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## Coal Combustion Residue Impoundment

## Round 9 - Dam Assessment Report

## *Weatherspoon Steam Electric Plant*

## *Ash Pond Embankment*
## *Progress Energy Carolinas, Inc.*
## Robeson County, North 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

Five million cubic yards of coal combustion residue was released from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008. The released material flooded more than 300 acres of land, damaging homes and property. To prevent such catastrophic failure and damage, the U.S. EPA is assessing the stability and functionality of ash impoundments and other management units at power plants, and, as necessary, take any needed corrective measures.

This assessment of the stability and functionality of the Weatherspoon Steam Electric Plant Ash Pond is based on a review of available documents and on the site assessment conducted by Dewberry personnel on February 22, 2011. We found the supporting technical documentation inadequate (Section 1.1.3). As detailed in Section 1.2.5, there are six recommendations based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Weatherspoon Steam Electric Plant Ash Pond is rated **POOR** for continued safe and reliable operation. There are recognized existing or potential management unit safety deficiencies such as evidence of significant embankment repairs that are needed and structural stability factors of safety that do not meet minimum applicable standards

## 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 and determine the 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).

<u>LIMITATIONS</u>

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

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**APPENDIX A**



**APPENDIX B**

# 1.0 CONCLUSIONS AND RECOMMENDATIONS

## 1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit, February 22, 2011, and review of technical documentation provided by Progress Energy Carolinas, Inc.

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

The structural soundness is poor. Sections of the original embankment system are in disrepair and require mitigation. Progress Energy is aware of the concerns and is preparing a plan of corrective actions to be permitted through the State. The factors of safety along many sections of the embankments did not meet minimum applicable standards and potential for liquefaction documentation was not provided.

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

Adequate impoundment capacity to contain the 1 percent probability design storm without overtopping the dikes is currently present.

### 1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is adequate. Engineering documentation reviewed is referenced in Appendix A.

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

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

### 1.1.5 Conclusions Regarding the Field Observations

The overall assessment of the ash pond embankment system was that it was in poor condition. Trees and shrubs were found on the northern and eastern downstream slopes. Removal of those trees is being coordinated at the direction of the North Carolina Department of Environment and Natural Resources (NCDENR). The original dike downstream slope was in disrepair, but it was documented to be part of a major repair plan that will occur concurrently with the northern embankment. Seeps along the downstream toe of the southern, eastern and western dike were observed. There were minor ruts observed along the crest and standing water within the roadside ditches adjacent to the downstream of toe.

#### 1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be inadequate for the ash management unit. There was evidence of significant embankment repairs that are needed. It was reported that the embankment repairs are planned in the near future.

#### 1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. The management unit dikes have just recently been instrumented. Progress Energy started recording piezometer readings in 2011, so there are no historical readings.

#### 1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

**The facility is rated POOR for continued safe and reliable operation due to the state of disrepair of the original dike. Trees 8-inches and larger in diameter were left along the northern and eastern dikes at the direction of NCDENR, but this also is a cause for concern. The slope stability analysis results did not meet minimum applicable standards for factors of safety. While other deficiencies need to be corrected, the observations described above led to the POOR classification.**

### 1.2 RECOMMENDATIONS

#### 1.2.1 Recommendations Regarding the Structural Stability

An action plan needs to be developed to address removing all trees and wooded vegetation along any ash pond embankment and for remediating the original dike. It was noted that the tree removal and dike repair will require NCDENR approval. A potential for liquefaction analysis should be provided. An action plan needs to be developed to address the areas of the embankment that do not meet minimum factors of safety standards.

1.2.2 Recommendations Regarding the Field Observations

The following issues need to be addressed:

- Remediate the original dike
- Install animal guards at toe drains
- Address trees and woody vegetation along downstream slopes
- Monitor seepage along downstream toe along southern, eastern and western dikes
- Repair rutting along crest
- Monitor and address standing water within roadside ditches downstream of toe

1.2.3 Recommendations Regarding the Maintenance and Methods of Operation

Removal of trees and woody vegetation needs to be addressed more often. It is noted this has been adopted in recent inspection reports and NCDENR has requested the current 8-inch and larger trees be left.

1.2.4 Recommendations Regarding Continued Safe and Reliable Operation

For continued safe operation we recommend the following:

- Develop an action plan to address the original dike in disrepair. Perform remediation along the downstream slope of the dike
- Address tree removal along the downstream slope while coordinating with NCDENR

## 1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Rob Miller, Progress Energy Carolinas, Inc.
Bill Forster, Progress Energy Carolinas, Inc.
Fred Holt, Progress Energy Carolinas, Inc.
Robin Bryson, Progress Energy Carolinas, Inc.
Larry Baxley, Progress Energy Carolinas, Inc.
Al Tice, MACTEC Engineering and Consulting, Inc. (MACTEC)

Sally Castle, NCDENR
Diane Adams, NCDENR
Andy Schneider, NCDENR
Steve Cook, NCDENR
Justin Story, Dewberry
Frederic Shmurak, Dewberry

#### 1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on February 22, 2011.

__________________________ __________________________

Frederic Shmurak, P.E. Justin Story, E.I.

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

## 2.1 LOCATION AND GENERAL DESCRIPTION

The Weatherspoon Steam Electric Plant and ash ponds are located just outside of Lumberton, NC. The ash ponds consist of a northern area and southern area split by an internal dike and discharge into a plant cooling lake that feeds the Lumber River. The nearest downstream town is Boardman which is approximately 12 miles away. Figure 2.1a depicts a vicinity map around the plant; Figure 2.1b depicts an aerial view of the facility.


**Figure 2.1 a: Weatherspoon Steam Electric Plant Vicinity Map**


Figure 2.1 b: Weatherspoon Electric Steam Plant Aerial View

| Table 2.1: Summary of Dam Dimensions and Size | |
|---|---|
| | **Weatherspoon Ash Pond** |
| **Dam Height (ft)** | 28 |
| **Crest Width (ft)** | 12 |
| **Length (ft)** | 6,600 |
| **Side Slopes (upstream) H:V** | 2:1 |
| **Side Slopes (downstream) H:V** | 2.5:1 |

## 2.2 COAL COMBUSTION RESIDUE HANDLING

### 2.2.1 Fly Ash

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

**Overview of Ash Handling System**

2.2.2 Bottom Ash

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

2.2.3 Boiler Slag

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

2.2.4 Flue Gas Desulfurization Sludge

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

## 2.3 SIZE AND HAZARD CLASSIFICATION

The ash pond is impounded by an earthen embankment system consisting of a dike configuration. Reference Table 2.1 for dam height, crest width, length and side slopes. The maximum storage volume corresponding to the top of the embankment is 425 acre-feet. (Dam Information Summary dated January 25, 2011 provided by

Progress Energy. See Appendix A: Doc: 02 – Ash Pond Summary). The size classification based on United States Army Corps of Engineers (USACE) standards is small.

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

A Hazard Classification of "Intermediate Hazard" has been assigned by the NC Dam Safety Regulations and Dam Safety Inventory program. Dewberry notes that the release of ash residue would remain on the power plant property. Therefore, per the Federal Guidelines for Dam Safety dated April 2004, a **Low** Hazard Potential classification applies to those dams where failure or mis-operation results in no probable loss of human life and low economic/environmental losses are expected. Losses are principally limited to the owner's property.

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

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

The ash pond permanently contains fly ash, bottom ash, pyrites and boiler slag. The drainage area is assumed to be the surface area of the ponds.

| **Table 2.4: Maximum Capacity of Unit** | |
|---|---|
| **Weatherspoon Ash Pond** | |
| **Surface Area (acre)** | 17 |
| **Current Storage Capacity (cubic yards)** | 553,373* |
| **Current Storage Capacity (acre-feet)** | 343* |
| **Total Storage Capacity (cubic yards)** | 1,174,507* |
| **Total Storage Capacity (acre-feet)** | 728* |

| | |
|---|---|
| **Crest Elevation (feet)** | 143 |
| **Normal Pond Level (feet)** | 139 |

*Information taken from the Dam Breach Analyses and Inundation Map. See MACTEC (Appendix A: Doc 09 – Ash Pond Inundation Report).

## 2.5 PRINCIPAL PROJECT STRUCTURES

### 2.5.1 Earth Embankment

Within the northern ash area, the dike fill consists predominantly of sandy soils with some silt and clay. The southern ash area dike soils consist of predominantly silty or clayey sands. A geotechnical analysis was performed and that documentation can be found in Appendix A: Doc 03: Seepage and Stability Anaylsis.

### 2.5.2 Outlet Structures

The outlet works consist of a 24-inch reinforced concrete pipe (RCP) vertical riser connected to a 24-inch RCP extending through the dike to a secondary settling basin. A similar riser and pipe combination discharges beyond the secondary settling basin dike into a channel leading to the Cooling Lake. Neither of the pipes has seepage collars.

## 2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

All critical infrastructures were located using aerial photography and might not accurately represent what currently exists down-gradient of the site. See Figure 2.6 for an aerial view of critical infrastructure downstream of the Weatherspoon Plant. Progress Energy provided a 5-mile downstream map showing Weatherspoon Steam Electric Plant and associated critical infrastructure that can be found in Appendix A (Doc 05 - Weatherspoon Five-mile map). There are a few places of worship, schools and Wilmington Highway (72) within the 5 mile down gradient radius of the ash pond. Not all critical infrastructures are labeled for clarity purposes.

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**Figure 2.6: Downstream Gradient of Weatherspoon Plant**

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

Summary of Reports on the Safety of the Management Unit

Progress Energy has provided their dam inspection procedure which can be found in Appendix A. (Doc 06 - Dam Inspection Procedure). Additional five-year and annual inspections can be found in Appendix A as well.

Key results from the Five-Year Independent Consultant Inspection, dated 12/20/2010 (Appendix A: Doc 07 - 2010 Five-Year Inspection), are as follows:

Northern Ash Area

- Dikes have performed well; no dike failures have occurred. Locally steep areas exist in the exterior slope some of which indicate past slumping. No areas indicate recent activity (Perform remedial work);
- There was no evidence of seepage emerging from the dikes or immediately adjacent to toe areas;
- No ash slurry has been discharged into the areas adjacent to the dikes for over 20 years; the sedimented ash present has a dry surface capable of supporting light traffic;
- Vegetation on the exterior slopes has not been maintained due to the inactive conditions, and small and large trees have grown up on the slope. No indications of structural distress to the dike from the tree growth were seen (Develop a plan for management).

Southern Ash Area

- No evidence of excessive, erosion, instability or settlement of the dikes was observed. In general, the ash pond dikes appear to be in good condition and are well maintained. The discharge structures appear to be in good condition;
- Seepage is present at localized spots on the lower portion of the south dike, the base of the east dike and at the southeast corner of the pond dike. The seepage on the south dike appears to have increased slightly in recent years. Remedial measures should be considered, consistent with the potential future use plans for the ash pond (Continue to be observed and potentially remediated);

- The toe drain installed along the south dike continues to function. Outlets from the drain into the drainage ditch are partially blocked with soil and need to be cleaned. The outlet ditch from the toe drain is being well maintained (Clear drains of sediment);

- Local erosion along the interior slopes of the south dike and the dike separating the pond from the settlement basin has generally been covered by ash and has thick growth of reeds limiting risk of further erosion (Should be monitored and if increasing in size place geotextile fabric and rip rap);

Results from report of 2009 Limited (Annual) Field Inspection, dated 05/05/2009 (Appendix A: Doc 08 - 2009 Annual Inspection):

- Eroded spots on interior of south dike and separator dike should be monitored;

- The outlet of the collector ditch for the south dike toe drain should be cleared of sediment and vegetation;

- Local seepage on the south dike slope, the east dike and the southeast corner of the pond should be observed;

- A review of seepage and stability conditions along the toe of the ash pond dikes in conjunction with engineering for the next lift or phase of ash pond storage capacity additions;

- Shallow holes in the exterior slope of the "geotube" containment dikes should be monitored. The holes may be related to animal burrows.

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

The dam is inspected by NCDENR Dam Safety and Division of Water Quality on an annual basis.

Discharge from the impoundment is regulated by the Federal National Pollutant Discharge Elimination Program (NPDES) and the impoundment has been issued a National Pollutant Discharge Elimination System Permit. Permit No. NC0005363.

## 3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

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

# 4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

## 4.1 SUMMARY OF CONSTRUCTION HISTORY

### 4.1.1 Original Construction

Construction began in 1955 for the ash storage area and was expanded in 1963. No additional information was provided for the structures built prior to 1979. There was a dike built in 1979, creating the southern ash disposal area, designed by Carolina Power & Light and constructed by C.M. Lindsay. A subsurface exploration was performed, but no seepage or stability analysis was performed for the design.

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

In 1993, a trench drain was installed along a berm parallel to the south dike with outlet pipes extended to the adjacent ditch to lower the water level on the south dike. In 2004 the riser height elevation was increased to elevation 141.5’ from the original riser height of 135’ (Appendix A: Doc 10 – Ash Pond Sections & Details).

### 4.1.3 Significant Repairs/Rehabilitation since Original Construction

In 1994 the exterior slope of the south dike experienced surface erosion due to heavy vehicular, animal and human traffic and was repaired by placing woven plastic bags filled with a mixture of cement, blasting sand and Blastox along the embankment.

## 4.2 SUMMARY OF OPERATIONAL PROCEDURES

### 4.2.1 Original Operational Procedures

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

4.2.2 Significant Changes in Operational Procedures and Original Startup

No documentation was provided describing any significant changes in operating procedures.

4.2.3 Current Operational Procedures

To the best of our knowledge, original operational procedures are in effect.

4.2.4 Other Notable Events since Original Startup

No additional information was provided.

# 5.0 FIELD OBSERVATIONS

## 5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Frederic Shmurak, P.E. and Justin Story, E.I. performed a site visit on Tuesday, February 22, 2011 in company with the participants.

The site visit began at 10:00 AM. The weather was a cloudy cool day. Photographs were taken of conditions observed. Please refer to the Dam Inspection Checklist in Appendix B for additional site 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 impoundment system was that it was in poor condition due to the general disrepair of the northern dike.

## 5.2 NORTHERN ASH AREA EMBANKMENT

### 5.2.1 Crest

The crest had no signs of depressions, tension cracking, or other indications of settlement or shear failure and appeared to be in satisfactory condition; however, there were signs of minor rutting most likely from vehicular traffic.

**Crest showing minor rutting – Northern Ash Area**

5.2.2 Upstream/Inside Slope

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

5.2.3 Downstream/Outside Slope and Toe

Areas of the downstream slope were eroding, in disrepair and had large trees established within the embankment. This area needs to be remediated. We were made aware by Progress Energy that a plan is already in place and they are awaiting approval from NCDENR to begin the repairs.

**Downstream slope – Northern Ash Area**

**Downstream slope – Northern Ash Area**

#### 5.2.4 Abutments and Groin Areas

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

### 5.3 SOUTHERN ASH AREA EMBANKMENT

#### 5.3.1 Crest

The crest had no signs of depressions, tension cracking, or other indications of settlement or shear failure and appeared to be in satisfactory condition; however, there were signs of minor rutting most likely from vehicular traffic.

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**Crest - Southern Ash Area**

5.3.2 Upstream/Inside Slope

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

5.3.3 Downstream/Outside Slope and Toe

No scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were observed. It is recommend the power plant install animal guards for the toe drains. Seepage was observed at a few locations and this needs to be monitored.

Toe drains – Southern Ash Area

Potential seepage along downstream toe – Southern Ash Area

## 5.4 OUTLET STRUCTURES

### 5.4.1 Overflow Structure

The outlet works consist of a 24-inch reinforced concrete pipe (RCP) vertical riser connected to a 24-inch RCP extending through the dike to a secondary settling basin. A similar riser pipe combination discharges beyond the secondary settling basin dike into a channel leading to the Cooling Lake.

5.4.2 Outlet Conduit

The visual portion of the outlet conduit was functioning properly with no apparent deterioration. There was undercutting around the concrete outfall.

5.4.3 Emergency Spillway

No emergency spillway is present.

5.4.4 Low Level Outlet

No low level outlet is present.

# 6.0 HYDROLOGIC/HYDRAULIC SAFETY

## 6.1 SUPPORTING TECHNICAL DOCUMENTATION

### 6.1.1 Flood of Record

No documentation has been provided about the flood of record. The ash pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore the impounded pool would not be anticipated to experience significant flood stages.

### 6.1.2 Inflow Design Flood

According to FEMA Federal Guidelines for Dam Safety, the current practice in the design of dams is to use the Inflow Design Flood (IDF) that is deemed appropriate for the hazard potential of the dam and reservoir, and to design spillways and outlet works that are capable of safely accommodating the floodflow without risking the loss of the dam or endangering areas downstream from the dam to flows greater than the inflow. The recommended IDF or spillway design flood for a low hazard small sized structure (See section 2.2), in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria is the 50-year to 100-year frequency (See Table 6.1.2).

**Table 6.1.2: USACE Hydrologic Evaluation Guidelines Recommended Spillway Design floods**

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

The 100-year frequency, 24 hour duration storm event is 9.06 inches. Since the facility has a contributing drainage area equal to the surface area of the impoundment, it is anticipated the facility would not experience significant flood states. There is approximately 2 feet of freeboard, thus adequate freeboard exists.

6.1.3 Spillway Rating

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

6.1.4 Downstream Flood Analysis

A dam breach analysis and inundation map development was performed for the site (see Appendix A, Doc 9). The analysis concluded there were no bridges or other structures along the drainage course that might be impacted by the breach. It was also determined that a breach at any other locations, other than the drainage course, would drain through the Weatherspoon Plant and into the cooling reservoir which would accommodate the breach without a significant rise in the water level. (See Appendix A: Doc 09 – Ash Pond Inundation Report).

## 6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation reviewed by Dewberry is adequate.

## 6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

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

# 7.0 STRUCTURAL STABILITY

## 7.1 SUPPORTING TECHNICAL DOCUMENTATION

### 7.1.1 Stability Analyses and Load Cases Analyzed

A stability analysis report for the ash pond dated September 27, 2010, by MACTEC (MACTEC 2010) provides information on the stability analysis. The results are presented in Section 7.1.4 Factors of Safety and Base Stresses. Steady state (normal) and Seismic loading conditions were analyzed. See Appendix A. (Doc 03 - Slope Stability Analyses) for the complete report.

### 7.1.2 Design Parameters and Dam Materials

The MACTEC 2010 report includes documentation of the shear strength design properties for the ash pond embankments (see Appendix A, Doc 03 - Slope Stability Analyses).

Test results showing the strength parameters of the embankments are presented below. There are multiple sections analyzed in the report and only a portion of those analyzed are shown below. The ones shown below are sections that did not meet the minimum factors of safety.

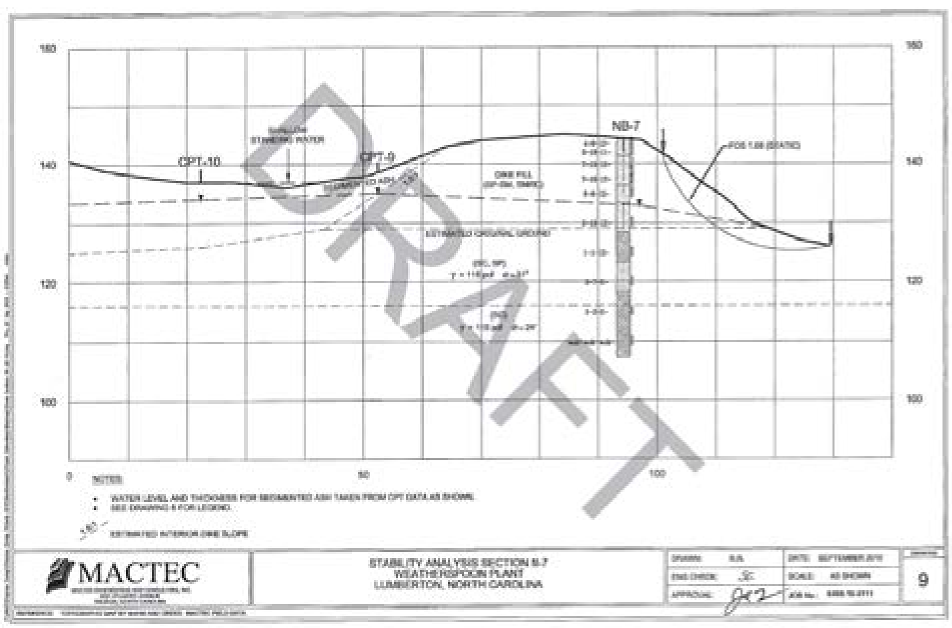


**Figure 7.1.2a: Stability Analysis (Section NB-7)**

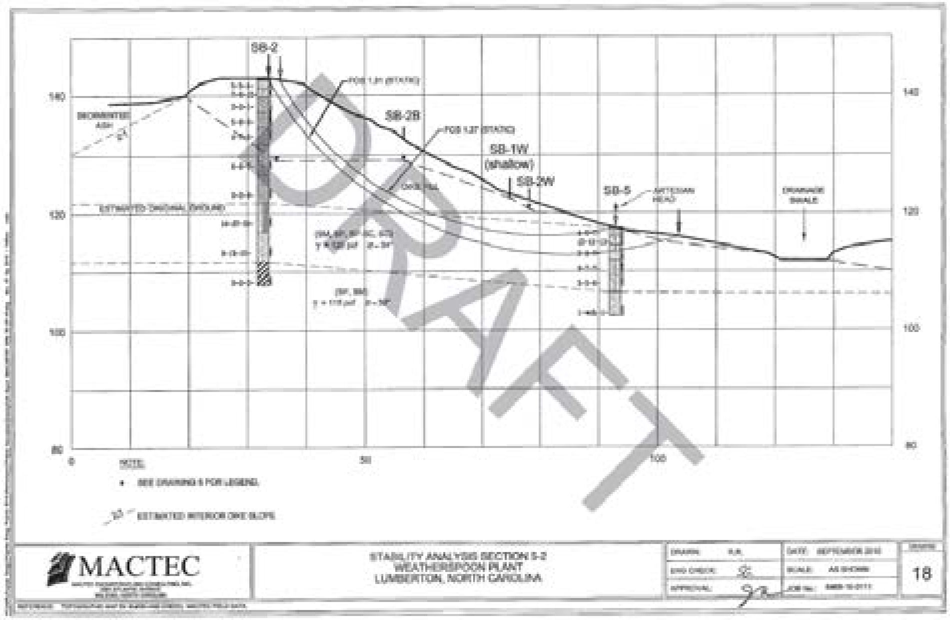


**Figure 7.1.2b: Stability Analysis (Section SB-7)**

7.1.3 Uplift and/or Phreatic Surface Assumptions

Monitoring instrumentation devices were just recently installed. The assumed phreatic surfaces are shown on the figures in section 7.1.2 above and the depiction seems appropriate for these types of structures. No additional information was provided.

7.1.4 Factors of Safety and Base Stresses

Stability analysis of the northern ash area has shown in a few locations factors of safety below the 1.5 NCDENR and United States of America Corp of Engineers (USACOE) thresholds. The MACTEC 2010 report concludes that the factors of safety below the threshold are acceptable because the dikes have been in place for 40 to 50 years, no failures have been noted, currently the dikes do not have water impounded against them, and exploration found water levels within the dikes at low levels.

Stability analysis of the southern ash area also showed a factor of safety in one area below the threshold. There was seepage occurring in this area, so it was recommended to place a “riprap blanket on the slope and toe berm/road.” (Appendix A: Doc 03 – Seepage and Stability Analysis)

| Table 7.1.4 – FACTORS OF SAFETY AGAINST SLOPE FAILURE | | |
|---|---|---|
| | Factor of Safety | |
| | Static | Seismic |
| North Dike Section N-1 | 1.38* | 0.99* |
| North Dike Section N-1 | 1.42* | 1.04 |
| North Dike Section N-2 | 1.07* | Not Run* |
| North Dike Section N-3 | 1.66 | 1.36 |
| North Dike Section N-4 | 1.75 | 1.15 |
| North Dike Section N-4 | 2.03 | Not Run* |
| North Dike Section N-4 | 1.35* | 0.96* |
| North Dike Section N-5 | 1.61 | 1.17 |
| North Dike Section N-6 | 2.00 | 1.37 |
| North Dike Section N-6 | 1.64 | 1.07 |
| North Dike Section N-7 | 1.08* | 0.8* |
| North Ash Area C and D - Section N-8 | 1.61 | 1.18 |
| North Ash Area C and D - Section N-9 | 1.59 | 1.22 |
| North Ash Area C and D - Section N-10 | 1.1* | Not Run* |
| South Ash Dike Section S-1 | 1.57 | 1.2 |
| South Ash Dike Section S-1 | 1.74 | 1.43 |
| South Ash Dike Section S-2 | 1.31* | 1.03 |
| South Ash Dike Section S-2 | 1.37* | 1.10 |
| South Ash Dike Section S-3 | 1.43* | 1.17 |

Table 7.1.4 information taken from Appendix A: Doc 03 – Seepage and Stability Analysis

*Static factors of safety should meet or exceed 1.5 and Seismic factors of safety should meet or exceed 1.0

7.1.5 Liquefaction Potential

No liquefaction potential documentation was provided.

7.1.6 Critical Geological Conditions

The ash ponds are near the western edge of the Inner Coastal Plain Physiographic province. The surficial materials in this area were deposited by river activity and typically consist of mixed layers of sand, silt and clay. Because the site is adjacent to the Lumber River, floodplain deposits of soft silt and clay are common. The upper deposits are underlain by silts and clays of the Yorktown Formation. Broken shells mixed with silt, clay and sand are often encountered in this formation. (Appendix A: Doc 03 – Seepage and Stability Analysis)

A separate document provided by MACTEC also states the plant is located in Black Creek Formation of the Coastal Plain. (Appendix A: Doc 02 – Ash Pond Summary)

Based on USGS Seismic-Hazard Maps for the Conterminous United States, the facility is located in an area anticipated to experience a 0.05g to 0.10g acceleration with a 2-percent probability of exceedance in 50-years.

## 7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation is adequate.

## 7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the dam appears to be poor based on the following observations:

- North ash area in disrepair
- Factors of safety do not meet NCDENR and USACOE standards
- Significant amount of large vegetation are on the North embankment

# 8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

## 8.1 OPERATING PROCEDURES

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

## 8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance procedures for the facility are based on weekly, monthly, annual and five-year inspections. If deficiencies are noted during the inspections, the first responsibility of the inspector is to discuss any noted issues or areas of concern with the plant environmental coordinator. A work order will then be requested as needed to address the issues or concerns, and the issue will be routed to the plant manager for review and the appropriate forms are filled out to get the necessary work completed. See Appendix A: Doc 06 – Dam Inspection procedure for the process.

## 8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

### 8.3.1 Adequacy of Operating Procedures

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

### 8.3.2 Adequacy of Maintenance

Based on the assessments of this report, maintenance procedures appear to be inadequate. Trees and other vegetation has established on the northern embankment. Multiple areas along the northern embankment showed signs of erosion and slope failure.

# 9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

## 9.1 SURVEILLANCE PROCEDURES

The current surveillance procedures consist of monthly, annual and five-year inspections.

Monthly Inspections:

Progress Energy initiated a monthly inspections program to visually assess the condition of the embankments. The procedures can be found in Appendix A – Doc 06: Dam Inspection Procedures.

Annual Inspections:

One annual inspection was provided by Progress Energy and can be found in Appendix A - Doc 08: 2009 Annual Inspection.

Five-Year Inspections:

A Five-Year inspections report was provided by Progress Energy and can be found in Appendix A - Doc 07: Five-Year Inspection.

## 9.2 INSTRUMENTATION MONITORING

The recently installed piezometers (2011) are adequate for monitoring the phreatic surface.

## 9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

### 9.3.1 Adequacy of Inspection Program

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

### 9.3.2 Adequacy of Instrumentation Monitoring Program

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

## System Purpose

The ash handling system consists of two major components: the bottom ash conveyor and the fly-ash conveyor. Because the characteristics of ash are very different from the front to the back of the boiler, the collection and transport are separate for the furnace bottom ash and collection points downstream. Both systems are essential in complying with air emission permits and eliminating river water pollution. Without effective ongoing removal of ash, the boiler unit would require outages to remove the ash. A wet bottom ash system collects and removes ash from the furnace. Bottom ash is a mixture of slag, clinkers and coarse granular ash. Bottom ash is produced during combustion by impurities contained within coal. The system uses water impounding for the following reasons:

· To break up large pieces of slag by thermal shock as they fall into the pool of ambient temperature water.
· To keep the ash and slag submerged so that they do not fuse into large unmanageable masses that would result if they were exposed to furnace heat

The fly-ash system collects ash particles that drop out of the flue gas when the gas changes direction abruptly in the back pass and air heater ducts and is collected in hoppers along the flue gas outlet passage and precipitator. If this ash were allowed to exit at the stack, opacity readings would be out of compliance.

## System Flow Path

*Bottom Ash Removal* : The bottom ash system begins in the furnace. Ash continuously falls into a water impounded ash hopper from the furnace above. The bottom ash hopper, which is designed with sloped sides for gravity flow, collects the ash. Water jets assist the removal of ash deposits from the ash hopper. The ash is changed to slurry form during the ash removal process. A manually operated vertical lifting door (inner door) in the dog house is opened to allow removal of bottom ash. During ash removal operations, the inner door and a pneumatically operated bottom ash supply valve are opened and the ash slurry is drawn from the hopper through the clinker grinder using a jetpulsion pump. High-pressure water from the ash pumps flows through the jetpulsion pump. The jet pump acts as a nozzle, increasing the velocity and creating a vacuum inside the jet pump nozzle. The vacuum draws the bottom ash slurry from the clinker grinder through the jet pump and discharges to the ash pond. The clinker grinder reduces any lumps or clinkers to a size, which will pass through the jetpulsion pump, and into the ash sluice line. The ash sluice line, located in a concrete trench below plant grade level, transports the ash away from the plant to the ash pond area.

*Fly Ash Removal* - This system consists of precipitator hoppers, economizer hoppers and air heater hoppers. The economizer hoppers are set directly beneath the economizer where the flue gas is exiting the boiler. They are located in a space where the flue gases change direction. This change in direction of the gas flow causes large particulates to fall out of the gas and accumulate in the hoppers. The air heater hoppers beneath the air pre-heaters have been disconnected from the fly ash system. The discharge from the air heater hoppers is piped to the bottom ash and is only set-up when washing the air heaters. The precipitator collects ash on the electrically charged plates and electrodes. Rappers and vibrators knock the dust off the plates and electrodes where it is collected in the hoppers. Fly ash is pneumatically conveyed from each hopper. The airflow necessary for conveying the ash is created by a hydroveyor

exhauster and air intake valves on each of the lines serving the dust hoppers. The fly ash and conveying air mix with water in the
inlet section of the hydroveyor exhauster and are discharged into an air separator tank. Conveying air after being separated from the fly ash is vented to the atmosphere. The ash-water slurry discharges by gravity from the air separator to a common header with Unit 2. The ash-slurry mixture is pumped through a jet pump to the ash pond. Figure 1 below is an illustration of the fly ash removal system.

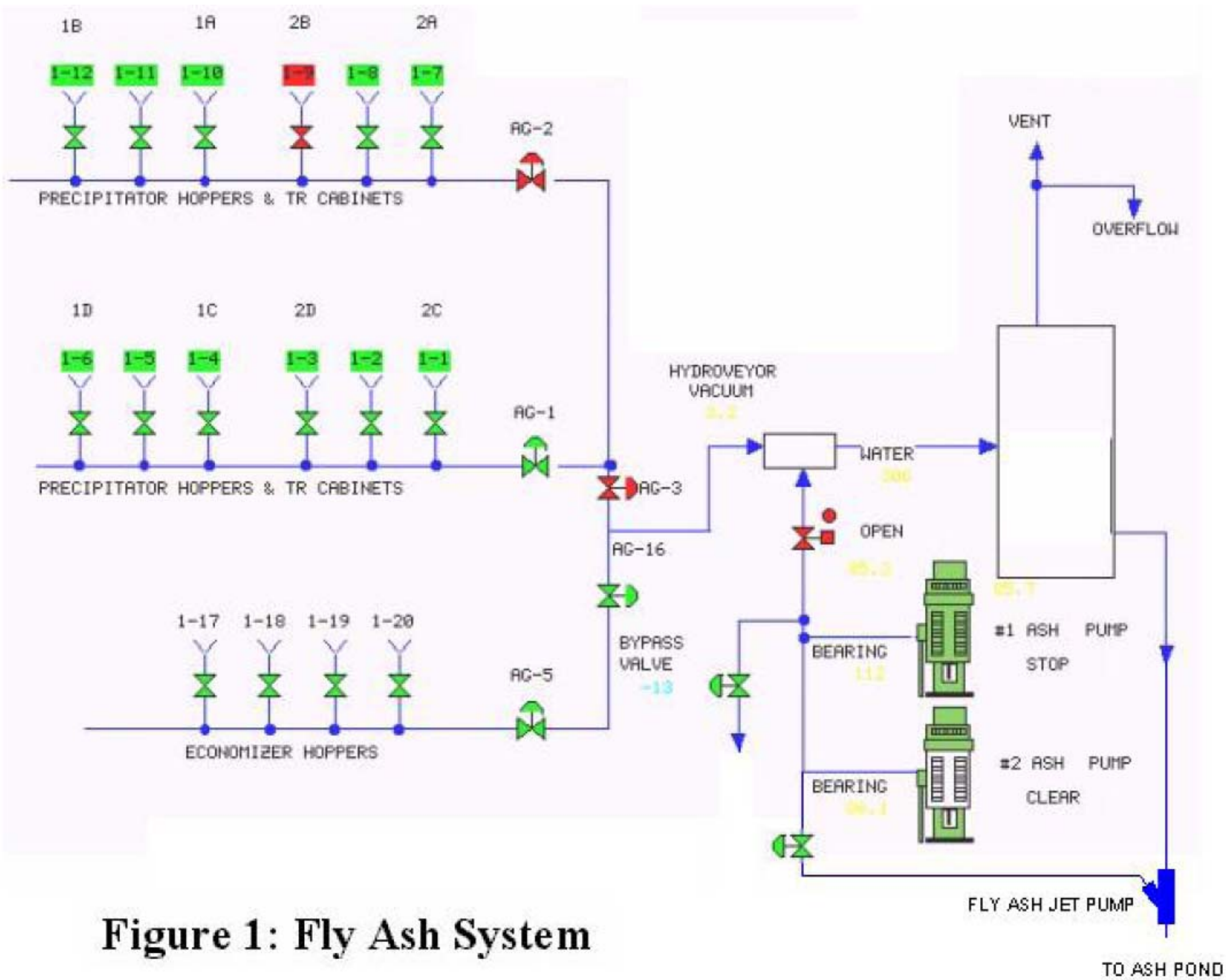


Figure 1: Fly Ash System

**DAM INFORMATION SUMMARY**
**Weatherspoon Steam Electric Plant**
**Ash Pond**
**Robeson County, North Carolina**

## 1. Location

Located on east bank of Lumber River about one mile southeast of Lumberton
Latitude: N34.5913°
Longitude: W78.9693°
Latitude and longitude taken from NC Dam Safety Inventory listing
NC Dam Identification Number: ROBES-009

## 2. Size and Dimensions UPDATE FOR NEW INCLUSION OF OLD POND SECTIONS

| | |
|---|---|
| Length: | 6,600 feet |
| Maximum Structural Height: | 28 feet |
| Surface Area | 17 acres (1979 portion) |
| Storage capacity: | 425 acre feet (1979 portion; most capacity is occupied by sedimented ash) |
| Size Classification: | Small |
| Hazard Classification: | Intermediate |
| (Classifications based on NC Dam Safety Regulations and Dam Safety Inventory) | |
| Regulatory Design Storm | 100 yr* |
| US Slope: | 2.0(H):1(V) |
| DS Slope: | 2.5(H):1(V) |
| Crest Width: | 12 feet |
| Crest Elevation: | 143 feet ** |
| Maximum Pool Elevation: | 141.0 feet** |
| Current Operating Level: | 139 feet ** |
| Instrumentation | None |

* Design is based on 100-yr storm of 6.3 inches over 6 hours.
** Original design used 1929 survey datum; elevations are adjusted to NAVD 1988

## 3. Geology and Seismicity

Located in Black Creek Formation of Coastal Plain,

Near Zone 1 and 2 boundary seismic zone according to Corps of Engineers with Design Earthquake: $a_h = 0.05$ to 0.1 g

## 4. Design Information

The ash pond as considered by NC Dam Safety includes portions constructed in the 1950's and 1960's that are now completely filled with sedimented ash as well as the currently active area constructed in 1979. No design or construction information is available for the earlier dikes. The 1979 dike was designed by CP&L. A subsurface exploration was performed. No stability or seepage analysis was performed for the design. No internal drainage was included in the design.

The outlet works consist of a 24-inch reinforced concrete pipe (RCP) vertical riser connected to a 24-inch RCP extending through the dike to a secondary settling basin. A similar riser and pipe combination discharges beyond the secondary settling basin dike into a channel leading to the Cooling Lake. Neither of the pipes has seepage collars.

Hydrologic evaluation has been conducted to show that the design freeboard and outlet works can safely store and pass a 100-yr storm.

**5. Construction History**

**1955:** Initial construction of ash storage area.
**1963:** Expansion of original area to the south.
**1979:** New dam constructed by C. M. Lindsay under CP&L direction. Testing was conducted.
**1990:** Placed concrete plug above discharge pipe to reduce seepage
**1993:** Installed trench drain along berm parallel to the dike with outlet pipes extended to the adjacent ditch to lower water level on south dike.
**1994:** Exterior slope along south dike experienced surface erosion due to 4-wheel traffic and horses. Repaired by placing woven plastic bags filled with a mixture of cement, blasting sand and Blastox.
**2004:** Riser height increased to elevation 141.5 feet.
**2006 - 2007:** New containment area was placed in service within the 2001-2002 dry stack area. The new containment area was created using geo-tubes and was constructed by Trans-Ash. New containment area within the existing ash pond area completed. Design by MACTEC.

**6. Inspection History**

The dam is inspected on 5-year intervals. Since 2002, yearly site visits have been made for limited visual observations. NC Dam Safety personnel inspected in January, 2010.

Ralph Fadum: *1985*
LAW/MACTEC: *1990*, *1995*, 1997, *2000*, 2002, 2003, 2004, *2005*, 2006, 2007, 2008, 2009, *2010*
Italics indicate 5-year inspections.

**7. Current Issues**

As a result of their 2010 inspection, NC Dam Safety issued a Notice of Deficiency related to excessive tree growth on portions of the dikes constructed prior to 1979 and seepage along the southern dike in the 1979 area. Progress Energy arranged for cutting of excessive trees. MACTEC conducted geotechnical studies to address the seepage items identified and to re-evaluate stability of the older and current areas of the ash pond dike sections. Results indicated generally acceptable factors of safety, but some local areas were identified for remedial work. MACTEC has prepared plans for the recommended remedial work related to stability and seepage. Implementation of the remedial plans will be done in 2011.

**8. Overall Summary**

The 2010 5-year inspection report indicates that the Ash Pond dikes are in generally satisfactory condition with some local areas of remedial work needed (non-emergency). There was no significant change in the condition of the 1979 section of the ash pond dikes from the 2005 five-year inspection or the 2009 limited field inspection.

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MACTEC

engineering and constructing a better tomorrow

September 27, 2010

Mr. Bill Forster
Progress Energy
7001 Pinecrest Road
Raleigh, North Carolina 27613

**SUBJECT: REPORT OFGEOTECHNICAL EVALUATION**
**ASH POND DIKES**
**PROGRESS ENERGY - WEATHERSPOON PLANT**
**MACTEC PROJECT NO. 6468-10-0111**



Dear Mr. Forster:

MACTEC Engineering and Consulting, Inc. (MACTEC) is pleased to submit the attached report of our geotechnical evaluation of the dikes surrounding the ash facilities at the Weatherspoon Plant. The work was authorized by Progress Energy under Work Authorization WA-2720-195. In addition to the geotechnical evaluation, a hydrologic evaluation of the capacity of the existing outlet structures was performed. That evaluation is reported separately.

The results of the work show the dikes overall are in satisfactory condition. Improvements are needed to local areas of the northern dike and for the south dike. The recommended repairs consist of earth anchoring systems, slope flattening or placement of riprap berms (northern dike) and riprap berms or installation of drainage for seepage control (south dike)

MACTEC is pleased to have performed this work for Progress Energy. Please provide your review comments as soon as possible. Contact Al Tice (919-831-8052) or Bob Miller (919-831-8019) if you have questions.

Sincerely,
MACTEC ENGINEERING AND CONSULTING, Inc.

9/27/10

Sharat Gollamudi, E.I.
Project Geotechnical Professional

J. Allan Tice, P. E.
Senior Principal Engineer
Registered, North Carolina 6428

NORTH CAROLINA PROFESSIONAL SEAL 6428 ENGINEER J. ALLAN TICE

Progress Energy

# Seepage and Stability Analysis
# Progress Energy -Weatherspoon Plant
# Lumberton, North Carolina



- Prepared By -


MACTEC ENGINEERING AND CONSULTING, INC.
3301 Atlantic Avenue
Raleigh, North Carolina 27604


September 27, 2010

MACTEC Job No. 6468-10-0111

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# STABILITY AND SEEPAGE ANALYSIS

## PROGRESS ENERGY – WEATHERSPOON PLANT
## LUMBERTON, NORTH CAROLINA

# 1.0 REPORT SUMMARY

This report presents the results of stability and seepage assessment of the ash pond dikes at Progress Energy Carolinas' W.H. Weatherspoon Steam Electric Plant in Lumberton, North Carolina. The site location map is shown on Drawing 1. This report is prepared partly in response to inspection by the North Carolina Department of Environment and Natural Resources (NCDENR) and partly from MACTEC's continuing inspections of the South Dike. NCDENR has issued a Notice of Deficiency dated April 29, 2010 in which two conditions were noted – seepage along the southern downstream slope of the dam and large trees growing on the eastern and northern downstream slopes of the dam. Note that NCDENR considered the entire perimeter dike system as the dam without distinction among dikes retaining old sedimented ash and dikes retaining current slurry ash. The letter also requested a stability and hydraulic analysis for the dam. The hydraulic analysis is submitted separately.

MACTEC conducted historical review of plant records regarding construction of the dikes. Several episodes of dike construction have occurred, beginning in 1955 and ending in 1979. There was limited information available; the most information was for the last construction in 1979. For purposes of the evaluation, the overall ash pond area was divided into a Northern Ash Area and a Southern Ash Area as shown on Drawing 3. MACTEC reviewed the concerns expressed by NCDENR and conducted site reconnaissance to select representative sections of Northern and Southern area dikes to assess the seepage and structural stability. The work involved geotechnical field exploration, laboratory testing, checking water levels in temporary observation casings several times and performing stability analyses.

The results of analyses show that, while there are local areas needing improvement, the overall stability of the perimeter dike system is satisfactory, and there is no immediate threat of dike failure. The dikes have performed with no failures or significant problems for 30 to 50 years. Some sections of the dikes do need repairs, and remedial measures consisting of slope flattening, use of ground anchors, placement of rip rap and other alternate measures are recommended to improve the stability.

It is our opinion that removal of trees on the exterior dike slopes in the Northern Ash Area is not a critical stability condition. The dikes are not impounding water in the area where trees are present, and water levels (phreatic lines) within the dikes are low. While a tree fall coupled with uprooting of its base might cause a local loss of ground at the surface, the potential for shortening a seepage flow path is not present due to the low phreatic line. Even a local loss of ground would not be sufficient to cause a breach of the dike, and materials behind the dike are not in a liquid condition. Ground disturbance caused by removing trees and stumps would create more damage and erosion potential than a local tree fall.

We recommend continuing the regular observation of the dikes by Progress Energy personnel, and supplementing that with monthly inspection by an independent engineer to check for tree-related issues or other items relative to dam safety. During the monthly engineering inspections, the full face of the dike in areas with trees will be walked. An engineering inspection should be performed shortly after an extreme wind event such as a tornado or hurricane or intense thunderstorm with high winds at the plant.

# 2.0 SCOPE OF SERVICES

To achieve the objectives of this study the following scope of work was conducted. Description of the field activities is presented in detail in Section 5.

## 2.1 Northern Ash Area

- Researched plant files and aerial photographs to learn as much as possible about the construction history of the dikes in the currently inactive north area.
- Obtained ground surveyed sections at locations selected by a MACTEC engineer experienced in dam inspection and analysis to illustrate a range of conditions.
- Obtained a new aerial topographic map from subcontractor McKim and Creed of all the ash pond area, primarily for use in the hydrologic analysis.
- Performed a geotechnical exploration including machine-drilled and hand augered borings, cone penetromenter probes, push probes and setting of temporary water level observation casings,
- Located borings after drilling using GPS methods referenced to site references set by McKim and Creed during the aerial topographic work.
- Obtained ground elevations at boring locations to supplement information obtained from the topographic map.
- Checked installed casings three times for water levels.
- Performed laboratory testing on samples from the borings.
- Conducted slope stability analysis of selected sections.

## 2.2 Southern Ash Area

The scope of work was essentially the same as for the northern area, except that no cone penetrometer or push probes were included. The work also included review of seepage conditions.

The information collected was used to evaluate the stability of the existing dikes. The information from the water level observations was used to set phreatic lines for analysis. Seepage patterns in the south dike were reviewed to see if the seepage is through the dike or from a surficial mechanism as has been postulated in past studies. Recommendations for improving dike stability or reducing/controlling seepage are included in this report.

# 3.0 DESIGN AND CONSTRUCTION INFORMATION

## 3.1 Ash Pond Construction Sequence

The Weatherspoon Plant is located east of Lumberton, North Carolina as shown on Drawing 1 (Drawings follow the text). The site is a low to upland area adjacent to the Lumber River. The ash pond area is located to the northeast of the generating units. The original generating units at the Weatherspoon Plant were constructed during the period 1947 to 1952. The first unit was placed in service in 1949. Construction photographs show the first diked area for receiving sluiced ash was created in a wooded area about 1600 feet north of the generating units. As the plant expanded and as ash volume increased, additional diked areas to receive sluiced ash were constructed to the south of the original pond. Drawing 2 shows our understanding of the sequence of these ash pond constructions. The last dikes were constructed in 1979.

For purposes of this report, the ash pond has been divided into a Northern Ash Area and a Southern Ash Area as indicated on Drawing 2, roughly corresponding to the division between the last dike construction in 1979 and the original dikes. Drawing 3 is a recent aerial photograph extracted from Google Earth that has been annotated to show these two areas as well.

## 3.2 Northern Ash Area

MACTEC reviewed available drawings and photographs on file at the Weatherspoon Plant. No specific design or construction records for the first ash pond areas (designated as Areas A and B on Drawing 2) were located. Some plant construction aerial photographs from the 1949 time frame (Exhibits 1 and 2) show the ash pond area prior to its construction. A photograph from 1955 (Exhibit 3) shows the 1955 original ash pond near completion.

The aerial photographs show the ash pond north area was wooded. The rail line entry to the plant is along the north and west edges of the original ash pond area. An excavation was required for the rail line. There are indications that the excavated material was cast up to become a material source for the original dikes.

While there are no plans, topographic mapping conducted in 1973 by Olsen Associates (Site Plan; Exhibit 4), in 1990 by Smith and Smith (Topographic Map, "Ash Pond Area", Exhibit 5) and by McKim and Creed for the current work (Drawing 4) all indicate crest elevations in the range of 143 feet to 146 feet. Current survey elevations are referenced to the North American Vertical Datum, 1988; older surveys are likely referenced to the 1929 USGS datum. There is an approximate 1 to 1.5 feet difference between the two datums in the Lumberton area, with the 1988 datum being lower than the 1929 datum. Thus, a direct comparison of elevations shown on older drawings to those on current drawings is misleading.

Additional dike construction in the Northern Ash Area occurred between the 1950's and 1979 as shown on Drawing 2. A file review at the Weatherspoon Plant found only the above referenced Site Plan prepared in 1973 by Olsen Associates. Topographic contours of the exterior slopes of dikes that were present in the southern portion of the Northern Ash Area indicate slopes that ranged from approximately 2(H) : 1(V) to 3(H) : 1(V).

## 3.3 Southern Ash Area

The design for the dikes constructed in 1979 was performed by Progress Energy (then known as Carolina Power and Light Company). Design drawings were previously obtained by MACTEC during regular dam inspections. The following drawings were obtained:

- Drawing RCD 1278 Site Plan
- Drawing RCD 1279 – Ash Pond Area Contours
- Drawing RCD 1280 Ash Pond Area Plan

- Drawing RCD 1281 Ash Pond – Sections and Details
- Drawing RCD 1282 Erosion and Sediment Control Plan

Drawings RCD 1280 and RCD 1281 are included as Exhibits 6 and 7 in a reduced size format.

Geotechnical borings were made in the planned construction area in 1978 by Law Engineering (now known as MACTEC) and submitted to Progress Energy. This work is discussed in section 5.1.

A design report or calculations have not been located. The planned dike configuration was for a 12-foot wide crest at elevation 145 feet (1929 datum), an interior side slope at 2(H) : 1(V) and an exterior side slope at 2.5 (H) : 1(V). A toe berm to allow for an access road was provided along the south end dike. A discharge basin with the same crest and side slope parameters was constructed in the southeast corner of the pond. As part of an earlier construction, a diversion canal to carry water of Jacobs Swamp Creek was constructed east of the 1979 pond area. The eastern dike of the 1979 construction was built parallel to that canal, but the dike slopes did not extend down to the canal.

The design water level was shown at elevation 135 feet in the storage pond and elevation 133 feet in the discharge basin. Vertical risers connecting to horizontal pipes provided for water removal. The exit of the pipe from the discharge basin was to be at elevation 117 feet. Over time, the vertical risers were extended to provide for a normal pond water level at elevation 143 feet and a normal discharge pond water level at elevation 141 feet. These elevations are referenced to the 1929 datum. Current surveying referenced to the NAVD 1988 datum places the dike crest at approximately elevation 143 feet, the water surface in the pond at approximately elevation 139 feet, and the water surface in the discharge basin at approximately elevation 134 feet.

### 3.4 Interior Dike Construction

As ash filled the storage areas and new areas were constructed, the filled areas drained and settled to form surfaces capable of supporting equipment. The original ash disposal areas were planted in vegetation for dust control and wildlife habitat. To more effectively handle the ash, Progress Energy began excavating settled ash and creating dry stacks in the northern areas. Starting in 2001, interior dikes of ash were constructed within the northern area and, most recently, in portions of the southern area. These interior dikes did not directly abut the exterior dikes.

In 2001, a new ash storage area was constructed on top of the north pond dry stacked area, using some of the dry-stacked ash to form new dikes. As that area was beginning to impound sluiced ash, a small erosional failure occurred in the north side of the system, and a small volume of water carrying suspended ash found its way across the original north perimeter dike and ultimately into the Lumber River. The flow was of short duration and caused no visible damage to the north perimeter dike. The failed dike section was reconstructed using ash, but no liquid ash slurry was permitted to be impounded against the dike.

## 4.0 INSPECTION HISTORY

### 4.1 Plant Personnel Inspections

Plant personnel have performed general visual inspections of the Southern Ash Area since it was constructed. Because the ash adjacent to the Northern Ash Area perimeter dikes had drained and was vegetated, plant personnel did not routinely observe these perimeter dikes.

## 4.2 Independent Consultant Inspections

Under an agreement with the North Carolina Utilities Commission (NCUC), Progress Energy began a program of independent consultant inspections of the dikes on 5-year intervals beginning in 1985. Law Engineering/MACTEC performed the inspections and issued reports that were transmitted to the NCUC. The independent consultant inspections were made for the dikes constructed in 1979, the Southern Ash Area.

## 4.3 North Carolina Dam Safety inspections

In August, 2009, the North Carolina Legislature adopted a bill that placed regulation of the ash pond dams and other power plant dams under the jurisdiction of the Dam Safety group of the Department of Environment and Natural Resources, Division of Land Resources, Land Quality Section, (DENR). In January, 2010, Dam Safety personnel conducted an inspection of the ash pond area. Their inspection covered the dikes around the complete perimeter. In their report, DENR commented on the tree growth on the exterior slopes of the Northern Ash Area and on the seepage emerging from the south dike of the Southern Ash Area. A Notice of Deficiency was issued dated April 29, 2010.

# 5.0 GEOTECHNICAL DATA COLLECTION

## 5.1 Historical Data

The earliest geotechnical data found in our file review is the Law Engineering report from 1978, performed in support of the 1979 dike construction. The work included 25 borings located as shown in Exhibit 6 and laboratory classification testing. Copies of the borings and laboratory test results are included in Appendix F-1. No records of laboratory strength testing were located.

A geotechnical exploration was conducted in 1988 by Law Engineering as part of a feasibility study for interior stacking of dry ash. The work included four borings along the crest of some of the Northern Ash Area east and west dikes and some hand auger borings at the toe of these dikes. No laboratory strength testing was conducted. Copies of the boring location plan and boring records are included in Appendix F-2.

In 1993, Law Engineering performed a geotechnical study of the stability and seepage conditions at the south dike of the 1979 construction. The work included three soil test borings advanced from the dike crest at observed downslope seepage areas and six hand auger borings on the exterior slope. Slotted pipe was placed in the boreholes to allow checks of water levels. Laboratory testing was conducted that included a trixial consolidated undrained compression test with pore pressure measurements. A copy of the 1993 report is included in Appendix F-3.

## 5.2 Present Field Exploration Program

A geotechnical exploration program was performed to obtain information on the materials within and below the perimeter dikes. Information was also obtained on the sedimented ash that has been in place adjacent to the Northern Ash Area, north perimeter dikes for over 50 years. The exploration program included the elements listed in the following subsections.

### 5.2.1 Topographic Mapping

McKim and Creed, under subcontract to MACTEC, performed aerial photographic mapping of the entire ash pond area. A topographic map with 1-foot contours was furnished for project use (Drawing 4). In addition, McKim and Creed obtained surveyed cross sections at selected locations on the perimeter dike of the Northern Ash Area. The cross sections were used in stability analysis and are discussed in section 7.3.

### 5.2.2 Geotechnical Borings

The boring program consisted of 16 soil test borings drilled with a track-mounted rig and 13 shallow-depth borings advanced using a hand auger, mainly on dike slopes. Drawing 5 shows the boring locations which were obtained using GPS methods and references to site markers placed by McKim and Creed for topographic information. Note that boring NB-2 originally planned was not drilled due to its close proximity to boring NB-3.

The soil borings were performed Bridger Drilling Enterprises under subcontract to MACTEC using a CME 45C drill rig mounted on an all-terrain carrier. Borings were drilled using mud-rotary drilling procedures. Standard penetration testing (SPT) was performed at 2.5 to 5-foot intervals by driving a 1-3/8 inch inside diameter split-spoon sampler in general accordance with ASTM D 1586. The split-spoon sampler is driven into the soil a distance of 18 inches by a manual hammer weighing 140-pounds from a free fall height of 30 inches. The number of blows required to drive each 6-inches of the sampler were noted, and the number of blows from the middle two increments are added to obtain the Standard Penetration Resistance (N-Value).

Samples were taken from the split-spoon sampler, described and identified based on visual-manual procedures. A representative portion of each sample was sealed in a glass jar with a moisture tight lid, labeled and returned to MACTEC's laboratory for further visual-manual identification and/or laboratory testing. Intact samples were obtained in at targeted depth intervals based on the SPT work and field observations of the samples. In some cases an adjacent borehole was drilled for the intact sampling. The methods described in ASTM D 1587 for thin walled tube sampling were used.

An experienced geotechnical engineering professional observed the drilling operations, logged the recovered soil samples, recorded SPT blow counts and measured ground water levels if encountered. Each of the soil samples was described in accordance Unified Soil Classification System (USCS). Detailed descriptions of the soil samples recovered from the borings are presented on the boring logs in Appendix A. The stratification lines indicated on the boring logs represent the approximate boundaries between soil types; in-situ, the transitions may be gradual. Variations in soil conditions between borings can also occur.

### 5.2.3 Cone Penetrometer Testing

Thirteen cone penetrometer probes (CPTu) were advanced within the sedimented ash area adjacent to the north perimeter dike to check thickness of the ash and water levels. The cone penetrometer information was also obtained for use in later evaluations of the ash that may be performed related to possible decommissioning of some the Northern Ash Area dikes. The locations are shown on Drawing 4. This work was performed by Cone-Tec of Virginia under subcontract to MACTEC. The CPTu is performed by hydraulically pushing rods with a conical tip into the soil. A track mounted rig was used. The cone tips are instrumented with an inclinometer and a pore water pressure measurement cell. The cones are advanced at a steady rate by hydraulic pressure. Data are transmitted to a data processing computer equipped that records tip bearing stress (qc), side sleeve friction (fs), pore water pressure (u2) created by the act of pushing the cone into the soil, and deviation of the cone tip from vertical. The data are recorded automatically for every 2 cm of soil penetration, thereby providing a nearly continuous subsurface profile.

At three locations, a cone equipped with a vibration sensor was used to allow measurement of the arrival times of shear waves generated by a horizontal impact on the ground surface. These data allow computation of the soil shear wave velocity.

Results of the CPTu testing are presented on summary plots in Appendix B.

#### 5.2.4 Water Level Observation Casings

To allow checks for water levels over time, temporary 1-inch diameter PVC pipes with slotted sections were installed in the boreholes. The PVC pipes were set in the open borehole, a sand pack was placed to approximately one foot above the slotted section, a bentonite seal placed above the sand pack, and a bentonite-cement grout used to fill the remainder of the borehole. Steel protective covers were installed flush with the dike soils in the south dike area. For the north dike area, the temporary casings were allowed to extend above the dike crest. After obtaining several sets of water level measurements, the temporary casings will be filled with grout.

### 5.3 Laboratory Testing

#### 5.3.1 Historical Data

As mentioned in section 5.1, only limited laboratory testing has been conducted in past geotechnical explorations. The data collected was in the 1979 south dike area. One consolidated undrained triaxial test with pore pressure measurements was conducted. Various laboratory classification tests have been conducted including particle size distribution, Atterburg limits and Proctor compaction. The available laboratory data was used to compare results from the current exploration.

