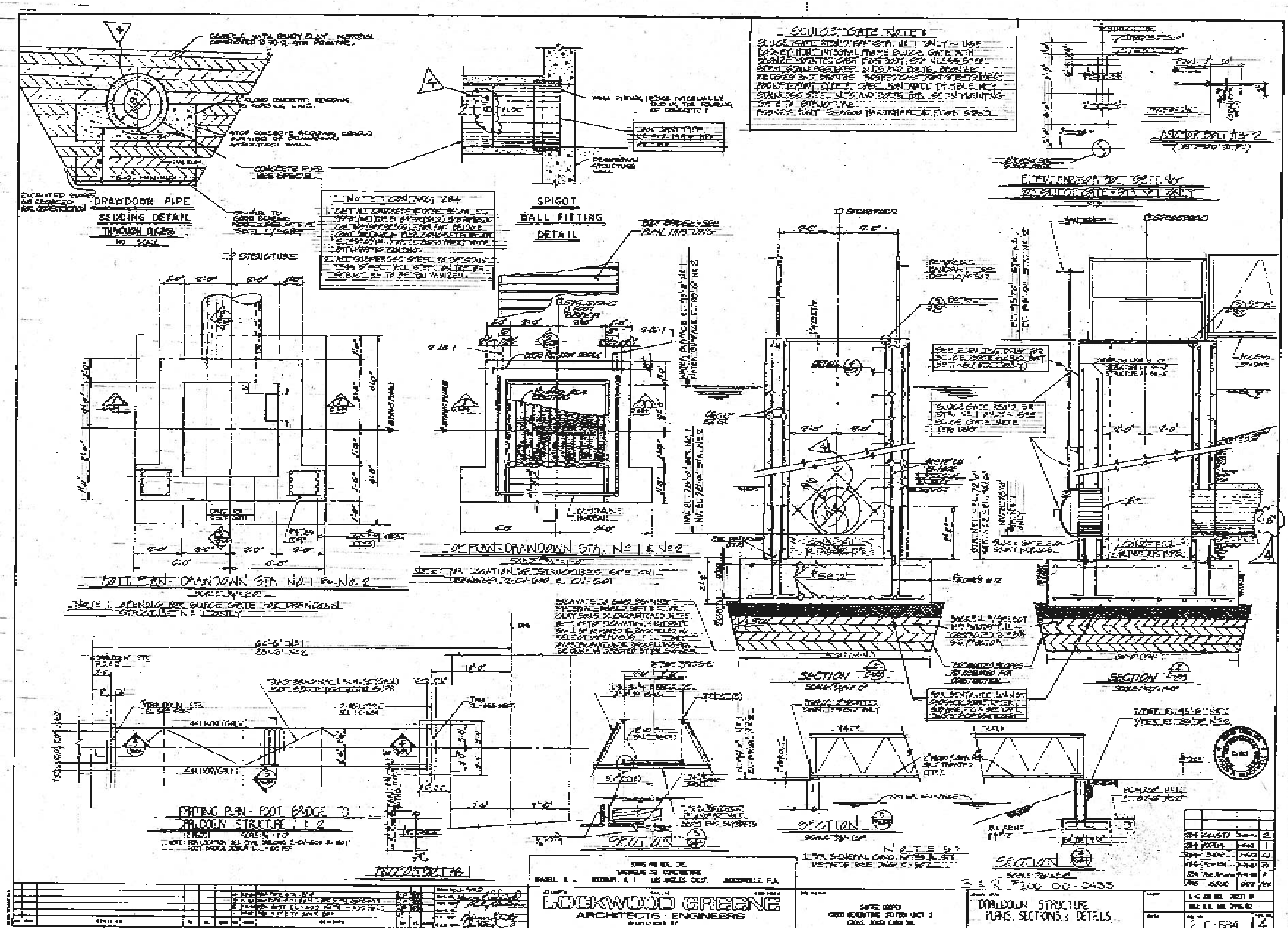


Ash Pond North Half

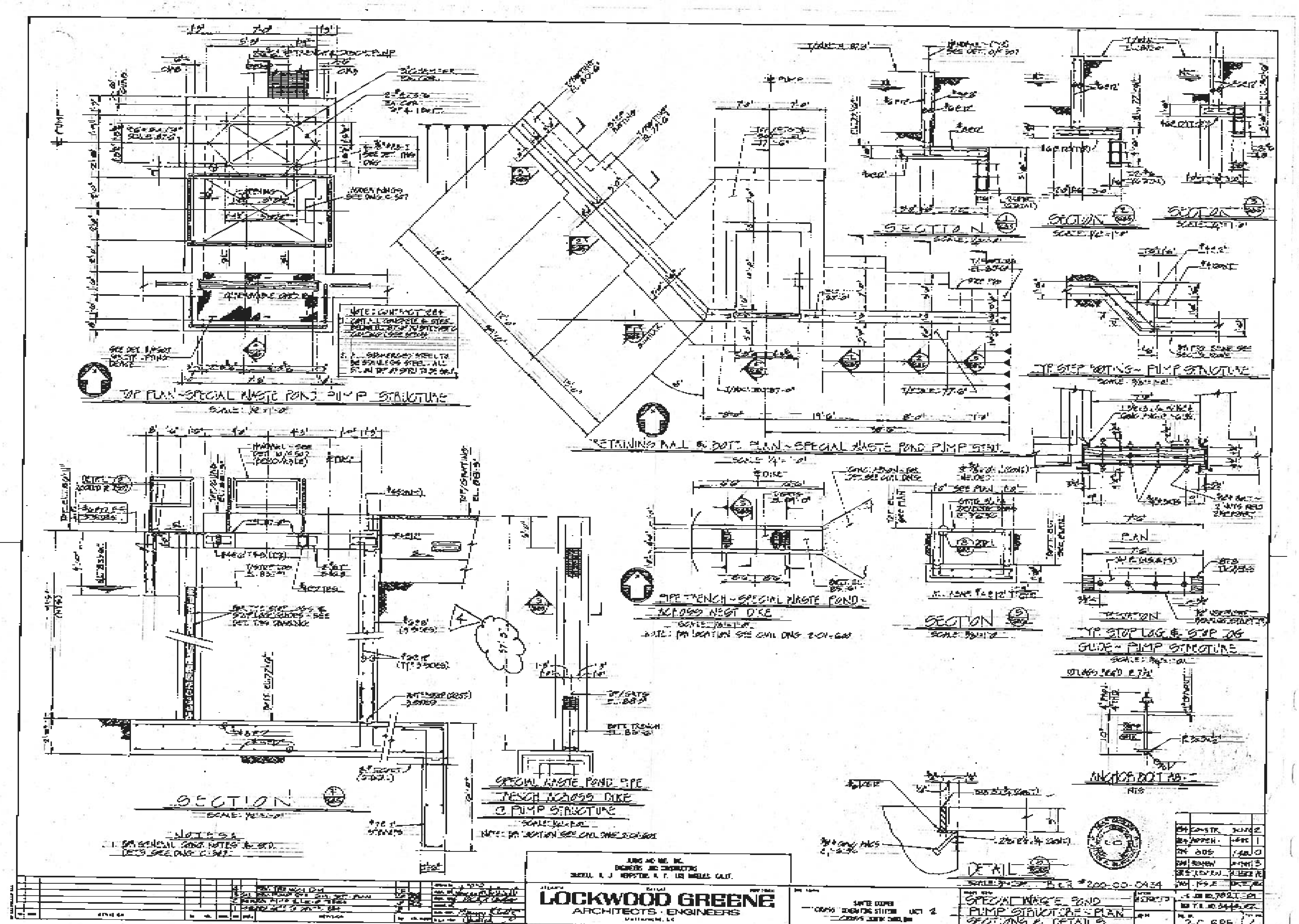

TOP PLAN ~ BOTTOM ASH POND INTAKE STRUCTURE
BOTTOM PLAN ~ BOTTOM ASH POND INTAKE STRUCTURE
SECTION
DETAIL
NOTES CONTRACT 284
2. ALL SUBMERGED STEEL TO BE STAINLESS STEEL. ALL STEEL ON TOP OF STRUCTURE TO BE GALVANIZED.
LOCKWOOD GREENE
ARCHITECTS · ENGINEERS
SANTEE COOPER
CROSS GENERATING STATION UNIT 2
CROSS SOUTH CAROLINA
FOUNDATION PLAN
BOTTOM ASH POND INTAKE STRUCTURE
2-C-680
6
B&R #200-00-0429



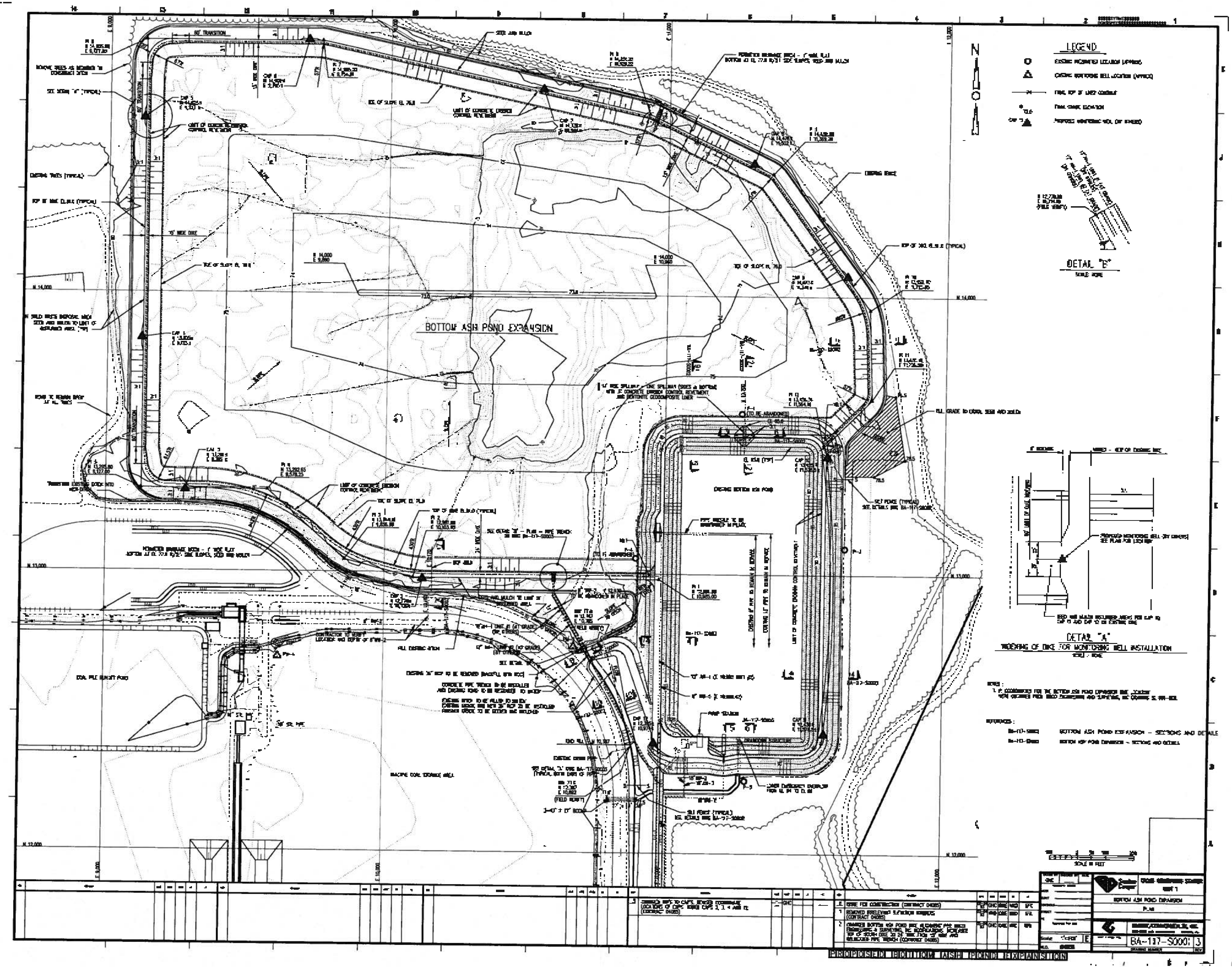
Ash Pond · Pump Str. Sections

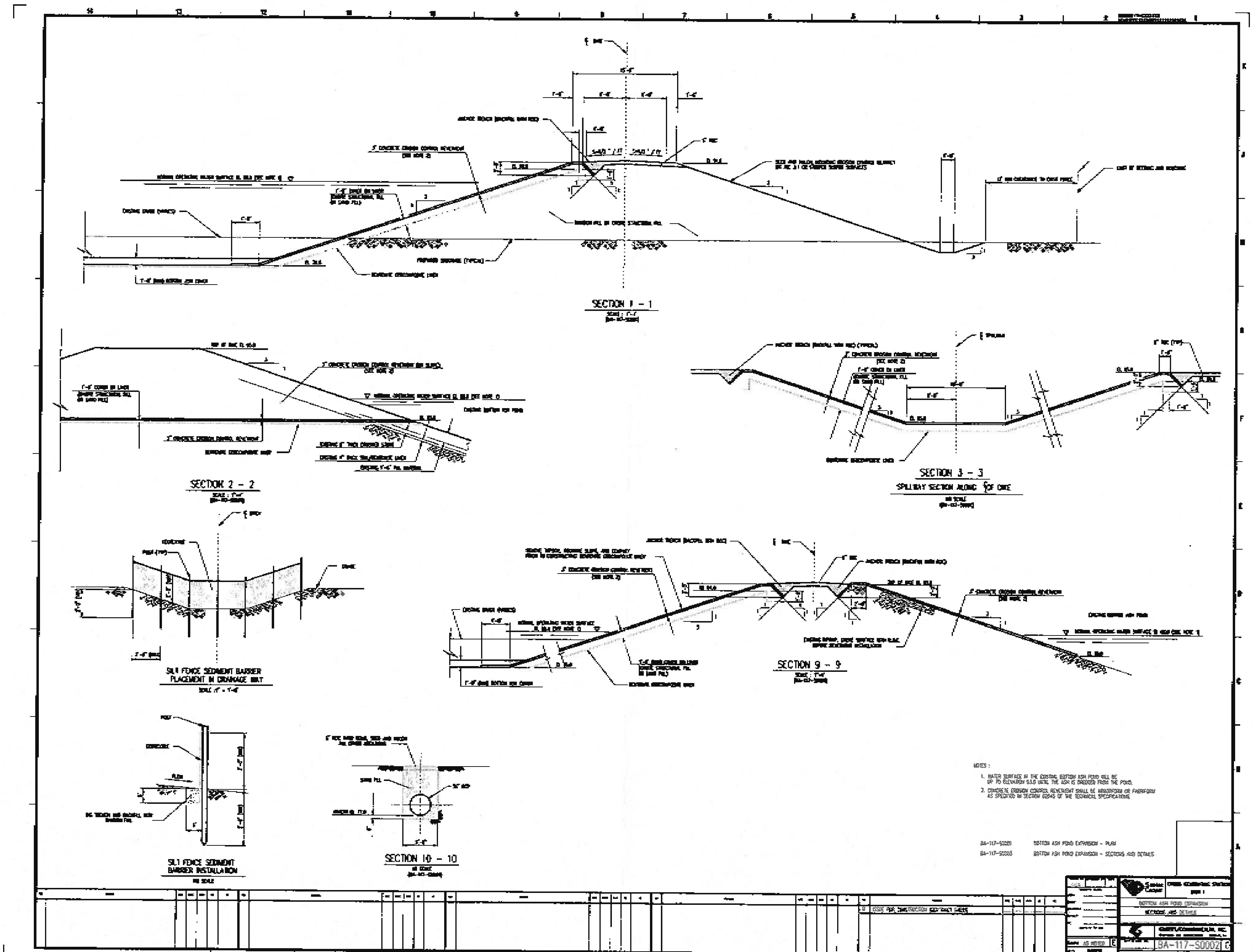


Drawdown Structures

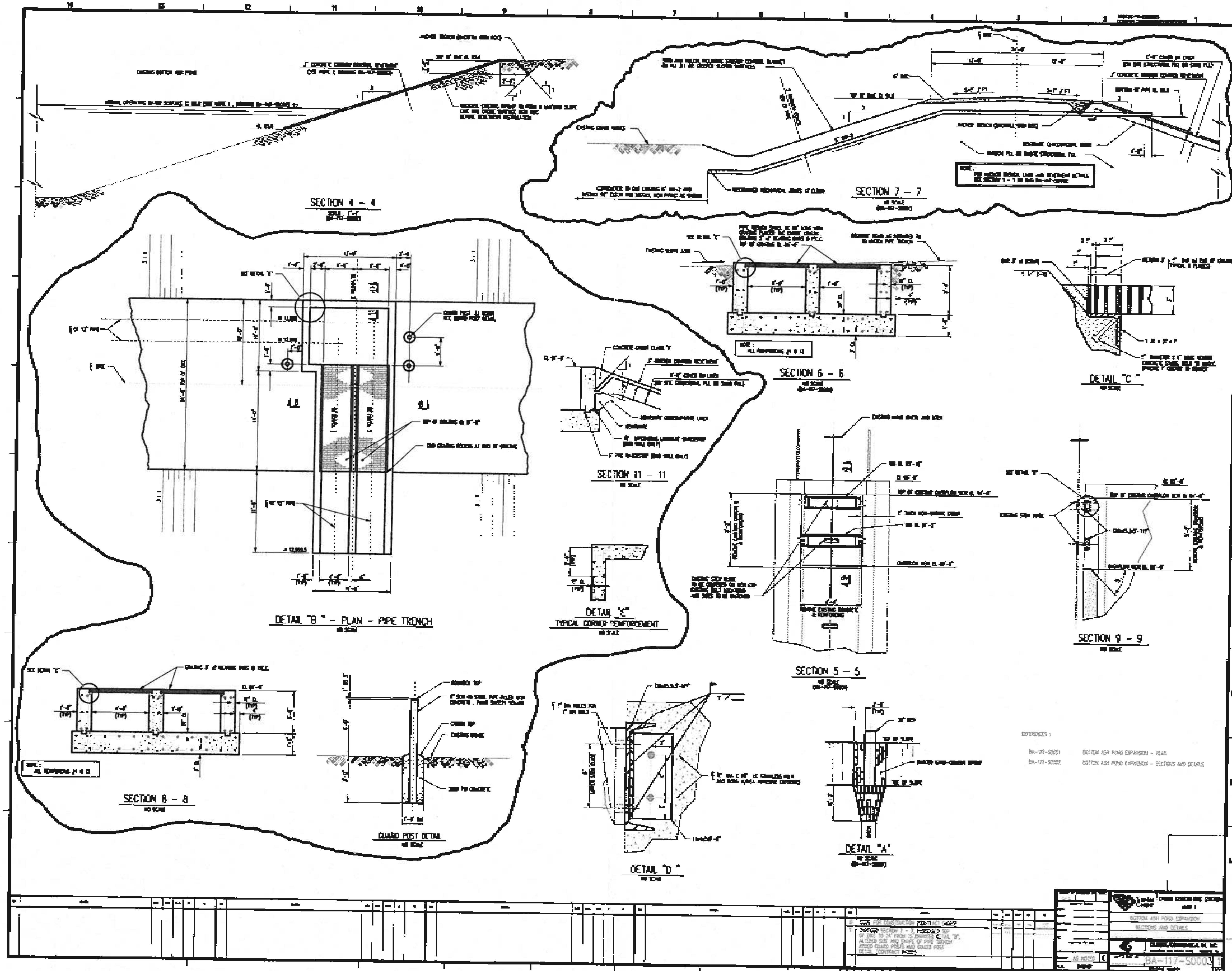


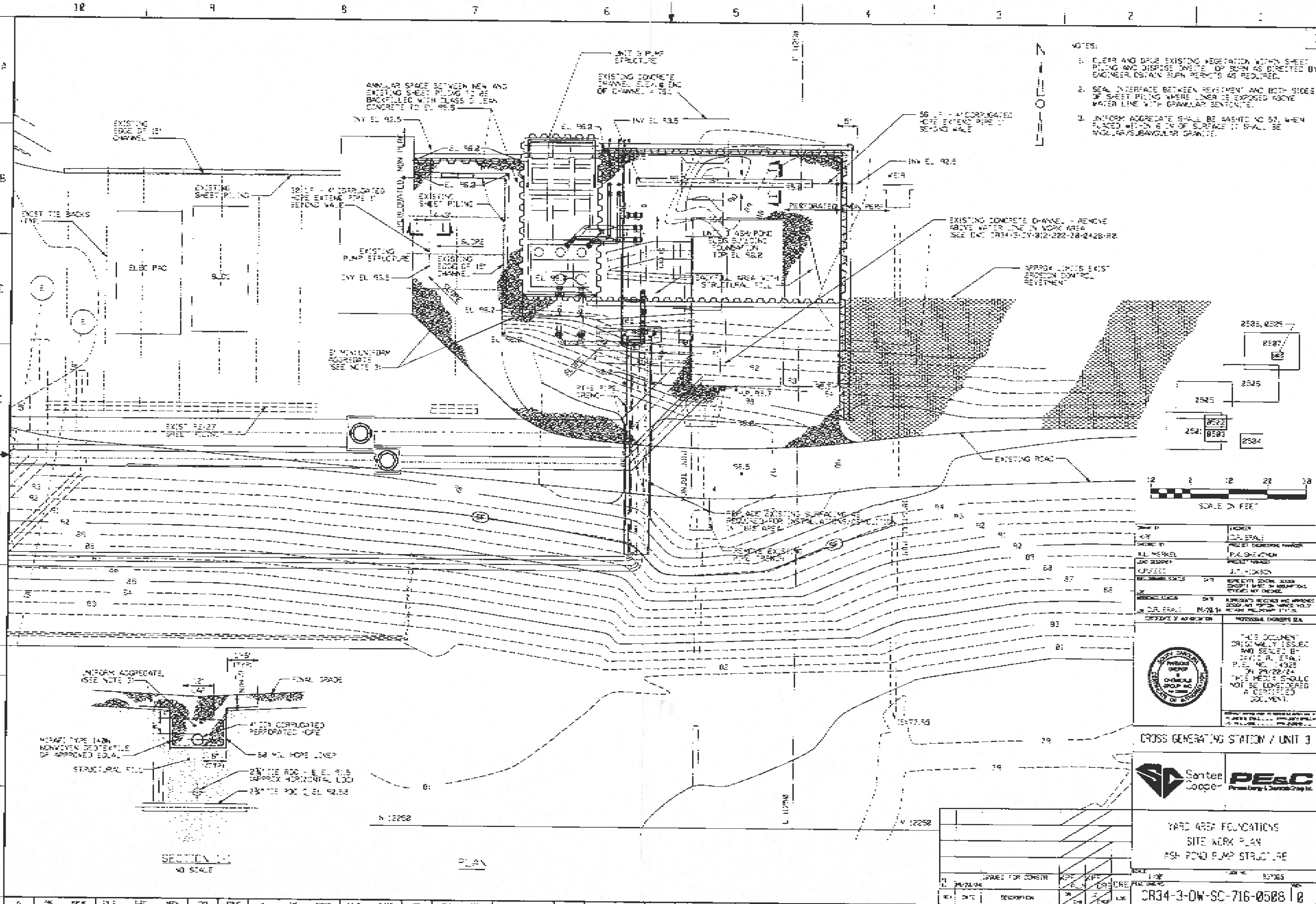
Gyp Pond Pump Str


BOTTOM ASH POND EXPANSION
LEGEND
DETAIL "B"
DETAIL "A"
WIDENING OF DIKE FOR MONITORING WELL INSTALLATION
EXISTING BOTTOM ASH POND
N 14,000
N 13,000
N 12,000
E 12,000
SCALE IN FEET
ISSUE FOR CONSTRUCTION (CONTRACT 04085)
REMOVED IRRELEVANT ELEVATION MARKERS (CONTRACT 04085)
BOTTOM ASH POND EXPANSION
PLAN
BA-137-S0001
3
PROPOSED BOTTOM ASH POND EXPANSION



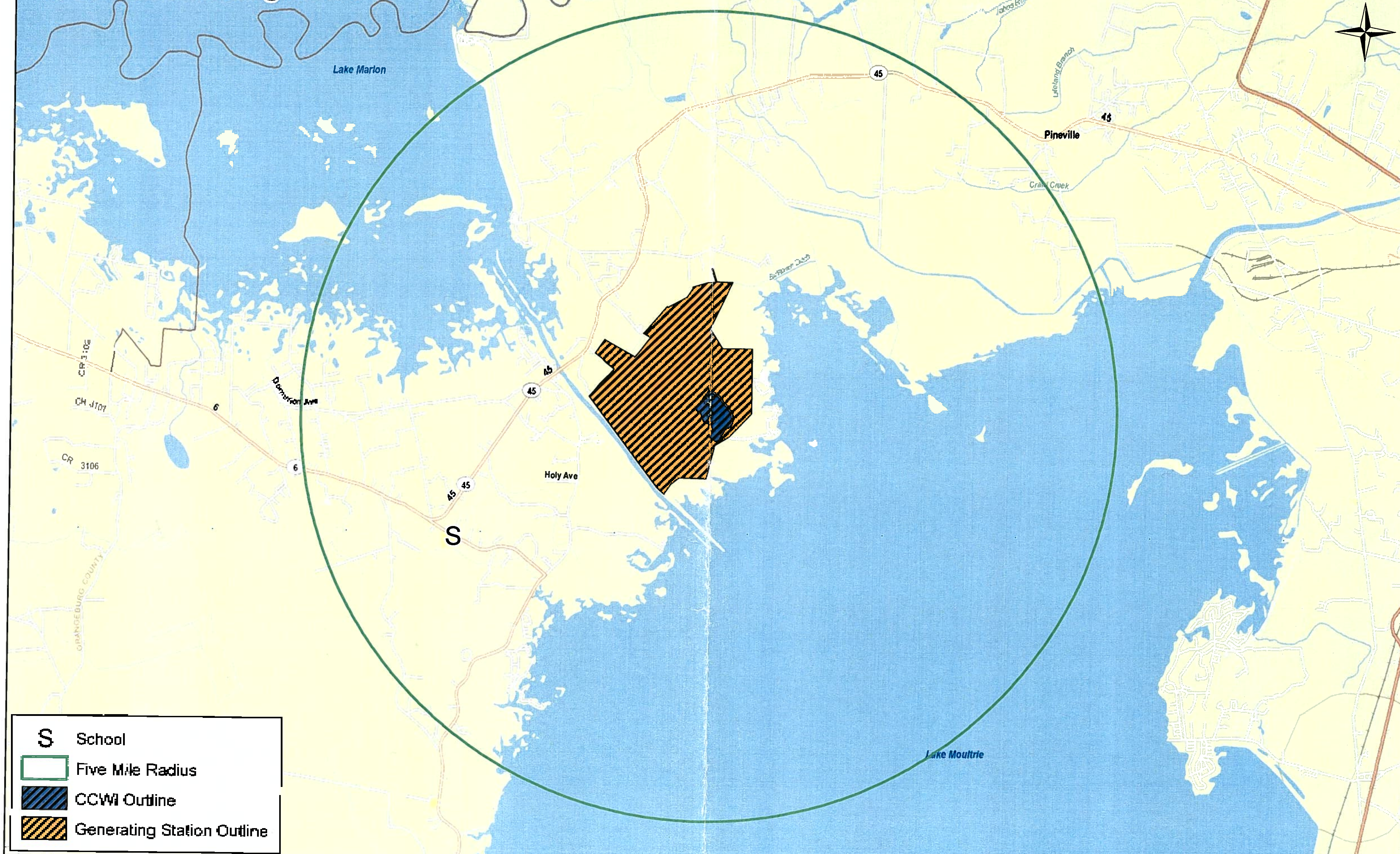
SECTION 1 - 1
SECTION 2 - 2
SECTION 3 - 3
SPILLWAY SECTION ALONG ℄ OF DIKE
SILT FENCE SEDIMENT BARRIER PLACEMENT IN DRAINAGE WAY
SECTION 9 - 9
SILT FENCE SEDIMENT BARRIER INSTALLATION
SECTION 10 - 10
NOTES :
1. WATER SURFACE IN THE EXISTING BOTTOM ASH POND WILL BE UP TO ELEVATION 51.0 UNTIL THE ASH IS DREDGED FROM THE POND.
2. CONCRETE EROSION CONTROL REVETMENT SHALL BE ARMORFORM OR FABRIFORM AS SPECIFIED IN SECTION 02645 OF THE TECHNICAL SPECIFICATIONS.
BA-117-S0001 BOTTOM ASH POND EXPANSION - PLAN
BA-117-S0003 BOTTOM ASH POND EXPANSION - SECTIONS AND DETAILS
BOTTOM ASH POND EXPANSION
SECTIONS AND DETAILS
AS NOTED
BA-117-S0002


SECTION 4 - 4
SECTION 7 - 7
SECTION 6 - 6
DETAIL "C"
DETAIL "B" - PLAN - PIPE TRENCH
SECTION 11 - 11
DETAIL "E"
TYPICAL CORNER REINFORCEMENT
SECTION 5 - 5
SECTION 9 - 9
SECTION 8 - 8
GUARD POST DETAIL
DETAIL "D"
DETAIL "A"
REFERENCES :
BA-117-S0001 BOTTOM ASH POND EXPANSION - PLAN
BA-117-S0002 BOTTOM ASH POND EXPANSION - SECTIONS AND DETAILS
BOTTOM ASH POND EXPANSION
SECTIONS AND DETAILS
AS NOTED
BA-117-S0003


NOTES:
1. CLEAR AND GRUB EXISTING VEGETATION WITHIN SHEET PILING AND DISPOSE ONSITE OR BURN AS DIRECTED BY ENGINEER. OBTAIN BURN PERMITS AS REQUIRED.
2. SEAL INTERFACE BETWEEN REVETMENT AND BOTH SIDES OF SHEET PILING WHERE LINER IS EXPOSED ABOVE WATER LINE WITH GRANULAR BENTONITE.
3. UNIFORM AGGREGATE SHALL BE AASHTO NO 57. WHEN PLACED WITHIN 6 IN OF SURFACE IT SHALL BE ANGULAR/SUBANGULAR GRANITE.
UNIT 3 PUMP STRUCTURE
EXISTING SHEET PILING
EXISTING PUMP STRUCTURE
ELEC PAD
BLDG
EXISTING ROAD
SCALE IN FEET
FINAL GRADE
4" DIA CORRUGATED PERFORATED HDPE
60 MIL HDPE LINER
STRUCTURAL FILL
SECTION 1-1
NO SCALE
PLAN
CROSS GENERATING STATION / UNIT 3
Santee Cooper
PE&C
YARD AREA FOUNDATIONS
SITE WORK PLAN
ASH POND PUMP STRUCTURE
ISSUED FOR CONSTR
CR34-3-OW-SC-716-0508
0

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

Cross Generating Station



Appendix A Doc 05: NPDES Violation Report

117 · L43 041 /

NPDES Violation Report Form

Santee Cooper Facility:	Cross Generating Station
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 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 9th. 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 11th, 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 12th 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:	[signature]
Date:	1/23/09
Signature of Plant Manager:	[signature]
Date:	1/23/09

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

PHASE II

CR34-3-LI-CS-0003-R0

FINAL REPORT

CROSS GENERATING STATION

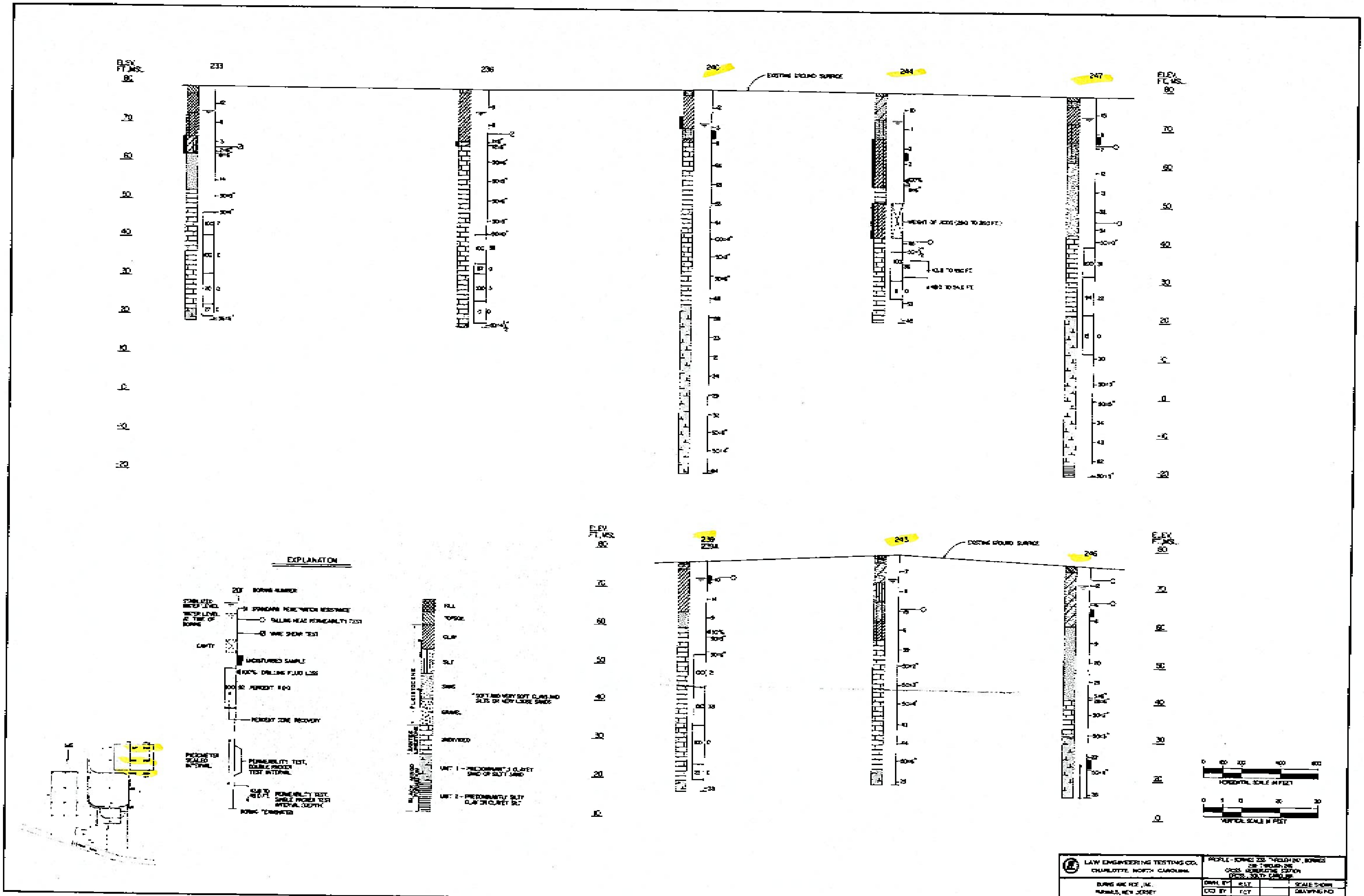
CROSS, SOUTH CAROLINA

LETCo. JOB NO. CH 4193

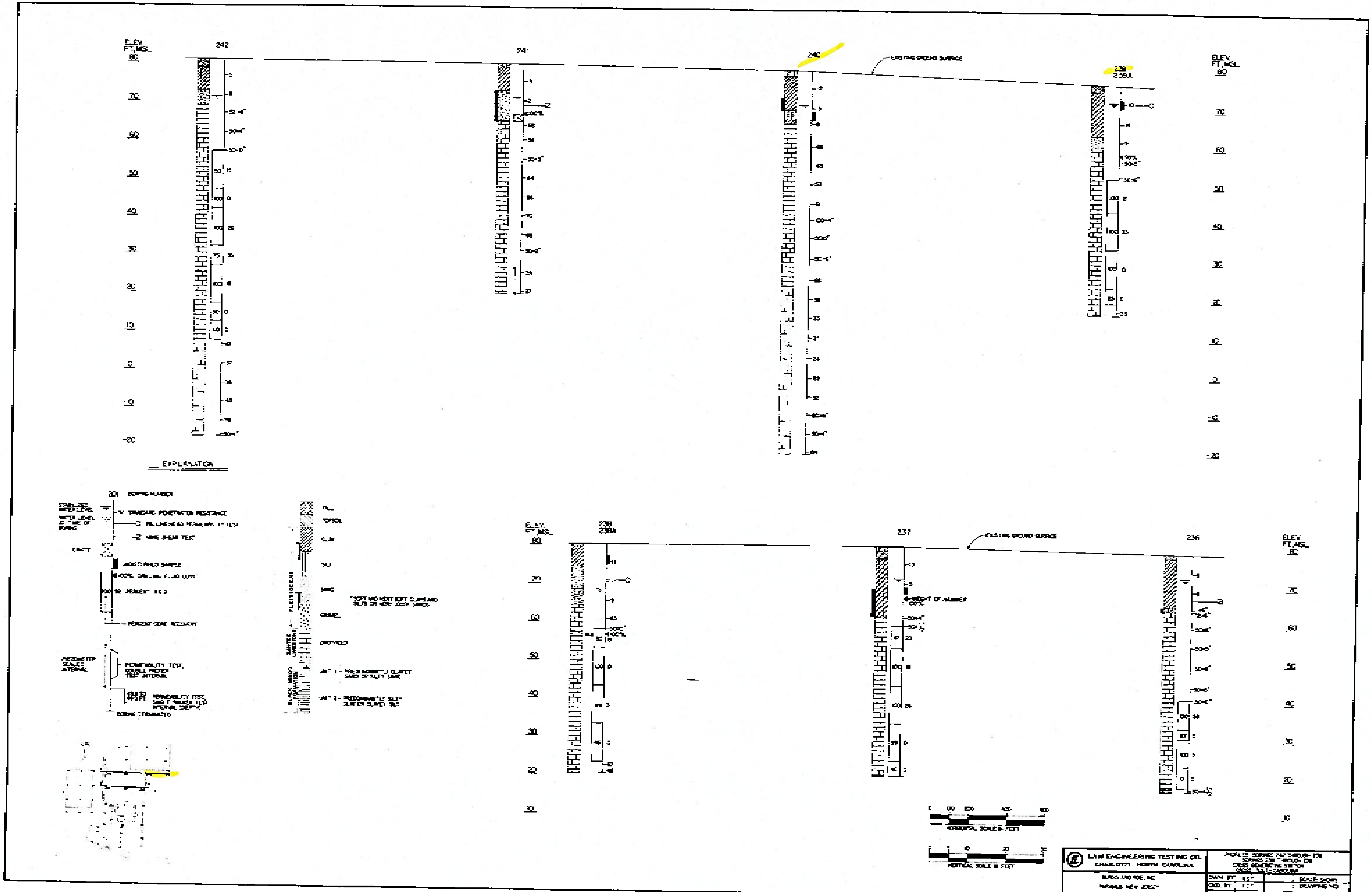
APPENDICES TO VOLUME 2 AND PROFILES

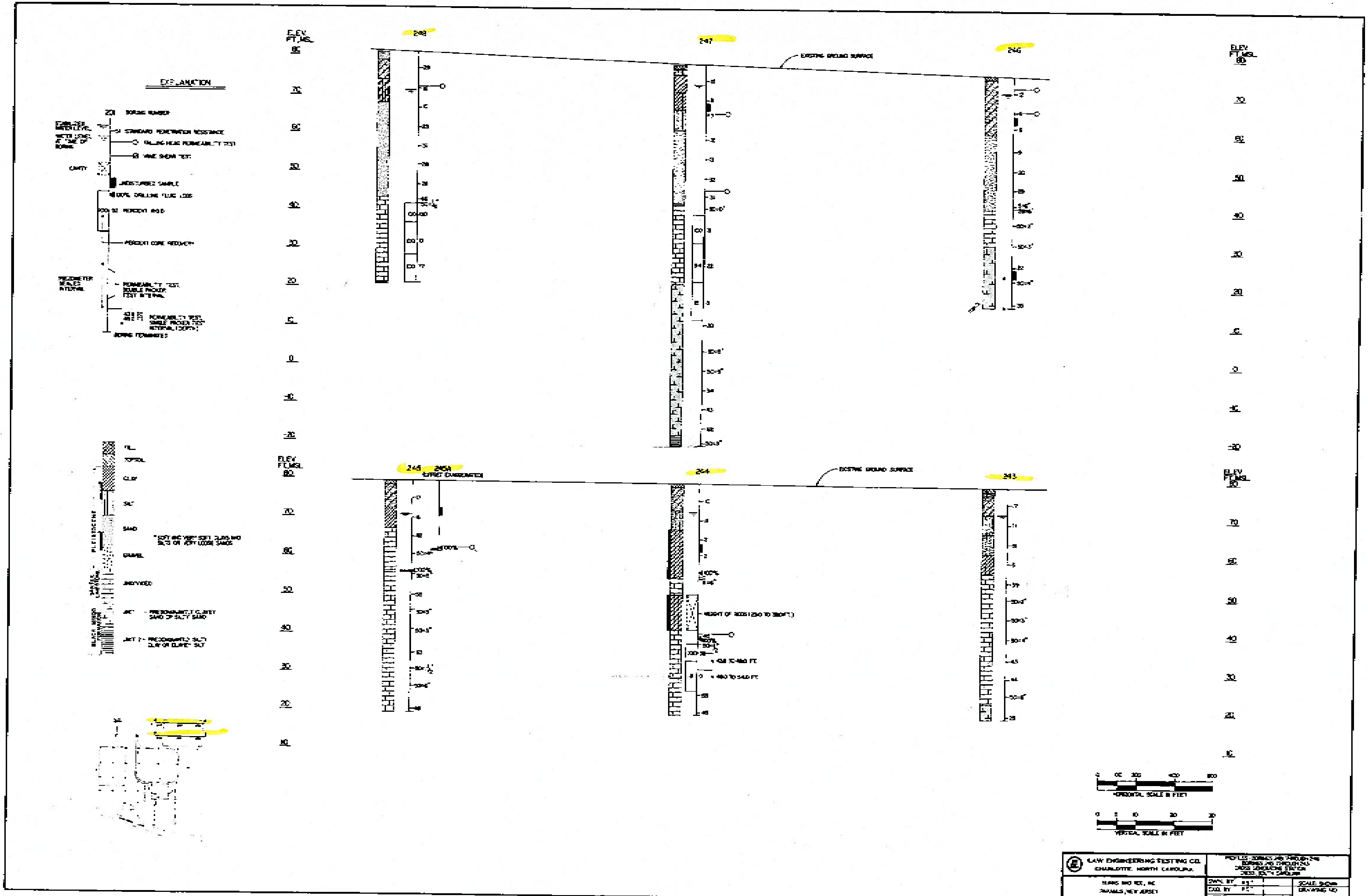
Law Engineering Testing Company

Report 5



ELEV. FT. MSL
233
236
240
244
247
EXISTING GROUND SURFACE
239
243
246
EXPLANATION
BORING NUMBER
STANDARD PENETRATION RESISTANCE
UNDISTURBED SAMPLE
PERCENT CORE RECOVERY
FILL
TOPSOIL
CLAY
SILT
SAND
GRAVEL
HORIZONTAL SCALE IN FEET
VERTICAL SCALE IN FEET
LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA
BURNS AND ROE, INC.
PARAMUS, NEW JERSEY
SCALE SHOWN
DRAWING NO.


ELEV FT. MSL
242
241
240
239
239A
EXISTING GROUND SURFACE
EXPLANATION
201 BORING NUMBER
STANDARD PENETRATION RESISTANCE
FALLING HEAD PERMEABILITY TEST
VANE SHEAR TEST
UNDISTURBED SAMPLE
100% DRILLING FLUID LOSS
PERCENT R.Q.D.
PERCENT CORE RECOVERY
PERMEABILITY TEST, DOUBLE PACKER TEST INTERVAL
BORING TERMINATED
FILL
TOPSOIL
CLAY
SILT
SAND
GRAVEL
PLEISTOCENE
238
238A
237
236
WEIGHT OF HAMMER
HORIZONTAL SCALE IN FEET
VERTICAL SCALE IN FEET
LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA
BURNS AND ROE, INC.
NEW JERSEY
SCALE SHOWN
DRAWING NO.



EXPLANATION
BORING NUMBER
STABILIZED WATER LEVEL
WATER LEVEL AT TIME OF BORING
STANDARD PENETRATION RESISTANCE
FALLING HEAD PERMEABILITY TEST
VANE SHEAR TEST
CAVITY
UNDISTURBED SAMPLE
100% DRILLING FLUID LOSS
PERCENT RQD
PERCENT CORE RECOVERY
PIEZOMETER SEALED INTERVAL
PERMEABILITY TEST, DOUBLE PACKER TEST INTERVAL
PERMEABILITY TEST, SINGLE PACKER TEST INTERVAL (DEPTH)
BORING TERMINATED
FILL
TOPSOIL
CLAY
SILT
SAND
GRAVEL
SOFT AND VERY SOFT CLAYS AND SILTS OR VERY LOOSE SANDS
UNDIVIDED
PREDOMINANTLY CLAYEY SAND OR SILTY SAND
PREDOMINANTLY SILTY CLAY OR CLAYEY SILT
ELEV FT MSL
248
247
246
245
245A
OFFSET CORRECTED
244
243
EXISTING GROUND SURFACE
WEIGHT OF RODS
HORIZONTAL SCALE IN FEET
VERTICAL SCALE IN FEET
LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA
BURNS AND ROE, INC.
PARAMUS, NEW JERSEY
SCALE SHOWN
DRAWING NO.

TEST BORING RECORD — Page 1 of 2

Depth Ft.	Description	Core % & Size	Time Min.	Elev. 76.7	Remarks	% R.Q.D.
0						
0.8	Topsoil-Black Silty Fine to Medium*					
2.0	Gray Tan Silty Clayey Fine to **					
	Stiff Gray Tan Silty Fine to Medium Sandy Clay			71.7	N=10 Pocket Penetrometer: Q_u = 3000 PSF Torvane: S=1420 PSF	
				66.7	N=14 Pocket Penetrometer: Q_u = 4400 PSF Torvane: S > 2000 PSF	
13.0	Loose Brown Slightly Silty Fine to Coarse Sand			61.7	N=9	
17.0	Very Dense Gray Tan Slightly Cemented Calcareous Slightly Clayey Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)				90% (loss of drilling water)	
				56.7	N=50/5"	
24.0				51.7	N=50/6" Drag Bit Refusal at 24.0 Ft.	
	Medium and Hard Cemented Calcareous Silt, Sand and Shell Fragments (Santee Limestone)	NQ 100			Crystalline Limestone: 24.0 to 24.4 Ft. 30.0 to 30.5 Ft. 32.0 to 35.5 Ft.	21
				46.7		
				41.7		
		100				33
				36.7		

*Sand and Organic Material
**Medium Sand

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT:
ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 1 of 2

TEST BORING RECORD

BORING NO. 239
DATE DRILLED 12-18-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

TEST BORING RECORD — Page 2 of 2

Depth Ft.	Description	Core % & Size	Time Min.	Elev. 36.7	Remarks	% R.Q.D.
40.0	Medium and Hard Cemented*					
41.0	Soft and Medium Gray Partially Cemented to Cemented Calcareous Silt, Sand and Shell Fragments (Santee Limestone)	NQ 100				33
				31.7		
		100				0
				26.7		
54.0	Core Loss	25		21.7		0
57.0	Dense Dark Green Silty Clayey Fine to Medium Sand (Black Mingo Formation)					
60.0				16.7	N=33	
	Boring Terminated at 60.0 Ft.					
	Groundwater Encountered At 4.0 Ft. 24 Hours After Boring					

*Calcareous Silt, Sand and Shell Fragments (Santee Limestone)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 2 of 2

TEST BORING RECORD

BORING NO. 239
DATE DRILLED 12-18-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

TEST BORING RECORD — Boring No. 239A

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV. 76.7 ±	REMARKS	% R Q D
0	Boring Drilled to Obtain Undisturbed Sample and Conduct Permeability Test				Field Permeability Test, 3.5 to 5.5 Ft.: K=1.08 x 10^{-5} cm/sec	
5.5				71.7	Pocket Penetrometer: Q_u = 4400 PSF Brown Gray Silty Fine to Medium Sandy Clay	
	Boring Terminated at 5.5 Ft.					