#### 5.3.2 Current Study

Soil samples were re-examined in the field and laboratory by an experienced engineer to confirm field classifications. The field classifications were revised where necessary. Soil samples were grouped into major strata based on visual-manual identification procedures. Laboratory testing was conducted on representative soil samples to aid in classification. Laboratory tests performed included natural moisture contents, grain size distribution and Atterberg limit determination tests. Consolidated, undrained triaxial shear tests with pore pressure measurements were performed on four selected intact samples. All testing was done in general accordance with applicable ASTM specifications. The results of the tests are included in Appendix C.

## 6.0 Geological Conditions

### 6.1 Geologic Setting

The Weatherspoon plant site is near the western edge of the Inner Coastal Plain Physiographic province. The surficial materials in this area were deposited by river activity and typically consist of mixed layers of sand, silt and clay. Because the site is adjacent to the Lumber River, floodplain deposits of soft silt and clay are common.

The upper deposits are underlain by silts and clays of the Yorktown Formation. Broken shells mixed with silt, clay and sand are often encountered in this formation.

## 6.2 Surface Conditions

The dike crests are all reasonably level. Gravel is presently in variable amounts to serve as a travel path. Vegetation on the crests is maintained by mowing. Past inspections and recent observations have found no indications of cracks along the edges of the crests and no unusual settlement or deformation.

Interior slopes have limited exposure due to the accumulated ash or impounded water. In the Northern Ash Area, the sedimented ash is within 1 to 2 feet of the dike crest, except in the northeast corner where remnants of the former discharge area are up to 9 feet below the crest. In the Southern Ash Area, sedimented ash or water is within 2 to 3 feet of the crest. Interior slopes are typically grassed. Vegetation is maintained by mowing.

Exterior slopes in the Northern Ash Area have not been maintained for some time because no ash was being placed in these areas. Vegetation consisting of brush and kudzu has grown up on the western portion. Trees ranging from deciduous saplings to 12-inch diameter or greater pines and some brush have grown up on the north and east portions of the area.

Along the north dike in particular, local slumps have occurred creating very steep upper slope portions. Many of these are currently partly retained by logs placed by plant personnel. Further down the slopes, a bench is present. Judging from the construction photographs in Exhibits 1 through 3, this bench could be original ground with the slope below the bench having been excavated as part of the rail line access. Within this lower slope, there are occasional very steep sections, possibly caused by erosion from flooding of the stream that is between the slope and the rail line embankment.

The exterior slope in the area of the former discharge pipe on the east side dike is very steep and has had surficial slides (area N-7 on Drawing 5).

A portion of the west dike approximately 125 feet in length and located near the entrance ramp from the plant has a very steep exterior slope suggestive of past slumps. The slope has been in this condition for some years and the dike crest shows no distress. This area is identified as N-10 on Drawing 5. There is no liquid material adjacent to the dike, and the dike is low height, approximately 10 feet.

Exterior slopes in the Southern Ash Area have light brush and grass vegetation that is maintained by mowing or hand cutting. These slopes are in fair condition. Past inspections have found no indications of slumping or cracks that would suggest slope failures. The south dike of this area does have slight seepage emerging at some locations; this condition was noted in 1990 after the pond water level was raised. The conditions have been observed in inspections since that time. The seepage is typically slow ooze with rare spot of concentrated, slight flow. Progress Energy plant personnel installed a toe drain in 1994 consisting of a trench filled with gravel dug near the toe of the slope and four solid pipe outlet drains leading to the drainage ditch between the dike toe road and the access road to the cooling lake. The seepage appeared to decrease after installation of the toe drain, but in recent inspections, seepage appeared to be increasing and involving additional slope areas.

## 6.3 Northern Ash Area Subsurface Conditions

Based on the construction photographs in Exhibits 1 through 3, the material for the dike construction was probably obtained from excavations for the adjacent rail line and supplemented by excavation from within the planned pond area. The exhibits also show the presence of a bench level along the dike alignment. Limited original contours from plant plans indicate elevations of 140 to 145 feet in the vicinity of the northern dike segment with elevations dropping toward the south. Because the tops of the dikes are now about elevation 145 feet, dike heights along the northern segment were likely 10 feet or less, assuming some interior excavation was made. Because materials excavated from natural ground were used as fill over natural ground, distinguishing a break between fill and natural ground from sample appearance is difficult. Indications of organic traces and color changes were used to select the boundary between fill and original ground for our evaluation.

### 6.3.1 Dike Fill

The dike fill consists of predominantly sandy soils with some silt and clay. Unified Soil Classification System (USCS) symbols of SP (poorly-graded sand), SM (silty sand) and SC (clayey sand) are typical. Standard penetration resistances (N-values) ranged from 4 blows per foot (bpf) to 28 bpf. The N-values were commonly high in the upper three to five feet and decreased with depth.

Borings NB-1, NB-3 and NB-4 are in the segment of dike constructed adjacent to the rail line. The standard penetration resistances (N-values) in these borings are generally lower and more variable than those in borings NB-5, NB-6, NB-7 and NB-8 which are in an area constructed a further distance from the rail line. The variable N-values suggest an irregular compaction, and the lower values suggest low compactive effort. The patterns are consistent with a construction technique of creating piles of excavated material and then grading to the dike shape.

While the soils in the dike fill in borings NB-5, NB-6, NB-7 and NB-8 are similar in composition to those discussed above; the N-values are greater than 20 bpf in the upper five feet and generally above 14 bpf below five feet. The N-value patterns suggest this dike segment may have had a more controlled construction and may have included some compaction effort.

### 6.3.2 Natural Ground

The natural ground surface was typically dark brown sand with traces of organic staining or small rootlets. The natural soils varied from sands with little fine material to clayey sand. Thin clay seams interbedded with sand were often present. N-values varied widely, ranging from 0 (weight of hammer advanced the sampler) to 28 bpf.

The soils below elevations of approximately 125 to 120 feet were identified as part of the Yorktown Formation. Mixtures of broken shell, fine sand and silt or clay, commonly termed “shell hash” were present in four borings.

### 6.3.3 Sedimented Ash

Sedimented ash is present adjacent to the Northern Ash Area dikes. For the purposes of the present study, only information on the ash thickness and water level within the ash was used. Based on the CPTu data, the thickness of the sedimented ash was typically nine to 10 feet with a thickness of 12 feet near section N-1. The thicknesses are consistent with the estimates of original ground levels made from borings.

### 6.3.4 Water Levels

Water levels were checked in the temporary observation casings several times after the installation. Table 1 summarizes the information for the Northern Ash Area. Water levels were also checked in the hand auger borings approximately a week after they were drilled. Water levels in the crest borings ranged from approximately 10 feet to approximately 15 feet below the crest. These depths correspond to elevations between approximately 130 and 134 feet (NAVD 1988).

Water levels estimated from the CPTu probes ranged from approximately 1 foot adjacent to a small area of standing water in a depression associated with the former discharge structure location, to 7 to 8 feet in other areas. The depths were converted to elevations for use in establishing a phreatic line for stability analysis. The results are shown on the stability analysis sections discussed in Section 7.3.

The hand auger borings on the slope that were near the upper part of the dike slope generally did not encounter water to their termination depths of 2 to 5 feet. Hand auger borings near the base of the dike slope typically did encounter water at depths of 1 to 4 feet below the ground surface. The measured water levels in hand auger borings for the Northern Ash Area are summarized in Table 1 on the next page.

**Table 1: Measured Groundwater Level Summary – Northern Ash Area**

| Location | Approx. Ground Elevation, ft | Groundwater Elevations | | |
|---|---|---|---|---|
| | | 6/24/2010 | 7/12/2010 | 8/3/2010 |
| NB-1 | 146.23 | 129.6 | 130.46 | 130.77 |
| NB-3 | 144.96 | 132.3 | 132.55 | 133.56 |
| NB-4 | 145.90 | 133.8 | 136.17 | 131.41 |
| NB-5 | 145.68 | - | 133.76 | 134.18 |
| NB-6 | 145.09 | 132.1 | 132.31 | 132.82 |
| NB-7 | 144.72 | 128.6 | 128.85 | 133.32 |
| NB-8 | 144.77 | 130.3 | 130.51 | 130.81 |
| NB-1A | 136.68 | dry @ 134.9 | * | * |
| NB-1C | 129.08 | 127.3 | * | * |
| NB-3A | 137.44 | dry @ 132.7 | * | * |
| NB-3C | 131.99 | 128.5 | * | * |
| NB-4B | 141 | dry @ 136 | * | * |
| NB-4C | 133 | 129.3 | * | * |
| NB-5B | 140.41 | dry @ 135.9 | * | * |
| NB-5C | 131.61 | 130.2 | * | * |
| NB-6B | 132.81 | 128.1 | * | * |
| NB-6C | 128.15 | 124.5 | * | * |
| NB-8B | 132.89 | dry @ 127.9 | * | * |
| NB-8C | 125.89 | 125.2 | * | * |

'-'Groundwater measurement not taken on the specified date.
'dry @ xxx.x' groundwater not encountered above boring termination/cave-in elevation listed.
'*'Hand Auger boreholes were backfilled on 6/24/10



## 6.4 Southern Ash Area Subsurface Conditions

The perimeter dikes for the southern area were constructed in 1979. The material used in the dikes was excavated from within the pond area as indicated on Exhibits 6 and 7. The dikes were constructed by placing soils in lifts and compacting them to not less than 95% of the standard Proctor maximum dry density (CP&L Specification No. PPCD-78-S-132).

### 6.4.1 Dike Fill

Original ground contours are available from the Olsen Associates 1973 Site Plan (Exhibit 4). The lowest areas of original contours are along the south dike with elevations ranging from approximately 116 feet to 125 feet at the west end. Along the western and eastern dikes, original ground elevations are in the range of 120 feet to 125 feet, increasing in a northerly direction. These elevations along with indications of root traces and abrupt changes in soil color or texture were used to estimate the thickness of the dike fill.

The soils comprising the dike are predominately silty or clayey sands with USCS symbols of SP, SM and SC. N-values ranged from a single low value of 3 bpf to a maximum value of 30 bpf with most values greater than 10 bpf. Overall, the N-values are interpreted as indicating a compacted condition. The conditions described in the present borings are very similar to those described in the 1993 borings contained in Appendix F-3.

### 6.4.2 Natural Ground

Natural soils are mainly sands and silty sands with USCS symbols of SP and SM. Dense to very dense consistencies were indicated by N-values greater than 30 bpf in several locations. Some black organic cementation was present in some samples (organic hardpan). Underneath the dense sands, below approximately elevation 110 feet, loose sand and some shell hash material was encountered.

### 6.4.3 Water Levels

Water levels were checked in the temporary observation casings several times after the installation. Table 2 on the next page summarizes the information for the Southern Ash Area. Water levels in the casings on the south dike crest ranged from approximately 11 feet to approximately 15 feet below the crest. These depths correspond to elevations between approximately 129 and 132 feet.

At the toe of the south dike, water levels showed unusual behavior. The temporary casings were installed in areas adjacent to indications of surface seepage. Two of the casings had water levels approximately 4 to 5 feet below ground surface, while one, SB-5, had an artesian pressure head of approximately 3 feet above the ground surface . At the SB-5 location, no water was actively emerging from the ground at the boring location.

The hand auger borings on the slope that were near the upper part of the dike slope generally did not encounter water to their termination depths of 2 to 5 feet. Hand auger borings near the base of the dike slope typically encountered water at depths of 1 to 4 feet below the ground surface.

**Table 2: Measured Groundwater Summary – South Disposal Area**

| Location | Approx. Ground Elevation, ft | Groundwater Elevations | | |
|---|---|---|---|---|
| | | 6/24/2010 | 7/12/2010 | 8/3/2010 |
| SB-1 | 143.2 | 132.2 | 132.1 | 132.0 |
| SB-1B | 133.21 | 128.1 | - | - |
| SB-1W (Shallow) | 123.3 | 122.2 | 122.4 | 122.4 |
| SB-1W (Deep) | 123.26 | 120.1 | 122.6 | 122.7 |
| SB-2 | 142 | 126.4 | 128.13 | 127.52 |
| SB-2W | 122.18 | 120.4 | 120.6 | 120.7 |
| SB-2B | 133.74 | dry @ 128.8 | 129.1 | 129.2 |
| SB-3 | 143.2 | 127.6 | 129.3 | 128.7 |
| SB-3B | 134.07 | 129.6 | 130.2 | 131.5 |
| SB-3W | 127.97 | 125.1 | 125.3 | 125.5 |
| SB-4 | 118.22 | 113.3 | 113.8 | - |
| SB-5* | 117.22 | 120.0 | - | 120.1 |
| SB-6 | 120.08 | 115.4 | - | - |

'-'Groundwater measurement not taken on the specified date.
'dry @ xxx.x' groundwater not encountered above boring termination/cave-in elevation listed.
'*' artesian conditions were noted in boring SB-5 performed at the toe of the slope.



# 7.0 SLOPE STABILITY ANALYSIS

Under the agreement between the North Carolina Utilities Commission and Progress Energy, the guidelines of the United States Army Corps of Engineers (USACOE) were applicable to evaluations of the dam safety. Effective January 1, 2010, state regulation of ash ponds is transferred to the North Carolina Department of Environment and Natural Resources (NCDENR), Land Quality Section, Dam Safety Program. For this study, the requirements from both agencies pertaining to slope stability factors of safety have been considered:

**NCDENR:** Based on North Carolina Administrative Code (NCAC) - Title 15A Department of Environment and Natural Resources of Subchapter 2K - Dam Safety

- Minimum factor of safety for steady state conditions at current pool or design flood elevation is 1.5.
- Minimum factor of safety for rapid draw-down conditions from current pool elevation is 1.25.

**USACOE:** Based on USACOE Engineering Manual (EM) 1110-2-1902[5]

- Minimum factor of safety for maximum surcharge pool (design flood) is 1.4
- Minimum factor of safety for seismic conditions from current pool elevation is 1.0

## 7.1 Material Properties for Stability Analysis

Based on the field exploration and laboratory data, the cross section was stratified into distinct soil layers. Material properties of each of these layers are described in the following subsections.

### 7.1.1 North Dike Fill

Consolidated, undrained triaxial shear tests with pore pressure measurements were performed on three intact samples obtained within the dike fill at boring locations NB-2, NB-3 and NB-5. The test results are included in the Appendix C of this report. Because the dike has been in place more than 50 years, pore water pressures would be stabilized. Thus, effective stress parameters were used in the analysis to assess the static stability. The results indicated fairly consistent soils. Two of the three tests show a component of effective cohesion. The effective friction angle, Φ', varied between $32.7^o$ and $35.2^o$ and the effective cohesion varied between 0 and 65 psf. For analysis the average values from the three tests were used.

For the portion of the dike at section N-10, no boring was available. A back-calculation assuming a factor of safety of at least 1.1 exists for the slope provided an estimated cohesion value of 95 psf for a friction angle of 30 degrees, and those properties were used in evaluating stability improvement approaches.

### 7.1.2 North Dike Foundation Soils

As mentioned in section 6.2 of this report, N-values varied widely, ranging from 0 to 28 bpf. The design soil parameters at each of the analyzed sections were typically interpreted using empirical correlations $\Phi = 28 + N_{avg}/4$ for cohesionless soils and $c = 125 \times N_{avg}$ in units of psf for cohesive soils with some modifications based on judgment. The parameters used in the analysis are shown on the stability analysis sections (Drawings 7 through 16) and on stability analysis output plots in Appendix D1.

### 7.1.3 South Dike Fill

One consolidated, undrained triaxial shear tests with pore pressure measurements was performed on an intact samples obtained within the dike fill at boring location SB-2. The test results are included in the Appendix C of this report. In addition, triaxial test data from tests performed in 1993 by Law Engineering was used. The report is included in Appendix F-3. Because the dike has been in place for over 30 years, pore water pressures would be stabilized. Thus, effective stress parameters were used in the analysis to assess the static stability. The current test results showed effective strength parameters of $\Phi = 35.6^o$ and c = 0 psf, and the previous test indicated $\Phi = 31.6^o$ and c = 317 psf. For analysis the average values from the two tests were used.

### 7.1.4 South Dike Foundation Soils

As mentioned in section 6.2 of this report, N-values greater than 30 bpf were observed in several locations. The design soil parameters at each of the analyzed sections were typically interpreted using empirical correlations mentioned in section 7.1.2. The parameters used in the analysis are shown on the stability analysis sections (Drawings 17 through 19) and on stability analysis output plots in Appendix D2.

## 7.2 SEISMIC LOADS

No additional load on the ground surface is considered for static slope stability analysis. For an earthquake analysis, seismic design parameters were obtained using American State Highway Transportation Officials software program AASHTO GM 2-1[4] which is based on based on 5% in 50 year probabilistic data from the United States Geological Survey (USGS). The program inputs include project site location information (Latitude: 34.591 and Longitude: -078.971) and the "Site Class" determined in accordance with the International Building Code 2006[5].

The site class is based on average soil properties in Top 100 feet. Based on the current and historic borings and general geological information the site class for the project site varies between D and E. For analysis purposes site class 'E' is used for North dike sections which corresponds to a soft soil profile ($N_{avg}$< 15). For South dike sections site class 'D' is used for analysis which corresponds to a stiff soil profile (15 ≤. $N_{avg}$ ≤ 50). Using the site coefficients from the AASHTO GM 2-1 program output, the Peak Ground Acceleration (PGA) is calculated in accordance with section 1802.2.7 of International Building Code 2006[5] and is included in Appendix E of this report. A PGA of 0.143g is applicable to south dike sections and 0.091g for North dike sections. Therefore, for a pseudo-static representation of earthquake effects, seismic coefficients of 0.143g and 0.091g are used to scale the horizontal component of earthquake force relative to the sliding mass for North Area and South Area dike sections respectively. It is also assumed that earthquake force does not change the pre-earthquake static pore pressure in the slope.

## 7.3 Analysis Methodology and Results

Slope stability analysis under static and seismic load conditions was performed for the exterior slopes of the dikes in the Northern and Southern Ash Areas. Interior slopes were not analyzed because they are covered to very near the crest elevations by sedimented ash. Hydraulic and hydrologic analyses performed in a parallel study, and reported separately, show that the design flood event would not cause overtopping of the dikes. The maximum pond water level from the event would be back to within ten percent of the normal pond level in approximately 2.5 days after the peak inflow. Such a short duration of an elevated water level would not be sufficient to modify the phreatic surface used in the analyses. Rapid drawdown conditions were not evaluated because in order to have a rapid drawdown condition, a breach of the dam would be needed.

There is no impounded water against the dikes in the Northern Ash Area. In the Southern Ash Area, the only impounded water is in the southern end of the area E where dikes were constructed in 1979. The analyses were conducted for the normal operating level of the 1979 pond (Area E).

Information from the CPTu probes in the Northern Ash Area, pond water levels in the Southern Ash Area, and from the measured water levels in the temporary observation casings and hand auger borings was used to create phreatic surfaces through the dikes for the stability analysis. In general, the highest measured water level was used in the analyses.

The computer program PCSTABL5M with Windows based interactive STEDwin software was used for analysis. The Modified Bishop's method was used in calculating the factor of safety for circular arc failure surfaces. The analyses performed included consideration of failures that included the foundation soils, failures constrained to be only within the dike, and local failures at edges of exterior slopes.

Considering the construction history and differences in results of borings and performance observations, four different dike segments were analyzed:

- Northern Ash Area dikes constructed in approximately 1955, identified as Area A on Drawing 2.
- Northern Ash Area dikes constructed in the 1950's, identified as Area B on Drawing 2.
- Northern Ash Area dike represented by section N-10 as shown on Drawing 5.
- Northern Ash Area - the eastern dike of the early 1970's construction identified as section N-9 on Drawing 2.
- Southern Ash Area dikes constructed in 1979, identified as Area E on Drawing 2.

Sections analyzed are identified on Drawing 5. The individual analysis sections are shown on Drawings 7 through 16 and include soil properties and plots of the minimum factors of safety for the static analyses. Drawing 6 is a legend common to all sections. Stability analysis output plots showing the section and soil properties are included in Appendices D1 and D2 for the Northern Ash Area and Southern Ash Area dikes respectively.

### 7.3.1 Stability Analysis– Northern Ash Area A

The dike forming the perimeter of Area A was constructed in 1955 based on construction photographs. There is no apparent excavation into the natural ground adjacent to these dikes. Based on field reconnaissance and considering locations areas flagged by NCDENR during their January, 2010 field visit, MACTEC selected sections N-5, N-6 and N-7 (see Drawing 5) to represent the range of slope conditions in Area A. The analysis included both static and seismic conditions.

The water levels for this dike area are deep, reflecting the absence of impounded water on the adjacent sedimented ash. Most water levels in the borings on the dike crest are near the interpreted level of the original ground. The stability analysis sections are shown on Drawings 7, 8 and 9. The nature of the analysis performed and the associated minimum factors of safety are provided in Table 3 below. Plots of the stability analysis results and the summary of input data are included in Appendix D1.

**Table 3: Factors of Safety against Slope Failure – Area 'A' sections**

| **Section Identification** | **Description of Analysis** | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| North Dike - Section N-5 | Exterior slope, phreatic surface developed from measured water level. | 1.61 | 1.17 |
| North Dike-Section N-6 | Exterior slope, phreatic surface developed from measured water level. Analysis surfaces constrained to be within the dike. | 2.00 | 1.37 |
| North Dike-Section N-6 | Exterior slope, phreatic surface developed from measured water level. Analysis surfaces extending into foundation soils. | 1.64 | 1.07 |

| | | | |
|---|---|---|---|
| North Dike-Section N-7 | Exterior slope, phreatic surface developed from measured water level. | 1.08 | 0.8 |

Stability sections N-5 and N-6 are comparable and are more representative of the conditions in Area B. The crest at these sections is about 20 feet wide with a slope of 2H:1V or flatter as shown on Drawings 7 and 8. From the CPT data, the depth of retained sedimented ash is estimated to vary between 9 and 10 feet. The stability analysis results indicate a minimum factor of safety of 1.61 for static conditions and 1.07 for seismic conditions. The results are above the minimum requirements set by governing agencies indicated in Section 7.0.

Section N-7 is located where the original outlet pipe penetrated the dike. There has been erosion and possibly local slumping at this area resulting in an exterior slope of approximately 1.4H:1V as shown on Drawing 9. The stability analysis results indicate a factor of safety of 1.08 and 0.8 for static and seismic conditions respectively. These results are well below the minimum regulatory requirements. Improvements to the portion of the dike represented by section N-7 are necessary as discussed in Section 9.

### 7.3.2 Stability Analysis– Northern Ash Area B

Based on field reconnaissance and considering locations areas flagged by NCDENR during their January, 2010 field visit, MACTEC selected sections N-1, N-2, N-3 and N-4 (see Drawing 5) to represent the range of slope conditions in this area. As discussed in Section 3.2, this dike was constructed from materials excavated during the rail line construction, and a bench was created by leaving in place some natural ground. The bench is not continuous along the exterior slope. Section N-3 represents the bench configuration condition. Section N-1 represents a condition where no bench is present. There are areas where past slumping or erosion has created local steep slopes both near the dike crest and in the lower exterior slope that are very steep. Sections N-2 and N-4 represent a very steep condition (N-2) and a more common condition (N-4).

The water levels for this dike area are deep, reflecting the absence of impounded water on the adjacent sedimented ash. Most water levels in the borings on the dike crest are near the interpreted level of the original ground. The stability analysis sections and locations of critical circles for the minimum factors of safety are shown on Drawings 10 through 13. The nature of the analysis performed and the associated minimum factors of safety are provided in Table 4 on the next page. Plots of the stability analysis results and the summary of input data are included in Appendix D1.

**Table 4: Factors of Safety against Slope Failure – Area 'B' sections**

| Section Identification | Description of Analysis | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| North Dike - Section N-1 | Exterior slope, phreatic surface developed from measured water level. Analysis surfaces extending into the foundation. | 1.38 | 0.99 |
| North Dike - Section N-1 | Exterior slope, phreatic surface developed from measured water level. Analysis surfaces constrained to be within the slope. | 1.42 | 1.04 |
| North Dike – Section N-2 | Steep section in lower portion of slope, Phreatic surface developed from measured water levels in borings at section N-3. Analysis limited to steep lower portion. | 1.07 | Not Run |
| North Dike Section N-3 | Exterior slope, bench present, analysis for slope at edge of bench. Phreatic surface developed from measured water level. | 1.66 | 1.36 |
| North Dike - Section N-4 | Exterior slope, phreatic surface developed from measured water level. Analysis surfaces through the crest extending into the foundation soils. | 1.75 | 1.15 |
| North Dike Section N-4 | Local slope with 2H:1V ratio at dike crest. Analysis surfaces limited to local failure. | 2.03 | Not Run |
| North Dike - Section N-4 | Exterior slope, phreatic surface developed from measured water level. Local failure at toe of the slope | 1.35 | 0.96 |

The crest at dike section N-1 is about 30 feet wide, and the exterior slope is 2H:1V or flatter as shown on Drawing 10. There is no bench present at the original ground level. The depth of ash retained behind the dike is estimated to be 10 feet deep. The phreatic line is below the dike fill material, and there are no signs of seepage emerging from the slope. The stability analysis results indicate factors of safety of 1.38 and 0.99 for static and seismic conditions, respectively for failure surface extending into the foundation soils. The factors of safety is 1.42 when the failure surface is constrained to be within the slope. In consideration of more than 50 years of satisfactory performance and no foreseen changes in the phreatic conditions of the dike, these results are deemed satisfactory.

The steep lower portion of the slope represented by section N-2 shows a factor of safety of 1.07 in the static analysis (Drawing 11). Remedial measures are needed where these very steep conditions exist.

The crest at dike section N-3 is about 20 feet wide with a slope of 2H:1V down to a bench that is about 25 feet wide leading to another slope of 2H:1Vor flatter as shown on Drawing 12. The depth of ash retained behind the dike is estimated at 9 feet. The phreatic line is below the dike fill material, and there are no signs of seepage emerging from the slope. The stability analysis results for the lower slope portion indicate a factor of safety of 1.66 for the static condition and 1.36 for a seismic condition. These factors of safety exceed stated regulatory values.

Cross-section N-4 is representative of the more irregular slope conditions in this area. The dike section consists of a 5-ft high upper slope with a 2H:1V ratio, a 16-ft horizontal bench and a 5-ft high lower slope, also with a 2H:1V rato as shown on Drawing 13. The stability analysis results indicate an overall slope stability factor of safety of 1.75 for static conditions and 1.15 for seismic conditions and satisfy regulatory requirements. The low height 2H:1V slope at the dike crest was analyzed for local failures and found to have a factor of safety of 2.03 which exceeds regulatory requirements. The lower slope was reviewed for shallow-seated failures, and factors of safety are 1.35 and 0.96 for static and seismic conditions, respectively were found. Lower factors of safety would result where the locally steeper slope conditions exist as discussed earlier for section N-2. Recommendations for addressing the local slumps are provided in Section 9.

### 7.3.3 Stability Analysis– Northern Ash Areas C and D

The dike forming the west perimeter of Area C was constructed in the 1960's and contains a portion with a very steep exterior slope. Section N-10 located as shown on Drawing 5 was selected to represent these conditions. On the east side of the Northern Ash Area, Area D dikes were constructed in the 1970's .slope Based on field reconnaissance and the areas flagged by NCDENR during their January field visit, MACTEC selected sections N-8 and SB-9 (see Drawing 5 for locations) to represent the slope conditions in Area D. The analysis included both static and seismic conditions. The analysis included both static and seismic conditions.

The water levels for this dike area are deep, reflecting the absence of impounded water on the adjacent sedimented ash. The nature of the analysis performed and the associated minimum factors of safety are provided in Table 5 below. Plots of the stability analysis results and the summary of input data are included in Appendix D1.

**Table 5: Factors of Safety against Slope Failure – Areas 'C' and 'D'**

| **Section Identification** | **Description of Analysis** | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| Section N-8 | Exterior Slope, Phreatic Surface developed from measured water level. | 1.61 | 1.18 |
| Section N-9 | Exterior slope, Phreatic Surface developed from water level observed in boring. | 1.59 | 1.22 |
| Section N-10 | Steep exterior slope with water in natural ground | 1.1 | Not Run |

The dike crest at section N-8 is about 25 feet wide and 16 feet high. The exterior slope is about 1.7H:1V with localized steeper sections as shown on Drawing 14. The stability analysis results indicate a minimum factor of safety of 1.61 for static conditions and 1.07 for seismic conditions. The results are above the minimum requirements set by governing agencies.

The dike section in the vicinity of section N-9 appears to have been constructed to a height of approximately 10 feet above the original ground. The exterior slope is approximately 2H:1V) based on field estimates. Due to the tree cover, the aerial topography in this location was not useful. The original ground slopes down on and estimated 3H:1V ratio to the diversion canal for Jacobs Swamp Creek.

Drawing 15 shows the estimated slope configuration. The water and soil information from boring SB-9 coupled with visual inspection of this area did not indicate seepage-related or stability issues. The stability analyses indicate factors of safety similar to those at section N-8 which has a similar topography.

The dike at section N-10 is estimated to be approximately 10 feet high and to have an approximate 60 degree slope. No water was observed exiting the slope. Old sedimented ash level with the dike crest is in place to the east of the dike with no standing water. Drawing 16 shows the stability analysis section. As noted in section 7.1.1, the factor of safety was assumed in order to back-calculate strength parameters for use in evaluating slope improvements.

### 7.3.4 Stability Analysis Summary – Northern Ash Area

Dikes in the Northern Ash Area are generally shown to have satisfactory factors of safety with local exceptions discussed below.

- Area A West End - The highest dike sections are on the western portion of Area A and are represented by Section N-1. Here the factor of safety from our analysis is less than the 1.5 required by regulatory documents. MACTEC considers the factor of safety obtained (1.38 to 1.42) to be acceptable from an engineering perspective for the following reasons:

    - The dike has been in satisfactory service for over 50 years with no indications of potential failure.

    - No water is impounded against the dike, and none has been impounded for many years.

    - The phreatic line within the dike is low, and may be in the natural ground

    - The dike crest is less than 2 feet above the adjacent sedimented ash, thus potential to impound water against the dike is minimal.

- Area A — General - Except for the section near the original discharge pipe represented by Section N-7, our analysis indicates satisfactory factors of safety are present for Area A. At Section N-7, very low factors of safety are indicated by our analysis. Improvements to the slope around Section N-7 are needed as discussed in Section 8.1.

- Area B – Steep Sections - There are local portions of the Area A dike where past erosion or local slumping have created irregular slope profiles. Sections at N-2 and N-4 indicate such local irregular profiles do have lower factors of safety, and field observation indicates there are other steeper local conditions present. Improvements are discussed in Section 8.1.

- West Side of Area C – The length of dike with very steep slopes represented by section N-10 does not show indications of active stability problems, but it is steeper than should be allowed to remain. Improvements are discussed in Section 8.1.

- Consideration of Tree Growth on Slopes – All of the dikes in the Northern Ash Area have extensive brush and tree growth. No damage to the dikes has been observed during field inspections related to the tree growth. Presence of tree roots within a slope provides some local reinforcement against shallow-seated slides. Our analysis did not assume any reinforcement from the vegetation.

The impact on a dike from tree overturning can be to create locally steep slope conditions that may be unstable or susceptible to future erosion. Such local conditions can be observed by Progress Energy's regular inspections and repaired as needed. A local removal of some of the dike section would not cause a large dike failure; the stability analyses critical surfaces are not near the dike slope surfaces. Also, there is no liquid material retained by the dikes that would be released even if a local edge failure occurred.

Another potential impact of tree overturning normally considered is creation of shorter flow paths for seepage and possible piping development. For the Northern Ash Area dikes, there is no impounded water, and the phreatic surface is not close to the dike slope. Thus, possible piping development is not of concern.

Decay of tree root structures can occur and create softened surficial conditions leading to local surface slumps or erosion. The successful 50-year service life of the Northern Ash Area dikes suggests such conditions have not been an issue.

MACTEC concludes that removing trees on the Northern Ash Area dikes is not an engineering need for stability provided the present locally steep areas are addressed and that Progress Energy continue its normal visual inspections of the dikes to detect and repair conditions that may result from fallen trees. Those normal inspections may be supplemented by a monthly inspection by an independent consultant who would walk the full faces of the dikes to check for areas needing repair related to tree falls.

### 7.3.5 Stability Analysis – Southern Ash Area E

The Southern Ash Area (designated as Area E on Drawing 2) is composed of the 1979 Ash Pond and its perimeter dike. The south segment of the perimeter dike has had observable slight seepage since at least 1998. This south segment was the focus of the stability analysis. MACTEC selected three locations for borings and analysis to represent the south dike area (shown as S-1, S-2 and S-3 on Drawing 5). The analysis included both static and seismic conditions.

The phreatic line for the analysis was developed from the measured water levels in observation casings installed in the machine-drilled and hand augered borings performed on as shown on Drawing 5. The stability analysis sections and circles with the minimum factors of safety (static analysis) results are shown on Drawings 17, 18 and 19. The nature of the analysis performed and the associated minimum factors of safety are provided in Table 6 below. Plots of the stability analysis results and the summary of input data are included in Appendix D2.

**Table 6: Factors of Safety against Slope Failure – South Dike Sections**

| Section Identification | Description of Analysis | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| South Dike - Section S-1 | Exterior Slope, Phreatic Surface developed from measured water level. Failure extending into foundation soils. | 1.57 | 1.2 |
| South Dike - Section S-1 | Exterior Slope, Phreatic Surface developed from measured water level. Failure constrained to be within the dike | 1.74 | 1.43 |
| South Dike - Section S-2 | Exterior Slope, Phreatic Surface developed from measured water level. Failure extending into foundation soils | 1.31 | 1.03 |
| South Dike - Section S-2 | Exterior Slope, Phreatic Surface developed from measured water level. Failure constrained to be within the dike | 1.37 | 1.10 |
| South Dike - Section S-3 | Exterior Slope, Phreatic Surface developed from measured water level. Failure circle unrestricted. | 1.43 | 1.17 |

The crest at south dike section 1 is about 20 feet wide and the dike height is estimated to 21 feet. The foundation soils generally consist of very dense sandy soils. There is water impounded adjacent to the south dike in the area of section S-1 with an approximate depth of 5 feet. No slope seepage is apparent in the S-1 section, and the water level measured in boring SB-4 at the toe of the dike is about 4 feet below the existing ground surface. A phreatic line connecting the impounded water surface and the water levels in the borings appears to follow a normally expected configuration. The stability analysis results indicate a minimum factor of safety of 1.57 for static conditions and 1.2 for seismic conditions. The results are above the minimum requirements set by governing agencies mentioned in section 7.0.

Section S-2 represents the poorest conditions along the south dike. Adjacent to this section, there is a surficial slide that the plant filled in with sandy soils. Seepage is oozing out at the dike toe and at some spots on the exterior slope with slight downslope movement during wet seasons. Water levels in the hand auger borings on the slope were within a few inches of the ground surface. At the toe, an artesian water pressure was exhibited in the installed observation casing, with the water rising to 35 inches above the ground surface. No water was otherwise coming up from the ground surface around the casing location; however, this area has had wet soils and some standing water during wet seasons.

Water levels in casings installed in the exterior slope indicated higher water levels than would be associated with a normal phreatic pattern as seen in section S-1. Review of original topographic information shown on Exhibit 4 indicates the general area of section S-2 was a low area with ground elevations along the dike centerline sloping up to both the east and west.

MACTEC interprets the observed conditions to indicate that water in the foundation soils is transmitting pressure from the impounded water head through the soils under the dike. Near the exterior slope face, the pressures underneath the dike are causing water to rise up into the dike and emerge as the seepage seen near the dike toe.

For analysis, the phreatic line was brought to the face of the exterior dike at an elevation equal to the artesian head at the dike toe. The stability analysis results indicated a minimum factor of safety of 1.31 and 1.03 for static and seismic conditions, respectively. These results do not indicate an immediate concern for the dike stability but they are below the minimum requirements set by governing agencies.

At section S-3, similar elevated water levels were observed within the dike slope, but not in the observation point at the dike toe. The stability analysis using the observed phreatic surface had a minimum factor of safety of 1.43 (static) and 1.17 (seismic).

Cross sections with soil conditions for the west dike (Drawing 20) and the east dike (Drawing 21) are shown for information. These dikes are similar in construction and composition to the South Dike, but do not have the elevated seepage conditions. Stability analyses for these sections were not performed given their similarity to the South Dike. The lower phreatic line would result in greater stability than the South Dike.

### 7.3.6 Stability Analysis Summary for the Southern Ash Area

The results of the exploration on the Southern Ash Area dikes indicated the South Dike has the highest potential for stability concerns due to the seepage that has been emerging from the dike slopes for several years. Dam inspections have also noted the seepage has slowly increased in affected area and amount. The stability analyses presented above show factors of safety in the worst seepage area (Section S-2) that are less than 1.5. While factors of safety at Section S-3 are slightly less than 1.5, they are higher than at Section S-2. MACTEC recommends close monitoring for Section S-3. If improvements are desired, the same method used for Section S-2 can be applied to Section S-3. Improvements to the South Dike area are recommended as discussed in Section 8.2.

# 8.0 DIKE IMPROVEMENTS

## 8.1 NORTHERN ASH AREA DIKES

There are several local spots along the dikes where steep conditions exist that should be repaired. Failures of low height, steep slopes occur from shallow-seated sliding. MACTEC recommends using an earth anchoring stabilization approach to improve resistance to such sliding. Individual earth anchors coupled with a geogrid material can be installed using hand-operated equipment for ease of access. Drawing 22 illustrates a typical anchor configuration. One system that is applicable and has been used on another Progress Energy site is the Platipus® Anchor manufactured by Platipus Earth Anchoring Systems. The anchors could be installed by plant personnel with training from the manufacturer.

Alternative improvement approaches to use of earth anchors are slope flattening and rip rap blankets/berms. The crest of the Northern Ash Area dikes is relatively broad and flattening can be achieved without removing all of the crest width. Drawings 23 and 24 illustrate application of slope flattening to sections N-1 and N-2. Localized grading on the interior of the dike may be needed to address surface drainage. Drawings 25 and 26 illustrate placement of rip rap for improvement at sections N-1 and N-2.

For the very steep slope section on the west side of Area C, improvements are best achieved by flattening the slope. Trucks entering and leaving the area of stacked dry ash travel along this section of the dike. There is adequate space to relocate the travel path for the trucks to the east. That would allow flattening the dike slope to achieve a 1.5H:1V ratio. Our analysis shows that ratio provides a factor of safety of 1.49. Drawing 27 shows this approach. Riprap placement can also be considered as shown on Drawing 28.

Results of slope stability analyses for the various improvement methods are summarized in Table 7. Plots of critical surfaces with factors of safety and the summary of input data are included in Appendix D3.

**Table 7: Stability Analysis Summary for Northern Ash Area Improvements**

| **Section Identification** | **Description of Analysis** | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| North Dike - Section 1 | Exterior slope flattened to 2.5H:1V by cutting into steeper sections of existing dike. | 1.54 | 1.04 |
| North Dike - Section 1 | Exterior slope, water level unchanged, added 2-ft thick riprap for 26-ft length at the toe of the slope. | 1.58 | 1.09 |
| North Dike - Section 2 | Exterior slope flattened to 2.5H:1V by cutting into steeper sections of existing dike. | 1.54 | 1.04 |
| North Dike - Section 2 | Exterior slope, water level unchanged, combination of riprap and slope flattening. Added 2-ft thick riprap starting 5-ft outside the toe of the slope to an elevation 137 on the slope. Exterior slope flattened to 2H:1V between elevation 137 and 140.5 by cutting into steeper sections of existing dike. | 1.62 | 1.09 |
| North Dike - Section 2 | Exterior slope, stabilized with Platipus Anchor System capable of providing an equivalent surface load of up to 250 psf acting normal to the surface. | 1.53 | 1.09 |
| North Dike - Section 10 | Exterior slope, stabilized with a 5-ft high and 8-ft wide, 1H:1V Riprap berm at the toe of the slope | 1.59 | 1.15 |
| North Dike - Section 10 | Exterior slope flattened to 1.5H:1V by cutting into steeper sections of existing dike. | 1.47 | 1.07 |

## 8.2 SOUTHERN ASH AREA - SOUTH DIKE

Because of the continuing seepage conditions and the encountered artesian pressure, MACTEC recommends improvements be made to the south dike for the area in the vicinity of Section S-2. Placing rip rap blanket on the slope and across the toe road provides stability improvement. Because excavation to install a drainage trench is difficult, the rip rap blanket is preferred. Drawing 29 illustrates the riprap blanket concept. The recommended linear extent of the riprap layer is approximately 200 feet starting approximately 50 feet west of section S-1 and extending approximately 100 feet west of section S-2.

Because the lower stability conditions at section S-2 are primarily caused by an elevated phreatic line within the dike, lowering the water level by drainage is an alternate to the use of rip rap. Drawing 30 illustrates the effect of lowering the water level approximately two feet.

Two methods have been considered that could lower the water level – a trench drain and horizontal drain points.

Drawing 31 shows a plan and section for a new trench drain and outlets along the toe of the slope. The presence of the generally sandy soils and the high water level at the toe (including the artesian condition) presents a difficult construction for installing drains. There is a risk that installing a drain could breach the confining soil layer now preventing the artesian pressure from causing direct water flow out onto the berm/road, creating a worse situation than now exists.

Water levels could be lowered by installing driven horizontal drains into the slope. A drive anchor point to which is attached a preformed drain provides a simple method to install horizontal drainage. Water flows out of the slope through the preformed drain and is allowed to exit onto the slope. The drains can be installed in a manner that allows continued slope vegetation maintenance with mowers. Drawing 32 shows information on the horizontal drains.

Stability analyses at Section S-2 were run for both the riprap and the drainage approaches. The results are summarized in Table 8. Plots of critical surfaces with factors of safety and the summary of input data are included in Appendix D3.

**Table 8: Factors of Safety against Slope Failure – Modified South Dike Sections**

| Section Identification | Description of Analysis | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| South Dike - Section 2 | Exterior slope, water level lowered by 2-ft in the slope and at the toe. Failure circle extending into foundations soils. | 1.46 | 1.12 |
| South Dike - Section 2 | Exterior slope, water level lowered by 2-ft in the slope and at the toe. Failure circle constrained to dike soils. | 1.58 | 1.28 |
| South Dike - Section 2 | Exterior slope, added 2-ft thick riprap extending from the edge of the ditch to 26-ft feet on the dike slope. Failure circle constrained to dike soils. | 1.62 | 1.30 |
| South Dike - Section 2 | Exterior slope, added 2-ft thick riprap extending from the edge of the ditch to 26-ft feet on the dike slope. Failure circle extending into foundations soils. | 1.51 | 1.15 |
| South Dike - Section 3 | Exterior slope, water level lowered by 2-ft in the slope and at the toe. Failure circle not constrained. | 1.57 | 1.28 |

The results indicate that both the riprap and the toe drain concepts achieve a desired improvement. MACTEC recommends the riprap approach. Using a toe drain to lower water levels would be a difficult construction because of the shallow water levels and relatively sandy soils. In addition, the artesian head present at the toe of Section S-2 could make local conditions worse if the soil layer confining the water were punctured by the toe drain installation. Placing riprap on a geotextile on the slope and across the toe berm/road appears to be a more feasible approach. We recommend beginning the riprap approximately 50 feet west of Section S-1 and continuing for 300 feet to the west.

# 9.0 CONCLUSIONS

## 9.1 NORTHERN ASH AREA

The dikes in the Northern Ash Area have been in place for 40 to 50 years and were constructed in four projects. There are no available records for their design or construction. During their life no failures have been noted by plant personnel. Currently these dikes do not have impounded water against them, only dry, sedimented ash. Exploration found water levels within the dikes at low levels. Stability analysis results generally show factors of safety greater than 1.5. There are local areas with steep slope conditions that should be improved using an earth anchoring system, slope flattening or placement of riprap.

The western portion of Area A (section N-1) does have a factor of safety marginally lower than NCDENR and the USACOE criteria. Considering sliding surfaces that extend into the foundation soils, the lowest factor of safety (1.38) occurs at the North Dike section 1. This value is below the NCDENR and the USACOE criteria. The factor of safety for the same section with the surface constrained to be within the dike and upper foundation soils is 1.42. Considering this and the successful performance of these dikes over the past 50 years, MACTEC interprets the analysis results as acceptable.

For the west side of the Northern Ash Area, flattening the existing slope in the vicinity of Section N-10 is recommended coupled with a slight relocation of the truck access path now on the crest of the dike.

Trees growing on the exterior slopes of the dikes are not a factor in the overall dike stability. Surficial disruptions that may be created if a tree is toppled in a windstorm would not lead to a dike breach or loss of impounded water, because there is no impounded water. Progress Energy's regular visual checks of the dikes supplemented by monthly inspection by an independent engineer would detect tree falls and provide for repairs of disrupted slopes as needed.

## 9.2 SOUTHERN ASH AREA

The area was created by a single dike construction event in 1979. Good design plans and construction records are available, although no engineering calculations were found. The available records indicate design and construction followed normal engineering practices.

The South Dike has had a history of local seepage on the lower part of the exterior slope since about 1990. This area was selected for stability analysis based on the seepage. The analysis results for the South Dike are generally within NCDENR and the USACOE criteria with the exception of section S-2, where the seepage is most prominent. An artesian pressure was observed in soils below the toe of the slope. This artesian condition contributes to the surface seepage on the slope and the lower factor of safety at this section is associated with phreatic line being close to the slope surface .

Improvements to the South Dike by placing a riprap blanket on the slope and toe berm/road are recommended to lower the phreatic line. Alternates of a drainage trench (difficult to construct) and driven horizontal drains are possible.



# 10.0 REFERENCES

1. U.S. Army Corps of Engineers, "Recommended Guidelines for Safety Inspection of Dams," Department of Army, Office of the Chief Engineers, Washington, D.C., 1976

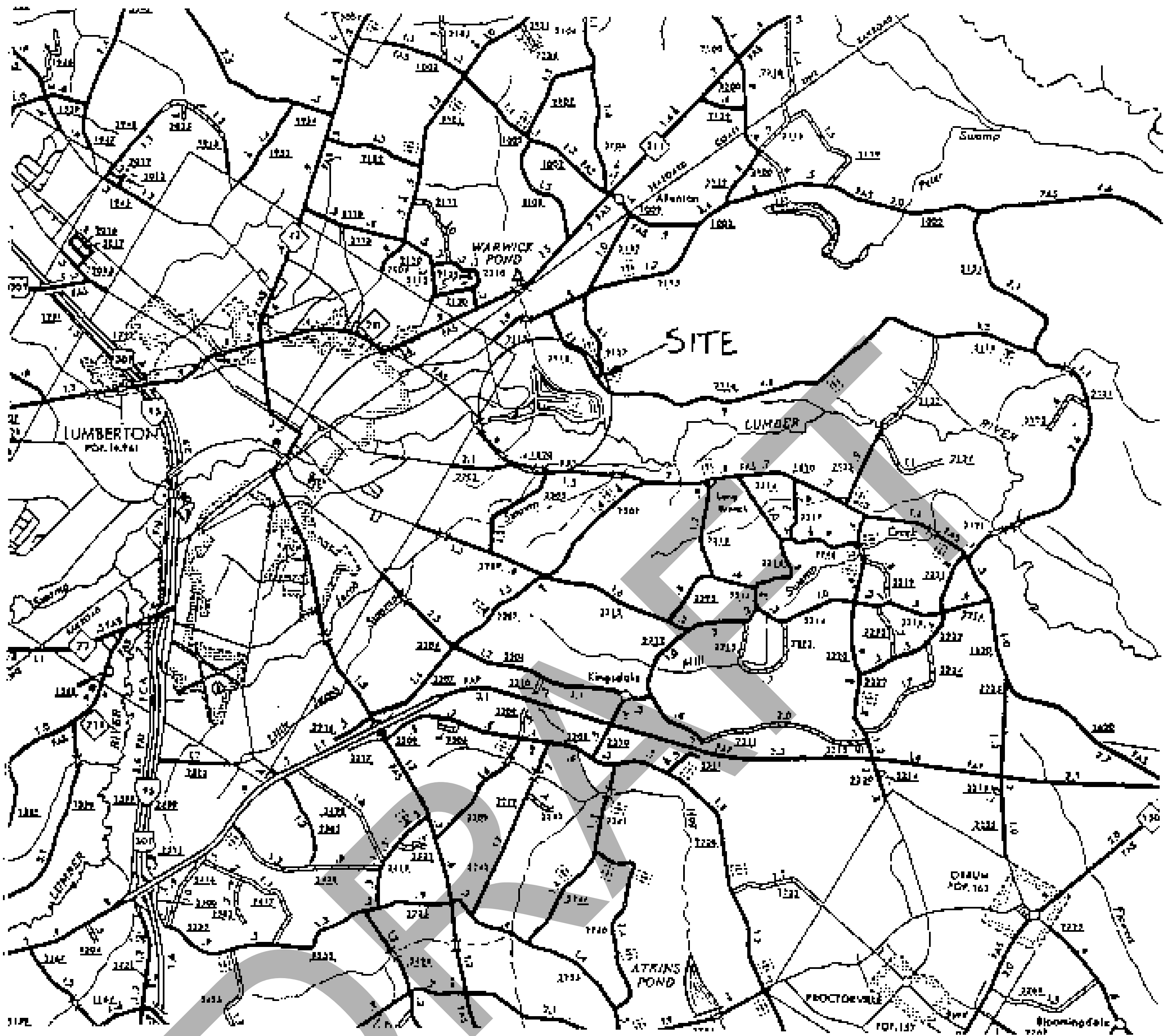
2. Law Engineering and Environmental Services, Inc., Seepage and Slope Stability Analysis Ash Pond Dike, W.H. Weatherspoon Steam Electric Plant, January 1993.

3. AASHTO Ground Motion Software Program, Version 2.1 "Seismic Design Parameters for 2007 AASHTO Seismic Design Guidelines" downloaded from USGS Earthquakes Hazards Program.

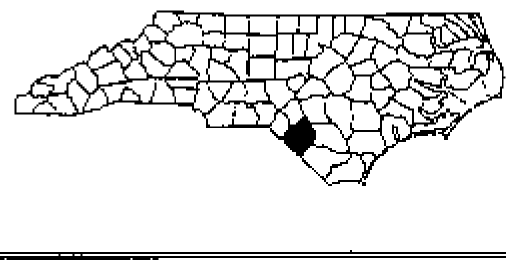
4. "International Building Code" (2006), International Code Council, Inc., USA

5. “Slope Stability” Engineering Manual, EM 1110-2-1902, Department of Army, U.S. Army Corps of Engineers,, Washington, D.C., October 2003

# DRAWINGS





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RALEIGH, NORTH CAROLINA

**SITE LOCATION MAP**
W.H. WEATHERSPOON STEAM ELECTRIC PLANT
PROGRESS ENERGY CAROLINAS
LUMBERTON, NC

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| DFT CHECK: | — | SCALE: | Not to Scale |
| ENG CHECK: | — | JOB: | 6468-10-0111 |
| APPROVAL: | | DRAWING: | 1 |

REFERENCE: DeLorme Map Export


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**AERIAL PHOTOGRAPH - ASH AREA**

WEATHERSPOON STEAM ELECTRIC PLANT

LUMBERTON, NORTH CAROLINA

MACTEC

RALEIGH, NORTH CAROLINA

| | | | |
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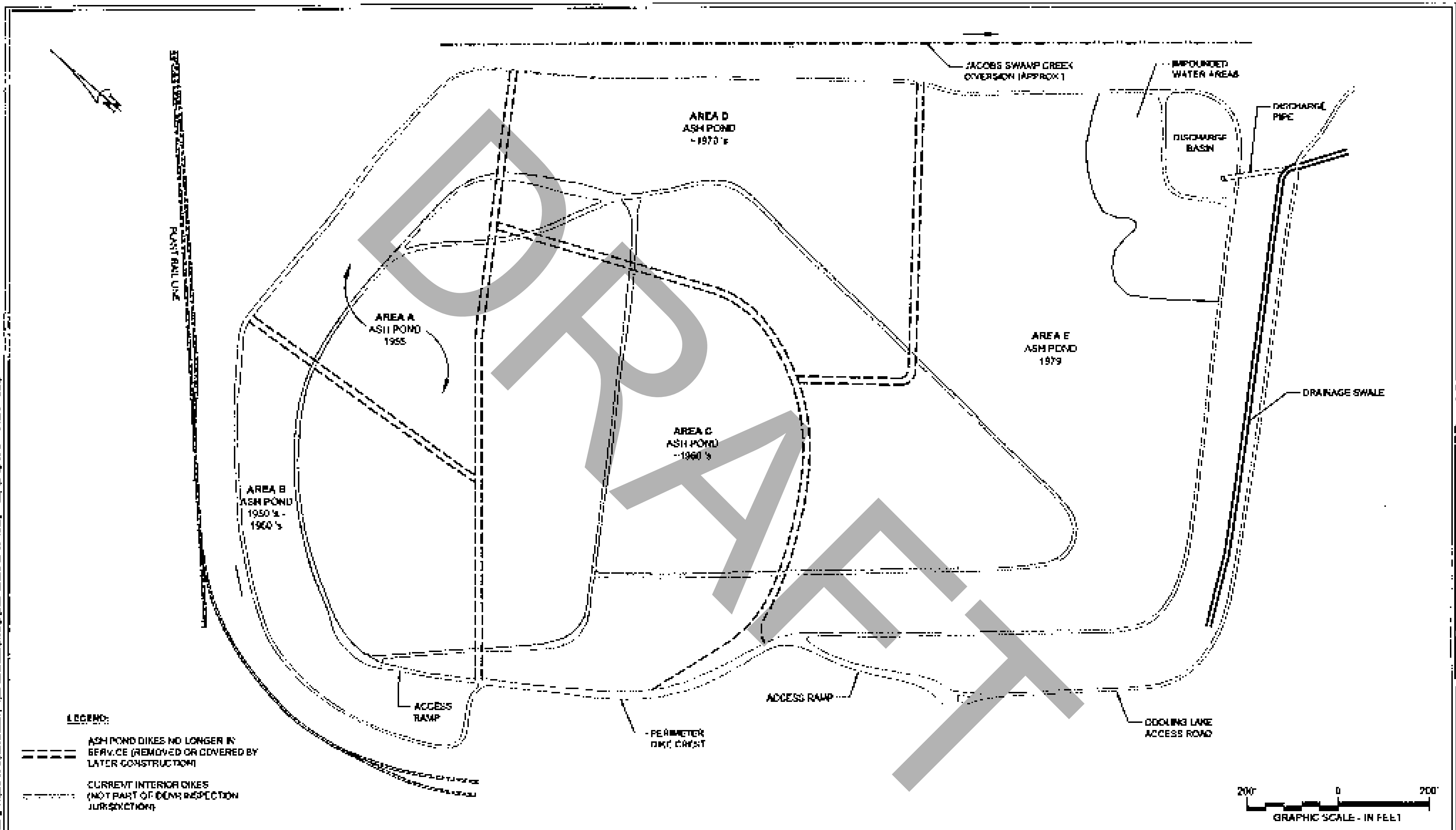


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| MACTEC<br>MACTEC ENGINEERING AND CONSULTING, INC.<br>3301 ATLANTIC AVENUE<br>RALEIGH, NORTH CAROLINA | ASH POND CONSTRUCTION SEQUENCE<br>WEATHERSPOON PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: R.R.<br>ENG CHECK: SG<br>APPROVAL: | DATE: SEPTEMBER 2010<br>SCALE: AS SHOWN<br>JOB No.: 6468-10-0111 | DRAWING 2 |

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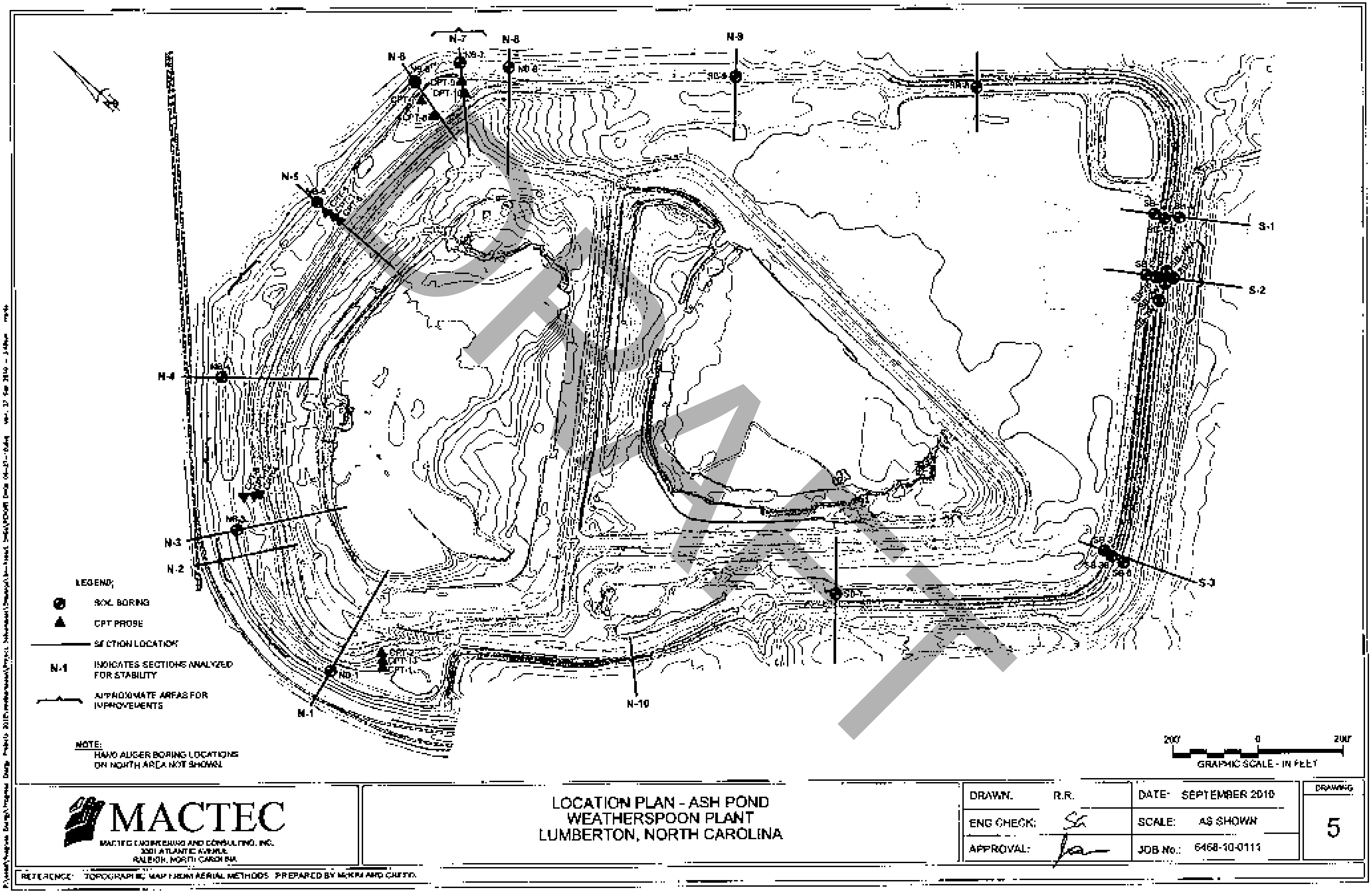
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N-1
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LEGEND:
SOIL BORING
CPT PROBE
SECTION LOCATION
N-1 INDICATES SECTIONS ANALYZED FOR STABILITY
APPROXIMATE AREAS FOR IMPROVEMENTS
NOTE:
HAND AUGER BORING LOCATIONS ON NORTH AREA NOT SHOWN.
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GRAPHIC SCALE - IN FEET
MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA
LOCATION PLAN - ASH POND
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA
DRAWN: R.R.
ENG CHECK:
APPROVAL:
DATE: SEPTEMBER 2010
SCALE: AS SHOWN
JOB No.: 6468-10-0111
DRAWING
5
REFERENCE: TOPOGRAPHIC MAP FROM AERIAL METHODS PREPARED BY McKIM AND CREED.

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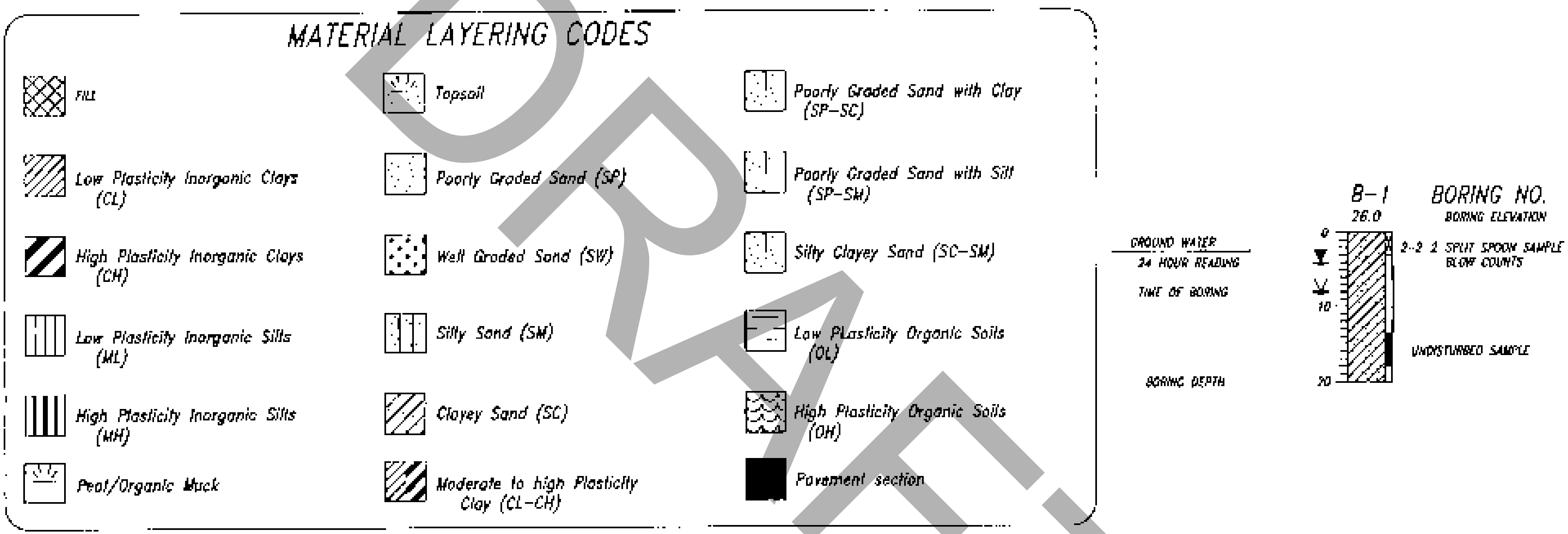


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3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

LEGEND FOR SECTIONS
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

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DRAWING 6

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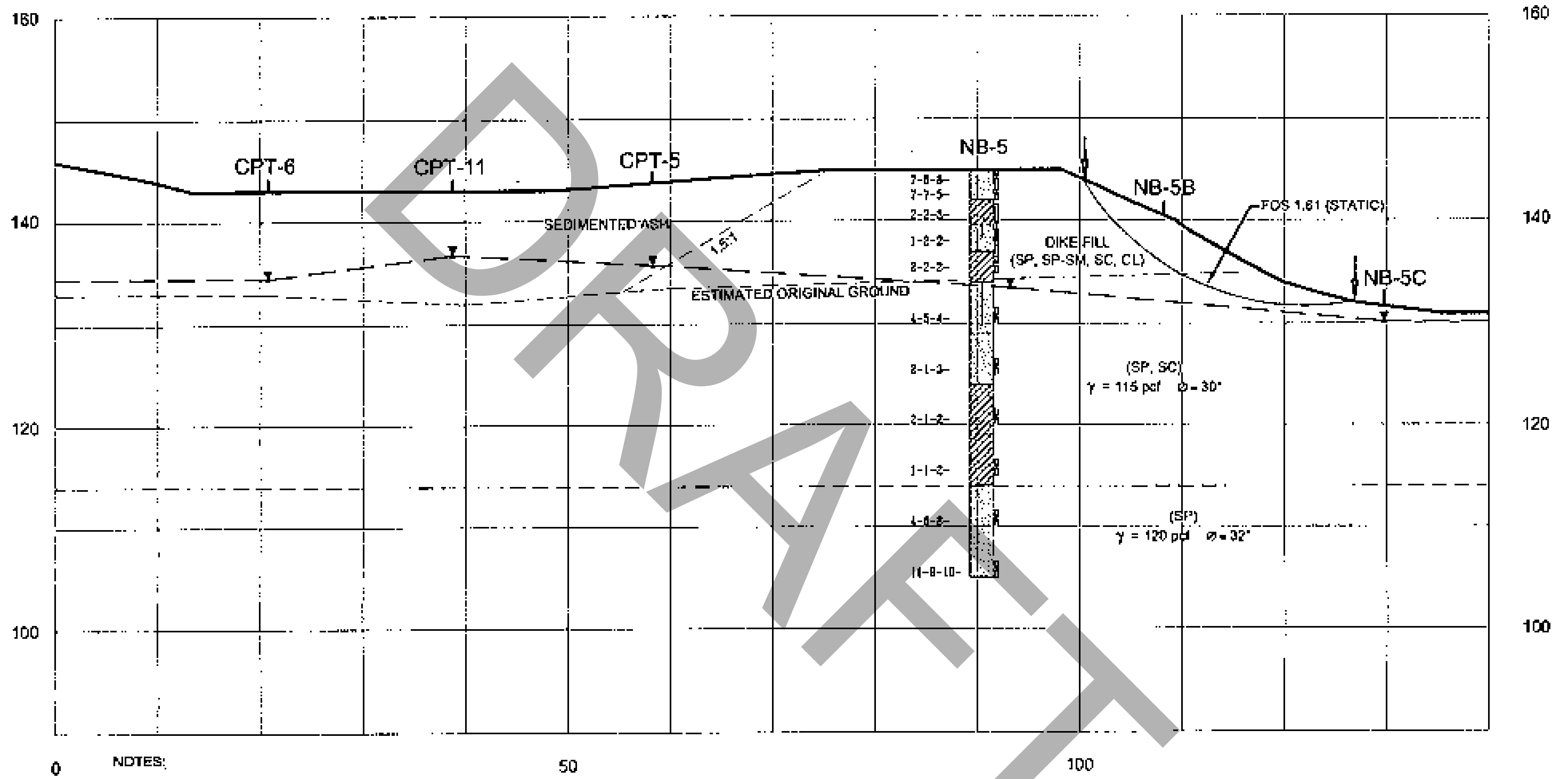


NOTES:

- WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT DATA AS SHOWN.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

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RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-5
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

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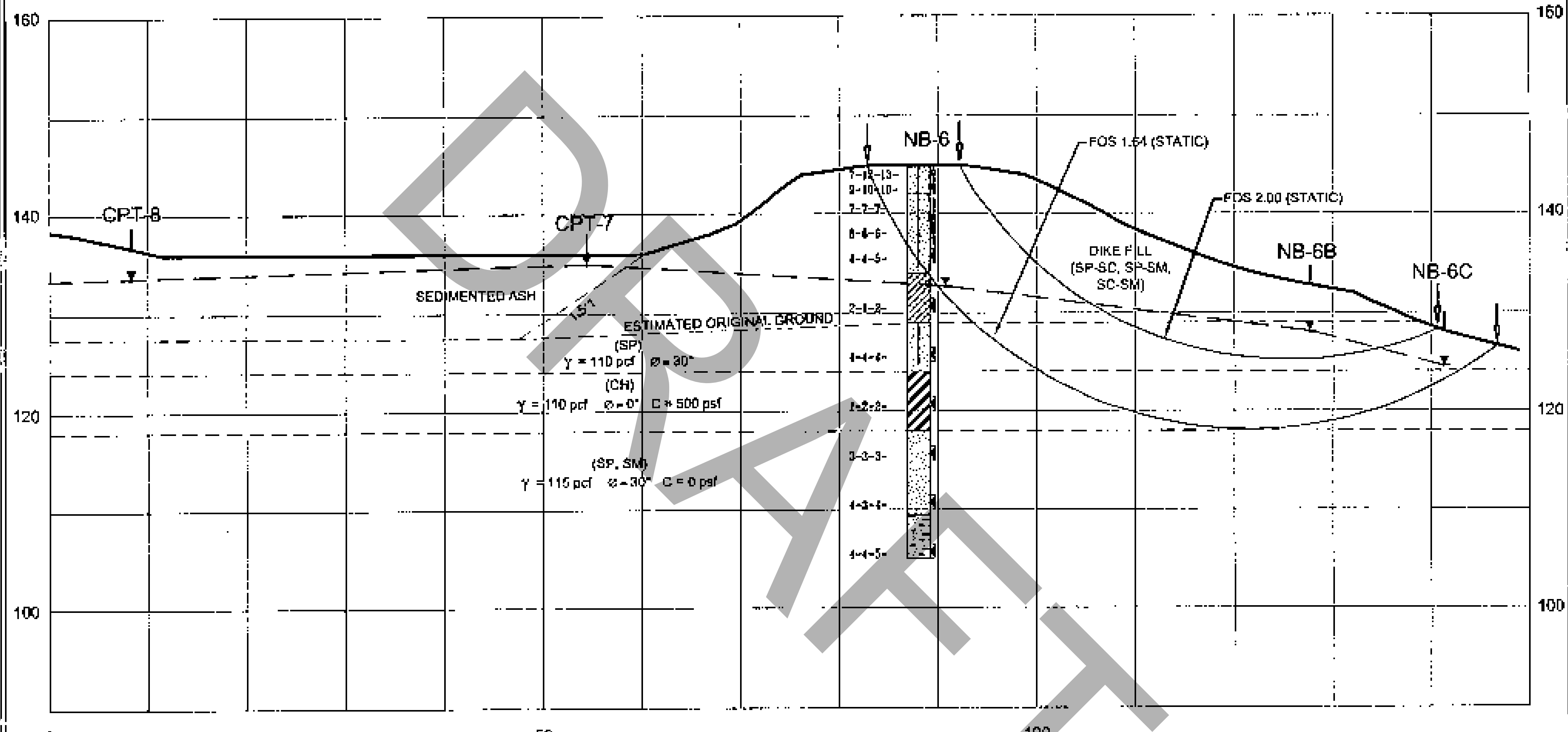
| APPROVAL: | JOB No.: 6468-10-0111 | | |

REFERENCE: TOPOGRAPHIC MAP BY MCKIM AND CREED; MACTEC FIELD DATA.




NOTES:

- WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT DATA AS SHOWN.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

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3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-6
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

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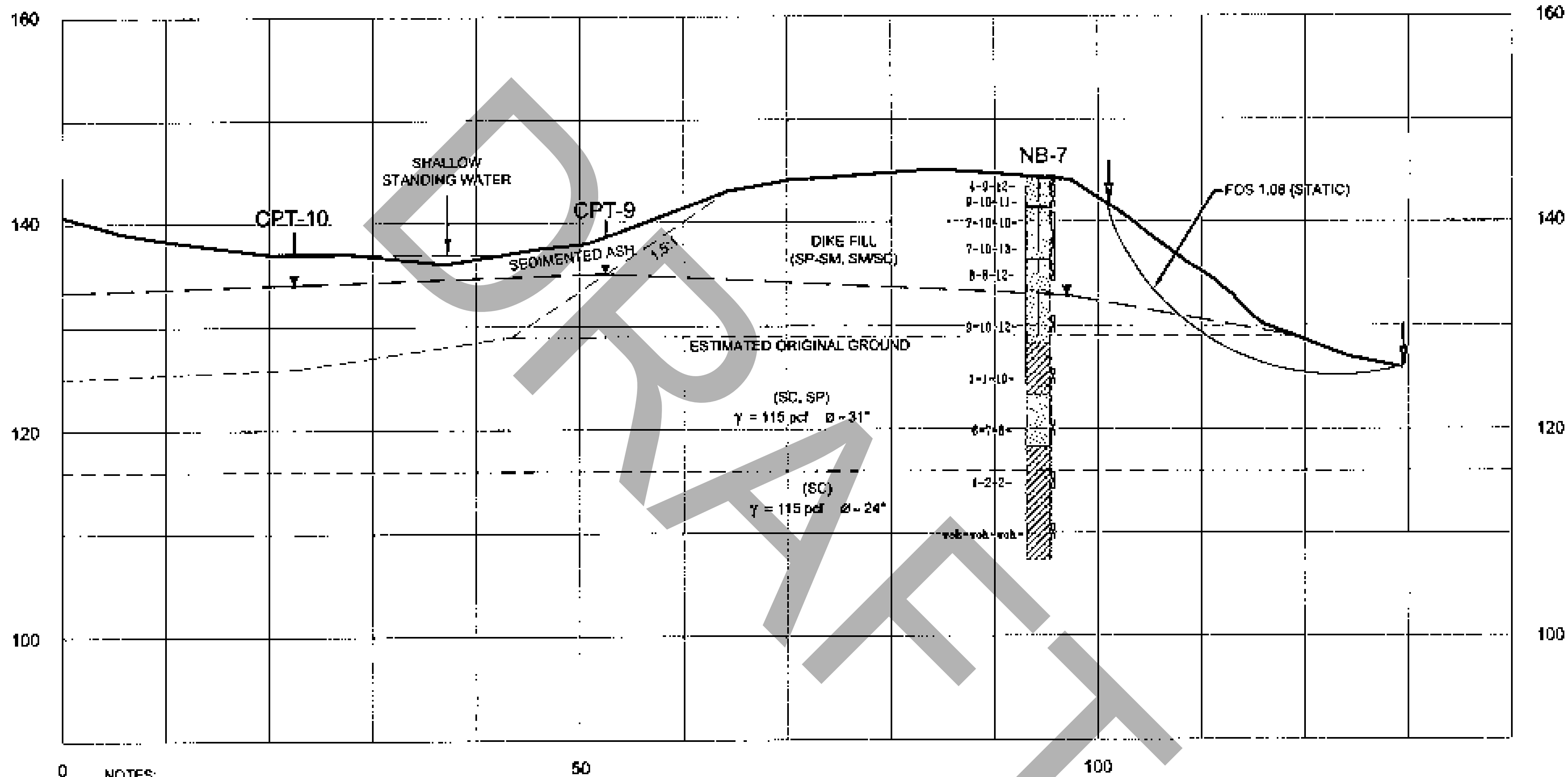
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED. MACTEC FIELD DATA.




NOTES:

- WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT DATA AS SHOWN.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

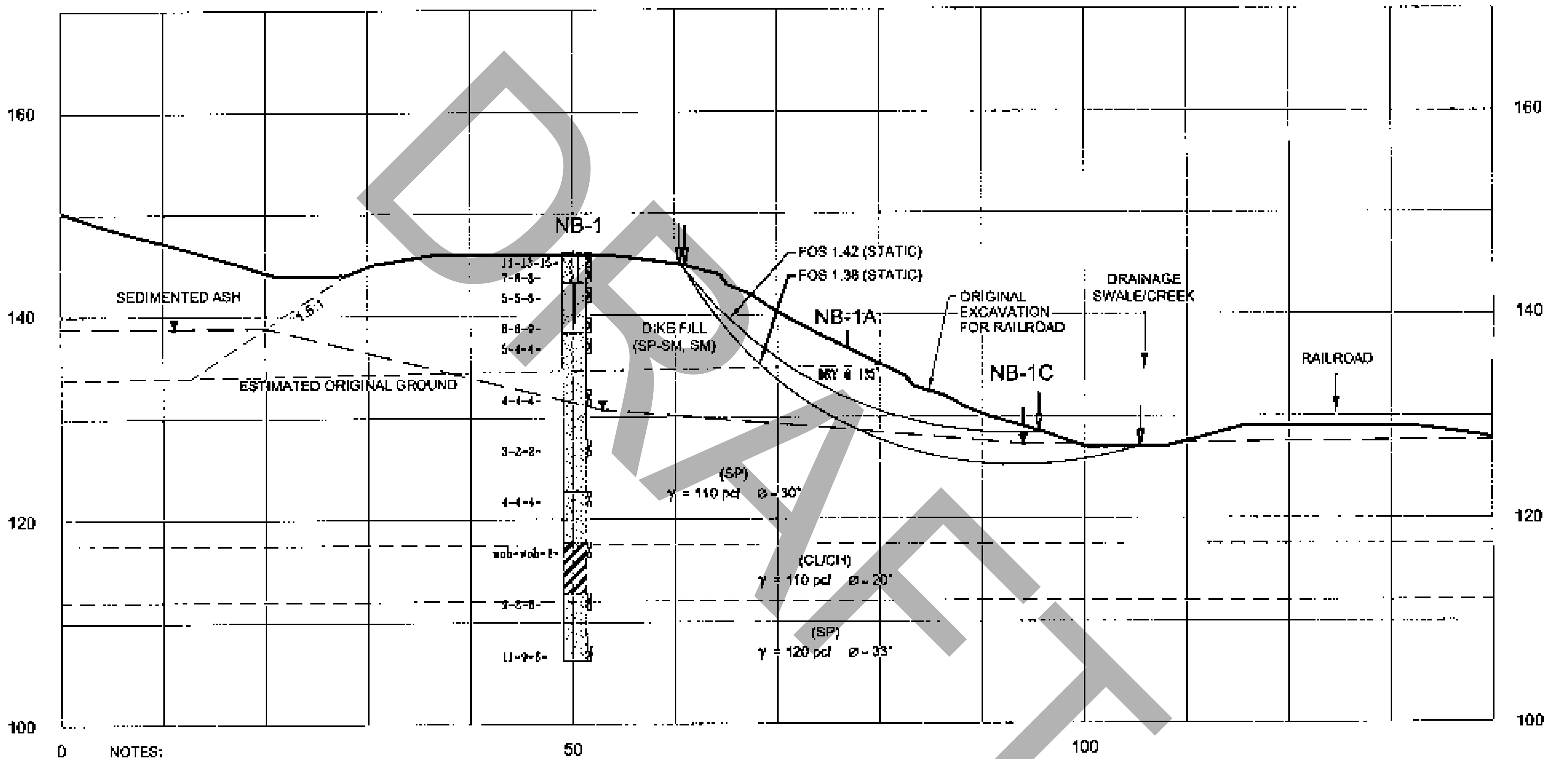
MACTEC
MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-7
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SC | SCALE: | AS SHOWN |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 |

DRAWING 9

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTES:

- WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-1.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC
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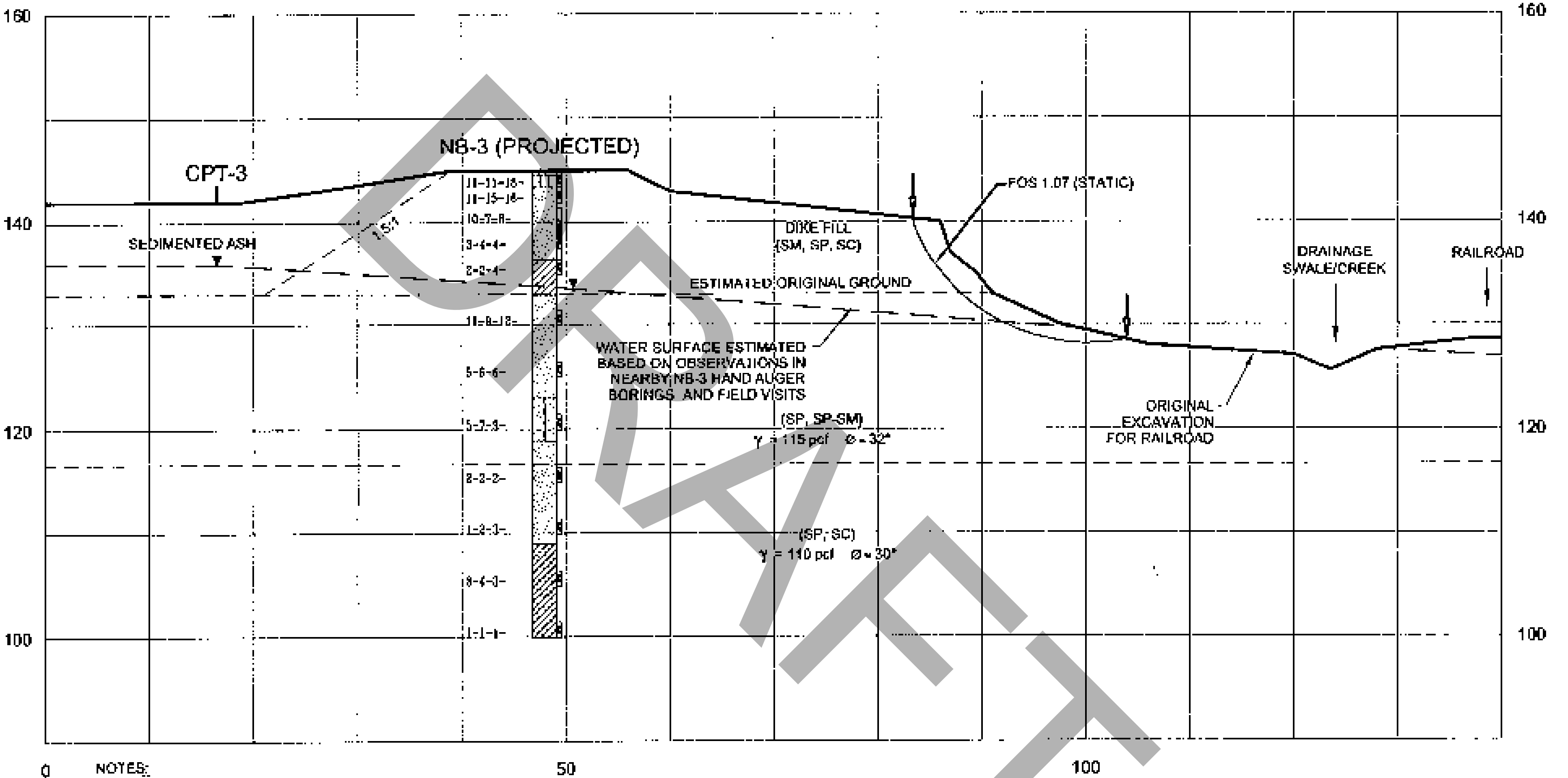
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-1
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | [signature] | SCALE: | AS SHOWN |
| APPROVAL: | [signature] | JOB No.: | 6468-10-411 |

DRAWING 10

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTES:

WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-3.
SEE DRAWING 5 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE



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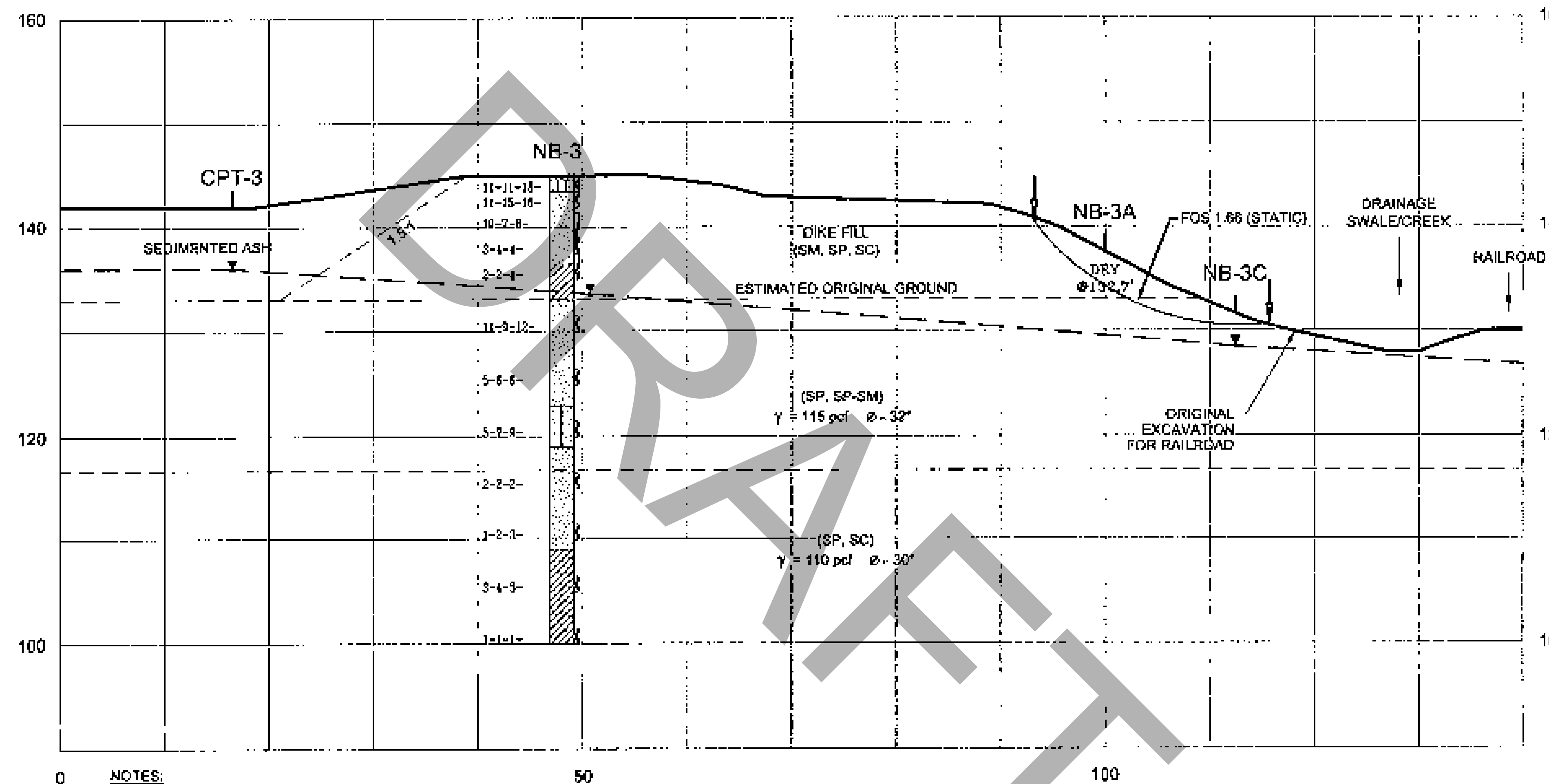
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS - SECTION N-2
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R R | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SC | SCALE: | AS SHOWN |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 |

DRAWING 11

REFERENCE: TOPOGRAPHIC MAP BY MCKIM AND CREED; MACTEC FIELD DATA




NOTES:

- WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-3.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 — ESTIMATED INTERIOR DIKE SLOPE.

MACTEC
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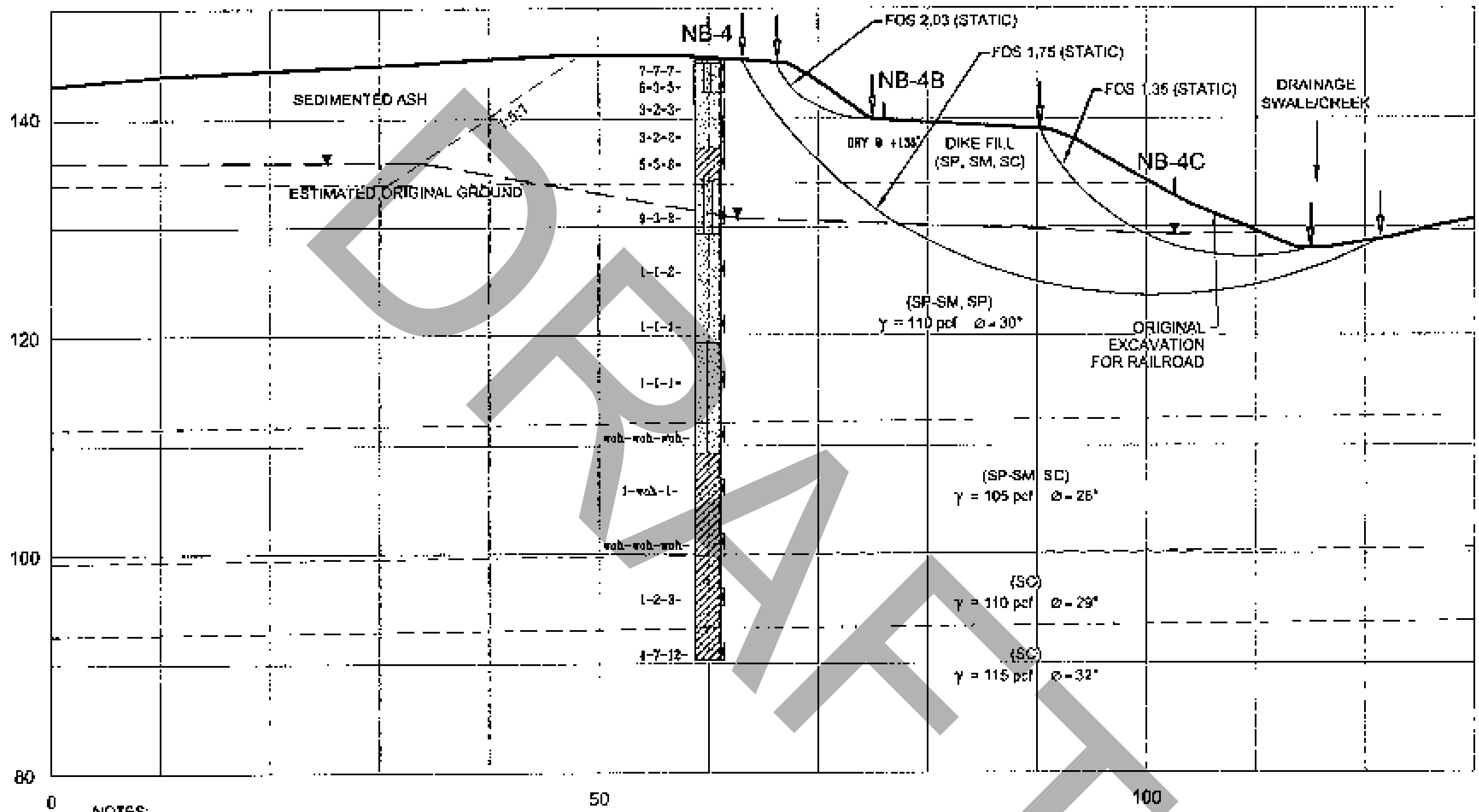
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS - SECTION N-3
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | A.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SA | SCALE: | AS SHOWN |
| APPROVAL: | JA 2 | JOB No.: | 6468-10-0111 |

DRAWING 12

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTES:

- WATER LEVEL IN SEDIMENTED ASH AND THICKNESS OF SEDIMENTED ASH INTERPOLATED FROM CPT-3 AND CPT-5 DATA.
- SEE DRAWING 6 FOR LEGEND.

1.5:1 — ESTIMATED INTERIOR DIKE SLOPE

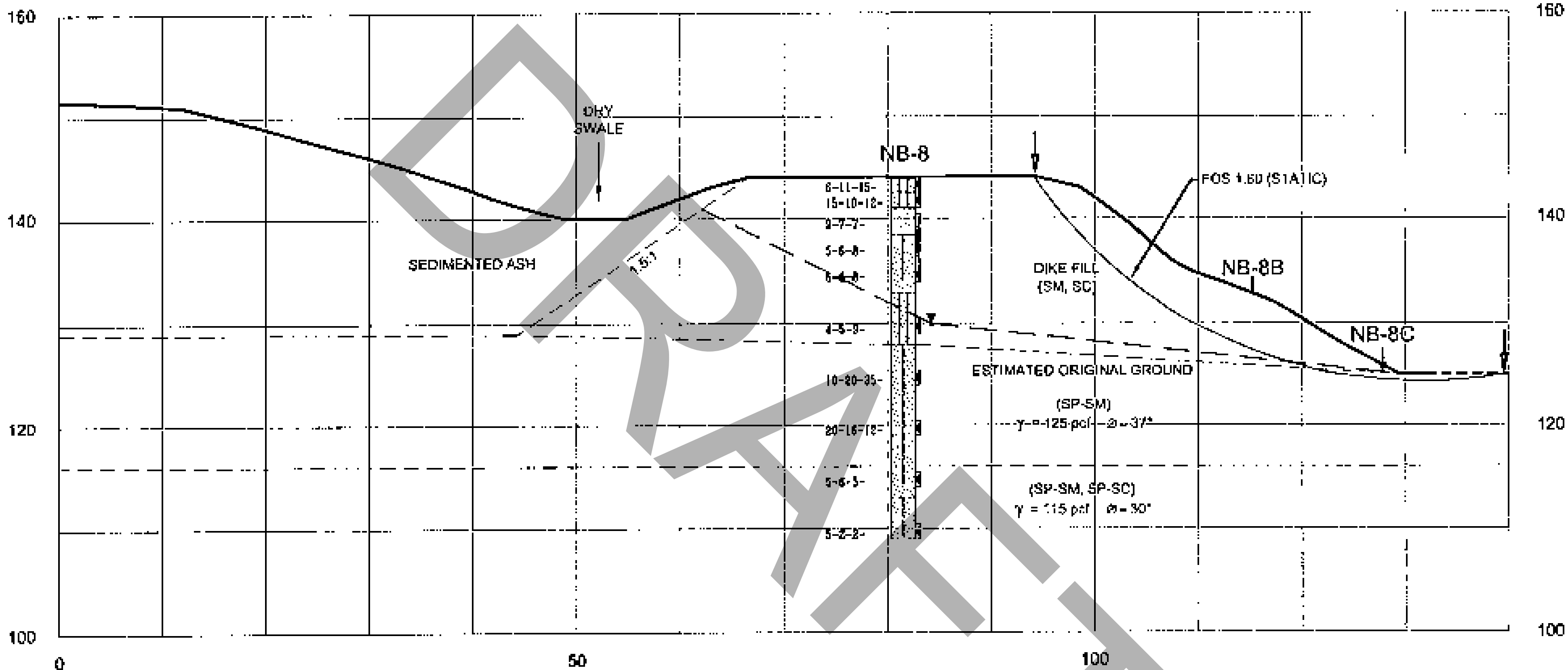
MACTEC
MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED, MACTEC FIELD DATA

**STABILITY ANALYSIS SECTION N-4**
**WEATHERSPOON PLANT**
**LUMBERTON, NORTH CAROLINA**

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 13




NOTE:

- SEE DRAWING 5 FOR LEGEND.

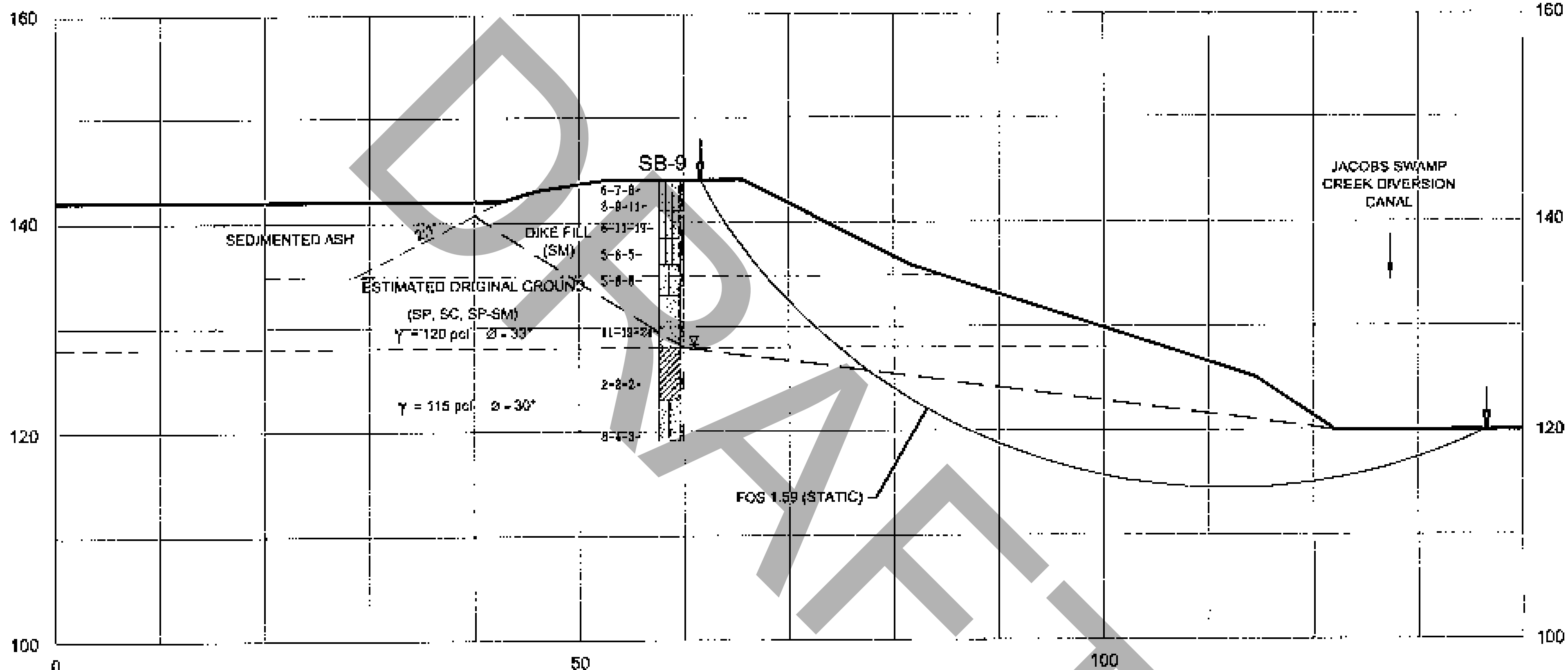
1.5:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC
MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-8
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 | DRAWING 14 |
| ENG CHECK: | | SCALE: | AS SHOWN | |
| APPROVAL: | | JOB No.: | 6468-10-0111 | |

REFERENCE: TOPOGRAPHIC MAP BY MOHAN AND CREEN, MACTEC FIELD DATA.




NOTE:

- SEE DRAWING 6 FOR LEGEND.

23 ESTIMATED INTERIOR DIKE SLOPE

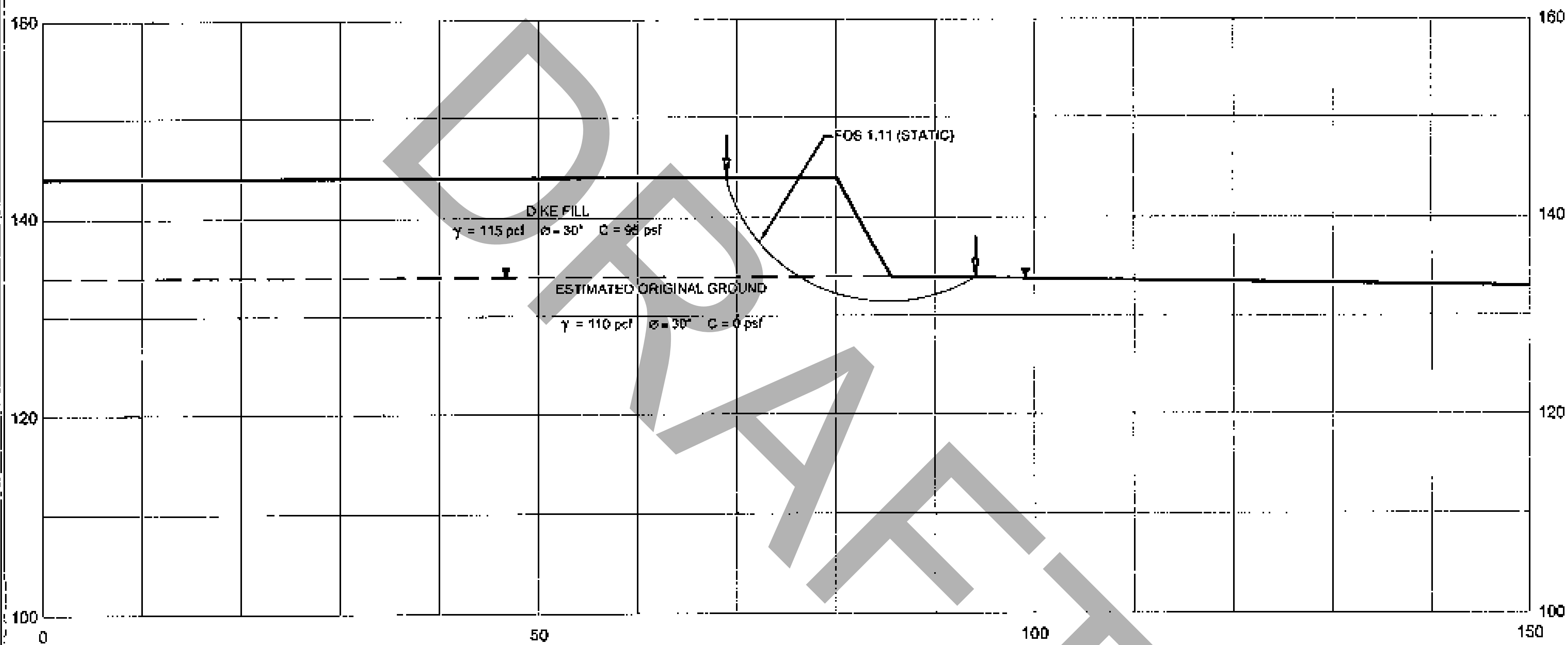
MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-9
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SC | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 5468-10-0111 |

DRAWING 15

REFERENCE: TOPOGRAPHIC MAP BY MCKIM AND CREED; MACTEC FIELD DATA.




NOTE:

- SEE DRAWING 8 FOR LEGEND.

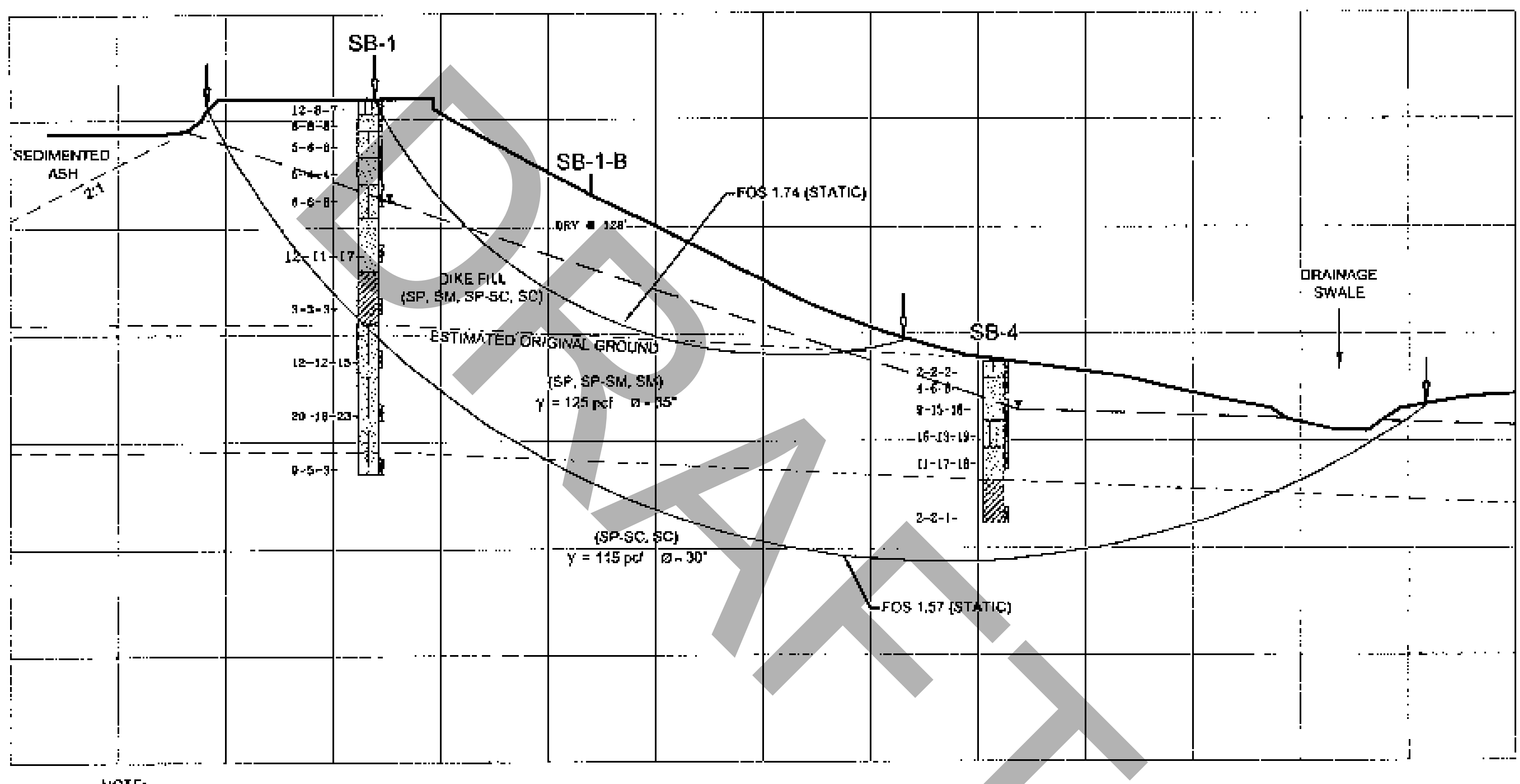
MACTEC

MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION N-10
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 | DRAWING |
| ENG CHECK: | SG | SCALE: | AS SHOWN | 16 |
| APPROVAL: | JP | JOB No.: | 6468-10-0131 | |

REFERENCE: TOPOGRAPHIC MAP BY MUNN AND CREED; MACTEC FIELD DATA




NOTE:

- SEE DRAWING 6 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC

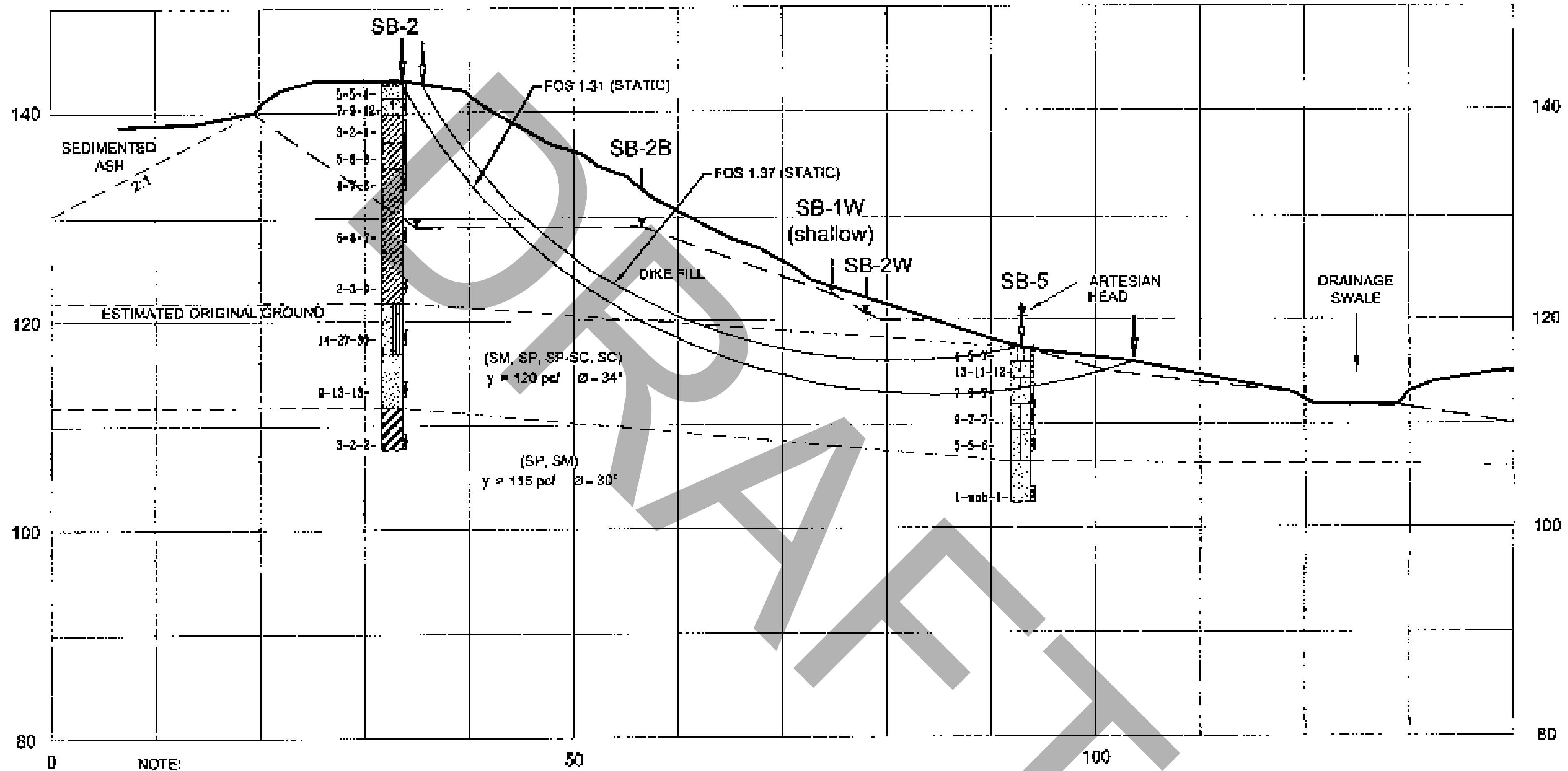
MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION S-1
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 17

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTE:

- SEE DRAWING 6 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC

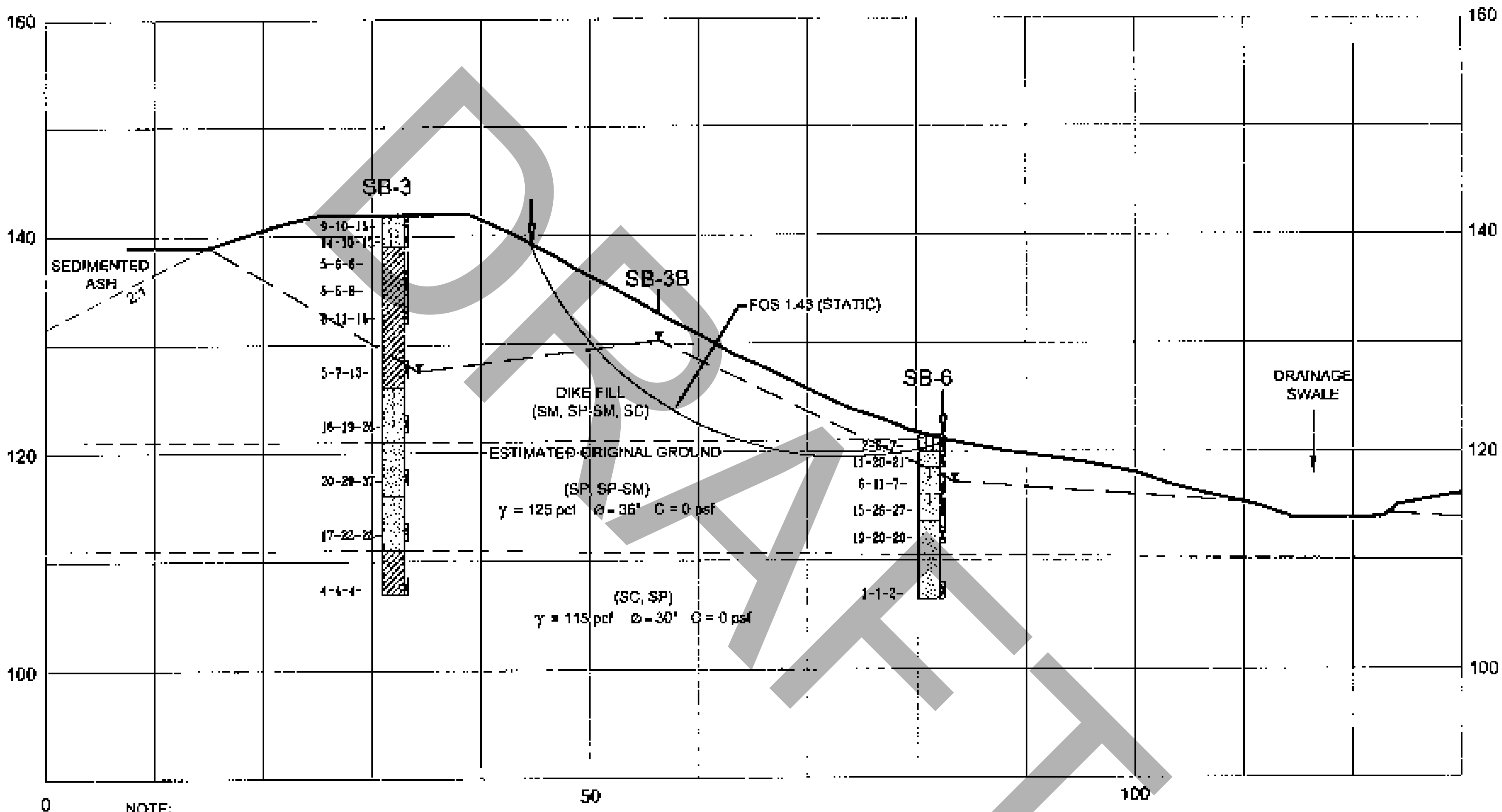
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION S-2
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | [signature] | SCALE: | AS SHOWN |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 |

DRAWING 18

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA




NOTE:

- SEE DRAWING 6 FOR LEGEND.
- 2:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC

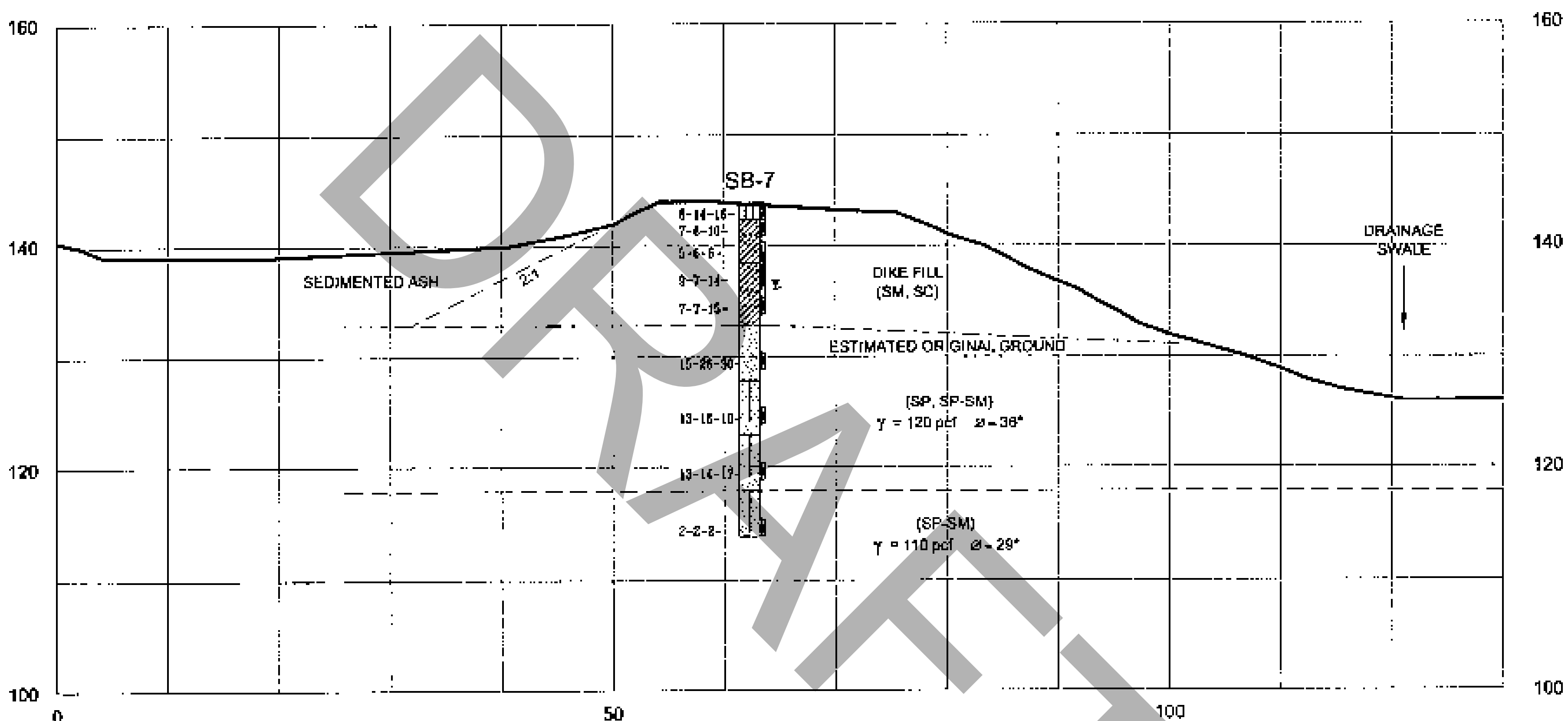
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION S-3
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 19

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED, MACTEC FIELD DATA




NOTES:

- SECTION PRESENTED FOR INFORMATION - NO STABILITY ANALYSIS IS JUDGED NECESSARY.
- SEE DRAWING 6 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE



MACTEC
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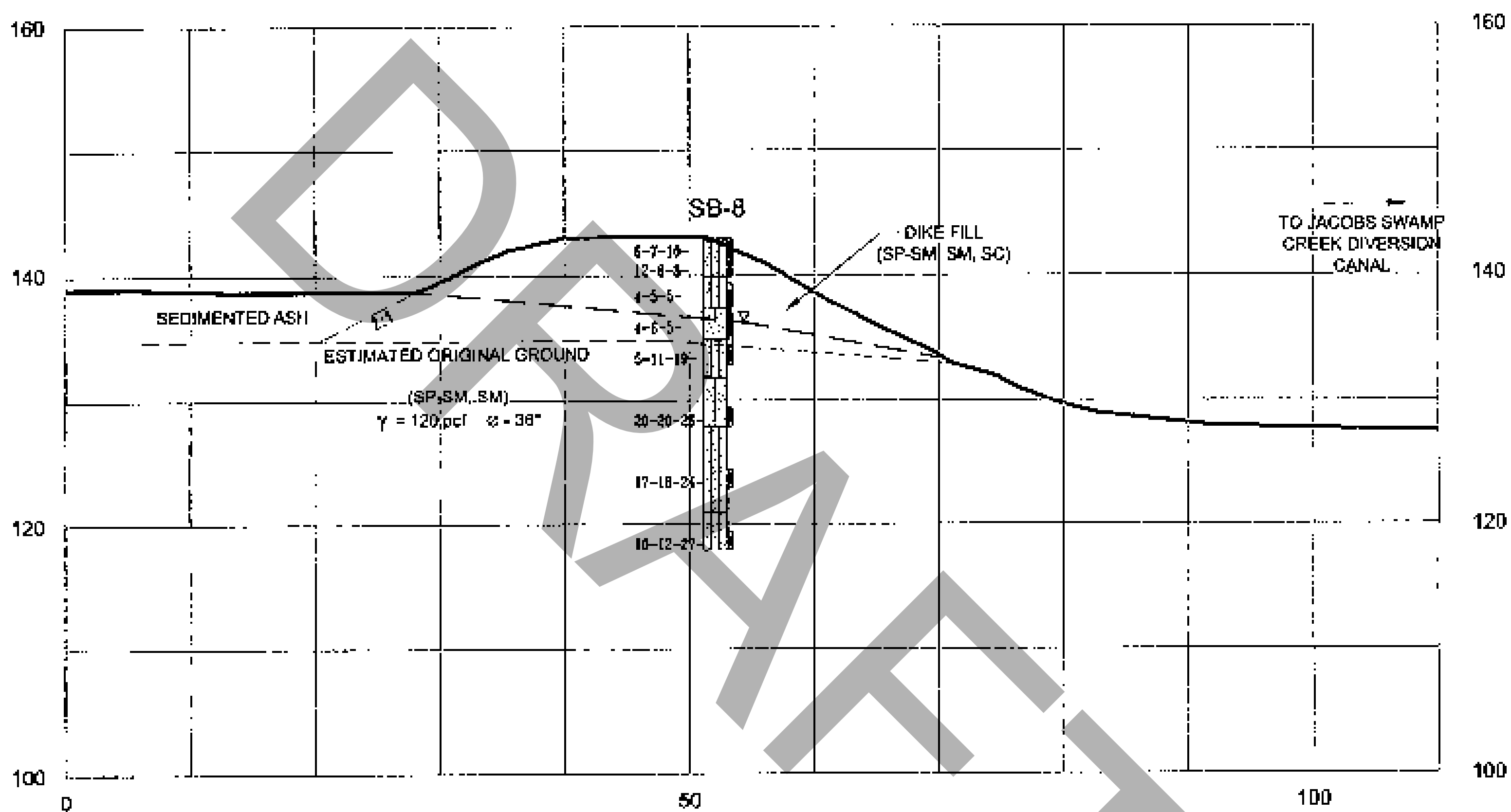
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

CROSS SECTION S-7
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK. | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 20

REFERENCE: TOPOGRAPHIC MAP BY LAUUM AND CREED; MACTEC FIELD DATA




NOTES:

- SECTION PRESENTED FOR INFORMATION - NO STABILITY ANALYSIS IS JUDGED NECESSARY.
- SEE DRAWING 6 FOR LEGEND.