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT:
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 1 of 1

TEST BORING RECORD

BORING NO. 239A
DATE DRILLED 12-18-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO.

TEST BORING RECORD — Boring No. 240

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV. 79.7	REMARKS	% R Q D
0	Black Fine to Medium Sandy Silt					
1.5	Stiff Gray Slightly Micaceous Fine Sandy Clay			74.7	N=12 Pocket Penetrometer: Q_u = 6000 PSF	
7.0	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.: S=720 PSF	
12.5	Firm Tan Gray Fine Very Sandy*				N=8	
13.5	Loose Yellow Tan Slightly Cemented Calcareous Slightly Clayey Silty Fine to Medium Sand (Santee**			64.7		
16.5	Very Dense Tan Slightly Cemented Calcareous Slightly Clayey Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			59.7	N=66	
				54.7	N=69	
				49.7	N=53	
				44.7	N=61	
					Hard Drilling (37.0 to 41.0 Ft.)	
					N=100/4" No Recovery	
				39.7		

*Clay
**Limestone)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT.
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 1 of 3

TEST BORING RECORD

BORING NO. 240
DATE DRILLED 12/16-17/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV.		REMARKS	% R.Q.D
40.0	Very Dense Tan Slightly Cemented Calcareous Slightly Clayey Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			39.7			
					N=50/2"	No Recovery	
				34.7		Hard Drilling: 42.0 to 44.5 Ft. 46.0 to 47.0 Ft.	
					N=50/6"	No Recovery	
				29.7			
				24.7	N=68		
56.0	Very Dense to Firm Dark Green Slightly Clayey Very Silty Fine to Medium Sand (Black Mingo Formation)						
				19.7	N=58		
				14.7	N=23		
				9.7	N=21		
				4.7	N=24		
77.0	Firm to Very Dense Gray Slightly Clayey Silty Fine to Medium Sand (Black Mingo Formation)						
80.0				-0.3	N=29		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0–30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°–60°
R.Q.D ROCK QUALITY DESIGNATION — S = STEEP DIP 60°–90°

TEST BORING RECORD

BORING NO 240
DATE DRILLED 12/16-17/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV.		REMARKS	% R.Q.D
80.0	Firm to Very Dense Gray Slightly Clayey Silty Fine to Medium Sand (Black Mingo Formation)			-0.3			
				-5.3	N=32		
					N=50/6"		
				-10.3			
					N=50/4"		
				-15.3			
				-20.3	N=84		
100.0	Boring Terminated at 100.0 Ft.						
	Groundwater Encountered At 8.8 Ft. 24 Hours After Boring						

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0–30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°–60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°–90°

TEST BORING RECORD

BORING NO 240
DATE DRILLED 12/16-17/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

Test Boring Record — Boring No. 242 (Page 3 of 3)

Ground elevation: 1.0

Depth (Ft.)	Description	Elev.	Remarks
80.0	Very Dense to Dense Dark Green to Gray Silty Fine to Medium Sand With Thin Interbedded Clay Seams (Black Mingo Formation)	-4.0	N=36
		-9.0	N=45
		-14.0	N=78 Thin Interbedded Cemented Sand Seams (89.5 to 98.6 Ft.)
98.6		-19.0	N=50/1"

Boring Terminated at 98.6 Ft.

Groundwater Encountered At 9.9 Ft. 24 Hours After Boring

NW Casing Set to 24.0 Ft.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

TEST BORING RECORD

BORING NO. 242
DATE DRILLED 12/11-12/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

Test Boring Record — Boring No. 243 (Page 1 of 2)

Ground elevation: 78.8

Depth (Ft.)	Description	Elev.	Remarks
0	Topsoil-Black Silty Fine to Medium*		
1.0	Tan Silty Fine Sand		
2.0	Firm Brown Gray Silty Very Clayey Fine to Medium Sand	73.8	N=17
7.0	Stiff Gray Clayey Fine Sandy Silt	68.8	N=11; Pocket Penetrometer: Q_u = 3600 PSF; Torvane: S=1700 PSF
12.0	Firm Tan Gray Slightly Clayey Silty Fine to Coarse Sand	63.8	N=19; Field Permeability Test, 13.5 to 15.0 Ft.; K=2.82 x 10^{-6} cm/sec
17.0	Firm Blue Gray Silty Clay ("Laminated")	58.8	N=6; Pocket Penetrometer: Q_u = 3000 PSF; Torvane: S=540 PSF
22.0	Very Dense to Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)	53.8	N=59
		48.8	N=50/2" No Recovery; Hard Drilling (28.0 to 31.0 Ft.)
		43.8	N=50/3" No Recovery; Hard Drilling (33.5 to 41.0 Ft.)
		38.8	N=50/4"

*Sand and Organic Material

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

TEST BORING RECORD

BORING NO. 243
DATE DRILLED 12-18-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

Depth Ft.	Description	Core % & Size	Time Min.	Elev. 38.8	Remarks	% R Q D
40.0	Very Dense to Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			33.8	N=43	
				28.8	N=44	
				23.8	N=50/6"	
56.0	Firm Dark Green Slightly Clayey Silty Fine to Medium Sand (Black Mingo Formation)			18.8	N=25	
60.0	Boring Terminated at 60.0 Ft. Groundwater Encountered At 6.5 Ft. 24 Hours After Boring					

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT: L = LOW DIP 0-30° — M = MED DIP 30°-60°
% ROCK CORE RECOVERY — WATER TABLE, 1 HR.
N STANDARD PENETRATION — LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. 243
DATE DRILLED 12-18-78
JOB NO. CH 4193
LAW ENGINEERING TESTING CO

Depth Ft.	Description	Core % & Size	Time Min.	Elev. 79.3	Remarks	% R Q D
0	Topsoil-Black Silty Fine to Medium*					
1.0	Gray Tan Very Clayey Fine to Medium Sand					
2.5	Loose Red Brown Gray Very Clayey Fine to Medium Sand			74.3	N=10	
7.0	Firm Gray Slightly Clayey Silty Fine to Medium Sand			69.3	N=11	
12.0	Very Soft Gray Tan Fine Sandy Silty Clay With Seams of Fine to Medium Sand			64.3	N=2	
					Pocket Penetrometer: Q_u = 1400 PSF; Torvane: S=500 PSF; Bottom of UD, Pocket Penetrometer: Q_u = 1400 PSF; Torvane: S=640 PSF	
				59.3	N=2; Pocket Penetrometer: Q_u = 1400 PSF; Torvane: S=500 PSF	
		100%		54.3	N=1; N=11/6"	
24.5	Firm Gray Calcareous Slightly Clayey Silty Fine to Coarse Sand (Santee Limestone)					
29.0	Very Soft Blue Green Silty Clay (Void Filling)			49.3		
				44.3	N=Weight of Rods (29.0 to 38.0 Ft.)	
					Field Permeability Test, 38.5 to 40.0 Ft.; K=1.32 x 10^{-5} cm/sec	
38.0	Santee Limestone - No Recovery			39.3	N=45 No Recovery	

*Sand and Organic Material

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT: L = LOW DIP 0-30° — M = MED DIP 30°-60°
% ROCK CORE RECOVERY — WATER TABLE, 1 HR.
N STANDARD PENETRATION — LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. 244
DATE DRILLED 12-18-19-78
JOB NO. CH 4193
LAW ENGINEERING TESTING CO

Depth Ft.	Description	Core Size	% & Time Min.	Elev. 39.3	Remarks	% R.Q.D.
40.0	Santee Limestone - No Recovery				100%	
41.5					N= 50/½" No Recovery Drag Bit Refusal at 41.5 Ft.	
	Medium and Hard Gray Cemented Calcareous Silt, Sand, and Shell Fragments (Santee Limestone)	NQ	100	34.3	Packer Test, 43.8 to 49.0 Ft.: $K = 7.62 \times 10^{-4}$ cm/sec Crystalline Limestone (41.5 to 43.0 Ft.)	36
46.0	Very Soft and Soft Slightly Cemented Calcareous Silt, Sand and Shell Fragments (Santee Limestone)		8	29.3	Packer Test, 48.0 to 54.0 Ft.: $K = 2.94 \times 10^{-4}$ cm/sec	0
54.0	Very Dense to Dense Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			24.3	N=53	
				19.3	N=45	
60.0	Boring Terminated at 60.0 Ft. Groundwater Encountered at 7.6 Ft. 24 Hours After Boring NW Casing Set to 38.5 Ft.					

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

TEST BORING RECORD

BORING NO. 244
DATE DRILLED 12/18-19/78
JOB NO. CH 4193
LAW ENGINEERING TESTING CO

Depth Ft.	Description	Core Size	% & Time Min.	Elev. 79.7	Remarks	% R.Q.D.
0	Topsoil-Black Silty Fine to Medium*					
1.0	Gray Tan Clayey Fine to Medium Sand					
3.0	Firm Gray Brown Very Clayey Fine to Medium Sand			74.7	N=17	
7.0	Firm Gray Slightly Micaceous Fine Sandy Clay With Thin Fine Sand Seams			69.7	N=6 Pocket Penetrometer: Q_u = 1800 PSF Torvane: S=1000 PSF	
12.3	Very Dense to Dense Gray to Light Green Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			64.7	N=62	
					N=50/4"	
				59.7		
					100% N=50/5" Void (23.2 to 23.5 Ft.)	
				54.7		
				49.7	N=55	
					N=50/5" No Recovery	
				44.7		
					N=50/3" No Recovery Hard Drilling (38.7 to 40.3 Ft.)	
				39.7		

*Sand and Organic Material

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

TEST BORING RECORD

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

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV. 39.7	REMARKS	% R.Q.D.
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=50/1½" No Recovery	
				29.7	Hard Drilling (51.3 to 52.7 Ft.)	
					N=50/6" No Recovery	
				24.7		
60.0				19.7	N=48	
	Boring Terminated at 60.0 Ft. Groundwater Encountered At 9.0 Ft. 24 Hours After Boring NW Casing Set to 28.0 Ft.					

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0°–30°
N STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°–60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°–90°

TEST BORING RECORD

BORING NO. 245
DATE DRILLED 12/17-18/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

DEPTH FT.	DESCRIPTION	CORE % & SIZE	TIME MIN.	ELEV. 79.7±	REMARKS	% R.Q.D.
0	Boring Drilled to Obtain Undisturbed Sample and Conduct Permeability Test					
				74.7	Tan Gray Slightly Micaceous Very Clayey Fine to Medium Sand	
				69.7	Pocket Penetrometer, 9.0 Ft. Q_u = 2800 PSF Torvane, 9.0 Ft. S=1100 PSF	
				64.7		
					100% Field Permeability Test, 16.5 to 18.0 Ft.: No Return (150 Gallons/2 Minutes)	
18.0	Boring Terminated at 18.0 Ft.			59.7		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0°–30°
N STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°–60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°–90°

TEST BORING RECORD

BORING NO. 245A
DATE DRILLED 12-15-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

TEST BORING RECORD — Page 1 of 2

Surface Elev. 76.0

Depth Ft.	Description	Elev.	N	Remarks
0 – 1.0	Topsoil-Black Silty Fine to Medium*			
1.0 – 2.5	Gray Tan Clayey Fine Sand			
2.5 – 7.0	Firm Brown Very Clayey Fine to Medium Sand	71.0	N=12	Field Permeability Test, 2.5 to 3.5 Ft.: $K=2.47 \times 10^{-7}$ cm/sec
7.0 – 15.0	Loose Gray Silty Very Clayey Fine to Medium Sand	66.0	N=6	Field Permeability Test, 8.5 to 10.0 Ft.: $K= 7.9 \times 10^{-8}$ cm/sec
		61.0	N=6	
15.0 – 34.5	Loose to Firm Gray Fine to Coarse Sand	56.0	N=9	
		51.0	N=20	
		46.0	N=29	
		41.0	N=5/6" N=28/6"	Rounded Fine Gravel (33.5 to 34.5 Ft.)
34.5 –	Very Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)	36.0	N=50/2"	No Recovery. Hard Drilling (37.5 to 42.0 Ft.)

*Sand and Organic Material

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0°-30°
N STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 1 of 2

TEST BORING RECORD

BORING NO. 246
DATE DRILLED 12/17-18/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

TEST BORING RECORD — Page 2 of 2

Elev. 36.0

Depth Ft.	Description	Elev.	N	Remarks
40.0 – 44.0	Very Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (Santee Limestone)			Hard Drilling (43.0 to 44.0 Ft.)
44.0 – 57.0	Firm and Very Dense Dark Green Clayey Silty Fine to Medium Sand (Black Mingo Formation)	31.0	N=50/3"	
		26.0	N=22	
			N=50/4"	No Recovery
		21.0		
57.0 – 60.0	Dense Gray Slightly Clayey Silty Fine to Medium Sand (Black Mingo Formation)	16.0	N=35	

Boring Terminated at 60.0 Ft.

Groundwater Encountered At 4.5 Ft. 24 Hours After Boring

1.25" I. D., PVC Piezometer Set to 58.0 Ft.

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0°-30°
N STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 2 of 2

TEST BORING RECORD

BORING NO. 246
DATE DRILLED 12/17-18/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO

TEST BORING RECORD — Page 1 of 3

Surface Elev. 78.6

Depth Ft.	Description	Core Size / % Recovery	Elev.	N	Remarks	% R.Q.D.
0			78.6			
1.0	Topsoil-Black Silty Fine to Medium*					
2.5	Brown Silty Fine to Medium Sand With Some Roots					
	Stiff Tan Brown Gray Fine to Medium Very Sandy Clay		73.6	N=15	Pocket Penetrometer: Q_u = 8000 PSF	
7.0	Firm Tan Gray Fine Slightly Sandy Silty Clay		68.6	N=8	Pocket Penetrometer: Q_u = 2000 PSF	
11.9	Loose Tan Slightly Clayey Silty Fine to Coarse Sand With Fine Gravel		63.6	N=7	Field Permeability Test, 12.0 to 13.5 Ft.: K=1.83 x 10^{-6} cm/sec	
17.0	Firm Tan Fine to Coarse Sand With Fine Gravel		58.6	N=12		
			53.6	N=13		
26.0	Dense Gray Fine to Medium Sand With Some Gravel		48.6	N=32	Field Permeability Test, 32.0 to 33.0 Ft.: K=4.18 x 10^{-5} cm/sec	
			43.6	N=31	Driller Reported Santee Limestone at 36.0 Ft.	
36.0	No Recovery			N=50/0"	Drag Bit Refusal at 39.0 Ft.	
39.0	Soft and Medium Light Gray**	NQ 100	38.6			31

BORING AND SAMPLING MEETS ASTM D-1586 *Sand and Organic Material
CORE DRILLING MEETS ASTM D-2113 **Green Cemented Calcareous Silt, Sand
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER and Shell Fragments
FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT. (Santee Limestone)

UNDISTURBED SAMPLE — WATER TABLE, 24 HR — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

BORING NO. 247
DATE DRILLED 12/18-20/78
JOB NO. CH 4193
LAW ENGINEERING TESTING CO.

TEST BORING RECORD — Page 2 of 3

Depth Ft.	Description	Core Size / % Recovery	Elev.	N	Remarks	% R.Q.D.
40.0	Soft and Medium Light Gray Green Cemented Calcareous Silt, Sand and Shell Fragments (Santee Limestone)	NQ 100	38.6		Crystalline Limestone: 39.0 to 41.6 Ft. 48.9 to 50.2 Ft.	31
			33.6			
		94	28.6			22
			23.6			
57.0	Very Soft Dark Green Slightly Clayey, Silty Fine to Medium Sand (Black Mingo Formation)	15	18.6			0
			13.6			
66.8	Firm and Very Dense Dark Green Silty Fine to Medium Sand With Traces of Organic Material (Black Mingo Formation)			N=30		
			8.6			
			3.6	N=50/5"		
			-1.4	N=50/5"		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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 — ROCK JOINT
% ROCK CORE RECOVERY — WATER TABLE, 1 HR — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

BORING NO. 247
DATE DRILLED 12-18-20-78
JOB NO. CH 4193
LAW ENGINEERING TESTING CO

TEST BORING RECORD

Boring No. 247 — Elev. -1.4

Depth Ft.	Description	Core Size	%	Time Min.	Elev.	Remarks	% R.Q.D.
80.0	Firm and Very Dense Dark Green Silty Fine to Medium Sand With*						
82.0	Dense to Very Dense Gray Silty Fine to Medium Sand With Interbedded Thin Clay Seams (Black Mingo Formation)				-6.4	N=34	
					-11.4	N=43	
					-16.4	N=62	
96.0	Very Hard Gray Green Fine Sandy Silty Clay (Black Mingo Formation)				-21.4	N=50/3"	
98.8	Boring Terminated at 98.8 Ft.						

Groundwater Encountered At 5.2 Ft. 15 Days After Boring

NW Casing Set to 39.0 Ft.

*Traces of Organic Material (Black Mingo Formation)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT.
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 3 of 3

TEST BORING RECORD

BORING NO. 247
DATE DRILLED 12/18-20/78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO.

TEST BORING RECORD

Boring No. 248 — Elev. 81.2

Depth Ft.	Description	Core Size	%	Time Min.	Elev.	Remarks	% R.Q.D.
0	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 Micaceous Fine Sandy Clayey Silt				71.2	N=16 Torvane: S=1060 PSF Pocket Penetrometer: Q_u = 3000 PSF	
13.0	Loose Gray Slightly Silty Fine to Medium Sand				66.2	N=10	
18.0	Firm to Dense Brown to Gray Slightly Silty Fine to Coarse Sand				61.2	N=23	
					56.2	N=31	
					51.2	N=28	
					46.2	N=28	
37.5	Very Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse*					N=66	
39.5	Hard Gray Calcareous Cemented**	NQ	100		41.2	N=50/½" Drag Bit Refusal at 39.5 Ft.	100

*Sand (Santee Limestone)
**Silt, Sand and Shell Fragments (Santee Limestone)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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. — ROCK JOINT.
% ROCK CORE RECOVERY — WATER TABLE, 1 HR. — L = LOW DIP 0-30°
N - STANDARD PENETRATION — LOSS OF DRILLING WATER — M = MED. DIP 30°-60°
R.Q.D. ROCK QUALITY DESIGNATION — S = STEEP DIP 60°-90°

Page 1 of 2

TEST BORING RECORD

BORING NO. 248
DATE DRILLED 12-17-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO.

TEST BORING RECORD — Boring No. 248 (Page 2 of 2)

Ground elevation: 41.2

Depth Ft.	Description	Core % & Size	Elev.	Remarks	% R.Q.D.
40.0 – 44.5	Hard Gray Calcareous Cemented Silt, Sand and Shell Fragments (Santee Limestone)	NQ 100	36.2	Crystalline Limestone: 39.5 to 44.5 Ft. 57.0 to 59.5 Ft.	100
44.5 – 55.0	Soft Gray Calcareous Partially Cemented Silt, Sand and Shell Fragments (Santee Limestone)	100	31.2 26.2		0
55.0 – 59.5	Hard Gray Calcareous Cemented Silt, Sand and Shell Fragments (Santee Limestone)	100	21.2		77
59.5 – 60.0					

Boring Terminated at 60.0 Ft.

Groundwater Encountered At 10.2 Ft. 24 Hours After Boring

NW Casing Set to 39.5 Ft.

*Soft Green Slightly Clayey Silty Fine to Medium Sand (Black Mingo Formation)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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.
% ROCK CORE RECOVERY — WATER TABLE, 1 HR
N - STANDARD PENETRATION — LOSS OF DRILLING WATER
R.Q.D. ROCK QUALITY DESIGNATION

ROCK JOINT
L = LOW DIP 0-30°
M = MED. DIP 30°-60°
S = STEEP DIP 60°-90°

Page 2 of 2

TEST BORING RECORD

BORING NO. 248
DATE DRILLED 12-17-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO.

TEST BORING RECORD — Boring No. 249 (Page 1 of 3)

Ground elevation: 78.6

Depth Ft.	Description	Core % & Size	Elev.	Remarks	% R.Q.D.
0 – 1.5	Topsoil				
1.5 – 3.0	Black Silty Clayey Fine to Medium Sand				
3.0 – 7.0	Firm Gray Clayey Fine to Medium Sand		73.6	N=11	
7.0 – 17.0	Soft and Very Soft Gray Green Silty Clay		68.6 63.6	N=4 N=2	
17.0 – 22.0	Firm Gray Slightly Micaceous Very Clayey Fine to Medium Sand		58.6	N=13	
22.0 – 27.0	Very Dense Gray Clayey Fine to Coarse Sand		53.6	N=65	
27.0 – 38.5	Very Dense Gray Slightly Cemented Calcareous Silty Fine to Coarse Sand With Few Shell Fragments (Santee Limestone)		48.6 43.6	N=81 N=83 50/0 Drag Bit Refusal at 38.5 Ft.	
38.5 – 40.0	Medium to Hard Gray Cemented*	NQ 100	38.6		19

*Calcareous Silt, Sand and Shell Fragments (Santee Limestone)

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113
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.
% ROCK CORE RECOVERY — WATER TABLE, 1 HR.
N - STANDARD PENETRATION — LOSS OF DRILLING WATER
R.Q.D. ROCK QUALITY DESIGNATION

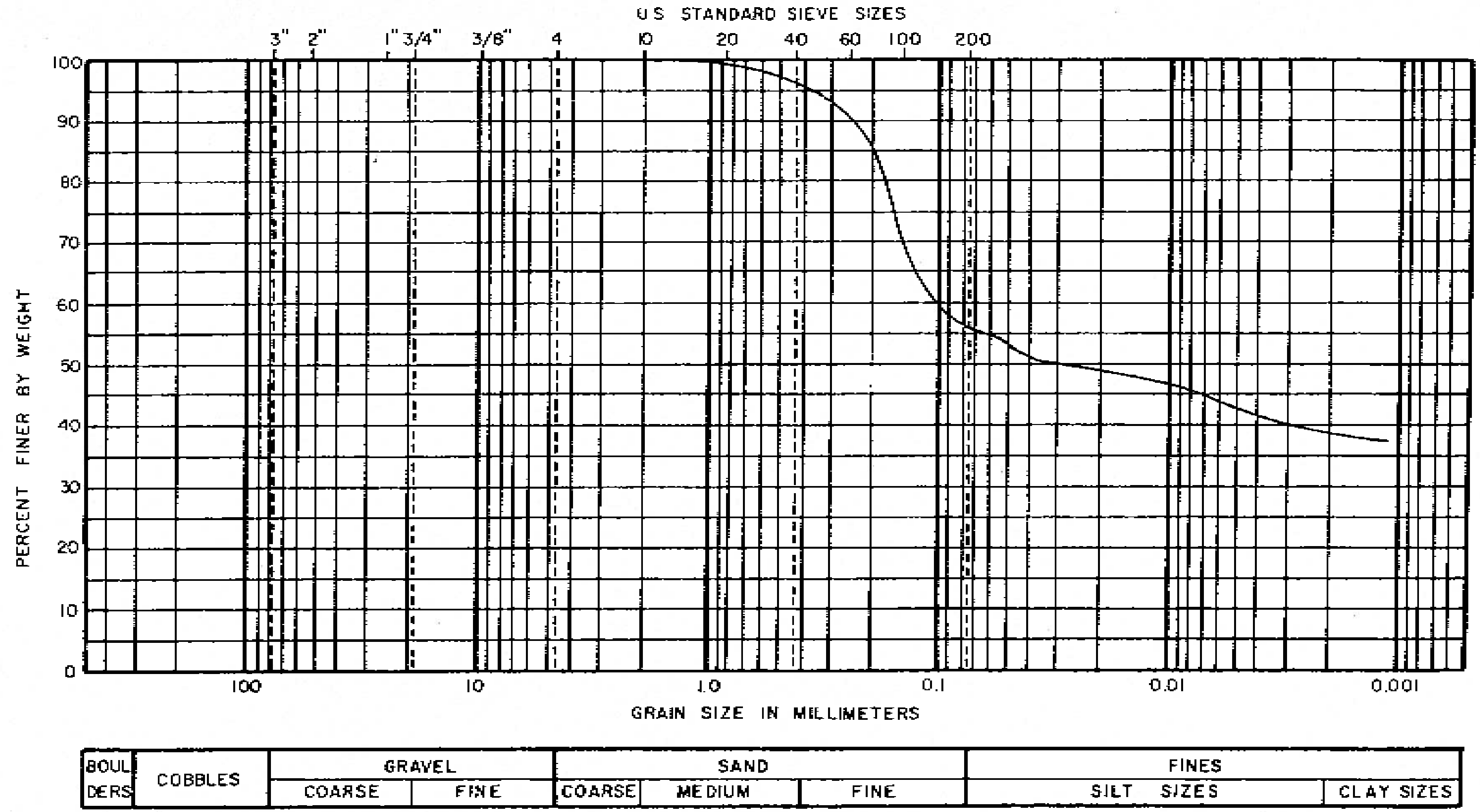
ROCK JOINT
L = LOW DIP 0-30°
M = MED. DIP 30°-60°
S = STEEP DIP 60°-90°

Page 1 of 3

TEST BORING RECORD

BORING NO. 249
DATE DRILLED 12-4-5-78
JOB NO. CH 4193

LAW ENGINEERING TESTING CO



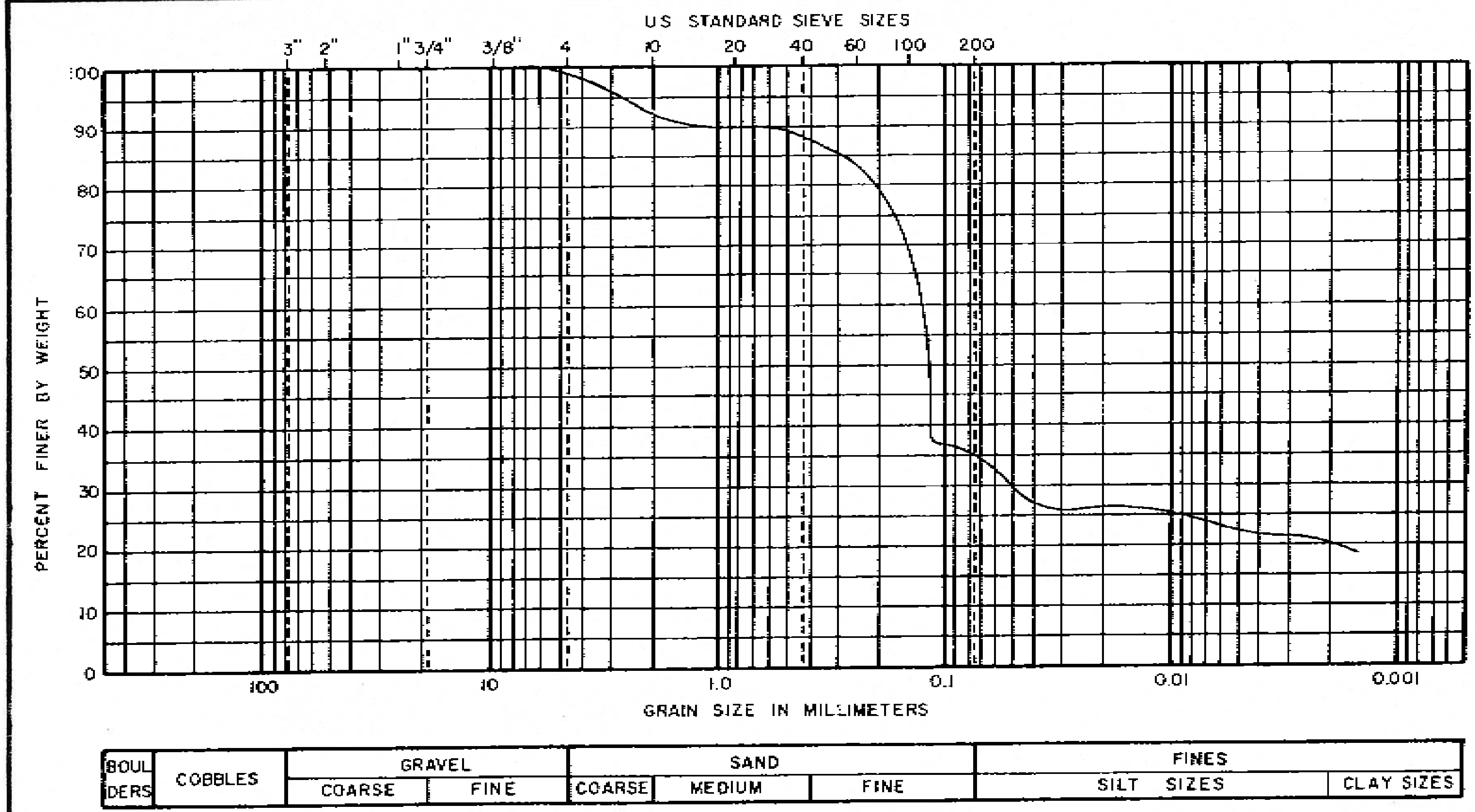
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
239	3.5 to 5.0 Ft.	25.4%				Brown Gray Silty Fine to Medium Very Sandy Clay (CL)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 3178



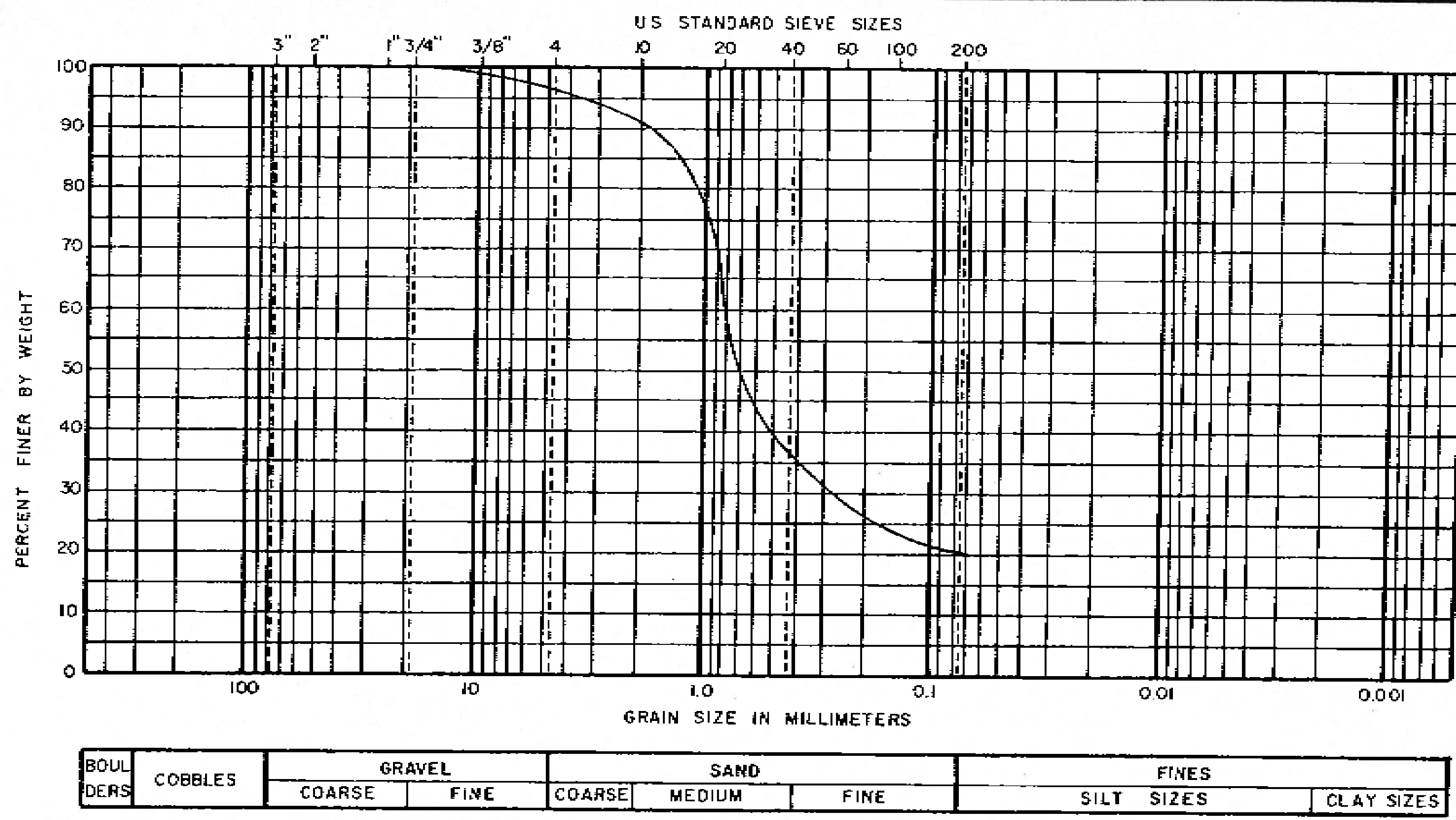
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
240	10.5 to 12.5 Ft.	26.7%			NP	Tan Gray Slightly Clayey Silty Fine to Coarse Sand With Clay Lenses (SM)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178

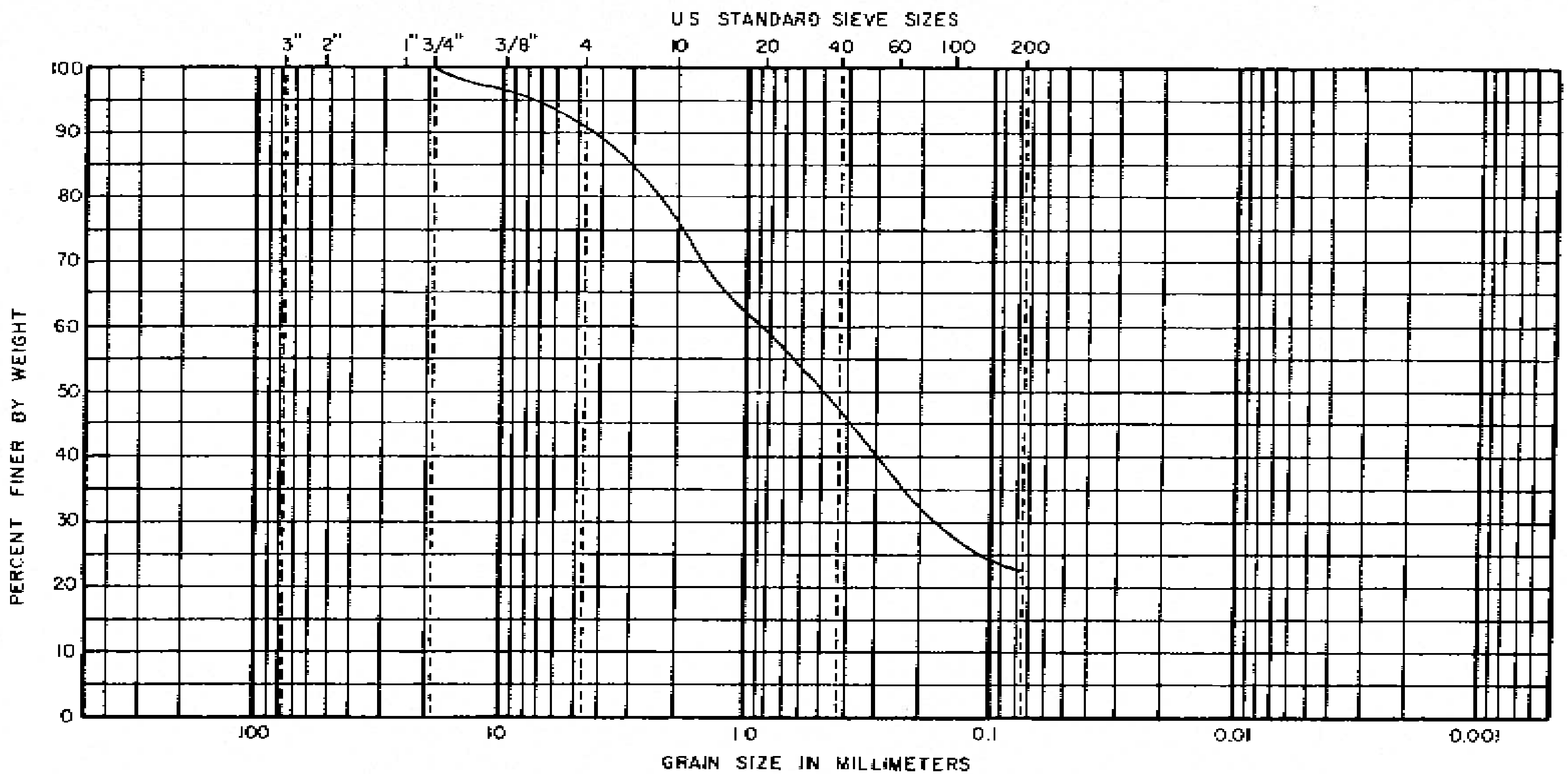


BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
243	13.5 to 15.0 Ft.	19.5%				Tan Gray Slightly Clayey Silty Fine to Coarse Sand (SM)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

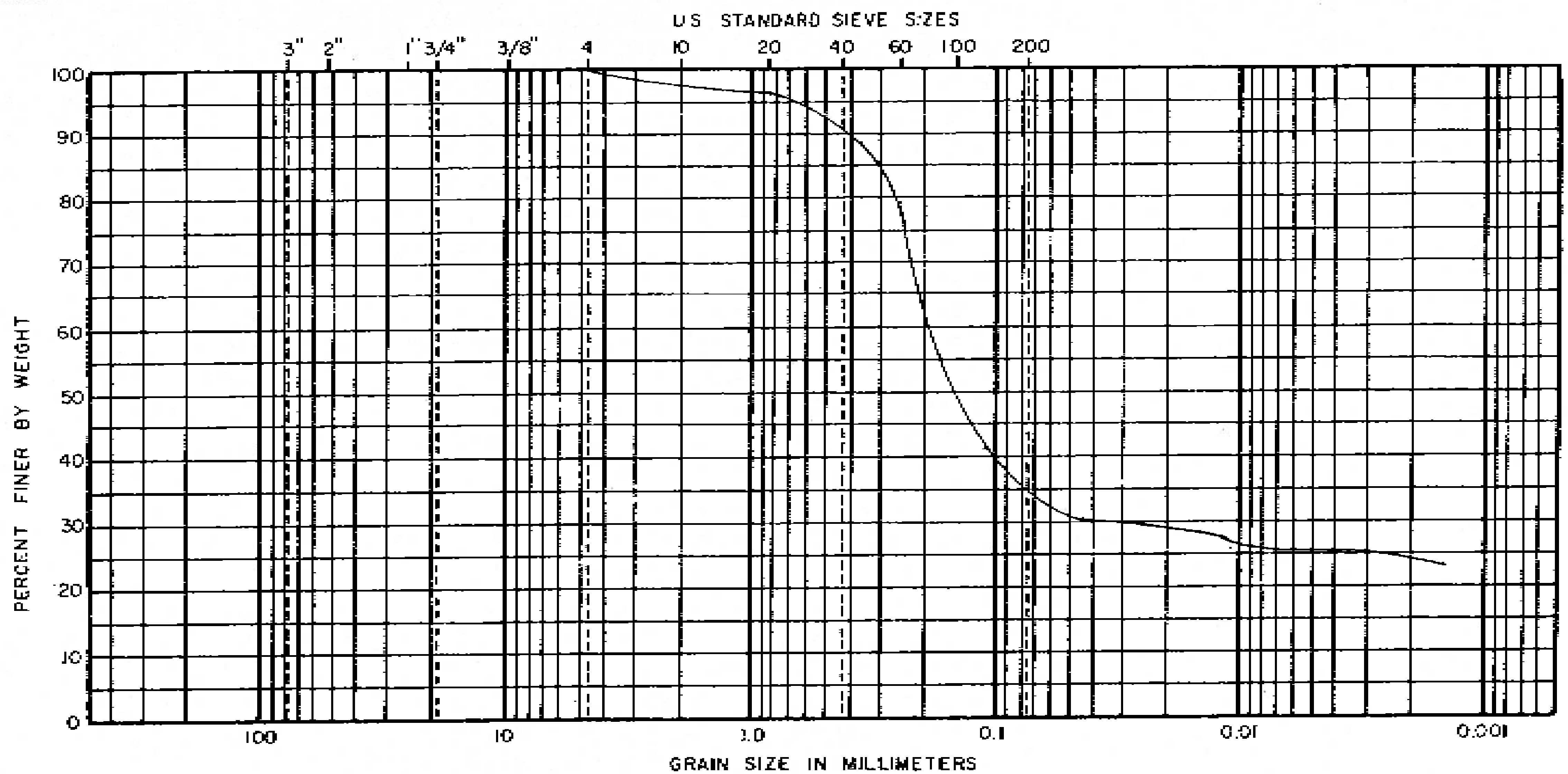
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
244	54.0 to 55.5 Ft.	24.2%				Gray Calcareous Silty Fine to Coarse Sand With Some Shell Fragments (SM)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

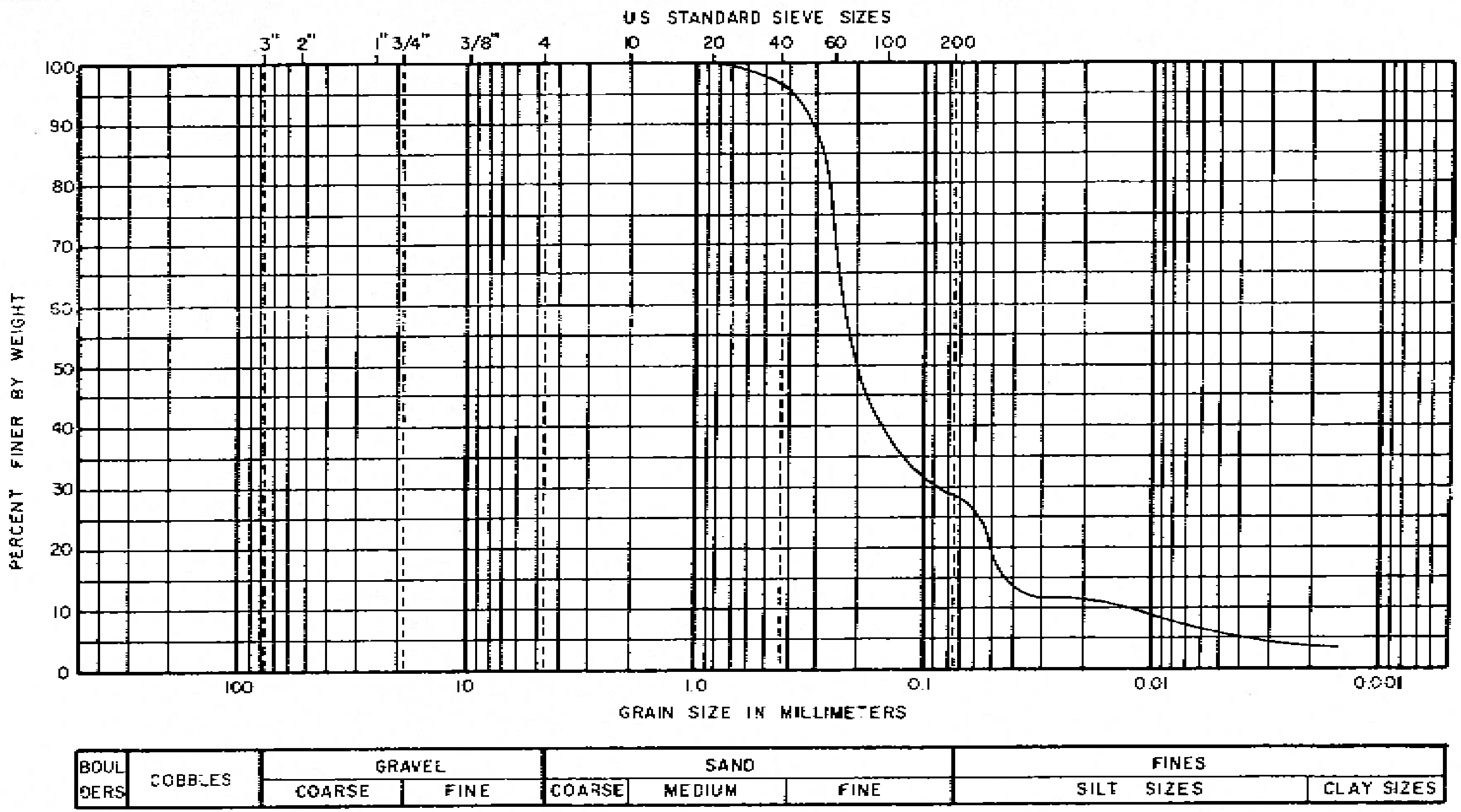
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
246	10.5 to 12.5 Ft.	24.7%				Gray Slightly Silty Clayey Fine to Medium Sand (SC)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178



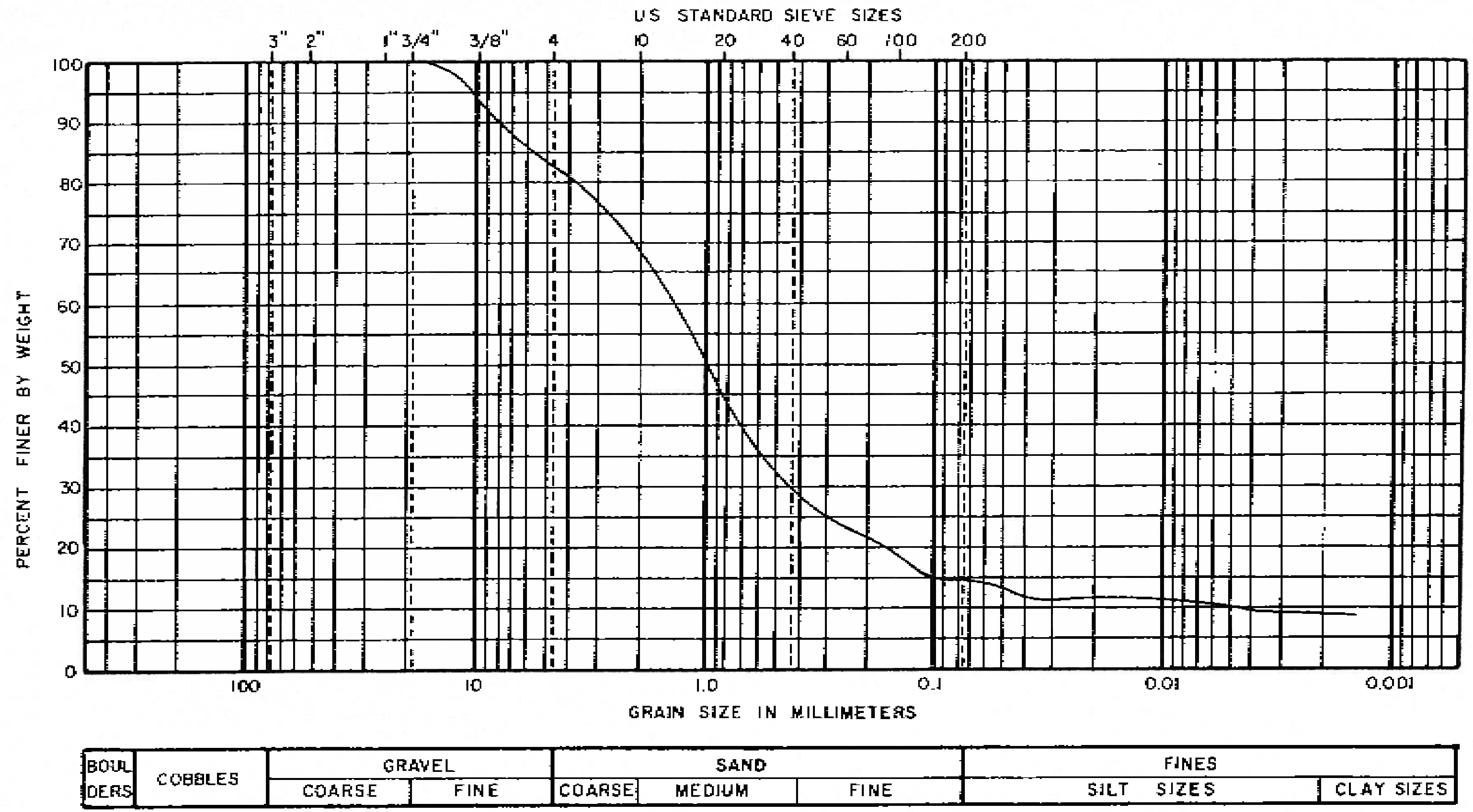
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
246	50.5 to 52.0 Ft.	21.3%				Gray Slightly Clayey Silty Fine Sand (SM)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178