2/1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC

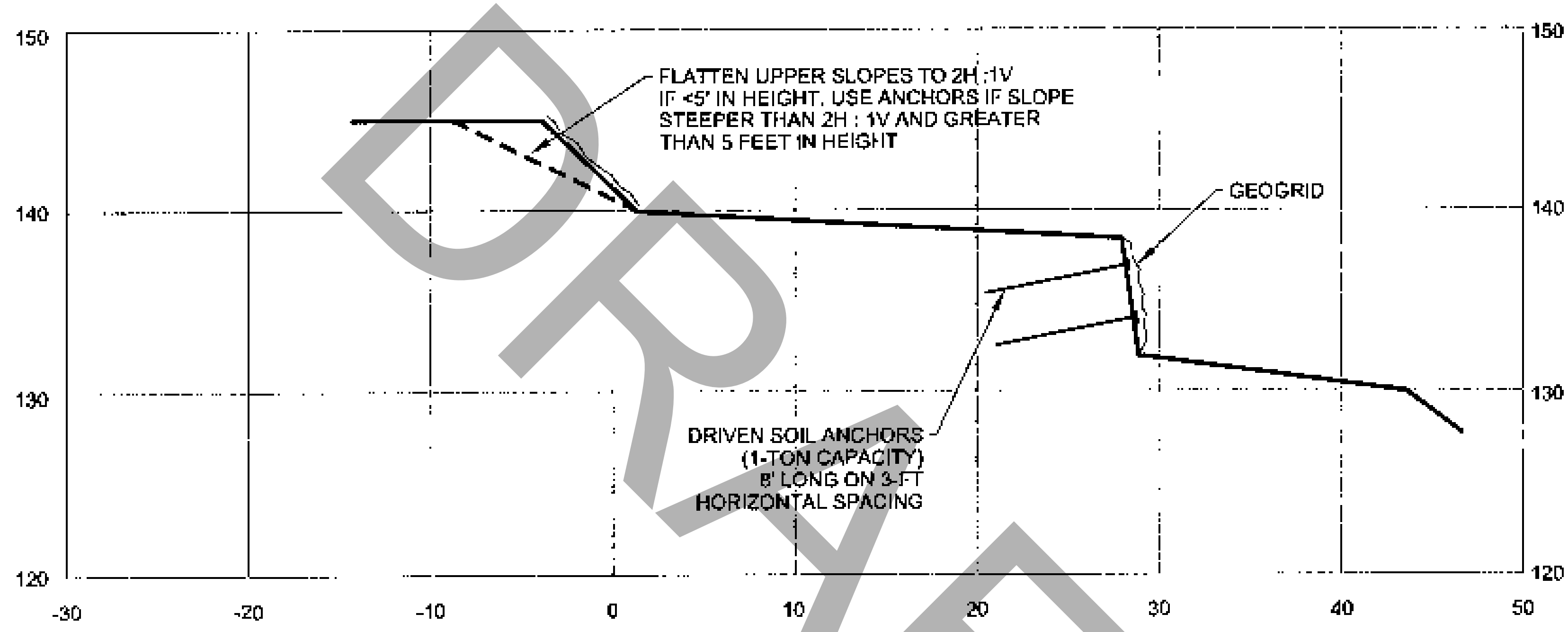
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

CROSS SECTION S-8
WEATHERSPOON PLANT
LUBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: R.R. | DATE: SEPTEMBER 2010 | DRAWING | |
| ENG CHECK: | SCALE: AS SHOWN | 21 | |
| APPROVAL: | JOB No.: 6468-10-0111 | | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED, MACTEC FIELD DATA.

P:\6468\Progress Energy\Progress Energy Projects 2010\Weatherspoon\Project Deliverables\Drawings\E4-Report DWGs\REPORT DWGs 09-27-10.dwg Mon, 27 Sep 2010 — 3:56pm




**NOTE:**
SECTION REPRESENTS TYPICAL LOCAL AREAS WHERE EITHER SURFICIAL SLIDES OR EROSION HAVE OCCURRED. HEIGHT OF AREAS VARIES. AREAS ARE MORE COMMON BETWEEN BORINGS NB-1 AND NB-5.

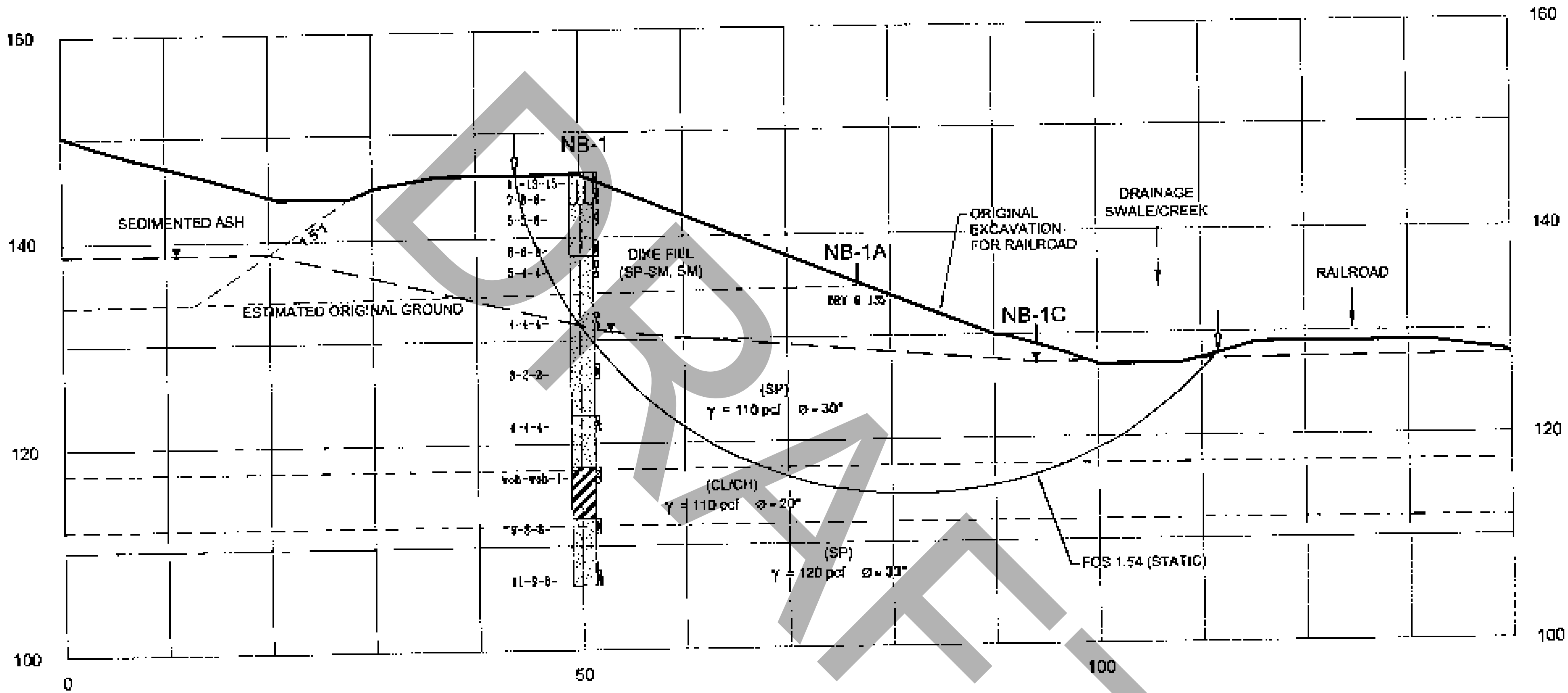
10' 0 10'
GRAPHIC SCALE - IN FEET

MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

CONCEPTUAL SLOPE STABILIZATION APPROACH
NORTH DIKE EROSION AREAS
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: R.R. | DATE: SEPTEMBER 2010 | DRAWING | |
| ENG CHECK: | SCALE: AS SHOWN | 22 | |
| APPROVAL: | JOB No.: 6468-10-0111 | | |

REFERENCE:




NOTES:

WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-1. SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

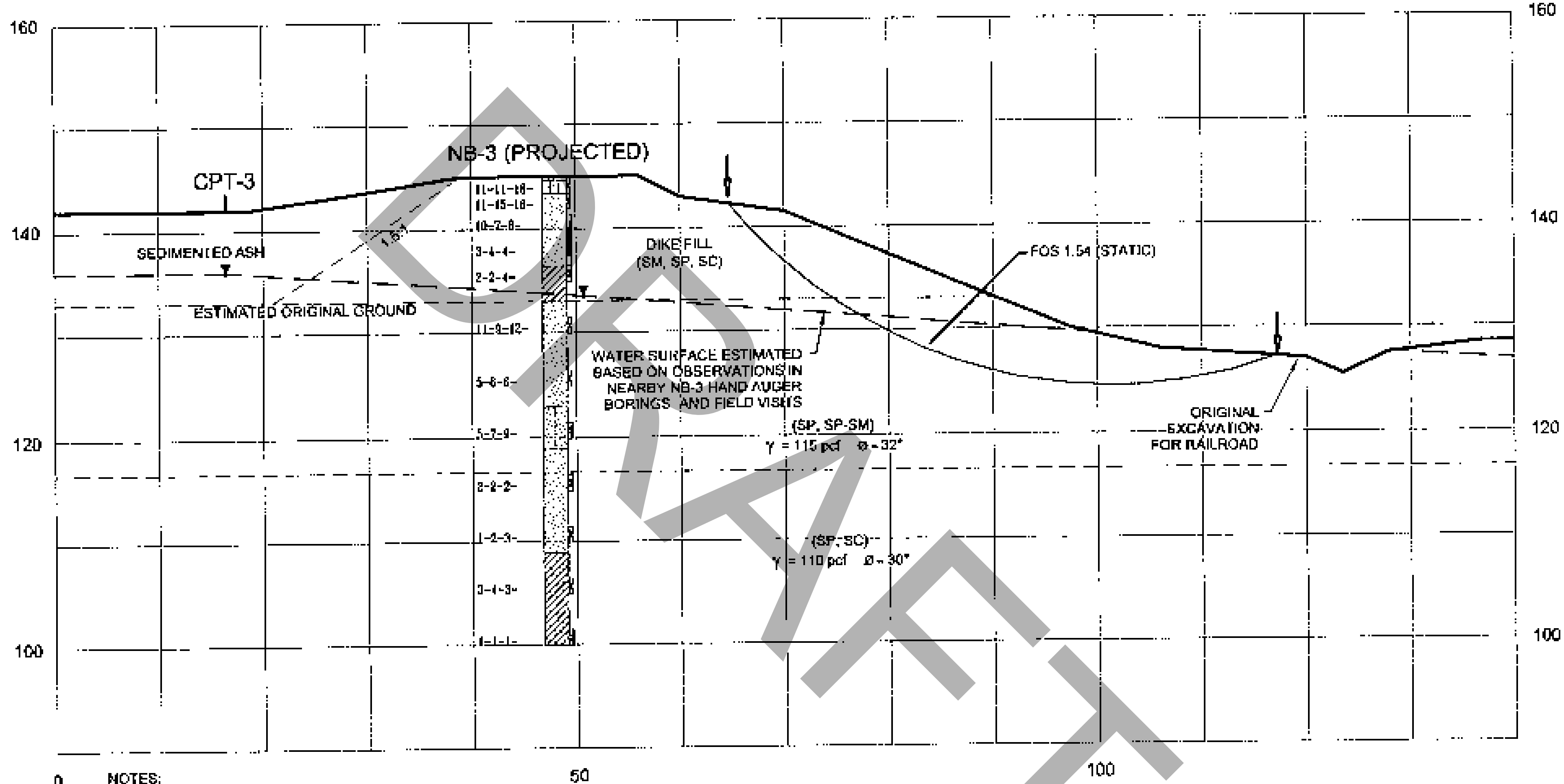
MACTEC

MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

SLOPE FLATTENING ALTERNATE SECTION N-1
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | H.R. | DATE: | SEPTEMBER 2010 | DRAWING 23 |
| ENG CHECK: | SG | SCALE: | AS SHOWN | |
| APPROVAL: | | JOB No.: | 5468-10-011 | |

REFERENCE: TOPOGRAPHIC MAP BY MEEKS AND CREECH, MACTEC FIELD DATA.




NOTES:

WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-3.
SEE DRAWING 6 FOR LEGEND.

1.5:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC

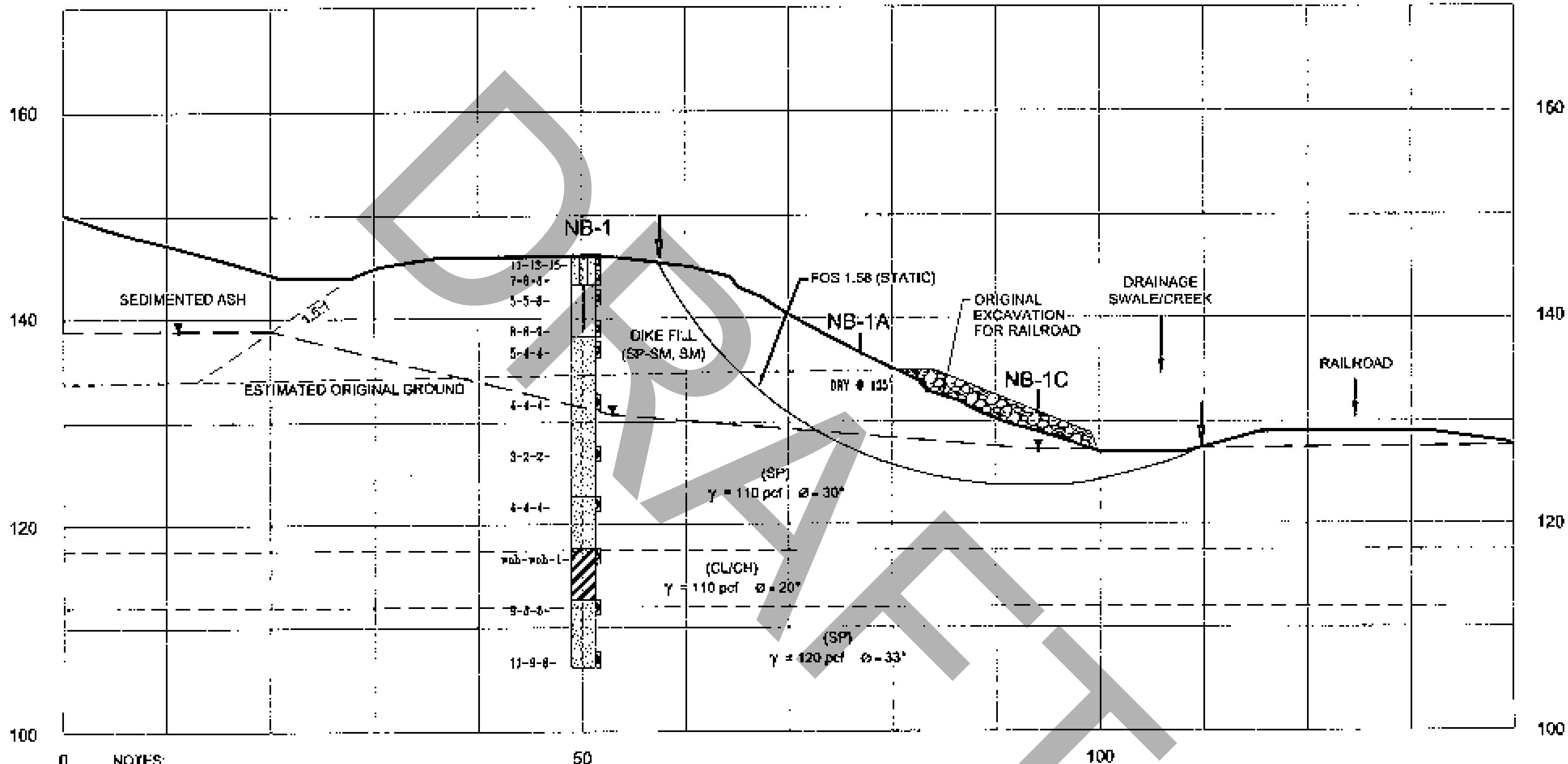
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

SLOPE FLATENING ALTERNATE SECTION N-2
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0151 |

DRAWING 24

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA




NOTES:

WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-1.
SEE DRAWING 6 FOR LEGEND.

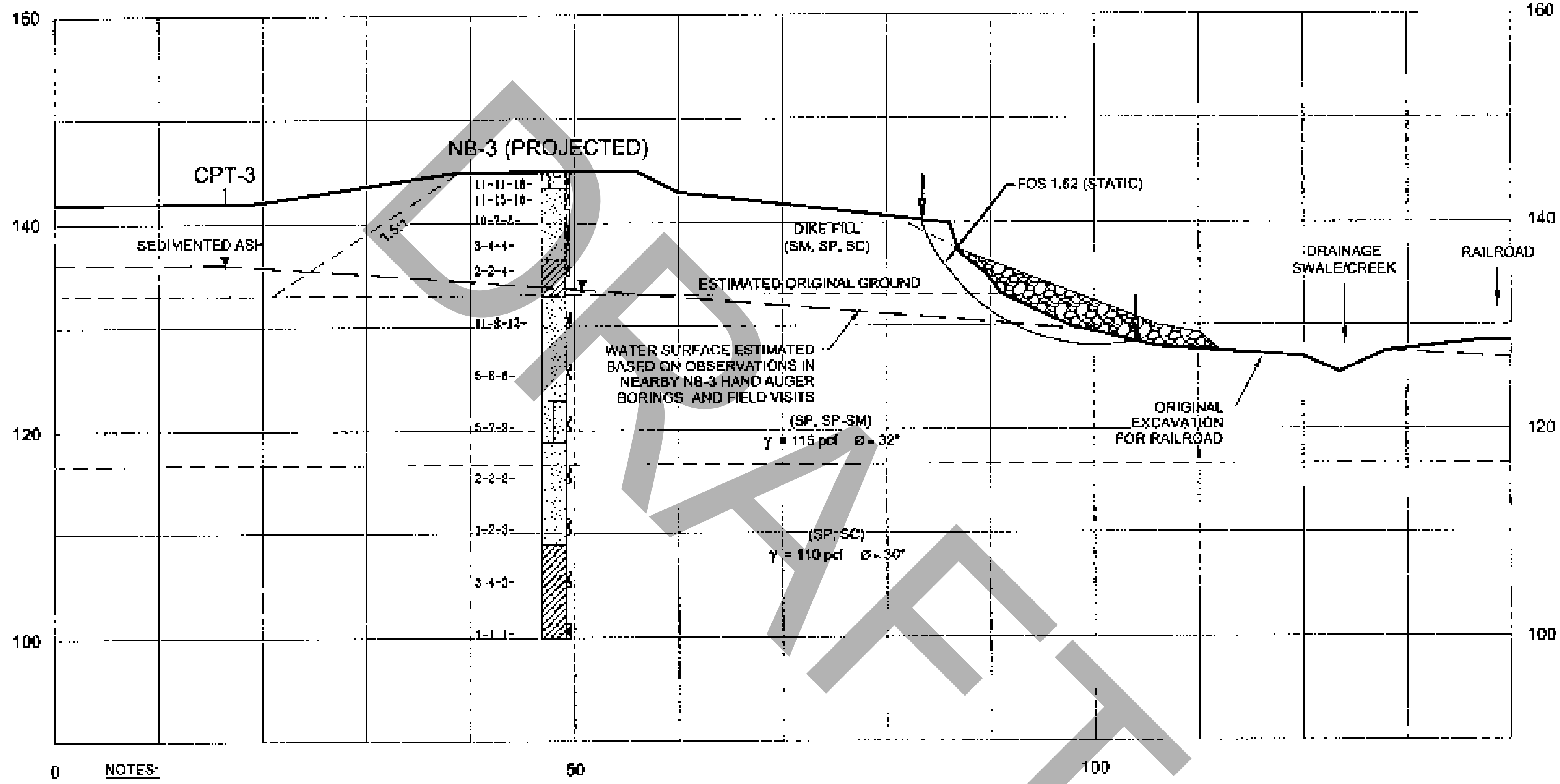
1.5:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

# RIPRAP ALTERNATE SECTION N-1
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 | DRAWING |
| ENG CHECK: | SA | SCALE: | AS SHOWN | 25 |
| APPROVAL: | [signature] | JOB No.: | 6468-10-011 | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTES:

WATER LEVEL AND THICKNESS FOR SEDIMENTED ASH TAKEN FROM CPT-3.
SEE DRAWING 6 FOR LEGEND.

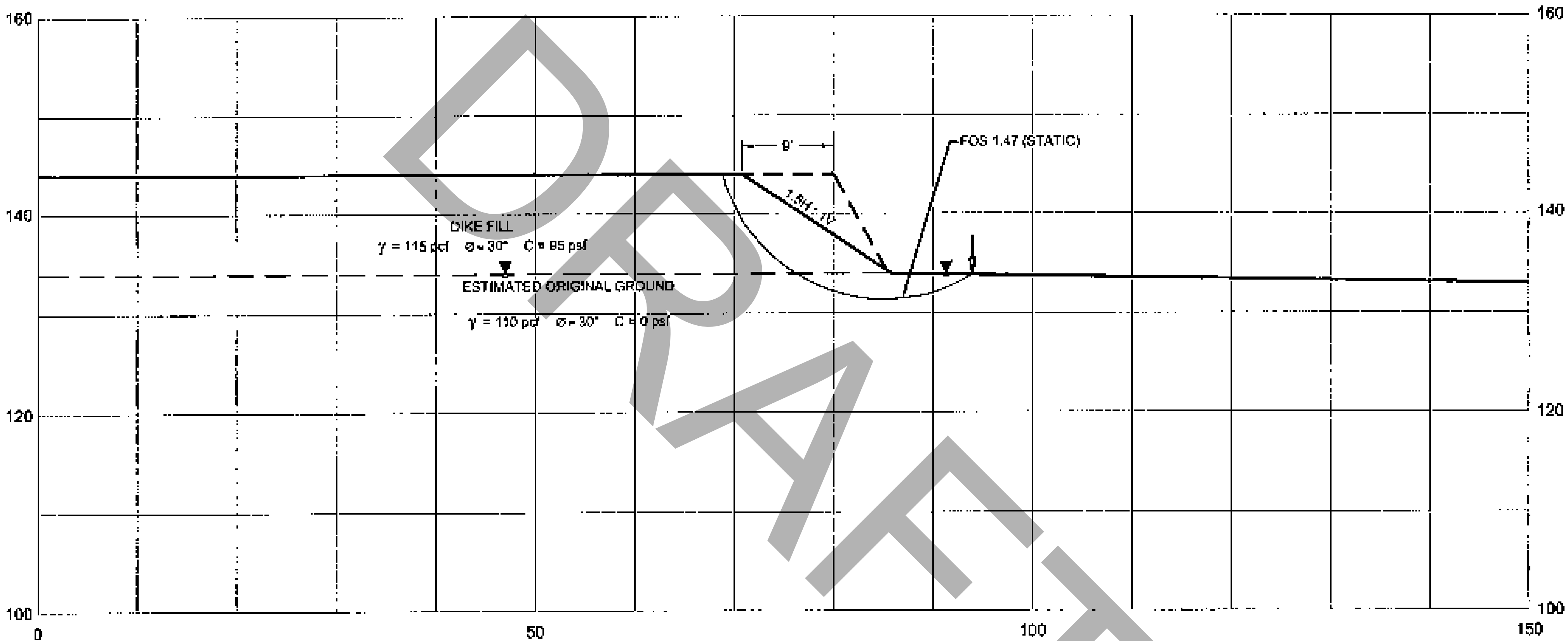
1.5:1 ESTIMATED INTERIOR DIKE SLOPE

MACTEC
MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

REFERENCE: TOPOGRAPHIC MAP BY MURAM AND GREGG; MACTEC FIELD DATA

RIPRAP ALTERNATE SECTION N-2
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: R.R. | DATE: SEPTEMBER 2010 | DRAWING | |
| ENG CHECK: | SCALE: AS SHOWN | 26 | |
| APPROVAL: | JOB No.: 6468-10-0111 | | |




**MACTEC**

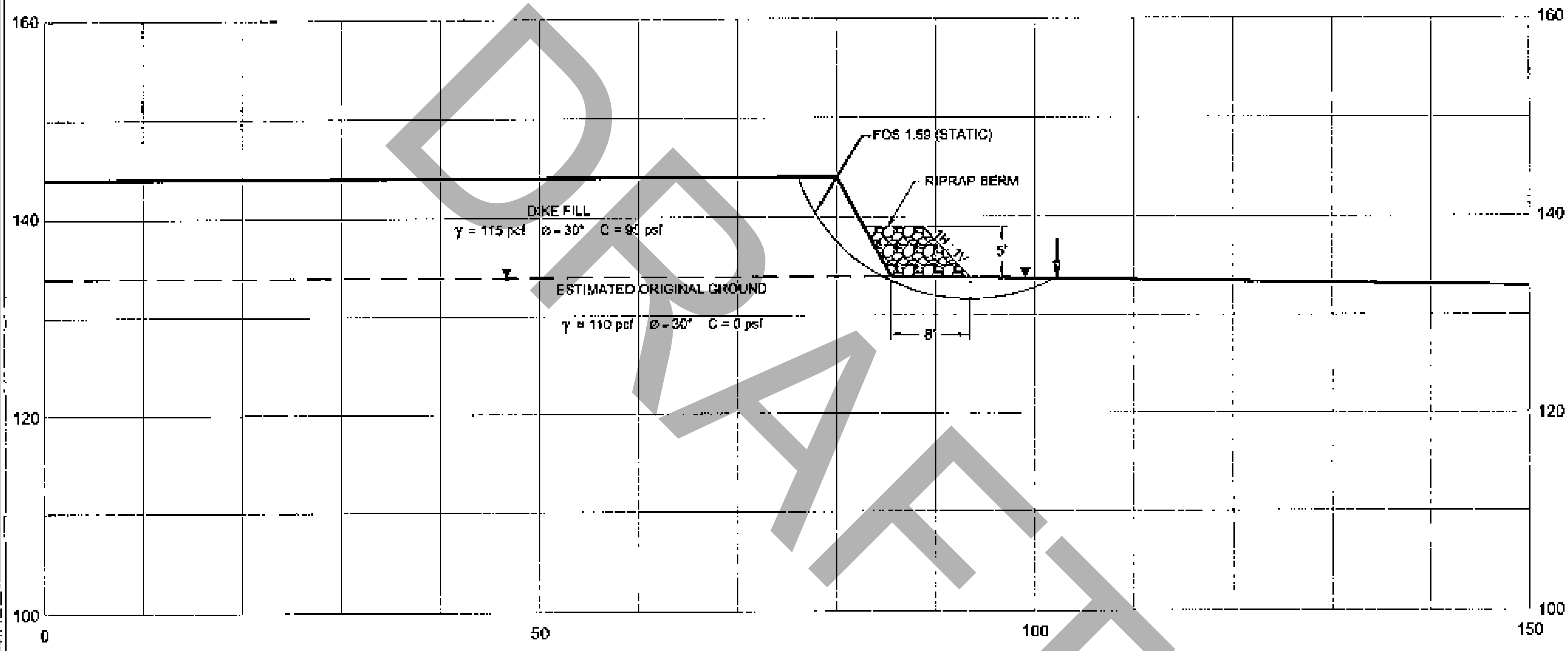
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

IMPROVEMENT FOR SECTION N-10 BY FLATTENING SLOPE
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SC | SCALE: | AS SHOWN |
| APPROVAL: | JC | JOB No.: | 6468-10-0111 |

DRAWING 27

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED, MACTEC FIELD DATA.




MACTEC

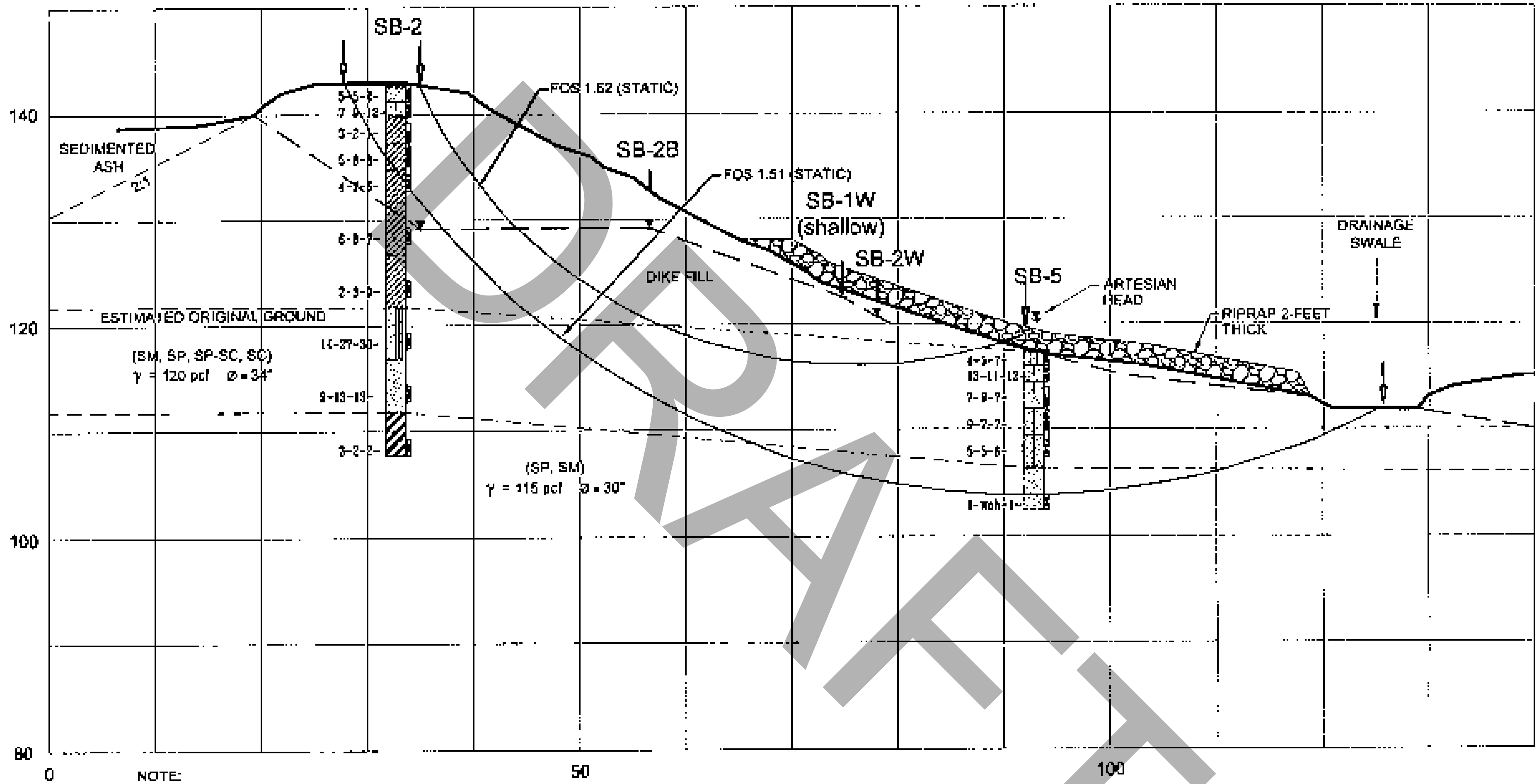
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

IMPROVEMENT FOR SECTION N-10 USING RIPRAP BERM
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | [signature] | SCALE: | AS SHOWN |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 |

DRAWING 28

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED. MACTEC FIELD DATA.




NOTE:

- SEE DRAWING 6 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

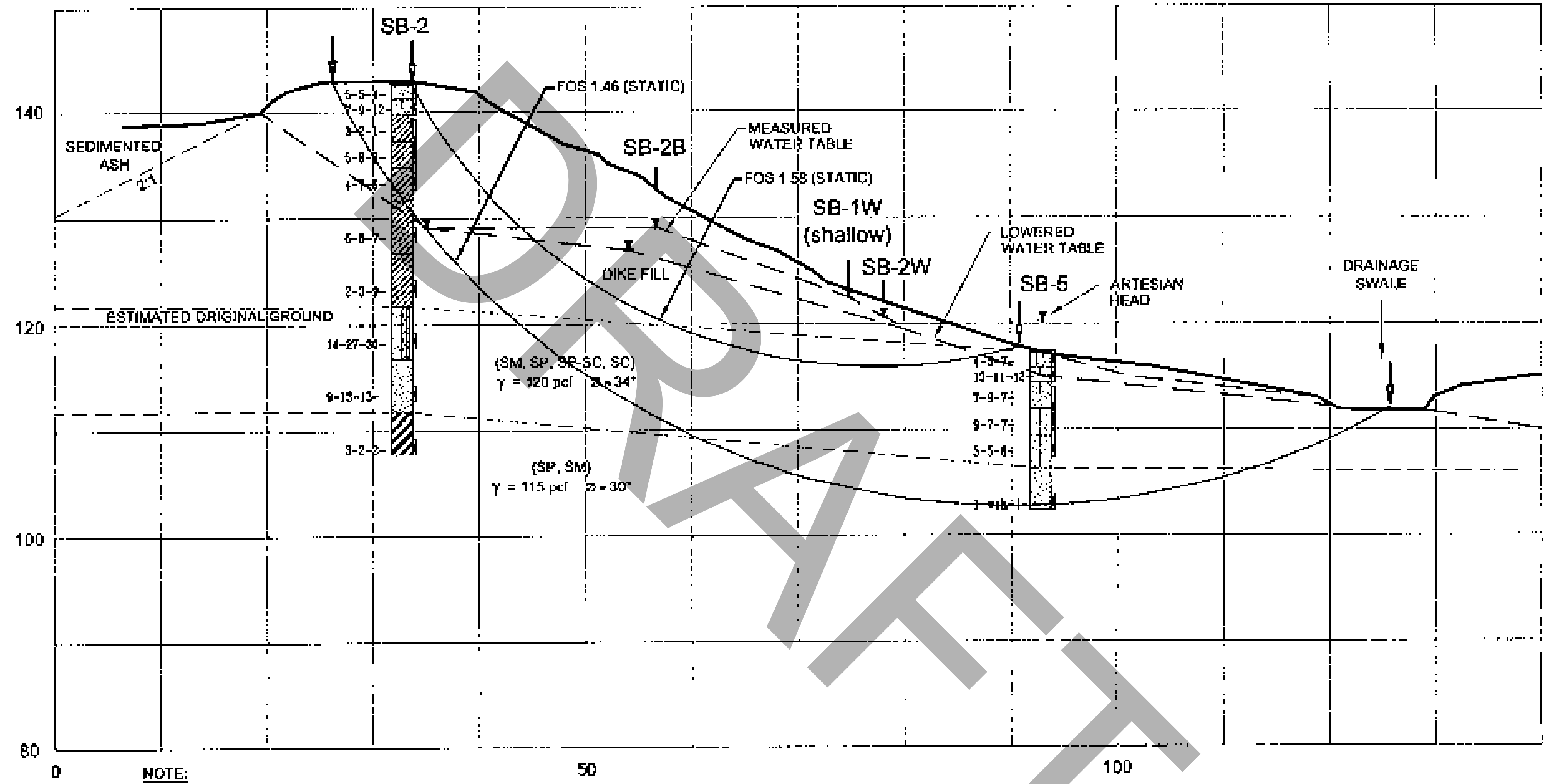
MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

IMPROVEMENT FOR SOUTH DIKE SECTION S-2 USING RIPRAP
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | SL | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 29

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA



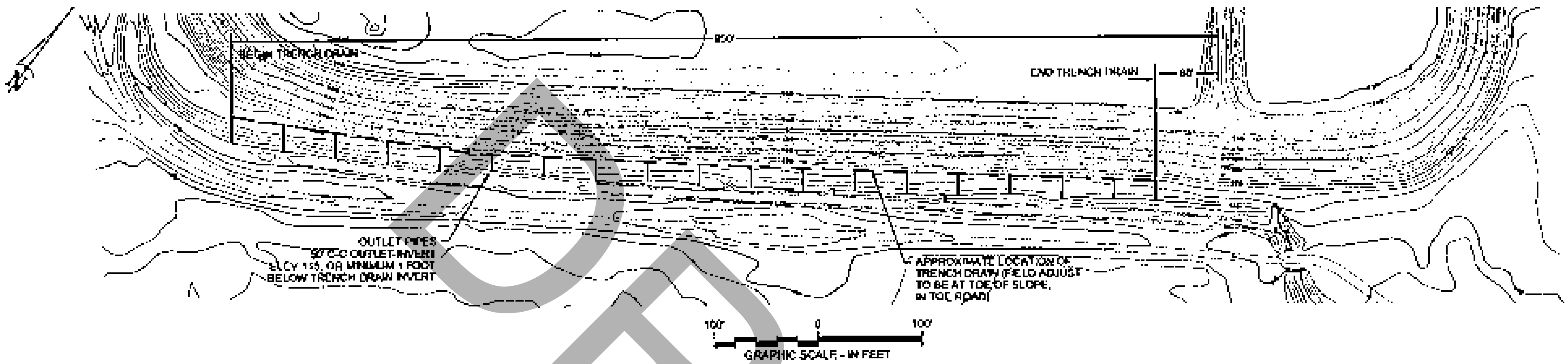

NOTE:

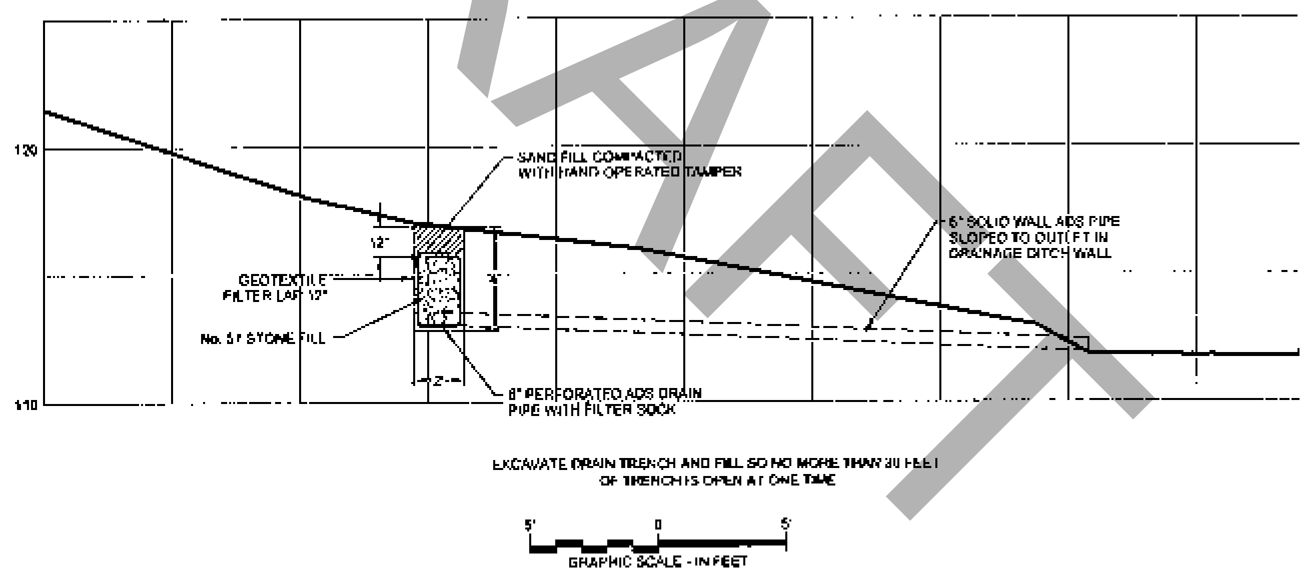
SEE DRAWING 6 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

| | | | |
|---|---|---|---|
| MACTEC ENGINEERING AND CONSULTING, INC. 3301 ATLANTIC AVENUE RALEIGH, NORTH CAROLINA | STABILITY ANALYSIS FOR LOWERED WATER LEVEL SECTION S-2<br>WEATHERSPOON PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: R.R.<br>ENG CHECK:<br>APPROVAL: | DATE: SEPTEMBER 2010<br>SCALE: AS SHOWN<br>JOB No.: 6468-10-0111 | DRAWING 30 |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA




**MACTEC**

MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

ALTERNATE TRENCH DRAIN FOR SOUTH DIKE 1979 ASH POND
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

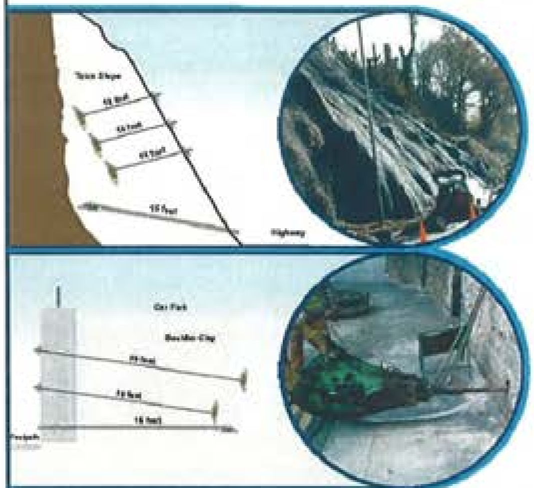
| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | SEPTEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0111 |

DRAWING 31

REFERENCE: TOPOGRAPHIC MAP FROM AERIAL METHODS; PREPARED BY McKIM AND CREED.

# PLATI-DRAIN

## S8 'PASSIVE' SYSTEM



***'A unique solution to reduce pore water pressure within clay slopes and behind temporary or permanent retaining walls'.***

- Unlike conventional weep holes, Plati-Drain® provides deep slope penetration in excess of 32 feet.
- The 'Passive' Plati-Drain® system creates an immediate channel for water to drain.
- Can prevent shallow and deep seated slope failures.
- Fast and easy installation using simple tools.

| PHYSICAL PROPERTIES | TYPICAL US VALUE | TYPICAL SI VALUE | TEST METHOD |
|---|---|---|---|
| ***FABRIC PROPERTIES*** | | | |
| Material | Polypropylene | Polypropylene | |
| Grab Tensile Strength | 145 lbs | 645 N | ASTM D-4632 |
| Puncture Strength | 50 lbs | 222 N | ASTM D-4833 |
| Trapezoidal Tear | 70 lbs | 311 N | ASTM D-4533 |
| Mullen Burst Strength | 150 psi | 1034 kPa | ASTM D-3786 |
| Elongation | 60% | 60% | ASTM D-4632 |
| EOS (AOS) | 80 sieve | 180 micron | ASTM D-4751 |
| Permittivity | 0.8 sec⁻¹ | 0.8 sec⁻¹ | ASTM D-4491 |
| Permeability | 0.016 in/sec | 0.041 cm/sec | ASTM D-4491 |
| Flow Rate | 80 gal/min/ft² | 3259 L/min/m² | ASTM D-4491 |
| UV Stability | 70% | 70% | ASTM D-4355 |
| ***CORE PROPERTIES*** | | | |
| Material | Polypropylene | Polypropylene | |
| Tensile Strength | 200 lbs | 885 N | ASTM D-4632(Mod.) |
| ***PRODUCT PROPERTIES*** | | | |
| Discharge Capacity | 1.6 gal/min | 6 L/min | ASTM D-4716 |
| Roll length | 1000 ft | 305 m | |
| Roll width | 4 in | 102 mm | |
| Roll weight | 52 lbs | 23.6 kg | |

All information, drawings and specifications are based on the latest product information available at the time of printing. Constant improvement and engineering progress make it necessary that we reserve the right to make changes without notice. All physical properties are typical values. Standard variations in mechanical properties of 10% and in hydraulic properties of 20% are normal.

***PLATIPUS ANCHORS LIMITED,*** 2008 Garner Station Boulevard, Raleigh, NC 27603, USA.
Phone Toll Free: 919 PLATIPUS (854 6145) Fax: 919 859 9597
www.platipus-anchors.com E-Mail: info@platipus-anchors.com



| | | | | |
|---|---|---|---|---|
| MACTEC<br>MACTEC ENGINEERING AND CONSULTING, INC.<br>3301 ATLANTIC AVENUE<br>RALEIGH, NORTH CAROLINA | DRIVEN DRAIN INFORMATION<br>WEATHERSPOON PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: R.R. | DATE: SEPT. 2010 | DRAWING |
| | | ENG CHECK: | SCALE: AS SHOWN | 32 |
| | | APPROVAL: | JOB No.: 6468-10-0111 | |

REFERENCE:

# EXHIBITS




Exhibit 1 – Construction photograph from 8/5/1948 showing rail line construction and ash pond general area.

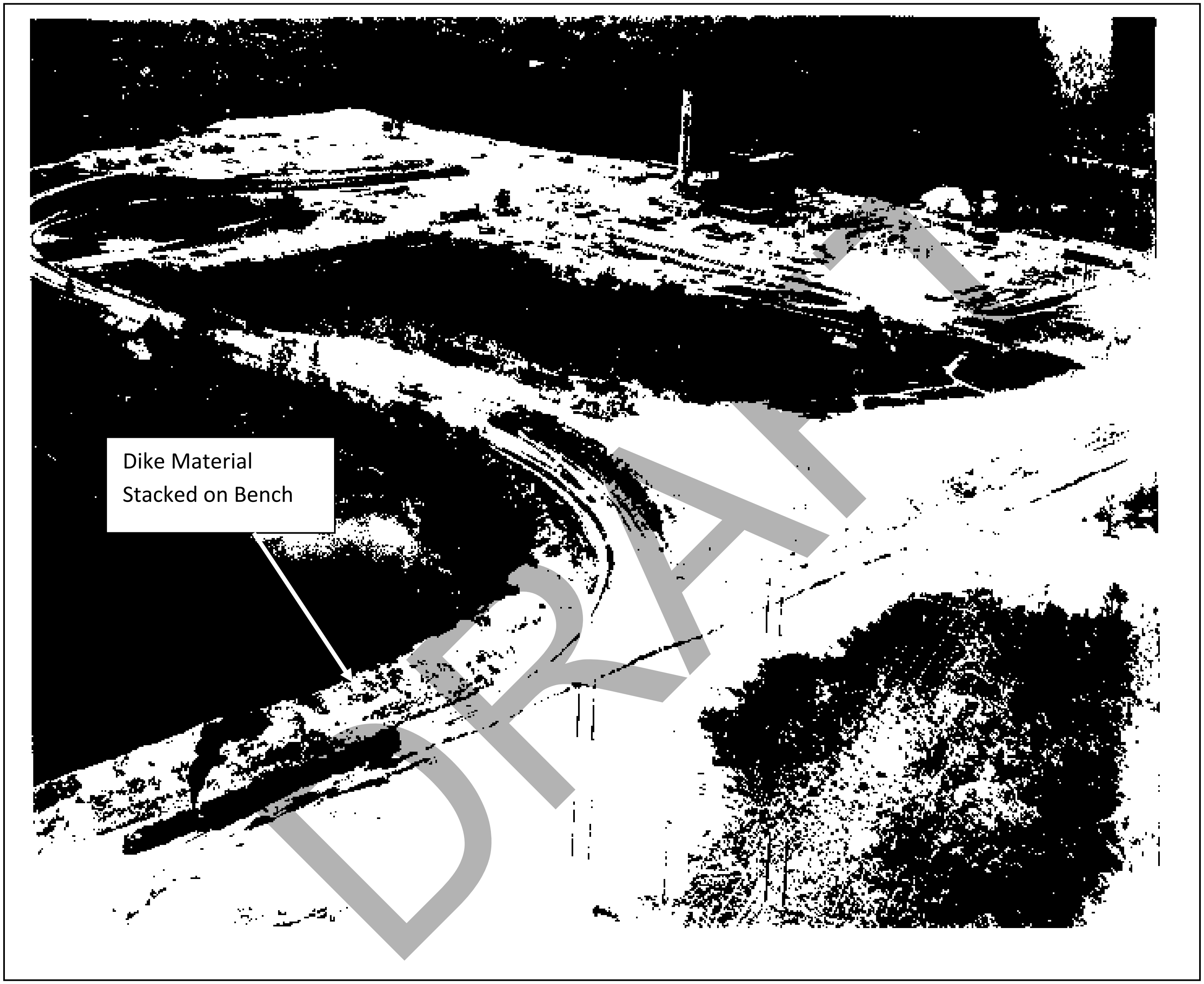
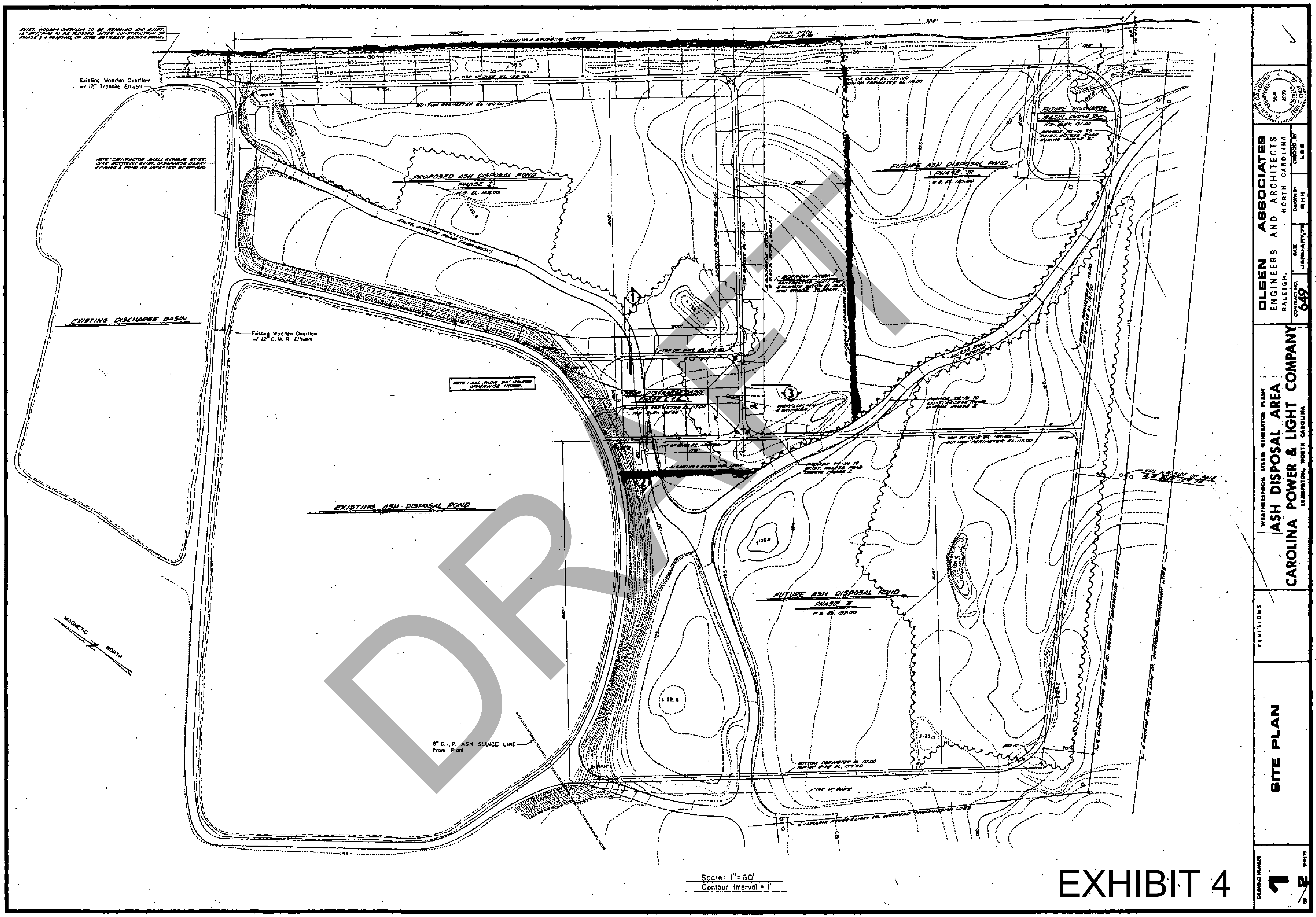



Exhibit 2 - Construction photograph from 7/20/1949 showing excavated slope for railroad access and material from the excavation placed on bench made in original ground at top of the cut.



Exhibit 3. Construction photograph from 2/28/1955 showing "New ash disposal area..completed retaining dyke tying into old railroad cut spoil banks and new pipeline to disposal area."