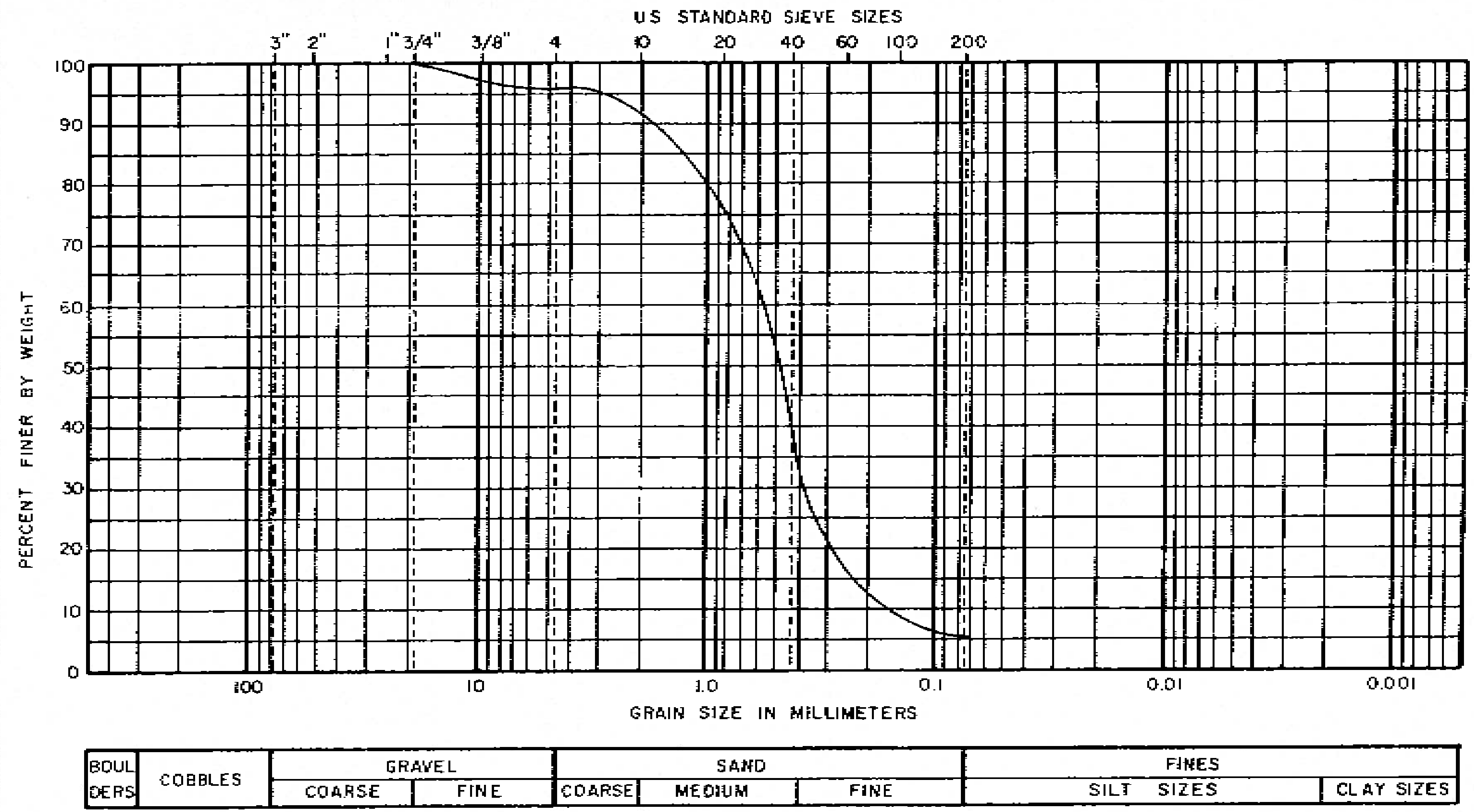
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
247	12.0 to 13.5 Ft.	31.9%				Tan Slightly Clayey Slightly Silty Fine to Coarse Sand With Fine Gravel (SC-SM)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178



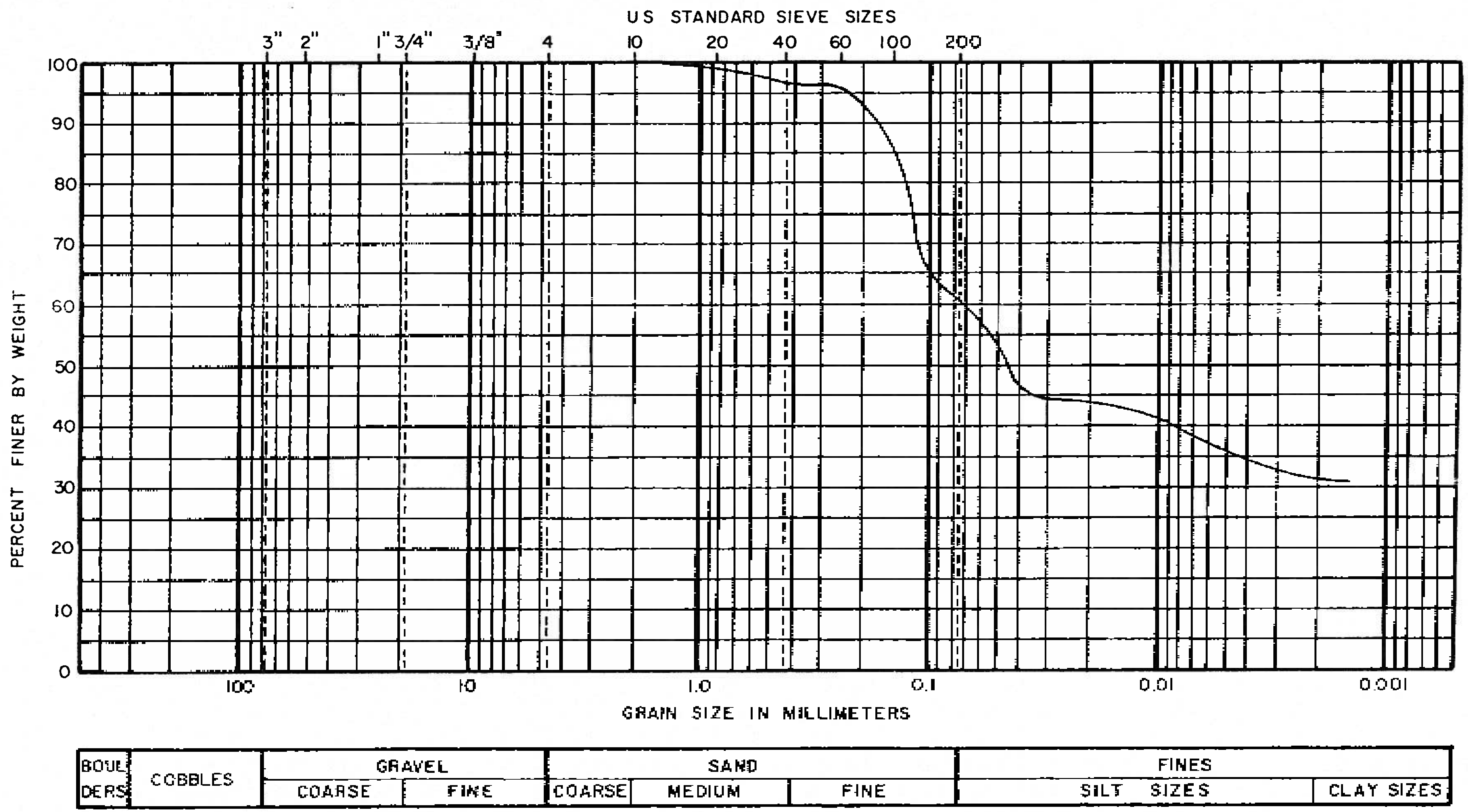
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
247	33.5 to 35.9 Ft.	[illegible]				Gray Slightly Silty Fine to Coarse Sand With Some Fine Gravel (SP)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

DUNCAN-PARNELL, INC., CHARLOTTE 1178



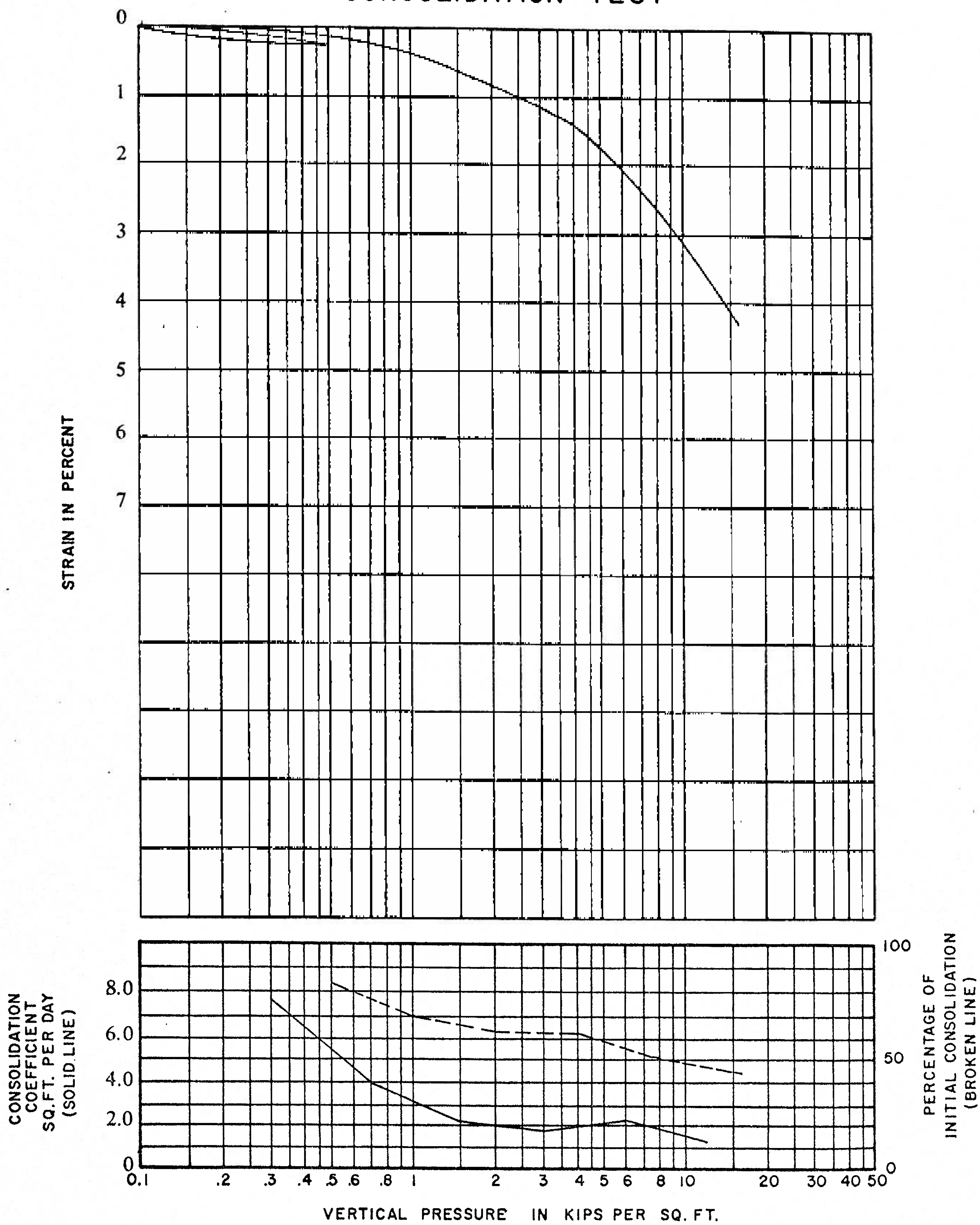
BORING NO.	ELEV. OR DEPTH	NAT. W.C.	L.L.	P.L.	P.I.	DESCRIPTION OR CLASSIFICATION
248	8.5 to 10.0 Ft.	41.9%				Gray Tan Slightly Micaceous Fine Sandy Clayey Silt (MH)

GRAIN SIZE DISTRIBUTION

JOB NO. CH 4193

LAW ENGINEERING TESTING COMPANY

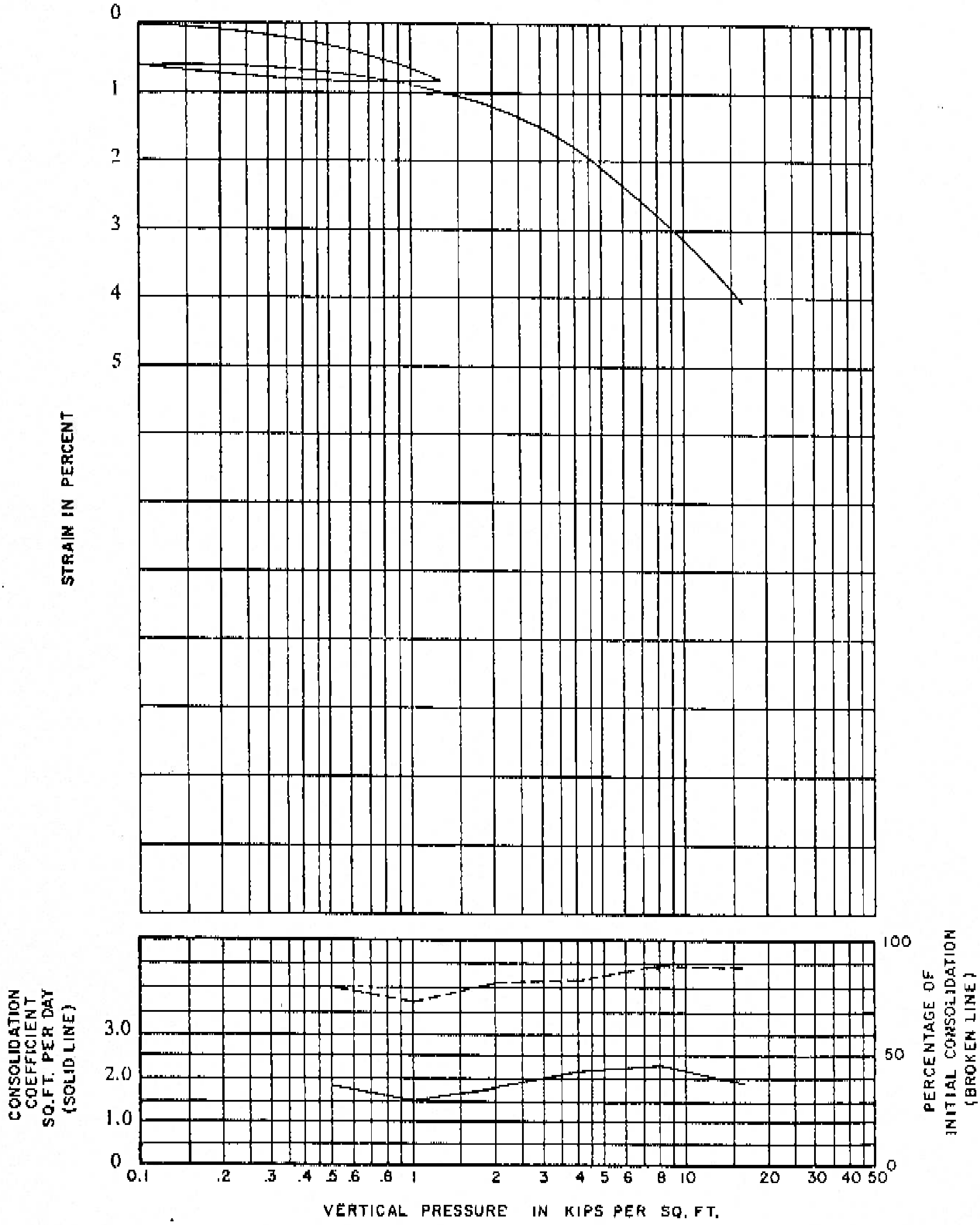
LAW ENGINEERING TESTING CO.
CONSOLIDATION TEST



COMPRESSION INDEX 0.01 @ 12 KSF
UNIT WEIGHT 119.0 PCF (Wet) 94.9 PCF (Dry)
WATER CONTENT 25.4%
SATURATION 88.8%

JOB NO. CH 4193
BORING NO. 239A
ELEV. OR DEPTH 3.5'-5.5'
SAMPLE TYPE UD

LAW ENGINEERING TESTING CO.
CONSOLIDATION TEST

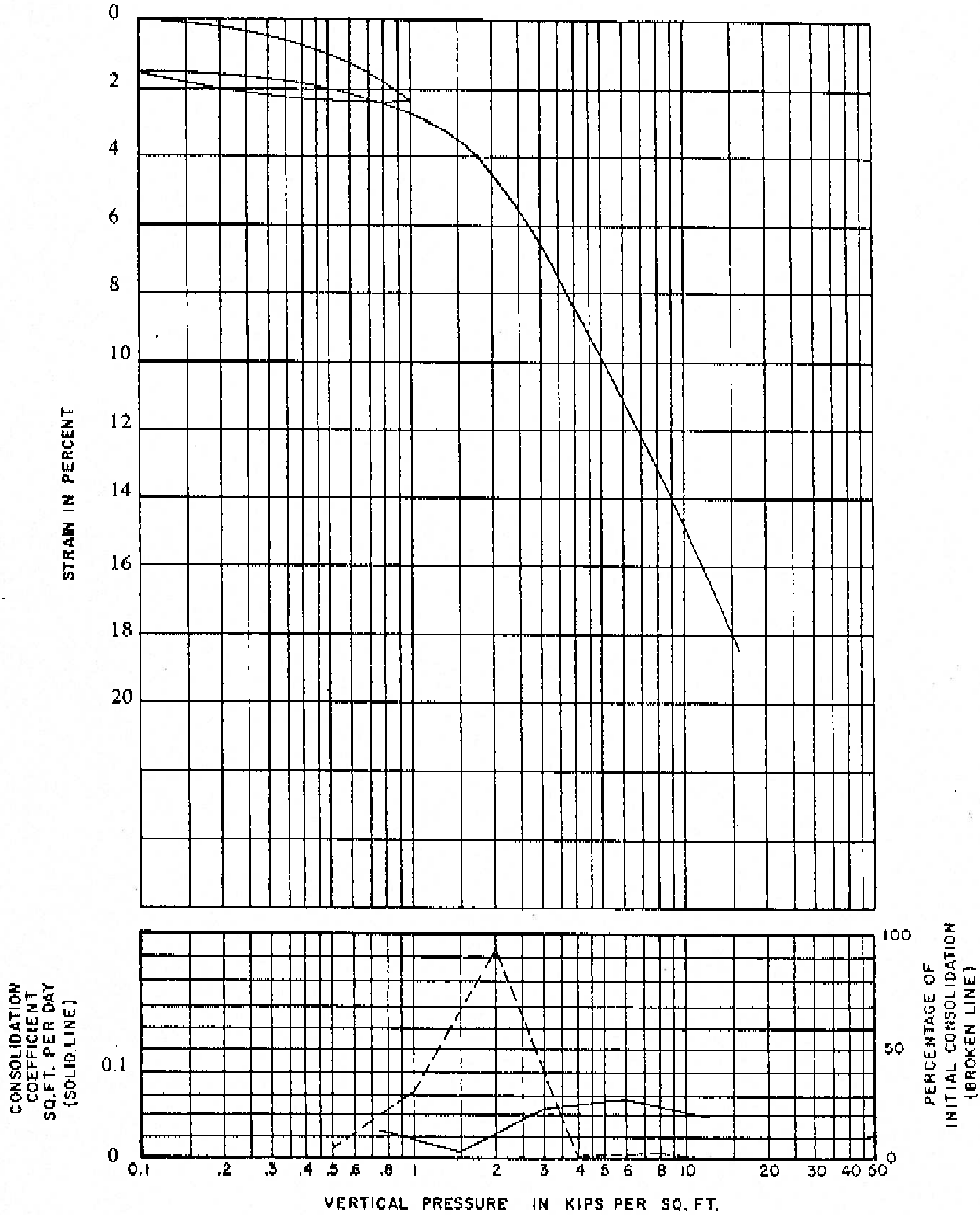


COMPRESSION INDEX 0.07 @ 16 KSF
UNIT WEIGHT 123.8 PCF (Wet) 97.7 PCF (Dry)
WATER CONTENT 26.7%
SATURATION 100%

JOB NO. CH 4193
BORING NO. 240
ELEV. OR DEPTH 10.5'-12.5'
SAMPLE TYPE UD

LAW ENGINEERING TESTING CO.

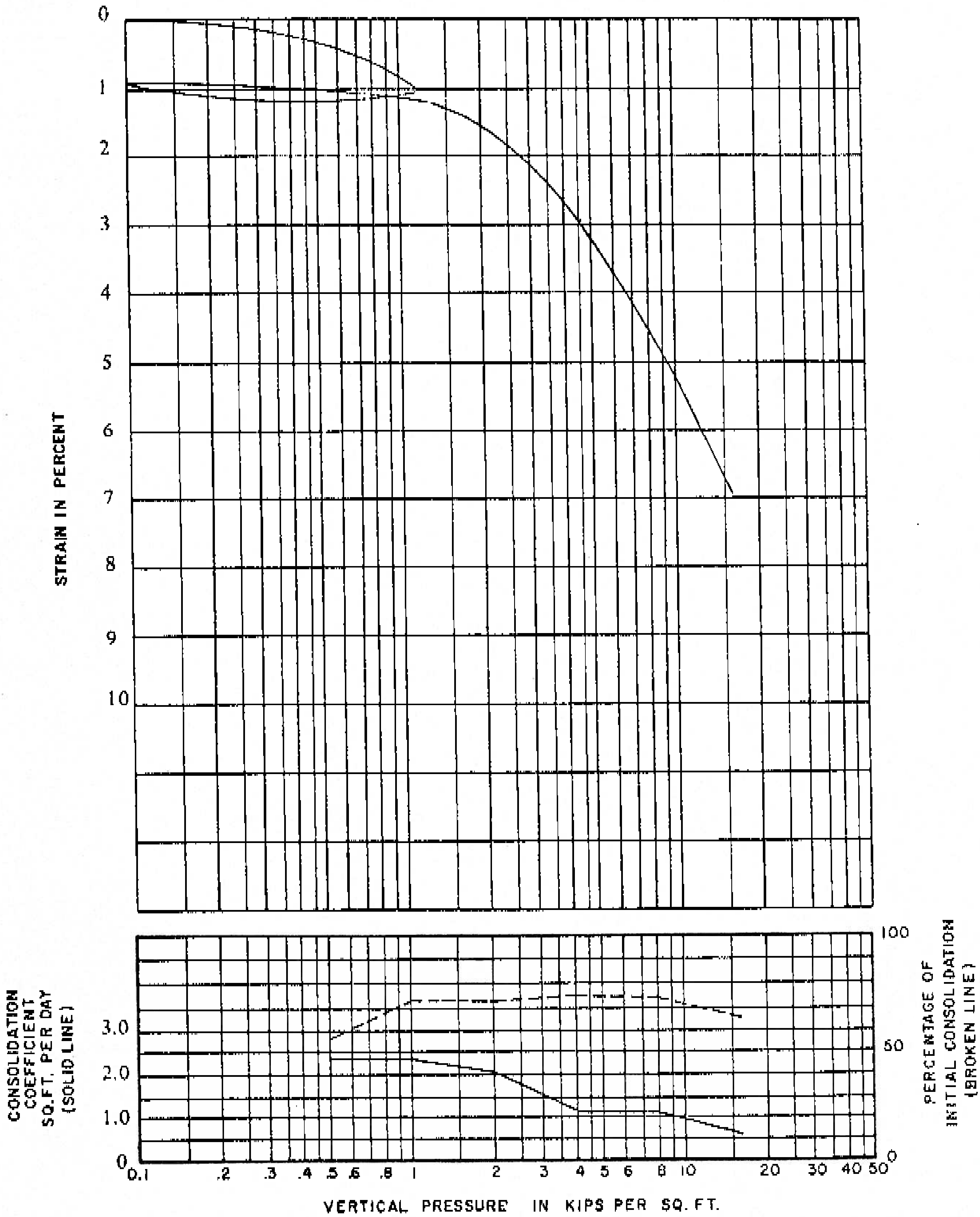
CONSOLIDATION TEST



COMPRESSION INDEX 0.38 @ 12 KSF
UNIT WEIGHT 108.2 PCF (Wet) 78.2 PCF (Dry)
WATER CONTENT 38.3%
SATURATION 90.9%

JOB NO. CH 4193
BORING NO. 244
ELEV. OR DEPTH 15'-17.5'
SAMPLE TYPE UD

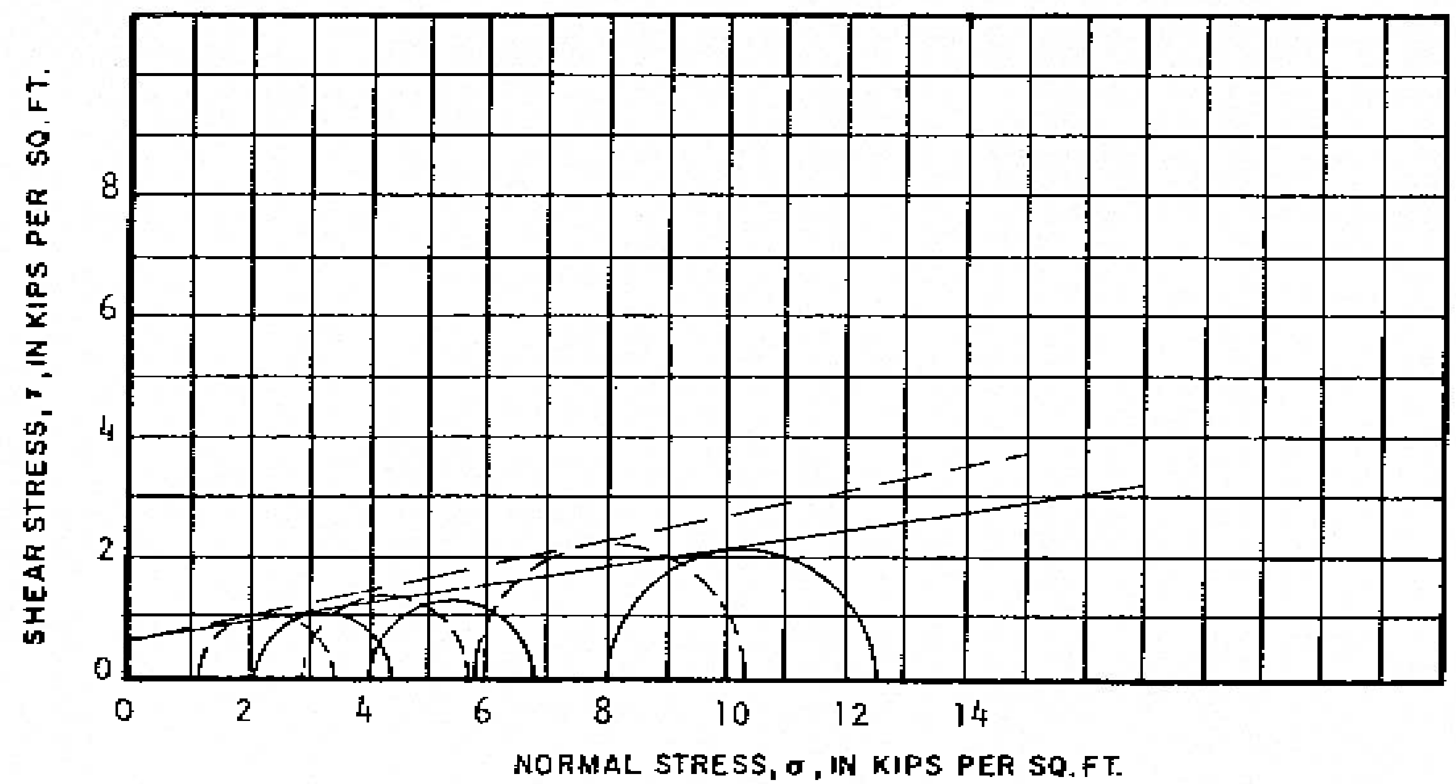
LAW ENGINEERING TESTING CO.
CONSOLIDATION TEST



COMPRESSION INDEX 0.11 @ 16 KSF
UNIT WEIGHT 133.9 PCF (Wet) 112.1 PCF (Dry)
WATER CONTENT 19.4%
SATURATION 100%

JOB NO. CH 4193
BORING NO. 245A
ELEV. OR DEPTH 7'-9'
SAMPLE TYPE UD

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

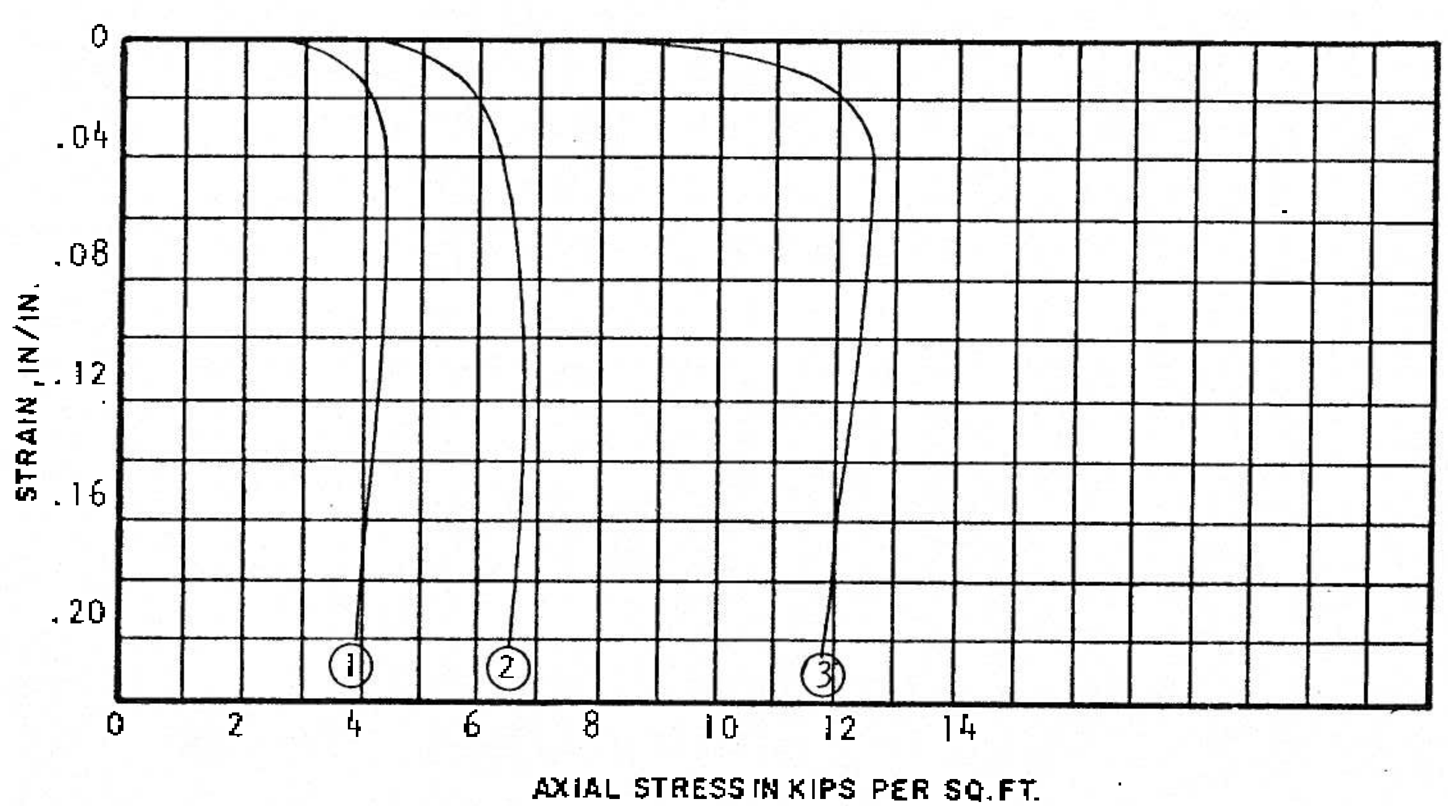
EFFECTIVE COHESION, c' 630 psf
EFFECTIVE SHEAR ANGLE, φ' 12°
TOTAL COHESION, c 630 psf
TOTAL SHEAR ANGLE, φ 9.1°

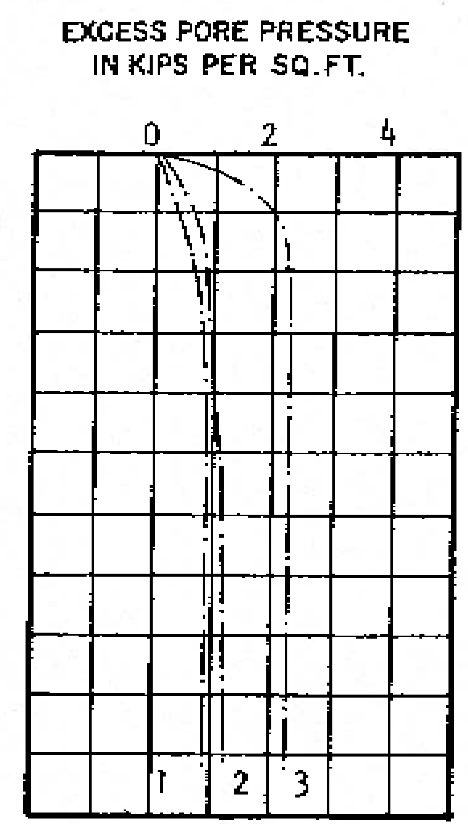
INITIAL PROPERTIES:

	①	②	③	AVG.	
UNIT WEIGHT γ	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, γ	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	100	%





STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

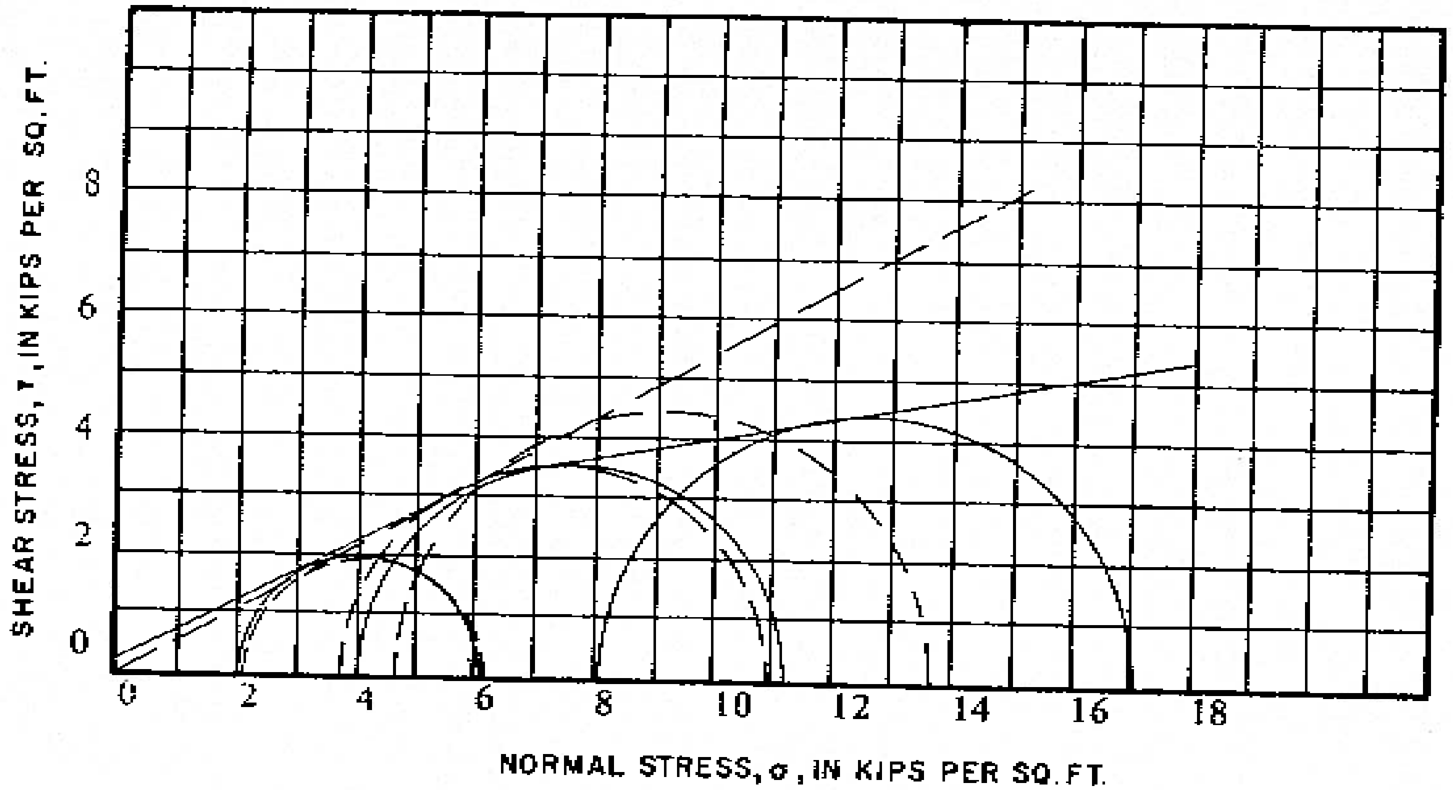
SAMPLE DESCRIPTION:
Very Soft Gray Tan Fine Sandy Silty Clay (CL)

TOTAL STRESSES ————
EFFECTIVE STRESSES — — —

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

JOB NO. CH 4193 BORING NO. 244
DEPTH 15.5'-17.5' SAMPLE TYPE UD

LAW ENGINEERING TESTING COMPANY



MOHR DIAGRAMS

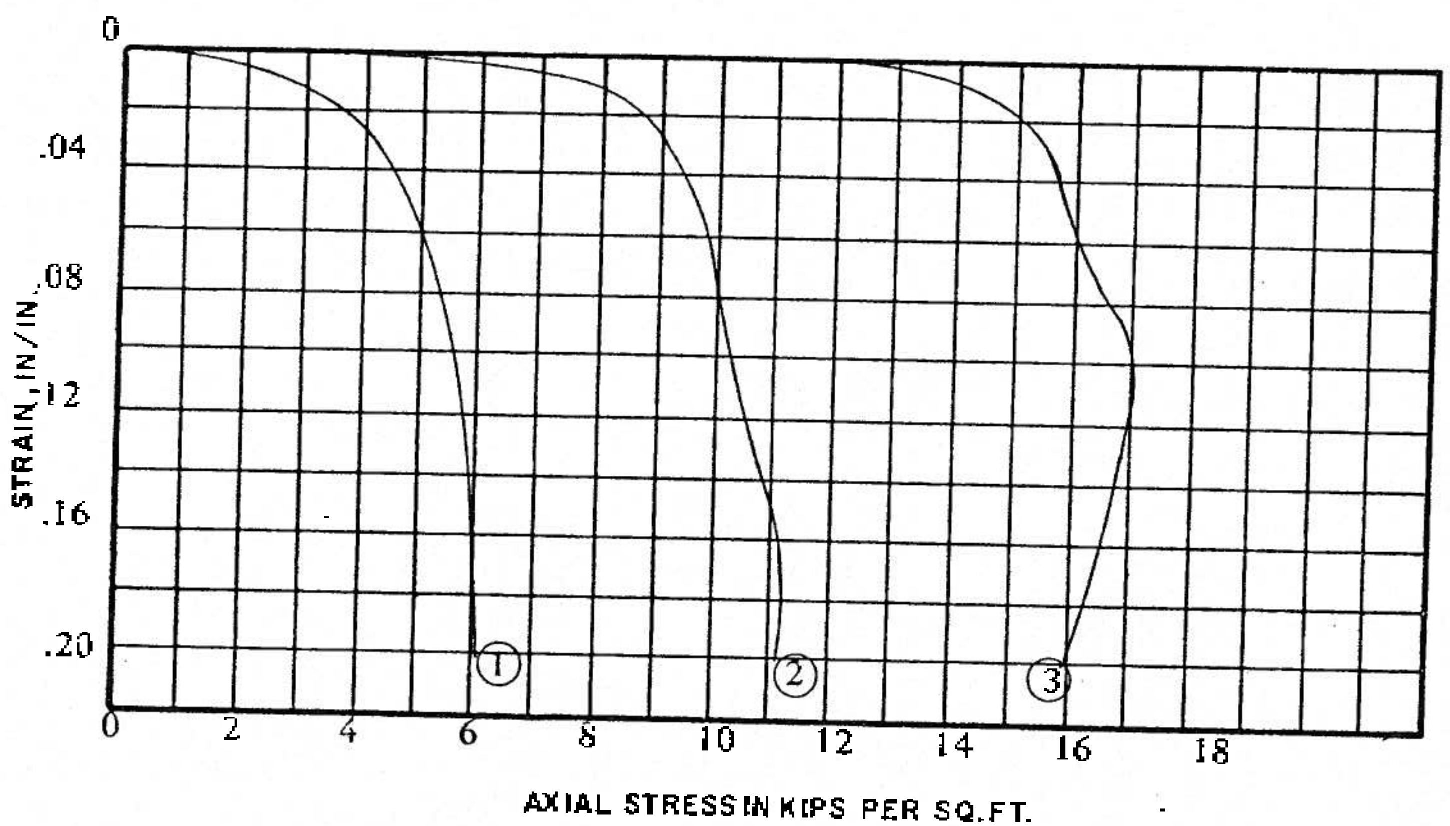
EFFECTIVE COHESION, c' 0
EFFECTIVE SHEAR ANGLE, φ' 28.5°
TOTAL COHESION, c 200 psf
TOTAL SHEAR ANGLE, φ 26.6° 9.5° above 6.25 ksf

INITIAL PROPERTIES:

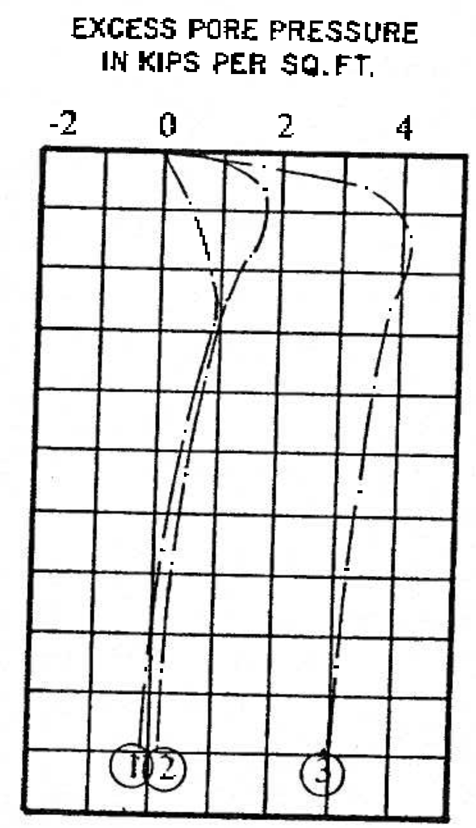
	①	②	③	AVG.	
UNIT WEIGHT γ	130.3	132.0	134.4	132.2	pcf
WATER CONTENT, w	20.7	20.1	19.3	20.0	%
VOID RATIO, e	0.527	0.499	0.463	0.496	
SATURATION, s	100	100	100	100	%

FINAL PROPERTIES:

	①	②	③	AVG.	
UNIT WEIGHT, γ	130.3	131.7	134.8	132.3	pcf
WATER CONTENT, w	19.2	18.0	15.6	17.6	%
VOID RATIO, e	0.508	0.476	0.413	0.466	
SATURATION, s	100	100	100	100	%



STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES



SAMPLE DESCRIPTION: Loose Tan Gray Slightly Micaceous Very Clayey Fine to Medium Sand (SC)

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

Appendix A Doc 07: Cross GS Volume 2 Appendices –

Unit 2 Subsurface Investigation

FIRST UNIT

VOLUME TWO - APPENDICES

UNIT ~~1~~ 2 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
80C4090

Report 2

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 Structural Information

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 freeboard. 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 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 Subsurface Conditions

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, 1 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.

2. 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 Voids

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 Materials of Construction

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 1.7×10^{-8} cm/sec to 8.7×10^{-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 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.

Liner Material	Estimated Maximum Rate of Seepage	Remarks
natural soil	$4x10^{-4}$ gpm/ft	4 ft thick liner
bentonite - soil mixtures	$6x10^{-5}$ 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^2 over a membrane, and an apparent savings of about $0.40/ft^2 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^2 and the future pond area would total about 4,000,000 ft^2. A savings of $.50/ft^2 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 on-site 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:

1. 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.

*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 $\$1/ft^2$ to $\$2/ft^2$.

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 accelerated 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/ft^2 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. The 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^2/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.

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 summarized below:

Height of Embankment, Ft	Calculated Factor of Safety	Type of Analysis
19 (5 ft of excavation in pond interior)	2.24	undrained strength
24 (no excavation in pond interior)	1.68	undrained strength
24	2.45	drained strength with seepage

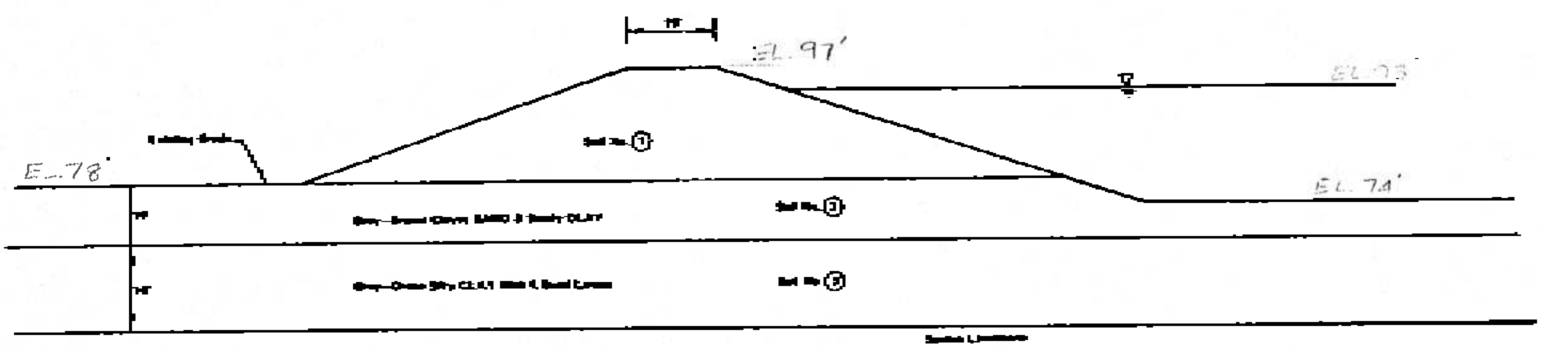
3.8 LIMITATIONS

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 ($\pm$ 1 standard deviation) of foundation movement. Consequently, movements greater than or less than those indicated are possible.

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.

CASE [illegible]



ABOVE EXISTING

CASE	TYPE OF ANALYSIS	HEIGHT OF EMBANKMENT	FACTOR OF SAFETY	BOTTOM OF FAILURE CIRCLE IS IN SOIL NO.
1	"φ = 0"	[illegible]	[illegible]	[illegible]
[illegible]	"φ = 0"	24	[illegible]	[illegible]
[illegible]	DRAINED (EFFECTIVE STRESS)	24	[illegible]	[illegible]

SOIL PROPERTIES

SOIL NO.	CASE 1		CASE 2		CASE 3	
	c psf	φ°	c psf	φ°	c psf	φ°
1 T = [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] T = [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] T = [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HORIZONTAL & VERTICAL SCALE

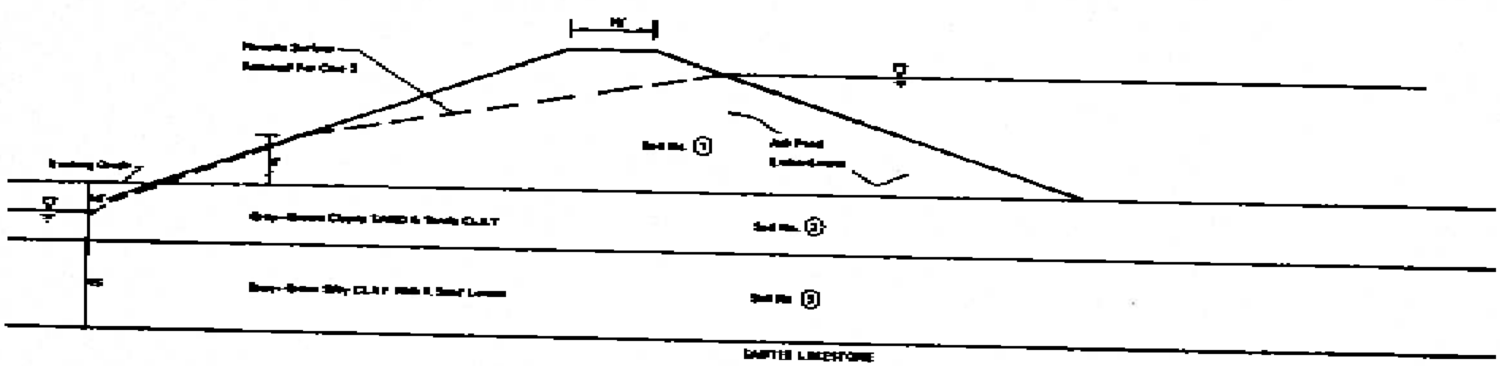
1 OF [illegible]

SUMMARY OF EMBANKMENT STABILITY ANALYSIS
SANTEE COOPER CROSS GENERATING STATION
CROSS, SOUTH CAROLINA

WOODWARD-CLYDE CONSULTANTS, INC
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	[illegible]	SCALE:	AS SHOWN	PROJECT NO.:	[illegible]
CH'D. BY:	[illegible]	DATE:	[illegible]	FIG. NO.:	[illegible]

CASES 2 & 3



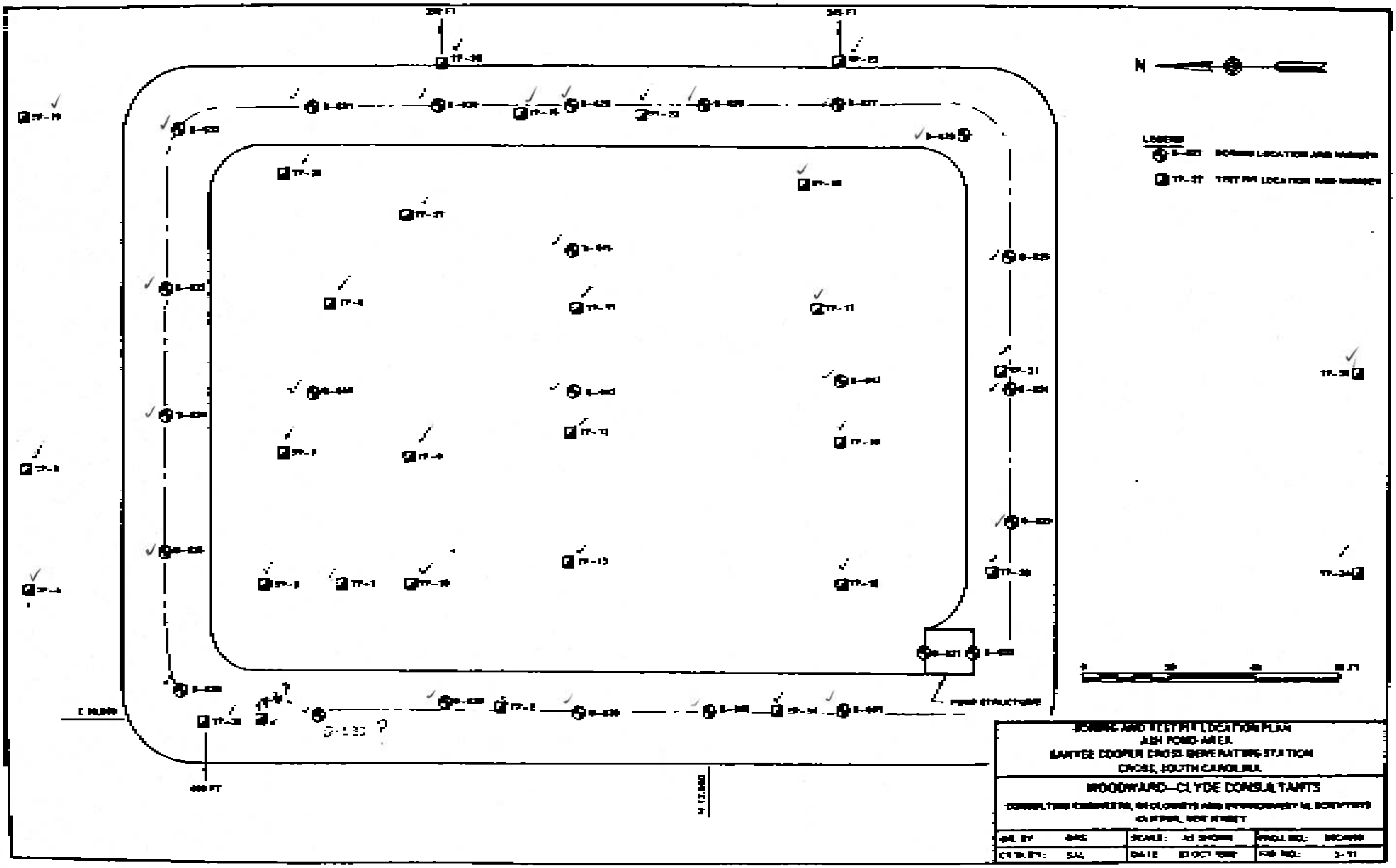
2 OF 2

SUMMARY OF EMBANKMENT STABILITY ANALYSIS
SANTEE COOPER CROSS GENERATING STATION
CROSS, SOUTH CAROLINA

WOODWARD–CLYDE CONSULTANTS, INC

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:		SCALE:	AS SHOWN	PROJ. NO.:	
CK'D. BY:		DATE:		FIG. NO.:	


N
LEGEND
PUMP STRUCTURE
BORING AND TEST PIT LOCATION PLAN
ASH POND AREA
SANTEE COOPER CROSS GENERATING STATION
CROSS, SOUTH CAROLINA
WOODWARD-CLYDE CONSULTANTS
SCALE: AS SHOWN

BORING LOGS

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LOG OF BORING B-621 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.86 ft MSL	PROJECT NO.: 80C4080C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 14 July 1980	DATE FINISHED: 15 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 66.5 ft	ROCK DEPTH: 25.7 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 17	UNDIST 1; CORE --
CASING: 4" "Flush Joint"		WATER LEVEL: FIRST ---	COMPL. ---; 24 HR 5.0 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Dk gray to lt gray f-SAND, loose (dry)		1	S-1	1.0	2 6 4					
(2.0 ft)	75.8	2								
Gray & yellow brn f-sandy CLAY w/occ. lenses of silty f-sand, firm (moist)		3	S-2	1.3	3 3 2					
Dk gray CLAY w/lenses of brn/tan sandy clay, firm (moist)		4–6	S-3	1.5	3 2 3					
Lt brownish gray CLAY w/ lenses of silty f-sand, firm (moist)		7–8	S-4	1.4	2 2 2					
Gray & brn (mottled) CLAY w/lenses of lt gray silty f-sand, loose (moist)		9–11	S-5	1.5	1 3 2					
Dk gray CLAY w/lenses (16.2 ft)	61.7	12–16	S-6	1.5	1 2 6					
Bottom 4": Lt gray silty f-SAND (16.8 ft)	61.1	17								
Dk gray CLAY, highly plastic, soft (moist)		18–19	UD-1	2.5	PUSH					
Dk gray CLAY w/frequent		20	S-7	1.5	1					

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LOG OF BORING B-621 | SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST. BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
seams of lt gray silty f. SAND, soft. (moist)		21	S-7	1.5	1 2					
		22								
		23								
		24								
Top 2": Dk gray f-c sandy CLAY, some lt grey limestone rock fragments, tr silt (wet) (25.7 ft)	52.2	25	S-8	1.0	1 31 43					14 July 1980 15 July 1980
Bottom 4": Lt gray f-c calcareous clayey SAND, same limestone rock fragments, tr silt, v.dense, (wet) (decomposed rock)		26								
		27								
		28								
		29								
t gray clayey calcareous SAND, some coarse sand tr limestone rock fragments, v.dense (moist) (decomposed rock)		30	S-9	1.5	30 32 41					Bottom 1": hard
		31								
		32								
		33								
		34								
Lt gray silty, calcareous f-c SAND, some limestone rock fragments, tr clay, v. dense, (decomposed rock) (moist to wet)		35	S-10	1.1	41 61 54					
		36								
Lt gray silty calcareous f-c SAND, some limestone rock fragments, tr clay, v. dense (decomposed rock) (wet)		37	S-11	0.1	60/[illegible]					
		38								
		39								
Lt gray silty calcareous f-SAND, some limestone rock fragments, tr clay, v.dense, (decomposed rock) (wet to moist)		40	S-12	1.5	41 63 52					
		41								
		42								
		43								
		44								
		45								

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LOG OF BORING B-621 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray clayey f-m SAND & limestone rock fragments tr c-sand, tr silt, v.dense (decomposed rock) (wet)		46	S-13	1.2	55 53 103					
		47								
		48								
		49								
Lt gray clayey f-m SAND, some silt, tr limestone rock fragments, c-sand, v. dense (decomposed rock) (wet)		50	S-14	1.3	20 26 34					
		51								
		52								
		53								
		54								
Lt gray clayey f-c SAND, some silt, tr limestone rock fragments, v.dense, (decomposed rock) (wet)		55	S-15	1.0	43 34 53					
		56								
		57								
		58								
	17.9	59								
Dk grayish green SAND, some silt, v.dense (wet)		60	S-16	1.4	32 43 47					
		61								
		62								
		63								
		64								
Dk grayishgreen f-m silty SAND, some clay, tr shells, dense (wet)		65	S-17	1.0	16 21 26					A hard lense found from approx. 64.8 ft to 65.0 ft
		66								
Boring terminated at 66.5'		67								
		68								
		69								
		70								

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LOG OF BORING B-622

SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.03 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 15 July 1980	DATE FINISHED: 16 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 56.1 ft	ROCK DEPTH: 24.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 10	UNDIST -- ; CORE 20.0 ft
CASING:		WATER LEVEL: FIRST --	COMPL -- ; 24 HR 5.9 ft
CASING HAMMER: WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER: WEIGHT 140 LBS	DROP 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT	REMARKS
Top 6": Dk brn f-SAND, some veg. roots (dry) Bottom: Lt brn-gray f-SAND some silt, tr veg., m. dense (dry) (2.0 ft)	76.0	1	S-1	1.0	1 10 10					
Dk gray & yell. brn (mottled) CLAY, some silt, tr f. sand, firm (dry)		3	S-2	1.5	3 3 4					
[illegible]k & lt gray & yellowish brn (mottled) silty CLAY, some fine sand, firm (moist) (7.5 ft)	70.5	6	S-3	1.5	2 3 3					
Lt gray to lt yellow brn silty CLAY, clayey SILT, some f-sand, tr roots, firm (moist)		8	S-4	1.1	1 2 3					
Lt gray clay										Lt gray return at approx. 9.5 ft
Lt gray to tan silty CLAY & clayey SILT, some f-sand firm. (moist)	64.5	11	S-5	1.2	2 2 3					
Dk gray CLAY, tr silt, f-sand, plastic (moist)		16	S-6	1.5	2 2 4					

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LOG OF BORING B-622 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk gray & yellowish brn silty CLAY, some f-sand, v.soft		21	S-7	1.5	0 0 2					
(24.0 ft)	54.0	24								
Lt gray silty, calcareous f.SAND, some clay, limestone rock fragments (decomposed rock) (moist)		26	S-8	1.2	2 1 1					WATER LOST BET. 24.0 ft & 27.5 ft
[illegible] gray clayey calcareous f-SAND, some limestone rock fragments, tr silt (moist) v.dense (decomposed rock)		31	S-9	1.0	19 21 29					
Lt gray & black clayey fine calcareous SAND, some limestone rock fragments, tr silt, v.dense (moist) (decomposed rock)										
(36.1 ft)	41.9	36	S-10	1.0	28 31 50/5					Driving casing to 36.0 ft Changed to coring at 36.1 ft 16 July 1980
Gray, deeply to mod. weathered fossiliferous LIMESTONE, closely to intensely fractured.		37–41				Run-1	100%	72%	1.0	
Gray, deeply weathered fossiliferous LIMESTONE, mod. to closely fractured, locally crushed.		41–45				Run-2	100%	66%	8/5 ft= 1.6	

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LOG OF BORING B-622

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		45–46				R-2	100	66		
Gray deeply weathored fossiliferous LIMESTONE, mod. to closely fractured, locally intensely fractured		46–51				Run-3	98%	54%	0.8	
Gray-lt gray deeply weathored to locally decomposed fossiliferous LIMESTONE mod. fractured to slightly locally intensely fractured		51–56				Run-4	100%	78%	0.8	
Boring terminated at 56.1'		56–70								

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LOG OF BORING B-623 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.66 ft MSL	PROJECT NO: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 16 July 1980	DATE FINISHED: 18 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 55.0 ft	ROCK DEPTH: 28.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 9	UNDIST 2; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL --; 24HR 4.0 ft
CASING HAMMER: WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER: WEIGHT 140 LBS	DROP 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk brn, silty f-SAND, tr clay, veg., decomposed, wood loose (dry)		0–1.5	S-1	1.0	2 3 3					
(2.5 ft)	75.2	2.5								
Dk gray brn to yellowish/tannish brn (mottled), f-sandy CLAY, some silt, stiff (dry)		3	S-2	1.5	3 4 5					
Dk to lt brn & yellow brn (mottled) f.sandy CLAY & clayey f-SAND, some silt, v.stiff (dry)		5.5	S-3	1.5	7 8 8					
Lt grayish brn & lt brn silty CLAY, some f. sand, tr. decomposed wood, firm (moist)		8	S-4	1.5	2 3 4					Frequent seams of brown silt in S-4
Lt greenish gray & lt brn f.sandy CLAY, some silt, firm (moist)		9	S-5	1.4	3 3 4					
Lt green gray & lt brn CLAY some f.s, tr silt (moist) 12.5 ft	65.2	12.5								
Bottom 12": Lt green gray & lt brn CLAY, freq. f.sand seams, occ. c-sand, seams, stiff (moist)		12.5	S-6	1.3	1 2 7					
Top: As above Bottom: Dk gray CLAY, some f-sand seams (moist)		14	UD-1	2.5	PUSH					
Dk green-gray CLAY, highly plastic		16	S-7	1.5	1 2 2					
As above		18	UD-2	2.5	PUSH					

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LOG OF BORING B-623 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
(22.5 ft)	55.2	21–22.5								
Dk greenish gray clayey silty f-c SAND, some shell, tr f. gravel (moist)		25–26.5	S-8	1.5	0 1 2					
(28.0 ft)	49.7	28								
t gray silty f-SAND, some clay, tr fossiliferous LIMESTONE fragments, v.dense (moist)		30–31.5	S-9	1.3	15 22 40					
(35.0 ft)	42.7	35								Refusal at 35.0 ft
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, mod. to closely fractured, occ. sm. vugs.		35–37.5			50/0	Run-1	92%	72%	6 min/2.5ft	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.		37.5–42.5				Run-2	100%	80%	1.4	
Lt gray deeply weathered to locally decomposed fossiliferous LIMESTONE, mod. to closely fractured.		42.5–45				Run-3	100%	62%	1.8	

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LOG OF BORING B-623 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46–47.5				Run-3	100%	62%	1.8	
Lt gray to gray, deeply weathered to decomposed fossiliferous LIMESTONE, closely to mod. fractured, locally crushed		47.5–52.5				Run-4	90%	44%	1.0	
Lt gray, decomposed to deeply weathered fossili- ferous LIMESTONE, mod. to closely fractured.		52.5–55				Run-5	2.5/25=100	1.1/2.5=44	1.0	
Boring terminated @ 55.0'		55–70								

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LOG OF BORING B-624

SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.73 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 18 July 1980	DATE FINISHED: 18 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 46.5 ft	ROCK DEPTH: 25.0 ft
SIZE AND TYPE OF BIT: CASING 3" "Flush Joint"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 7, UNDIST 1	CORE 20.5
CASING HAMMER / WEIGHT / DROP		WATER LEVEL: FIRST --, COMPL. 1.9	24HR
SAMPLER: 2-IN O.D. SPLIT SPOON		BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER HAMMER: WEIGHT 140 LBS	DROP 30-IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk gray brown silty f.SAND tr veg, v.loose (Dry) 1.0'	76.7	0–1.5	S-1	1.5	1 0 1					
Bott: gray & yellow brn, f. sandy CLAY, some silt, tr. veg, firm (Dry)		2								
Gray & yellow brown, f. sandy CLAY, some silt, tr. veg., wood firm (Dry)		3	S-2	1.4	3 4 4					
Gray & light grayish brn (mottled) f.sandy CLAY, some veg., roots, wood (Dry) stiff		5–6	S-3	1.5	6 6 7					
Light gray & light tannish brown silty, f.sandy CLAY tr wood, firm. (Moist)		8	S-4	1.4	3 3 4					
Light gray & tannish brown (mottled) f.sandy CLAY, some silt, firm (Dry-Moist)		10–11	S-5	1.5	3 2 3					
Lt gray & tannish brn, f. sandy CLAY, some silt (Moist) (15.5 ft)	62.2	14–15								
Dark greenish gray CLAY some f.sand seams, soft, (Moist)		15.5–17	S-6		1 2 1					
Dark greenish gray CLAY, some f.sand seams		17–19	UD-1	2.5	PUSH					
		20								

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LOG OF BORING B-624

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
(25.0 ft) Light gray, silty, calcareous f. SAND, some limestone rock fragments, tr. clay, shells, v. dense (Moist) (26.0 ft)	53.5	25.0–26.0	S-7	1.0	20 82 50/1"					Changed to coring at 26.0 ft
Light gray deeply weathered to decomposed foss - LIMESTONE, closely fractured to crushed		26.0–29.5				Run-1	88%	25%	1.4	
Light gray deeply weathered to decomposed foss LIMESTONE massive, locally crushed		29.5–35.0				Run-2	91%	69%	1.3	
Light gray mod. to deeply weathered foss. LIMESTONE, occ. small vugs, mod. to closely fractured.		35.0–40.0				Run-3	96%	84%	3.6	
Light gray, decomposed to deeply weathered foss. LIMESTONE, closely fractured to crushed.		40.0–45.0				Run-4	96%	40%	8	

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LOG OF BORING B-624

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Light gray decomposed to deeply weathered foss. LIMESTONE closely fractured, locally crushed		46				R-5	67%	0%	1	
Boring terminated at 46.5'		47								
		48								
		49								
		50								
		51								
		52								
		53								
		54								
		55								
		56								
		57								
		58								
		59								
		60								
		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								
		70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-625 — SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.96 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 18 July 1980	DATE FINISHED: 18 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 51.5 ft	ROCK DEPTH: 26.5 ft
SIZE AND TYPE OF BIT:	SIZE AND TYPE CORE BARREL: NX Double Tube CB	NO SAMPLES: DIST 9	UNDIST 1; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST —	COMPL 5.8; 24HR
CASING HAMMER: ; WEIGHT:	DROP:	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER: ; WEIGHT: 140 LBS	DROP: 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC.	RECOV. FT	PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Light gray-brown to dark gray silty SAND, tr. veg., loose (2.0 ft)	76.0	0–2	S-1	1.5	2, 5, 4					
Grayish & yellowish brown (mottled) CLAY, some f-sand lenses, tr. silt, veg., stiff (Dry)		3–4	S-2	1.0	3, 5, 6					
Grayish brown & light brown (mottled), f. sandy CLAY, tr silt (stiff) (dry)		5–6	S-3	1.5	3, 3, 5					
Light gray & tannish brn. (mottled), f. sandy CLAY & clayey f. SAND, some silt, firm (Moist)		8–9	S-4	1.3	2, 3, 4					
Tannish brn, f-m sandy, silty CLAY, firm (Moist) (15.0)	63.0	10–11	S-5		2, 3, 4					
Dark greenish grayish CLAY, some silty f. sand seams, highly plastic, soft (Moist)		15–16	S-6		1, 1, 2					
Dark greenish gray CLAY tr veg. (Moist)		18–20	UD-1		PUSH					

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-625 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT.	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Dark green gray CLAY some f.sand & silt seams,highly plastic,soft (Moist) (25.0 ft)	55.0	21–25	S-7	1.5	1 2 2					
Dark green-bluish gray clayey,silty f-c SAND,tr rock fragments,soft (Moist)		25–30	S-8	1.4	1 0 1					
·t gray,silty fine calcare- us SAND,some foss,limestone rock frags,tr clay,v.dense (Moist) (31.5 ft)	46.5	30–31.5	S-9	1.3	31 42 70					
Light gray deeply weathered to decomposed foss. LIME-STONE,bottom 1.7 ft mod. weathered,massive locally intensely fractured.		31.5–36.5				Run-1	98%	90%	1.0	Changed to coring at 31.5 ft
Gray,deeply to mod.weath-ered foss LIMESTONE,mod.to closely fractured,locally crushed,occ.med.vugs, bottom 3" - decomposed.		36.5–41.5				Run-2	96%	74%	1.2	
Light gray decomposed to deeply weathered foss.LIME-STONE,closely fractured to crushed.		41.5–45				Run-3	30%	8%	0.9	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-625

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46				R-3	30%	8%		
Light gray deeply weathered to decomposed foss. LIMESTONE, closely to mod. fractured, locally crushed.		47–51				Run-4	98%	56%		
Boring terminated at 51.5'		52–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-626 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.16 ft MSL	PROJECT NO: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 18 July 1980	DATE FINISHED: 18 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 51.0 ft	ROCK DEPTH: 26.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX Double Tube CB	NO SAMPLES: DIST 9; UNDIST --; CORE 20.0 ft	
CASING: 3" Flush Joint		WATER LEVEL: FIRST --; COMPL --; 24HR	
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30 -IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Light brown silty SAND, v. loose (Dry) (1.0)	77.2	0–1.5	S-1	1.5	1 2 3					
Light gray & yellowish brown (mottled) f. sandy CLAY		2.5–4	S-2	1.4	5 5 7					
Light gray & tannish-yellow brown (mottled) f. sandy, silty CLAY, tr. veg., stiff (Moist)		5–6.5	S-3	1.5	4 4 6					
Light gray & tannish brn silty CLAY, some f. sand seams, firm (Moist)		7.5–9	S-4	1.5	3 4 4					
Light gray & tannish brn f. sandy CLAY, some silt tr veg, firm (Moist) (15.0 ft)	63.2	10–11.5	S-5	1.4	2 2 3					
Light tannish brown silty fine SAND, tr veg. v. loose. (Dry) (17.0 ft)	61.2	15–16.5	S-6	1.0	2 2 3					

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-626 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dark greenish gray CLAY, occ. f.sand seams, very soft (Moist)		21	S-7	1.5	0 1 1					
		22								
		23								
		24								
Dark greenish gray clayey, m-c SAND, some f.sand, tr.si loose (wet) (26.0)	52.2	25–26	S-8	1.5	3 1 4					
Lt gray silty calcareous f. SAND, some clay, tr limestone rock fragments (Decomposed Rock) (wet)		27–28								
Lt gray silty calcareous f-m SAND, some clay tr limestone rock fragments v. dense (Decomposed Rock) (wet) (31.0 ft)	47.2	29–31	S-9	1.4	80 90					Change to coring at 31.0 ft
Light gray deeply weathered fossiliferous LIMESTONE, bottom 1.25 ft hard slightly to mod. weathered.		32–36				Run-1	100%	76%	3.4	
Light gray deeply weathered fossiliferous LIMESTONE, top 1.0 ft mod.weathered, massive to locally crushed.		37–41				Run-2	90%	92%	1.2	
Gray deeply weathered fossiliferous LIMESTONE closely fractured, occ.small vugs		42–45				Run-3	92%	58%	1.5	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-626

DESCRIPTION	ELEV. FT.	DEPTH. FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Light gray decomposed fossiliferous LIMESTONE crushed						R-3	92%	58%		
		46–51				Run-4	10%	0%	1.2	
Boring terminated at 51.0'		51								

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-627

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.94 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 17 July 1980	DATE FINISHED: 17 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 51.5 ft	ROCK DEPTH: 25.5 ft
SIZE AND TYPE OF BIT: 3" "Flush Joint"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 9, UNDIST 1	CORE: 20.0 ft
CASING		WATER LEVEL: FIRST --	COMPL --, 24 HR 4.9 ft
CASING HAMMER	WEIGHT / DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2–IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS / DROP 30–IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Light gray silty SAND, loose (Dry) (1.0 ft)	76.9	0–1	S-1	1.4	1 2 4					
Light gray & yellow brown f. sandy CLAY, firm. (Dry)		1–2.5								
Dark grayish brown & yellow brown f.sandy CLAY, tr silt, veg. (Dry)		2.5–4	S-2	1.3	4 5 6					
Gray to light brown & yellow brown (mottled) f.sandy silty CLAY, tr veg. (Moist)		5–6.5	S-3	1.5	3 5 5					
Light gray & tannish brn, fine sandy, silty CLAY tr.veg (Moist)		7.5–9	S-4	1.4	2 4 4					
Light tannish brn silty, clayey f-m SAND, some coarse sand (Wet) (15.0 ft)	62.9	10–11.5	S-5	1.5	2 2 3					
Dark greenish gray silty CLAY, some lenses of silty f.sand (Moist)		15–16.5	S-6	1.5	2 1 2					
Dark greenish gray CLAY some silt (Moist)		17–19.5	UD-1	2.5	PUSH					

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-627 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC.	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST. BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		21								Attempted vane shear test at 20.0 ft and not successful. Pushed vane 18" and would not fail
Dk greenish-gray CLAY, some lenses silty f. sand, soft (Moist)		22–23	S-7	1.5	0 1 3					
Dk greenish gray f. sandy CLAY (25.5 ft)	52.4	24–25	S-8	1.3	1 6 15					
Light gray clayey calcareous f.SAND, some silt, tr limestone rock fragments. (Moist)		26–29								
Light gray silty f.SAND, some limestone rock fragments, tr. shells, clay, v. dense (Moist) 31.5 ft)	46.4	30–31	S-9	1.2	44 51 114					Change to coring at 31.5 ft
Light gray mod. weathered foss. LIMESTONE, top 1.5 ft deeply weathered to decomposed		32–36				Run-1	92%	94%	15 min/5 ft	
Light gray, mod. to deeply weathered foss. LIMESTONE, occ. small vugs.		37–41				Run-2	100%	64%	5.5 min/5 ft	
Light gray, deeply weathered foss. LIMESTONE. Massive to mod. fractured.		42–45				Run-3	100%	68%	6.5 min/5 ft	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-627 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Light gray to gray deeply weathered to locally decomposed foss. LIMESTONE, massive to mod. fractured, occ. small vugs		46				R-3	100%	68%		
		47–51				Run-4	98%	94%	4 min/5 ft	
Boring terminated at 51.5'		52–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-628 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.61 ft MSL	PROJECT NO.: 80C4080C01	
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 24 July 1980	DATE FINISHED: 24 July 1980	
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 53.0 ft	ROCK DEPTH: 26.0 ft	
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 10	UNDIST 1	CORE 19.5 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST __	COMPL __	24HR 4.5 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2–IN O.D. SPLIT SPOON				
SAMPLER HAMMER	WEIGHT: 140 LBS	DROP: 30–IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Lt grayish brn, silty f-SAND, tr. veg., v. loose (dry)		0–1.5	S-1	1.2	2 3 2					4' west of stake
(2.5 ft)	75.1	2.5								
Grayish brn & yellowish brn CLAY, some f-sand, tr silt, veg, stiff (dry)		2.5–4	S-2	1.5	4 6 6					
(5.0 ft)	72.6	5.0								
Lt grayish brn & lt brn f-sandy CLAY, some silt, stiff (dry) (7.5 ft)		5–6.5	S-3	1.5	6 6 6					
Lt gray brn & tannish brn sandy CLAY, some silt, (moist) firm		7.5–9	S-4	1.0	2 3 2					
Lt brn fine sandy CLAY w/pockets of m-f silty sand, tr lenses of green clayey f-sand, soft (moist)		10–11.5	S-5	1.5	2 1 2					
(12.5 ft)		12.5								
Lt grayish brn & lt brn silty f-SAND, some lense, green clay, tr m-sand (14.4')	63.2	12.5–14	S-6	1.5	3 3 4					
Greenish gray f-sandy CLAY Dk green clay, some f-sand w/silt, highly plastic		15–17	UD-1	0.5						
Dk green gray CLAY, tr pockets of dark gray silty fine sand, highly plastic		17.5–19	S-7	1.5	1 0 1					

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-628 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Greenish gray CLAY, some silt, tr f-sand, v.soft-soft, (moist), highly plastic		20.5–21.5	S-8	1.5	0 0 2					
(26.0 ft)	51.6	25.0–26.0	S-9	1.4	2 1 5					
Lt greenish gray silty f-SAND-f.sandy silt, some clay, tr.limestone rock fragments, shells, loose (wet-moist) (decomposed rock)		27–29								Driller reports hard material 27.5 ft - 28.5 ft
Lt greenish gray silty, calcareous f-SAND, some limestone rock fragments, tr clay, shells, v.dense (moist) (decomposed rock) (33.5 ft)		30.0–31.4	S-10	1.5	30 50 50/5"					Casing to 32.0 ft
		33.5								Change to coring at 33.5 ft
(35.5 ft)	44.1	35.5		0	50/0					
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, massive to slightly fractured, freq. medium vugs (¼"- 1")		35.5–37.5				Run-1	98%	98%	7.5	
Lt gray, mod. weathered fossiliferous LIMESTONE, Bottom 1.9': deeply weathered, mod. to closely fractured, freq. large vugs (1")		37.5–43.0				Run-2	100%	75%	3.8	Lost circulation at 43.0 ft
Lt gray, deeply weathered to decomposed fossiliferous LIMESTONE closely to intensely fractured, occ. sm. vugs (¼")		43.0–45				Run-3	96%	64%	1.4	

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-628

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46–48				Run-3	48/5.0=96%	3.2/5.0=64%	1.4	
Lt gray deeply weathered to decomposed fossiliferous LIMESTONE, closely to intensely fractured, freq. sm. vugs (¼")		48–53				Run-4	82%	20%		
Boring terminated at 53.0'		53								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-629 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.61 ft MSL	PROJECT NO: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 21 July 1980	DATE FINISHED: 22 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 53.5 ft	ROCK DEPTH: 27.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 10; UNDIST --; CORE 20.0 ft	
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --; COMPL 7.2; 24HR	
CASING HAMMER	WEIGHT; DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS; DROP 30-IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6 IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT	REMARKS
Top 7": Dk brn, silty f SAND some veg, loose (dry)		0–1	S-1	1.4	1 3 2					
Dk brn silty f-SAND (2.5 ft)	75.1	2								
Dk gray to light grayish brn & yellow brn, f-sandy CLAY, some silt, stiff (dry)		3–4	S-2	1.5	3 4 5					
Lt gray & lt brn (mottled) f. sandy CLAY, some silt, stiff (dry)		5–7	S-3	0.9	6 6 5					
Lt gray & tannish to yellow brn (mottled), fine sandy, silty CLAY, soft (dry		8–9	S-4	1.5	2 2 2					
Lt gray & tan, f-sandy silty CLAY (11.0 ft)	66.1	10–11	S-5	1.5	2 2 2					
Lt greenish gray & tan clayey f-m SAND, some silt tr. c. sand veg, loose (moist) (13.5 ft)	64.1	12–13								
Lt grayish brn, f-sandy SILT, some clay, soft (moist-wet) (15.0 ft)	62.6	14–15	S-6	1.5	2 2 1					
Gray CLAY w/frequent pockets of f-sandy silt, soft (wet)		15–20	S-7	1.5	1 1 1					qu=0.75 (pocket penetrometer) Vane shear test 17.0 ft-18.5 ft Disturbed: 1.09 tsf Remolded: 0.78 tsf Vane shear test 19.0 ft-20.0 ft Disturbed: 0.93 tsf Remolded: 0.62 tsf

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-629 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk gray silty CLAY, some silty f-sand seams (moist) v.soft (25.0 ft)	52.6	21–25	S-8	1.5	1 1 1					Vane shear 20.5 ft-21.5 ft Disturbed: 1.25 tsf Remolded : 0.85 tsf qu=0.75 (pocket penetrometer)
Dk greenish gray clayey f-m SAND, some silty (wet) v.loose (27.0 ft)	50.6	25–27	S-9	1.5	2 2 1					
		27–30								
Lt gray clayey, calcareous f-SAND, some limestone rock fragments, tr.silt, v. dense, (decomposed rock) (moist) (33.5 ft)	44.1	30–33.5	S-10	1.2	25 45 50					Change to coring 33.5 ft
Lt gray, slightly weathered locally deeply weathered fossiliferous LIMESTONE Top 2.0: hard occ.sm.vugs Bottom: glauconitic		33.5–37.5				Run-1	93%	88%	6.3	
Lt greenish gray, deeply weathered fossiliferous LIMESTONE, freq.sm.vugs, locally decomposed glauconite abundant.		37.5–43				Run-2	95%	51%	1.3	
Lt greenish gray deeply weathered to decomposed fossiliferous LIMESTONE closely to mod.fractured glauconite abundant		43–45				Run-3	100%	50%	2.2	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-629

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46–48				Run-3	100%	50%	1.2	
Lt gray, deeply weathered to decomposed LIMESTONE closely fractured, locally crushed		48–53.5				Run-4	100%	45%	1.1	
Boring terminated at 53.5'		54–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-630

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.21 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 21 July 1980	DATE FINISHED: 21 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 51.5 ft	ROCK DEPTH: 22.0 ft
SIZE AND TYPE OF BIT: 3-7/8" Tricone	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 10	UNDIST 1; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL --; 24 HR 5.0 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			INSPECTOR
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO LOC	SAMPLES RECOV. FT	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Dk brn, fine SAND, some veg roots, tr silt, loose (dry) (1.0 ft)	76.2	0–1	S-1	0.7	1 4 4					
Gray & yellowish-light brn f sandy, silty CLAY, tr veg roots, stiff (dry)		2.5–4	S-2	1.0	3 4 5					
Gray & yellowiwh-lt brn f-sandy CLAY, some silt, stiff, dry		5–6.5	S-3	0.8	3 5 6					
Lt gray & tannish brn f-sandy CLAY & clayey f-SAND some silt, firm moist		7.5–9	S-4	1.0	3 4 4					
Lt greenish gray & tan silty, f-sandy CLAY, tr veg, firm, moist		10–11.5	S-5	1.5	2 2 4					
(13.0 ft)	64.2	13								Driller reports v.soft material 13.0 Ft
Dk greenish gray CLAY, some fine sand, tr silt		15–17.5	UD-1	2.5	PUSH					
Dk greenish gray CLAY w/ frequent f-sand seams, some silt, tr veg.		17.5–19	S-6	1.5	1 1 2					

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-630

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk greenish gray silty CLAY some f-sand pockets, v. soft (moist) (21.5 ft)	55.7	21	S-7	1.5	0 0 0					
Gray, clayey silt & lt gray f-SAND (22.0)	55.2	22	S-8	0.5	0 4					Slight water loss
Lt gray silty calcareous f-c SAND, some gray silt, tr. limestone rock fragments, loose (moist) (decomposed rock)	54.7	23–24								Lost 10.09 gals bet. 23.0 ft & 25.0 ft Driller reports hard material 23.5 ft
Lt gray, silty calcareous f-c SAND, some limestone rock fragments, tr clay, v. dense (decomposed rock) (wet)	50.7	25–26	S-9	1.5	53 48 76					
		27–29								Still losing water (slight)
Lt gray, silty, calcareous fine SAND, some limestone rock fragments, tr clay, v. dense (decomp. rock) (wet-moist) (31.5 ft)	45.7	30–31	S-10	1.5	41 69 163					Driving casing change coring to 31.5 ft
Light gray, slightly to mod weathered fossiliferous LIMESTONE Top 3.2 ft v. hard, massive. Bottom: frequent small to med vugs, glauconite noted.	40.7	32–36				Run-1	84%	82%	3.4	
Light gray, deeply to mod. weathered, locally decomposed fossiliferous LIMESTONE, slightly to mod. fractured, locally crushed, frequent sm. vugs	35.7	37–41				Run-2	100%	74%	2.2	
Lt gray deeply weathered fossiliferous LIMESTONE, mod. fractured, frequent sm. vugs.		42–45				Run-3	100%	78%	2.2	

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LOG OF BORING B-630 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46				R-3	100%	78%	2.2	
Lt gray, deeply weathered to decomposed, fossiliferous LIMESTONE, frequent small vugs, massive to mod. fractured		47–51				Run-4	100%	82%	0.9	
Boring terminated at 51.5'		52–70								

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LOG OF BORING B-631 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.53 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 23 July 1980	DATE FINISHED: 23 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 54.0 ft	ROCK DEPTH: 20.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 9, UNDIST 1	CORE: 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --, COMPL --, 24HR 4.5 ft	
CASING HAMMER, WEIGHT, DROP		BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER WEIGHT: 140 LBS	DROP: 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Dk brn silty f-SAND tr veg (dry)	77.3									
Grayish & yellowish brn fine-sandy, silty CLAY, tr veg. soft (dry-moist)		1	S-1	1.4	2 1 2					
Grayish & yellowish brn fine sandy CLAY, some silt, veg, firm (dry-moist) 4.5'	73.0	3	S-2	1.5	2 3 4					
Dk gray & yellowish brn, clayey f-SAND, some silt, stiff (moist) (7.0 ft)	70.5	5	S-3	1.3	3 5 6					
Dk to lt grayish to yellow brn, f-sandy silty CLAY, stiff (moist)		8	S-4	1.5	3 4 4					
Lt gray & tannish brn f-sandy CLAY w/freq lenses of silty f-sand (soft-firm) (moist)		10	S-5	1.2	2 2 2					
Lt gray f-sandy clay (15.5 ft)	62.0									
Gray CLAY w/thin lenses of silty f-sand, (soft-firm) tr. veg., highly plastic (moist)		15	S-6	1.5	1 2 2					
Greenish gray CLAY, highly plastic (moist)		17	UD-1	2.0	PUSH					
		20								

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LOG OF BORING B-631 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
fossiliferous LIMESTONE mod.to closely fractured, locally intensely fractured freq. sm. to med.vugs		46–49				Run-3	100%	86%	1.5	
Lt gray deeply weathered fossiliferous LIMESTONE closely fractured locally decomposed.freq.sm. vugs		49–54				Run-4	16%	6%	0.8	Lost circulation at 52.5 ft Driller reports 52.5 ft-54.0 ft--soft material
ring terminated at 54.0'		54								

Depth scale: 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70

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LOG OF BORING B-631 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST. BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Grn gray CLAY w/pockets v. dense sand (23 ft)	54.5	20–23	S-7	1.5	3, 2, 1					
Lt gray silty calcareous f-c SAND, some limestone rock fragments, m. dense moist (decomposed rock)		23–30	S-8	1.0	1, 9, 21					
gray, silty, clayey, calcareous f-SAND, some limestone rock fragments (decomposed rock) (34 ft)	43.5	30–34	S-9	1.4	44, 51, 78					Driven casing to 34.0 ft
Lt gray, slightly weathered to fresh, locally moderately weathered, fossiliferous LIMESTONE, occ. sm. vugs. Top 1.8 ft: fresh, slightly fossiliferous, hard, massive		34–39				Run-1	98%	92%	7.0	Change to coring 34.5 ft
Lt gray, mod weathered fossiliferous LIMESTONE, freq. med. to large vugs, massive locally closely fractured.		39–44				Run-2	96%	78%	5.0	22 July 1890
Lt gray mod. weathered		44–45								23 July 1980

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LOG OF BORING B-632 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.11 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 23 July 1980	DATE FINISHED: 23 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 66.5 ft	ROCK DEPTH: 39.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL	NO SAMPLES: DIST 15; UNDIST --; CORE --	
CASING: 3" "Flush Joint"	NX "Double Tube" CB	WATER LEVEL: FIRST --; COMPL 4.5; 24HR 4.5 ft	
CASING HAMMER / WEIGHT / DROP		BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER WEIGHT: 140 LBS	DROP: 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT	REMARKS
Dk brn silty f-SAND, some veg., v.loose (dry) (1.5 ft)	75.6	1	S-1	1.4	1 2 2					23 July 1980
		2								
Dk grayish & yellowish brn f-sandy CLAY, some silt ?m (dry) (5.0 ft)	72.1	3–4	S-2	1.3	3 3 4					
No recovery		5–6	NR	0.0	6 6 7					No sample
Gray & yellowish brn clayey, f-SAND (8.0 ft)	69.1	7								
Lt gray & yellowish brn f-sandy CLAY, freq. silty f. sand lenses, firm (moist)		8–9	S-3	1.5	2 3 4					
Lt yellowish brn f-sandy CLAY (10.8 ft)	66.3	10								
Lt tannish brn m-f SAND, some clay, tr. c. sand (moist) (12.5 ft)	64.6	10–12	S-4	1.5	2 1 2					
Lt tannish brn f-sandy CLAY, some silt, v.soft (moist)	61.6	13–14	S-5	1.1	1 2 1					Vane shear test: 14.0 ft - 16.5 ft Undisturbed: 1.17 tsf Remolded: 1.09 tsf
?reenish gray silty CLAY frequent lenses of silty f-sand, v.soft (moist)		16–17	S-6	1.5	1 WH 1					
Greenish gray silty CLAY w/frequent lenses of silty f-sand, v.soft (moist)		18–20	S-7	1.5	1 WH					Vane shear test: 17.5 ft - 19.0 ft Undisturbed: 0.78 tsf Remolded: 0.78 tsf

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LOG OF BORING B-632 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		20–21	S-7	1.5	2					Vane shear 21.0 ft - 22.4 ft Undisturbed:1.09 tsf Remolded:0.82 tsf
(22.4 ft)	54.7	22								
Gray, silty c-f SAND, some clay (m.dense-loose) (wet)		25–26	S-8	0.7	3 5 5					
Top 6":Lt gray, silty f-SAND (30.5 ft) Gray clay, some f-m SAND, tr silt, veg., firm (moist)		30–31	S-9	1.3	5 3 3					
Top 6":Gray clay, some f-m SAND, tr silt Lt gray, f-SAND, some silt, tr clay, loose (moist)		35–36	S-10	1.5	3 4 3					
(39.0 ft)	38.1	39								
Lt greenish gray, f-c, calcareous SAND & limestone rock fragments, tr silt v.dense (moist) (decomposed rock)		40–41	S-11	1.3	7 17 50/5					Lost drilling fluid at 40.0 ft
		45								

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LOG OF BORING B-632

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty, calcareous f-m SAND, some limestone rock fragments, shells, v. dense (moist) (decomposed rock)		46			35 50 50/3"					Casing to 47.5 ft still no circulation
		47								
		48								
		49								Possible void: 49.0 ft to 56.5 ft
		50								
		51								
		52								Drill rods fell to 56.5 ft
		53								
		54								
		55								
		56								Casing to 58.0 ft
Lt greenish gray, silty f-c SAND, tr limestone rock fragments, shells, clay, m. dense-v. dense, (wet) (decomposed rock) (60.0 ft)		57	S-13	1.5	15 28 38					Circulation return from 58.0 ft
		58								
		59								
Dk greenish gray silty f-SAND phosphate abundant, v. dense (wet)	17.1	60	S-14	1.5	21 31 41					
		61								
		62								
		63								
		64								
Dk greenish gray, silty f-SAND, some clay, phosphate abundant, m. dense, (moist)		65	S-15	1.5	30 21 19					
		66								
Boring terminated at 66.5'		67								
		68								
		69								
		70								

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LOG OF BORING B-633 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.39 ft MSL	PROJECT NO.: 80C4080C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 24 July 1980	DATE FINISHED: 25 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 59.0 ft	ROCK DEPTH: 30.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 11, UNDIST 2	CORE 20.0 ft
CASING 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL. -- 24HR
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			INSPECTOR: M. Giordano
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Top 12": Dk brn f-sandy CLAY, tr. veg., soft (dry)	76.4	1	S-1	1.5	1 2 2					
Gray & yellowish brn CLAY some f-sand, tr silt (dry to moist)		2								
Gray & yellowish brn CLAY some f-sand, tr. silt, firm (moist)		3–4	S-2	1.4	2 2 4					
Gray to lt gray CLAY, soft (moist)		5–6	S-3	1.0	1 1 3					
Lt gray CLAY w/frequent pockets of lt brownish gray f-sandy silty, firm (moist)	67.9	7–9	S-4	0.9	2 2 3					
Lt greenish gray silty CLAY w/frequent silty, f-sand seams, firm (moist) (14.0 ft)	63.4	10–14	S-5	1.5	1 2 3					
Lt gray clayey f. SAND w/ frequent thick lenses of grn clay, soft, firm (moist) (17.0 ft)	60.4	15–17	S-6	1.5	2 2 2					
Dk greenish gray CLAY, some silty f-sand seams, v.soft (moist)		18	S-7		1 1 1					
Dk greenish gray CLAY, highly plastic (moist)		19–20	UD-1	2.0	PUSH					

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LOG OF BORING B-633 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT.	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
			UD	2.5	PUSH					
Dk greenish gray CLAY w/ frequent fine sand seams v.soft, (moist)		21	S-8	1.5	WH WH 1					
Dk greenish gray CLAY, highly plastic (23.5 ft)	53.9	22								
		23	UD-2	2.0	PUSH					Change of soil in tube
Dk gray clayey silty f-m SAND, tr.c-sand, loose (moist-wet)		24								
		25	S-9	1.5	2 1 8					
		26								
		27								
		28								
(30.0 ft)	47.4	29								
Lt gray, clayey, silty f-SAND some limestone rock fragments, v. loose (moist) (decomposed rock)		30								
		31	S-10	1.5	1 1 3					
		32								Losing water slowly at 31.5 ft
		33								
		34								
		35								Spoon dropped at 35.0 ft, about 2½", no recovery (probable void)
		36								
Lt gray, clayey, silty, f-c SAND, some limestone rock fragments (moist), v.dense (decomposed rock) (39.0 ft)	38.4	37								
		38	S-11	1.5	11 23 37					Change to coring at 39.0 ft
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, hard, closely fractured, glauconite noted		39								
		40								Partial water loss
		41				Run-1	26%	22%	2.2	
		42								Casing to 44.0 ft
		43								24 July 1980
		44								25 July 1980
		45								

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LOG OF BORING B-633 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray moderately to deeply weathered fossiliferous LIMESTONE closely fractured glauconite noted		45–49				Run-2	50%	26%	3.0	Lost 200 gals. water bet. 45.0 ft-48.0 ft
Lt gray, deeply weathered fossiliferous LIMESTONE, crushed to intensely broken, glauconite noted		49–54				Run-3	10%	0%	1.6	
Lt gray deeply weathered to decomposed fossiliferous LIMESTONE, glauconite noted. Moderately to closely fractured.		54–59				Run-4	76%	62%	0.5	
Boring terminated at 59.0'		59–70								

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LOG OF BORING B-634

SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: ?	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 15 July 1980	DATE FINISHED: 16 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 52.5 ft	ROCK DEPTH: 20.5 ft
SIZE AND TYPE OF BIT: 4-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 9; UNDIST --; CORE 20.0 ft	
CASING: 4" Flush Joint		WATER LEVEL: FIRST --; COMPL. --; 24 HR. 3.0 ft	
CASING HAMMER	WEIGHT	DROP	
SAMPLER: 2-IN O.D. SPLIT SPOON		BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk gr organic silty SAND some veg (0.5 ft)	0.5?									
Lt brown CLAY, tr veg, (Dry-Moist) plastic	?	0–1.5	S-1	1.5	1 1 1					
Gray & yellow, brn CLAY, tr silt, plastic (Dry)		2.5–4	S-2	1.5	3 4 4					
Gray-lt. gray (mottled) CLAY, some silt, tr f. sand plastic, tr. veg. (Moist)		5–6.5	S-3	1.2	8 8 8					
Gray-lt gray (mottled) CLAY, some silt, tr f. sand veg, plastic, soft (Moist)		7.5–9	S-4	1.4	2 2 2					
Light gray CLAY, tr f sand silt, plastic, soft (Moist)		10–11.5	S-5	1.1	3 1 2					
(13.5 ft)		13.5								
Dark greenish gray, clayey, silty f. SAND, loose (wet)		15–16.5	S-6	1.0	2 1 2					
		20								