Existing Wooden Overflow w/ 12" Transite Effluent
EXISTING DISCHARGE BASIN
Existing Wooden Overflow w/ 12" C.M.R. Effluent
PROPOSED ASH DISPOSAL POND
PHASE I
EXISTING ASH DISPOSAL POND
FUTURE ASH DISPOSAL POND
PHASE II
FUTURE ASH DISPOSAL POND
PHASE III
8" C.I.P. ASH SLUICE LINE
From Plant
MAGNETIC NORTH
Scale: 1" = 60'
Contour Interval = 1'
OLSEN ASSOCIATES
ENGINEERS AND ARCHITECTS
RALEIGH, NORTH CAROLINA
CONTRACT NO. 649
WEATHERSPOON STEAM GENERATOR PLANT
ASH DISPOSAL AREA
CAROLINA POWER & LIGHT COMPANY
LUMBERTON, NORTH CAROLINA
REVISIONS
SITE PLAN


EXHIBIT 4

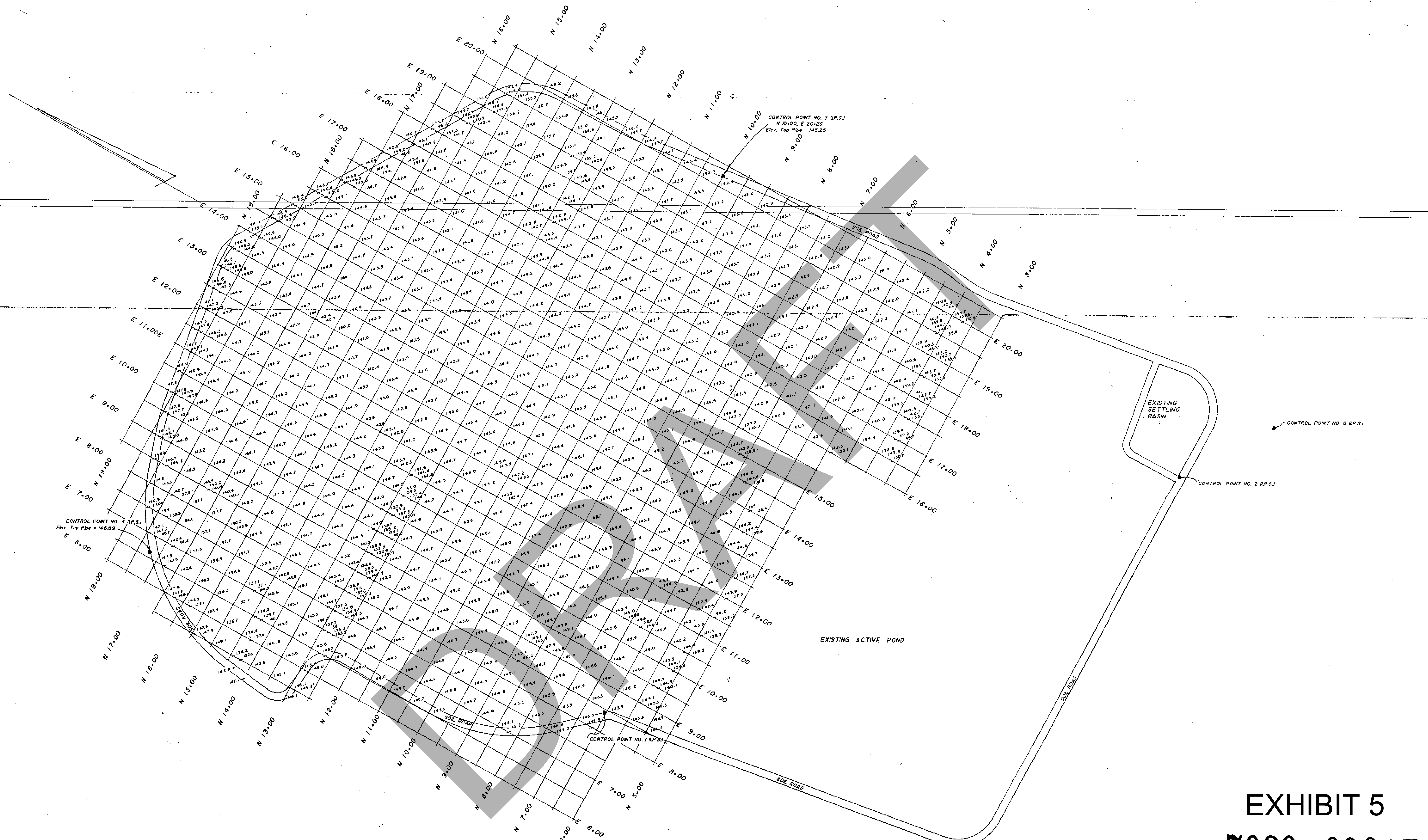



EXHIBIT 5

7030-00018

NOTES:

THIS MAP WAS PREPARED FROM FIELD INFORMATION PERFORMED DURING MAY, 1990.

ELEVATIONS SHOWN ARE BASED ON BENCHMARK WITH AN ELEVATION OF 128.375 AND BEING AN EXISTING CONCRETE CYLINDER WITH SCREW IN BRASS PLATE IN VERTICAL R.C.P. ON HILL SIDE BETWEEN PLANT AND INTAKE STRUCTURE.

COPY

TOPOGRAPHIC MAP OF

Carolina Power & Light Company
WEATHERSPOON STEAM ELECTRIC PLANT
"ASH POND AREA"
LUMBERTON, NORTH CAROLINA

| | |
|---|---|
| SEAL | |
| ZONE | |
| TAX PARCEL | |
| P.I.N. | |

Smith and Smith surveyors
P.O. BOX 457, APEX, N.C. 27502, (919) 362-7111
P.O. BOX 277, PITTSBORO, N.C. 27312, (919) 542-4321

| | |
|---|---|
| DATE | JUNE 8, 1990 |
| SCALE | 1" = 100' |
| DRAWN BY | JAMES A. BLACKMON |
| PROJECT NO. | 90-70 |

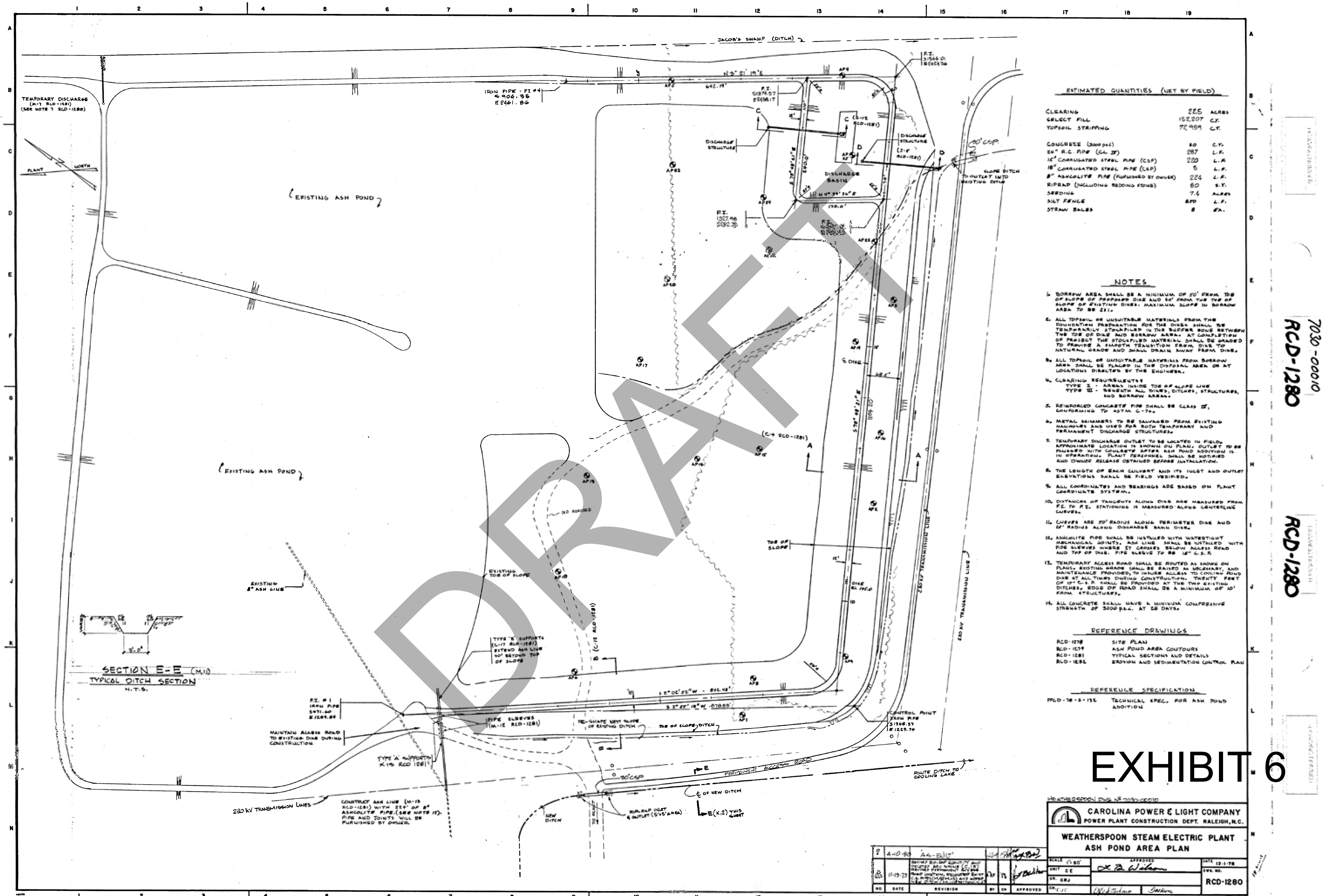

JACOB'S SWAMP (DITCH)
TEMPORARY DISCHARGE (M-7 RCD-1281) (SEE NOTE 7 RCD-1280)
EXISTING ASH POND
EXISTING ASH POND
DISCHARGE BASIN
DISCHARGE STRUCTURE
SECTION E-E (M,11)
TYPICAL DITCH SECTION
N.T.S.
230 KV TRANSMISSION LINES
230 KV TRANSMISSION LINE
ROUTE DITCH TO COOLING LAKE
PERMANENT ACCESS ROAD
MAINTAIN ACCESS ROAD TO EXISTING DIKE DURING CONSTRUCTION
TOE OF SLOPE DITCH
ESTIMATED QUANTITIES (NET BY FIELD)
CLEARING 22.5 ACRES
SELECT FILL 152,207 C.Y.
TOPSOIL STRIPPING 72,959 C.Y.
CONCRETE (3000 psi) 80 C.Y.
24" R.C. PIPE (CL. IV) 287 L.F.
15" CORRUGATED STEEL PIPE (CSP) 220 L.F.
18" CORRUGATED STEEL PIPE (CSP) 5 L.F.
8" ASHCOLITE PIPE (FURNISHED BY OWNER) 224 L.F.
RIPRAP (INCLUDING BEDDING STONE) 80 S.Y.
SEEDING 7.4 ACRES
SILT FENCE 850 L.F.
STRAW BALES 8 EA.
NOTES
1. BORROW AREA SHALL BE A MINIMUM OF 50' FROM TOE OF SLOPE OF PROPOSED DIKE AND 50' FROM THE TOE OF SLOPE OF EXISTING DIKES. MAXIMUM SLOPE IN BORROW AREA TO BE 2:1.
2. ALL TOPSOIL OR UNSUITABLE MATERIALS FROM THE FOUNDATION PREPARATION FOR THE DIKES SHALL BE TEMPORARILY STOCKPILED IN THE BUFFER ZONE BETWEEN THE TOE OF DIKE AND BORROW AREA. AT COMPLETION OF PROJECT THE STOCKPILED MATERIAL SHALL BE GRADED TO PROVIDE A SMOOTH TRANSITION FROM DIKE TO NATURAL GRADE AND SHALL DRAIN AWAY FROM DIKE.
3. ALL TOPSOIL OR UNSUITABLE MATERIALS FROM BORROW AREA SHALL BE PLACED IN THE DISPOSAL AREA OR AT LOCATIONS DIRECTED BY THE ENGINEER.
4. CLEARING REQUIREMENTS:
TYPE I - AREAS INSIDE TOE OF SLOPE LINE
TYPE III - BENEATH ALL DIKES, DITCHES, STRUCTURES, AND BORROW AREAS.
5. REINFORCED CONCRETE PIPE SHALL BE CLASS IV, CONFORMING TO ASTM C-76.
6. METAL SKIMMERS TO BE SALVAGED FROM EXISTING MANHOLES AND USED FOR BOTH TEMPORARY AND PERMANENT DISCHARGE STRUCTURES.
7. TEMPORARY DISCHARGE OUTLET TO BE LOCATED IN FIELD. APPROXIMATE LOCATION IS SHOWN ON PLAN. OUTLET TO BE PLUGGED WITH CONCRETE AFTER ASH POND ADDITION IS IN OPERATION. PLANT PERSONNEL SHALL BE NOTIFIED AND OWNER RELEASE OBTAINED BEFORE INSTALLATION.
8. THE LENGTH OF EACH CULVERT AND ITS INLET AND OUTLET ELEVATIONS SHALL BE FIELD VERIFIED.
9. ALL COORDINATES AND BEARINGS ARE BASED ON PLANT COORDINATE SYSTEM.
10. DISTANCES OF TANGENTS ALONG DIKE ARE MEASURED FROM P.I. TO P.I. STATIONING IS MEASURED ALONG CENTERLINE CURVES.
11. CURVES ARE 50' RADIUS ALONG PERIMETER DIKE AND 25' RADIUS ALONG DISCHARGE BASIN DIKE.
12. ASHCOLITE PIPE SHALL BE INSTALLED WITH WATERTIGHT MECHANICAL JOINTS. ASH LINE SHALL BE INSTALLED WITH PIPE SLEEVES WHERE IT CROSSES BELOW ACCESS ROAD AND TOP OF DIKE. PIPE SLEEVE TO BE 12" C.S.P.
13. TEMPORARY ACCESS ROAD SHALL BE ROUTED AS SHOWN ON PLANS. EXISTING GRADE SHALL BE RAISED AS NECESSARY, AND MAINTENANCE PROVIDED, TO INSURE ACCESS TO COOLING POND DIKE AT ALL TIMES DURING CONSTRUCTION. TWENTY FEET OF 12" C.S.P. SHALL BE PROVIDED AT THE TWO EXISTING DITCHES. EDGE OF ROAD SHALL BE A MINIMUM OF 10' FROM STRUCTURES.
14. ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 p.s.i. AT 28 DAYS.
REFERENCE DRAWINGS
RCD-1278 SITE PLAN
RCD-1279 ASH POND AREA CONTOURS
RCD-1281 TYPICAL SECTIONS AND DETAILS
RCD-1282 EROSION AND SEDIMENTATION CONTROL PLAN
REFERENCE SPECIFICATION
PPCD-78-5-132 TECHNICAL SPEC. FOR ASH POND ADDITION
WEATHERSPOON DWG № 7030-00010
CAROLINA POWER & LIGHT COMPANY
POWER PLANT CONSTRUCTION DEPT. RALEIGH, N.C.
WEATHERSPOON STEAM ELECTRIC PLANT
ASH POND AREA PLAN
'AS-BUILT'
NO. DATE REVISION BY CH APPROVED
SCALE 1"=60'
UNIT CE
DR. GRJ
APPROVED
DATE 12-1-78
DWG. NO. RCD-1280
7030-00010
RCD-1280

EXHIBIT 6

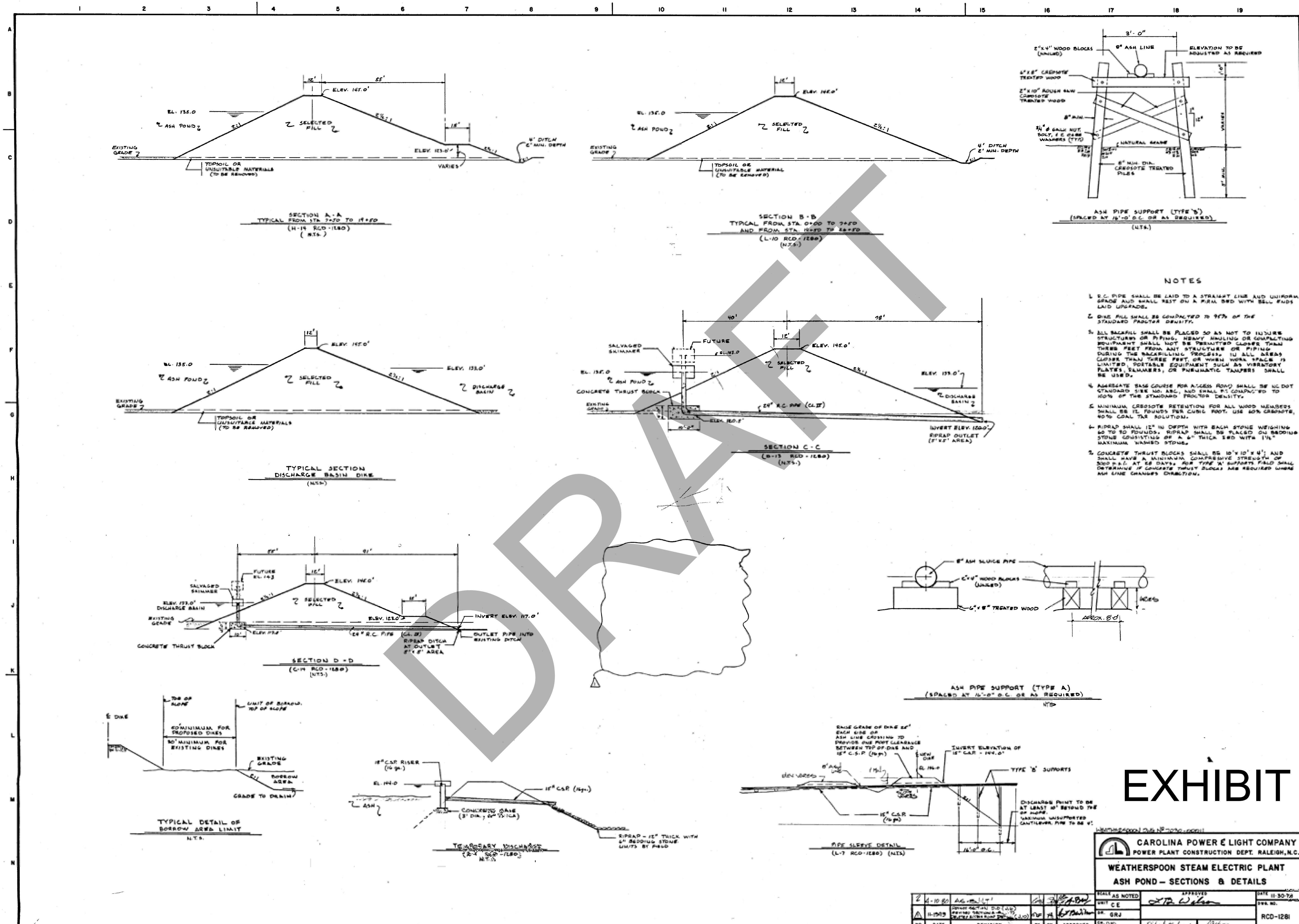

SECTION A - A
TYPICAL FROM STA. 7+50 TO 19+50
(H-19 RCD-1280)
(N.T.S.)
SECTION B - B
TYPICAL FROM STA. 0+00 TO 7+50
AND FROM STA. 19+50 TO 26+50
(L-10 RCD-1280)
(N.T.S.)
ASH PIPE SUPPORT (TYPE 'B')
(SPACED AT 16'-0" O.C. OR AS REQUIRED)
(N.T.S.)
TYPICAL SECTION
DISCHARGE BASIN DIKE
(N.T.S.)
SECTION C - C
(B-13 RCD-1280)
(N.T.S.)
SECTION D - D
(C-14 RCD-1280)
(N.T.S.)
ASH PIPE SUPPORT (TYPE A)
(SPACED AT 16'-0" O.C. OR AS REQUIRED)
N.T.S.
TYPICAL DETAIL OF
BORROW AREA LIMIT
N.T.S.
PIPE SLEEVE DETAIL
(L-7 RCD-1280) (N.T.S.)
NOTES
1. R.C. PIPE SHALL BE LAID TO A STRAIGHT LINE AND UNIFORM GRADE AND SHALL REST ON A FIRM BED WITH BELL ENDS LAID UPGRADE.
2. DIKE FILL SHALL BE COMPACTED TO 95% OF THE STANDARD PROCTOR DENSITY.
3. ALL BACKFILL SHALL BE PLACED SO AS NOT TO INJURE STRUCTURES OR PIPING. HEAVY HAULING OR COMPACTING EQUIPMENT SHALL NOT BE PERMITTED CLOSER THAN THREE FEET FROM ANY STRUCTURE OR PIPING DURING THE BACKFILLING PROCESS. IN ALL AREAS CLOSER THAN THREE FEET, OR WHEN WORK SPACE IS LIMITED, PORTABLE EQUIPMENT SUCH AS VIBRATORY PLATES, RAMMERS, OR PNEUMATIC TAMPERS SHALL BE USED.
4. AGGREGATE BASE COURSE FOR ACCESS ROAD SHALL BE NC DOT STANDARD SIZE NO. ABC, AND SHALL BE COMPACTED TO 100% OF THE STANDARD PROCTOR DENSITY.
5. MINIMUM CREOSOTE RETENTION FOR ALL WOOD MEMBERS SHALL BE 12 POUNDS PER CUBIC FOOT. USE 60% CREOSOTE, 40% COAL TAR SOLUTION.
6. RIPRAP SHALL 12" IN DEPTH WITH EACH STONE WEIGHING 60 TO 90 POUNDS. RIPRAP SHALL BE PLACED ON BEDDING STONE CONSISTING OF A 6" THICK BED WITH 1½" MAXIMUM WASHED STONE.
7. CONCRETE THRUST BLOCKS SHALL BE 10'x10'x4'; AND SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 P.S.I. AT 28 DAYS. FOR TYPE 'A' SUPPORTS FIELD SHALL DETERMINE IF CONCRETE THRUST BLOCKS ARE REQUIRED WHERE ASH LINE CHANGES DIRECTION.
CAROLINA POWER & LIGHT COMPANY
POWER PLANT CONSTRUCTION DEPT. RALEIGH, N.C.
WEATHERSPOON STEAM ELECTRIC PLANT
ASH POND – SECTIONS & DETAILS
SCALE AS NOTED
UNIT CE
DR. GRJ
CH. DJD
DATE 11-30-78
DWG. NO. RCD-1281
RCD-1281
7030-000 11



EXHIBIT 7

# APPENDIX A

**Boring Logs-Current Study**

## SOIL CLASSIFICATION

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

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

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

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

U.S. STANDARD SIEVE SIZE

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

## NON-SOIL CLASSIFICATION

| | |
|---|---|
| Undisturbed Sample | Auger Cuttings |
| Split Spoon Sample | Bulk Sample |
| Rock Core | Crandall Sampler |
| Dilatometer | Pressure Meter |
| Packer | No Recovery |
| Water Table at time of drilling | Water Table after 24 hours |
| Grab Bag Sample | Caved-in Depth |

Correlation of Penetration Resistance with Relative Density and Consistency

| SAND & GRAVEL | | SILT & CLAY | |
|---|---|---|---|
| No. of Blows | Relative Density | No. of Blows | Consistency |
| < 4 | Very Loose | < 2 | Very Soft |
| 4 - 10 | Loose | 2 - 4 | Soft |
| 10 - 30 | Medium Dense | 4 - 8 | Medium Stiff |
| 30 - 50 | Dense | 8 - 15 | Stiff |
| > 50 | Very dense | 15 - 30 | Very Stiff |
| | | > 30 | Hard |

**Sample Moisture Description**

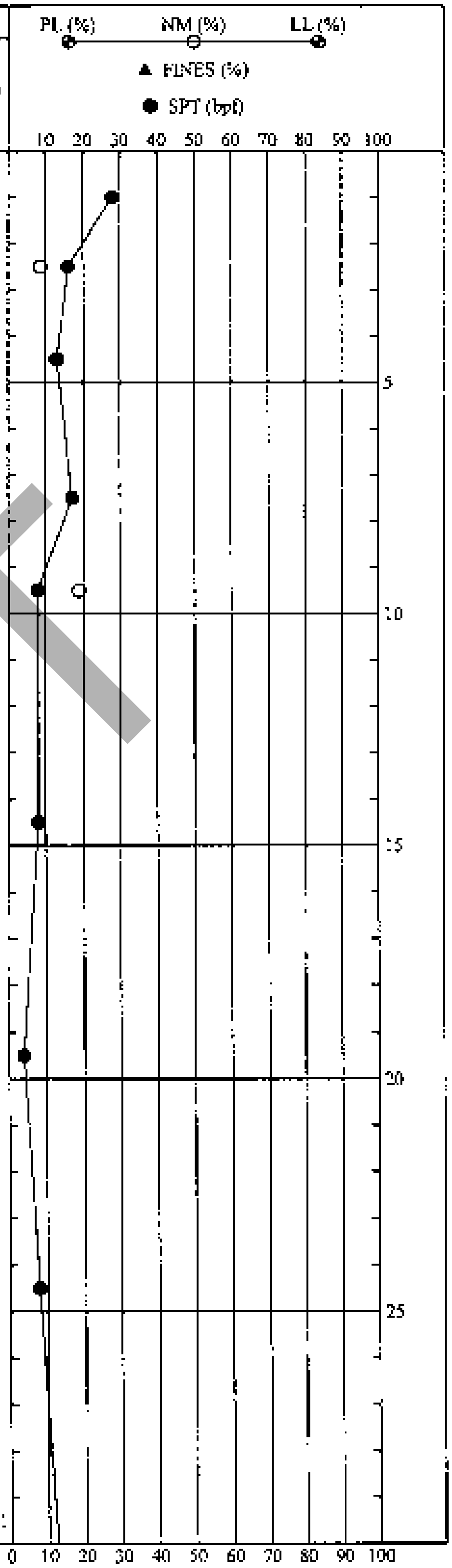
Saturated: Usually liquid; very wet, usually from below the groundwater table
Wet: Semisolid; required drying to attain optimum moisture
Moist: Solid; at or near optimum moisture
Dry: Requires additional water to attain optimum moisture

KEY TO
SYMBOLS AND DESCRIPTIONS

MACTEC

# SOIL TEST BORING RECORD

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Fill-Medium dense, dry, light brown, silty fine SAND (SM) | 146.2 | SS-1 | 11-13-15 |
| | | | SS-2 | 7-8-8 |
| | Fill-Medium dense, damp, brown and light gray, slightly silty fine to medium SAND, trace root material (SP-SM) | | SS-3 | 5-5-8 |
| 5 | | 141.2 | | |
| | | | SS-4 | 8-8-9 |
| | Possible original ground-Loose, moist, brown and light gray, silty fine SAND (SM) | | SS-5 | 5-4-4 |
| 10 | | 136.2 | | |
| | | | SS-6 | 4-4-4 |
| 15 | | 131.2 | | |
| | | | SS-7 | 3-2-2 |
| 20 | Loose wet, light green gray, fine to medium SAND (SP) | 126.2 | | |
| | Loose, wet, light green and gray, fine to medium SAND (SP) | | SS-8 | 4-4-4 |
| 25 | | 121.2 | | |
| | Very soft, wet, dark gray, slightly fine sandy CLAY (CL/CH) | | SS-9 | WOH-WOH-1 |
| 30 | | 116.2 | | |




STD NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 40 ft. Hole backfilled with bentonite to 18.5 ft. Installed a 1-inch PVC casing with hand cut slots between 10.5 and 18.5 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 0.8 |

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

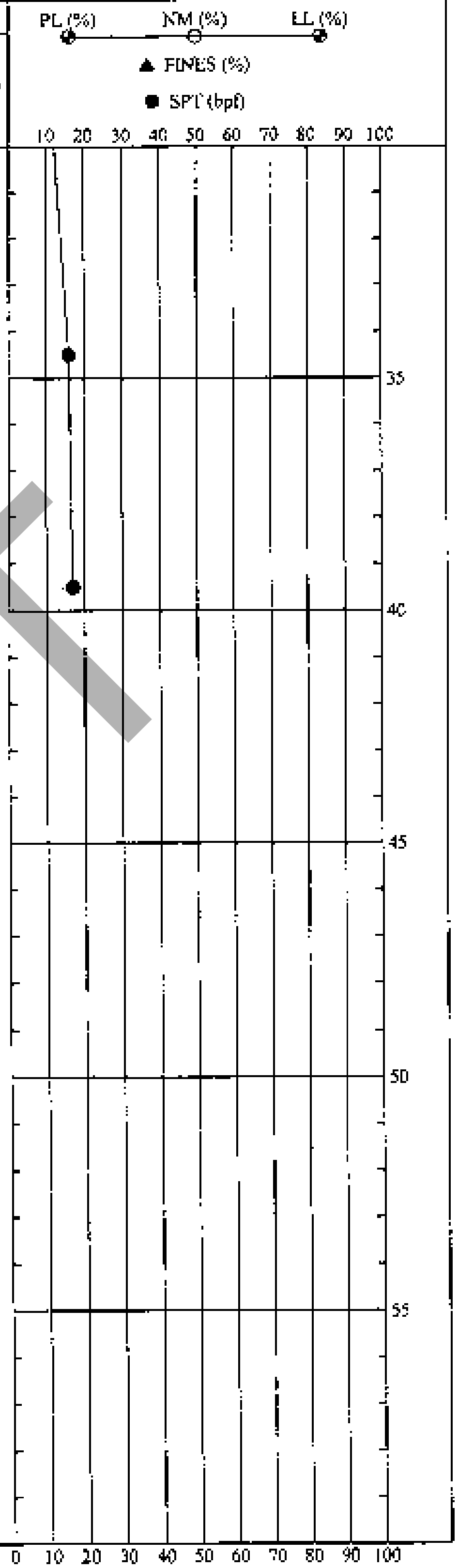
**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-1
**Location:** Lumberton, North Carolina
**Drilled:** June 15, 2010
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS<br>SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|---|
| 30 | Very soft, wet, dark gray, slightly fine sandy CLAY (CL/CH) | 116.2 | | | |
| | Medium dense, wet, gray, fine SAND with broken shell fragments, trace silt (SP) | | SS-10 | | 9-8-8 |
| 35 | | 111.2 | | | |
| | | | SS-11 | | 11-9-8 |
| 40 | Boring terminated at 40 feet. | 106.2 | | | |
| 45 | | 101.2 | | | |
| 50 | | 96.2 | | | |
| 55 | | 91.2 | | | |
| 60 | | 86.2 | | | |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 40 ft. Hole backfilled with bentonite to 18.5 ft. Installed a 1-inch PVC casing with hand cut slots between 10.5 and 18.5 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 0.8

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

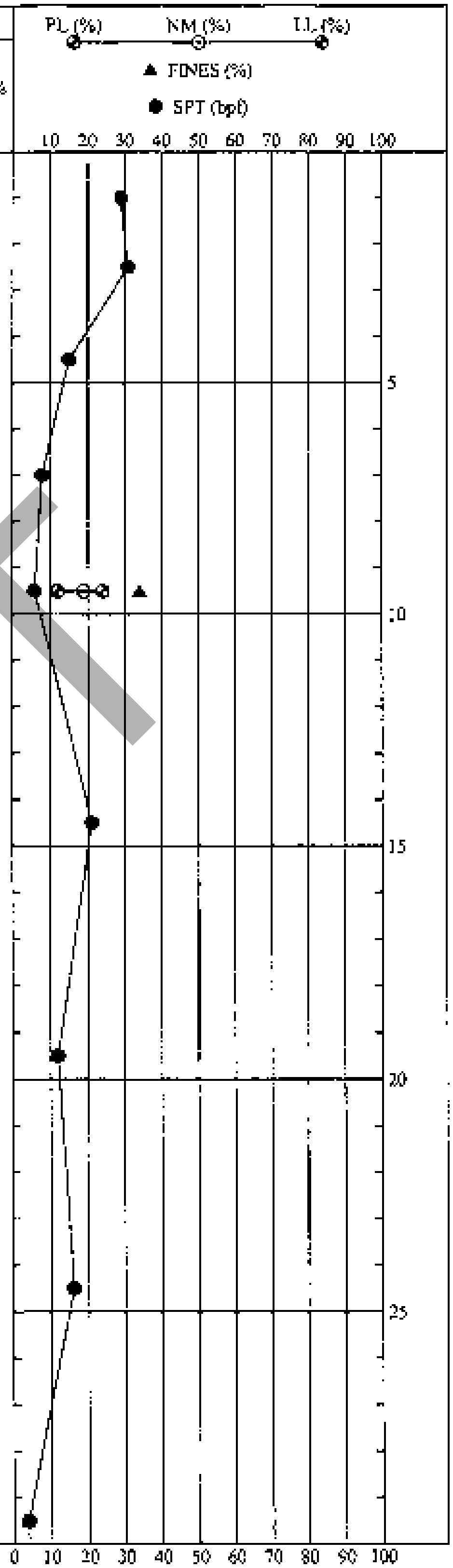
**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-1
**Location:** Lumberton, North Carolina
**Drilled:** June 15, 2010
**Project #:** 6468-10-0111


MACTEC

# SOIL CLASSIFICATION AND REMARKS

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

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) | SAMPLE IDENT | N-COUNT or Rec%/RQD% (1st 6" - 2nd 6" - 3rd 6") |
|---|---|---|---|---|
| 0 | Organic laden TOPSOIL | 145.0 | | |
| | Fill-Medium dense, dry, silty fine SAND (SM) | | SS-1 | 11-11-18 |
| | Fill-Dense to loose, dry, gold and brown, fine SAND (SP) | | SS-2 | 11-15-16 |
| | | | SS-3 | 10-7-8 |
| 5 | | 140.0 | | |
| | | | SS-4 | 3-4-4 |
| | Fill-Medium stiff, moist, yellowish brown, clayey SAND (SC) Undisturbed sample taken in an adjacent location between 8 and 10 feet. UD-1: silty SAND, LL: 19, PL: 15, PI: 3, %<#200 = 21.2 | | SS-5 | 2-2-4 |
| 10 | ▼ | 135.0 | | |
| | Possible original ground-Medium dense to loose, moist to wet, tan and brown, fine SAND (SP) | | | |
| | | | SS-6 | 11-9-12 |
| 15 | | 130.0 | | |
| | | | SS-7 | 5-6-6 |
| 20 | Medium dense, wet, dark brown to brown, slightly silty fine SAND (SP-SM), trace organic cementing | 125.0 | | |
| | | | SS-8 | 5-7-9 |
| 25 | | 120.0 | | |
| | Loose, wet, light tan to white, fine to medium SAND (SP) | | | |
| | | | SS-9 | 2-2-2 |
| 30 | | 115.0 | | |






STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 45 ft. Hole backfilled with bentonite sealed to 15.9 ft. installed a 1-inch PVC casing with hand cut slots between 7.9 and 15.9 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 2.2 |

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** NB-3

**Location:** Lumberton, North Carolina

**Drilled:** June 15, 2010

**Project #:** 6468-10-0111



MACTEC

# SOIL CLASSIFICATION AND REMARKS

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

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) | SAMPLE IDENT | N-COUNT (1st 6" - 2nd 6" - 3rd 6") |
|---|---|---|---|---|
| 30 | Loose, wet, light tan to white, fine to medium SAND (SP) | 115.0 | | |
| 34.5 | | | SS-10 | 1-2-3 |
| 35 | | 110.0 | | |
| 36 | Loose to very loose, wet, clayey fine to medium SAND (SC) | | | |
| 39.5 | | | SS-11 | 3-4-3 |
| 40 | | 105.0 | | |
| 44.5 | | | SS-12 | 1-1-1 |
| 45 | Boring terminated at 45 feet. | 100.0 | | |
| 50 | | 95.0 | | |
| 55 | | 90.0 | | |
| 60 | | 85.0 | | |

SAMPLES: IDENT, TYPE, N-COUNT or Rec%/RQD% (1st 6", 2nd 6", 3rd 6", 4th 6")

PL (%) — NM (%) — LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/26/10

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 45 ft. Hole backfilled with bentonite sealed to 15.9 ft. Installed a 1-inch PVC casing with hand cut slots between 7.9 and 15.9 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 2.2

REVIEWED BY: ____

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-3
**Location:** Lumberton, North Carolina
**Drilled:** June 15, 2010
**Project #:** 6468-10-0111



MACTEC

# SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-4
**Location:** Lumberton, North Carolina
**Drilled:** June 15, 2010
**Project #:** 6468-10-0111
**Page 1 of 2**

SOIL CLASSIFICATION AND REMARKS — SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) |
|---|---|---|
| 0 | Organic laden TOPSOIL | 145.9 |
| | Fill-Medium dense to loose, dry, light brown, silty fine to medium SAND (SM) | |
| | Fill-Loose, dry, white, light gray, brown and yellowish brown, fine to medium SAND (SP) | |
| 5 | | 140.9 |
| | Fill-Medium dense, moist, brown, very clayey fine to medium SAND (SC), trace root hairs<br>Undisturbed sample taken from adjacent location between 8 and 10 feet. UD-1: silty clayey SAND (SC-SM). LL: 20, PL: 14, PI: 6, %<#200: 29.5 | |
| 10 | | 135.9 |
| | Possible original ground-Loose, moist, gray, silty fine to medium SAND (SM) | |
| 15 | | 130.9 |
| | Very loose, wet, brown, fine to medium SAND (SP) | |
| 20 | | 125.9 |
| 25 | | 120.9 |
| | Very loose, wet, gray to dark gray, slightly silty fine to medium SAND (SP-SM) | |
| 30 | | 115.9 |

SAMPLES

| IDENT | N-COUNT or Rec%/RQD% (1st 6"-2nd 6"-3rd 6") |
|---|---|
| SS-1 | 7-7-7 |
| SS-2 | 6-3-5 |
| SS-3 | 3-2-3 |
| SS-4 | 3-2-2 |
| SS-5 | 5-5-8 |
| SS-6 | 9-3-3 |
| SS-7 | 1-1-2 |
| SS-8 | 1-1-1 |
| SS-9 | 1-1-1 |

PL (%) — NM (%) — LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

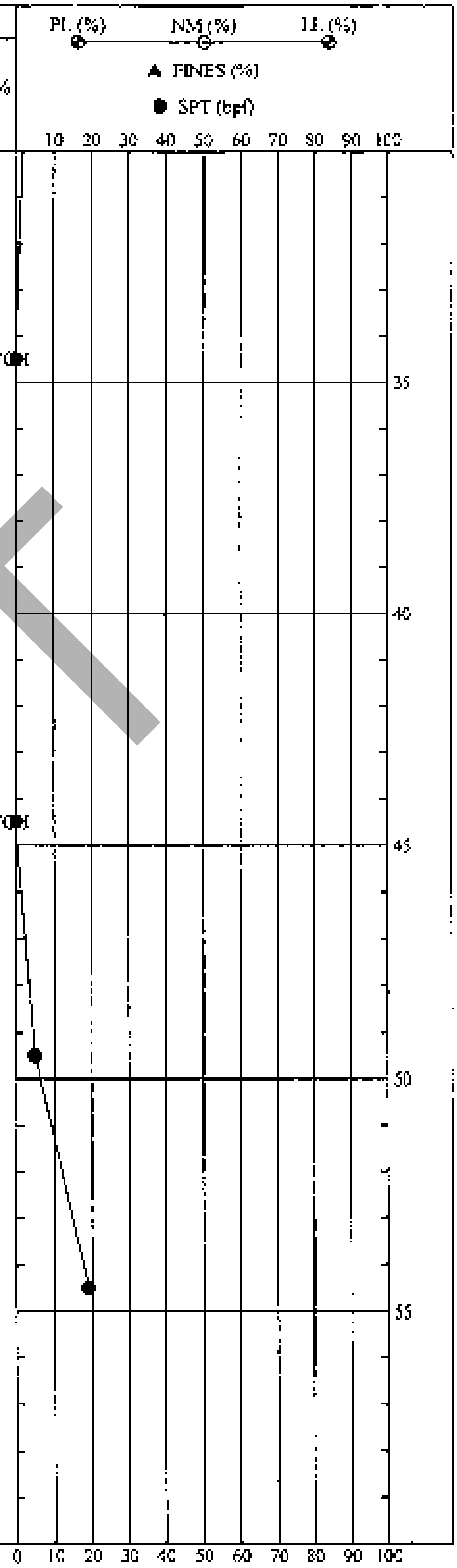
| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 55 ft. Hole backfilled with bentonite sealed to 18.1 ft. Installed a 1-inch casing with hand cut slots between 10.1 and 18.1 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 1.9 |

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | LEGEND | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" 2nd 6" 3rd 6" 4th 6") |
|---|---|---|---|---|---|---|
| 30 | Very loose, wet, gray to dark gray, slightly silty fine to medium SAND (SP-SM) | | 115.9 | | | |
| 35 | | | 110.9 | SS-10 | | WOH-WOH-WOH |
| | Very loose to loose, wet, dark gray, clayey fine to medium SAND (SC), increasing clay content with depth | | | | | |
| 40 | | | 105.9 | SS-11 | | 1-WOH-1 |
| 45 | | | 100.9 | SS-12 | | WOH-WOH-WOH |
| 50 | | | 95.9 | SS-13 | | 1-2-3 |
| | Medium dense, wet, dark gray, fine to coarse clayey SAND (SC) with seams of sandy clay or clay with suspended sand grains | | | | | |
| 55 | Boring terminate at 55 feet | | 90.9 | SS-14 | | 4-7-12 |
| 60 | | | 85.9 | | | |






DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 55 ft. Hole backfilled with bentonite sealed to 18.1 ft. Installed a 1-inch casing with hand cut slots between 10.1 and 18.1 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 1.9

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

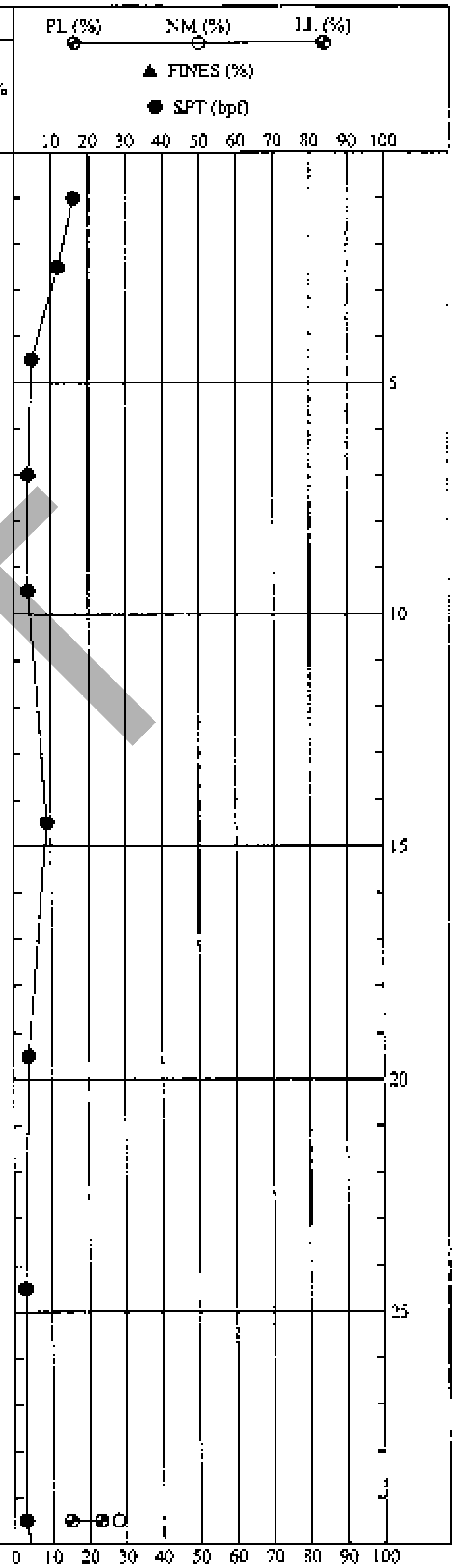
**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-4
**Location:** Lumberton, North Carolina
**Drilled:** June 15, 2010
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Organic Laden TOPSOIL | 145.7 | | |
| | Fill-Medium dense, dry, red and tan, fine to medium SAND (SP) | | SS-1 | 7-8-8 |
| | | | SS-2 | 7-7-5 |
| | Fill-Loose, moist, red and tan, clayey fine to medium SAND (SC) | | SS-3 | 2-2-3 |
| 5 | Fill-Loose, moist, tan, slightly silty fine to medium SAND (SP-SM) | 140.7 | SS-4 | 1-2-2 |
| | Fill-Medium stiff, wet, light brown, fine sandy CLAY (CL) | | SS-5 | 2-2-2 |
| 10 | Fill-Loose, wet, red to tan, slightly silty fine to medium SAND (SP-SM) | 135.7 | SS-6 | 4-5-4 |
| 15 | Estimated original ground | 130.7 | | |
| | Very loose, wet, light tan, fine SAND (SP) | | | |
| | Lost drilling fluid at 18 feet. | | SS-7 | 2-1-3 |
| 20 | Very loose, wet, orange brown, clayey SAND (SC) | 125.7 | SS-8 | 2-1-2 |
| 25 | Very loose, wet, dark gray, clayey fine to medium SAND (SC) | 120.7 | SS-9 | 1-1-2 |
| 30 | | 115.7 | | |




| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 40 ft. Hole backfilled with bentonite sealed to 18.8 ft. Installed a 1-inch PVC casing with hand cut slots between 10.8 and 18.8 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup 1.8 feet. |

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** NB-5

**Location:** Lumberton, North Carolina

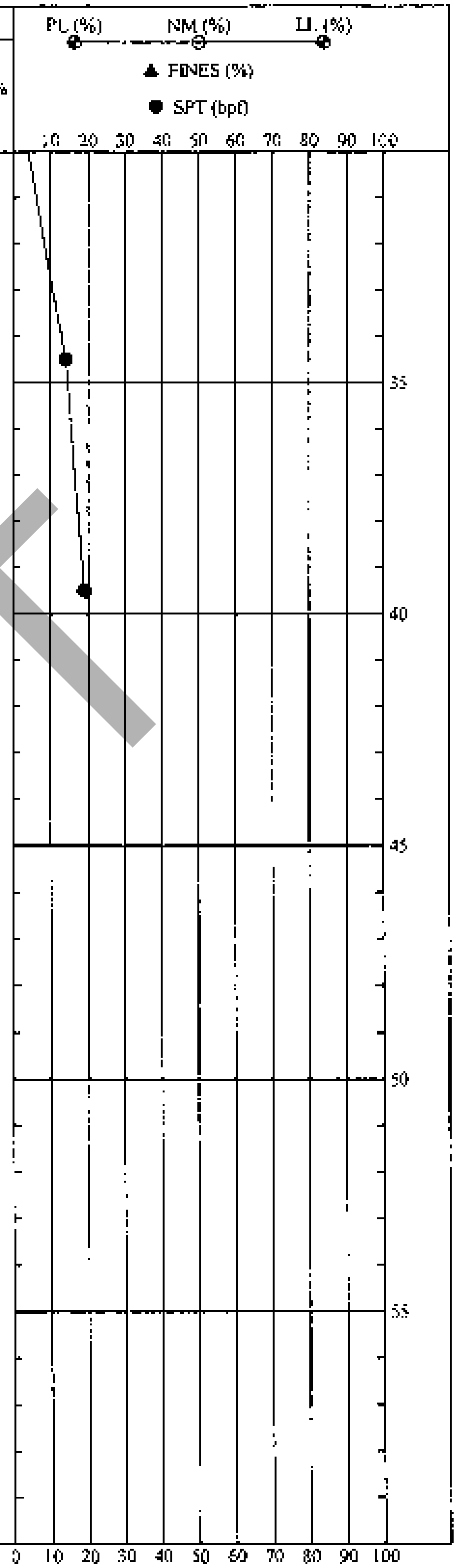
**Drilled:** June 15, 2010

**Project #:** 6468-10-0111

**Page 1 of 2**

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|---|
| 30 | Very loose, wet, dark gray, clayey fine to medium SAND (SC) | 115.7 | | | |
| | Medium dense, wet, gray, fine to medium SAND (SP) with broken shell fragments/shell hash | | SS-10 | | 4-6-8 |
| 35 | | 110.7 | | | |
| | | | SS-11 | | 11-9-10 |
| 40 | Boring terminated at 40 feet. | 105.7 | | | |
| 45 | | 100.7 | | | |
| 50 | | 95.7 | | | |
| 55 | | 90.7 | | | |
| 60 | | 85.7 | | | |




DRAFT

STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

| | |
|---|---|
| DRILLER: | G. Bridger-Caroline Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 40 ft. Hole backfilled with bentonite sealed to 18.8 ft. Installed a 1-inch PVC casing with hand cut slots between 10.8 and 18.8 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup 1.8 feet. |

REVIEWED BY: [signature]

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## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** NB-5

**Location:** Lumberton, North Carolina

**Drilled:** June 15, 2010

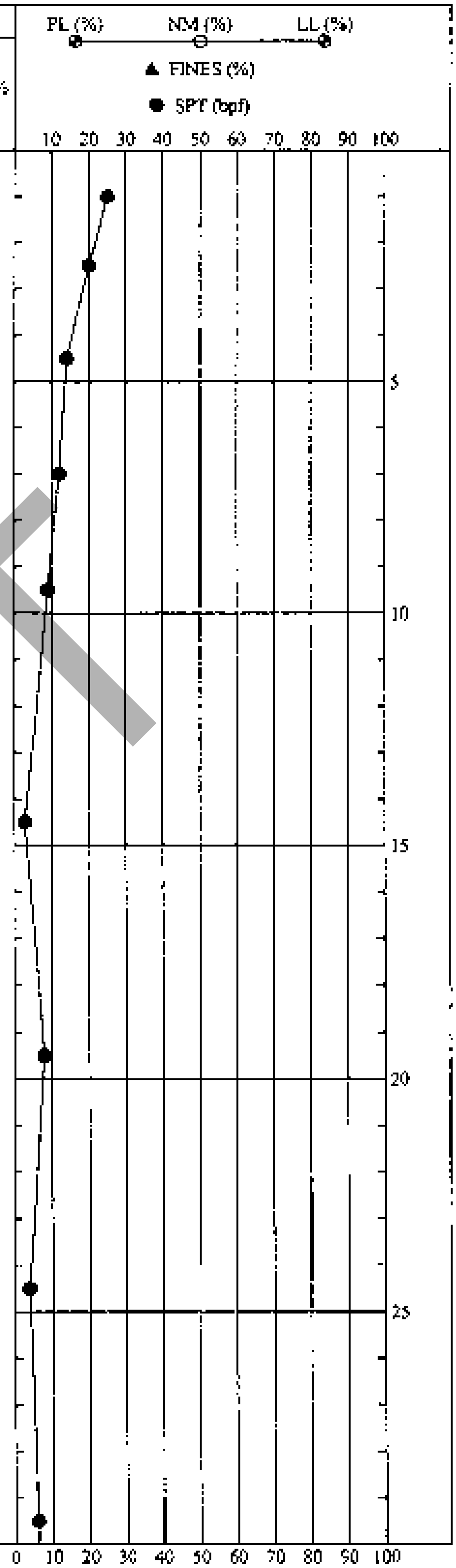
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) |
|---|---|---|
| 0 | Fill-Organic laden TOPSOIL | 145.1 |
| | Fill-Medium dense, dry, red brown, slightly clayey fine to medium SAND (SP-SC) | |
| | Fill-Medium dense to loose, damp, light brown and light tan, slightly silty fine to medium SAND (SP-SM) | |
| 5 | | 140.1 |
| 10 | | 135.1 |
| | Fill-Very loose, moist, light tan with trace red mottles, clayey fine SAND (SC), trace limonite nodules<br>Undisturbed sample taken from adjacent location between 13 and 15 feet. UD-1: silty clayey SAND (SC-SM), LL: 20, PL: 14, PI: 6, %<#200: 21.6 | |
| 15 | | 130.1 |
| | Possible original ground-Loose, wet, light gray and tan, slightly silty fine to medium SAND (SP) | |
| 20 | | 125.1 |
| | Medium stiff, wet, varved tan, silty fine SAND and light gray CLAY (CH) | |
| 25 | | 120.1 |
| | Loose, wet, tan, fine to coarse SAND with broken shell (SP), shell hash | |
| 30 | | 115.1 |

| SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6", 2nd 6", 3rd 6", 4th 6") |
|---|---|
| SS-1 | 7-12-13 |
| SS-2 | 9-10-10 |
| SS-3 | 7-7-7 |
| SS-4 | 6-6-6 |
| SS-5 | 4-4-5 |
| SS-6 | 2-1-2 |
| SS-7 | 4-4-4 |
| SS-8 | 1-2-2 |
| SS-9 | 3-3-3 |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 40 ft. Hole backfilled and bentonite sealed to 18.1 ft. Installed a 1-inch PVC casing with hand cut slots between 10.1 and 18.1 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 1.8 ft.

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** NB-6

**Location:** Lumberton, North Carolina

**Drilled:** June 16, 2010

**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6", 2nd 6", 3rd 6", 4th 6") |
|---|---|---|---|---|---|
| 30 | Loose, wet, tan, fine to coarse SAND with broken shell (SP), shell hash | 115.1 | | | |
| | | | SS-10 | | 4-3-4 |
| 35 | Loose, wet, brown, SHELL HASH and marine fossils | 110.1 | | | |
| | | | SS-11 | | 4-4-5 |
| 40 | Boring terminated at 40 feet. | 105.1 | | | |
| 45 | | 100.1 | | | |
| 50 | | 95.1 | | | |
| 55 | | 90.1 | | | |
| 60 | | 85.1 | | | |

PL (%) — NM (%) — LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Boring terminated at 40 ft. Hole backfilled and bentonite sealed to 18.1 ft. Installed a 1-inch PVC casing with hand cut slots between 10.1 and 18.1 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 1.8 ft. |

REVIEWED BY: ________

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** NB-6

**Location:** Lumberton, North Carolina

**Drilled:** June 16, 2010

**Project #:** 6468-10-0111

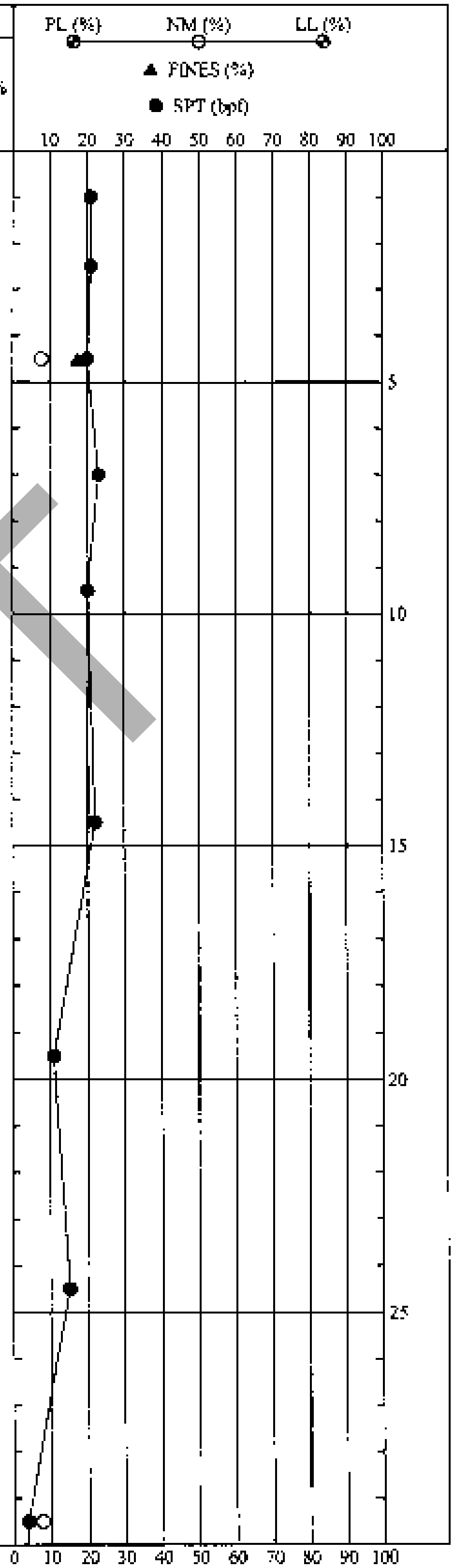


MACTEC

# SOIL TEST BORING RECORD

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) |
|---|---|---|
| 0 | Organic laden TOPSOIL | 144.7 |
| | Fill-Medium dense, dry, brown, slightly silty fine SAND (SP-SM) | |
| | Fill-Medium dense, damp, brown, silty fine to medium SAND (SM) | |
| 5 | | 139.7 |
| | Fill-Medium dense, moist, brown, slightly silty fine SAND (SP-SM) | |
| 10 | | 134.7 |
| | Possible Fill-Medium dense, moist, brown with red mottles, slightly clayey, silty fine SAND (SP-SM), trace root fragments | |
| 15 | | 129.7 |
| | Estimated original ground | |
| | Medium dense, wet, brown, fine to coarse SAND with thin sandy CLAY seams (SC), root hairs | |
| 20 | | 124.7 |
| | Medium dense, wet, very light gray, fine to medium SAND (SP) | |
| 25 | | 119.7 |
| | Loose to very loose, wet, orange to brown, clayey SHELL HASH (SC) | |
| 30 | | 114.7 |

| SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|
| SS-1 | 4-9-12 |
| SS-2 | 9-10-11 |
| SS-3 | 7-10-10 |
| SS-4 | 7-10-13 |
| SS-5 | 8-8-12 |
| SS-6 | 9-10-12 |
| SS-7 | 1-1-10 |
| SS-8 | 6-7-8 |
| SS-9 | 1-2-2 |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 37 ft. Hole backfilled and bentonite sealed to 19 ft. Installed a 1-inch PVC casing with hand cut slots between 11 ft and 19 ft. Backfilled with filter sand and place bentonite, 0-2'. PVC stickup above ground is 1.0 ft.

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-7
**Location:** Lumberton, North Carolina
**Drilled:** June 16, 2010
**Project #:** 6468-10-0111
**Page 1 of 2**

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | IDENT | N-COUNT or Rec%/RQD% |
|---|---|---|---|---|
| 30 | Loose to very loose, wet, orange to brown, clayey SHELL HASH (SC) | 114.7 | | |
| | | | SS-10 | woh-woh-woh |
| 35 | | 109.7 | | |
| 37 | Boring terminated at 37 feet. | | | |
| 40 | | 104.7 | | |
| 45 | | 99.7 | | |
| 50 | | 94.7 | | |
| 55 | | 89.7 | | |
| 60 | | 84.7 | | |

PL (%) — NM (%) — LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 37 ft. Hole backfilled and bentonite sealed to 19 ft. Installed a 1-inch PVC casing with hand cut slots between 11 ft and 19 ft. Backfilled with filter sand and place bentonite, 0-2'. PVC stickup above ground is 1.0 ft.