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LOG OF BORING B-634 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt greenish gray clayey f. sand 20.5 ft		21	S-7	1.0	2 3 13					Losing water at 20.0'
Lt gray, clayey calcareous f-m SAND, some silt, tr limestone rock fragments, m.dense (wet)		22–24								
Light gray silty, calcareous f.SAND & limestone rock fragments, v.dense. (wet)		25–26	S-8	1.0	13 25 28					
		27–29								
		30	S-9	1.0	20 50/5					
Light gray clayey, silty calcareous f-c.SAND, some limestone rock fragments, v.dense (moist) (32.5 ft)		31–32								
Light gray, deeply weathered to decomposed foss.LIMESTONE, closely fractured.		33–35				Run-1	100%	48%	0.4	Changed to boring at 2.5 ft
Light gray, mod to slightly weathered, foss. LIMESTONE, massive to slightly fractured, hard.		35–40				Run-2	100%	94%	5	
Light gray, sl. to mod. weathered, foss. LIMESTONE, massive to slightly fractured, hard.		40–45				Run-3	100%	100%	4	

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LOG OF BORING B-634 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Light gray, deeply to mod. weathered, foss. LIMESTONE, closely to mod. fractured, locally intensely fractured		46–50				Run-4	100%	78%		
Light gray, deeply weathered foss. LIMESTONE, closely to mod. fractured.		50–52.5				Run-5	100%	2.0/2.5=80		
Boring terminated at 52.5'		53–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-635 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: ?	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 16 July 1980	DATE FINISHED: 16 July 1980
DRILLING EQUIPMENT: CMP-55 Hydro Rotary		COMPLETION DEPTH: 52.0 ft	ROCK DEPTH: 18.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 9, UNDIST --	CORE: 20.0 ft
CASING: 4" "Flush Joint"		WATER LEVEL: FIRST --, COMPL. --	24HR. 1.0 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT: 140 LBS	DROP: 30-IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk gray org. f-sandy SILT sm. veg. tr. wood		0–1	S-1	1.4	1 3 2					
Grayish brn to yellow brn f. sandy (O.S.) CLAY, some veg. decomposed wood, tr silt. firm		1–3								
Lt gray brn f.sandy silty CLAY, tr roots, veg., firm (moist)		3–4	S-2	1.5	3 3 3					
Gray brn-tan f.sandy CLAY some silt, (moist) tr.veg.		5–6	S-3	1.5	2 2 4					
Lt gray brn to yellow brn (mottled) CLAY, some f. sand, firm. (moist)		7.5–9	S-4	1.5	2 3 3					
Lt greenish gray to lt brn (mottled) f.sandy CLAY, some silt, tr veg., firm. (moist)		10–11.5	S-5	1.4	1 2 2					
(14.0 ft)		14								Gray return at approx. 14.0 ft
Greenish gray, silty f-SAND, some clay, loose (wet)		15–16.5	S-6	1.1	1 1 2					
(18.5 ft)		18.5								Change at 18.5 ft.
		19–20								

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LOG OF BORING B-635 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty calcareous f-m SAND, some coarse sand, tr limestone rock fragments, clay, v. dense (wet)		20–22	S-7	1.3	29 32 45					
Lt gray, silty calcareous f-c SAND, some limestone rock fragments, tr clay, v. dense (wet)		25–26	S-8	1.0	37 30 64					
Lt gray silty calcareous f SAND, some limestone rock fragments, tr clay, v. dense (moist) (32.0 ft)		30–31	S-9	1.4	37 47 150/5½"					
Lt gray deeply weathered fossiliferous LIMESTONE closely to mod. fractured locally crushed		32–37				Run-1	84%	58%	1.2	Changed to coring at 32.0 ft
Lt gray, mod to deeply weathered, fossiliferous LIMESTONE, closely to mod. fractured, locally crushed.		37–42				Run-2	100%	94%	2.8	
Lt gray, deeply tp mod. weathered, fossiliferous LIMESTONE, mod. to closely fractured, locally crushed.		42–45				Run-3	100%	42%		

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LOG OF BORING B-635 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46				Run-3	100%	42%		
Lt gray to gray deeply weathered fossiliferous LIMESTONE, closely to mod. fractured, locally intensely fractured.		47–52				Run-4	100%	56%		
Boring terminated at 52.0'		52–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-636 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 79.15 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 24 July 1980	DATE FINISHED: 25 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 57.5 ft	ROCK DEPTH: 19.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 12, UNDIST --, CORE 20.0 ft	
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --, COMPL ---, 24HR	
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2–IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30–IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Top 6": Dk brn, silty f.sand loose (dry); Lt brn & yellow brn (mottled) silty f-SAND (dry) v. loose; Lt brn & yellow brn silty f-SAND (3.0 ft)	76.2	0–3	S-1	0.8	3, 3, 4					
Gray-brn & yellow brn clayey fine SAND, some lt, stiff-firm (dry)		3–5	S-2	0.5	4, 6, 7					
Lt gray & yellow brn clayey f. SAND, some silt, firm (moist) (7.0 ft)	72.2	5–7	S-3	1.1	2, 3, 4					
Lt gray & yellow brn f. sandy CLAY (moist)		7–9	S-4	1.5	1, 3, 2					Seams of silt in S-4
Lt gray & yellow brn silty CLAY, some f-sand	66.7	10–12.5	S-5	1.5	2, 1, 3					
Green silty CLAY w/frequent thin seams of silty f-sand, firm (moist)		13–15	S-6	1.1	2, 3, 5					
Green silty CLAY w/frequent thin seams of silty f-sand, firm (moist) (17.0 ft)	62.2	15–17	S-7	1.5	3, 3, 4					
[Gr]een silty f-SAND, some [th]in clay lenses, stiff (moist) (19.0 ft)	60.2	17–19	S-8	1.1	3, 4, 5					

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LOG OF BORING B-636

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty f-calcareous SAND, some limestone rock fragments, v.dense (moist) (decomposed rock)		21	S-9	1.0	25 32 32					
Lt gray, silty f-calcareous SAND, some limestone rock fragments, tr. shells, v. dense (moist) (decomposed rock)		25	S-10	1.1	30 50 50/3"					
Lt brn f-calcareous SAND, some silt, tr rock fragments v.dense (wet) (decomposed rock)		30	S-11	1.3	30 34 39					
Lt gray f-m silty, calcareous SAND, tr. limestone, rock fragments, v.dense (moist) (37.5 ft)	41.7	35	S-12	1.5	18 24 35					Change to coring at 37.5 ft
		37.5		0						Refusal
Lt gray, slightly to mod. weathered, fossiliferous LIMESTONE, mod. fractured occ. sm. to med. vugs (½"-1½")		38-42.5				Run-1	96%	50%	3.6	
Lt gray, deeply weathered fossiliferous LIMESTONE. frequent sm. vugs (2½") mod. fractured		42.5-45				Run-2	100%	70%	1.4	

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LOG OF BORING B-637 — SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.51 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. May	DATE STARTED: 19 July 1980	DATE FINISHED: 19 July 1980
DRILLING EQUIPMENT: CME-45 Hydro Rotary		COMPLETION DEPTH: 50.5 ft	ROCK DEPTH: 18.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double-Tube" CB	NO. SAMPLES: DIST 9	UNDIST 0; CORE 20.0 ft
CASING: 3" Flush Joint		WATER LEVEL: FIRST --	COMPL --; 24 HR 2.9 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			INSPECTOR: M. Giordano
SAMPLER HAMMER	WEIGHT: 140 LBS	DROP: 30-IN	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Top 6": Dk gray f- SAND some roots (dry)		0–1.5	S-1	1.5	1 1 1					
Gray & yellow brn f-sandy CLAY, tr veg., stiff (dry) (2.0 ft)	76.2	2								
Dk gray & yellow brn f-sandy CLAY, tr.veg., stiff. (Dry) (4.5 ft)	74.0	2.5–4	S-2	1.5	4 6 7					
Light gray, clayey fine SAND, tr. silt, stiff (moist) (7.0 ft)	71.5 / 69.2	5–6.5	S-3	1.5	4 6 7					
Lt gray & tannish brn silty CLAY & f-SAND, stiff (moist) (10.0 ft)	68.5	7.5–9	S-4	1.5	6 6 4					
Gray & lt brn, f-sandy CLAY & clayey f-SAND firm, tr veg. (moist) (15.5 ft)	63.0	10–11.5	S-5	1.5	2 2 3					
Dk gray silty CLAY w/freq f-sand partings, (wet to moist) soft (18.0 ft)	60.5	15–16.5	S-6	1.5	1 1 1					
		18–20								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-636 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46–47.5				Run-2	100%	70%	1.4	
Lt gray deeply weathered to decomposed fossiliferous LIMESTONE, closely fractured to crushed, occ. sm. vugs (2½")		47.5–52.5				Run-3	76%	16%	2.4	
Lt gray, deeply weathered to decomposed fossiliferous LIMESTONE, closely fractured to crushed.		52.5–57.5				Run-4	22%	6%	1.0	
Boring terminated at 57.5'										

Depth scale: 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70

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LOG OF BORING B-637 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT.	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Lt gray silty f-c SAND, & limestone rock fragments, tr. shells (wet) v. dense		21	S-7	1.3	25 28 40					
Lt gray silty f-c SAND & limestone rock fragments, tr. shells, very dense, (wet		25–26	S-8	1.0	27 31 50/5					
Lt gray silty f-c SAND, some limestone rock fragments, tr. shells, v. dense (wet) (30.5 ft)	48.0	30	S-9	13	50/3					
Slightly to mod. weathered fossiliferous LIMESTONE; closely to mod. fractured, light gray		31–35				Run-1	92%	58%	1.3	Begin to core at 30.5 ft
Slightly weathered, v. hard fossiliferous LIMESTONE; slightly fractured, lt gray		36–40				Run-2	100%	96%	4.4	Very hard drilling
Deeply weathered, closely fractured fossiliferous sandy LIMESTONE; lt gray		41–45				Run-3	40%	0.0%	3.4	Driller reports 6" clay lense at 41.5 ft & at 43.5 ft

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LOG OF BORING B-637 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT.	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Moderately to deeply weathered, mod. fractured shelly LIMESTONE, lt gray		46–50.5				Run-4	100%	30%	1.4	
Boring terminated at 50.5'		51–70								

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LOG OF BORING B-638 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.03 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 19 July 1980	DATE FINISHED: 19 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 55.1 ft	ROCK DEPTH: 17.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 9	UNDIST -- ; CORE 19.5 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL -- ; 24 HR. 3.7 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2–IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30 –IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk brown, silty f-SAND, some veg., wood, v.loose (dry) (2.5 ft)	75.3	0–2.5	S-1	1.5	1 1 2					
Lt grayish & yellowish brn, silty, f-sandy CLAY, firm (moist)			S-2	1.5	2 2 3					
Lt gray & tannish brn, f-sandy, silty CLAY (soft) (moist)			S-3	1.5	2 1 2					
Lt gray & tan silty CLAY some f-sand, soft (moist) tr.veg.			S-4	1.4	2 2 1					
	65.0		S-5	1.3	1 1 2					
Dk greenish gray silty CLAY, some f-sand seams v.soft, tr.veg. (moist) (17.5 ft)	60.3		S-6	1.5	0 0 1					

Depth scale: 1–20 ft

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LOG OF BORING B-63B SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty, calcareous f-c SAND, some limestone rock fragments, tr. clay, v. dense (wet) (decomposed rock)		21	S-7	1.0	27 48 50/3					
		22 23 24								
Lt gray silty, calcareous f-c SAND, some limestone rock fragments, tr. shells, clay, v. dense (wet) (decomposed rock)		25 26	S-8	1.5	50 30 50					
		27 28 29								
		30 31	S-9	1.2	12 25 37					
		32 33 34								
(no recovery)	42.4	35		0.0	50 50/2"					
Lt gray, slightly weathered to mod. weathered fossiliferous LIMESTONE, mod. fractured to slightly frequent sm. vugs, v. hard		36 37 38 39 40				Run-1	91%	87%	3.6	Changed to coring at 35.6 ft
Lt gray, mod. weathered fossiliferous LIMESTONE, closely fractured to broken, locally massive, frequent sm. vugs.		41 42 43 44 45				Run-2	94%	36%	5.0	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-638 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT.	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Lt gray, deeply weathered, locally decomposed fossiliferous LIMESTONE closely to intensely fractured locally crushed, occ. sm. vugs.		46–50				Run-3	80%	14%	2.2	
Lt gray, deeply weathered to decomposed fossiliferous LIMESTONE closely to intensely fractured, locally crushed.		50–55				Run-4	28%	0%	1.0	
Boring terminated at 55.1'		55–70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-639 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.12 ft MSL	PROJECT NO.: 80C4080C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 19 July 1980	DATE FINISHED: 19 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 56.0 ft	ROCK DEPTH: 16.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO SAMPLES: DIST 8	UNDIST 1; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL --; 24HR 5.0 ft
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			INSPECTOR: M. Giordano
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk grayish brn silty f-SAND some clay, tr.veg., wood, dry v.loose (1.5 ft)	76.6	1	S-1	1.5	1 2 1					
		2								
Lt gray & yellowish brn silty, f-sandy CLAY, tr.veg., firm (moist)		3	S-2	1.2	2 2 3					
		4								
		5								
(no recovery)		6	N.R.	0.0	2 2 3					No sample
		7								
Lt gray & tannish brn, f-sandy CLAY, some silt, firm (moist)		8	S-3	1.5	1 2 3					
	68.6	9								
		10								
Dk greenish gray & tannish brn silty CLAY, some f-sand seams, soft-firm (moist)		11	S-4	1.4	1 2 2					
		12								
Dk greenish gray CLAY, some f-sand seams (moist)		13								
		14	UD-1	2.5	PUSH					
Dk greenish gray silty CLAY, frequent f-sand pockets, soft (moist) (16.5 ft)		15								
	61.6	16	S-5	1.5	1 2 3					
Bottom 6": Lt gray silty alcareous f-SAND, some .imestone rock fragments, v.loose (wet-moist)		17								
		18								
		19								
		20								

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LOG OF BORING B-639

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, clayey-silty, calcareous f-SAND, some fossiliferous limestone fragments v.dense (moist) (decomposed rock)		20.5–21.5	S-6	1.3	23 31 33					
Lt gray, silty calcareous f-SAND, some fossiliferous limestone fragments, v.dense (moist) (decomposed rock)		25–26.5	S-7	1.4	42 44 40					
Lt gray silty calcareous f-SAND, some fossiliferous limestone rock fragments, v.dense (decomposed rock) (moist)		30–31.5	S-8	1.5	22 27 101					
(36.0 ft)	42.1	35.5–36			100/3					Change to coring at 36.0 ft
Lt gray, slightly weathered fossiliferous LIMESTONE, v. hard, massive to mod. fractured, occ. sm. to med. vugs		36–41				Run-1	90%	90%	5.0	
Lt gray, slightly to mod. weathered, hard fossiliferous LIMESTONE slightly weathered, occ. med. vugs, glauconite noted.		41–45				Run-2	100%	92%	7.0	

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-639 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray deeply weathered locally mod. fossiliferous LIMESTONE, closely fractured to mod.		46, 47, 48, 49, 50				Run-3	50%	26%	3.0	-36.0 ft-46.5 ft hard slightly weathered limestone
Lt gray, deeply weathered locally decomposed fossiliferous LIMESTONE glauconitic slightly fractured to locally intensely fractured		51, 52, 53, 54, 55				Run-4			6 min/5 ft	
Boring terminated at 56.0'		56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70								

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CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-640 — SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.99 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 19 July 1980	DATE FINISHED: 19 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 45.5 ft	ROCK DEPTH: 15.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 8; UNDIST --	CORE: 20.0 ft
CASING		WATER LEVEL: FIRST --; COMPL. --	24 HR. 5.4 ft
CASING HAMMER — WEIGHT 140 lbs	DROP 30-inch	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER — WEIGHT 140 LBS	DROP 30-IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC.	RECOV. FT	PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Lt brn silty-sand (0.5 ft)	77.5									
Dk gray & yellowish brn f-sandy CLAY, some silt, tr veg., firm (moist)		0–1.5	S-1	1.5	2 2 3					
Dk. gray & yellowish brn CLAY, some m-c sand, tr. gravel, stiff, tr. veg. (moist)		2.5–4	S-2	1.4	2 4 4					
Lt gray & grayish brn f-sandy CLAY, some silt, plastic		5–6.5	S-3	1.5	2 2 4					
Lt gray & yellowish brn silty CLAY, some f-sand (moist) firm		7.5–9	S-4	1.3	1 3 3					
Top 12": Same as S-4 (11.0 ft)	67.0	10–11.5	S-5	1.5	1 2 2					
Lt gray & tannish brn clayey f-SAND, some silt, tr. m. sand, loose (moist-wet) (13.0 ft)	65.0									
Dk greenish gray CLAY some f. sand seams (15.5')	62.5									
Lt gray silty f-calcareous SAND & limestone rock fragments (wet) v. dense		15–16.5	S-6	1.4	1 10 25					

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LOG OF BORING B-640

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC.	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray silty calcareous f-c SAND, some limestone rock fragments, tr. clay, shells, v.dense (moist-wet (decomposed rock)		21	S-3	1.0	27 35 38					
		22								
		23								
Lt gray silty, calcareous f-c SAND, some limestone rock frags., some clay, tr. shells, v.dense (decomp. rock) (wet) (25.5 ft)	52.5	24–25	S-8	0.5	140					Change to coring at 25.5'
Lt gray, deeply weathered to decomposed fossiliferous LIMESTONE closely fractured to crushed.		26–30				Run-1	28%	- 0%	1.2	
Lt gray deeply weathered to decomposed fossiliferous LIMESTONE, closely fractured to crushed.		31–35				Run-2	64%	6%	0.8	Barrel plugged off, recovered 2.0 in 2nd attempt
Top 12": Lt gray deeply weathered to decomposed fossiliferous LIMESTONE Bottom: Slightly to mod. weathered, fossiliferous LIMESTONE, closely to mod. fractured.		36–40				Run-3	96%	26%	4.0	
Lt gray decomposed to deeply weathered, fossiliferous LIMESTONE, intensely fractured to crushed.		41–45				Run-4	30%	0%	2.2	

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LOG OF BORING B-640 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
						R-4				
Boring terminated at 45.5'		46								
		47								
		48								
		49								
		50								
		51								
		52								
		53								
		54								
		55								
		56								
		57								
		58								
		59								
		60								
		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								
		70								

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LOG OF BORING B-641 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 78.42 ft MSL	PROJECT NO: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 19 July 1980	DATE FINISHED: 19 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 46.1 ft	ROCK DEPTH: 17.5 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 9	UNDIST -- ; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL -- ; 24HR
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			INSPECTOR: M. Giordano
SAMPLER HAMMER	WEIGHT: 140 LBS	DROP: 30-IN	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT	REMARKS
Dk brn, silty f-SAND, some clay, tr. veg. v. loose (dry)		1	S-1	1.5	1 2 2					
(2.5 ft)	75.9	2								
Dk grayish brn. fine sandy CLAY, tr. c-sand, stiff, dry		3	S-2	1.4	9 9 6					
		4								
Gray & lt yellow brn (mottled) fine sandy CLAY & clayey f-SAND some silt, stiff dry		5–6	S-3	1.5	6 5 6					
		7								
Lt gray & yellowish brn (mottled) fine sandy, silty CLAY, soft (moist)	68.9	8–9	S-4	1.5	2 1 3					
Lt green & greenish gray f-sandy CLAY w/freq. silty f.sand seams, tr. veg., soft moist		10–11	S-5	1.3	2 2 2					Vane shear test 12.0 ft - 13.0 ft Undisturbed: 0.54 tsf Remolded: 0.41 tsf
		12								
Dk greenish gray CLAY w/ frequent silty f-sand seams, tr. m-sand, firm (moist)		13–14	S-6	1.5	2 2 3					
Dk grn gray CLAY w/freq silty f.sand seams (moist)		15–16								Vane shear test 16.0 ft - 17.0 ft Undisturbed: 0.11 tsf Remolded: 0.08 tsf
(17.5 ft)	60.9	17								
Bottom 18": Lt gray, silty, calcareous f-c SAND, limestone rock fragments (wet) v. dense (decomposed rock)		18–20	S-7	1.4	8 32 50/6					

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LOG OF BORING B-641

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST. BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty, calcareous f-c SAND, limestone rock fragments, tr. clay, v. dense (decomposed rock) (wet)		20–21	S-8	1.5	32 35 50					starting to lose water @ 20.0 ft
		25–26	S-9	1.0	45 90 50/1.5"					
(26.1 ft)	52.3	26.1								
Lt gray deeply weathered to decomposed fossiliferous LIMESTONE, occ. med. vugs, mod. fractured, locally crushed.		26.1–31				Run-1	94%	74%	1.0	Change to coring at 26.1 ft
Lt gray, deeply weathered fossiliferous LIMESTONE, massive locally closely fractured to crushed.		31–36				Run-2	100%	92%	5.0	
Top 1.9': Lt gray deeply weathered fossiliferous LIMESTONE, mod. fractured Bottom 3.1: Lt gray, slightly weathered to mod., hard, fossiliferous LIMESTONE, massive, occ. sm. vugs, glauconite noted.		36–41				Run-3	100%	98%	3.2	Top 1.9 ft soft Bottom 3.1 ft hard
Lt greenish gray mod. weathered, fossiliferous LIMESTONE, massive glauconitic		41–45				Run-4	96%	94%	3.6	

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LOG OF BORING B-641 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES			ROCK CORE				REMARKS
			TYPE NO. LOC	RECOV. FT.	PENETR RESIST BL/6IN.	CORE NO	RECOV. %	RQD	CORE TIME MIN/FT.	
						R-4	96%	94%	3.6	
Boring terminated at 46.1 ft		46								
		47								
		48								
		49								
		50								
		51								
		52								
		53								
		54								
		55								
		56								
		57								
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		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								
		70								

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LOG OF BORING B-642 SHEET 1 OF 3

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.18 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. May	DATE STARTED: 16 July 1980	DATE FINISHED: 17 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 47.5 ft	ROCK DEPTH: 25.5 ft
SIZE AND TYPE OF BIT: 3-7/8" Tricone	SIZE AND TYPE CORE BARREL: NX"Double Tube"CB	NO. SAMPLES: DIST 8, UNDIST 2; CORE 20.0 ft	WATER LEVEL: FIRST 9.3, COMPL --, 24 HR 5.1 ft
CASING: Hollowstem Auger			
CASING HAMMER	WEIGHT	DROP	BORING ANGLE AND DIRECTION: VERTICAL
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS	DROP 30-IN	INSPECTOR: M. Giordano

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Dark gray, f.SAND, loose (dry) (1.0 ft)	76.2	1	S-1	1.5	4 6 6					
Dark gray brn.& SAND, some clay, tr.silt, roots, veg. loose (2.5 ft)	74.7	2								
Dark gray & yellow, brown & lt.brown (mottled) f-sandy CLAY, some silt. Stiff; (dry)		3–4	S-2	1.5	10 8 7					
Light gray brn CLAY w/frequent yellow brn clayey f sand seams, some veg., stiff (moist)		5–7	S-3	1.5	3 5 8					
Light green, gray & lt tannish brown CLAY, some f sand tr silt, firm. (moist) (9.5 ft)		8–9	S-4	1.4	5 4 3					
Light green-blue gray & lt brown f-sandy CLAY, some silt, tr.veg., decomposed wood, soft (moist)	65.2	10–12	S-5	1.3	1 2 1					
Dark greenish gray CLAY w/ some silty sand seams.		13–14	UD-1	2.0	PUSH					Vane shear test ran at 15.0 ft in B-642-A qu= 2.0 tsf
Dark greenish gray CLAY, packets of light gray silty f.sand, tr veg.soft. (wet/moist)		15–16	S-6	1.5	0 0 0					
Dark greenish gray CLAY.		17–20	UD-2	2.5	PUSH					

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LOG OF BORING B-642 SHEET 2 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dark gray, silty CLAY, (Moist) highly plastic		21	S-7	1.5	WR					
Dark gry. silty clay f-m SAND (wet) tr c-sand (25.5 ft)	50.7	25								
Light gray silty calcareous f. SAND & LIMESTONE ROCK FRAGMENTS, some shells (wet) (27.5 ft)	49.7	26	S-8	1.5	0 25 50/4					
Light gray deeply weathered to decomposed foss. LIMESTONE closely fractured to broken		28–32				Run-1	80%	38%	1.0	Changed to coring at 27.5 ft
Light gray deeply weathered to decomposed foss. LIMESTONE closely fractured to broken bottom 1.4 ft mod. to slightly weathered.		33–37				Run-2	100%	36%	2.4	Hard rock at 36.0 ft
Light gray, mod. to deeply weathered foss. LIMESTONE mod. fractured locally closely fractured, chlorite noted		38–42				Run-3	100%	80%	5.0	
Light greenish gray decomposed to deeply weathered foss. LIMESTONE, closely fractured to crushed, chlorite noted.		43–45				Run-4	72%	18%	1.6	

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LOG OF BORING B-642 SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46–47				Run-4	72%	18%	1.6	
Boring terminated at 47.5'		48								
		49								
		50								
		51								
		52								
		53								
		54								
		55								
		56								
		57								
		58								
		59								
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		61								
		62								
		63								
		64								
		65								
		66								
		67								
		68								
		69								
		70								

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LOG OF BORING B-643

SHEET 1 OF 2

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.07 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: D. Gandy	DATE STARTED: 22 July 1980	DATE FINISHED: 22 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 44.0 ft	ROCK DEPTH: 18.0 ft
SIZE AND TYPE OF BIT: 3-7/8" "Tricone"	SIZE AND TYPE CORE BARREL: NX "Double Tube" CB	NO. SAMPLES: DIST 8	UNDIST -- ; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL. -- ; 24HR 4.0 ft
CASING HAMMER	WEIGHT / DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: M. Giordano	
SAMPLER HAMMER	WEIGHT 140 LBS / DROP 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	RECOV. FT	PENETR. RESIST BL/6IN.	ROCK CORE CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk brn silty fine SAND, some veg., v.loose (dry) (2.5 ft)	74.6	0–2	S-1	1.3	1 2 3					
Dk brn to yellowish grn fine-sandy CLAY, some silt tr decomposed veg (dry) stiff		3	S-2	1.5	5 5 5					
Gray & yellowish to tannish brn, fine sandy CLAY & clayey f-SAND (dry) stiff	69.0	5	S-3	1.5	5 6 6					
Lt tannish brn & lt greenish gray, f-sandy silty CLAY, soft (moist)	67.1	8	S-4	1.5	2 2 2					
Lt greenish gray sandy silty CLAY, v.soft, tr veg (moist)		10	S-5	1.5	1 1 1					Vane shear test 13.5 ft-14.5 ft Undisturbed=1.40 tsf Remolded =1.24 tsf
Greenish gray CLAY w/freq thin silty f-sand seams, Top 6" greenish gry clay w/fr silty sand seams (18.0 ft)	59.1	15	S-6	1.4	1 2 1					qu=1.25 tsf (pocket penetrometer) Vane shear test 16.5 ft-17.5 ft Undisturbed=0.93 tsf Remolded =0.93 tsf
Lt gray silty calcareous f-SAND, tr limestone rock fragments, v.dense, wet		18	S-7		2 9 25					

LOG OF BORING B-643

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Lt gray, silty f-c calcareous SAND, some limestone rock frags, tr clay, v.dense (wet) (24.1 ft)	53.0	21–24	5-8	0.5	50/1					Change to coring 24.1 ft
Lt gray, deeply weathered to decomposed fossiliferous LIMESTONE crushed to intensely fractured		24–29				Run-1	12%	0%	1.4	
Lt gray, deeply weathered fossiliferous LIMESTONE locally decomposed, closely to intensely fractured, locally crushed		29–34				Run-2	46%	6%	2.4	
Lt gray, mod. to slightly weathered fossiliferous LIMESTONE, massive to mod. fractured occ. sm. vugs		34–39				Run-3	96%	78%	4.8	
Lt gray, deeply weathered fossiliferous LIMESTONE closely fractured to crushed, occ. sm. vugs.		39–44				Run-4	39%	0%	5.2	
Boring terminated at 44.0'		44–45								

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LOG OF BORING B-644

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.38 ft MSL	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: J. Jones	DATE STARTED: 22 July 1980	DATE FINISHED: 22 July 1980
DRILLING EQUIPMENT: CME-55 Hydro Rotary		COMPLETION DEPTH: 52.0 ft	ROCK DEPTH: 25.0 ft
SIZE AND TYPE OF BIT: 3-7/8" Tricone	SIZE AND TYPE CORE BARREL: NX "Double Barrel"	NO SAMPLES: DIST 12	UNDIST -- ; CORE 20.0 ft
CASING: 3" "Flush Joint"		WATER LEVEL: FIRST --	COMPL -- ; 24-HR 3.9 ft
CASING HAMMER	WEIGHT / DROP	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON			
SAMPLER HAMMER	WEIGHT 140 LBS / DROP 30-IN	INSPECTOR: M. Giordano	

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	RECOV. FT	PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	RECOV. %	RQD	CORE TIME MIN/FT.	REMARKS
Dk grayish brn, f-sandy CLAY some silt, tr veg, soft dry		1	S-1	1.4	2 2 2					
		2								
Dk grayish brn & yellow brn (mottled) CLAY, some f-sand, tr silt, veg., firm (moist)		3	S-2	1.5	2 2 3					
		4								
		5								
		6	N.R.	0.0	2 3 5					
		7								
Lt greenish gray & yellow to lt brn (mottled) fine sandy CLAY, some silt, firm (moist)	67.9	8	S-3	1.1	1 3 4					
		9								
Lt green CLAY w/frequent thin f-sand seams, tr.veg., silt, soft (moist)		10–11	S-4	1.5	1 2 2					
Lt green CLAY w/frequent thin silty f-sand seams tr veg. (13.0 ft)	64.4	12	S-5	1.5	1 1 3					
Lt grn silty f-m sandy CLAY & silty, clayey f-m SAND, tr veg. (moist) (13.5 ft)	63.9	13–14	S-6	1.2	1 3 5					
Lt greenish gray, silty f-m SAND & f-m sandy SILT, tr clay, loose, wet		15–16	S-7	1.1	3 4 5					
Lt greenish gray, silty f-SAND, some m-sand, tr.clay loose (wet)		17	S-8	1.1	2 2 3					
Lt greenish gray silty f-m SAND, some clay, v.loose (wet) (20.0 ft)	57.4	18–20								

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LOG OF BORING B-644

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dk greenish gray CLAY w/ frequent pockets of silty f-sand, v.soft (wet-moist) (22.5 ft)	54.9	21, 22	S-9	1.5	0 0 1					qu=0.25 tsf Vane shear test 21.5 ft-22.5 ft Undisturbed:0.39 tsf Remolded :0.31 tsf
Lt green silty, f-m SAND, some clay, v.loose (wet) (25.0 ft)	52.4	23, 24, 25	S-10	0.5	WR WR WR WR					Spoon fell 2.0 ft. Attempted U.D. @24.5 ft, hit rock at 25.0'
Lt gray silty f-c SAND, & limestone rock fragments, v.dense (moist)		25, 26, 27, 28, 29, 30	S-11	1.0	4 5 21					Void bet. 25.5 ft & 25.9 ft - lost water very slowly.
Lt gray, silty f-SAND, some clay, tr limestone rock fragments, v.dense (moist)	45.4	31, 32	S-12	1.5	35 40 100/5"					Change to coring 32.0 ft
Lt gray slightly to mod. weathered fossiliferous LIMESTONE. Top 1.3': deeply weathered, occ. sm. vugs, massive to slightly fractured, locally crushed.		32, 33, 34, 35, 36, 37				Run-1	94%	74%	3.8	Top 1.3 ft soft
Lt gray mod. weathered fossiliferous LIMESTONE, frequent sm. vugs, locally massive to mod. fractured.		37, 38, 39, 40, 41, 42				Run-2	100%	90%	5.8	
Lt gray deeply to mod. weathered LIMESTONE, mod. to closely fractured, frequent sm. vugs		42, 43, 44, 45				Run-3	96%	88%	4.0	

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LOG OF BORING B-644

SHEET 3 OF 3

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		46				R-3	96%	88%	4.0	
Lt gray deeply weathered fossiliferous LIMESTONE freq. sm. vugs, massive locally closely fractured.		47–52				Run-4	98%	84%	1.2	
Boring terminated at 52.0'		52–70								

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LOG OF BORING B-645 SHEET 1 OF 2

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 77.3	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: John May	DATE STARTED: 10/7/80	DATE FINISHED: 10/7/80
DRILLING EQUIPMENT: Failing 1500		COMPLETION DEPTH: 24.9 ft	ROCK DEPTH: 24.0 ft
SIZE AND TYPE OF BIT	SIZE AND TYPE CORE BARREL: N/A	NO SAMPLES: DIST –	UNDIST 4, CORE –
CASING: 4 in. PVC		WATER LEVEL: FIRST –	COMPL –, 24HR –
CASING HAMMER	WEIGHT – / DROP –	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2–IN O.D. SPLIT SPOON		INSPECTOR: D. Pate	
SAMPLER HAMMER	WEIGHT 140 LBS / DROP 30–IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES TYPE NO. LOC	SAMPLES RECOV. FT	SAMPLES PENETR RESIST BL/6IN.	ROCK CORE CORE NO.	ROCK CORE RECOV. %	ROCK CORE RQD	ROCK CORE CORE TIME MIN/FT.	REMARKS
Topsoil (HUMUS, ROOTS, SILTY SAND)		0–1								PVC Casing set to 4.5 ft Drilling with water
Dark brown silty CLAY, tr fine to medium sand; moist, stiff	69.8	5–7	UD-1	2.0	PUSHED					Driller reports change at 7.5 ft
Light bluish-gray silty CLAY, trace fine SAND, moist, stiff	65.8	10–12	UD-2	2.0	PUSHED					
Light Buff to Gray sandy CLAY, trace silt, moist stiff	64.3	13								Driller reports change at 13 ft
Dark gray silty CLAY, some fine sand; moist, soft		15–17	UD-3	2.0	PUSHED					
		20								

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF BORING B-645 SHEET 2 OF 2

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dark gray silty CLAY, moist, firm	55.8	21	UD-4	2.0	PUSHED					
Dark gray clayey medium to fine SAND, trace silt, shells, wet, stiff		22								
		23								
		24	S-1	0	35 50/5"					Driller reports rock at 24 ft
	52.3	25								
Boring terminated at 24.9'										

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LOG OF BORING B-646 SHEET 1 OF 2

PROJECT AND LOCATION: SANTEE COOPER GENERATING STATION, UNIT 1		ELEVATION AND DATUM: 81.10	PROJECT NO.: 80C4090C01
DRILLING AGENCY: ARDAMAN AND ASSOCIATES	FOREMAN: Gandy	DATE STARTED: 10/2/80	DATE FINISHED: 10/2/80
DRILLING EQUIPMENT: CME-750		COMPLETION DEPTH: 32.0'	ROCK DEPTH: 32.0'
SIZE AND TYPE OF BIT: 3 7/8 Tricone	SIZE AND TYPE CORE BARREL: –	NO. SAMPLES: DIST 1	UNDIST 5; CORE -
CASING: 4 in. PVC		WATER LEVEL: FIRST ±30'	COMPL -; 24HR -
CASING HAMMER	WEIGHT – ; DROP –	BORING ANGLE AND DIRECTION: VERTICAL	
SAMPLER: 2-IN O.D. SPLIT SPOON		INSPECTOR: J.M. Kerr	
SAMPLER HAMMER	WEIGHT 140 LBS; DROP 30-IN		

DESCRIPTION	ELEV. FT.	DEPTH, FT	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
		1–4								Set PVC casing to 4'
White/red mottled sandy stiff CLAY	76.1	5–6	UD-1	1.5'	PUSHED					
		7–9								Boring drilled to obtain UD samples of overburden soils
Tan/Yellow, very plastic silty moist CLAY	71.1	10–12	UD-2	2.0'	PUSHED					
		13–14								
Grey, Plastic Silty CLAY with fine sand	65.6	15–17	UD-3	2.0'	PUSHED					
		18–20								

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LOG OF BORING B-646 SHEET 2 OF 2

DESCRIPTION	ELEV. FT.	DEPTH, FT.	SAMPLES: TYPE NO. LOC	SAMPLES: RECOV. FT.	SAMPLES: PENETR. RESIST BL/6IN.	ROCK CORE: CORE NO.	ROCK CORE: RECOV. %	ROCK CORE: RQD	ROCK CORE: CORE TIME MIN/FT.	REMARKS
Dark, grey, plastic silty CLAY with pockets of fine sand, moist, firm	60.8	21–22	UD-4	+ 2'	PUSHED					Pushed easy first 1.5', harder last 0.5'
		25–27	UD-5	0.0'	PUSHED					Pushed very easy, no recovery. Tried over-pushing to 29.0' and still no recovery
		29–30.5	S-1	2.0'	2 2 2					
Dark gray, moist, very soft, CLAY, with a trace of silt and sand	49.1	31–32	UD6	1.1	*					*Pushed very easy until rock at 32.0'
Boring terminated at 32.0'										Top of Rock @ 32.0'

TEST PIT LOGS

WOODWARD–CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-1

SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 78.0 MSL	PROJECT NO.: 80C4090C02
COORDINATES: N13079.5 E11055.0		COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 15 ft x 3 ft
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	NO. OF SAMPLES: DIST. 0	UNDIST. –
EXCAVATION EQUIPMENT: Case 580C		WATER LEVEL, FT: FIRST – *	COMP. –
DATE STARTED: 9/10/80	DATE FINISHED: 9/10/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
Silty CLAY: Gray, tan, quartz, dry, hard, slightly plastic. USC = 3.75	0–1
Silty CLAY: Gray, red-brown, trace fine to medium quartz SAND, slightly damp, firm, blocky. UCS = 2.5 (3 ft); UCS = 2.5 (4 ft)	1–5
Clayey SAND to Sandy CLAY: Yellowish gray, fine grained, few roots, slightly damp becoming moist with depth, wet @ 7.0 ft. USC = 1.5	5–9.5
Interlayered light brown CLAY and light green silty SAND: Discontinuous thin layers, very fine to fine grained quartz SAND, slightly moist	9.5–11
Clayey SAND and sandy CLAY: Interlayered, as above, but blue-green, moist, some coarse SAND	11–12

SAMPLES: NO. LOC.	TYPE	SIZE

* 1.2 ft water after 20 hours

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LOG OF TEST PIT TP-2 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER [COOR]DINATES: N1289.0 E10915.0		ELEVATION AND DATUM: 78.1 MSL	PROJECT NO.: 80C4090C02
[EXC]AVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / UNDIST. –	WATER LEVEL, FT: FIRST – / COMP. –
DATE STARTED: 9/10/80	DATE FINISHED: 9/10/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
Silty SAND: Dark gray, organics, numerous roots, dry, loose, silty CLAY with some sand from 0.5 ft - 1.0 ft. USC = 1.25	0 – 1
Silty CLAY: Red-brown, gray, some quartz sand, damp, roots common, mottled UCS = 1.0 (3 ft) UCS = 2.0 (4 ft)	1 – 6
Silty SAND: White-tan, predominately fine grained, quartz, some clay lenses	6 – 7
Grades to interlayered light brown CLAY and light green silty SAND: Thin discontinuous bedding, slightly moist, occ. wood fragments UCS = 1.5 (9 ft)	7 – 11
As above, but moist, blue-green, more clayey UCS=2.25	11 – 12

* 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

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LOG OF TEST PIT TP-3 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N13162.0 E11055.0		ELEVATION AND DATUM: 78.3 MSL	PROJECT NO: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/10/80	DATE FINISHED: 9/10/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
SAND: Clean, fine grained, quartz, sm med-coarse grain, tan, porous, loose	
Clayey SILT: Dark brown, with sand as above, dry, loose-moderately firm, slightly plastic — UCS = 2.75	1
Silty CLAY: Red-brown, gray, pockets of fine-med grained silty sand decreasing in abundance downwards, very slightly damp, abundant wood fragments, mottled	2–3
UCS = 2.5	4
	5
Silty SAND: Yellowish gray, fine grained, slightly damp, 1 in. CLAY layers common, laminated	6
UCS = 1.25	7
	8
UCS = 1.5	9
Grades to interlayered green silty SAND and green-brown slightly silty CLAY: Sand is fine grained quartz, becoming med-coarse grained at base, firm, moist	10–11
UCS = 1.75	11–12

* 0.2 ft water after 10 minutes
3.5 ft water after 48 hours (caved walls at base)

SAMPLES: NO. LOC. | TYPE | SIZE (none recorded)

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-4

SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 78.5 MSL	PROJECT NO: 80C4090C02
COORDINATES: N13439.5 E11055			
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 11.5 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0; UNDIST. –	
		WATER LEVEL, FT: FIRST –; COMP. –	
DATE STARTED: 9/10/80	DATE FINISHED: 9/10/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
Sandy CLAY: Organics, fine grained, dry, slightly plastic	0–0.5
SAND: Clean, fine grained, quartz, dry	1
Clayey SAND grading to sandy CLAY: Red-brown, gray, silty, fine-med grained quartz, mottled, damp UCS = 2.3	2–5
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	5–9
Silty-clayey SAND: Usually very fine grain, occ beds of med-coarse grained quartz sand, interlayed with light brown-green irregular seams of clay	9–11.5

SAMPLES: NO. LOC. | TYPE | SIZE

WOODWARD–CLYDE CONSULTANTS
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LOG OF TEST PIT TP-5 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER; DINATES: N13439.5 E11187.5		ELEVATION AND DATUM: 78.3 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/10/80	DATE FINISHED: 9/10/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES: NO. LOC.	TYPE	SIZE
Sandy SILT: Organics abundant, damp, some clay, loose, slightly plastic. UCS = 1.25	0–1			
CLAY: Light green-dark gray, red-brown, discontinuous lenses of fine grained silty sand common, damp, mottled. UCS=1.25; UCS = 1.75	1–4.5			
Silty SAND: Yellow-brown, damp, mostly fine grained, quartz, thin clay seams common	4.5–10			
Interlayered green silty SAND and CLAY: Very fine to fine grained quartz, irregular bedding, moist	10–12			

* No initial water influx
1.4 ft water after 34 hours

WOODWARD--CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-6 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N13169.0 E10903.5		ELEVATION AND DATUM: 78.8 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 3 UNDIST. –	
		WATER LEVEL, FT: FIRST – COMP –	
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy SILT: Organic rich, roots, some clay, dark brown, dry-slightly damp UCS = 1.25	0–0.6			
Clayey SAND and clayey SILT: Gray, red-brown, mottled, slightly damp, with vertically oriented pockets of white quartz sand, fine-med grained slightly damp	0.6–4.4	1 (3–4)		
Silty SAND: Yellow-tan, mostly fine-very fine grained, quartz slightly damp to moist at base, thin CLAY seams common especially near base.	4.4–8.6	2 (6.5–7.5)		
Interlayered green silty SAND and light brown CLAY: Thin discontinuous beds, laminated, slightly moist. Sand is very fine-fine grained, becoming coarser at base	8.6–12	3 (10–11)		

* 0.2 ft water after 20 minutes
0.5 ft water after 2 hours
2.4 ft water after 20 hours

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LOG OF TEST PIT TP-7 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N13139.5 E11202.5		ELEVATION AND DATUM: 77.2 MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.1 ft	APPROX. DIMENSIONS, FT: 12 ft x 5 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 4	UNDIST. -
		WATER LEVEL, FT: FIRST -	COMP. -
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.
Sandy SILT: Dary gray, brown, organics, some clay, dry to slightly damp, mod hard, slightly plastic USC = 3.25	0–1	1
Silty-sandy CLAY: Gray, yellow, red-brown, silty or clayey sand pockets common, firm-mod hard	1–5	
UCS = 2.0		
UCS = 2.0		
UCS = 2.0	4–5	2
Silty CLAY: Yellow-green, gray, laminated, some very fine-fine grained quartz sand	5–7.5	
UCS = 1.5	7–8	3
Grades to interlayered silty SAND and CLAY: Green to light brown, fine-med grained quartz sand, some coarse sand, moist, very firm	7.5–10.5	
UCS = 2.0		
SAND: Quartz, coarse, wet	10.5–12.1	4

* 0.2 ft water influx immediately
0.4 ft water after 20 min.

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-8 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.4 MSL	PROJECT NO.: 80C4090C02
COORDINATES: N13088.0 E11375.5			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 11.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 1	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
Sandy CLAY: Dark gray, with organics, fine grained sand, dry, hard	0–1
UCS = 4.5	1
Silty CLAY: Brown, gray, some fine grained sand, slightly damp	1–2
UCS = 1.75	3
As above but reddish-brown and gray, trace sand mottled	3–5.5
CLAY: Yellow-gray, some sand, moist (Sample 1 at 6–7 ft)	5.5–8.5
UCS = 1.2	7
Interlayered SAND and CLAY: Green, brown, fine to very fine grained sand, damp, slightly moist	8.5–11
UCS = 1.2	9.5

* No initial water influx
0.05 ft water after 30 minutes

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LOG OF TEST PIT TP-9 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12999.0 E11202.5		ELEVATION AND DATUM: 77.9 MSL	PROJECT NO.: 80C4090C01
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 11.0 ft	APPROX. DIMENSIONS, FT: 12 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / UNDIST. –	
		WATER LEVEL, FT: FIRST – / COMP. –	
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy SILT: Abundant tree roots, some clay, very loosely held, dry, slightly plastic	0–0.8			
Silty CLAY*: Reddish-brown, gray-black, some sandy patches, mottled, slightly damp	0.8–7			
UCS = 2.5	4			
UCS = 2.25	6			
Silty SAND: Yellowish gray-green, mostly fine grained, occ med grain, damp	7–9.5			
UCS = 1.75	9			
Interlayered SAND and CLAY: Green, mostly very fine to fine grained sand, moist, thin discontinuous clay units	9.5–11			
UCS = 1.2	11			

* No water infiltration after 20 minutes
0.1 ft water infiltration after 24 hours

WOODWARD–CLYDE CONSULTANTS
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LOG OF TEST PIT TP-10 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12990.5 E11055		ELEVATION AND DATUM: 78.1 MSL	PROJECT NO: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 12 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 UNDIST. – WATER LEVEL, FT: FIRST – * COMP. –	
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy SILT: Brown, porous, loosely held, roots common, some organic black clay, dry-damp, slightly plastic.	0–1			
Silty CLAY: Gray, red-brown, mottled, some fine grained sand, damp UCS = 1.5 (at 3)	1–4			
Silty CLAY: As above but silty sand layers becoming common, fine to med grained, slightly moist, very clean sand in places UCS = 1.5	4–6.5			
Silty SAND and silty CLAY: Gradational contact, yellow-gray, fine grained quartz, occ muscovite, some discontinuous light green clay seams common near base, damp, UCS = 1.0	6.5–8.2			
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 UCS=1.5	8.2–12			

* No initial water influx
0.2 ft water after 24 hours

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-11 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.0 MSL	PROJECT NO: 80C4090C02
COORDINATES: N12806.0 E11368			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 11.1 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/11/80	DATE FINISHED: 9/11/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Silty CLAY-Silty SAND: Dry, light gray, fine grained, occ coarse grained sand, very hard, decaying leaves and roots at top. UCS > 4.5	0–2			
As above but trace sandy CLAY present, black hard, dry. UCS > 4.5	2–3			
Sandy SILT: Light gray, reddish-brown in places, occ mica, hard, dry. UCS > 4.5	3–4.5			
Silty CLAY: Gray-dark gray, some yellowish, reddish-brown, hard, slightly damp, occ organics, occ sandy lenses. UCS =3.75	4.5–8			
Gradational contact to silty SAND: Yellow, gray, quartz, abundant mica, fine-med grained, thin clay lenses common especially near base, firm, damp, slightly moist	8–10.5			
Tannish gray silty SAND interlayered with green CLAY: Generally fine grained, some med grained, weak-firm, moist	10.5–11.1			

* No initial water influx
0.1 ft water after 18 hours

WOODWARD–CLYDE CONSULTANTS
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LOG OF TEST PIT TP-12 — SHEET 1 OF 1

(PRO)JECT AND LOCATION	SANTEE COOPER
COORDINATES	N12813.0 E11225.5
ELEVATION AND DATUM	77.6 MSL
PROJECT NO.	80C4090C02
EXCAVATION CONTRACTOR	R. Lewis
FORMAN	R. Lewis
COMPLETION DEPTH, FT	12.0 ft
APPROX. DIMENSIONS, FT	12 ft x 5 ft
EXCAVATION EQUIPMENT	Case 580C
NO. OF SAMPLES	DIST. 5 — UNDIST. –
WATER LEVEL, FT	FIRST – — COMP. –
DATE STARTED	9/11/80
DATE FINISHED	9/11/80
INSPECTOR	R. Blickwedel

DESCRIPTION	DEPTH, FT.	SAMPLES NO.
DECAY MATERIAL: Leaves and roots		
Silty CLAY-silty SAND: Hard to very hard, 3" thick beds of gray-black clay at base; sand/silt is lt gray, poorly sorted, very fine to coarse grained quartz UCS > 4.5	1	1
CLAY and silty SAND: Lt gray, reddish-brown patches, clay increasing downwards, mod hard and blocky, some mica, abundant decaying wood and roots, nearly all clay at base with minor sand stringers; fine grain, quartz	2–4	2
CLAY: Yellow-dark gray, sandy or silty, firm, some mica, locally reddish-brown UCS=4.5	5	3
Grades into yellowish green-gray fine grained, silty SAND, occ yellow-green clay lenses, mod loose	6–7	4
CLAY: Green, lenses of very fine-fine grained quartz sand, moist	8–9	
Interlayered green silty SAND and light brown CLAY: Sand mostly very fine grained, occ clayey, moist	10–11	
SAND: Yellow, coarse grain, loose, some CLAY	12	5

* Water flowing into pit immediately caving sides at bottom – 0.6 ft deep after 20 minutes
3.2 ft deep after 18 hours

WOODWARD—CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-13 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12812.0 E 11079.0		ELEVATION AND DATUM: 78.0 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / UNDIST. – WATER LEVEL, FT: FIRST – / COMP. –	
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
~~DECAY MATERIAL: Black, Clayey~~				
Clayey SAND: Light gray, fine grained, dry, very hard, slightly plastic. UCS > 4.5	0–1			
As above with dark gray CLAY as major constituent	1–2			
Silty CLAY: Red-brown, gray, some sand; clean, fine quartz in vertical stringers, trace to some organics, trace mica, firm, slightly damp UCS = 2.8	2–5.4			
Silty SAND: Yellowish gray, mostly fine grained, micaceous, yellow-gray clay seams common near base	5.4–7.8			
CLAY: Light green to light brown laminated with layers of fine, gray sand, micaceous, firm	7.8–9			
As above: Clay becoming blue-green, sandy, firm-mod hard	9–11.4			
SAND: Light brown, coarse, occ gravel size, some silt or clay.	11.4–12.2			

* No initial water influx
0.1 ft water after 60 minutes

WOODWARD–CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-14 SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 78.2 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N12586.0 E10911.5			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Silty CLAY-silty SAND: White-light grey, friable to firm, fine grained, dry — UCS = 3.4	0–0.8			
Silty CLAY: Gray, reddish brown, mottled, silty fine grained sand stringers common near top, firm, slightly damp — UCS = 2.5 (at 3 ft)	0.8–5			
CLAY and SAND: Interbedded, yellow, greenish gray; sand is clean, fine grained, some dark gray clay — UCS=2.7	5–6.2			
Silty SAND: Yellow-brown, fine grained, trace to some clay, damp	6.2–8.4			
Interlayered CLAY and SAND: Light green-blue, brown, thin discontinuous lenses; sand is fine grained, clean quartz — UCS = 1.75	8.4–11.7			
SAND: Coarse, wet, trace to some silt or clay	11.7–12.0			

* 0.1 ft water after 30 minutes
0.6 ft water after 3 hours
2.0 ft water after 20 hours

WOODWARD—CLYDE CONSULTANTS

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LOG OF TEST PIT TP-15

SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12510.0 E11053.0		ELEVATION AND DATUM: 77.7 ft MSL	PROJECT NO: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / WATER LEVEL, FT: FIRST –	UNDIST. – / COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy CLAY, Dark brown, organics, dry, slightly plastic	0			
Silty SAND: Tan-gray, predominately fine grained, firm to hard, dry	0–1			
Silty SAND as above with gray, red-brown clay layers, grades to silty-sandy CLAY: Red-brown, gray, very firm, blocky, slightly damp, mottled	1–5.6			
Interbedded CLAY and silty SAND: Clay is yellow-gray; sand is fine grained, micaceous, yellow-gray	5.6–6.6			
Interbedded light green silty SAND and light brown CLAY: Clay is in thin, discontinuous seams; sand is fine grained and thinly lensed. (UCS=3.25; UCS=2.8; UCS = 1.75)	6.6–9.8			
Interbedded silty SAND and CLAY: As above but clay most abundant, sand is fine grained	9.8–11.2			
SAND: Med-coarse grained, some silt or clay, occ pebble size, wet, loose	11.2–12.2			

* No initial water influx
0.5 ft water after 15 hours

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LOG OF TEST PIT TP-16   **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12509.0 E11215.0		ELEVATION AND DATUM: 77.3 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 5	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLE NO. LOC.
Silty SAND–sandy SILT: Light gray-dark gray, abundant roots, mostly fine-med grained quartz, hard, friable, blocky, porous	0–1.2	
As above but hard gray CLAY is major constituent UCS > 4.5	1.2–1.6	1 (1.0–1.5)
Silty CLAY: Gray, red-brown, some black slightly damp, firm-mod hard, some yellowish clay near base, vertical clean quartz sand stringers common. UCS = 2.3 (at 4 ft)	1.6–5.4	2 (3.0–4.0)
Silty SAND and CLAY: Gradational contact, fine grained quartz, micaceous, seams of yellow-dark gray and red-brown clay. USC = 1.9 (at 8 ft)	5.4–9.3	3 (5.5–6.0)
Interlayered white-light green, fine quartz SAND and green-brown blue CLAY, thin discontinuous beds, firm , damp	9.3–11.0	4 (9.0–10.0)
SAND: Coarse, some med grained to pebble size, quartz, wet, occ silt or clay	11.0–12.0	5 (11.0–12.0)

* No initial water influx
0.5 ft water after 20 hours

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LOG OF TEST PIT TP-17 — **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.5 ft MSL	PROJECT NO: 80C4090C02
COORDINATES: N12537.5 E11367.5			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.
Organic CLAY layer	
Silty SAND: to silty CLAY: White-light gray, dry, black organic, silty clay common near base, slightly plastic.	1
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.	2–5
Gradational contact to silty-clayey SAND: Yellow, gray, micaceous, mostly fine grained, trace med grain, clay is yellow-green, slightly damp	6–8
Interlayered thick light green CLAY and thin-fine grained silty SAND: Becomes more sandy downwards, coarse grained sand at 11.5 ft-12.0 ft with trace to some silt or clay, slightly moist	9–12

Samples: NO. LOC. | TYPE | SIZE — (none recorded)

* No initial water influx
2.8 ft water after 24 hours

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LOG OF TEST PIT TP-18 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.7 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N12548.5 E11508.0			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.4 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	FILE	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
~~Organic CLAY layer~~					
Sandy CLAY: Tan, fine grained, quartz, dry, slightly plastic. UCS = 1.75		1			
Silty-sandy CLAY: Gray, orange-brown, some organics, loose-mod firm, mottled, laminated yellow-green sandy clay near base. UCS = 1.75; UCS = 2.0		2–6			
Silty SAND: Yellow, gray, fine grained, tr med grained, trace clay, damp, slightly moist		6–7.5			
Interlayered green-gray silty CLAY and silty SAND: Irregular lenses, grades into silty or clayey fine grained sand, moist. UCS = 1.9; UCS = 1.25		7.5–11			
SAND: Coarse, wet, some silt or clay		11–12.4			

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LOG OF TEST PIT TP-19 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER	COORDINATES: N12872.5 E11589	ELEVATION AND DATUM: 77.4 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/12/80	DATE FINISHED: 9/12/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	PIEZ.	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Organic CLAY layer: roots, silty, dark gray, dry					
Silty CLAY-sandy SILT: White-light gray, fine grained, hard, dry		1			
Silty CLAY: Gray-dark gray, yellowish green, orange-brown, sand pockets of fine grained quartz common, slightly damp, firm-mod hard		2, 3			
UCS = 4.1		4			
Silty SAND: Yellow-gray, fine grained, quartz, some mica, occ light brown clay lenses, occ decayed material, damp-moist		5, 6, 7, 8			
Interlayered silty SAND and blue green-brown silty CLAY: thin irregular beds, loose-slightly firm		9			
UCS=1.1		10, 11			
SAND: Yellow-green, coarse, wet,		12			
* No initial water influx		13			

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LOG OF TEST PIT TP-20 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12331.0 E11067.0		ELEVATION AND DATUM: 77.9 ft	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 15 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/13/80	DATE FINISHED: 9/13/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Organic CLAY layer: silty, 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 clean, white, fine sand	2, 3, 4			
As above but sandy-silty CLAY is major constituent, gray and yellow-green laminae, mod firm, damp	5			
Silty SAND and CLAY: Yellow, gray, fine grained, occ med grain damp, some thin beds of yellow-green clay, trace decayed material, micaceous	6, 7, 8			
Interlayered light green SAND and light brown CLAY: Irregular bedding, very fine-fine grained sand; clay is laminar, firm, slightly moist-moist	9, 10			
As above but clay is blue green	11, 12			

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LOG OF TEST PIT TP-21 SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N12322 E11297.5		ELEVATION AND DATUM: 77.7 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0; UNDIST. – WATER LEVEL, FT: FIRST –; COMP. –	
DATE STARTED: 9/13/80	DATE FINISHED: 9/13/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
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	1–3			
Silty-sandy CLAY: Gray, red-brown, mottled, slightly damp, firm UCS = 4.5	3–5			
CLAY and Silty SAND: Yellow-gray, occ clean pure quartz sand stringers, light green-gray clay lenses, slightly moist UCS = 1.75	5–7			
Silty SAND: As above but less clay, yellow-brown, firm grained, slightly moist to moist	7–8			
Interlayered tan-light green, fine grained silty SAND and green-light brown CLAY, moist firm, some mica	8–12			

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LOG OF TEST PIT TP-22

SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.5 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N12731.0 E11588.0			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0; UNDIST. –	
		WATER LEVEL, FT: FIRST –; COMP. –	
DATE STARTED: 9/13/80	DATE FINISHED: 9/13/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy CLAY: Tan-gray, generally very fine-fine grained, some med-coarse grain, hard, dry UCS > 4.5	0–1			
Silty-sand CLAY: Abundant vertical sand stringers in clay becoming more clayey with depth, gray, orange brown patches, dry, firm where clayey, loose where sandy, some organic material UCS = 3.5	1–4			
As above: Clay becoming gray to yellow-green, silty and sandy	4–4.5			
Silty SAND: Yellow-green, gray, very fine-fine grained quartz, some light green clay lenses	4.5–6.3			
Gradational contact to interlayered tan-light green, fine silty SAND and green to light brown CLAY, moist, firm, irregular beds UCS = 1.9	6.3–12			

* No initial water infiltration

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LOG OF TEST PIT TP-23 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER	COORDINATES: N12510.0 E11990.0	ELEVATION AND DATUM: 77.8 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 2; UNDIST. –	WATER LEVEL, FT: FIRST –; COMP. –
DATE STARTED: 9/13/80	DATE FINISHED: 9/13/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
SAND and SILT: Very fine-fine quartz, clean, yellow-tan, dry	0–1	1		
SAND and SILT: As above but orange, hard, dry	2–5			
Interlayered light green silty CLAY and tan-orange silty SAND: Thin, irregular beds, very clayey in places; sand is very fine-fine grained, quartz, micaceous, damp-slightly moist	5.5–12.2			
UCS = 3.3	~6			
UCS = 2.25	~10	2		

* No initial water influx

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LOG OF TEST PIT TP-24 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: Not available	PROJECT NO: 80C4090C02
COORDINATES: N11915.0 E11065.0			
EXCAVATION CONTRACTOR: R. Lewis	FORMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 4	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/15/80	DATE FINISHED: 9/15/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Organic CLAY layer	0			
Sandy CLAY: Tan-light gray, fine-med grained, dry, hard, slightly plastic	0–1	1		
Sandy-silty CLAY: Gray, red-orange patches, mottled, abundant vertical sand stringers of fine grained, pure quartz, some roots, dry, hard, clay becomes gray and yellow-green at base (sandier in this region)	1–5	2		
Silty CLAY: Gradational from above, yellow, gray, white, orange patches, occasional fine-grained quartz sand, tr muscovite.	5–9	3		
CLAY and silty SAND: Interbedded, thin, irregular lenses, light green, very fine-fine grained sand, occ mica, slightly moist to moist	9–11.5	4		
SAND: Med-coarse grained, quartz, wet, some clay or silt	11.5–12.2			

* Initially dry

WOODWARD-CLYDE CONSULTANTS

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LOG OF TEST PIT TP-25 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N11915.0 E11295.0		ELEVATION AND DATUM: Not available	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 11.5 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / UNDIST. –	WATER LEVEL, FT: FIRST – * / COMP. –
DATE STARTED: 9/15/80	DATE FINISHED: 9/15/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Organic gray SILT: Abundant tree roots				
Silty CLAY-sandy CLAY: fine-med grained powdery, hard, blocky, dry UCS > 4.5	1			
Sandy-silty CLAY: Gray, red-orange patches, mottled; sand mostly fine grained, occ med grained, dry, hard, some roots, some vertical sand pockets UCS > 4.5	2–3			
Grades into gray, yellow-green CLAY with micaceous, gray, fine grained sand stringers common, slightly damp, firm-hard UCS > 4.75	3–5			
Silty SAND and CLAY: Yellow, gray, white, orange patches, fine grained, micaceous, some discontinuous clay lenses, damp UCS = 4.5	6–8			
Silty SAND and CLAY: Interlayered, light green, very fine-fine grained, slightly moist-moist, becomes blue-green with depth, sand is coarse at base	9–11.5			

* Initially dry

WOODWARD–CLYDE CONSULTANTS

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LOG OF TEST PIT TP-26 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.0 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N12960.0 E11995.0			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP –
DATE STARTED: 9/15/80	DATE FINISHED: 9/15/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Silty SAND: Tan, quartz, fine grained, tr med grain, dry, clayey at base.	0–1			
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-gray some red-orange patches, damp, mod firm to hard. UCS > 4.5 (at 3 ft); UCS > 4.5 (at 5 ft)	2–5			
Grades into yellow-gray, fine grained silty SAND: with gray CLAY seams 1-2" in thickness, sand is quartz, abundant mica flakes, slightly damp	6–7			
As above but sand is very fine-fine grained, becoming more clayey downwards, firm, damp-slightly moist	8–11			
SAND: Coarse, clayey, moist	12			

* Water flowing in base of pit caving walls
0.4 ft water after 30 minutes

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LOG OF TEST PIT TP-27 **SHEET** 1 **OF** 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.1 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N13000.0 E11475.5			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.0 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/15/80	DATE FINISHED: 9/15/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Silty CLAY: Light gray, tr fine to med grained sand, hard dry, blocky, porous, powdery. UCS > 4.5	0–1.6			
Silty CLAY: Gray, orange-brown, mottled, roots common, hard, dry-slightly damp, some black organic clay, some yellowish clay from 5.5 ft to 6.0 ft (becoming sandier in this region) UCS = 4.25 * UCS = 4.25	1.6–6			
Silty SAND: Yellow gray, very fine to fine grained, quartz, occ mica, abundant finely laminated layers of yellow-gray CLAY, slightly moist UCS = 2.5	6–9.7			
Grades into interlayered sand as above and light brown-green clay becoming blue-green at base UCS = 1.5	9.7–12			

* Test pit dry

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LOG OF TEST PIT TP-28 — SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER		ELEVATION AND DATUM: 77.3 ft MSL	PROJECT NO.: 80C4090C02
COORDINATES: N13137.5 E11522.5			
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580 C		NO. OF SAMPLES: DIST. 0; UNDIST. –	
		WATER LEVEL, FT: FIRST –; COMP. –	
DATE STARTED: 9/15/80	DATE FINISHED: 9/15/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy CLAY: Light gray, fine grained, some med grain, trace coarse grain, dry, hard, porous, blocky, slightly plastic	0–1			
Silty CLAY: Occ sand stringers, gray, reddish brown, mottled, roots, some organic black clay, dry-slightly damp, hard, blocky, some yellow-gray clay from 4.5 ft – 5.0 ft (sandier in this region) UCS=3.5	1–5			
Silty SAND: Yellow-gray, quartz, micaceous, very fine-fine grained, some yellowish green-dark gray CLAY, slightly damp	5–7			
Interlayered laminated CLAY and thin SAND lenses: light green, silty, very-fine grained sand, some mica, slightly moist	7–10.8			
Interlayered fine-coarse SAND and laminated CLAY: Light green-brown becoming blue-green near base, moist, discontinuous beds	10.8–12.2			

* Initially dry
  0.5 ft water after 24 hours

WOODWARD–CLYDE CONSULTANTS
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LOG OF TEST PIT TP-29   SHEET 1 OF 1

PROJECT AND LOCATION: SANTEE COOPER; COORDINATES: N13440.0 E11590.0		ELEVATION AND DATUM: 77.1 ft MSL	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.2 ft	APPROX. DIMENSIONS, FT: 10 ft x 4 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 2	UNDIST. –
		WATER LEVEL, FT: FIRST –	COMP. –
DATE STARTED: 9/16/80	DATE FINISHED: 9/16/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES NO. LOC.	TYPE	SIZE
Sandy CLAY-silty CLAY: Light gray, hard, dry, some very fine-fine grained sand, some med-coarse grain, porous. UCS > 4.5	0–1.5			
Silty CLAY: Gray-dark gray, red-brown patches, mottled, fine grained clean quartz sand stringers common, slightly damp, hard. Clay becomes yellow-gray with depth. UCS > 4.5	1.5–5.5	(2–3)		
Silty SAND: Gradational contact, yellow-gray, orange patches, some yellow-gray CLAY at top and bottom, fine grained, slightly, damp. UCS = 2.75	5.5–8.5	(6–7)		
Grades into interlayered CLAY and SAND: Light green-light brown, sand coarsens and increases in abundance with depth, moist to wet with depth. UCS = 1.5; UCS = 0.75	8.5–12.2			

* no water influx

WOODWARD–CLYDE CONSULTANTS

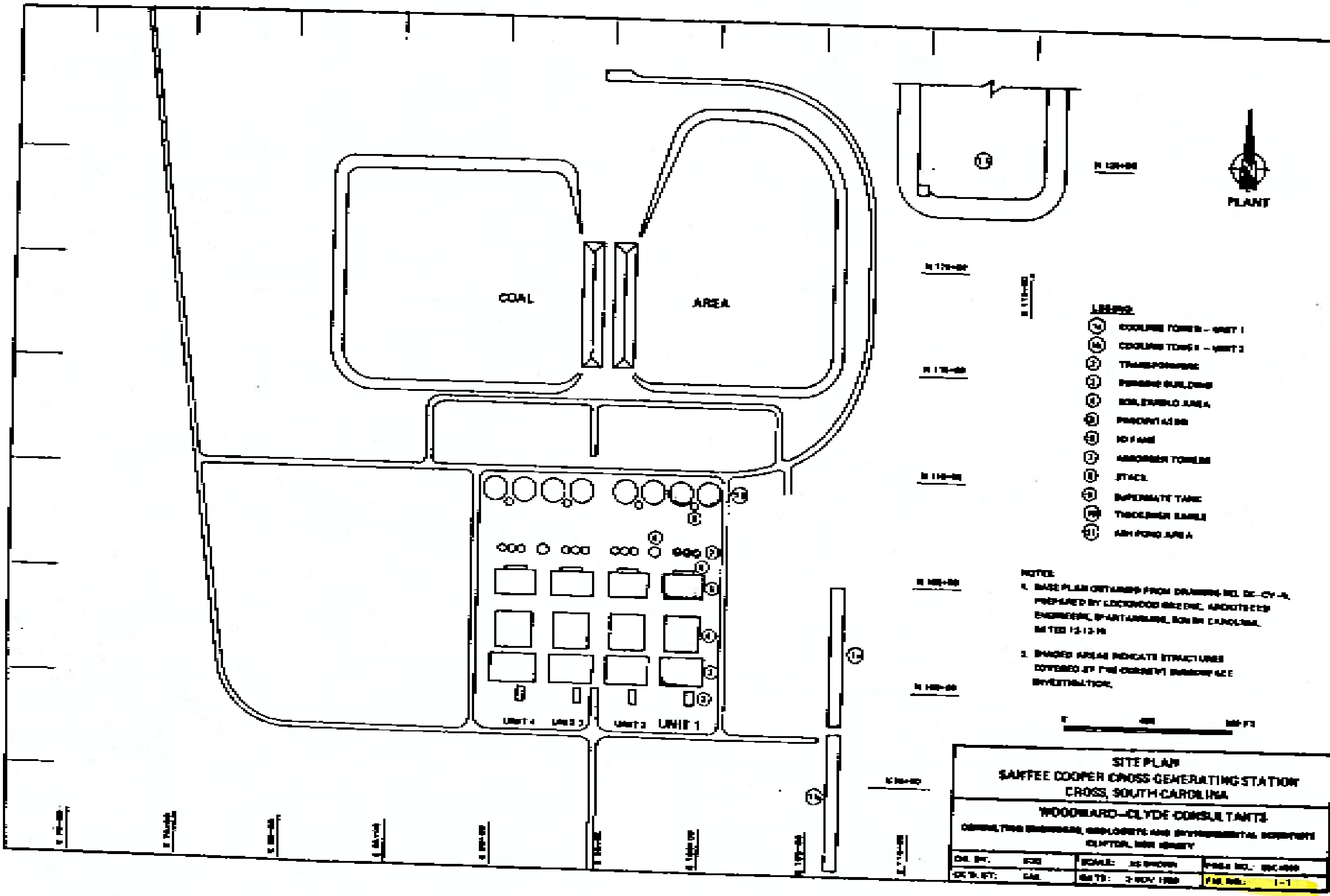
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

LOG OF TEST PIT TP-30 **SHEET** 1 **OF** 1

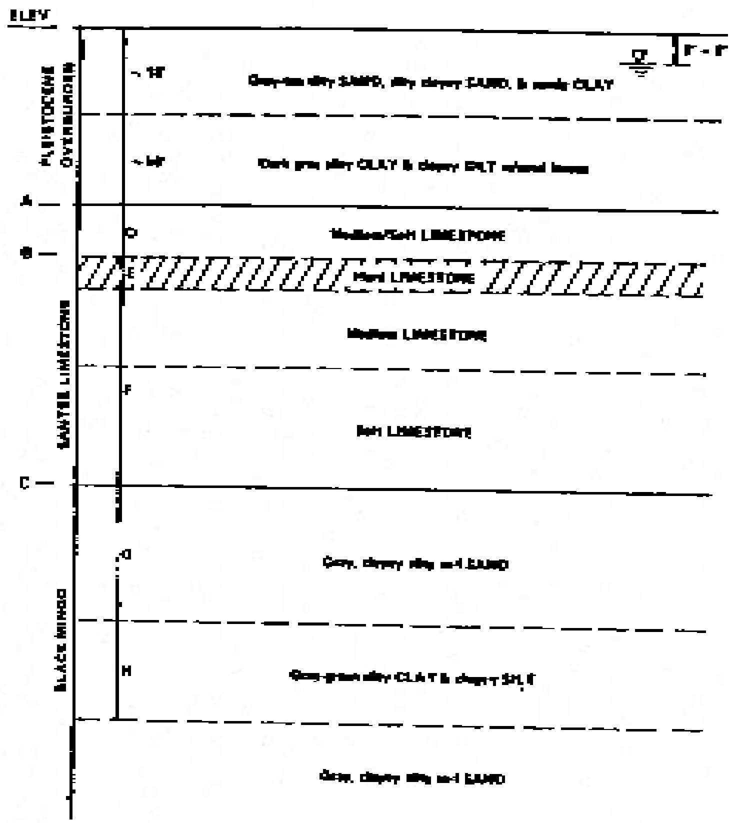
PROJECT AND LOCATION: SANTEE COOPER COORDINATES: N13233.0 E10500.0		ELEVATION AND DATUM: Not available	PROJECT NO.: 80C4090C02
EXCAVATION CONTRACTOR: R. Lewis	FOREMAN: R. Lewis	COMPLETION DEPTH, FT: 12.6 ft	APPROX. DIMENSIONS, FT: 12 ft x 5 ft
EXCAVATION EQUIPMENT: Case 580C		NO. OF SAMPLES: DIST. 0 / UNDIST. –	
		WATER LEVEL, FT: FIRST – / COMP. –	
DATE STARTED: 9/16/80	DATE FINISHED: 9/16/80	INSPECTOR: R. Blickwedel	

DESCRIPTION	DEPTH, FT.	SAMPLES: NO. LOC.	TYPE	SIZE
Gray organic root layer: clayey.				
SAND: Tan, mostly very fine-fine grained, some silt, dry, loose. UCS = 4.0	1			
SAND and sandy-silty CLAY: Light gray, orange-brown, sand is fine grained some med-coarse grain, dry with occ organics, abundant pure white vertical quartz sand stringers, mostly fine-very fine grained. UCS = 2.5	2–4			
Silty SAND and CLAY: Yellowish-gray, fine grained, quartz and muscovite, abundant very thin light green-gray lenses. UCS = 1.25	5–8			
Grades into interlayered very fine-fine grained silty SAND and laminated CLAY: Thin irregular bed. Green-brown, blue-green near base, quartz, occ mica, moist. UCS = 1.25	9–12			
SAND: Coarse, some silt and clay, wet, loose. UCS = 0.5	12.6			

* 0.1 ft water after 20 minutes


PLANT
COAL
AREA
UNIT 1
LEGEND
COOLING TOWER – UNIT 1
COOLING TOWER – UNIT 2
STACK
NOTES
SITE PLAN
SANTEE COOPER CROSS GENERATING STATION
CROSS, SOUTH CAROLINA
WOODWARD-CLYDE CONSULTANTS

GENERALIZED SOIL PROFILE



AVERAGE ELEVATIONS AND DIMENSIONS, FT
PLANT AREA STRUCTURES

ELEVATION	DIMENSION	Turbine Bldg	Boiler/Silo Area	Precipitator Area
A	—	53	53	11
B	—	38	41	40
C	—	-3	-4	3
—	D	13	11	9
—	E	8	8	4
—	F	40	38	30
—	G	~ 38	~ 35	~ 25
—	H	> 22	> 37	~ 20

NOTES:

1. Medium LIMESTONE below the hard layer is typically 30% to 50% of dimension F
2. See isopach maps and isopachs for variation across the site of the above elevations and dimensions

PLANT AREA STRUCTURES
GENERALIZED SOIL PROFILE,
AVERAGE ELEVATIONS AND DIMENSIONS
SANTEE COOPER CROSS GENERATING STATION
CROSS, SOUTH CAROLINA

WOODWARD–CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
CLIFTON, NEW JERSEY

DR. BY:	[illegible]	SCALE:	NONE	PROJ. NO.:	[illegible]
CH'D. BY:	[illegible]	DATE:	5 JAN 1981	FIG. NO.:	[illegible]

SUMMARY OF BORING DATA
(Continued)

Structure Area	Boring No.	N Coor.	E Coor.	Elev of Ground Surface (ft)	Elev of Top of Santee Limestone (ft)	Elev of Top of Void (ft)	Height of Void (ft)	Elev of Top of Black Mingo	Groundwater Elev (ft)[1]	Thickness of Limestone Penetrated Before Coring (ft)
Ash Pond										
	B-621	12415.0	10975.0	77.9	52.2	-	-	17.9	72.9	0
	B-622	12360.0	10975.0	78.0	54.0	54.0*	3.5	-	72.6	12.1
	B-623	12315.0	11120.0	77.7	49.7	-	-	-	73.7	7.0
	B-624	12315.0	11270.0	77.7	53.5	-	-	-	75.8**	1.0
	B-625	12315.0	11420.0	78.0	55.0	-	-	-	72.2**	6.5
	B-626	12365.0	11595.0	78.2	52.2	-	-	-	-	5.0
	B-627	12510.0	11595.0	77.9	52.4	-	-	-	73.0	6.0
	B-628	12660.0	11591.0	77.6	51.6	34.0*	small	-	73.1	9.5
	B-629	12810.0	11595.0	77.6	50.6	-	-	-	70.4**	8.5
	B-630	12965.0	11595.0	77.2	55.2	54.2*	2.0	-	72.2	9.5
	B-631	13100.0	11595.0	77.5	54.5	25.0*(2)	1.5	-	73.0	11.0
	B-632	13255.0	11571.5	77.1	54.7	29.1	8.5	17.1	72.6	0
	B-633	13270.0	11390.0	77.4	47.4	42.4	0.2	-	-	9.0
						32.4*	3.0			
	B-634	13270.0	11265.0	77.2	57.0	-	-	-	76.5	12.0
	B-635	13270.0	11090.0	78.4	59.0	-	-	-	76.5	13.5
	B-636	13255.0	10935.0	79.2	60.2	-	-	-	-	18.5
	B-637	13095.0	10905.0	78.5	60.5	-	-	-	75.6	12.5
	B-638	12960.0	10920.0	78.0	60.3	-	-	-	76.3	17.8
	B-639	12810.0	10910.0	78.1	61.6	-	-	-	73.0	19.5
	B-640	12660.0	10910.0	78.0	62.5	-	-	-	72.6	10.0
	B-641	12510.0	10910.0	78.4	60.9	58.4*	small	-	-	8.6
	B-642	12510.0	11280.0	77.2	50.7	-	-	-	72.1	2.0
	B-643	12810.0	11270.0	77.1	59.1	-	-	-	73.0	6.1
	B-644	13100.0	11270.0	77.4	52.4	51.9*	0.4	-	73.5	7.0
	B-645	12810.0	11432.0	77.3	53.3	-	-	-	-	-

* Water loss
** At completion

(1) Groundwater elevations based on readings 24 hr after completion of boring unless otherwise noted
(2) No drill water return between el 37 and el 19

Sheet 2 of 2
Table 1-1

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

POWER AND INDUSTRIAL SYSTEMS DIVISION – READING
CALCULATION

Gilbert Commonwealth Companies

PROJECT: SANTEE COOPER CROSS GENERATING STATION

IDENTIFIER: S-SL-173-3

SUBJECT: BOTTOM ASH POND EXTENSION

CLASSIFICATION: N/A

SECTION NAME AND NUMBER: CIVIL / GEOTECHNICAL 0413

W.O. 04-6151-006

REVISION	0	1	2	3
ITEM(S) REVISED	X			
ORIGINATOR	J.D. Winterbottom			
DATE	10-9-90			
REVIEWER/VERIFIER	D.R. Eal			
DATE	10/9/90			
APPROVAL	Kumm			
DATE	10/24/90			
ASSUMPTIONS/PRELIMINARY DATA	YES			
PAGES REFERENCE	P4			

THIS CALCULATION REQUIRES ■ REVIEW PER E-1 NO. 9 RESULTS ARE NOTED BELOW. ☐ VERIFICATION PER DCP 2.05

THE REVIEW OF THE CALCULATION INCLUDED EVALUATION AGAINST THE FOLLOWING QUESTIONS:	REMARKS	REMARKS	REMARKS	REMARKS
WERE INPUTS, INCLUDING CODES, STANDARDS, AND REGULATORY REQUIREMENTS, CORRECTLY SELECTED AND APPLIED?	YES			
ARE ASSUMPTIONS REASONABLE AND ADEQUATELY IDENTIFIED?	YES			
HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCES BEEN CONSIDERED?	YES			
WAS AN APPROPRIATE CALCULATION METHOD USED?	YES			
IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	YES			

TABLE OF CONTENTS

Gilbert/Commonwealth ENGINEERS/CONSULTANTS CALCULATION	SUBJECT: BOTTOM ASH POND EXTENSION			IDENTIFIER: S-SL173-3		PAGE 3 OF 8 PAGES
	REV. 0	1	2	3		
	MICROFILMED					
	ORIGINATOR Winterhalter					
	DATE 10-9-90					

A. PURPOSE

Design an extension of the existing ash pond to provide storage for a total of 35 years of bottom ash production for Units 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 pond capacity = 217 ac-ft. therefore 1183 ac.-ft. additional storage required.
   Expand to north and west of existing pond
   Depth of new pond = 18 ft. with 2 ft. freeboard
   Top of dike = elev. 95.0 ft. (max. water = 93.0 ft.)
   Use bentonite liner per existing pond
   Sideslopes shall be 3:1 (H:V). (All from Ref. 1)

2. Pond liner shall provide a permeability of 1×10^{-6} centimeters/second or less. From verbal request of Santee Cooper. Phone conversation with Bergstrom and Kroener.

Gilbert/Commonwealth ENGINEERS/CONSULTANTS CALCULATION	SUBJECT BOTTOM ASH POND EXTENSION			IDENTIFIER S-SL173-3	PAGE 4 OF 8 PAGES
	REV. 0	1	2	3	
	MICROFILMED				
	ORIGINATOR Winterhalter				
	DATE 10-9-90				

C. REFERENCES

1. Meeting Minutes, GS-C0007, May 3, 1990
2. Letter GS-L0025, June 20, 1990, from E.K. Bergstrom to B.C. Rodgers, Jr. Report of study of landfill and bottom ash pond expansion.
3. Drawing BA-117-C1, Bottom Ash Pond Expansion, Plan
4. Drawing BA-117-C2, Bottom Ash Pond Expansion, Section and Details
5. Law Engineering Testing Co., Final Report, Cross Generating Station, Volume 2, Phase II, Feb. 9, 1979
6. Woodward-Clyde Consultants, Vol. 1&2, Unit I Subsurface Investigation, Cross Generating Station, Prepared for Burns and Roe, Inc., January 1981

D. ASSUMPTIONS (REF. 2)

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

E. CALCULATIONS

1. ADDITIONAL STORAGE CAPACITY REQUIRED:

Reference 1 states that 1183 ac-ft. of additional storage is 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 1250 ac-ft. for design.

2. POND CONSTRUCTION:

Santee Cooper has verbally agreed to the pond construction method proposed in Scheme I, Option B, in Reference 2, using soil/bentonite slurry walls.

Pond bottom elevation = 72.0 ft.
Maximum water/ash elev. = 90.0 ft.
Embankment side slopes = 3:1 (H:V)
} Ref. 2, Att'mt D

Two feet of freeboard per existing pond and construct the embankment 1 foot higher to allow for settlement.

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

Area of bottom of pond = 3,176,576 SF
= 72.924 ac.

Pond depth = 18 ft.

Capacity w/o embank = 72.924 × 18 = 1312.6 ac-ft.
Capacity along embank = 76 in × 100 ft/in × 9 × 54 = 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 permeability test results. See the attached table.

Type of Test - Legend

B = bailing test in piezometer - LETCO

F = falling head field test - LETCO

L = laboratory constant head test - LETCO

P = packer field test - LETCO

L.U = laboratory test on undisturbed samples, various W_c - WCC

L.R = laboratory test on composite, recompacted samples, various W_c - WCC

Gilbert/Commonwealth
ENGINEERS/CONSULTANTS
CALCULATION

SUBJECT	IDENTIFIER	PAGE
BOTTOM ASH POND EXTENSION	S-SL173-3	7 of 8 PAGES

REV.	0	1	2	3
MICROFILMED				
ORIGINATOR	Winterhaller			
DATE	10-15-90			

BORING NUMBER	GRADE ELEV. (FT)	SAMPLE/TEST DEPTH (FT)	SAMPLE/TEST ELEV. (FT)	UNIFIED SOIL CLASSIFICATION	SITE AREA	PERMEABILITY (cm/sec)	TYPE OF TEST
221 A	81 ±	9.0 - 10.0	72.0 - 71.0	SC		3.69×10^{-5}	F
223	80.2	8.5 - 10.0	71.7 - 70.2	SC		3.11×10^{-5}	F
223	"	15.0 - 15.5	65.2 - 63.7	SC		3.81×10^{-5}	F
225	79.9	3.5 - 4.5	76.4 - 75.4	SC		3.32×10^{-8}	F
225	"	9.0 - 10.0	70.9 - 69.9	SP		2.65×10^{-4}	F
HA-225	"	3.0 - 5.0	76.9 - 74.9	SC		6.82×10^{-6}	F
HA-225	"	8.0 - 10.0	71.9 - 69.9	SM	Solid Waste Landfill area	1.78×10^{-5}	F
HA-227	80.6	3.0 - 5.0	77.6 - 75.6	SC		1.04×10^{-7}	F
HA-227	"	8.0 - 10.0	72.6 - 70.6	CL		3.17×10^{-7}	F
229	80.4	10.0 - 12.0	70.4 - 68.4	SC		3.88×10^{-5}	L
TP-229	"	1.0 - 3.0	79.4 - 77.4	SM		1.102×10^{-5}	L
230	81.4	13.5 - 15.0	67.9 - 66.4	SM		4.43×10^{-5}	L
HA-231	81.6	3.0 - 5.0	78.6 - 76.6	SC		4.38×10^{-7}	F
HA-231	"	8.0 - 10.0	73.6 - 71.6	SC		9.24×10^{-7}	F
232	82.1	8.5 - 10.0	73.6 - 72.1	SC		1.28×10^{-6}	F
HA-234	83.2	3.0 - 5.0	80.2 - 78.2	SC		2.33×10^{-4}	F
HA-234	"	8.0 - 10.0	75.2 - 73.2	CL	COAL PILE AREA	1.07×10^{-5}	F
HA-237	80.2	3.0 - 5.0	77.2 - 75.2	SC		4.76×10^{-6}	F
HA-237	"	8.0 - 10.0	72.2 - 70.2	CL		5.24×10^{-6}	F
HA-238	80.2	3.0 - 5.0	77.2 - 75.2	CL		2.22×10^{-6}	F
HA-238	"	8.0 - 10.0	72.2 - 70.2	CL, SC		5.43×10^{-5}	F
238 A	80.2 ±	8.5 - 10.0	71.7 - 70.2	SM		3.08×10^{-4}	F
239 A	76.7 ±	3.5 - 5.5	73.2 - 71.2	CL	E. of B.A. Pond	1.08×10^{-5}	F
240	79.7	10.5 - 12.5	69.2 - 67.2	SM, SC	in B.A. Pond	7.961×10^{-7}	L

GAI-446 7-84

Gilbert/Commonwealth
ENGINEERS/CONSULTANTS
CALCULATION

SUBJECT: BOTTOM ASH POND EXTENSION
IDENTIFIER: S-SL173-3
PAGE 8 OF 8 PAGES
REV. 0 | 1 | 2 | 3
MICROFILMED
ORIGINATOR Winterhalter
DATE 10-16-90

BORING NUMBER	GRADE ELEV. (FT)	SAMPLE/TEST DEPTH (FT)	SAMPLE/TEST ELEV. (FT)	UNIFIED SOIL CLASSIFICATION (w.c.)	SITE AREA	PERMEABILITY (cm/sec)	TYPE OF TEST
243	78.8	13.5-15.0	65.3-63.8	SM	E. of Bot. Ash Pond Expansion	2.82×10^{-6}	F
HA-243	"	3.0-5.0	75.8-73.8	SM-SC		1.48×10^{-5}	F
HA-243	"	10.0-12.0	68.8-66.8	SM		2.44×10^{-5}	F
HA-244	79.3	3.0-5.0	76.3-74.3	SC	in Bot. Ash Pond	3.22×10^{-5}	F
HA-244	"	8.0-10.0	71.3-69.3	SC	in Bot. Ash Pond	1.03×10^{-4}	F
246	76.0	2.5-3.5	73.5-72.5	SC	N. of Bot. Ash Pond	2.47×10^{-7}	F
246	"	8.5-10.0	67.5-66.0	SC		7.9×10^{-8}	F
246	"	10.5-12.5	65.5-63.5	SC		5.4×10^{-6}	L
HA-246	76.0	3.0-5.0	73.0-71.0	CL		1.08×10^{-6}	F
HA-246	"	8.0-10.0	68.0-66.0	CL		1.24×10^{-5}	F
247	78.6	12.0-13.5	66.6-65.1	SM		1.83×10^{-6}	F
247	"	32.0-33.0	46.6-45.6	SW		4.18×10^{-5}	F
248	81.2	8.5-10.0	72.7-71.2	ML		3.54×10^{-7}	F
TP-248 (45' E of 248)	81±	2.5-5.0	78.5-76.0	SM		8.866×10^{-7}	L
B-623	77.66	14.0	63.66	CH 60.0	Embankment of ex. Bot. Ash Pond at pump house	6.7×10^{-9}	LU
B-623	"	14.0	"	CH 52.4		4.2×10^{-9}	LU
B-623	"	14.0	"	CH 57.1		3.2×10^{-9}	LU
B-623	"	14.5	"	CH 57.2		1.7×10^{-8}	LU
Comp. 1	77±	1	76±	16.5	composite samples from Test Pits in or near ex. Bot. Ash Pond	5.9×10^{-9}	LR
Comp. 1	77±	1	76±	15.6		8.7×10^{-8}	LR
Comp. 2	77±	3±	74±	27.1		8.7×10^{-9}	LR
Comp. 2	77±	3±	74±	25.5		3.5×10^{-9}	LR
Comp. 3	78±	7±	71±	25.0		6.9×10^{-9}	LR
Comp. 3	78±	7±	71±	25.3		1.7×10^{-8}	LR

GAI-446 7-84

ENGINEERING INSTRUCTION NO. 2

CALCULATION

PROJECT: Santee Cooper – Cross Station Unit 1

IDENTIFIER: S-SL173-4

SUBJECT: Ash Pond Dike Stability

CLASSIFICATION: Non-nuclear Environmental Safety Related

SECTION NAME AND NUMBER: Civil/Structural, No. 2141

W.O. 04-6151-006

REVISION	0	1	2	3
ITEM(S) REVISED	X			
ORIGINATOR (Y.S. SHAH)	[signature]			
DATE	3-3-92			
REVIEWER/VERIFIER	D.R. [signature]			
DATE	3/3/92			
APPROVAL	[signature]			
DATE	3/4/92			
ASSUMPTIONS/PRELIMINARY DATA	NO			
PAGES REFERENCE				

THIS CALCULATION REQUIRES ☒ REVIEW PER EI-9 RESULTS ARE NOTED BELOW. ☐ VERIFICATION PER DCP 2.05

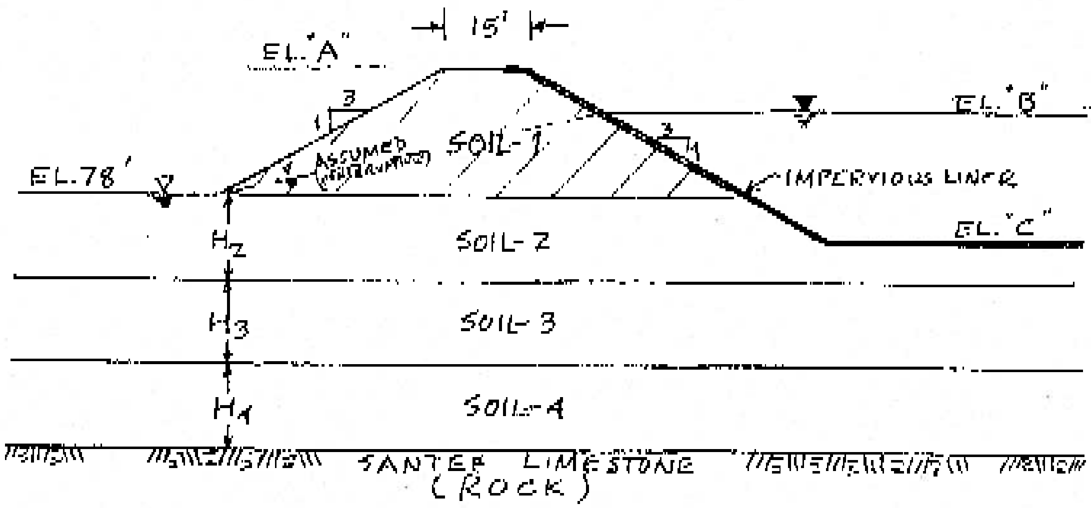
THE REVIEW OF THE CALCULATION INCLUDED EVALUATION AGAINST THE FOLLOWING QUESTIONS:	REMARKS	REMARKS	REMARKS	REMARKS
WERE INPUTS, INCLUDING CODES, STANDARDS, AND REGULATORY REQUIREMENTS, CORRECTLY SELECTED AND APPLIED?	YES			
ARE ASSUMPTIONS REASONABLE AND ADEQUATELY IDENTIFIED?	YES			
HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCES BEEN CONSIDERED?	YES			
WAS AN APPROPRIATE CALCULATION METHOD USED?	YES			
IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	YES			

ENGINEERING INSTRUCTION NO. 2

CALCULATION	SUBJECT CROSS SIN ASH-POND DIKE STABILITY		IDENTIFIER 5-SL173-4		PAGE 2 OF 100 PAGES
	REV. 0	1	2	3	
	MICROFILMED				
	ORIGINATOR Y.S.SHAH				
	DATE 2/14/92				

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
"A"	91	95
"B"	88	88 OR 93
"C"	76	75

- SOIL-1 will be compacted excavated clayey sand/sandy clay (SC or SC-CL) soil. Compaction to be 0.9x Mod. Proctor max. dry density. SOIL-2 surface will be compacted using several passes of a large roller.
- Other soil properties and soil-profile data as determined in the following pages.
- Assume that no solution cavities exist in the rock surface below dikes.