REVIEWED BY: __________

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

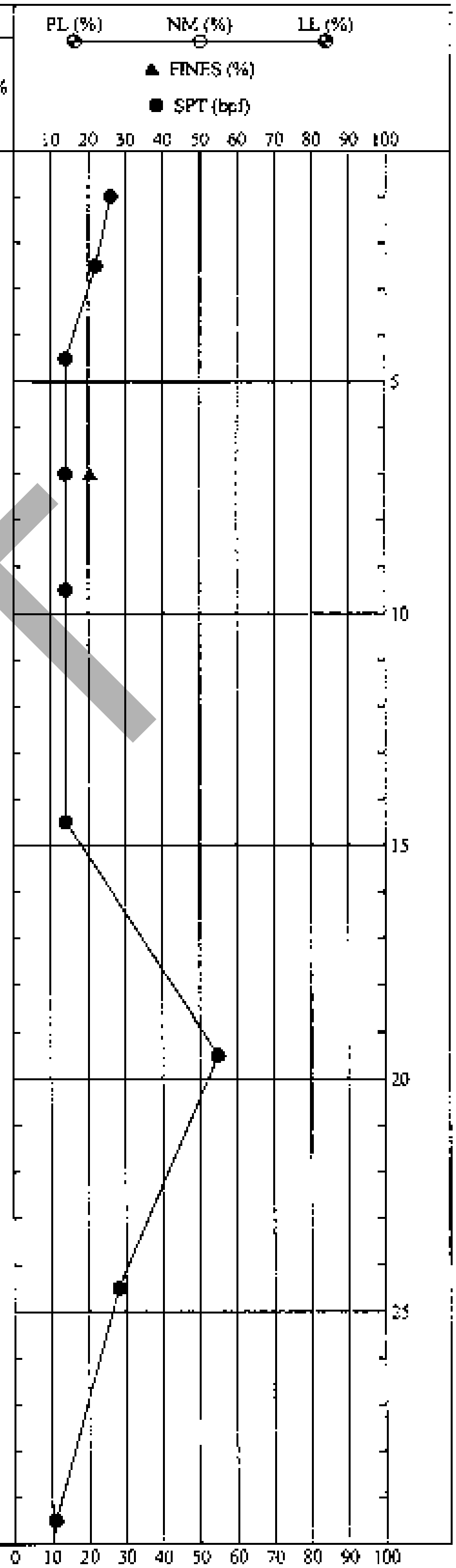
## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-7
**Location:** Lumberton, North Carolina
**Drilled:** June 16, 2010
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS<br>SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" 2nd 6" 3rd 6" 4th 6") |
|---|---|---|---|---|
| 0 | Organic laden sandy TOPSOIL with rootlets | 144.8 | | |
| | Fill-Medium dense, dry, brown, silty fine SAND (SM) | | SS-1 | 6-11-15 |
| | Fill-Medium dense, damp, brown, silty fine to medium SAND (SM) | | SS-2 | 15-10-12 |
| | Fill-Medium dense, moist, light brown and light gray, fine SAND (SP), trace silt | | SS-3 | 9-7-7 |
| 5 | | 139.8 | | |
| | Fill-Medium dense, moist, brown and gray, clayey fine to medium SAND (SC) | | SS-4 | 5-6-8 |
| | | | SS-5 | 6-6-8 |
| 10 | | 134.8 | | |
| | Fill-Medium dense, wet, brown to dark brown, silty fine to medium SAND (SM) | | | |
| | Possible Fill-Medium dense, wet, dark brown to black, silty fine to medium SAND (SM) | | SS-6 | 4-5-9 |
| 15 | | 129.8 | | |
| | Estimated original ground | | | |
| | Very dense to medium dense, wet, light gray, slighty silty fine to medium SAND (SP-SM), trace silt lenses | | SS-7 | 10-20-35 |
| 20 | | 124.8 | | |
| | | | SS-8 | 20-16-12 |
| 25 | | 119.8 | | |
| | | | SS-9 | 5-6-5 |
| 30 | | 114.8 | | |






DRILLER: G. Bridger-Caroline Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 35 ft. Hole backfilled and bentonite sealed to 18.4 ft. Installed a 1-inch PVC casing with hand cut slots between 10.4 and 18.4 ft. Backfilled with filter sand and placed bentonite, 0-2'. PVC stickup above ground is 1.6 feet.

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-8
**Location:** Lumberton, North Carolina
**Drilled:** June 16, 2010
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS<br>SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. | LEGEND | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% 1st 6" 2nd 6" 3rd 6" 4th 6" |
|---|---|---|---|---|---|---|
| 30 | Very dense to medium dense, wet, light gray, slightly silty fine to medium SAND (SP-SM), trace silt lenses | | 114.8 | | | |
| | Loose, wet, light gray and yellow, slightly clayey fine SAND (SP-SC) | | | SS-10 | | 5-2-2 |
| 35 | Boring terminated at 35 feet. | | 109.8 | | | |
| 40 | | | 104.8 | | | |
| 45 | | | 99.8 | | | |
| 50 | | | 94.8 | | | |
| 55 | | | 89.8 | | | |
| 60 | | | 84.8 | | | |

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

STD-NO STATION WEATHERSPOON.GPJ MACTEC GLO.GDT 8/28/10

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Boring terminated at 35 ft. Hole backfilled and bentonite sealed to 18.4 ft. Installed a 1-inch PVC casing with hand cut slots between 10.4 and 18.4 ft. Backfilled with filter sand and placed bentonite, 0-3'. PVC stickup above ground is 1.6 feet.

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** NB-8
**Location:** Lumberton, North Carolina
**Drilled:** June 16, 2010
**Project #:** 6468-10-0111

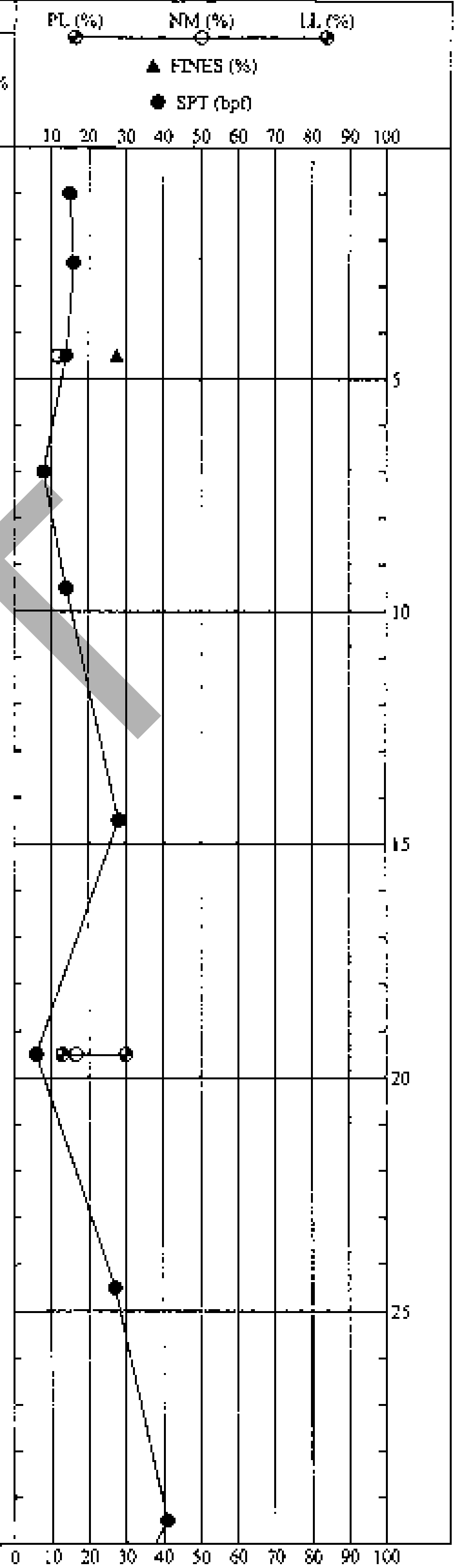

MACTEC

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-1
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111
**Page 1 of 2**

SOIL CLASSIFICATION AND REMARKS — SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) | SAMPLE IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Organic laden sandy TOPSOIL with rootlets | 143.2 | | |
| | Fill-Medium dense, dry, brown, silty fine SAND (SM) | | SS-1 | 12-8-7 |
| | Fill-Medium dense, moist, orange and brown, fine to medium SAND (SP), trace silt | | SS-2 | 8-8-8 |
| | Fill-Medium dense, moist, gray and tan, clayey fine SAND (SC) layering with thin black seams (possibly ash) | | SS-3 | 5-6-8 |
| 5 | | 138.2 | | |
| | Fill-Loose, moist, gray and brown, fine to medium SAND (SP), trace clay | | SS-4 | 5-4-4 |
| | Fill-Medium dense, moist, gray and brown, slightly clayey fine to medium SAND (SP-SC) | | SS-5 | 6-6-8 |
| 10 | | 133.2 | | |
| | Fill-Medium dense, wet, light brown, fine to medium SAND (SP), trace clay, trace silt | | SS-6 | 12-11-17 |
| 15 | | 128.2 | | |
| | Fill-Loose, wet, reddish brown, clayey fine to medium SAND (SC/SP-SC) | | SS-7 | 3-3-3 |
| 20 | | 123.2 | | |
| | Estimated original ground | | | |
| | Medium dense, moist, black, slightly silty fine SAND (SP-SM), with trace roots and organics | | SS-8 | 12-12-15 |
| 25 | | 118.2 | | |
| | Medium dense, moist, light gray and tan, slightly silty fine SAND (SP-SM) | | SS-9 | 20-18-23 |
| 30 | | 113.2 | | |



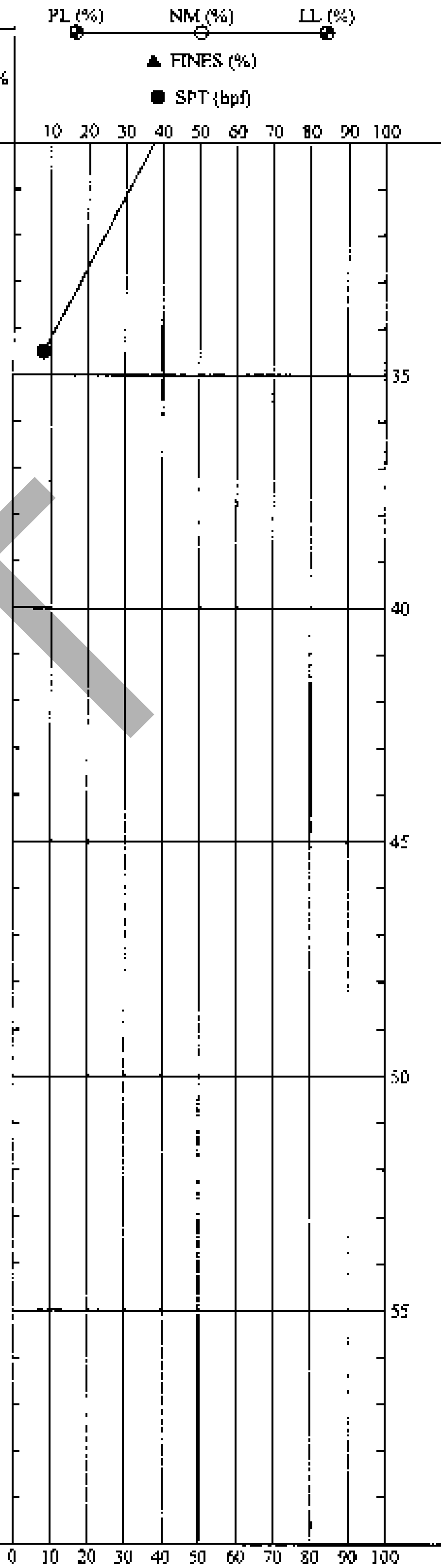

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval: 10 to 18 ft. Filter sand: 10 to 20 ft. Bentonite seal: 8 to 10 ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed.

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS<br>SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. | LEGEND | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" 2nd 6" 3rd 6" 4th 6") |
|---|---|---|---|---|---|---|
| 30 | Medium dense, moist, light gray and tan, slightly silty fine SAND (SP-SM) | | 113.2 | | | |
| | Loose, wet, light gray brown, slightly clayey fine SAND (SP-SC) with shell fragments (shell hash) | | | SS-10 | | 9-5-3 |
| 35 | Boring terminated at 35 feet. | | 108.2 | | | |
| 40 | | | 103.2 | | | |
| 45 | | | 98.2 | | | |
| 50 | | | 93.2 | | | |
| 55 | | | 88.2 | | | |
| 60 | | | 83.2 | | | |




STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed. 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval. 10 to 18 ft. Filter sand. 10 to 20 ft. Bentonite seal: 8 to 10-ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed.

REVIEWED BY: JAB

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-1

**Location:** Lumberton, North Carolina

**Drilled:** June 21, 2010

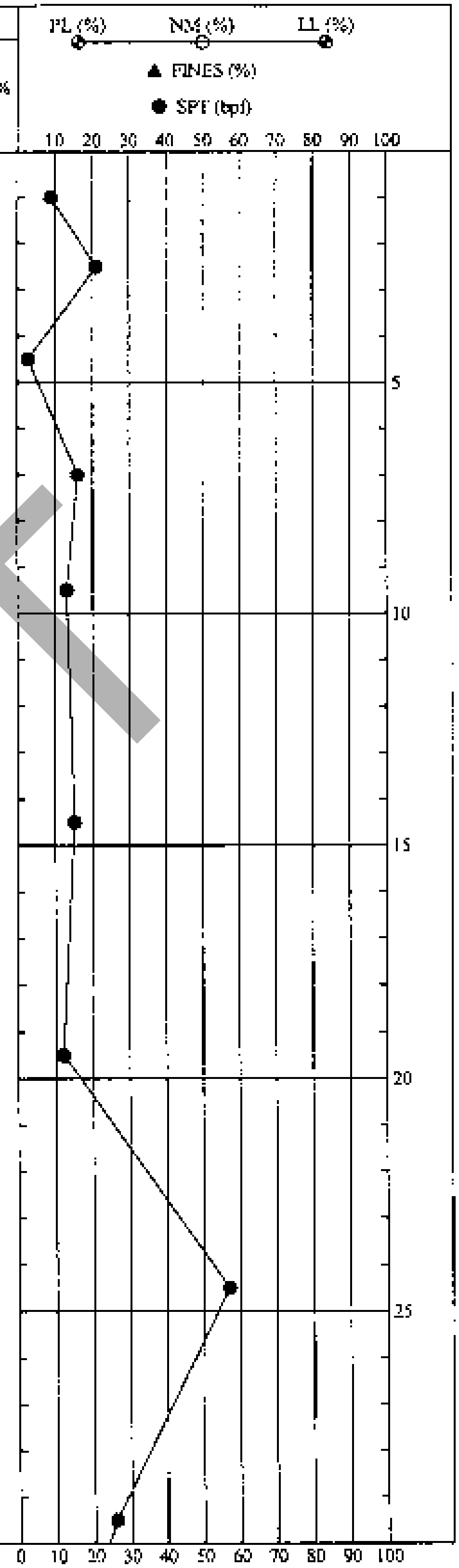
**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) |
|---|---|---|
| 0 | Fill-Crushed Stone/Gravel | 143.1 |
| | Fill-Loose, damp, dark brown, fine SAND (SP), trace silt | |
| | Fill-Medium dense, brown and gray, fine SAND (SP), trace clay, trace roots | |
| | Fill-Loose, moist, brown and gray, clayey fine SAND (SC) Undisturbed sample taken from adjacent location between 3.5 and 5.5 feet. UD: clayey SAND (SC), LL: 24, PL: 12, PI: 12, %<#200: 25.5 | |
| 5 | | 138.1 |
| | Fill-medium dense | |
| | Fill-medium dense, wet, trace root hair | |
| 10 | | 133.1 |
| | Fill-medium dense, wet, thin rootlets | |
| 15 | | 128.1 |
| | Possible Fill-Medium dense, wet, light brown and gray, slightly silty fine to medium SAND (SP-SM) | |
| 20 | | 123.1 |
| | Very dense, wet, light brown, fine to medium SAND (SP) | |
| 25 | | 118.1 |
| | Estimated original ground | |
| | Medium dense, damp, light gray with black mottles, fine SAND (SP) with some fine roots | |
| 30 | | 113.1 |

| SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|
| SS-1 | 5-5-4 |
| SS-2 | 7-9-12 |
| SS-3 | 3-2-1 |
| SS-4 | 5-8-8 |
| SS-5 | 4-7-6 |
| SS-6 | 6-8-7 |
| SS-7 | 2-3-9 |
| SS-8 | 14-27-30 |
| SS-9 | 9-13-13 |




STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/2/10

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3'
REMARKS: Hole collapsed and bentonite sealed: 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval: 10 to 18 ft. Filter sand: 10 to 20 ft. Bentonite seal: 8 to 10-ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed.

REVIEWED BY: ____

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-2
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111



MACTEC

DRAFT

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS<br>SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW. | LEGEND | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6", 2nd 6", 3rd 6", 4th 6") |
|---|---|---|---|---|---|---|
| 30 | Medium dense, damp, light gray with black mottles, fine SAND (SP) with some fine roots | | 113.1 | | | |
| | Medium stiff, wet, light gray, fine sandy CLAY (CH) with fine sand seams seperating clay lenses | | | | | |
| | | | | SS-10 | | 3-2-2 |
| 35 | Boring terminated at 35 feet. | | 108.1 | | | |
| 40 | | | 103.1 | | | |
| 45 | | | 98.1 | | | |
| 50 | | | 93.1 | | | |
| 55 | | | 88.1 | | | |
| 60 | | | 83.1 | | | |

PL (%) — NM (%) — LL (%)
▲ FINES (%)
● SPT (bpf)
0 10 20 30 40 50 60 70 80 90 100

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval: 10 to 18 ft. Filter sand: 10 to 20 ft. Bentonite seal: 8 to 10-ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed.

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-2
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111



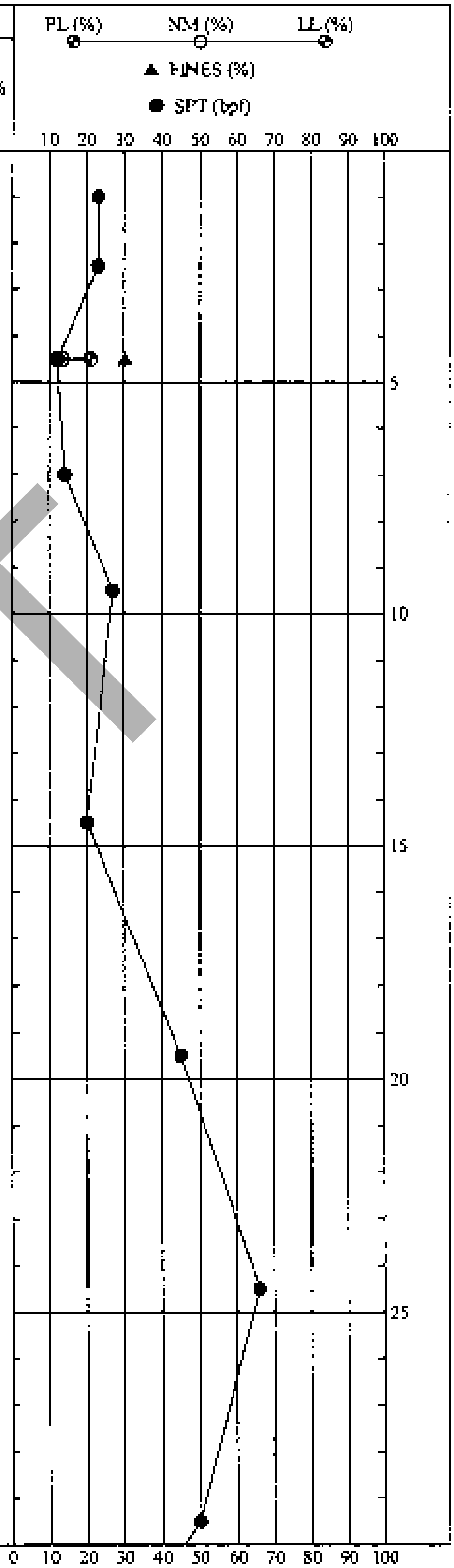
MACTEC



STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/2/10

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) |
|---|---|---|
| 0 | Fill-Crushed stone/ Gravel | 142.0 |
| | Fill-Medium dense, dry to moist, dark brown, silty fine SAND (SM) | |
| | Fill-Medium dense, moist, dark brown, gray brown and gray, clayey fine to medium SAND (SC) | |
| 5 | | 137.0 |
| 10 | | 132.0 |
| 15 | | 127.0 |
| | Estimated original ground | |
| | Dense, moist, gray and brown, slightly silty fine to medium SAND (SP-SM) | |
| 20 | | 122.0 |
| | Very dense, damp, light tan, fine to medium SAND (SP) | |
| 25 | | 117.0 |
| | Dense, moist, light gray, fine SAND (SP), some lightly cemented nodules | |
| 30 | | 112.0 |

| SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|
| SS-1 | 9-10-13 |
| SS-2 | 14-10-13 |
| SS-3 | 5-6-6 |
| SS-4 | 6-6-8 |
| SS-5 | 8-11-16 |
| SS-6 | 5-7-13 |
| SS-7 | 16-19-26 |
| SS-8 | 20-29-37 |
| SS-9 | 17-22-28 |






DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval: 10 to 18 ft. Filter sand: 10 to 20 ft. Bentonite seal: 8 to 10-ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed.

REVIEWED BY:

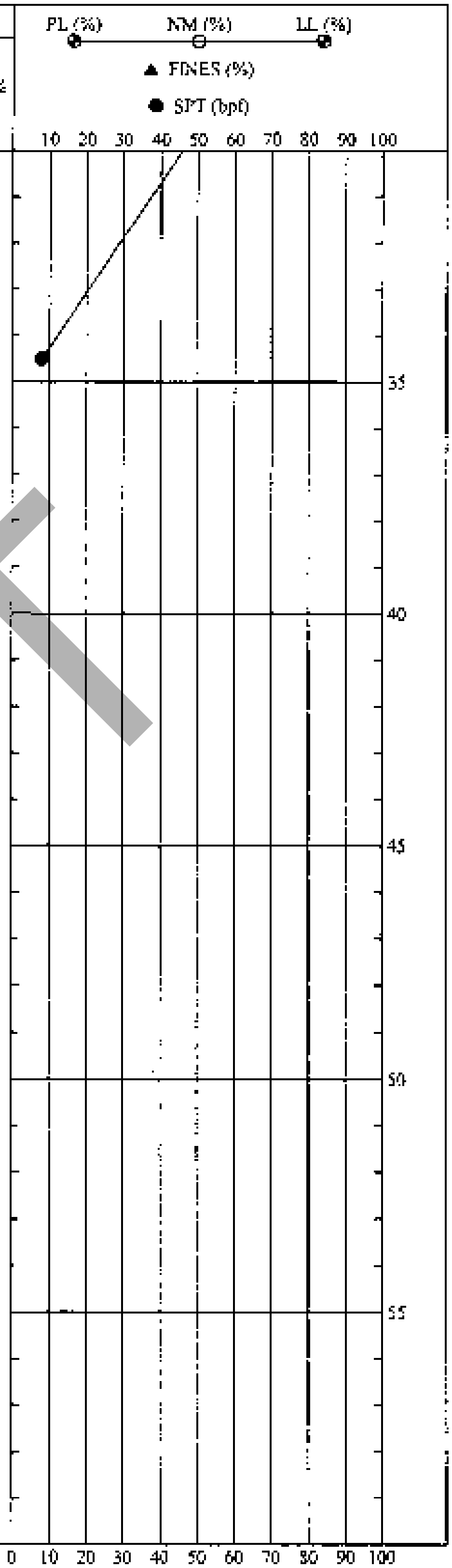
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-3
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111
**Page 1 of 2**

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|---|
| 30 | Dense, moist, light gray, fine SAND (SP), some lightly cemented nodules | 112.0 | | | |
| | Loose, wet, gray, clayey fine to medium SAND (SC) with paper thin clay laminae | | SS-10 | | 4-4-4 |
| 35 | Boring terminated at 35 feet. | 107.0 | | | |
| 40 | | 102.0 | | | |
| 45 | | 97.0 | | | |
| 50 | | 92.0 | | | |
| 55 | | 87.0 | | | |
| 60 | | 82.0 | | | |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 20 to 35 ft. Installed a 1-in. PVC slotted casing to a depth of 18 ft. Slot interval: 10 to 18 ft. Filter sand: 10 to 20 ft. Bentonite seal: 8 to 10-ft Cement/Bentonite Grout: 0 to 8 ft. Manhole cover installed

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-3
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111


MACTEC

DRAFT

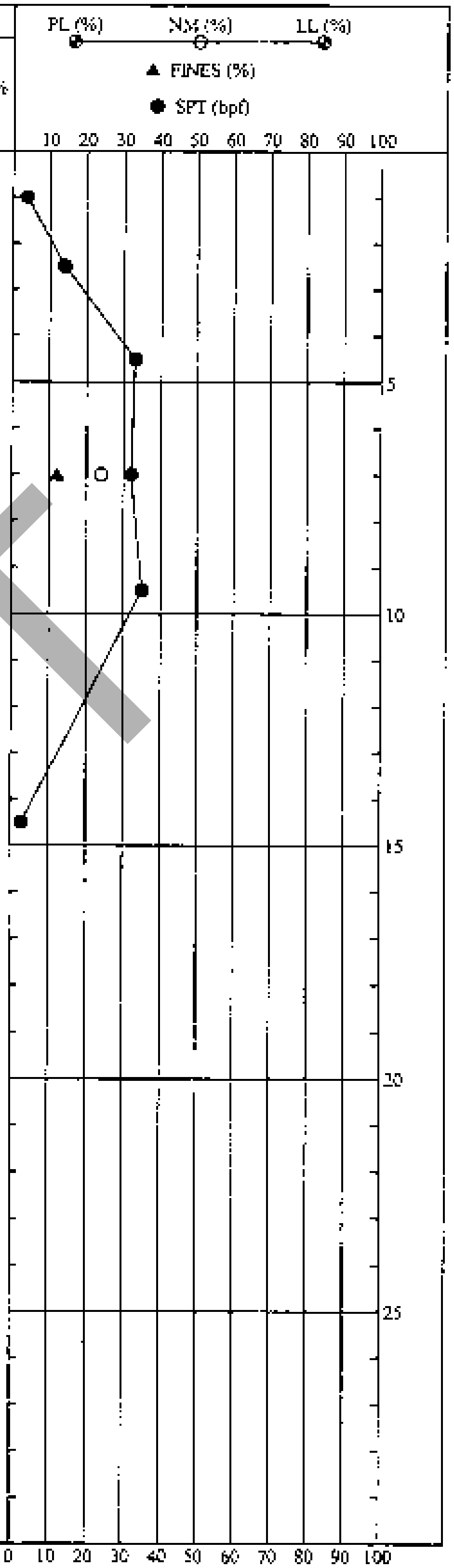
STD-NO STATION WEATHERSPOON.GPJ MACTEC DEG.GDT 8/28/10

# SOIL TEST BORING RECORD

SOIL CLASSIFICATION AND REMARKS

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

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Fill-Loose, wet, brown, slightly silty fine SAND (SP-SM) with grass roots | 118.2 | SS-1 | 2-2-2 |
| | Fill-Medium dense, moist, light brown, fine to medium SAND (SP), trace silt | | SS-2 | 4-6-8 |
| | Estimated original ground | | | |
| | Dense, moist, dark brown and black, silty fine SAND (SM), organic hard pan | | SS-3 | 9-15-18 |
| 5 | | 113.2 | | |
| | | | SS-4 | 16-15-19 |
| | Dense, wet, gray, fine to medium SAND (SP) | | | |
| | | | SS-5 | 11-17-18 |
| 10 | | 108.2 | | |
| | Soft, wet, blue gray, very clayey fine SAND (SC) with some decayed organic pieces and clay seams | | | |
| | | | SS-6 | 2-2-1 |
| 15 | Boring terminated at 15 feet. | 103.2 | | |
| 20 | | 98.2 | | |
| 25 | | 93.2 | | |
| 30 | | 88.2 | | |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 12 to 15 ft. Installed a 1-in. PVC slotted casing to a depth of 12 ft. Slot interval: 7 to 12 ft. Manhole cover installed.

REVIEWED BY: ________

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-4

**Location:** Lumberton, North Carolina

**Drilled:** June 16, 2010

**Project #:** 6468-10-0111

**Page 1 of 1**

MACTEC

STD-NO STATION WEATHERSPOON.GPJ MACTEC-GEO.GDT 8/28/10

# SOIL TEST BORING RECORD

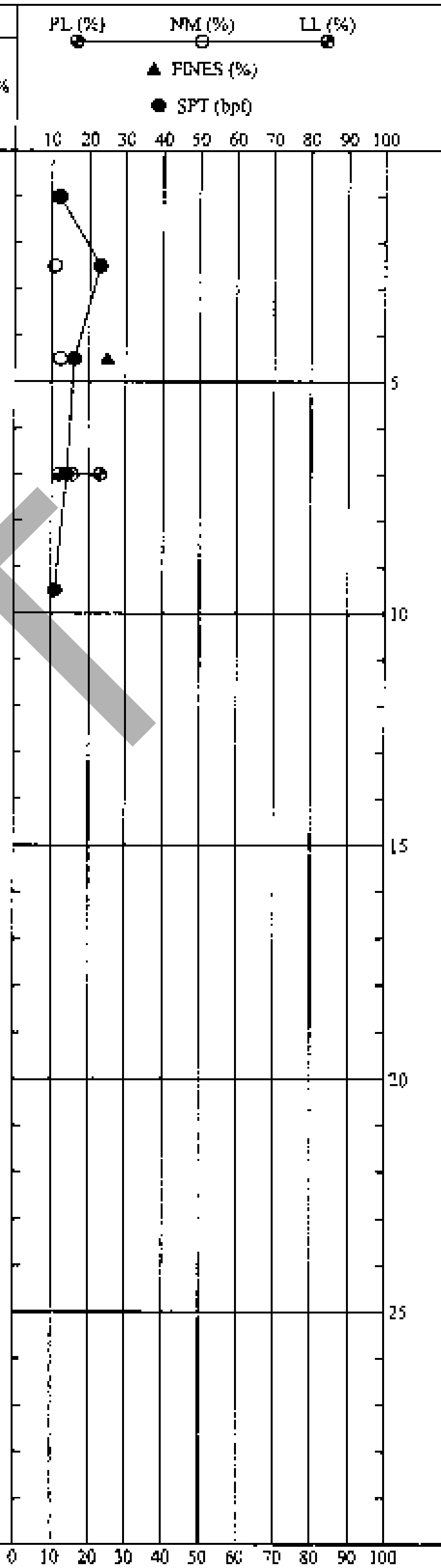
**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-5
**Location:** Lumberton, North Carolina
**Drilled:** June 16, 2010
**Project #:** 6468-10-0111
**Page** 1 **of** 1

SOIL CLASSIFICATION AND REMARKS

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

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) |
|---|---|---|
| 0 | Organic laden sandy TOPSOIL with roots | 117.2 |
| | Fill-Medium dense, dry, brown, silty fine SAND (SM) | |
| | Fill-Medium dense, dry, brown and gray, slightly clayey, slightly silty fine SAND (SP-SM), trace roots, some thin laminated clay seams | |
| | Fill-Medium dense, moist, mixed brown, clayey SAND (SC), trace root hairs, possible bottom ash pieces | |
| 5 | Estimated original ground | 112.2 |
| | Medium dense, moist, gray and tan, clayey fine SAND (SC), trace root hairs | |
| | Medium dense, wet, dark gray, slightly clayey, fine to medium SAND (SP-SC) | |
| 10 | | 107.2 |
| | Very loose, moist, fine SAND (SP), trace clay | |
| 15 | Boring terminated at 15 feet. | 102.2 |
| | Note: Artesian head noted in observation casing. Head approximately 35 inches above ground surface. No water emerging from adjacent ground. | |
| 20 | | 97.2 |
| 25 | | 92.2 |
| 30 | | 87.2 |

| SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" - 2nd 6" - 3rd 6") |
|---|---|
| SS-1 | 4-5-7 |
| SS-2 | 13-11-12 |
| SS-3 | 7-9-7 |
| SS-4 | 9-7-7 |
| SS-5 | 5-5-6 |
| SS-6 | 1-WOH-1 |



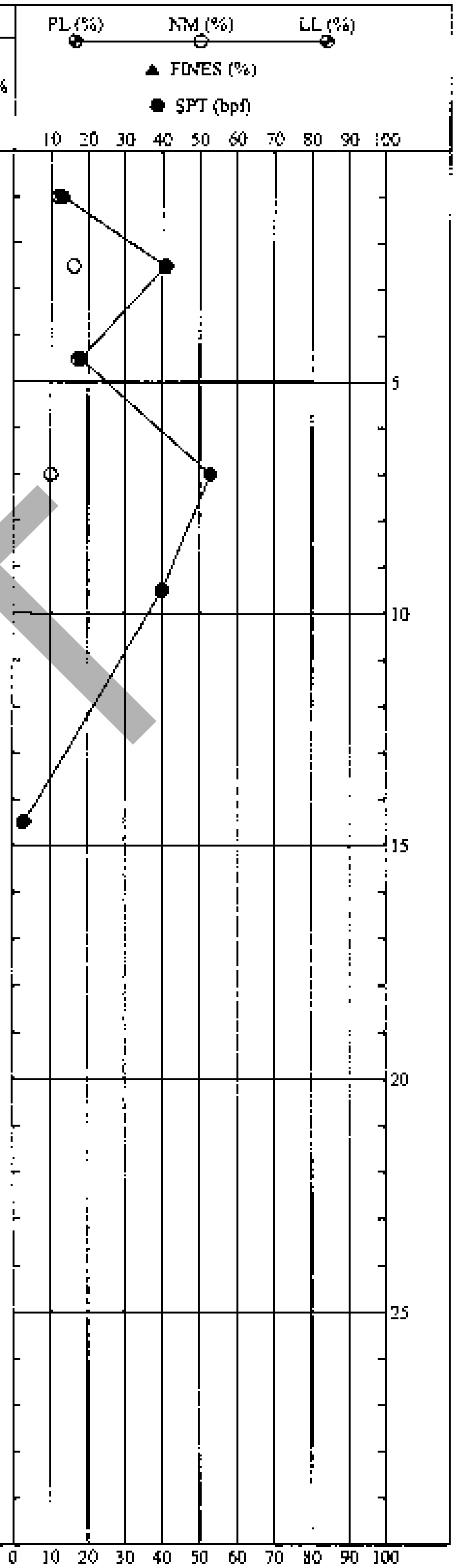

| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Hole collapsed and bentonite sealed: 12 to 15 ft. Installed a 1-in. PVC slotted casing to a depth of 12 ft. Slot interval: 7 to 12 ft. Casing stickup 35 inches. |

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Organic laden sandy TOPSOIL | 120.1 | | |
| | Fill-Medium dense, damp, dark brown, silty fine SAND (SM) | | SS-1 | 2-6-7 |
| | Fill-Dense, moist, gold and brown, fine SAND (SP), trace silt | | SS-2 | 11-20-21 |
| | Fill-Medium dense, moist, tan, slightly silty fine SAND (SP-SM), laminae of grey clay | | SS-3 | 6-11-7 |
| 5 | Estimated original ground | 115.1 | | |
| | Very dense, moist, light brown, slightly silty fine SAND (SP-SM), trace root hairs | | SS-4 | 15-26-27 |
| | Dense, moist, light gray, fine to medium SAND (SP), trace silt | | SS-5 | 19-20-20 |
| 10 | | 110.1 | | |
| | Very loose, dark brown and black, fine SAND (SP), trace clay, trace rootlets | | SS-6 | 1-1-2 |
| 15 | Boring terminated at 15 feet. | 105.1 | | |
| 20 | | 100.1 | | |
| 25 | | 95.1 | | |
| 30 | | 90.1 | | |






DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Hole collapsed and bentonite sealed: 12 to 15 ft. Installed a 1-in. PVC slotted casing to a depth of 12 ft. Slot interval: 7 to 12 ft. Manhole cover installed.

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-6

**Location:** Lumberton, North Carolina

**Drilled:** June 16, 2010

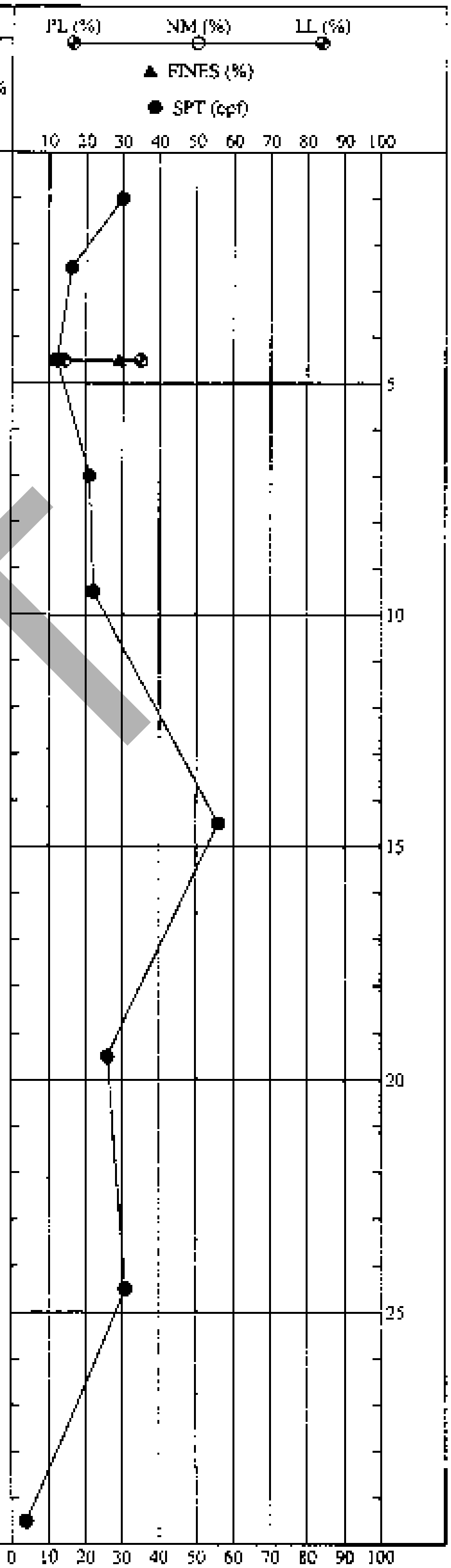
**Project #:** 6468-10-0111

**Page** 1 **of** 1

MACTEC

SID-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 8/28/10

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Fill-Crushed Stone/Gravel | 143.7 | | |
| | Fill-Medium dense, dry, brown, silty fine SAND (SM) | | SS-1 | 8-14-16 |
| | Fill-Medium dense, damp, yellowish brown, clayey fine SAND (SC) | | SS-2 | 7-6-10 |
| | Fill - moist | | SS-3 | 5-6-6 |
| 5 | | 138.7 | | |
| | Fill- wet, trace organic matter | | SS-4 | 9-7-14 |
| | Fill- moist | | SS-5 | 7-7-15 |
| 10 | | 133.7 | | |
| | Estimated original ground | | | |
| | Very dense, moist, light tan, fine SAND (SP) | | SS-6 | 15-26-30 |
| 15 | | 128.7 | | |
| | Medium dense, moist, orange, slightly silty fine SAND (SP-SM) | | SS-7 | 13-16-10 |
| 20 | | 123.7 | | |
| | light gray and yellow | | SS-8 | 13-14-17 |
| 25 | | 118.7 | | |
| | wet, light gray to white | | SS-9 | 2-2-2 |
| 30 | Boring terminated at 30 feet. | 113.7 | | |




DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Backfilled hole with bentonite chips after 24 hour water readings.

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-7

**Location:** Lumberton, North Carolina

**Drilled:** June 22, 2010

**Project #:** 6468-10-0111

**Page 1 of 1**

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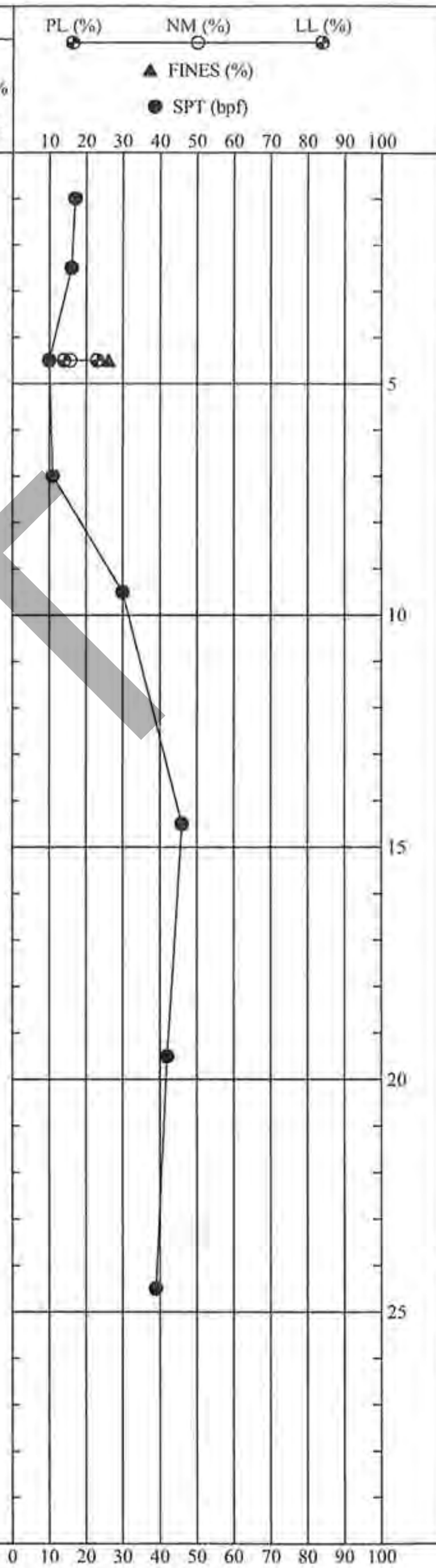
# SOIL CLASSIFICATION AND REMARKS

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

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | ELEV (ft) |
|---|---|---|
| 0 | Fill-Crushed Stone/Gravel | 142.5 |
| | Fill-Medium dense, damp, dark gray to dark brown, silty fine SAND (SM), trace roots | |
| | Fill-Medium dense, moist, olive yellow, clayey SAND (SC) | |
| 5 | | 137.5 |
| | Fill-Medium dense, moist, slightly clayey, slightly silty fine SAND (SP-SM), trace roots, trace possible bottom ash pieces ∇ | |
| | Estimated original ground | |
| | Medium dense, moist, gray brown, silty fine SAND (SM), some thin clay laminations | |
| 10 | | 132.5 |
| | Dense, moist, light tan, slightly silty fine SAND (SP-SM), occasional small pebbles or concretion | |
| 15 | Dense, moist, gray to light tan, silty fine SAND (SM) | 127.5 |
| 20 | | 122.5 |
| | - wet, light tan to gray | |
| 25 | Boring terminated at 25 feet. | 117.5 |
| 30 | | 112.5 |

## SAMPLES

| IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6" - 2nd 6" - 3rd 6" - 4th 6") |
|---|---|---|
| SS-1 | X | 6-7-10 |
| SS-2 | X | 12-8-8 |
| SS-3 | X | 4-5-5 |
| SS-4 | X | 4-6-5 |
| SS-5 | X | 5-11-19 |
| SS-6 | X | 20-20-26 |
| SS-7 | X | 17-18-24 |
| SS-8 | X | 10-12-27 |




| | |
|---|---|
| DRILLER: | G. Badger-Carolina Drilling |
| EQUIPMENT: | CME-45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA: | 3" |
| REMARKS: | Backfilled hole with bentonite chips immediately after initial water readings |

REVIEWED BY:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-8

**Location:** Lumberton, North Carolina

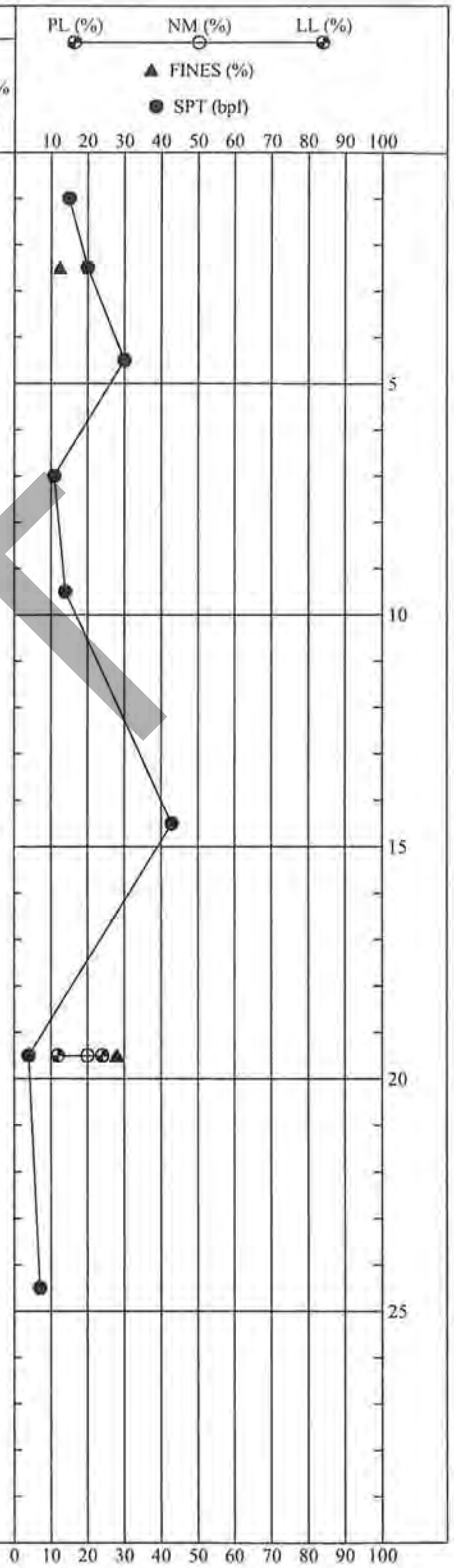
**Drilled:** June 21, 2010

**Project #:** 6468-10-0111



MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Fill-Curshed stone\Gravel | 142.8 | | |
| | Fill-Medium dense, damp, reddish brown, silty fine to medium SAND (SM) | | SS-1 | 6-7-8 |
| | | | SS-2 | 8-9-11 |
| | Fill-Medium dense, damp, brown, slightly clayey, silty fine to medium SAND (SM) | | SS-3 | 6-11-19 |
| 5 | | 137.8 | | |
| | Fill- moist, light brown | | SS-4 | 5-6-5 |
| | Estimated original ground | | | |
| | Medium dense, moist, light brown with trace red mottles, slightly clayey, slighlty silty fine to medium SAND (SP-SM) with limonite concretion | | SS-5 | 5-6-8 |
| 10 | | 132.8 | | |
| | Dense, moist, light brown, fine to medium SAND (SP) | | SS-6 | 11-19-24 |
| 15 | | 127.8 | | |
| | Loose, wet, light brown, clayey fine SAND (SC) | | SS-7 | 2-2-2 |
| 20 | | 122.8 | | |
| | Loose, wet, dark red and tan, slightly clayey, slightly silty fine to medium SAND (SP-SM) | | SS-8 | 8-4-3 |
| 25 | Boring terminated at 25 feet. | 117.8 | | |
| 30 | | 112.8 | | |




STD NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 9/20/10

DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Backfilled hole with bentonite chips immediately after initial water readings.

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**SOIL TEST BORING RECORD**

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-9
**Location:** Lumberton, North Carolina
**Drilled:** June 21, 2010
**Project #:** 6468-10-0111
**Page** 1 **of** 1

MACTEC

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: : 6-15-2010 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB1-A | Boring Location: North Dike Section 1 on slope | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| | Not Taken | Not Recorded |
| | | |
| | | |
| | | |
| | | |
| | | Note: Auger refusal on tree roots at 2 feet below existing ground surface. Water was not encountered within boring depth. |
| | | |
| | | |
| | | |
| | | |



| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-15-2010 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB1-C | Boring Location: North Dike Section 1 at Toe | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-1 | Not Taken | Organic Laden Topsoil |
| 1-2 | | Wet, gray, clayey fine to medium SAND |
| | | |
| | | |
| | | Note: Auger refusal on tree roots at 2-feet below existing ground. Borehole left open for stabilized water reading. Water measured at 1.8 feet below ground on 6-24-10. |
| | | |
| | | |
| | | |
| | | |
| | | |

Prepared by: JAS Reviewed by: JAS

MACTEC

| Hand Auger Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date: 6-15-10** |
| **Client: Progress Energy** | | **MACTEC Job No. 6468-10-0111** |
| **Boring No.** NB3-A | **Boring Location: North Dike Section 3 on slope** | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-2 | Not Recorded | Gray fine SAND |
| 2-4 | | Yellow and orange SAND |
| 4-5 | | Slightly damp, Gray sandy CLAY to clayey SAND |
| | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Boring caved-in to 4.7 feet below existing ground and dry on 6-24-10. |

| Hand Auger Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date: : 6-15-2010** |
| **Client: Progress Energy** | | **MACTEC Job No. 6468-10-0111** |
| **Boring No.** NB3-C | **Boring Location: North Dike Section 3 at Toe** | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-2 | 7-9-11 | Dry, white and yellow SAND |
| 2-3 | | Same as above except, wet |
| 4 | 7-12-15 | |
| 5 | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 3.5 feet below ground on 6-24-10. |

Note: No hand auger boring at location NB-2 due to proximately to location NB-3.

Prepared by: J.A.S. Reviewed by: [signature]

MACTEC

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-15-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB4-B | Boring Location: North Dike Section 4 on slope | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 - 0.3 | | Organic laden TOPSOIL |
| 0.3 - 2 | 7-10-10 | Dry, gray and white SAND |
| 2 - 4 | 9-20-21 | Transitions to clayey SAND |
| 4 - 5 | | Orange yellow clayey SAND |
| | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Borehole was dry to 5 feet on 6-24-10. |

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-15-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB4-C | Boring Location: North Dike Section 4 at Toe | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 - 1 | | Damp, gray white SAND |
| 1 -2 | 5-4-3 | |
| 2 - 4 | 5-5-7 | Same as above, moist to wet |
| 4-5 | | Wet, orange yellow SAND |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 3.75 feet below ground on 6-24-10. |



Prepared by: J. A. S. Reviewed by: [signature]

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-15-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB5-B | Boring Location: North dike section 5 on slope | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 – 4 | 3-5-5 | Yellow SAND |
| 4 - 5 | 17-19-80 | Clayey SAND |
| | | |
| | | |
| | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Borehole was dry to 4.5 feet below the ground on 6-24-10. |

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-15-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB5-C | Boring Location: North dike section 4 at Toe | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-2 | Not taken | Wet, yellow SAND |
| 2 | 5-3-5 | |
| 2-5 | Not taken | Wet, clayey SAND |
| 5 | 3-4-5 | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 1.4 feet below ground on 6-24-10. |



Prepared by: J.A.S. Reviewed by: JAJ

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| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-16-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB6-B | Boring Location: North dike section 6 on slope | |

| Depth (feet) | Blow Counts | Visual Soil Description |
|---|---|---|
| 0-1 | | Organic Laden Top Soil |
| 1-2 | 8-11-12 | Gray, clayey SAND |
| 2-5 | | Gray fine SAND |
| 4-5 | 25+ | Gray fine SAND |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 4.7 feet below ground on 6-24-10. |

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: 6-16-10 |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB6-C | Boring Location: North dike section 6 at Toe | |

| Depth (feet) | Blow Counts | Visual Soil Description |
|---|---|---|
| 0-1 | | Damp, SAND |
| 1-2 | 5-6-6 | Moist to wet, Clayey SAND |
| 2-5 | 5-6-4 | |
| | | |
| | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 3.66 feet below ground on 6-24-10. |



Prepared by: J.A.S. Reviewed by: JA2

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| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB8-B | Boring Location: North Dike section 8 on slope | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-1 | | Organic Laden Top Soil |
| 1-2 | 7-11-14 | Gray silty fine SAND |
| 2-5 | 25+ | Gray silty fine SAND |
| | | Hand auger refusal at 5 feet |
| | | |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Borehole dry at 5 feet below ground on 6-24-10. |

| Hand Auger Log | | |
|---|---|---|
| Job Name: Weatherspoon Dike Evaluation | | Date: |
| Client: Progress Energy | | MACTEC Job No. 6468-10-0111 |
| Boring No. NB8-C | Boring Location: North Dike section 8 on slope | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 2 | 4-7-8 | Wet, gray silty SAND |
| 4 | 5-7-9 | Wet, gray silty fine SAND, trace Clay |
| 5 | | Bottom of auger boring |
| | | |
| | | Note: Hand auger terminated at 5-ft below existing ground. Borehole left open for stabilized water reading. Water measured at 0.7 feet below ground on 6-24-10. |

Note: No hand auger boring at location NB-7 due to steep slope.

Prepared by: J.A.S. Reviewed by: JAS

MACTEC

| Auger Boring Well Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date:** June 21, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Piezometer No.** SB-1B | **Boring Location**: See drawing 5. | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 5 | Not taken | Moist, orange-yellow, slightly clayey medium SAND |
| | | |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 5 feet, 2 feet of hand slotted PVC pipe and 4.8 feet solid riser pipe. Stickup 4.8 ft. Sand and bentonite (0-2' seal) placed. No water present after installing piezometer, or on August 3, 2010. |

| Auger Boring Well Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date:** June 21, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB-1W (Deep) | **Boring Location**: See drawing 5. | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 1 | Not taken | Wet at surface-Medium Brown SAND underlain by a moist to wet, dark gray CLAY |
| 3 to 4 | | Wet , dark gray, Clay with rootlets |
| 4 to 6 | | Moist to dry, brown, SAND, with stiff dark gray, black sandy Clay. Soil drier with depth. |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 6 feet, 3 feet of hand slotted PVC pipe and 5 feet solid riser pipe. Stickup 2.15 ft. Sand and bentonite (0-2' seal) placed. Water was at 0.59 feet below ground surface on August 3, 2010. |

| Auger Boring Well Log | | |
|---|---|---|
| **Job Name**: Seepage and Stability Evaluation Weatherspoon Plant – Lumberton, NC | | **Date:** June 21, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Piezometer No.** SB1-W (Shallow) | **Boring Location:** See drawing 5. | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 2 | Not taken | See SB-1W for soil description. |
| | | |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 2 feet,1 foot of hand slotted PVC pipe and 1.6 feet solid riser pipe. Stickup 0.6 ft. Sand and bentonite (0-2' seal) placed. No water encountered after installation. Water measured on August 3, 2010 at 0.91 feet below ground surface. |

| Auger Boring Well Log | | |
|---|---|---|
| **Job Name**: Seepage and Stability Evaluation Weatherspoon Plant – Lumberton, NC | | **Date:** June 21, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB-2B | **Boring Location:** See drawing 5. | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0-5 | Not taken | Light Brown and gray fine to medium sandy Silt (Moist to Wet) |
| | | |
| | | |
| | | |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 5 feet, 2 feet of hand slotted PVC pipe and 5 feet solid riser pipe. Stickup 2 ft. Sand and bentonite (0-2' seal) placed. Water at 4.6 feet below ground surface on August 3, 2010. |

Prepared by: V.A.S Reviewed by: [signature]

MACTEC

| **Job Name**: Seepage and Stability Evaluation Weatherspoon Plant – Lumberton, NC | | **Date:** June 21, 2010 |
|---|---|---|
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Piezometer No.** SB-2W (Deep) | **Boring Location:** See drawing 5 | |

| Depth (feet) | Blow Counts | Visual Soil Description |
|---|---|---|
| 0 to 3 | Not taken | Very loose, wet, brown fine SAND |
| 3 to 5 | | Wet, stiff, gray brown SAND |
| | | |
| | | |
| | | |
| | | |
| | | Note: Wet at 8" below ground surface. Installed 1 inch PVC Piezometer at 5 feet, 1 foot of hand slotted PVC pipe and 6.54 feet solid riser pipe. Stickup 2.5 ft. Sand and bentonite (0-2' seal) placed. Water was at 1.48 feet below ground surface on August 3, 2010. |

**Auger Boring Well Log**

| **Job Name:** Seepage and Stability Evaluation Weatherspoon Plant – Lumberton, NC | | **Date:** June 21, 2010 |
|---|---|---|
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB-3B | **Boring Location:** See drawing 5. | |

| Depth (feet) | Blow Counts | Visual Soil Description |
|---|---|---|
| 0 to 5 | Not taken | Light Brown and gray fine to medium sandy Silt (Moist to Wet) |
| | | |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 5 feet, 2 feet of hand slotted PVC pipe and 5.2 feet solid riser pipe. Stickup 2.2 ft. Sand and bentonite (0-2' seal) placed. Water was at 2.6 feet below ground surface on August 3, 2010. |

Prepared by: J.A.S. Reviewed by: [signature]

MACTEC

| **Job Name**: Seepage and Stability Evaluation Weatherspoon Plant – Lumberton, NC | | **Date:** June 21, 2010 |
|---|---|---|
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Piezometer No.** SB-3W (Deep) | **Boring Location:** See drawing 5. | |
| **Depth (feet)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 1 | Not taken | Very loose, dry, brown fine SAND |
| 2 to 3 | | Damp, gray brown Clayey SAND |
| 3 to 5 | | Wet, clayey SAND |
| 5 to 6 | | Moist, gray-black, clayey SAND, hard augering |
| | | |
| | | |
| | | Note: Installed 1 inch PVC Piezometer at 6 feet, 2 feet of hand slotted PVC pipe and 7.4 feet solid riser pipe. Stickup 3.4 ft. Sand and bentonite (0-2' seal) placed. Water was at 2.45 feet below ground surface on August 3, 2010. |



Prepared by: J. A. S. Reviewed by: [signature]

MACTEC

# APPENDIX B

## Cone Penetrometer Test Results

(Note – Ground surface elevations as surveyed by MACTEC personnel have been added to the CPTu plots provided by ConeTec.)