CALCULATION	SUBJECT	IDENTIFIER 5-SU73-1	PAGE 3 OF 100 PAGES
REV.	0	1	2	3
MICROFILMED				
ORIGINATOR	YSS			
DATE	2/17/92			

NEW DIKE - WEST SIDE

BORING	G.S. Elev.	SOIL-2 "SC" (F-M) N	SOIL-3 "CH" N	SOIL-4 "SM" (F-C) N	G.W.L. Elev.
701	79.9	6 G.S.-6½'	6 6½'-17½'	10 12½'-17½'	78.3
702	79.6	6 G.S.-5'	5 5'-11¾'	6 11¾'-13'	78.3
704	79.8	3 G.S.-4½'	7 4½'-10½'	12 10½'-13'	79.1
705	79.6	8 G.S.-5'	11 5'-12¾'	5+ 12¾'-17'	78.4
708	79.9	3 G.S.-4½'	7 4½'-10½'	1 10½'-20'	79.1
709	79.8	7 G.S.-5'	11 5'-10±	- 10'-13'	77.8
712	80.3	- None	5 G.S.-11'	- None	78.6
713	80.0	7 G.S.-5'	6 5'-11'	11'-14'	76.7
717	80.9	5 G.S.-7'	- 7'-11'	11'-12'	77.4
718	79.8	3 G.S.-16'	2 16'-22'	22'-25'	76.8'
AVE...	80.0	G.S.-6' N=5	6'-12' N=5	12'-17' [illegible] N=7	78.1

Thus, for analysis of the west-side dike, use the following subsoil profile and the soil properties (see evaluation on p. 4 & 5):

	ELEV.	H	γ_t (pcf)	C (psf)	ϕ
SOIL-1 (FILL)	Above 78'	-	125.0	675	33°
SOIL-2	78'-74'	4'	124.5	500	28°
SOIL-3	74'-68'	6'	107.5	600	0
SOIL-4	68'-63'	5'	122.5	50	30°
ROCK	At 63'	--		50,000	0 (assumed)

CALCULATION	SUBJECT				IDENTIFIER 5-SL 173-A	PAGE 4 OF 100 PAGES
	REV.	0	1	2	3	
	MICROFILMED					
	ORIGINATOR	YSS				
	DATE	2/17/92				

Soil Properties:

SOIL-1 Fill: Assume "SC",

1. $\gamma_d = 0.9\,\gamma_{dmax}$ (D1557)
   $= 0.9 \times 120$ ---- { DM7.2, p.39 / SM-SC, ave γ_{dmax} = 120 pcf
   $= \underline{108}$ pcf

2. $\omega = 16\,\%$ -- { " ω_{opt} = 13 % / use ω = 13 + 3% = 16%

3. $\gamma_t = 108 \times 1.16$
   $= \underline{125}$ pcf ·· { ω_{sat} = 20% / ∴ γ_{sat} = 129.6 pcf

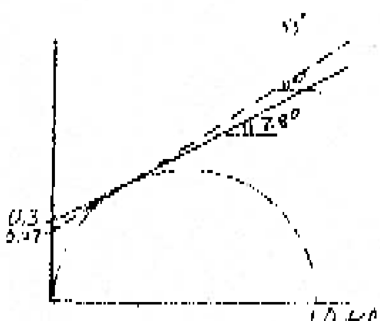
4. $q_u \geq 1$ tsf ---- stiff soil, $N \geq 8$

If q_u = 1 tsf, ϕ = 33°, $c = 0.5\left(\frac{1-\sin 33°}{\cos 33°}\right)$ = 0.271 tsf = 542 psf

∴ Use { $\underline{c}$ = $\underline{675}$ psf, ϕ = $\underline{33°}$ ---- { DM7.2, p.39, c_{comp} = 1050 psf, $\bar{c}_{sat}$ = 300 psf, $\bar{\phi}$ = 33°, ∴ Ave c = $\frac{1050+300}{2}$ = 675 psf
γ_t = $\underline{125}$ pcf }

SOIL-2: "SC" N = 5 (avg), assume ≈ 8 due to subgrade compaction

Per W-C Report, App. D, Table, for similar soil,



$\gamma_d \doteq 100$ pcf ...
∴ $\omega_{sat} \doteq 24.5\,\%$ ... G_s = 2.65
∴ $\gamma_{sat} \doteq \underline{124.5}$ pcf ⟶ $\bar{\gamma}$ = $\underline{62.0}$ pcf

q_u = 1 tsf -- N = 8
⇓
If ϕ = 28°
⟵ c_u = 0.30 tsf ⟶ use c_u = 0.25 tsf
= $\underline{500}$ psf

Alternatively,
$c = \frac{q_u}{2}\left(\frac{1-\sin\phi}{\cos\phi}\right)$
$= 0.5\left(\frac{0.53}{0.88}\right)$
= 0.301 tsf, 0.25 tsf,

∴ Use [$\bar{\gamma}_{sub}$ = 62.0 pcf
c = 500 psf, ϕ = 28°

SOIL-3 : CH, N = 5

↓

$q_u = 0.625$ tsf --- { O.K. per W-C Report, App. D, Table D-1.

↓

$C_u = 625$ psf ---→ use 600 psf

$\phi_u = 0$

$\gamma_t = 100.5$ pcf --- per W-C Report, App D, Table

↓

use 102.5 pcf

↓

$\bar{\gamma}_{sub} = \underline{40}$ pcf

∴ Use $\bar{\gamma}_{sub} = 40$ pcf

$c = 600$ psf

$\phi = 0.$

SOIL-4 : SM silty F-C sand with trace clay

N = 7 ⟶ D_r = 25%

↓

Use { $\phi = 30°$ ... DM-7.1, due to consequence of sand.

$c = 50$ psf .... Due to trace clay.

$\bar{\gamma} = 60$ pcf ... DM 7.1

CALCULATION	SUBJECT			IDENTIFIER: S-SL173-4	PAGE 6 OF 100 PAGES
	REV. 0	1	2	3	
	MICROFILMED				
	ORIGINATOR: YSS				
	DATE: 2/24/92				

NEW DIKE AT EXISTING DIKE & EAST SIDE :

BORING	G.S. Elev.	SOIL-2 "SC-CL(?)"	SOIL-3 "CH"	SOIL-4 SM(F-C)	G.W.L. Elev.
720 (Around Exist. Dike)	80.0	N 6 0–13½′	N - 13½′–17′	N 2 17′–19′	78.0
719 (Around Exist. Dike)	78.6	6 0–10′	2 10′–21′	- 21′–28½′	76.6
714 (Around Exist. Dike)	78.8	7 0′–10′	3 10′–20′	None	76.8
710 (Around Exist. Dike)	79.0	7 0–10′	3 10′–20′	None	77.5
715 (Around Exist. Dike)	77.8	7 0–7½′	- 7½′–14′	14′–21′	77.8
716 (Around Exist. Dike)	77.5	3 0–5′	5′–25′	None	77.2
[illegible]	78.6	[illegible]	[illegible]	[illegible]	
706	80.2	9 0–8½′	- 8½′–12′	8 12′–18′	78.9
703					
707	79.1	15 0–9½′	3 9½′–25′	4 25′–31′	76.1
711	80.2	11 0–9′	5 9′–25′	7 25′–30′	76.7
AVE..	79.0	GS–11′ N=7	11′–21′ N=3	Say None –	77.0

Thus, for the new dike at the existing dike, assume the following profile & parameters per the following calc's :

	ELEV.	H	γ_T (pcf)	C (psf)	ϕ
SOIL-2	78′–68′	10′	124.5	1000	0
SOIL-3	68′–58′	10′	100.5	400	0
SOIL-4	DOES NOT EXIST →				
ROCK	At 58′	–	–	–	–
SOIL-1	— same as on west side →				

CALCULATION	SUBJECT		IDENTIFIER 5-SL173-4	PAGE 7 OF 100 PAGES
REV.	0	1	2	3
MICROFILMED				
ORIGINATOR	YSS			
DATE	2/24/92			

Soil Properties:

SOIL-2 : SC-CL, N = 7, use 8 .. due to compaction during constr.

q_u = 1.00 tsf

∴ c = 1000 psf

ϕ = 0

γ = 62 psf --- Same as on p.2 - for Soil-2, conservatively as clayey for weight lighter

∴ γ_{sat} = 124.5 pcf

SOIL-3 : CH, N = 3

q_u = 0.375 tsf, use 0.4 tsf due to consolidation during constr.

∴ c = 400 psf

ϕ = 0

γ = 38 pcf .. assumed, see p.5, γ = 40 pcf if N=5.

γ_{sat} = 100.5 pcf

POND CONTENT (ASH + WATER):

Assume it to be silt + water, weighing ≥ 80 (90) pcf. For loose silt, $\bar{\phi}$ = 27° (30°) (TZ P. p.107)

∴ τ = (80 − 62.5) tan $\bar{\phi}$ = 8.92 psf (18.76)

= 80 (90) × tan ϕ_u say

∴ ϕ_u = tan⁻¹ 8.92 (18.76) / 80 (90)

= 6.4° (11.8°) ... Aus: γ_t = 85, $\bar{\phi}$ = 9.5°

∴ 85 tan 9.2° = 8.92 for ϕ_u ...

∴ ϕ_{u} = tan⁻¹ (18.77/90) ←——

= 9.76° or 10° → Use, γ_t = 80 pcf & ϕ_u = 10° .. (rounded numbers)

CALCULATION	SUBJECT			IDENTIFIER		PAGE 7A OF PAGES
	REV.	0	1	2	3	
	MICROFILMED					
	ORIGINATOR	YSS				
	DATE	3/12/42				

Alternatively,

ASH :

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

Assume, based on the data presented in the reference above,

$$Sp.Gr. = 2.40$$

$$\gamma_{d_{max}} \doteq 90 \text{ pcf} \quad \text{-- compacted}$$

$$\therefore \gamma_{d_{field}} \doteq 65 \text{ pcf} \quad \text{-- } (= 0.72\, \gamma_{d_{max}})$$

Also, $C \doteq 100$ psf

$\phi \doteq 35^\circ$

$$\therefore \gamma_{sat} = \gamma_d \left(1 + \frac{\gamma_w}{\gamma_d} - \frac{1}{G}\right)$$

$$= 100.3 \qquad \text{-- } \gamma_w = 62.5,\ \gamma_d = 65,\ G = 2.40$$

say $\underline{100.5}$ pcf

For use in the program (where total pressure is used to compute the shearing resistance),

$$100.5 \times \tan \phi_{Prog.} = (100.5 - 62.5)^{=38} \cdot \tan 35^\circ$$

$$\therefore \text{Program } \phi = \tan^{-1}\left(\frac{38}{100.5} \tan 35^\circ\right)$$

$$= 14.83 \quad \text{say } \underline{15^\circ}$$

$\therefore$ FOR THE PROGRAM INPUT, USE

$$\begin{cases} \gamma = 100.5 \text{ pcf} \\ C = 100 \text{ psf} \\ \phi = 15^\circ \end{cases}$$

-- no reduction as it's independent of Ph

CALCULATION	SUBJECT			IDENTIFIER S-SL173-1	PAGE 8 OF 100 PAGES
	REV. 0	1	2	3	
	MICROFILMED				
	ORIGINATOR				
	DATE				

EXISTING DIKE - WORST AREA:

- Refer to W-C Report, Fig. 3-11
- Refer to logs of borings B621 thru B-641.

BORING	T/L.S. ELEV.	SOIL 2 CL + SC (Avl. El.)	SOIL-3 CH (Avl. El.)	
B-621	52			
-622	54			
-623	50			
-624	54			
-625	52±			
-626	50			
-627	51			
-628	50	G.S.-63 (7)	63-50 (2)	
-629	50	G.S.-64 (6)	64-50 (2)	
-630	53	G.S.-64 (8)	64-53 (3)	WORST AREA
-631	51	G.S.-62 (6)	62-51 (3)	AVL.
-632	38 ([illegible])	G.S.-62 (6)	62-54 (2)	CL-SC ... El 78'-63'
-633	41 ([illegible])	G.S.-61 (5)	61-54 (2)	CH ... El. 63'-53'
-634	52±	G.S.-63 (6)	63-56 (3)	
-635	58±	G.S.-64 (6)	64-59 (3)	
-636	60	G.S.-66 (6)	66-60 (3)	
-637	60			
-638	60			
-639	59			
-640	62			
-641	60			

Thus, for the existing dike,

G.S. ~ Elev. 63' ... CL/SC, N ≐ 6 ... SOIL-2
Elev. 63' - Elev. 53' ... CH, N = 2 ... SOIL-3

Soil Properties (Exist. Dike)

SOIL-1 (FILL): ... Use $\gamma = 125$ pcf, $c = 1000$ psf, $\phi = 0°$ } -- Assumed

SOIL-2: CL/SC, N = 6, assuming that it's not compacted.

$\therefore q_u = 3/4$ tsf = 1500 psf

$\therefore c = 750$ psf

$\phi = 0°$

$\gamma' = 55$ pcf ... assumed

$\therefore \gamma_{sat} = 117.5$ pcf

SOIL-3: CH N = 2

$\therefore q_u \doteq 1/4$ tsf

$\therefore c = 250$ ~ 300 psf ... due to some consolidation already taken place

$\phi = 0°$

$\gamma' \doteq 38$ pcf

$\gamma_{sat} = 100.5$ pcf

THUS, FOR THE EXIST. DIKE, USE

	γ_t (pcf)	c (psf)	ϕ (deg)	H
SOIL-1, FILL	125	1000	0	--
SOIL-2	112.5	750	0	15'
SOIL-3	100.5	300	0	10' -- SOIL-4 DOES NOT EXIST.

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 tangent to a given surface. It uses DOS operating systems. The program inputs and outputs are included in the following pages.

In the analysis, stability of the pond-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 earthquake 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 pond 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 bottom surface of the weakest subsurface soil layer(s). See Page 14 and beyond.

CALCULATION	SUBJECT		IDENTIFIER S-SL173-4	PAGE 11 OF 170 PAGES
	REV. 0	1	2	3
	MICROFILMED			
	ORIGINATOR YSS			
	DATE 2/28/92			

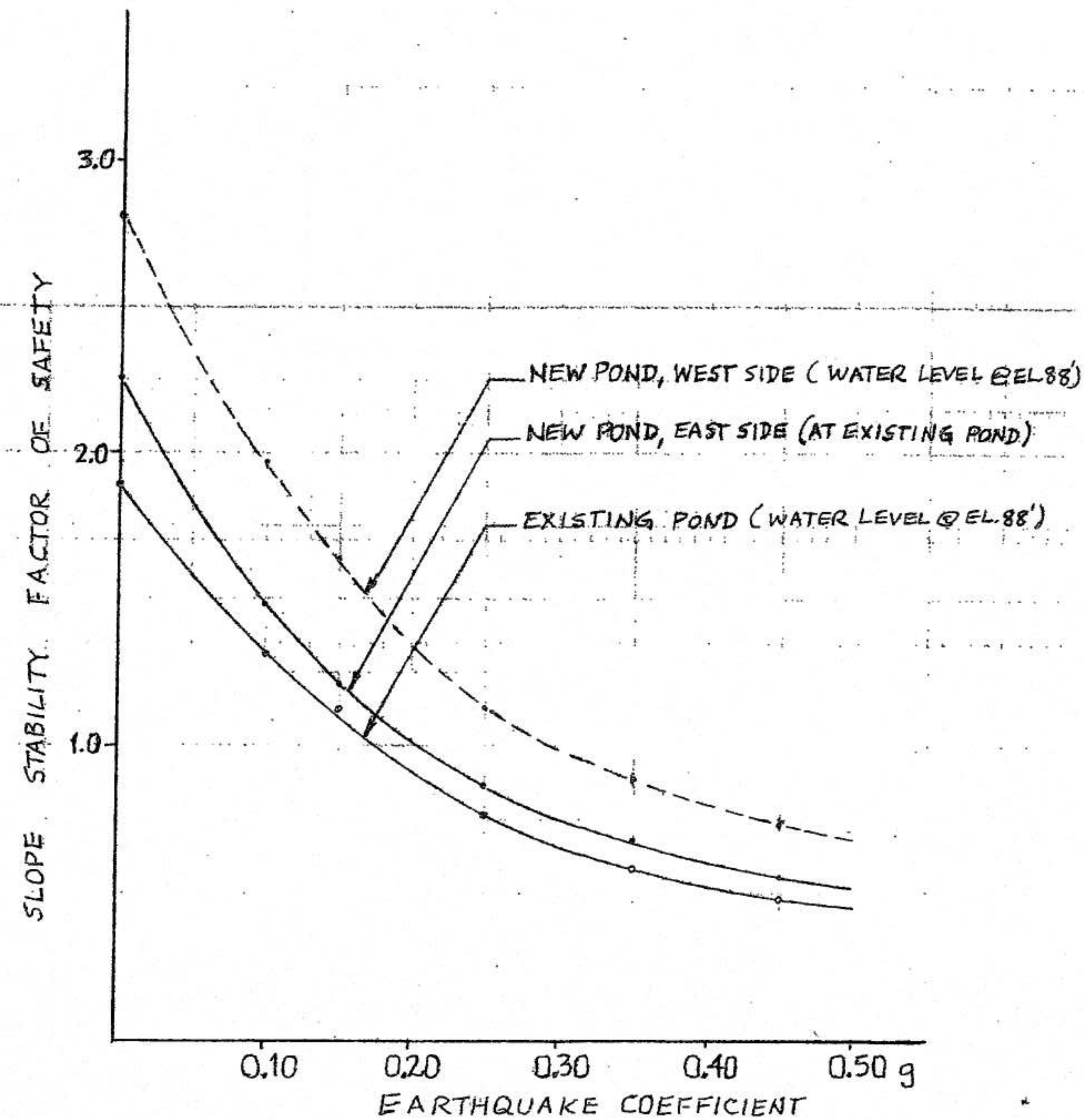
RUN No.	FILE ID	DIKE (SLOPE)	POND W.L.	DEPTH TO ROCK	EARTHQUAKE COEFF.	F.S.	
1	CR-GC000	NEW-WESTSIDE (INNER)	EL. 88'	15 FT	0.00	3.956	
2	CR-GC010	↓	↓	↓	0.10	2.154	
3	CR-GC025	↓	↓	↓	0.25	1.115	
4	CRGWOU00	NEW-WESTSIDE (OUTER)	EL. 88'	15 FT	0.00	2.806	
5	CRGWOU10	↓	↓	↓	0.10	1.929	
6	CRGWOU15	↓	↓	↓	0.15	1.639	
7	CRGWOU25	↓	↓	↓	0.25	1.138	WITH ASH (γ=100.5, ~100, φ=35°) 1.197
8	CRGWOU35	↓	↓	↓	0.35	0.891	
9	CRGWOU45	↓	↓	↓	0.45	0.732	
10	CR-GW000	NEW-EAST SIDE (INNER)	EL. 88'	20 FT	0.00	3.388	
11	CR-GW010	↓	↓	↓	0.10	1.833	
12	CR-GW025	↓	↓	↓	0.25	0.954	
13	CR-GWE00	EXIST.& NEW (INNER)	EL. 88'	20 FT	0.00	2.370	
14	CR-GWE10	↓	↓	↓	0.10	1.452	
15	CR-GWE25	↓	↓	↓	0.25	0.840	
16	CRGEOU00	NEW-EAST SIDE (OUTER)	EL. 88'	20 FT	0.00	2.261	WITH ASH (γ=[illegible], φ=[illegible]°)
17	CRGEOU10	↓	↓	↓	0.10	1.481	
18	CRGEOU15	↓	↓	↓	0.15	1.208	1.217
19	CRGEOU25	↓	↓	↓	0.25	0.872	0.874 0.881
20	CRGEOU35	↓	↓	↓	0.35	0.681	
21	CRGEOU45	↓	↓	↓	0.45	0.558	
22	CRGOUE00	EXIST.& NEW (OUTER)	EL. 88'	20 FT	0.00	1.892	
23	CRGOUE10	↓	↓	↓	0.10	1.316	
24	CRGOUE15	↓	↓	↓	0.15	1.126	
25	CRGOUE25	↓	↓	↓	0.25	0.769	0.790
26	CRGOUE35	↓	↓	↓	0.35	0.594	
27	CRGOUE45	↓	↓	↓	0.45	0.483	

CALCULATION	SUBJECT		IDENTIFIER S-SL173-4	PAGE 12 OF 100 PAGES
	REV. 0	1	2	3
	MICROFILMED			
	ORIGINATOR YSS			
	DATE 3/2/92			

RUN NO.	FILE ID	DIKE (SLOPE)	POND W.L.	DEPTH TO ROCK	EARTHQUAKE COEFF.	F.S.
28	CRGOUE93	EXIST. @ NEW (OUTER)	EL. 93'	20 FT	0.00	1.692
29	CR-GCE00	EXIST. - WORST (INNER)	EL. 88'	25 FT	0.00	2.369
30	CR-GCE10	↓	↓	↓	0.10	1.302
31	CRGCE25	↓	↓	↓	0.25	0.670
32	CRGCEW00	EXIST. - WORST (OUTER)	EL. 88'	25 FT	0.00	1.557
33	CRGCEW10	↓	↓	↓	0.10	1.056
34	CRGCEW25	↓	↓	↓	0.25	0.597
35	CRGCEW93	↓	EL. 93'	↓	0.00	1.558

0.598

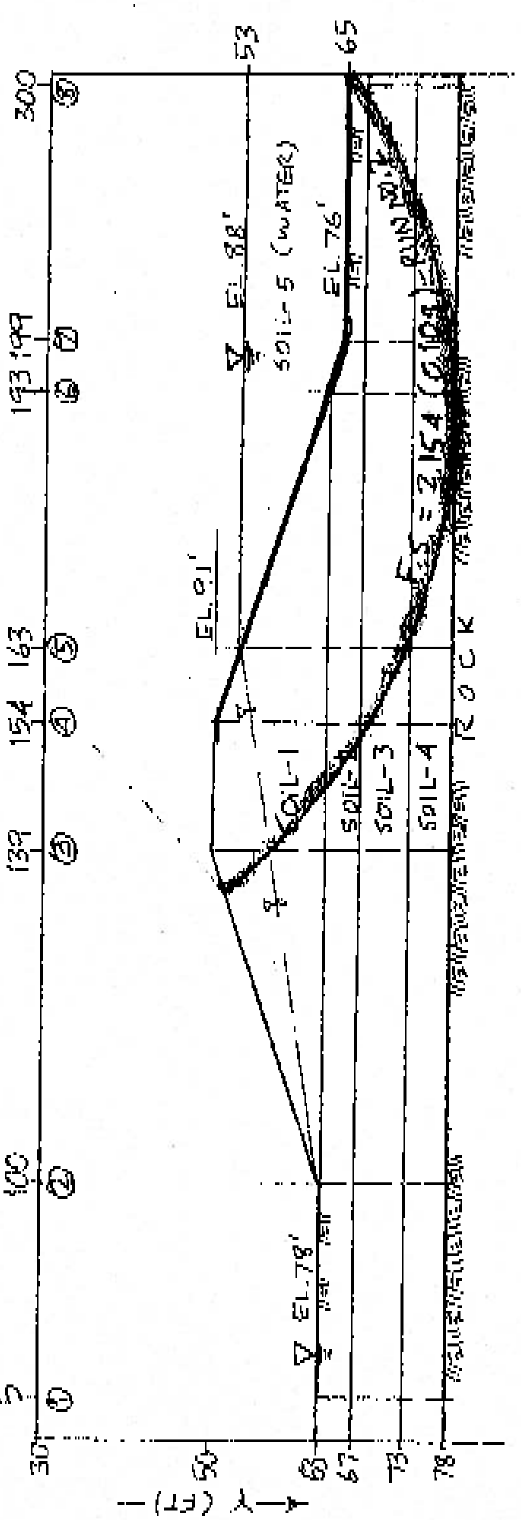
CROSS STATION, UNIT 1	MADE 02-28-92	GILBERT ASSOCIATES, INC. ENGINEERS AND CONSULTANTS READING, PENNA.
ASH POND DIKE STABILITY	CHK'D	
	EQ. CP.	
	CP DFN.	04-6151-006 S-SL173-4
	ENG. Y.S. SHAH	WORK ORDER / ID / REV
	REV CW APP DATE	



ENGINEERING INSTRUCTION NO. 2

CALCULATION	SUBJECT CROSS - NEW ASH POND DIKE SEISMIC STABILITY	IDENTIFIER S-SL173-4	PAGE 14 OF 100 PAGES
REV.	0	1	2	3
MICROFILMED				
ORIGINATOR	Y.S.S.			
DATE	7/18/92			

"TYPICAL" "STABRG" INPUT



NEW DIKE - WEST SIDE

		γ (pcf)	C (psf)	φ (deg)
LAY-1	SOIL-1	125.0	675	33
LAY-3	SOIL-2	124.5	500	28
LAY-4	SOIL-3	102.5	600	0
LAY-5	SOIL-4	122.5	50	30
LAY-2	SOIL-5	62.5	0	0

Appendix A Doc 09: Santee Cooper BMP Plan santee cooper®

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 file: CCST229

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

DATE: 12/2/09
INSPECTOR: [illegible]
REVIEWED BY: Station Manager

SIGNATURE: [illegible]
SIGNATURE: [illegible]

FEATURE	OK ✓	LOCATION & COMMENTS
[illegible]		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Sides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Boils	✓	
Drainage Ditches	✓	
Drainage Pipes	✓	
Vegetation (trees present, no grass)	✓	
[illegible]		
Inspect Concrete, Metal, and Wood	✓	
[illegible]		
Note 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

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Revised 4/15/2009

Report 6

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

BOTTOM ASH POND 2

DATE: 12/20/09
INSPECTOR: [illegible] **SIGNATURE:** [signature]
REVIEWED BY: Station Manager **SIGNATURE:** [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	√	
Settlement (V)	√	
Cracks (Measure Dimensions)	√	
Excessive Vegetation	√	
Burrows or Ruts	√	
2. Slopes		
Seepage (Flow, lush grass, clarity)	√	
Erosion gullies	√	
Slides (cracks, bulges, scarps)	√	
Vegetation (trees present, no grass)	√	
Animal burrows	√	
Rip-rap displacement	√	
Freeboard Adequate	√	
Settlement/Depression	√	
3. Area Downstream		
Seepage (Flow, lush grass, clarity)	√	
Soils	√	
Drainage Ditches	√	
Drainage Pipes	√	
Vegetation (trees present, no grass)	√	
4. Outlet Works		
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
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FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES
DIKE INSPECTION REPORT
CROSS STATION
GYPSUM POND

DATE: 12/21/09
INSPECTOR: [signature]
REVIEWED BY: Station Manager
SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note any other issues	✓	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY
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file
CGS 1229

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

DATE: 3/12/2010
INSPECTOR: [illegible]
REVIEWED BY: Station Manager

SIGNATURE: [illegible]
SIGNATURE: [illegible]

FEATURE	OK ✓	LOCATION & COMMENTS
[illegible]		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Sides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Boils	✓	
Drainage Ditches	✓	
Drainage Pipes	✓	
Vegetation (trees present, no grass)	✓	
[illegible]		
Inspect Concrete, Metal, and Wood	✓	
[illegible]		
Note 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

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

BOTTOM ASH POND 2

DATE: 3/12/2010
INSPECTOR: [signature]
REVIEWED BY: Station Manager

SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

DATE: 3/12/2010
INSPECTOR: R [illegible] SIGNATURE: [signature]
REVIEWED BY: Station Manager SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition	✓	
Note 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

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Revised 4/15/2009

file CGS 1229

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

DATE: 5/5/2010
INSPECTOR: Rluhe [illegible] SIGNATURE: [signature]
REVIEWED BY: Station Manager SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

BOTTOM ASH POND 2

DATE: 5/4/2010
INSPECTOR: [illegible]
REVIEWED BY: Station Manager

SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note any other issues	✓	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY
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FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES
DIKE INSPECTION REPORT
CROSS STATION

GYPSUM POND

DATE: 5/4/2010
INSPECTOR: [illegible]
REVIEWED BY: Station Manager

SIGNATURE: [illegible]
SIGNATURE: [illegible]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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HP: CGS-1227

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

BOTTOM ASH POND 1 (ORIGINAL)

DATE: 6/12/2010
INSPECTOR: D. Lahrs SIGNATURE: [signature]
REVIEWED BY: Station Manager SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

DATE: 6/12/2010
INSPECTOR: [illegible] SIGNATURE: [illegible]
REVIEWED BY: Station Manager SIGNATURE: [illegible]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note any other issues	✓	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY
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FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES
DIKE INSPECTION REPORT
CROSS STATION
GYPSUM POND

DATE: 6/12
INSPECTOR: [signature]
REVIEWED BY: Station Manager

SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Sides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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		
5. Overall Condition		
Note any other issues	✓	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY
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FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES
DIKE INSPECTION REPORT
CROSS STATION
BOTTOM ASH POND 1 (ORIGINAL)

DATE: 10/21/2010
INSPECTOR: [signature] SIGNATURE: [signature]
REVIEWED BY: Station Manager SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

DATE: 10/21/2010
INSPECTOR: [handwritten signature]
REVIEWED BY: Station Manager
SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

GYPSUM POND

DATE: 10/21/2010
INSPECTOR: [illegible]
REVIEWED BY: Station Manager
SIGNATURE: [illegible]
SIGNATURE: [illegible]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note any other issues	✓	

NOTE: SHOW LOCATION OF PROBLEM AREAS ON AN ATTACHED DRAWING and DESCRIBE DEFICIENCY
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FOSSIL & HYDRO GENERATION - TECHNICAL SERVICES
DIKE INSPECTION REPORT
CROSS STATION
BOTTOM ASH POND 1 (ORIGINAL)

DATE: 2/15/11
INSPECTOR: [signature]
REVIEWED BY: Station Manager

SIGNATURE: [signature]
SIGNATURE: [signature]

FEATURE	OK √	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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

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

DATE: 3/15/11
INSPECTOR: [signature] SIGNATURE: [signature]
REVIEWED BY: Station Manager SIGNATURE: [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
1. Crest		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
2. Slopes		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Sides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
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	✓	
5. Overall Condition		
Note 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 (original)
Fossil and Hydro Generation Technical Services - Jane Hood

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

DATE: 2/15/11
INSPECTOR: Robert Luther **SIGNATURE:** [signature]
REVIEWED BY: Station Manager **SIGNATURE:** [signature]

FEATURE	OK ✓	LOCATION & COMMENTS
[illegible]		
Alignment (H)	✓	
Settlement (V)	✓	
Cracks (Measure Dimensions)	✓	
Excessive Vegetation	✓	
Burrows or Ruts	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Erosion gullies	✓	
Slides (cracks, bulges, scarps)	✓	
Vegetation (trees present, no grass)	✓	
Animal burrows	✓	
Rip-rap displacement	✓	
Freeboard Adequate	✓	
Settlement/Depression	✓	
[illegible]		
Seepage (Flow, lush grass, clarity)	✓	
Boils	✓	
Drainage Ditches	✓	
Drainage Pipes	✓	
Vegetation (trees present, no grass)	✓	
[illegible]		
Inspect Concrete, Metal, and Wood	✓	
[illegible]		
Note 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

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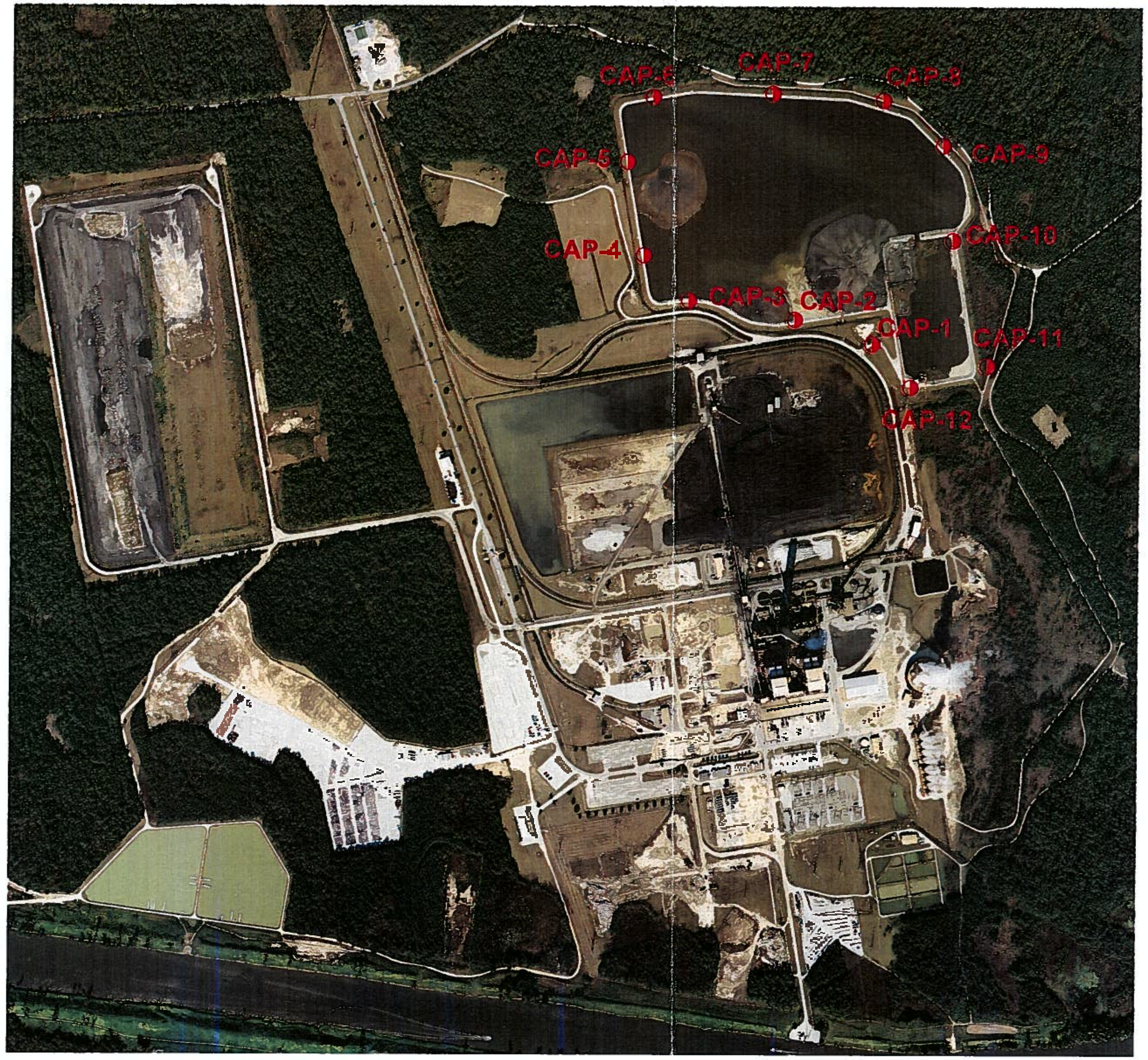
Appendix A Doc 11: Monitoring Well Location Map and Readings



Cross Generating Station NPDES Groundwater Monitoring Well Location Map

◑ **CAP Well Location**

note: PM-3 was renamed CAP-1

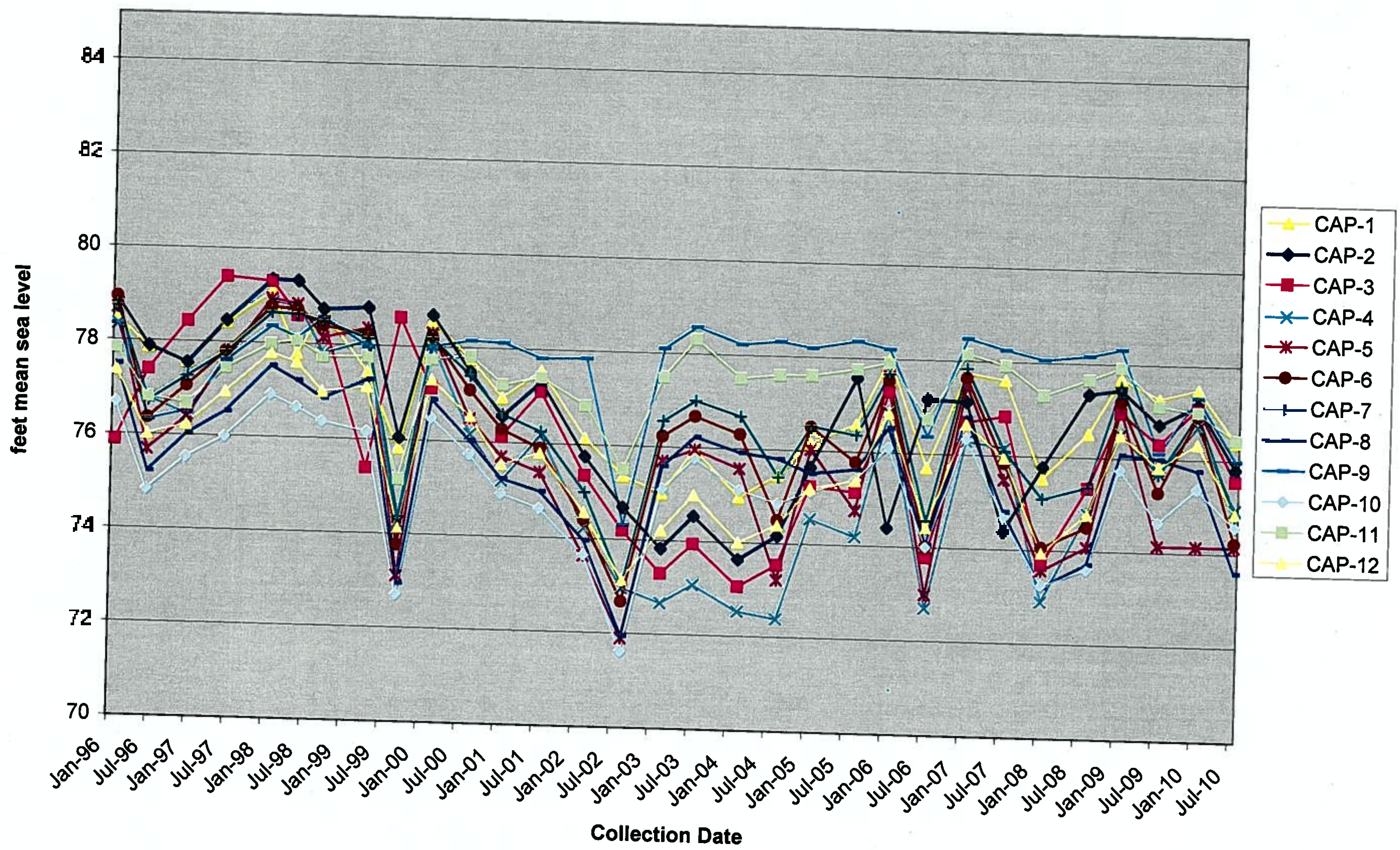
N

Date: 2/16/2011, MDH

Groundwater Elevations at Cross Generating Station

Date	Well Locations											
	CAP-1	CAP-2	CAP-3	CAP-4	CAP-5	CAP-6	CAP-7	CAP-8	CAP-9	CAP-10	CAP-11	CAP-12
Top of pad Elevation (msl)	82.92	89.70	89.62	89.77	89.80	89.63	89.54	89.70	89.60	93.67	93.61	96.61
1/23/1996	76.48	78.9	75.89	78.37	78.89	78.93	78.75	77.52	78.38	76.69	77.85	77.39
6/26/1996	77.87	77.9	77.4	76.61	75.65	76.36	76.75	75.24	76.35	74.84	76.92	76.02
12/3/1996	77.57	77.56	78.43	76.47	76.39	77.06	77.29	76.05	75.55	75.54	76.69	76.24
6/17/1997	78.42	78.47	79.39	77.72	77.67	77.81	77.82	76.55	77.64	75.99	77.46	76.95
1/6/1998	79.08	79.36	79.31	78.91	78.94	78.76	78.67	77.54	78.39	76.91	77.98	77.79
5/20/1998	77.79	79.34	78.59	78.84	78.84	78.73	78.65	77.24	78.16	76.65	76.06	77.6
9/24/1998	78.7	78.75	78.5	77.83	78.14	78.38	78.51	76.87	78.59	76.36	77.74	77
4/7/1999	77.43	78.81	75.4	78.12	78.36	78.25	78.17	77.29	78	76.17	77.77	77.12
5/13/1999	75.83	76.06	78.6	74.27	73.11	73.77	74.39	72.97	74.09	72.71	75.18	74.14
2/23/2000	78.54	78.68	77.12	79.08	78.29	78.23	78.2	76.9	76.34	76.49	77.75	77.3
8/9/2000	77.76	77.5		76.19	76.5	77.1	77.43	76.04	78.18	75.73	77.83	76.55
1/23/2001	76.96	76.57	76.15	75.21	75.71	76.28	76.63	75.25	79.15	74.91	77.24	75.54
7/9/2001	77.55	77.33	77.11	76.21	75.39	75.9	76.28	75	77.84	74.62	77.41	75.8
2/25/2002	76.14	75.76	75.35	74.26	73.84	74.42	75.01	73.98	77.87	73.66	76.84	74.56
8/19/2002	75.38	74.7	74.2	72.99	71.9	72.68	73.05	71.97	74.34	71.62	75.51	73.15
2/4/2003	75.01	73.84	73.3	72.69	75.7	76.23	76.58	75.61	79.13	75.11	77.5	74.22
7/22/2003	75.96	74.55	73.95	73.09	75.96	76.67	77.03	76.25	78.6	75.77	78.32	74.99
2/2/2004	74.97	73.65	73.06	72.55	75.58	76.31	76.72	75.94	78.26	75.12	77.51	74
8/16/2004	75.46	74.17	73.54	72.41	73.22	74.5	75.44	75.62	78.34	74.86	77.6	74.39
1/24/2005	76.17	75.66	75.24	74.57	76.03	76.51	76.55	75.53	78.22	75.13	77.61	75.2
8/22/2005	76.59	77.59	75.14	74.21	74.75	75.78	76.38	75.64	78.39	75.41	77.76	75.36
1/9/2006	77.89	74.41	77.3	75.89	77.64	77.54	77.71	76.54	78.24	76.11	77.92	76.88
7/24/2006	75.71	77.18	73.78	72.73	72.99	74.02	74.59	74.07	76.39	74.01	76.75	74.43
1/23/2007	77.74	77.14	76.7	76.31	77.49	77.54	77.87	76.81	78.51	76.35	78.16	76.66
7/30/2007	77.61	74.39	76.84	76.15	75.49	75.84	76.12	74.82	78.28	74.69	77.93	75.95
1/16/2008	75.53	75.79	73.69	72.92	73.57	74.06	75.12	73.23	78.09	73.26	77.31	73.94
8/20/2008	76.51	77.36	75.34	74.62	74.08	74.51	75.38	73.73	76.19	73.6	77.66	74.79
1/22/2009	77.69	77.47	76.96	76.53	77.06	77.19	77.55	76.09	78.34	75.75	77.93	76.5
7/7/2009	77.28	76.74	76.31	75.72	74.14	75.28	75.68	76.01	76.14	74.64	77.13	75.83
1/11/2010	77.49	77.17	77.09	76.72	74.14	76.92	76.99	75.77	77.34	75.37	77.01	75.33
7/6/2010	76.38	75.81	75.55	74.96	74.14	74.22	74.82	73.60	75.99	74.57	76.43	74.87

Groundwater Elevations at Cross Generating Station



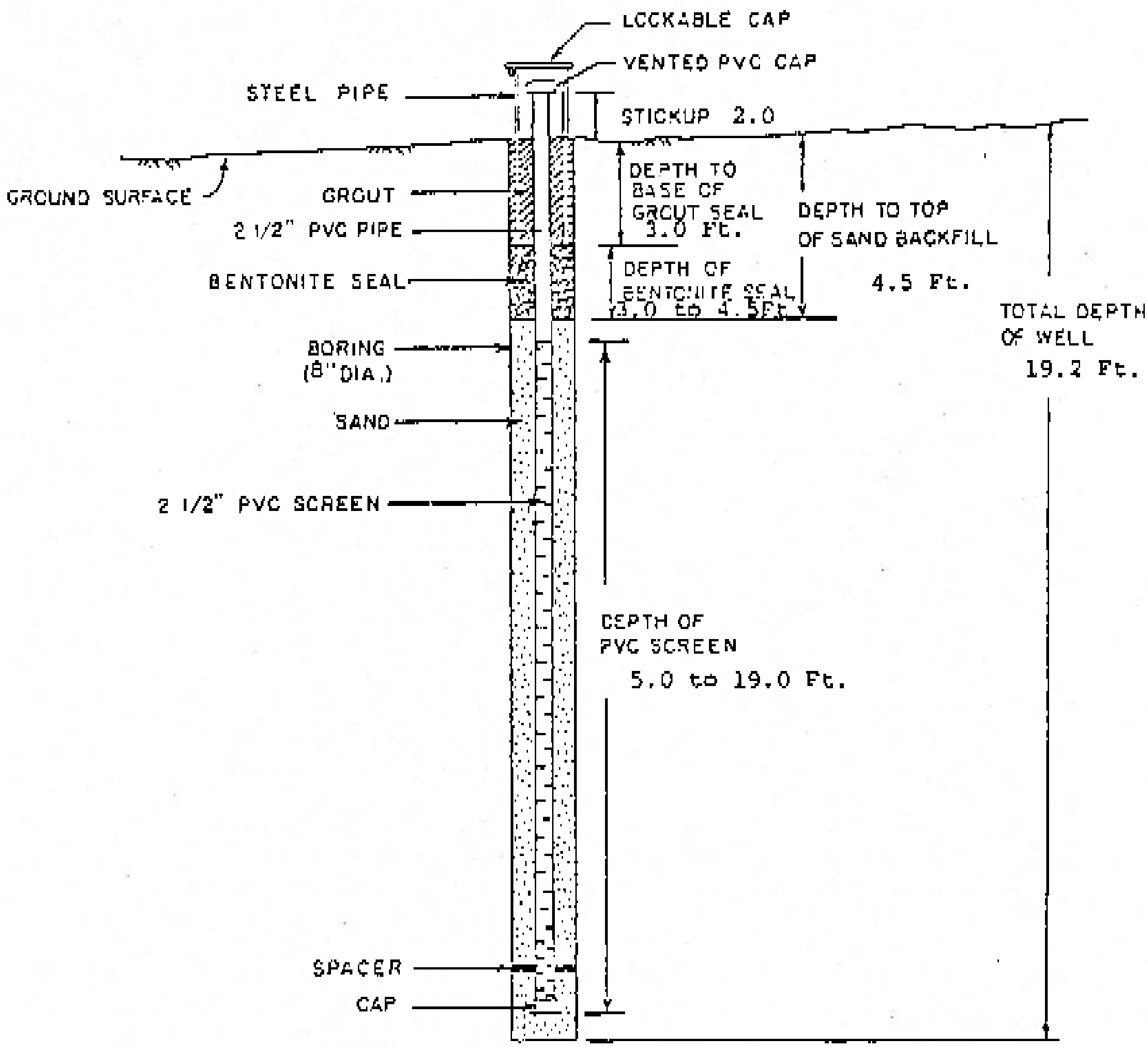
MONITORING WELL INSTALLATION RECORD

JOB NAME Cross Generating Station JOB NUMBER CH 4781 C

WELL NUMBER PM-3A /CAP -1 GROUND SURFACE ELEVATION 82.3 Ft. (1)

LOCATION About 10 Ft. Plant Grid Northwest of PM-3 (2)

INSTALLATION DATE 5/25/83



(1) Elevation Furnished by Ruscon

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

NOTE: ALL PVC PIPE JOINTS HAVE SCREW CONNECTORS

Ruscon Corporation Charleston, South Carolina	LAW ENGINEERING TESTING COMPANY CHARLOTTE, NORTH CAROLINA	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 Designation	Ground Surface Elev. (Ft)	Depth Interval (Ft)	Description
PM-3A	82.3	0 to 2.0	Fill - Sandy Clayey Silt
CAP-1		2.0 to 10.0	Sediments - Slightly Clayey Sandy Silt
		10.0 to 16.0	Gray Slightly Sandy Clayey 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:tmc

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 734-5331 | Water Well Record

CAP2

1. LOCATION OF WELL

County: Berkeley | System Name:

Latitude: | Longitude:

Distance And Direction from Road Intersections

Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 12383.9998
East: 10101.3920

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay (Fill)	13'	13'
Moist gray, brown Silty Sandy Clay	8'	21'
moist gray Sandy Clay	2'	23'
Moist gray Clay	11'	34'
* wet black Sandy Clay	4'	38'
* Sat. black Sand	1'	39'
* Sat. light yellow Clay Sand	3'	42'
* Sat light green Clayey Silty Sand	4'6"	46'6"
Fractured limestone	4'6"	51'
limestone	11'	62'
*Indicate water bearing zones		
(use a 2nd sheet if needed)		

3. REMARKS:

4. OWNER OF WELL:
Address: Santee Cooper

Telephone No.

Engineer
Address: ~~[crossed out]~~

Telephone No.

5. WELL DEPTH (Completed) 62' ft. | Date Started: 10-19-94 | Date Completed: 10-20-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug
☑ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE:
☐ Domestic ☐ Public Supply Permit No. ________ ☐ Industry
☐ Irrigation ☐ Air Conditioning ☐ Commercial
☑ Test Well ☐ ________

8. CASING ☑ Threaded ☐ Welded
Diam. 2¼"
Type ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
+2'6" in. to 42' ft. depth
____ in. to ____ ft. depth

Height: Above/Below
Surface ______ ft.
Weight ______ lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC | Diam. 2¼"
Slot/Gauge .010 | Length 20'
Set Between 42' ft. and 62' ft. NOTE: MULTIPLE SCREENS
____ ft. and ____ ft. USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL
12' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
____ ft. after ____ hrs. pumping ____ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield ________

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No | Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 39½' ft. to 62' ft.
Effective size FX50 uniformity coefficient ______

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 2' bentonite
Depth From 0 ft. to 39½' ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ Feet ____ Direction
____ Type | Well disinfected upon completion ☐ Yes ☐ No | Type ____ Amount ____

16. PUMP: Date Installed ________ Not installed ☐
Mfr. name ________ model no. ________
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME:

Signed: ________ Date:
AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/86) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 734-5331 | Water Well Record

CAP 3

1. LOCATION OF WELL

County: Berkeley   System Name:

Latitude: Longitude:

Distance And Direction from Road Intersections:

Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 13289.5179
East: 9276.5139

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay	11'	11'
moist brown Silty Clayey Sand	2'	13'
moist brown Silty Sandy Clay	10'6"	23'6"
* Sat white, frag. limestone with Clay layers	3'6"	27'
* sat. white fract. limestone with Clay	5'	32'

*Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL:
Address: Santee Cooper

Telephone No.