# ConeTec Inc.

**Geotechnical and Environmental Site Investigation Contractors**

606-S Roxbury Industrial Center, Charles City, VA 23030 • Tel: (804) 966-5696 • Fax: (804) 966-5697
• E-mail: ecargill@conetec.com • Website: www.conetec.com


June 30, 2010

**Mr. Al Tice, P.E.**
**MACTEC Engineering & Consulting, Inc.**
**3301 Atlantic Avenue**
**Raleigh, NC 27604**

Dear Mr. Tice,

***Re: CPTu Testing***
***Weatherspoon Power Plant; Lumberton, NC***

We are pleased to enclose our data submission for the in-situ testing that ConeTec performed for you at the above referenced site on June 21 and 22, 2010.

Nine cone penetration test (CPTu) soundings and three seismic cone penetration test (SCPTu) soundings were performed to depths of approximately 15 to 21 feet below existing grade. A compression model electronic piezo cone penetrometer, with a 15 $cm^2$ tip and a 225 $cm^2$ friction sleeve, was used. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. At the beginning of each sounding, the cone was outfitted with a vacuum-saturated, six millimeter-thick, porous plastic pore pressure element that is located immediately behind the tip (the $U_2$ location).

The cone was advanced using a 15-ton tracked-mounted cone penetration rig. As the cone was advanced into the ground, tip resistance (qc), sleeve friction (fs) and dynamic pore water pressure (U) were recorded every five centimeters (approximately every two inches) and are included in the attached files. A tabular output of this data and summary of engineering parameters, is included in the .xls files. Additionally, shear wave measurements were performed on approximately 1-meter intervals in sounding CPT-2, CPT-4 and CPT-8. The results from measurements and shear wave velocity estimates can be found in the *-Vs.xls files. A summary of the field testing program can be found in the attached Table 1.

Thank you very much for using ConeTec. It was a pleasure working with you and your staff and we look forward to working with you again in the future. If you have any questions or require additional information, please do not hesitate to contact us.

Best regards,

Ethan Cargill
Manager

# Weatherspoon Power Plant

June 21 and 22, 2010
10-947

**Table 1: Sounding Information Table**

| Test Type | Sounding Number | Filename | Depth (ft) | Estimated GWT (ft) | Comments |
|---|---|---|---|---|---|
| CPTu | CPT-1 | 947CP01 | 16.4 | 7 | |
| SCPTu | CPT-2 | 947CP02 | 20.8 | 7 | Seismic |
| CPTu | CPT-3 | 947CP03 | 16.4 | 6 | |
| SCPTu | CPT-4 | 947CP04 | 21.7 | 4 | Seismic |
| CPTu | CPT-5 | 947CP05 | 16.6 | 8 | |
| CPTu | CPT-6 | 947CP06 | 21.2 | 8 | |
| CPTu | CPT-7 | 947CP07 | 16.4 | 1 | |
| SCPTu | CPT-8 | 947CP08 | 21.2 | 3 | Seismic |
| CPTu | CPT-9 | 947CP09 | 15.9 | 3 | |
| CPTu | CPT-10 | 947CP10 | 21.2 | 3 | |
| CPTu | CPT-11 | 947CP11 | 21.3 | 7 | |
| CPTu | CPT-12 | 947CP12 | 21.2 | 4 | |
| CPTu | CPT-13 | 947CP13 | 21.3 | 6 | |

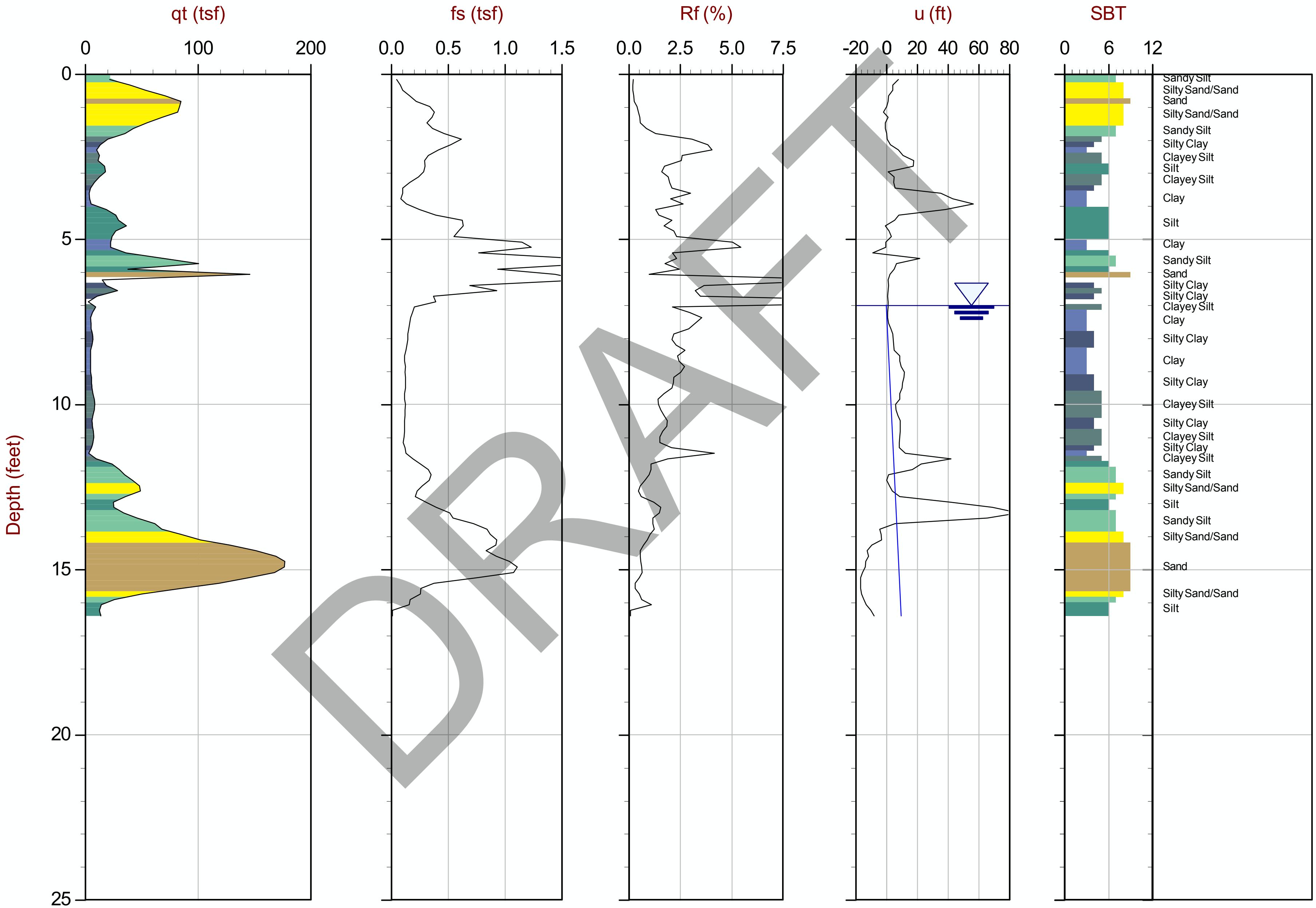
# CPTu Plots

CONETEC

MACTEC

Job No: 10-947
Date: 06:21:10 13:45
Site: Weatherspoon

Sounding: CPT-1
Cone: 214:T1500F15U500
Elevation: 144.3




Max Depth: 5.000 m / 16.40 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP01.COR
Unit Wt: SBT Chart Soil Zones

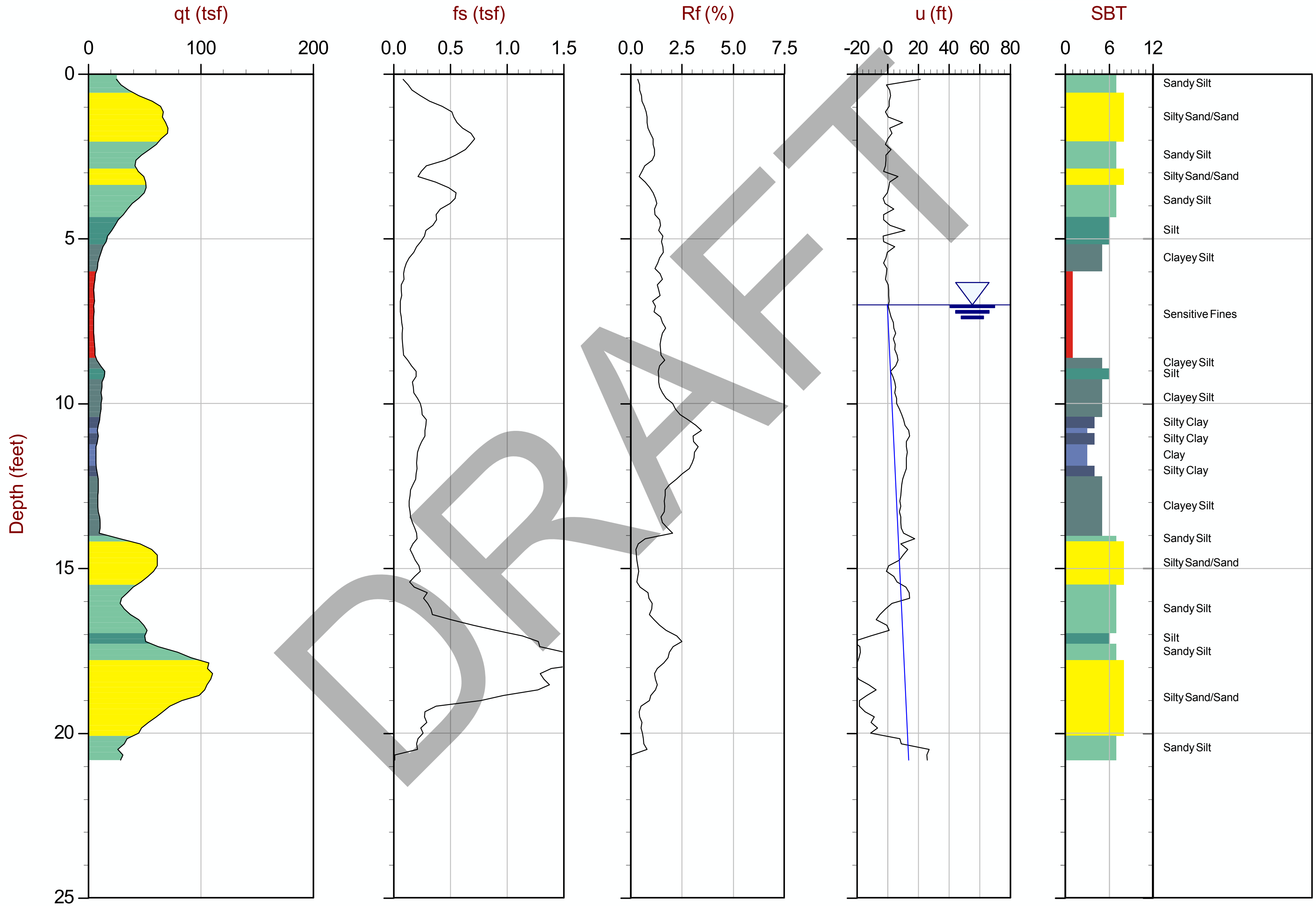
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:21:10 14:29
Site: Weatherspoon

Sounding: CPT-2
Cone: 214:T1500F15U500
Elevation: 144.3




Max Depth: 6.350 m / 20.83 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP02.COR
Unit Wt: SBT Chart Soil Zones

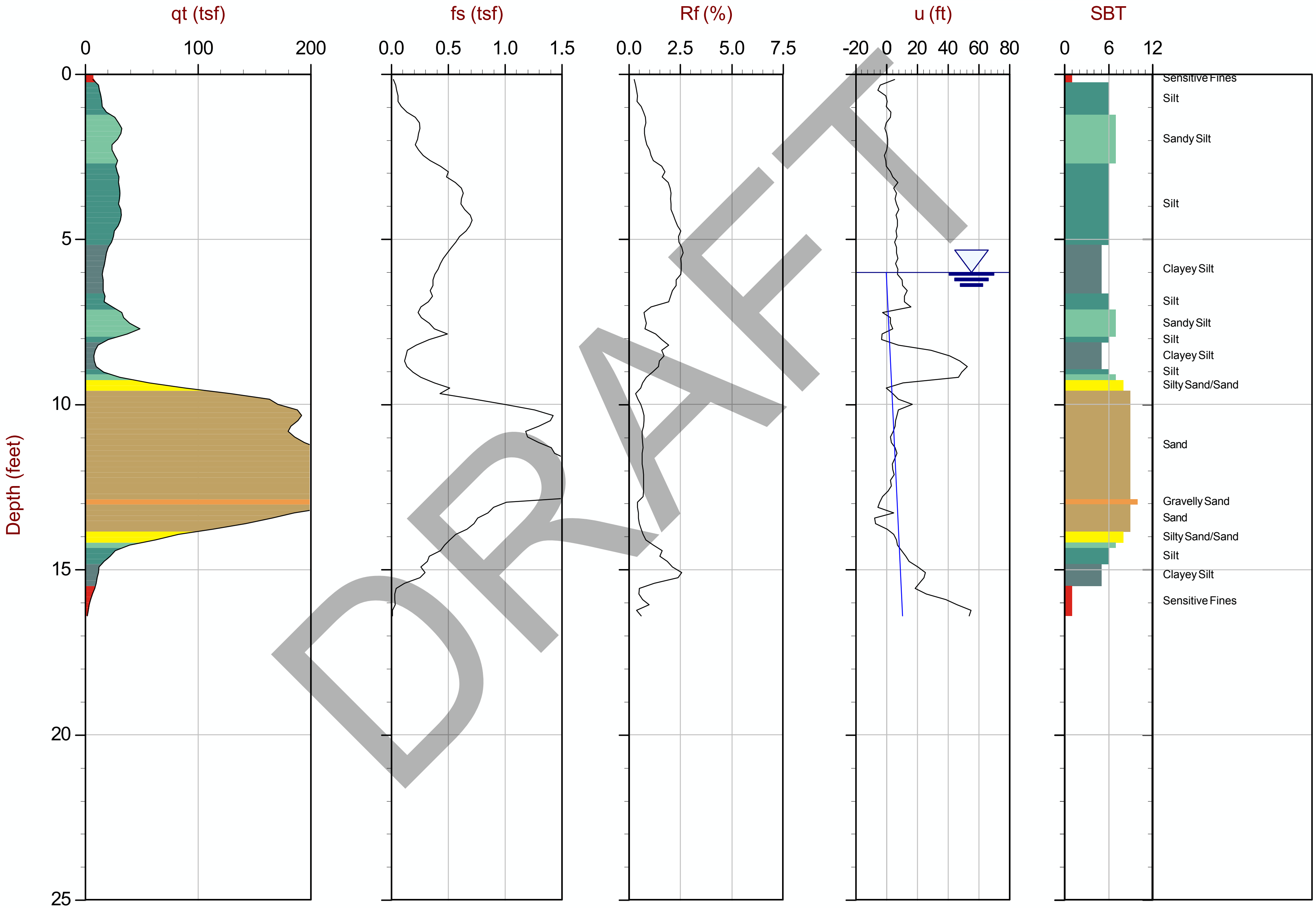
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

ConeTec

MACTEC

Job No: 10-947
Date: 06:21:10 15:27
Site: Weatherspoon

Sounding: CPT-3
Cone: 214:T1500F15U500
Elevation: 143.2




Max Depth: 5.000 m / 16.40 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP03.COR
Unit Wt: SBT Chart Soil Zones

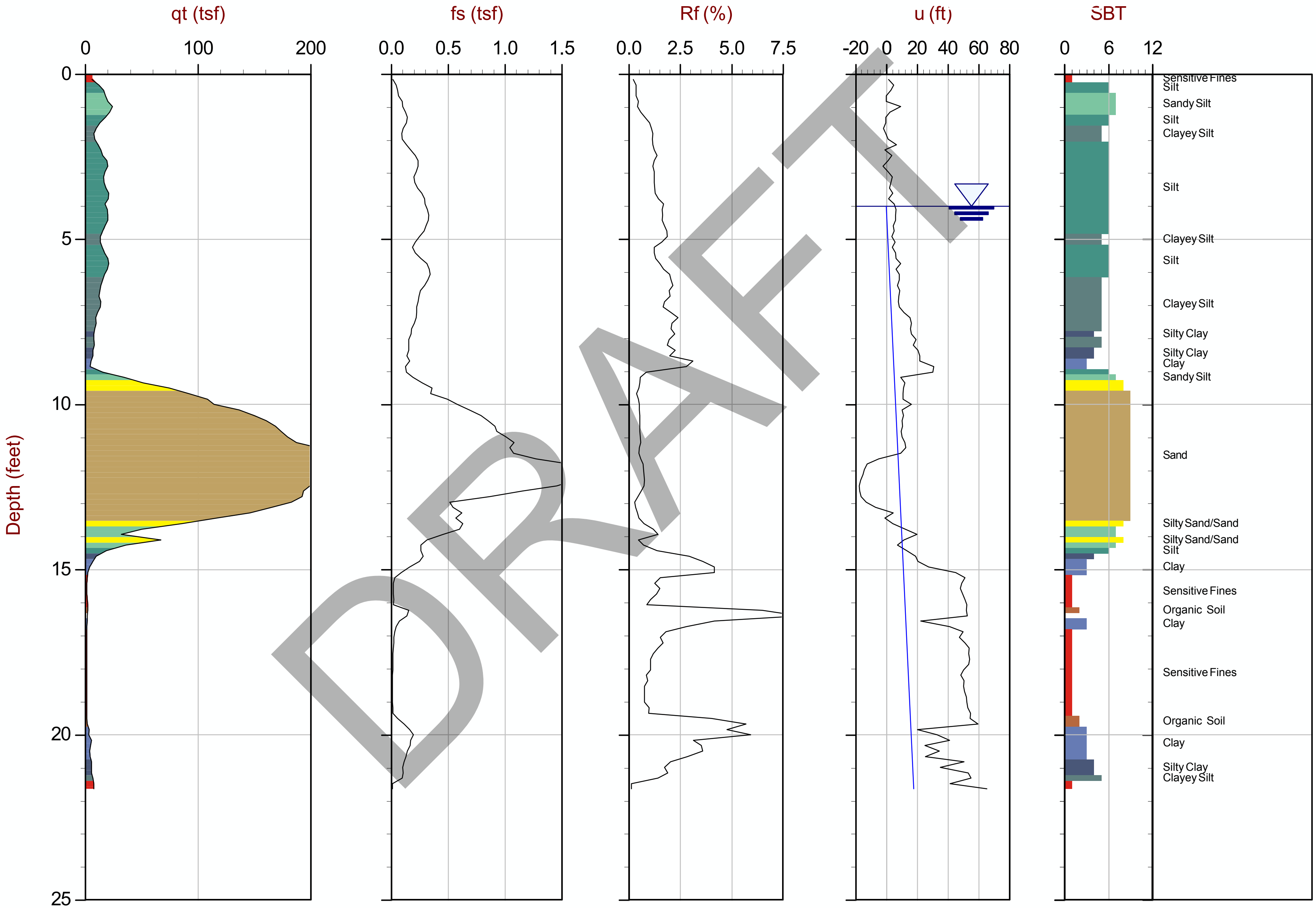
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

ConeTec

MACTEC

Job No: 10-947
Date: 06:21:10 16:16
Site: Weatherspoon

Sounding: CPT-4
Cone: 214:T1500F15U500
Elevation: 143.0




Max Depth: 6.600 m / 21.65 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP04.COR
Unit Wt: SBT Chart Soil Zones

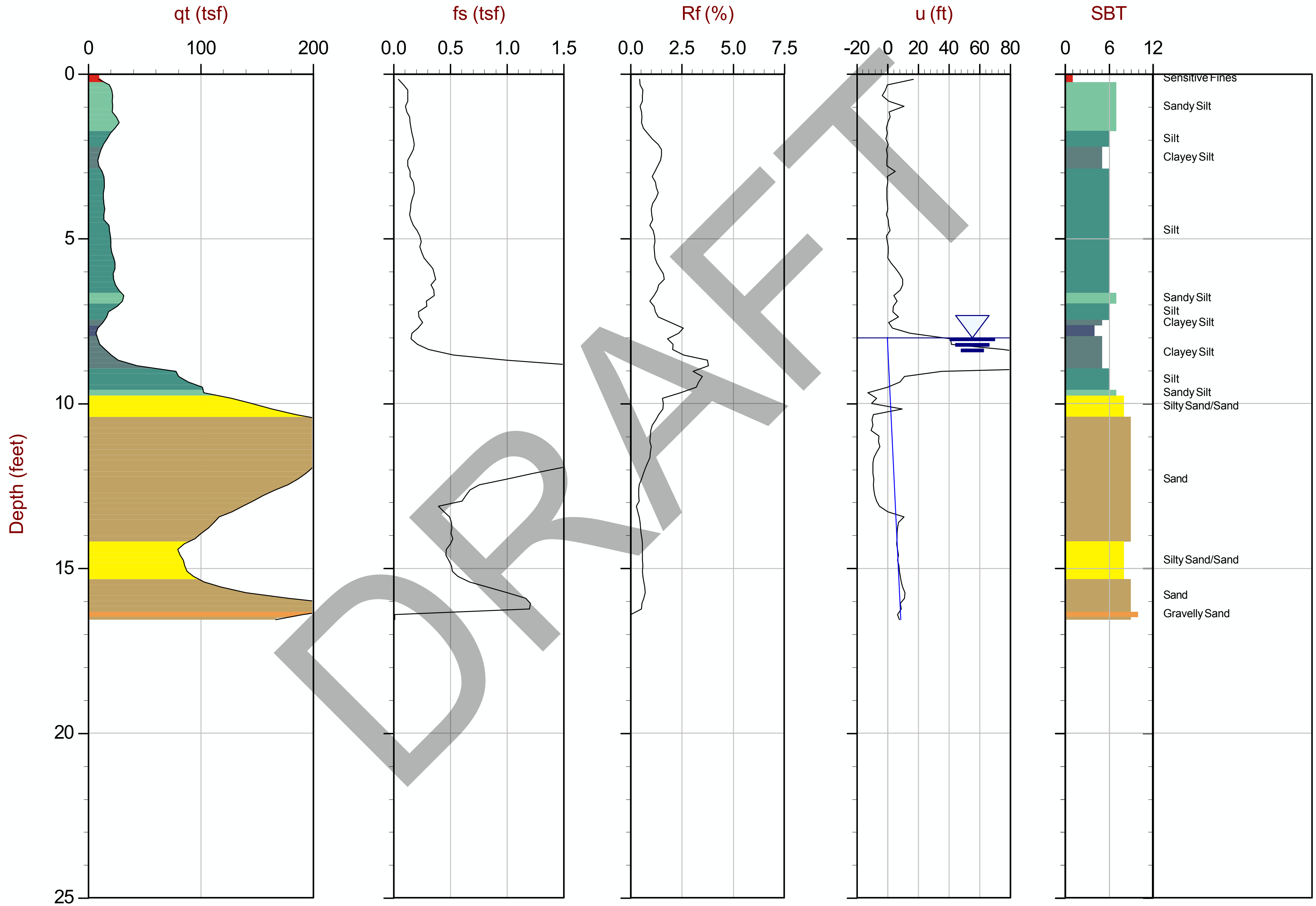
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:22:10 07:53
Site: Weatherspoon

Sounding: CPT-5
Cone: 214:T1500F15U500
Elevation: 143.8




Max Depth: 5.050 m / 16.57 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP05.COR
Unit Wt: SBT Chart Soil Zones

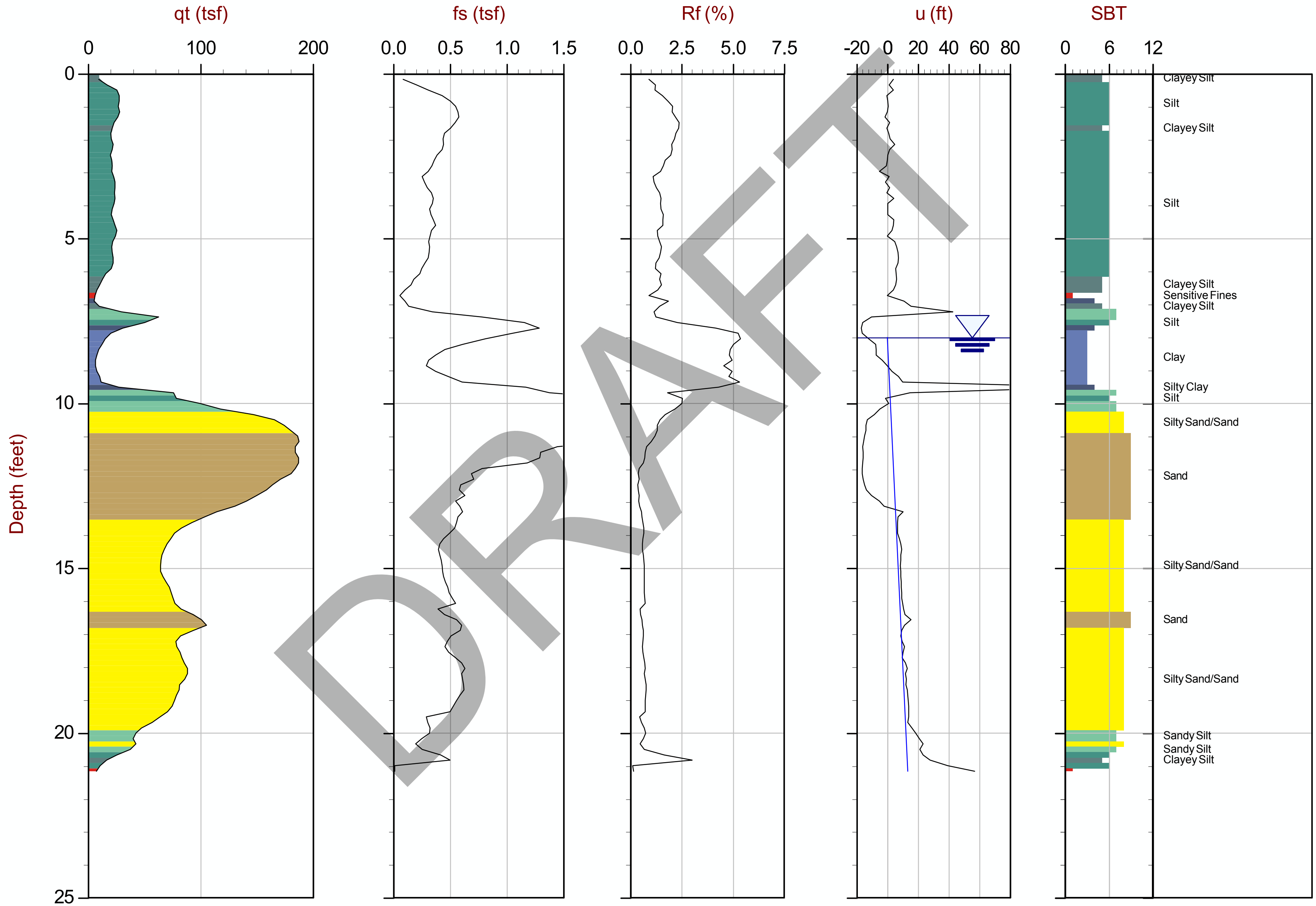
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:22:10 08:34
Site: Weatherspoon

Sounding: CPT-6
Cone: 214:T1500F15U500
Elevation: 142.5




Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP06.COR
Unit Wt: SBT Chart Soil Zones

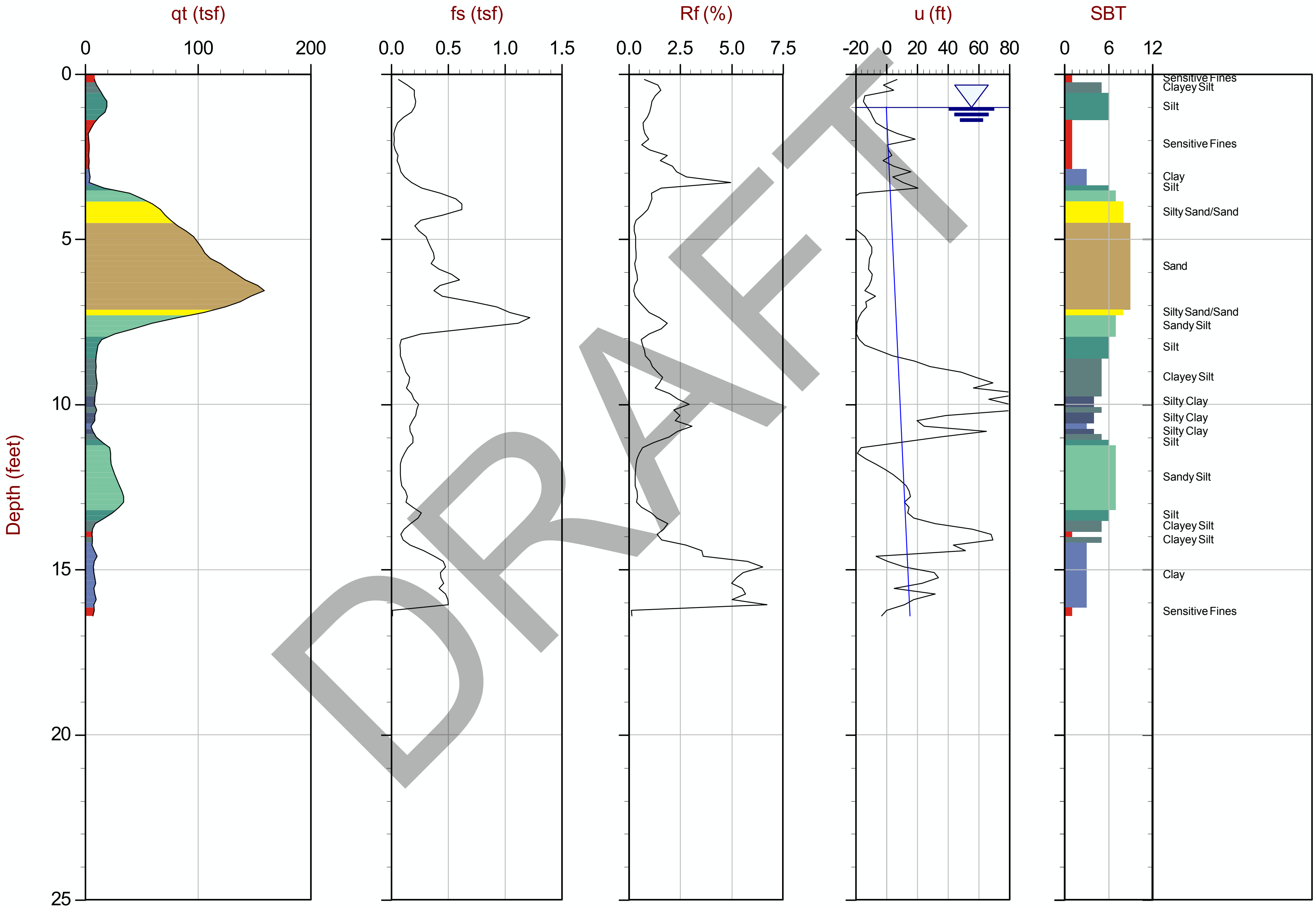
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

**MACTEC**

Job No: 10-947
Date: 06:22:10 09:52
Site: Weatherspoon

Sounding: CPT-7
Cone: 214:T1500F15U500
Elevation: 135.2






Max Depth: 5.000 m / 16.40 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP07.COR
Unit Wt: SBT Chart Soil Zones

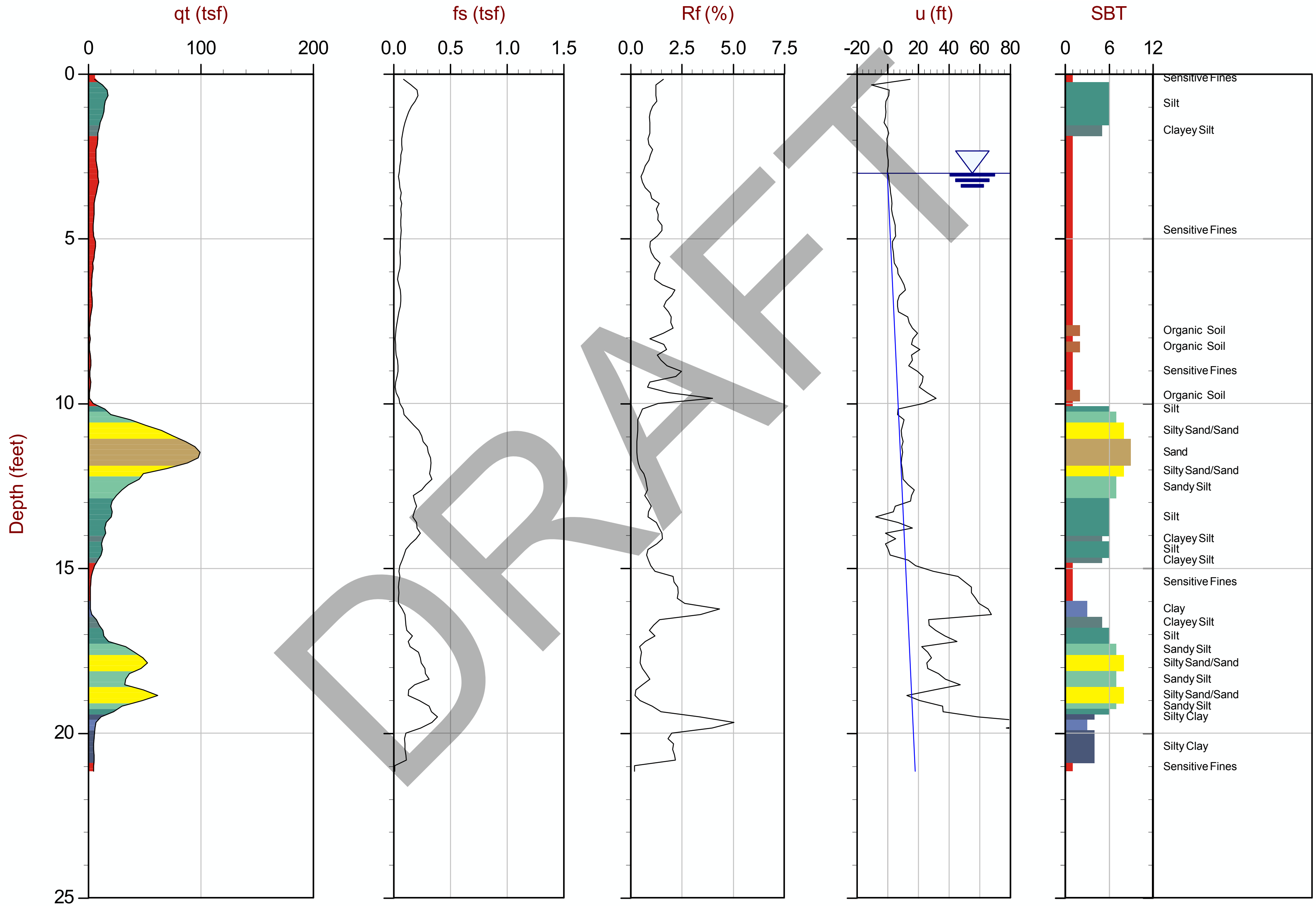
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

ConeTec

MACTEC

Job No: 10-947
Date: 06:22:10 09:09
Site: Weatherspoon

Sounding: CPT-8
Cone: 214:T1500F15U500
Elevation: 138.3






Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP08.COR
Unit Wt: SBT Chart Soil Zones

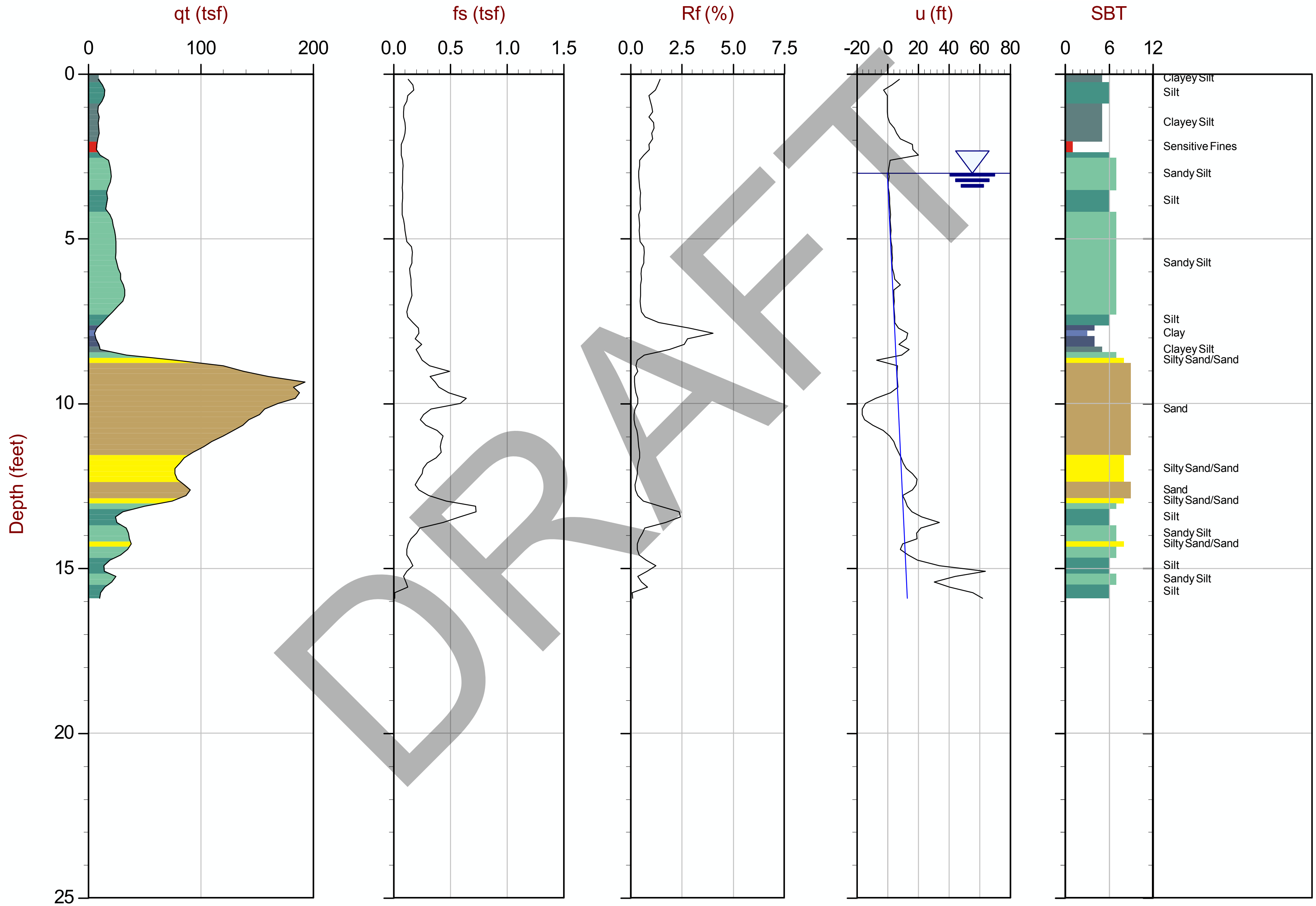
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:22:10 10:20
Site: Weatherspoon

Sounding: CPT-9
Cone: 214:T1500F15U500
Elevation: 136.6




Max Depth: 4.850 m / 15.91 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP09.COR
Unit Wt: SBT Chart Soil Zones

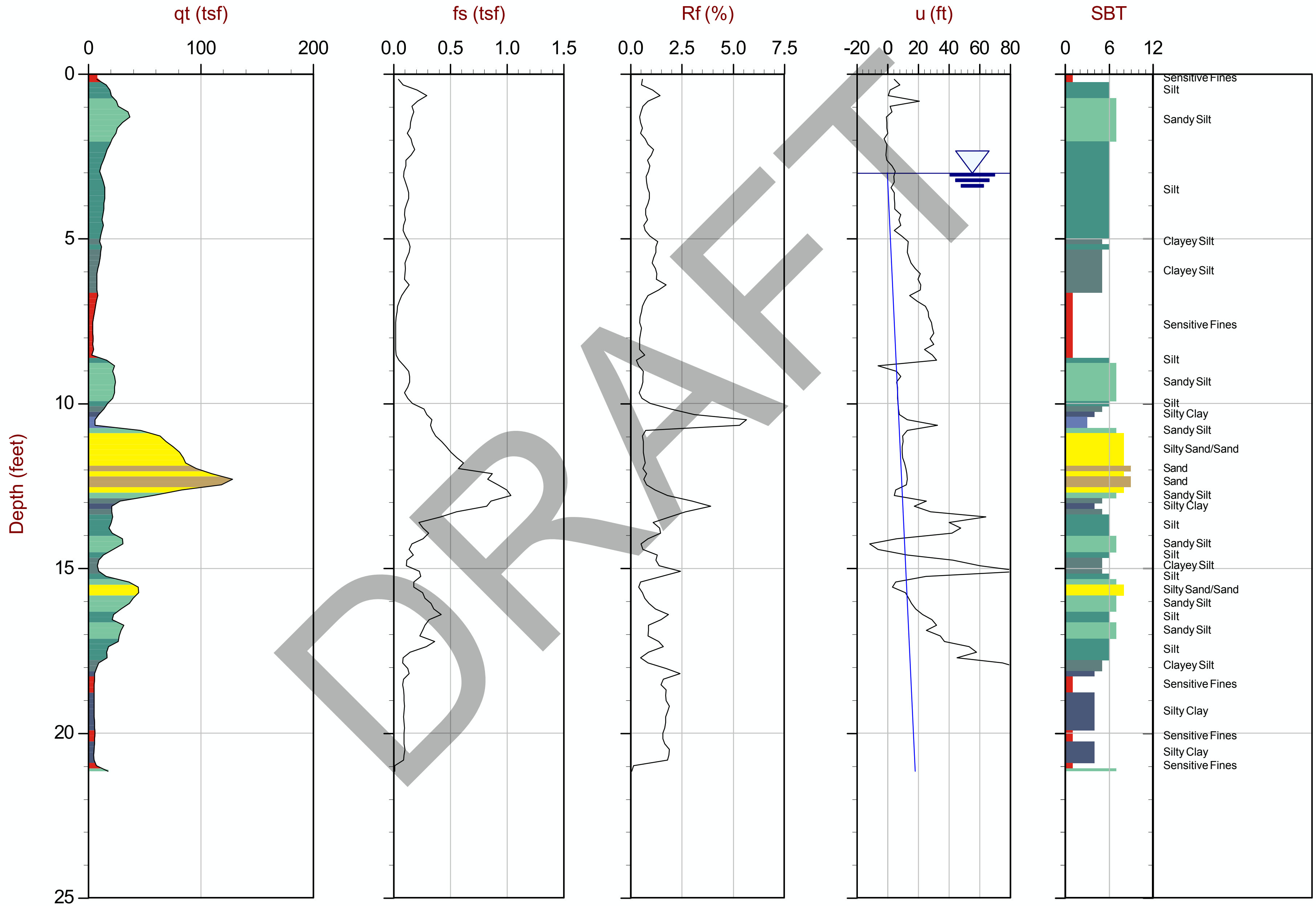
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

ConeTec

MACTEC

Job No: 10-947
Date: 06:22:10 10:47
Site: Weatherspoon

Sounding: CPT-10
Cone: 214:T1500F15U500
Elevation: 137.6




Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP10.COR
Unit Wt: SBT Chart Soil Zones

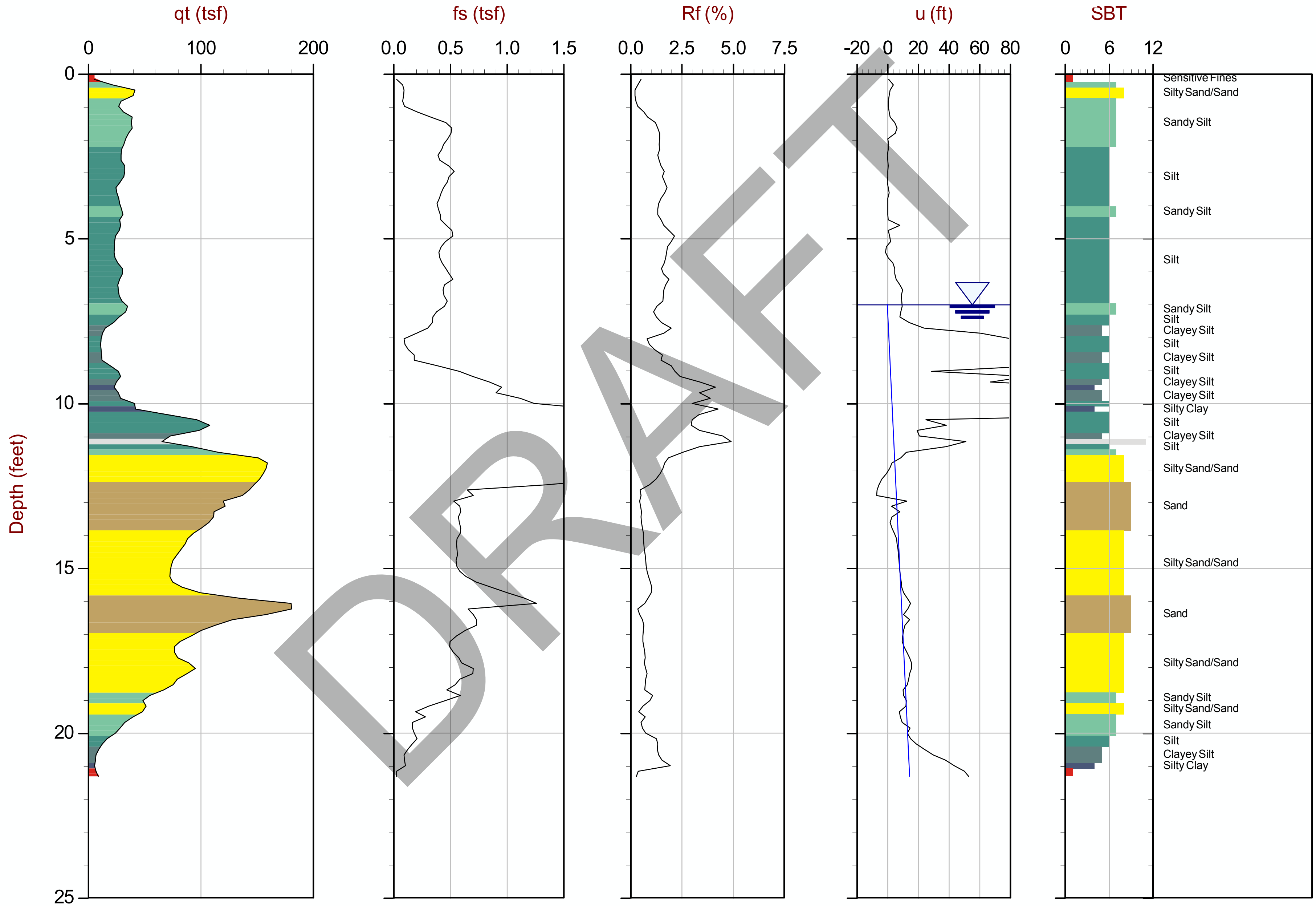
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

ConeTec

MACTEC

Job No: 10-947
Date: 06:22:10 12:13
Site: Weatherspoon

Sounding: CPT-11
Cone: 214:T1500F15U500
Elevation 143.7






Max Depth: 6.500 m / 21.33 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP11.COR
Unit Wt: SBT Chart Soil Zones

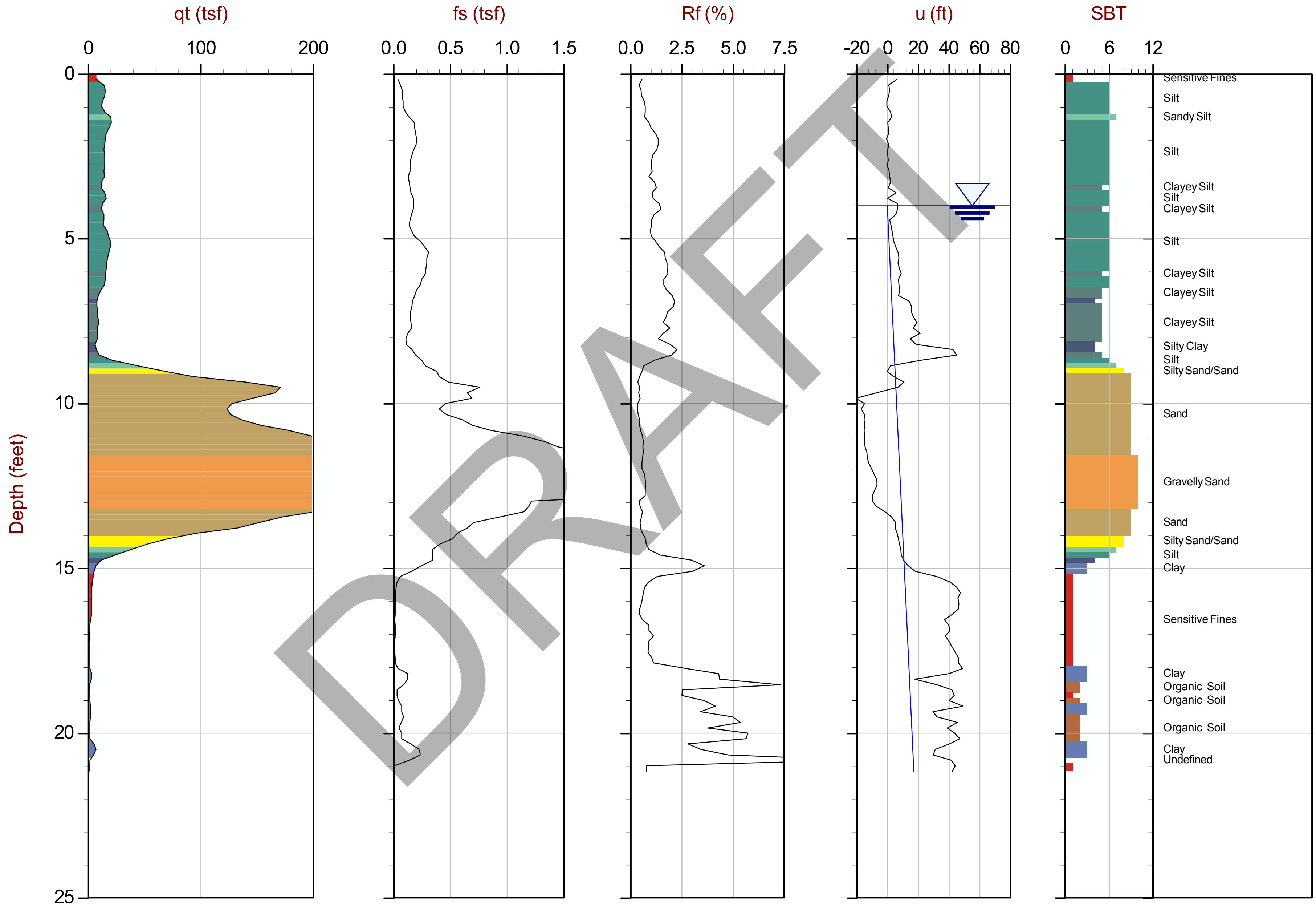
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:22:10 12:53
Site: Weatherspoon

Sounding: CPT-12
Cone: 214:T1500F15U500
Elevation:142.8




Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP12.COR
Unit Wt: SBT Chart Soil Zones

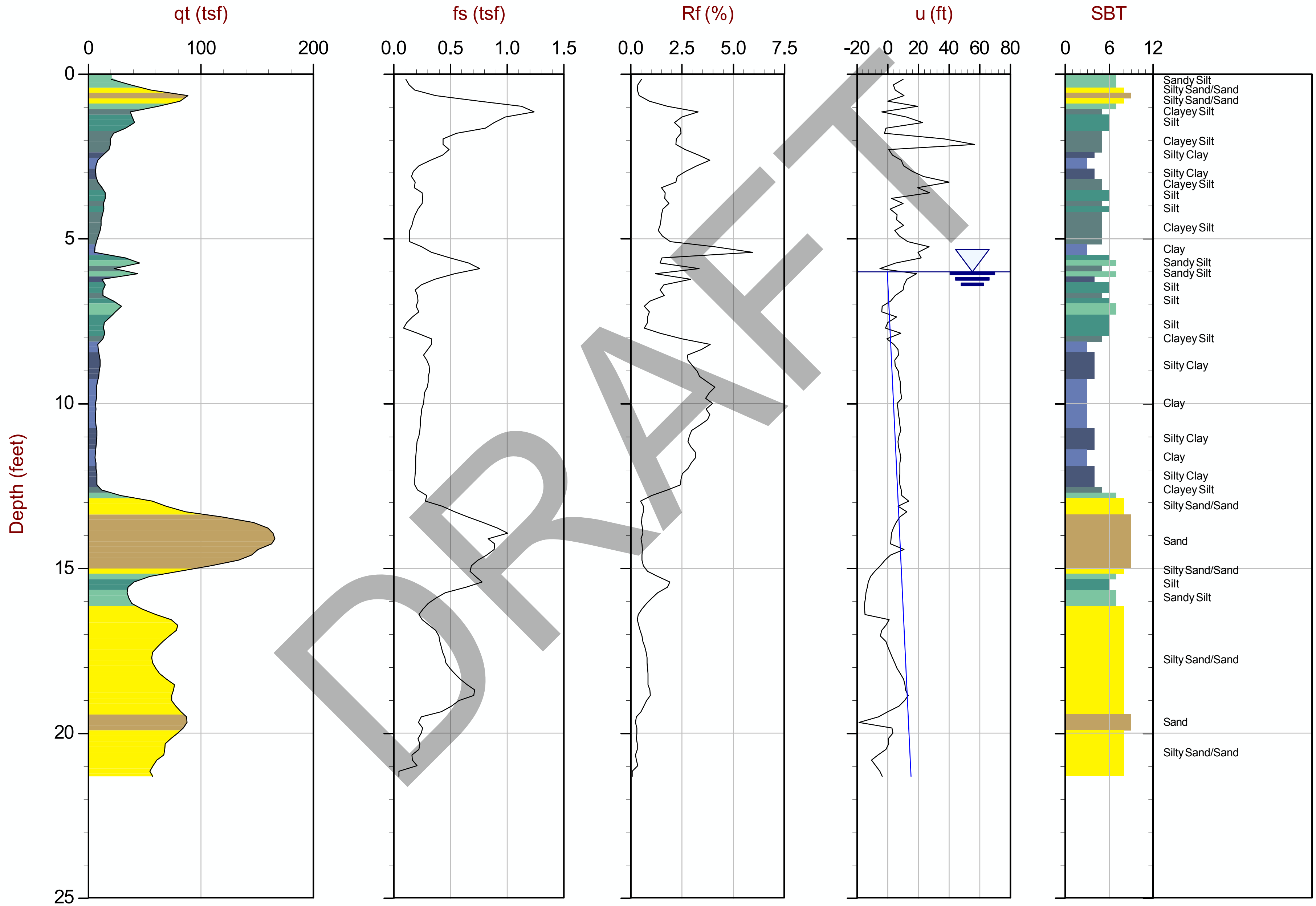
SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

CONETEC

MACTEC

Job No: 10-947
Date: 06:22:10 14:32
Site: Weatherspoon

Sounding: CPT-13
Cone: 214:T1500F15U500
Elevation:143.2




Max Depth: 6.500 m / 21.33 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP13.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

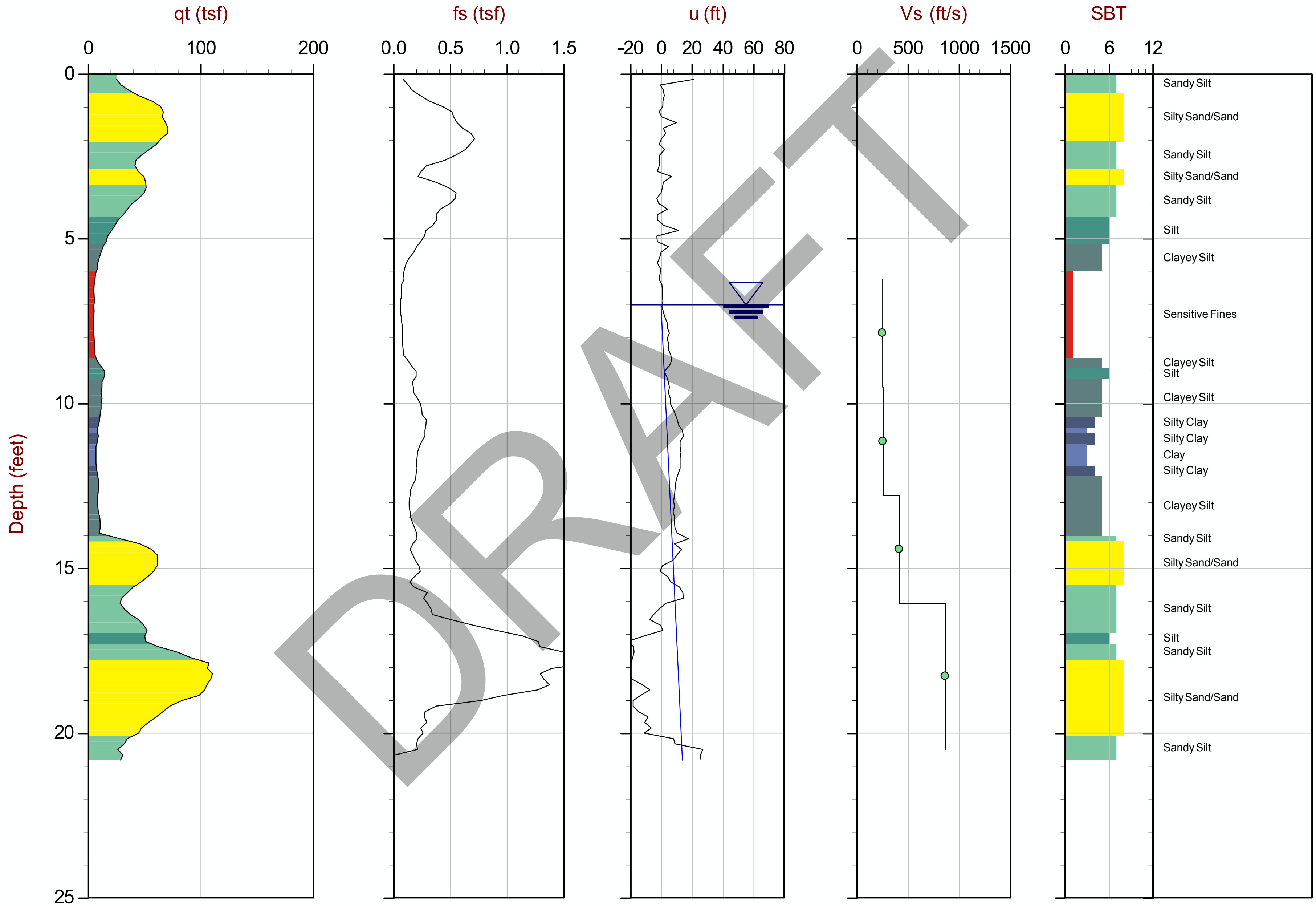
# Shear Wave Data and Velocity Estimates