Engineer
Address:

Telephone No.

5. WELL DEPTH (Completed) 30'6" ft.   Date Started: 9-21-94   Date Completed: 9-22-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ____ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded
Diam. 2"
Type ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
+2'6" in. to ____ ft. depth
____ in. to ____ ft. depth

Height: Above/Below Surface ____ ft.
Weight ____ lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC   Diam. 2¼"
Slot/Gauze .010   Length 15'
Set Between 15'6" ft. and 30'6" ft.   NOTE: MULTIPLE SCREENS USE SECOND SHEET
____ ft. and ____ ft.
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL
12' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
____ ft. after ____ hrs. pumping ____ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No   Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 14'6" ft. to 30'6" ft.
Effective size FX50   uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 2' bentonite
Depth From 0 ft. to 14'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ Feet ____ Direction
____ Type   Well disinfected upon completion ☐ Yes ☐ No   Type ____ Amount ____

16. PUMP: Date installed ____ not installed ☐
Mfr. name ____ model no. ____
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

REGISTERED BUSINESS NAME:

Signed ____ AUTHORIZED REPRESENTATIVE   Date 12-8-94

DHEC # 1903 (10/86)   COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 **Water Well Record**

CAP4

1. LOCATION OF WELL

County: Berkeley System Name:

Latitude: Longitude:

Distance And Direction from Road Intersections

Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 13843.3886
East: 9122.2396

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Moist brown to red brn Sandy Clay	13'	13'
Moist light gray Silty Sandy Clay	10'	23'
SAT gray Clay Sand with Shells & Silt	5'6"	28'6"
Limestone	33'6"	62'

*Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: Santee Cooper
Address
Telephone No.
Engineer
Address
Telephone No.

5. WELL DEPTH (Completed) 60'6" ft. Date Started: 9-27-94 Date Completed: 9-28-94

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug
☑ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE:
☐ Domestic ☐ Public Supply Permit No. ______ ☐ Industry
☐ Irrigation ☐ Air Conditioning ☐ Commercial
☑ Test Well ☐ ______

8. CASING: ☑ Threaded ☐ Welded
Diam. 2¼"
Type ☑ PVC ☐ Galvanized
☐ Steel ☐ Other
+2'6" in. to 40'6" ft. depth
____ in. to ____ ft. depth

Height: Above/Below
Surface ____ ft.
Weight ____ lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC Diam. 2¼"
Slot/Gauze .010 Length 20'
Set Between 40'6" ft. and 60'6" ft. **NOTE: MULTIPLE SCREENS USE SECOND SHEET**
____ ft. and ____ ft.
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL 12'6" ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
____ ft. after ____ hrs. pumping ____ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield ____

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 39'6" ft. to 62' ft.
Effective size FX50 uniformity coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 1' Bentonite
Depth From 0 ft. to 39'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ Feet ____ Direction
____ Type Well disinfected upon completion ☐ Yes Type ____
☐ No Amount ____

16. PUMP: Date installed ____ not installed ☐
Mfr. name ____ model no. ____
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine
☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.
REGISTERED: 852
BUSINESS
NAME:
Signed: [signature]
AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/86) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division   2600 Bull Street   Columbia, S.C. 29201   (803) 734-5331   Water Well Record

Cap 5

1. LOCATION OF WELL

County: Berkeley   System Name:

Latitude: Longitude:

Distance And Direction from Road Intersections

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 14425.6720
East: 9121.6129

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay	14'	14'
very moist gray Silty Clay Sand	5'	19'
wet gray/green Clay with Silt	10'	29'
* sat gray Sand	3'	32'

*Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: Santee Cooper

Address

Telephone No.

Engineer

Address

Telephone No.

5. WELL DEPTH (Completed) 30'6" ft.   Date Started: 10-25-94   Date Completed: 10-26-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded

Diam. 2¼"   Height: Above/Below

Type ☑ PVC ☐ Galvanized   Surface ft.

☐ Steel ☐ Other   Weight lbs./ft.

+2'6" in. to 15'6" ft. depth   Drive Shoe? ☐ Yes ☐ No

in. to ft. depth

9. SCREEN:

Type: PVC   Diam. 2¼"

Slot/Gauge .010   Length 15'

Set Between 15'6" ft. and 30'6" ft.   NOTE: MULTIPLE SCREENS USE SECOND SHEET

ft. and ft.

Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL

13' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: ☐ Yes (Please enclose) ☐ No

Yield

12. WATER QUALITY

Chemical Analysis ☐ Yes ☐ No   Bacterial Analysis ☐ Yes ☐ No

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No

Installed from 14'6" ft. to 32' ft.

Effective size Fx50 uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No

Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ Al'bentonite

Depth From 0 ft. to 14'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: Feet Direction

Type   Well disinfected upon completion ☐ Yes ☐ No   Type   Amount

16. PUMP: Date Installed   not installed ☐

Mfr. name   model no.

H.P.   volts   length of drop pipe   ft. capacity   gpm

TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: and this report is true to the best of

REGISTERED BUSINESS NAME:

Signed

AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/86)   COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (ADDRESS ABOVE)

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 734-5331 | Water Well Record

CAP6

1. LOCATION OF WELL

County: Berkeley System Name:

Latitude: Longitude:

Distance And Direction from Road Intersections: Cross Generation Station

Street address & City of Well Location:

Sketch Map: (See example on back)

Horizontal Control
North: 14909.1184
East: 7772.0689

4. OWNER OF WELL: Santee Cooper

Address:

Telephone No.

Engineer:

Address:

Telephone No.

5. WELL DEPTH (Completed): 60'6" ft.

Date Started: 9-28-94

Date Completed: 9-29-94

6. [ ] Mud Rotary [ ] Jetted [x] Bored [ ] Dug [x] Air Rotary [ ] Driven [ ] Cable tool [ ] Other

7. USE: [ ] Domestic [ ] Public Supply-Permit No. ____ [ ] Industry [ ] Irrigation [ ] Air Conditioning [ ] Commercial [x] Test Well [ ] ____

8. CASING: [x] Threaded [ ] Welded

Diam. 2¼"

Type: [x] PVC [ ] Galvanized [ ] Steel [ ] Other

+2'6" in. to 40'6" ft. depth

____ in. to ____ ft. depth

Height: Above/Below Surface ____ ft.

Weight ____ lbs./ft.

Drive Shoe? [ ] Yes [ ] No

2. CUTTING SAMPLES [ ] Yes [ ] No

Geophysical Logs [ ] Yes (Please enclose) [ ] No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown sandy clay	12'	12'
moist gray clay with sand & silt	9'	21'
wet gray clay	3'	24'
* ~~Sat gray sand & silt~~ with clay		
* Sat gray sand with silt	4'	28'
Limestone	34'	62'

Indicate water bearing zones

(use a 2nd sheet if needed)

9. SCREEN:

Type: PVC Diam.: 2¼"

Slot/Gauze: .010 Length: 20'

Set Between: 40'6" ft. and 60'6" ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET

____ ft. and ____ ft.

Sieve Analysis [ ] Yes (Please enclose) [x] No

10. STATIC WATER LEVEL 12' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

____ ft. after ____ hrs. Pumping ____ G.P.M.

Pumping Test: [ ] Yes (Please enclose) [ ] No

Yield: ____

12. WATER QUALITY

Chemical Analysis [ ] Yes [ ] No Bacterial Analysis [ ] Yes [ ] No

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) [x] Yes [ ] No

Installed from 39'6" ft. to 60'6" ft.

Effective size FX50 uniformity coefficient ____

14. WELL GROUTED? [x] Yes [ ] No

Neat Cement [x] Sand Cement [ ] Concrete [ ] Other [ ] 1' bentonite

Depth From 0 ft. to 39'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ____ Feet ____ Direction ____ Type

Well disinfected upon completion [ ] Yes [ ] No Type ____ Amount ____

16. PUMP: Date Installed ____ not installed [ ]

Mfr. name ____ model no. ____

H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm

TYPE: [ ] Submersible [ ] Jet (shallow) [ ] Turbine [ ] Jet (deep) [ ] Reciprocating [ ] Centrifugal

3. REMARKS:

17. WATER WELL CONTRACTOR'S CERTIFICATION: [illegible] and this report is true to the best of my knowledge [illegible]

REGISTERED BUSINESS NAME: [illegible]

Signed: [signature] AUTHORIZED REPRESENTATIVE

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division — 2600 Bull Street — Columbia, S.C. 29201 — (803) 734-5331 — Water Well Record

CAP7

1. LOCATION OF WELL

County: Berkeley — System Name:

Latitude: — Longitude:

Distance And Direction from Road Intersections:

Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 14737.5767
East: 10550.6947

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Moist brown Sandy Clay	11'	11'
Moist gray yellow brown Sandy Clay	5'	16'
very moist light brown Silty Clay (lenses of Sand)	11'	27'
* Sat yellow brown SAND	5'	32'

*Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: Santee Cooper
Address:
Telephone No.
Engineer
Address
Telephone No.

5. WELL DEPTH (Completed) 30'6" ft. — Date Started: 10-25-94 — Date Completed: 10-26-94

6. ☐ Mud Rotary ☐ Jetted ☐ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ______ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded
Diam. 2¼" — Height: Above/Below
Type ☑ PVC ☐ Galvanized — Surface ______ ft.
☐ Steel ☐ Other — Weight ______ lbs./ft.
+2'6" in. to 15'6" ft. depth — Drive Shoe? ☐ Yes ☐ No
______ in. to ______ ft. depth

9. SCREEN:
Type: PVC — Diam. 2¼"
Slot/Gauge .010 — Length 15'
Set Between 15'6" ft. and 30'6" ft. — NOTE: MULTIPLE SCREENS USE SECOND SHEET
______ ft. and ______ ft.
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL 12' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
______ ft. after ______ hrs. pumping ______ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No — Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 14' ft. to 32' ft.
Effective size FX50 uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 2' bentonite
Depth From 0 ft. to 14' ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ______ Feet ______ Direction ______ Type — Well disinfected upon completion ☐ Yes ☐ No — Type ______ Amount ______

16. PUMP: Date Installed ______ not installed ☐
Mfr. name ______ model no. ______
H.P. ______ volts ______ length of drop pipe ______ ft. capacity ______ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: ... and this report is true to the best of my knowledge ...
REGISTERED BUSINESS NAME:
Signed: ______ AUTHORIZED REPRESENTATIVE

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division — 2600 Bull Street — Columbia, S.C. 29201 — (803) 734-5331 — **Water Well Record**

CAP 8

1. LOCATION OF WELL

County: Berkeley   System Name:

Latitude: Longitude:

Distance And Direction from Road Intersection:
Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)
Horizontal Control
North: 14479.7079
East: 11292.9635

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
Mout brown Sandy Clay with Silt	20'	20'
Very moist white Sandy Clay	6'	26'
Very moist gray Silty Clay with Sand	8'	34'
Limestone	26'	62'

*Indicate water bearing zones (use a 2nd sheet if needed)

3. REMARKS

4. OWNER OF WELL: Santee Cooper
Address
Telephone No.
Engineer
Address
Telephone No.

5. WELL DEPTH (Completed) 60'6" ft.   Date Started: 10-11-94   Date Completed: 10-12-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☑ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply-Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded
Diam. 2¼"   Height: Above/Below
Type ☑ PVC ☐ Galvanized   Surface ___ ft.
☐ Steel ☐ Other   Weight ___ lbs./ft.
+2'6" in. to 40'6" ft. depth   Drive Shoe? ☐ Yes ☐ No
___ in. to ___ ft. depth

9. SCREEN:
Type: PVC   Diam. 2¼"
Slot/Gauze .010"   Length 20'
Set Between 40'6" ft. and 60'6" ft.   NOTE: MULTIPLE SCREENS USE SECOND SHEET
___ ft. and ___ ft.
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL
13' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
___ ft. after ___ hrs. pumping ___ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No   Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 39' ft. to 62' ft.
Effective size Ex50   uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☐ Sand Cement ☐ Concrete ☐ Other ☑ 2' bentonite
Depth From 0' ft. to 39' ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ___ Feet ___ Direction
___ Type   Well disinfected upon completion ☐ Yes ☐ No   Type ___ Amount ___

16. PUMP: Date installed ___ not installed ☐
Mfr. name ___ model no. ___
H.P. ___ volts ___ length of drop pipe ___ ft. capacity ___ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: ... and this report is true to the best ...
REGISTERED BUSINESS NAME:
Signed: AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/88)   COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 734-5331 | Water Well Record

CAP 9

1. LOCATION OF WELL

County: Berkeley   System Name:

Latitude: Longitude:

Distance And Direction from Road Intersection:
Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)
Horizontal Control
North: 190853.6910
East: 11632.7247

2. CUTTING SAMPLES ☐ Yes ☐ No

Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay	12'	12'
moist brown Sandy Clay	5'	17'
Moist brown silty clay with sand	4'	21'
very moist light brown sandy silty clay	5'	26'
very moist gray silty clay with sand	2'	28'
very moist gray clay	4'	32'

*Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL:
Address: Santee Cooper
Telephone No.
Engineer
Address
Telephone No.

5. WELL DEPTH (Completed) 30'6" ft.   Date Started: 10-26-94   Date Completed: 10-27-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☐ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ______ ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING: ☑ Threaded ☐ Welded
Diam. 2¼"
Type ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
+2'6" in. to ____ ft. depth
____ in. to ____ ft. depth
Height: Above/Below Surface ____ ft.
Weight ____ lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC   Diam. 2¼"
Slot/Gauge .010   Length 15'
Set Between 15'6" ft. and 30'6" ft. NOTE: MULTIPLE SCREENS
____ ft. and ____ ft. USE SECOND SHEET
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL
12' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
____ ft. after ____ hrs. pumping ____ G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield ____

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No   Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 14'6" ft. to 32' ft.
Effective size FX50 uniformity coefficient ____

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 2' bentonite
Depth From 0 ft. to 14'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION ____ Feet ____ Direction
____ Type   Well disinfected upon completion ☐ Yes ☐ No   Type ____ Amount ____

16. PUMP: Date Installed ____ not installed ☐
Mfr. name ____ model no. ____
H.P. ____ volts ____ length of drop pipe ____ ft. capacity ____ gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: ... and this report is true to the best of ...
REGISTERED BUSINESS NAME:
Signed: ____ AUTHORIZED REPRESENTATIVE

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division | 2600 Bull Street | Columbia, S.C. 29201 | (803) 734-5331 | Water Well Record

CAP10

4. OWNER OF WELL: Santee Cooper
Address
Telephone No.
Engineer
Address
Telephone No.

1. LOCATION OF WELL
County: Berkeley System Name:
Latitude: Longitude:
Distance And Direction from Road Intersection:
Cross Generating Station
Street address & City of Well Location
Sketch Map: (See example on back)
Horizontal Control
North: 13431.5169
East 11578.5674

5. WELL DEPTH (Completed) 63 ft. Date Started: 10-18-94 Date Completed: 10-19-94

6. [ ] Mud Rotary [ ] Jetted [✓] Bored [ ] Dug
[✓] Air Rotary [ ] Driven [ ] Cable tool [ ] Other

7. USE: [ ] Domestic [ ] Public Supply-Permit No. ______ [ ] Industry
[ ] Irrigation [ ] Air Conditioning [ ] Commercial
[✓] Test Well [ ] ______

8. CASING: [ ] Threaded [ ] Welded
Diam. 2¼"
Type [✓] PVC [ ] Galvanized
[ ] Steel [ ] Other
+2'6" in. to ___ ft. depth
___ in. to ___ ft. depth
Height: Above/Below Surface ___ ft.
Weight ___ lbs./ft.
Drive Shoe? [ ] Yes [ ] No

2. CUTTING SAMPLES [ ] Yes [ ] No
Geophysical Logs [ ] Yes (Please enclose) [ ] No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay	18'	18'
very moist brown Sandy Clay some organics	3'	21'
moist Sandy Silty Clay	9'	30'
very moist gray Clay	9'6"	34'6"
Limestone	26'6"	66'

Indicate water bearing zones
(use a 2nd sheet if needed)

3. REMARKS:

9. SCREEN:
Type: PVC Diam. 2¼"
Slot/Gauge .010 Length 20'
Set Between 43' ft. and 63' ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET
___ ft. and ___ ft.
Sieve Analysis [ ] Yes (Please enclose) [✓] No

10. STATIC WATER LEVEL
18' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
___ ft. after ___ hrs. pumping ___ G.P.M.
Pumping Test: [ ] Yes (Please enclose) [ ] No
Yield ___

12. WATER QUALITY
Chemical Analysis [ ] Yes [ ] No Bacterial Analysis [ ] Yes [ ] No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) [✓] Yes [ ] No
Installed from 42' ft. to 66' ft.
Effective size 1X50 uniformity coefficient ___

14. WELL GROUTED? [✓] Yes [ ] No
Neat Cement [✓] Sand Cement [ ] Concrete [ ] Other [ ] 2'bentonite
Depth From 0 ft. to 42' ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: ___ Feet ___ Direction
___ Type Well disinfected upon completion [ ] Yes [ ] No Type ___ Amount ___

16. PUMP: Date Installed ___ not installed [ ]
Mfr. name ___ model no. ___
H.P. ___ volts ___ length of drop pipe ___ ft. capacity ___ gpm
TYPE: [ ] Submersible [ ] Jet (shallow) [ ] Turbine
[ ] Jet (deep) [ ] Reciprocating [ ] Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: [illegible]
and this report is true to the best [illegible]
REGISTERED [illegible]
BUSINESS [illegible]
NAME
Signed [signature]
AUTHORIZED REPRESENTATIVE

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division 2600 Bull Street Columbia, S.C. 29201 (803) 734-5331 Water Well Record

CAP 11

1. LOCATION OF WELL

County: Berkeley System Name:

Latitude: Longitude:

Distance And Direction from Road Intersections

Cross Generating Station

Street address & City of Well Location

Sketch Map: (See example on back)

Horizontal Control
North: 12399.0324
East: 11574.9960

2. CUTTING SAMPLES [ ] Yes [ ] No

Geophysical Logs [ ] Yes (Please enclose) [ ] No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist black Silty Sandy Clay	3'	3'
moist light brown Sandy Clay with Silt	14'	17'
very stiff moist to wet Clay with Silt (brown Firm)	12'	29'
& wet gray Clay	5'	36'

Indicate water bearing zones

(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: Santee Cooper

Address

Telephone No.

Engineer

Address

Telephone No.

5. WELL DEPTH (Completed) 33'6" ft. Date Started: 10-26-94 Date Completed: 10-26-94

6. [ ] Mud Rotary [ ] Jetted [x] Bored [ ] Dug [ ] Air Rotary [ ] Driven [ ] Cable tool [ ] Other

7. USE: [ ] Domestic [ ] Public Supply Permit No. [ ] Industry [ ] Irrigation [ ] Air Conditioning [ ] Commercial [x] Test Well [ ]

8. CASING [x] Threaded [ ] Welded

Diam. 2"

Type [x] PVC [ ] Galvanized [ ] Steel [ ] Other

+2'6" in. to 18'6" ft. depth

in. to ft. depth

Height: Above/Below Surface ft.

Weight lbs./ft.

Drive Shoe? [ ] Yes [ ] No

9. SCREEN:

Type: PVC Diam. 2 1/4"

Slot/Gauze .010 Length 15'

Set Between 18'6" ft. and 33'6" ft. NOTE: MULTIPLE SCREENS

ft. and ft. USE SECOND SHEET

Sieve Analysis [ ] Yes (Please enclose) [x] No

10. STATIC WATER LEVEL

17' ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface

ft. after hrs. pumping G.P.M.

Pumping Test: [ ] Yes (Please enclose) [ ] No

Yield

12. WATER QUALITY

Chemical Analysis [ ] Yes [ ] No Bacterial Analysis [ ] Yes [ ] No

Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) [x] Yes [ ] No

Installed from 17'6" ft. to 36' ft.

Effective size FX50 uniformity coefficient

14. WELL GROUTED? [x] Yes [ ] No

Neat Cement [x] Sand Cement [ ] Concrete [ ] Other [x] 1' bentonite

Depth From 0 ft. to 17'6" ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: Feet Direction Type

Well disinfected upon completion [ ] Yes [ ] No Type Amount

16. PUMP: Date installed not installed [ ]

Mfr. name model no.

H.P. volts length of drop pipe ft. capacity gpm

TYPE: [ ] Submersible [ ] Jet (shallow) [ ] Turbine [ ] Jet (deep) [ ] Reciprocating [ ] Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: and this report is true to the best of my knowledge

REGISTERED BUSINESS NAME:

Signed

AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/88) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Ground Water Protection Division — 2600 Bull Street — Columbia, S.C. 29201 — (803) 734-5331 — Water Well Record

CAP 12

1. LOCATION OF WELL
County: Berkeley — System Name:
Latitude: — Longitude:
Distance And Direction from Road Intersections: Cross Generating Station
Street address & City of Well Location
Sketch Map: (See example on back)
Horizontal Control
North: 12387.5561
East: 10967.0956

2. CUTTING SAMPLES ☐ Yes ☐ No
Geophysical Logs ☐ Yes (Please enclose) ☐ No

FORMATION DESCRIPTION	THICKNESS OF STRATUM	DEPTH TO BOTTOM OF STRATUM
moist brown Sandy Clay with Silt	13'	13'
moist brown Sandy Clay	15'	28'
very moist light green silty sandy clay	5'	32'
* wet gray Silty Sand with clay	2'	34'
* wet gray Clay	3'	37'
* Sat gray Clayey Silty Sand	1'6"	38'6"
* wet gray Clay with Silt	7½'	46'
Limestone	34'	70'

*Indicate water bearing zones
(use a 2nd sheet if needed)

3. REMARKS:

4. OWNER OF WELL: Santee Cooper
Address:
Telephone No.
Engineer
Address
Telephone No.

5. WELL DEPTH (Completed) 67' ft.
Date Started: 10-18-94
Date Completed: 10-20-94

6. ☐ Mud Rotary ☐ Jetted ☑ Bored ☐ Dug ☑ Air Rotary ☐ Driven ☐ Cable tool ☐ Other

7. USE: ☐ Domestic ☐ Public Supply Permit No. ☐ Industry ☐ Irrigation ☐ Air Conditioning ☐ Commercial ☑ Test Well ☐

8. CASING ☑ Threaded ☐ Welded
Diam. 2¼"
Type ☑ PVC ☐ Galvanized ☐ Steel ☐ Other
+2'6" in. to 47' ft. depth
in. to ft. depth
Height: Above/Below
Surface ft.
Weight lbs./ft.
Drive Shoe? ☐ Yes ☐ No

9. SCREEN:
Type: PVC — Diam. 2¼"
Slot/Gauge .010 — Length 20'
Set Between 47 ft. and 67 ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET
ft. and ft.
Sieve Analysis ☐ Yes (Please enclose) ☑ No

10. STATIC WATER LEVEL
20'6" ft. below land surface after 24 hours

11. PUMPING LEVEL Below Land Surface
ft. after hrs. pumping G.P.M.
Pumping Test: ☐ Yes (Please enclose) ☐ No
Yield

12. WATER QUALITY
Chemical Analysis ☐ Yes ☐ No — Bacterial Analysis ☐ Yes ☐ No
Please Enclose Lab Results.

13. ARTIFICIAL FILTER (Gravel Pack) ☑ Yes ☐ No
Installed from 46' ft. to 70' ft.
Effective size FX50 uniformity coefficient

14. WELL GROUTED? ☑ Yes ☐ No
Neat Cement ☑ Sand Cement ☐ Concrete ☐ Other ☐ 2' bentonite
Depth From 0 ft. to 46' ft.

15. NEAREST SOURCE OF POSSIBLE CONTAMINATION: Feet Direction
Type — Well disinfected upon completion ☐ Yes ☐ No — Type — Amount

16. PUMP. Date Installed — not installed ☐
Mfr. name — model no.
H.P. volts length of drop pipe ft. capacity gpm
TYPE: ☐ Submersible ☐ Jet (shallow) ☐ Turbine ☐ Jet (deep) ☐ Reciprocating ☐ Centrifugal

17. WATER WELL CONTRACTOR'S CERTIFICATION: [illegible] and this report is true to the best of my knowledge [illegible]
REGISTERED BUSINESS NAME: PST, Inc. [illegible]
Signed: [signature] 12-8-94
AUTHORIZED REPRESENTATIVE

DHEC # 1903 (10/86) COPY 1 MAIL TO: S.C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL [illegible]

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

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 NPDES Permit SC0037401 **ASSESSOR** Frederic C. Tucker, PE; Anne Lee

Date January 2007
Impoundment Name Bottom Ash Pond 1

Impoundment Company Santee Cooper
EPA Region 4

State Agency (Field Office) Address 2600 Bull Street, Columbia, SC 29201
Name of Impoundment Bottom Ash Pond 1

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New [ ] **Update** [X]

	Yes	No
Is impoundment currently under construction?	[ ]	[X]
Is water or ccr currently being pumped into the impoundment?	[X]	[ ]

IMPOUNDMENT FUNCTION: Bottom Ash Pond 1 is downstream, in series, from Bottom Ash Pond 2. Receives bottom ash and boiler slag discharged directly from plant operations. Receives discharge from Coal Pile Runoff Pond and Gypsum pond.

Nearest Downstream Town Name: Cross, South Carolina

Distance from the impoundment: 5.5 miles

Location:

Latitude	33	Degrees	22	Minutes	15.2	Seconds	**N**
Longitude	80	Degrees	06	Minutes	16.8	Seconds	**W**

State South Carolina **County** Berkeley

	Yes	No
Does a state agency regulate this impoundment?	[X]	[ ]

If So Which State Agency? DHEC, Bureau of Water/Compliance Assurance Division. For water quality only.

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.

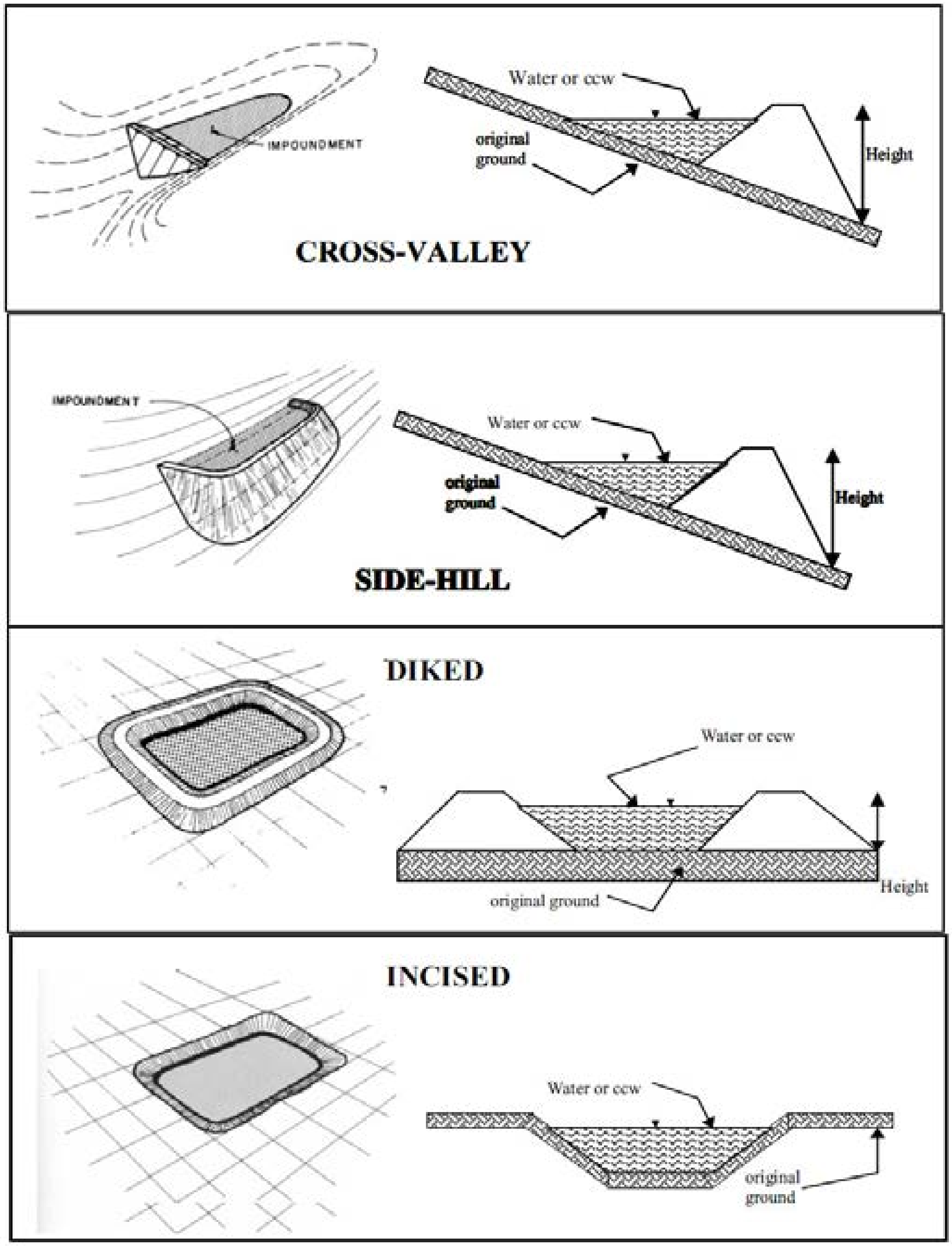
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

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:



- [ ] Cross-Valley
- [ ] Side-Hill
- [x] Diked
- [ ] Incised (form completion optional)
- [ ] Combination Incised/Diked

Embankment Height (ft)	18 (max)	**Embankment Material**	Earth
Pond Area (ac)	12.8	**Liner**	Yes (4” Soil-bentonite Liner)

Current Freeboard (ft)

Liner Permeability $< 1 \times 10^{-7}$ cm/sec

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

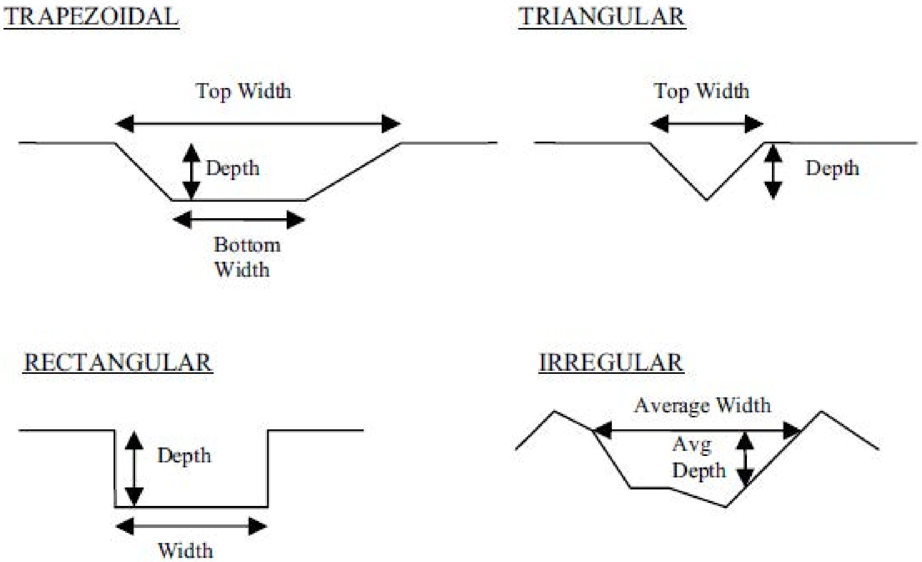
☐ Rectangular

☐ Irregular

depth (ft)

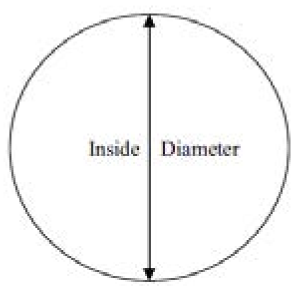
average bottom width (ft)

top width (ft)



☒ **Outlet (Emergency)**

18" inside diameter
(SDR 17 – smooth lined – 19.5" OD)



Material

☐ corrugated metal

☐ welded steel

☒ 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 Burns & Roe/ Lockwood Greene

	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?		

If So Please Describe :

	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,...)?		

If So Please Describe :

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

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	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 NPDES Permit SC0037401 **ASSESSOR** Frederic C. Tucker, PE; Anne Lee

Date January 2007
Impoundment Name Bottom Ash Pond 2

Impoundment Company Santee Cooper
EPA Region 4

State Agency (Field Office) Address 2600 Bull Street
Columbia, SC 29201
Name of Impoundment Bottom Ash Pond 2

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	No
Is impoundment currently under construction?	☐	☒
Is water or ccr currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Bottom Ash Pond 2 is upstream, in series, from Bottom Ash Pond 1. Receives bottom ash and boiler slag discharged directly from plant operations. Receives discharge from Coal Pile Runoff Pond and Gypsum pond.

Nearest Downstream Town Name: Cross, South Carolina

Distance from the impoundment: 5.4 miles

Location:

Latitude	33	Degrees	22	Minutes	25.0	Seconds	**N**
Longitude	80	Degrees	06	Minutes	2.6	Seconds	**W**

State South Carolina **County** Berkeley

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? SCDHEC, Bureau of Water/Compliance Assurance Division. For water quality only.

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.

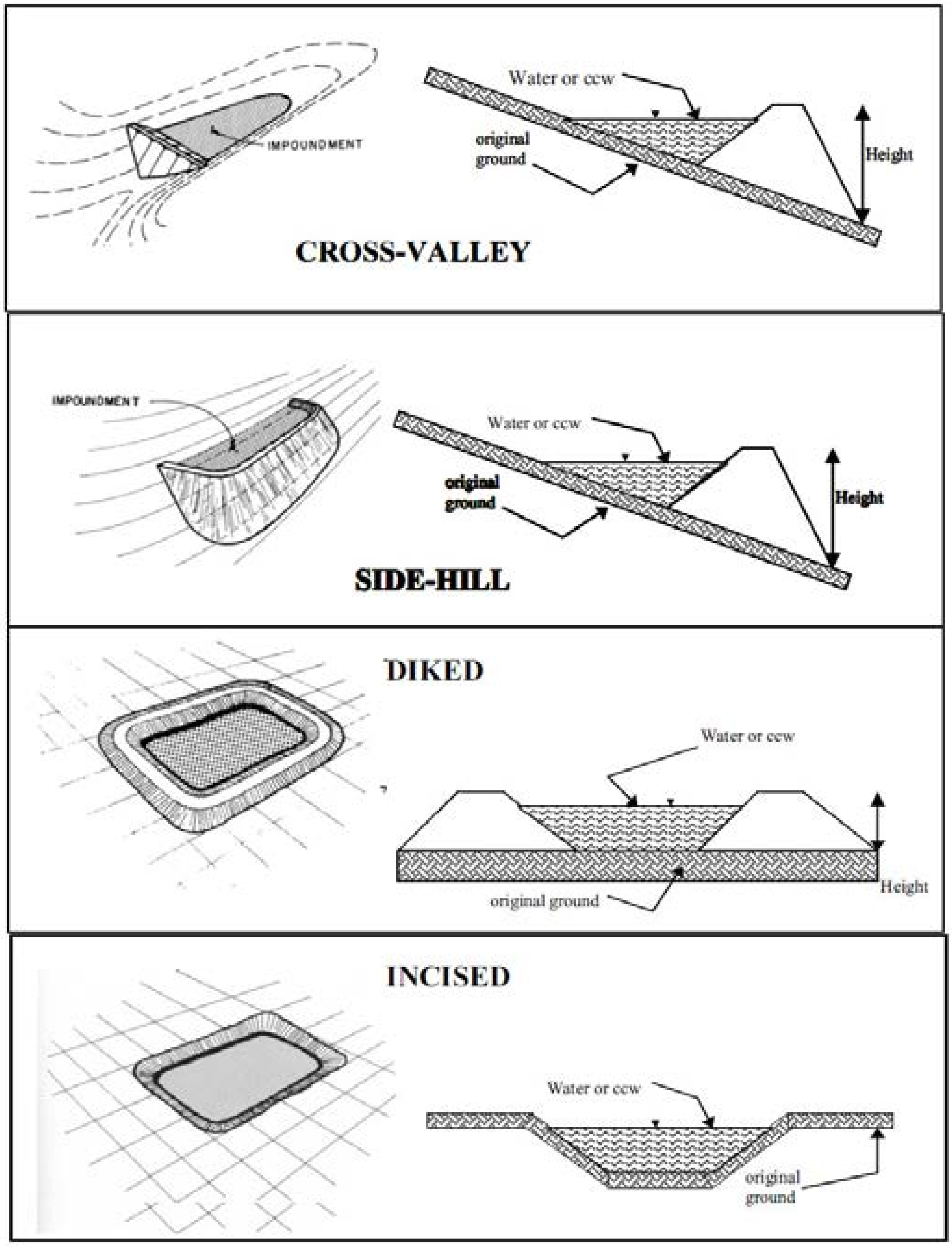
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

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:



☐ Cross-Valley ☐ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☒ Combination Incised/Diked

Embankment Height (ft) 14 (max) **Embankment Material** Earth

Pond Area (ac) 79 **Liner** Yes (Geosynthetic Clay Liner)

Current Freeboard (ft)

Liner Permeability < 1 x 10-7 cm/sec

TYPE OF OUTLET (Mark all that apply)

☒ **Open Channel Spillway** (Notch through former NE side dike of Ash Pond 1.)

☒ Trapezoidal

☐ Triangular

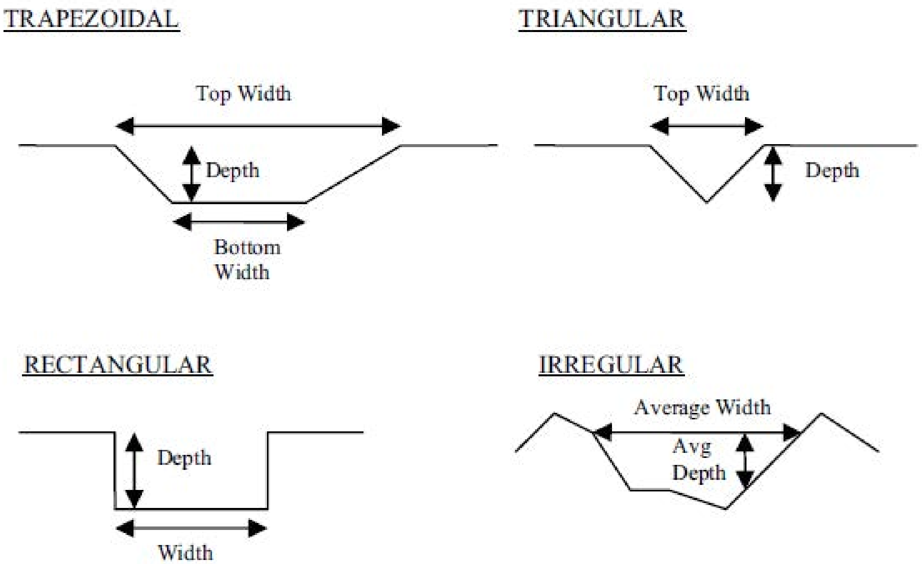
☐ Rectangular

☐ Irregular

depth (ft) TBP

average bottom width (ft) TBP

top width (ft) TBP



☐ **Outlet** (Ash Pond 2 is hydraulically connected to Ash Pond 1 through a wide trapezoidal notch in the former northeast side dike of Ash Pond 1. For practical purposes, Ash Pond 1 and Ash Pond 2 serve as one pond, with one emergency outfall located through the southwest side dike of Ash Pond 1-see Bottom Ash Pond 1 Checklist.)

Material

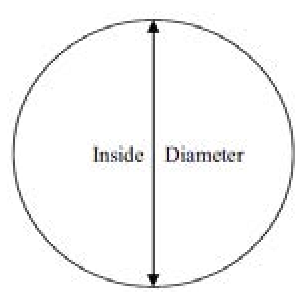
☐ corrugated metal

☐ welded steel

☐ 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 Commonwealth**

	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?		

If So Please Describe :

	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,...)?

If So Please Describe :

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; 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[2]		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	X[3]		19. Major erosion or slope deterioration?		X[5]
3. Decant inlet elevation (operator records)?	TBP[4]		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A	N/A	Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	TBP		Is water exiting outlet, but not entering inlet?		X[6]
6. If instrumentation is present, are readings recorded (operator records)?		X	Is water exiting outlet flowing clear?	N/A[7]	N/A[7]
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X		From underdrain?	N/A[8]	N/A[8]
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	N/A	N/A	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

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 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 Permit SC0037401 **ASSESSOR** Frederic C. Tucker, PE; Anne Lee

Date January 2007
Impoundment Name Gypsum Pond

Impoundment Company Santee Cooper
EPA Region 4

State Agency (Field Office) Address 2600 Bull Street
Columbia, SC 29201
Name of Impoundment Gypsum Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccr currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Receives flue gas emission control residuals.

Nearest Downstream Town Name: Cross, South Carolina

Distance from the impoundment: 5.2 miles

Location:

Latitude	33	Degrees	22	Minutes	4.5	Seconds	**N**
Longitude	80	Degrees	06	Minutes	31.6	Seconds	**W**

State South Carolina **County** Berkeley

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? SCDHEC, Bureau of Water/Compliance Assurance Division. For water quality only.

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.

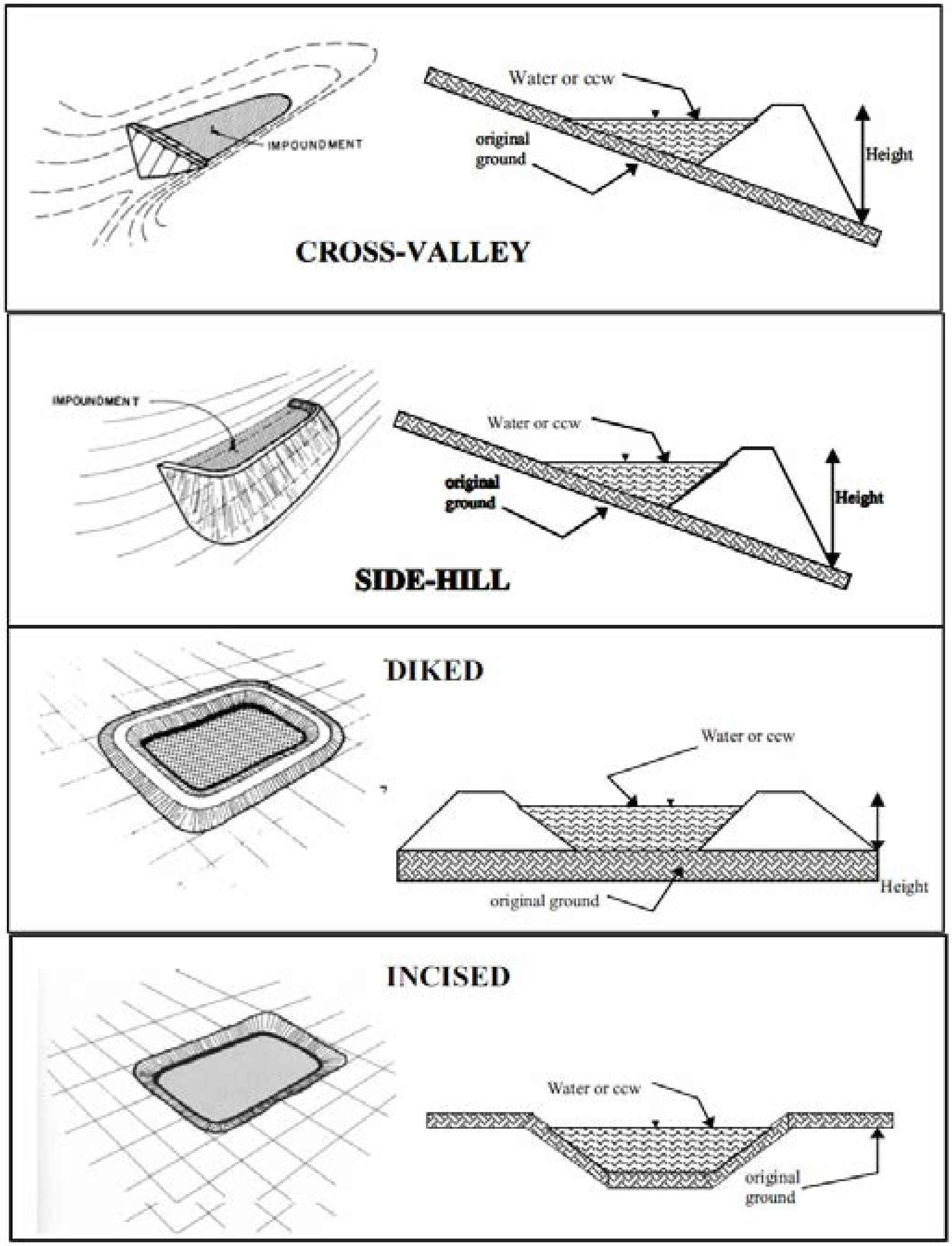
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:



☐ Cross-Valley ☐ Side-Hill ☒ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft) 6 (max) **Embankment Material** Earth

Pond Area (ac) 1 **Liner** Yes (4” Soil-bentonite Liner)

Current Freeboard (ft)

Liner Permeability < 1 x 10^{-7} cm/sec

TYPE OF OUTLET (Mark all that apply)

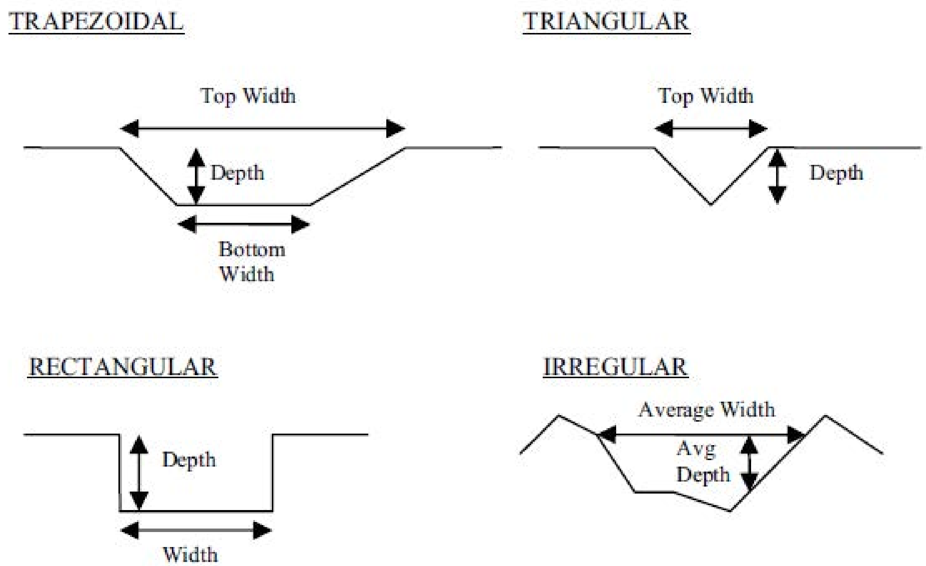
☐ **Open Channel Spillway**

- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

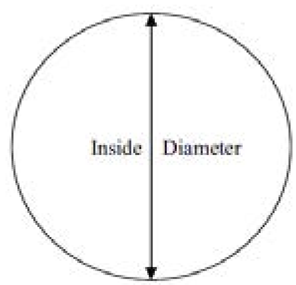
average bottom width (ft)

top width (ft)



☒ **Outlet**

18" inside diameter
(SDR 17 – smooth lined – 19.5" OD)



Material

- ☐ corrugated metal
- ☐ welded steel
- ☒ 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 Burns & Roe/ Lockwood Greene

	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?		

If So Please Describe :

	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,...)?		

If So Please Describe :

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.