CONETEC

MACTEC

Job No: 10-947
Date: 06:21:10 14:29
Site: Weatherspoon

Sounding: CPT-2
Cone: 214:T1500F15U500
Elevation 144.3



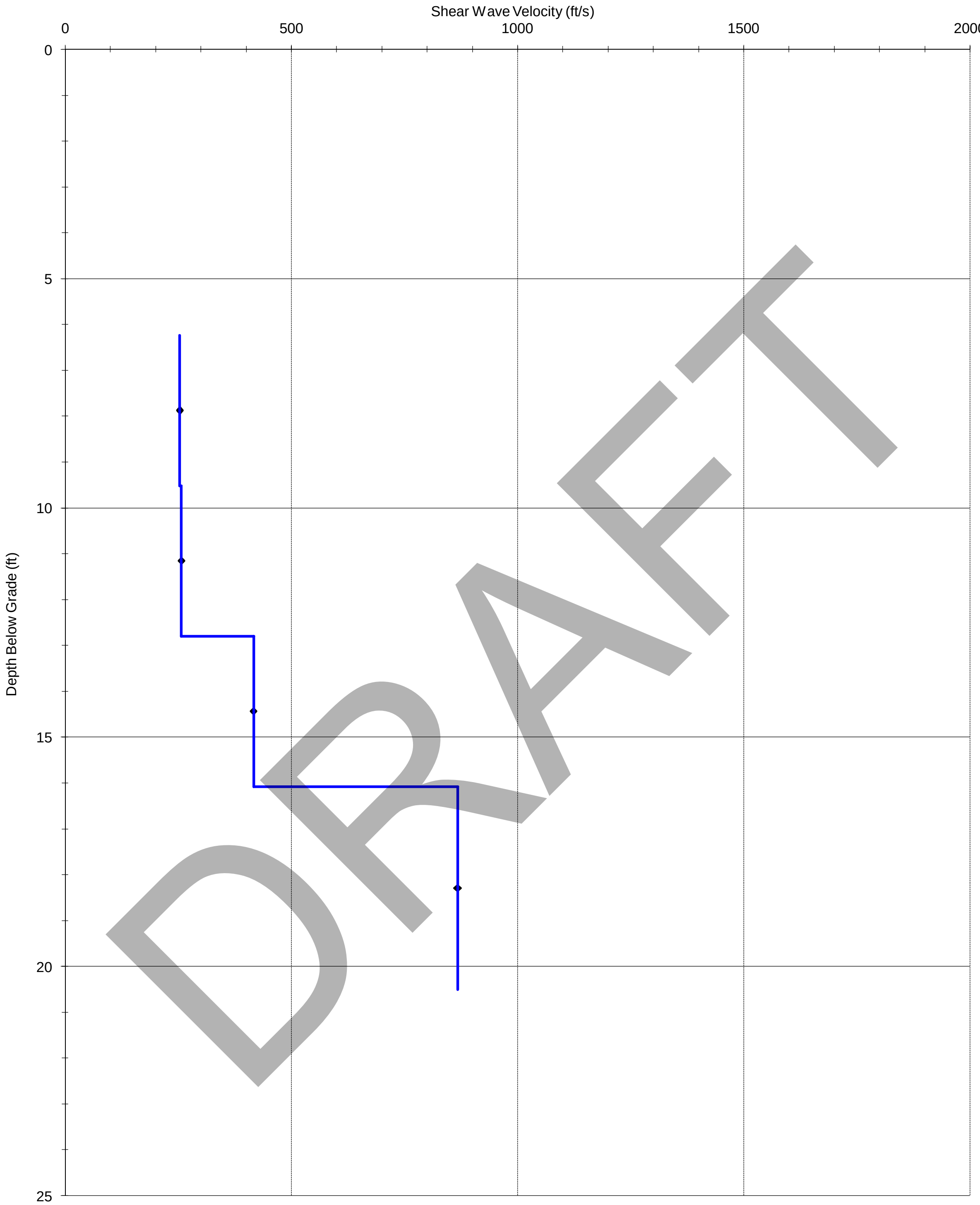



Max Depth: 6.350 m / 20.83 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP02.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997

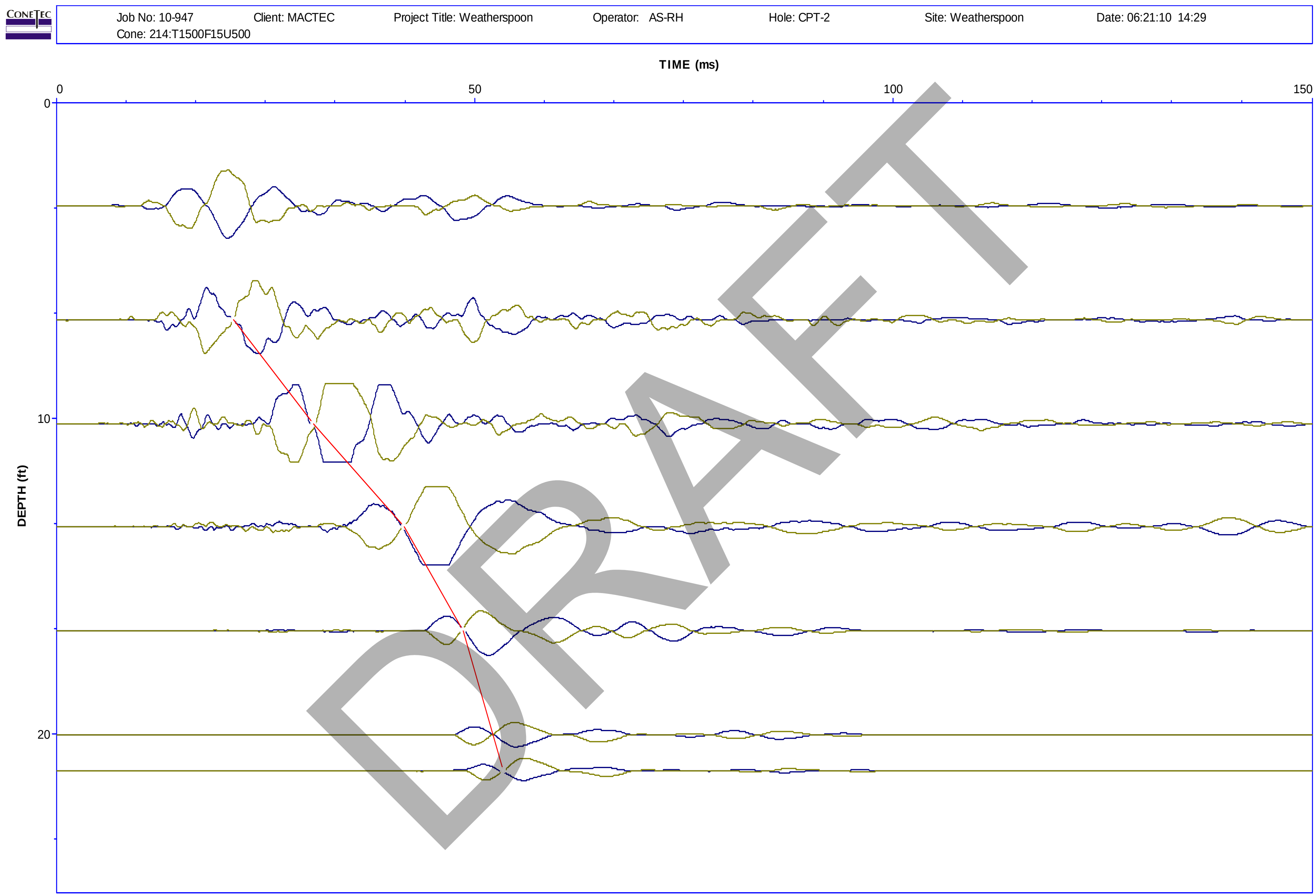
**Shear Wave Velocity- CPT-2**
**Weatherspoon Power Plant**
**10-947**
**June 21, 2010**



# ConeTec Shear Wave Velocity Data Reduction Sheet

| | |
|---|---|
| Hole: | CPT-2 |
| Location: | Weatherspoon Power Plant |
| Cone: | AD214 |
| Date: | 21-Jun-10 |
| Source: | Beam |
| Source Depth | 0.00 m |
| Source Offset | 2.15 m |

| Tip Depth (m) | Geophone Depth(m) | Travel Path (m) | Interval time (ms) | Velocity (m/s) | Velocity (ft/s) | Interval Depth (m) | Interval Depth (ft) |
|---|---|---|---|---|---|---|---|
| 0.00 | | | | | | | |
| 2.10 | 1.90 | 2.87 | | | | | |
| 3.10 | 2.90 | 3.61 | 9.59 | 77.3 | 253.5 | 2.40 | 7.87 |
| 4.10 | 3.90 | 4.45 | 10.77 | 78.3 | 256.8 | 3.40 | 11.15 |
| 5.10 | 4.90 | 5.35 | 7.07 | 126.9 | 416.4 | 4.40 | 14.44 |
| 6.45 | 6.25 | 6.61 | 4.76 | 264.5 | 867.8 | 5.57 | 18.29 |



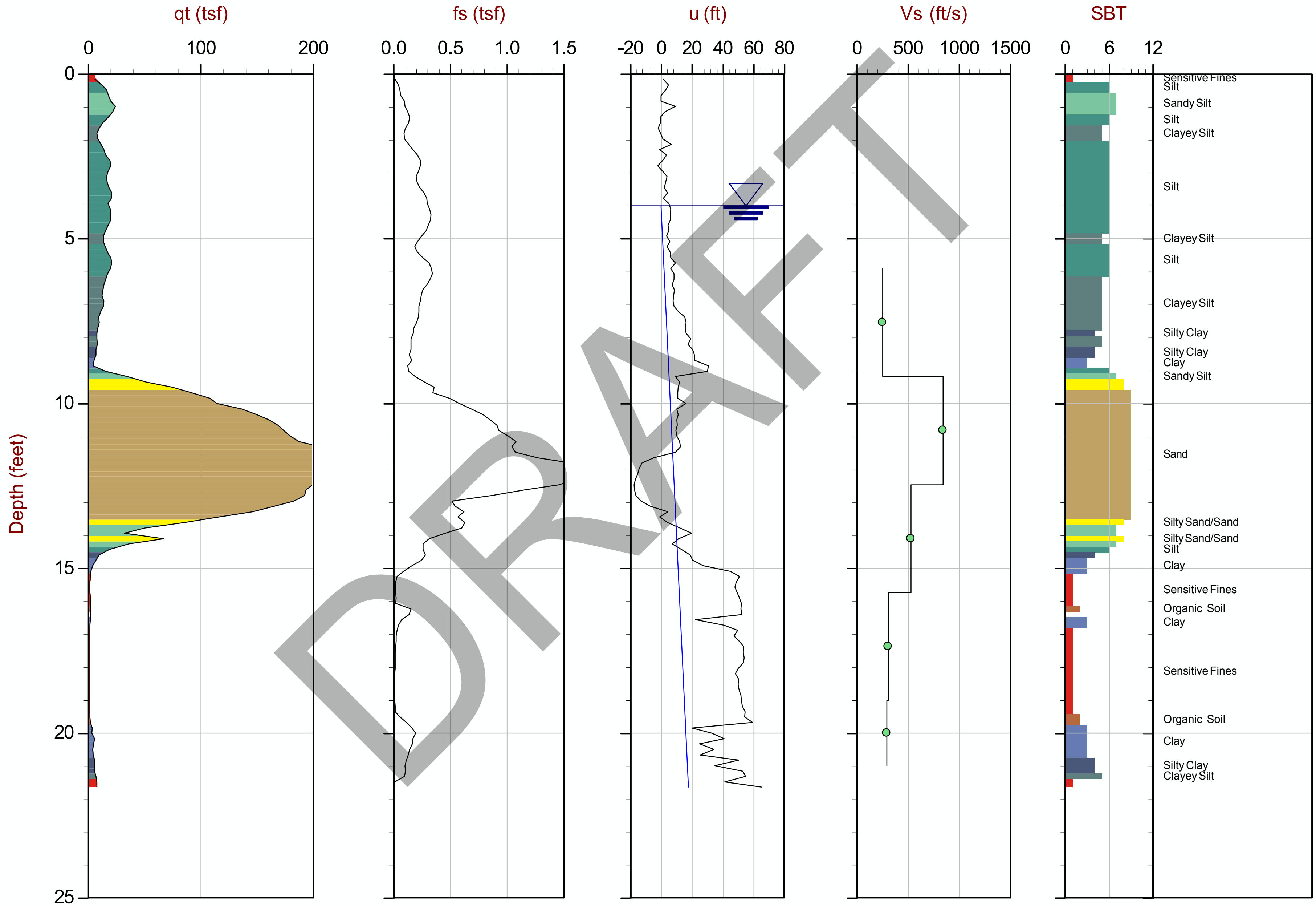
Job No: 10-947
Client: MACTEC
Project Title: Weatherspoon
Operator: AS-RH
Hole: CPT-2
Site: Weatherspoon
Date: 06:21:10 14:29
Cone: 214:T1500F15U500
TIME (ms)
0
50
100
150
DEPTH (ft)
0
10
20
DRAFT

CONETEC

MACTEC

Job No: 10-947
Date: 06:21:10 16:16
Site: Weatherspoon

Sounding: CPT-4
Cone: 214:T1500F15U500
Elevation 143.0

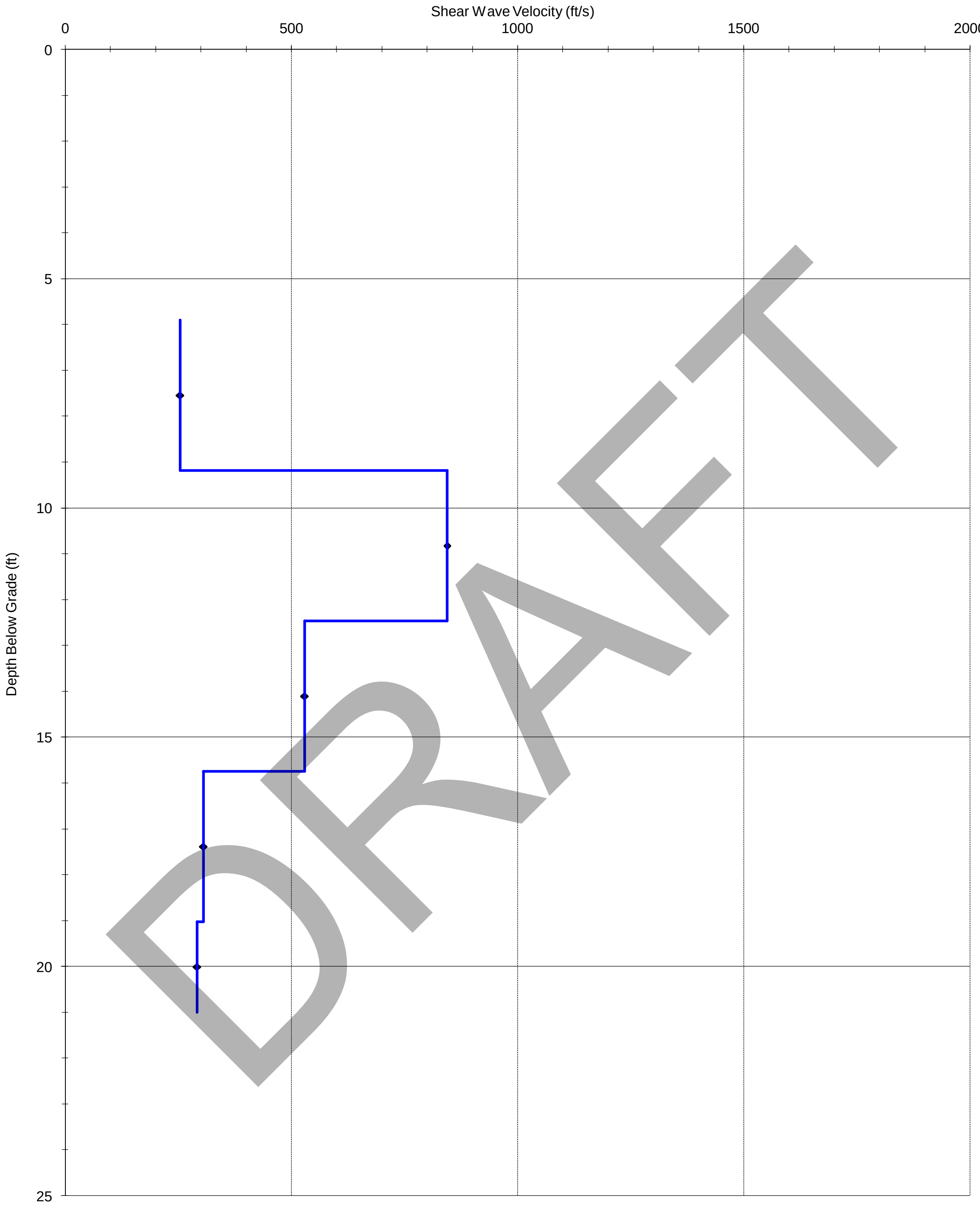



Max Depth: 6.600 m / 21.65 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP04.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

**Shear Wave Velocity- CPT-4**
**Weatherspoon Power Plant**
**10-947**
**June 21, 2010**



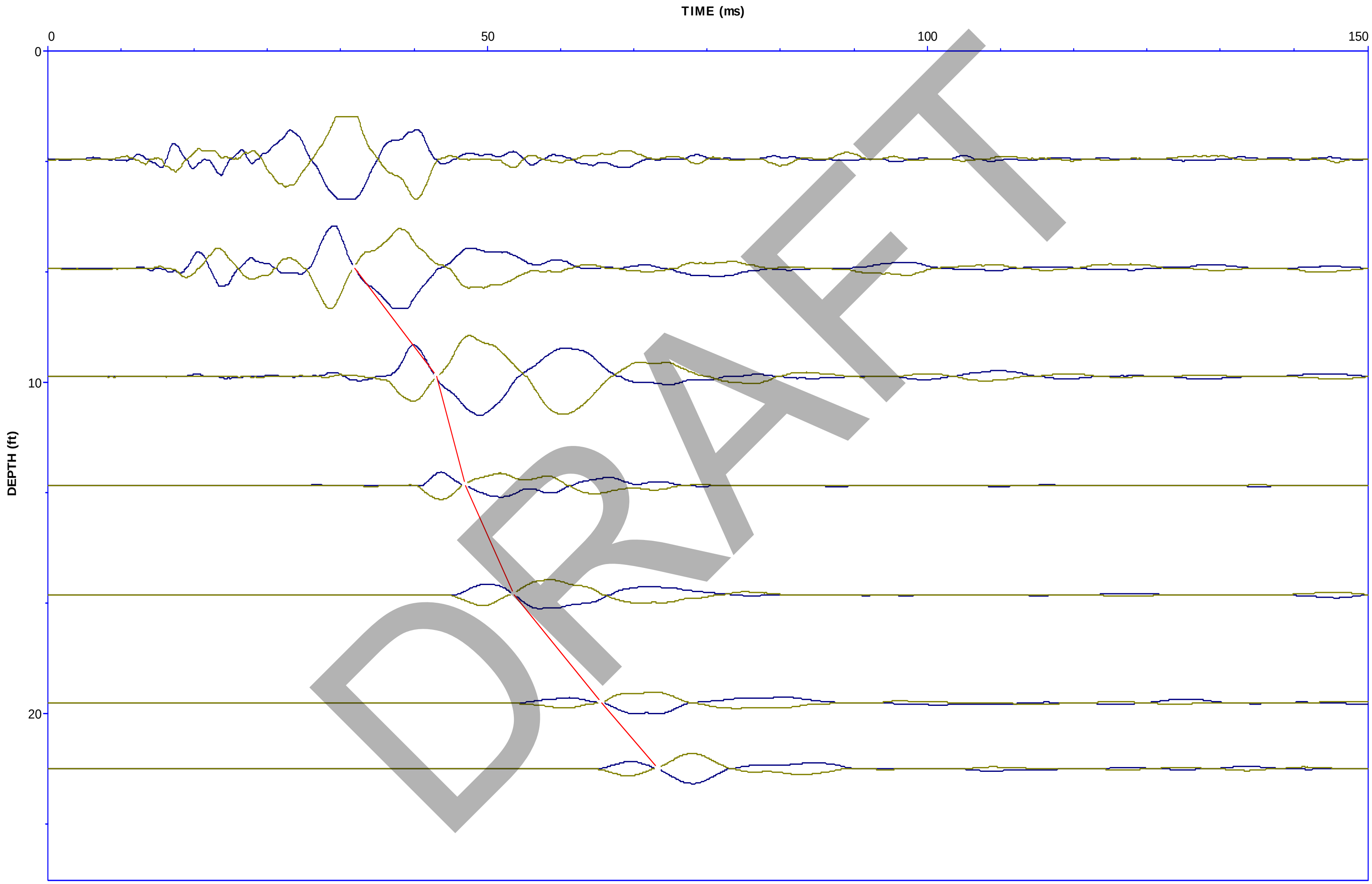
# ConeTec Shear Wave Velocity Data Reduction Sheet

| | |
|---|---|
| Hole: | CPT-4 |
| Location: | Weatherspoon Power Plant |
| Cone: | AD214 |
| Date: | 21-Jun-10 |
| Source: | Beam |
| Source Depth | 0.00 m |
| Source Offset | 2.15 m |

| Tip Depth (m) | Geophone Depth(m) | Travel Path (m) | Interval time (ms) | Velocity (m/s) | Velocity (ft/s) | Interval Depth (m) | Interval Depth (ft) |
|---|---|---|---|---|---|---|---|
| 0.00 | | | | | | | |
| 2.00 | 1.80 | 2.80 | | | | | |
| 3.00 | 2.80 | 3.53 | 9.39 | 77.4 | 253.8 | 2.30 | 7.55 |
| 4.00 | 3.80 | 4.37 | 3.25 | 257.5 | 844.8 | 3.30 | 10.83 |
| 5.00 | 4.80 | 5.26 | 5.54 | 161.4 | 529.4 | 4.30 | 14.11 |
| 6.00 | 5.80 | 6.19 | 9.94 | 93.2 | 305.6 | 5.30 | 17.39 |
| 6.60 | 6.40 | 6.75 | 6.37 | 88.8 | 291.4 | 6.10 | 20.01 |

ConeTec

| | | | | | | |
|---|---|---|---|---|---|---|
| Job No: 10-947 | Client: MACTEC | Project Title: Weatherspoon | Operator: AS-RH | Hole: CPT-4 | Site: Weatherspoon | Date: 06:21:10 16:16 |
| Cone: 214:T1500F15U500 | | | | | | |

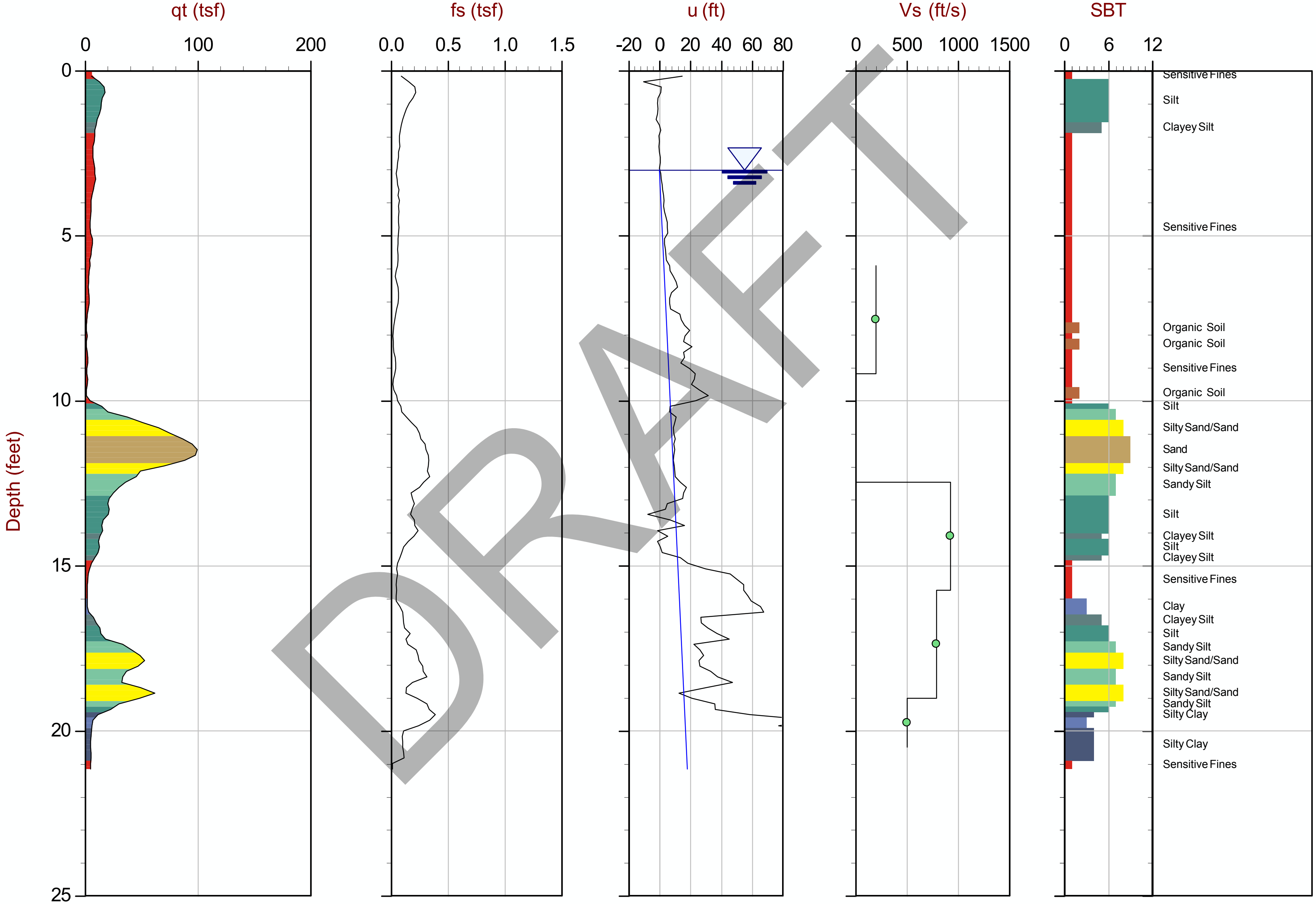


ConeTec

MACTEC

Job No: 10-947
Date: 06:22:10 09:09
Site: Weatherspoon

Sounding: CPT-8
Cone: 214:T1500F15U500
Elevation 138.3

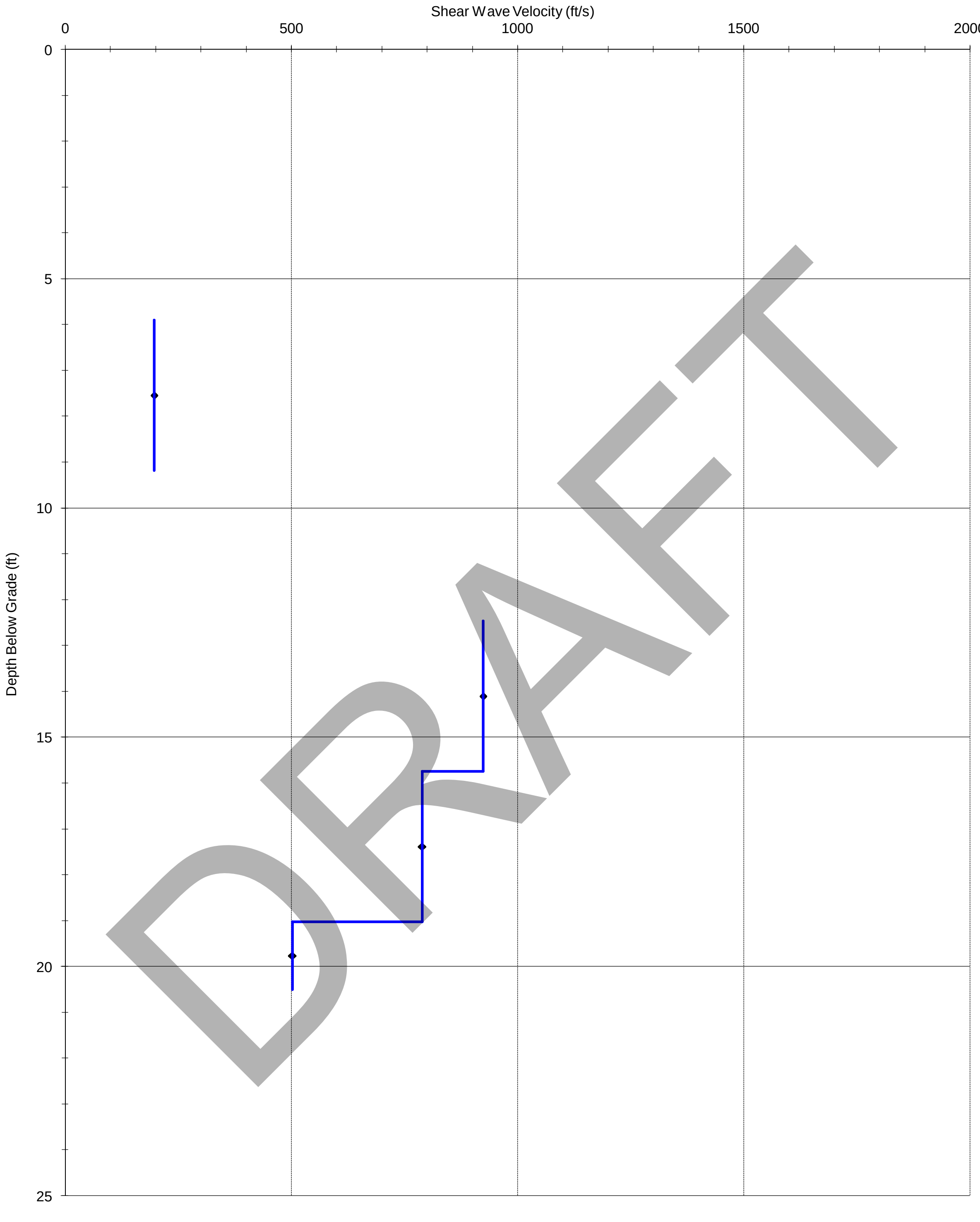



Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 947CP08.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Page No: 1 of 1

**Shear Wave Velocity- CPT-8**
**Weatherspoon Power Plant**
**10-947**
**June 22, 2010**



# ConeTec Shear Wave Velocity Data Reduction Sheet

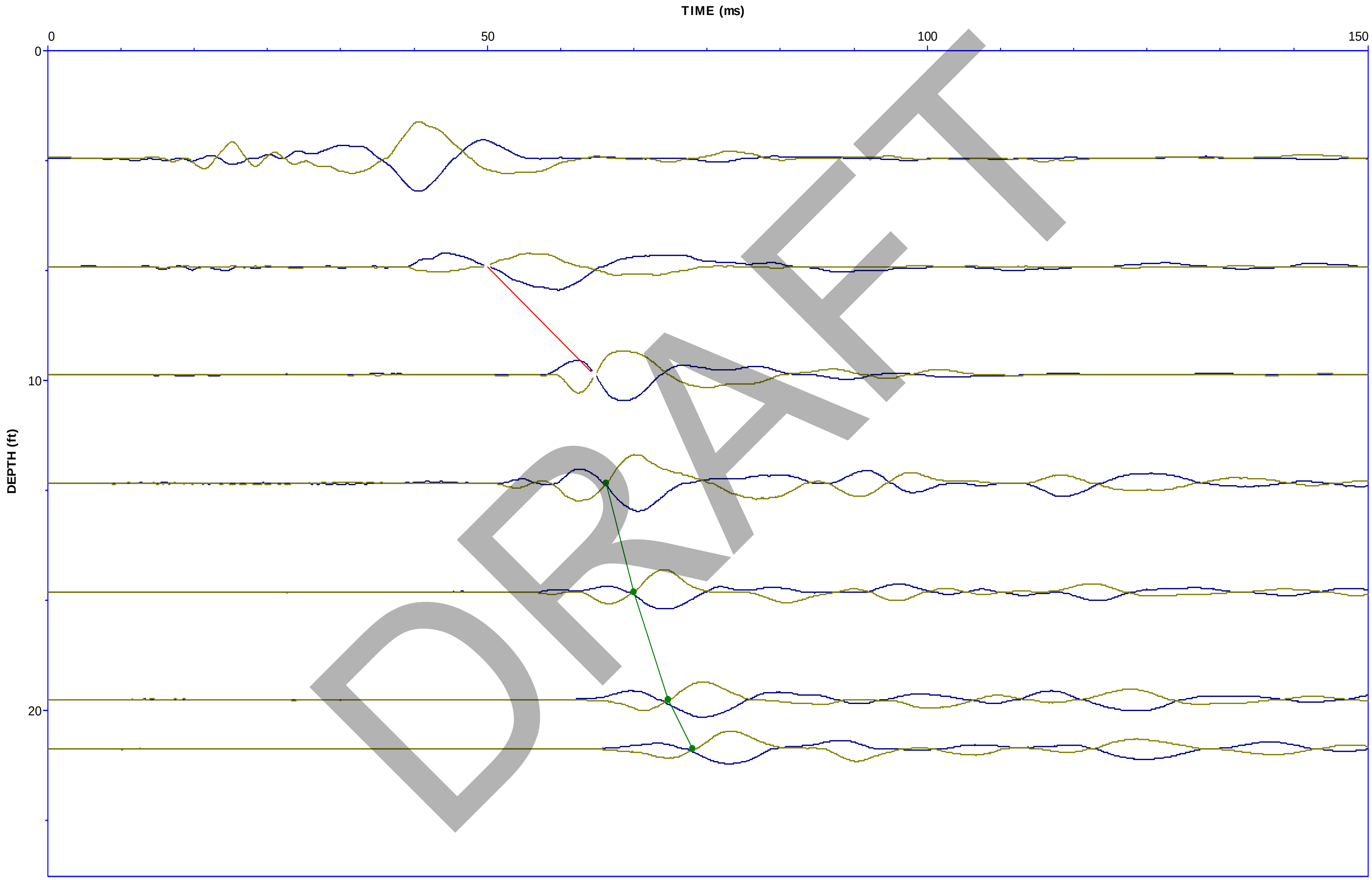
Hole: CPT-8
Location: Weatherspoon Power Plant
Cone: AD214
Date: 22-Jun-10
Source: Beam

| | |
|---|---|
| Source Depth | 0.00 m |
| Source Offset | 2.15 m |

| Tip Depth (m) | Geophone Depth(m) | Travel Path (m) | Interval time (ms) | Velocity (m/s) | Velocity (ft/s) | Interval Depth (m) | Interval Depth (ft) |
|---|---|---|---|---|---|---|---|
| 0.00 | | | | | | | |
| 2.00 | 1.80 | 2.80 | | | | | |
| 3.00 | 2.80 | 3.53 | 12.10 | 60.0 | 196.9 | 2.30 | 7.55 |
| 4.00 | 3.80 | 4.37 | | | | | |
| 5.00 | 4.80 | 5.26 | 3.17 | 281.7 | 924.2 | 4.30 | 14.11 |
| 6.00 | 5.80 | 6.19 | 3.85 | 240.6 | 789.4 | 5.30 | 17.39 |
| 6.45 | 6.25 | 6.61 | 2.77 | 153.0 | 502.1 | 6.02 | 19.77 |

ConeTec

| | | | | | | |
|---|---|---|---|---|---|---|
| Job No: 10-947 | Client: MACTEC | Project Title: Weatherspoon PP | Operator: RK-RH | Hole: CPT-8 | Site: Weatherspoon | Date: 06:22:10 09:09 |
| Cone: 214:T1500F15U500 | | | | | | |



# APPENDIX C

**Laboratory Test Results**

## Summary of Laboratory Test Results-Seepage and Stability Evaluation-North and South Dikes-Weatherspoon Plant, Lumberton, NC.

| Boring No. | Sample No. | Sample Depth (ft) | | Natural Moisture Content (%) | Grain Size | Atterberg Limits | | | USCS | Visual Description/Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | From | To | | # 200 | PL | LL | PI | | |
| NB 3 (UD) | U-1 | 8.0 | 10.0 | ND | 21.2 | 15 | 18 | 3 | SM | Yellow Brown Silty SAND with rootlets/Triaxial test performed |
| NB-4 (UD) | U-1 | 8.0 | 10.0 | ND | 29.5 | 14 | 20 | 6 | SC-SM | Yellow Brown Silty Clayey SAND/Triaxial test performed |
| NB-6 (UD) | U-1 | 13.0 | 15.0 | ND | 21.6 | 14 | 20 | 6 | SC-SM | Olive Gray Lean CLAY with Sand/Triaxial test performed |
| SB-2 (UD) | U-1 | 3.5 | 5.5 | ND | 25.5 | 12 | 24 | 12 | SC | Yellowish Brown Clayey SAND/Triaxial test performed |
| NB-1 | S-5 | 8.5 | 10.0 | 18.9 | ND | NP | 14 | NP | SP* | Light Olive Brown Silty SAND |
| NB-3 | S-5 | 8.5 | 10.0 | 16.9 | 34.2 | 12 | 24 | 12 | SC* | Yellow Brown Clayey SAND |
| NB-3 | S-9 | 28.5 | 30 | ND | 3.6 | ND | ND | ND | SP* | Tan and White Fine SAND |
| NB-4 | S-3 | 3.5 | 5.0 | 7.6 | 3.3 | ND | ND | ND | SP* | Light Gray & Brown |
| NB-4 | S-7 | 18.5 | 20.0 | 40.9 | 3.9 | ND | ND | ND | SP* | Light Yellowish Brown SAND |
| NB-4 | S-9 | 28.5 | 30.0 | ND | 19.5 | ND | ND | ND | SC* | Grayish Brown Clayey Fine to Medium SAND |
| NB-5 | S-8 | 23.5 | 25.0 | ND | 37.7 | 15 | 23 | 8 | SC* | Orange Brown Clayey SAND |
| NB-7 | S-3 | 3.5 | 5.0 | 7.8 | 17.4 | ND | ND | ND | SM* | Brown Silty SAND |
| NB 8 | S-4 | 6.0 | 7.5 | 13.9 | 20.4 | ND | ND | ND | SC* | Brown and Gray Clayey SAND |
| SB-1 | S-3 | 3.5 | 5.0 | 11.7 | 27.4 | ND | ND | ND | SC* | Gray & Tan Clayey SAND |
| SB 1 | S-7 | 18.5 | 20.0 | 16.6 | ND | 13 | 30 | 17 | SC* | Reddish Brown Clayey Fine to Medium SAND |
| SB-3 | S-3 | 3.5 | 5.0 | 13.4 | 30.3 | 12 | 21 | 9 | SM* | Brown Silty SAND |
| SB-4 | S-4 | 6.0 | 7.5 | 24.0 | 11.1 | ND | ND | ND | SM* | Brown and Black Silty Fine SAND |
| SB-5 | S-3 | 3.5 | 5.0 | 12.3 | 25 | ND | ND | ND | SC* | Mixed Brown Clayey SAND |
| SB-5 | S-4 | 6.0 | 7.5 | 15.4 | ND | 12 | 23 | 11 | SC* | Olive Yellow Fine Clayey F/M SAND |
| SB-7 | S-3 | 3.5 | 5.0 | ND | 29.1 | 14 | 35 | 21 | SC* | Yellowish Brown Clayey SAND |
| SB-7 | S-9 | 28.5 | 30.0 | ND | 7.4 | ND | ND | ND | SP* | Light Gray to White Fine SAND |
| SB-8 | S-3 | 3.5 | 5.0 | 15.7 | 26.1 | 14 | 23 | 9 | SC* | Olive Yellow Clayey SAND |
| SB-9 | S-2 | 1.5 | 3.0 | ND | 12.5 | ND | ND | ND | SC* | Reddish Brown Silty SAND |
| SB-9 | S-7 | 18.5 | 20.0 | ND | 28 | 12 | 24 | 12 | SC* | Light Brown Clayey Fine SAND |

USCS = Unified Soil Classification System Group Symbol
PL = Plastic Limit
LL = Liquid Limit
P.I. = Plasticity Index
NP = Non Plastic
NV = No Value
ND = Not Determined
*Visual Classification

Prepared By: V.A.S

Checked By: JAJ

July 23, 2010

Project No. 2010-692-01

Mr. Al Tice
MACTEC
3301 Atlantic Ave.
Raleigh, NC 27604

atice@mactec.com

**Transmittal**
**Laboratory Test Results**
**Weatherspoon Plant**

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was faxed to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
***Geotechnics, Inc.***

Michael P. Smith
Regional Manager

NOTE: Through a labeling error, samples furnished to Geotechnics labeled NB-2 and NB-3 were actually samples NB-3 and NB-4. MACTEC has corrected the sample numbers in this report to reflect correct numbering. J. A. Tice, MACTEC Senior Principal Engineer

***We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.***

geotechnics
INTEGRITY IN TESTING

# CONSOLIDATED UNDRAINED TRIAXIAL TEST
# WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | | |
| Client Reference | WEATHERSPOON PLANT | | |
| Project No. | 2010-692-01 | | |
| Lab ID | 2010-692-01-01 | Specific Gravity (assumed) | 2.7 |

Visual Description: BROWN SANDY SILT



## SAMPLE CONDITION SUMMARY

| | | |
|---|---|---|
| Boring No. | NB-3 | NB-3 |
| Depth (ft) | 9.4-9.9 | 8.9-9.4 |
| Sample No. | NA | NA |
| Test No. | T1 | T2 |
| Deformation Rate (in/min) | 0.004 | 0.004 |
| Back Pressure (psi) | 40.0 | 40.0 |
| Consolidation Time (days) | 1 | 1 |
| Initial State (w%) | 11.4 | 15.4 |
| Total Unit Weight (pcf) | 113.6 | 112.3 |
| Dry Unit Weight (pcf) | 102.0 | 97.3 |
| Final State (w%) | 20.2 | 20.9 |
| Initial State Void Ratio,e | 0.652 | 0.732 |
| Void Ratio at Shear, e | 0.621 | 0.657 |

Tested By TMS Date 7/19/2010 Input Checked By [signature] Date 7-22-10



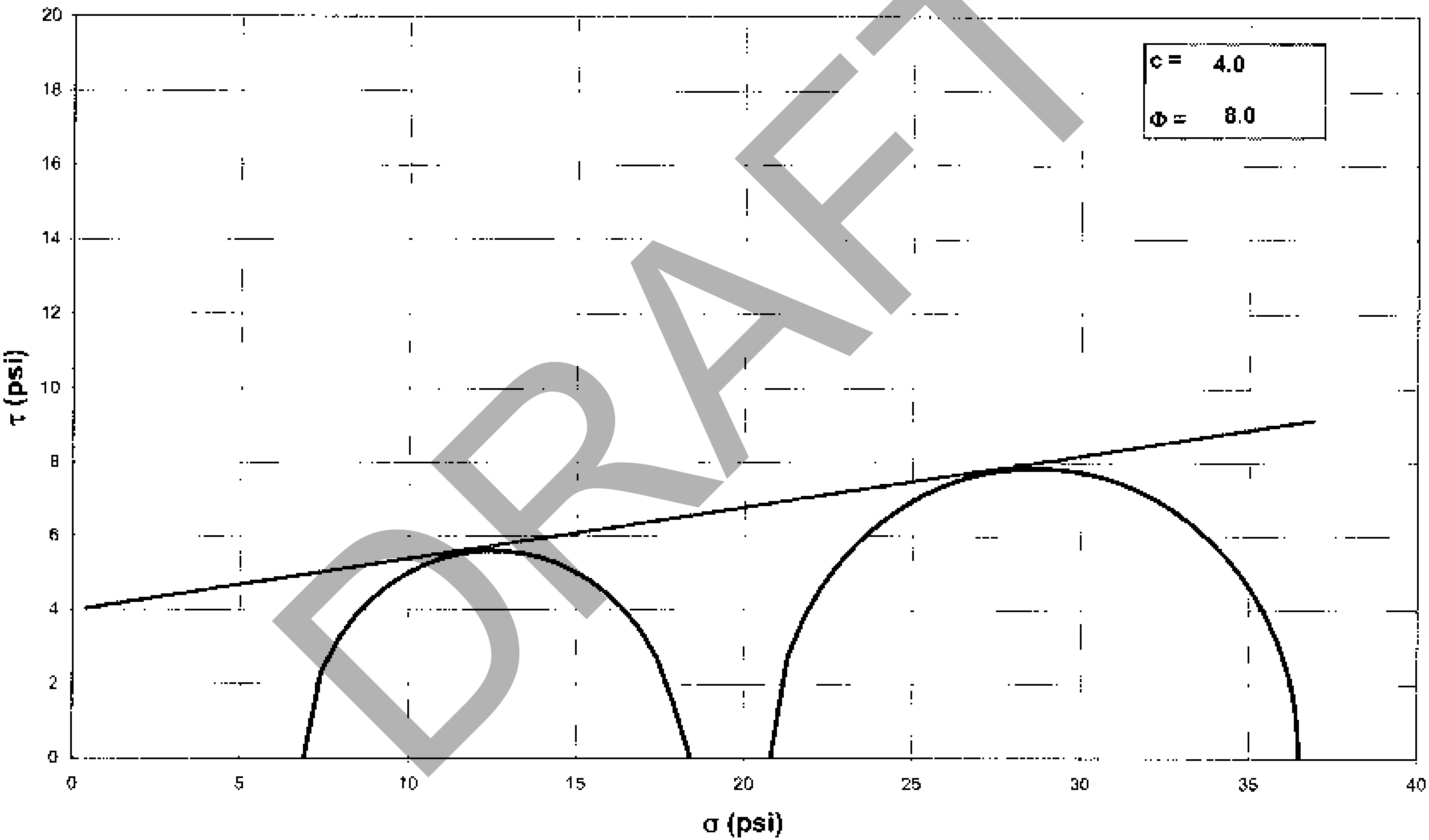


2200 Westinghouse Boulevard • Suite 103 • Raleigh, NC 27604 • Phone (919) 876-0405 • Fax (919) 876-0460 • www.geotechnics.net

# MOHR TOTAL STRENGTH ENVELOPE

geotechnics
INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 3 |
| Client Ref. No. | WEATHERSPOON PLANT | Depth(ft.) | 8-10 |
| Project no. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | Visual Description | BROWN SANDY SILT |






NOTE: GRAPH NOT TO SCALE

*Tested By:* TMS *Date:* 7/19/2010 *Approved By:* [signature] *Date:* 7-22-10

\\SERVER\Data Drive\2010 PROJECTS\2010-692 MACTEC\[2010-692-01-01 SIGMATRIAX.xls]SHEET1

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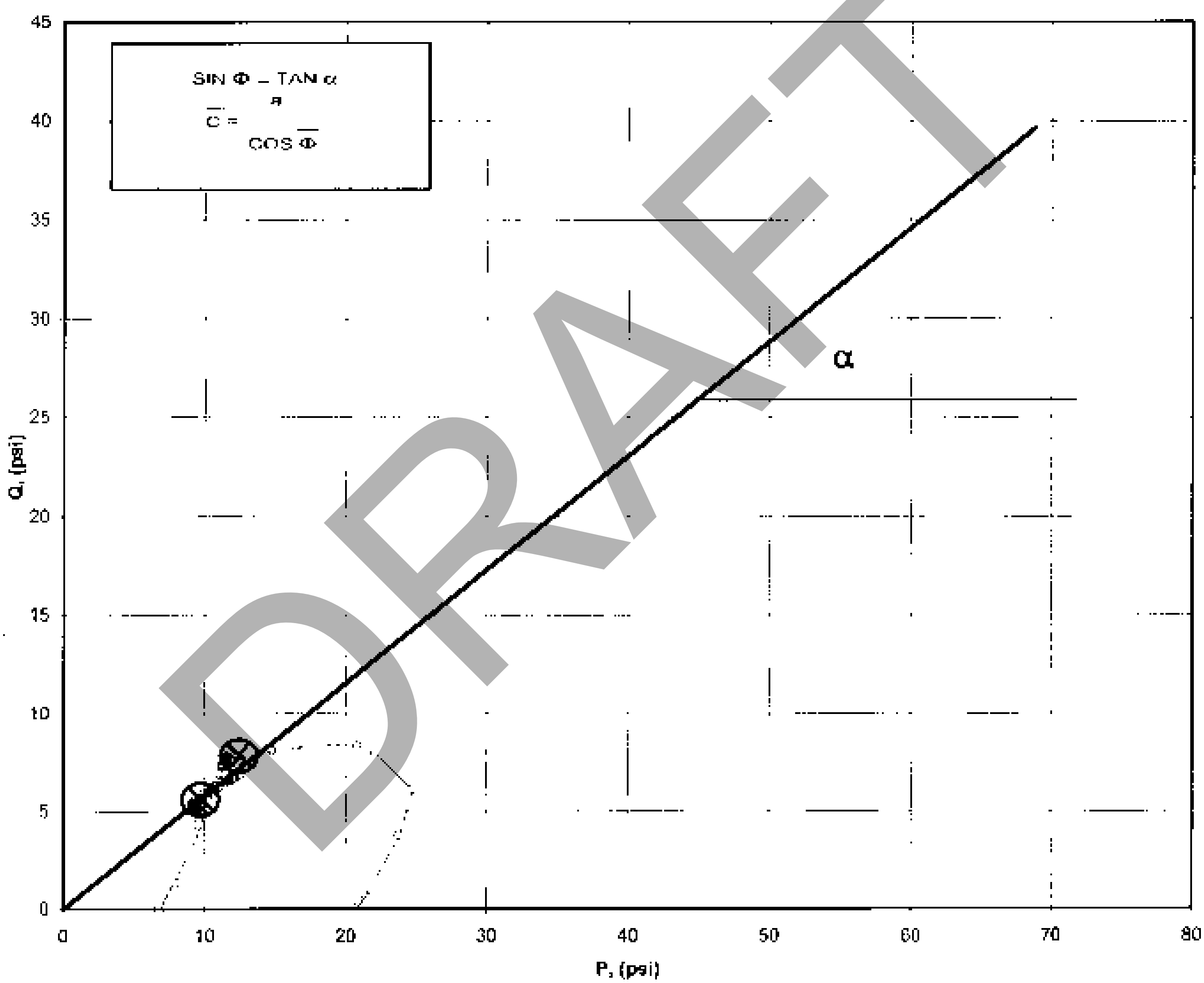
**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8-10 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |

**Consolidated Undrained Triaxial Test with Pore Pressure**






| | | | | | |
|---|---|---|---|---|---|
| a | = | 0.00 | $\bar{C}$ | = | 0.00 |
| α | = | 30.0 | $\bar{\Phi}$ | = | 35.19 |

Tested By TMS Date 7/19/2010 Approved By MHS Date 7-22-10


DCN: CT-S28 DATE 6-25-98 REVISION 1

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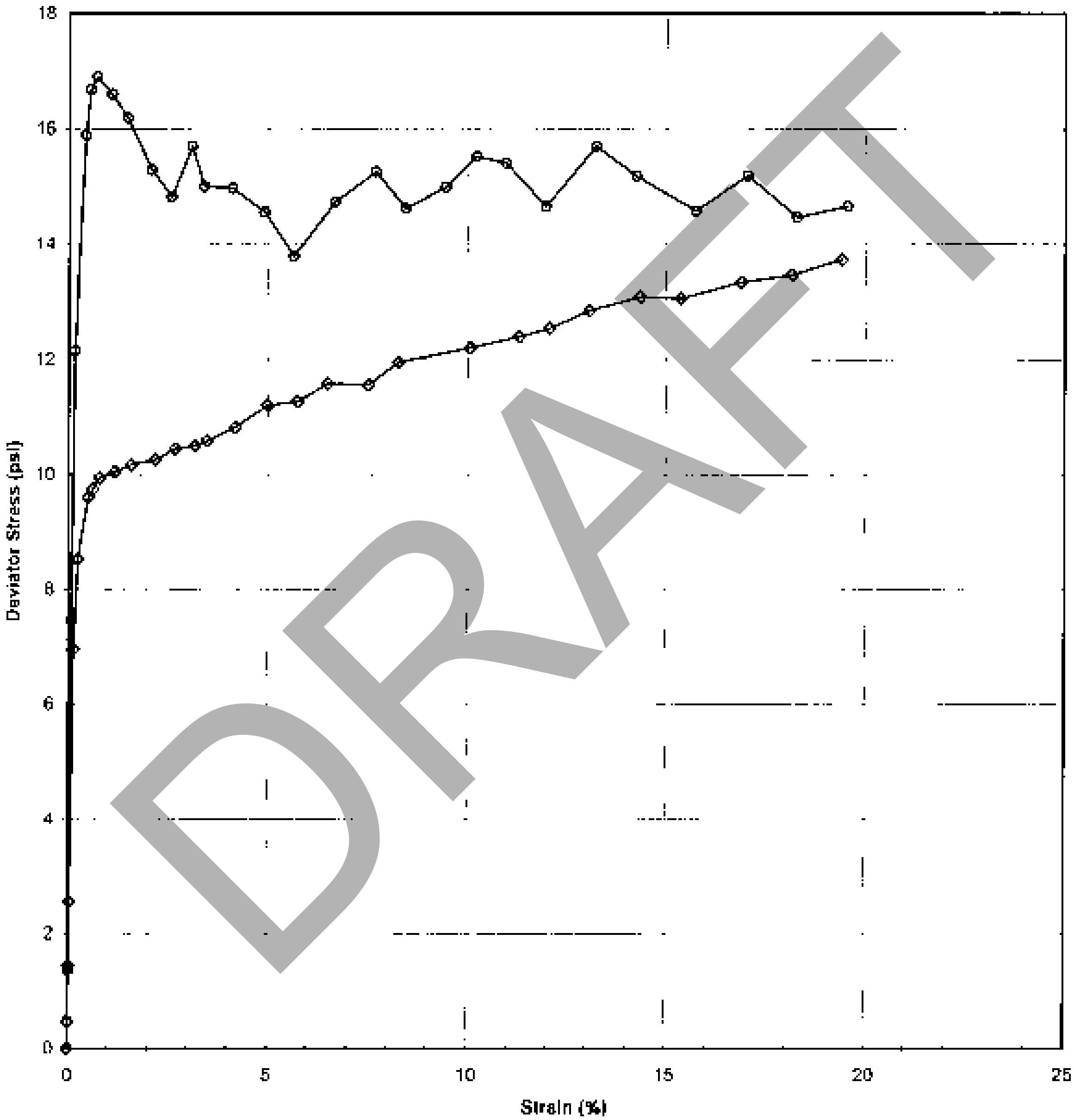
**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8-10 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |
| Visual Description: | BROWN SILTY SAND (UNDISTURBED) | | |

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 9.4-9.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |

Visual Description: BROWN SILTY SAND (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 1 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.930 | Diameter 1 | 2.851 |
| Length 2 | 5.935 | Diameter 2 | 2.854 |
| Length 3 | 5.936 | Diameter 3 | 2.874 |
| Avg Leng.= | 5.934 | Avg. Diam.= | 2.860 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 46.9 |
| Back Pressure(psi) | 40.0 |
| Eff. Cons. Pressure(psi) | 6.9 |
| Pore Pressure Response (%) | 97 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 21.7 |
| Final Change (ml) | 2.3 |
| Initial Dial Reading (D.R.), mils | 104 |
| D.R. After Saturation, mils | 134 |
| D.R. After Consolidation, mils | 142 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 9.72

Q = 5.60

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 8.6 | 0.000 | 40.0 |
| 17.7 | 0.001 | 40.2 |
| 24.8 | 0.003 | 40.4 |
| 52.7 | 0.007 | 41.0 |
| 62.7 | 0.013 | 41.4 |
| 69.8 | 0.029 | 41.9 |
| 70.7 | 0.036 | 42.0 |
| 72.1 | 0.046 | 42.1 |
| 73.0 | 0.068 | 42.4 |
| 74.1 | 0.092 | 42.6 |
| 75.1 | 0.128 | 42.8 |
| 76.6 | 0.158 | 42.8 |
| 77.3 | 0.187 | 42.8 |
| 78.1 | 0.204 | 42.8 |
| 80.2 | 0.247 | 42.8 |
| 83.3 | 0.294 | 42.8 |
| 84.4 | 0.339 | 42.7 |
| 87.1 | 0.383 | 42.5 |
| 87.8 | 0.443 | 42.6 |
| 91.2 | 0.487 | 42.5 |
| 94.6 | 0.593 | 42.3 |
| 97.2 | 0.666 | 42.2 |
| 99.0 | 0.712 | 42.1 |
| 102.3 | 0.771 | 42.0 |
| 105.5 | 0.846 | 41.9 |
| 106.4 | 0.905 | 41.7 |
| 110.3 | 0.995 | 41.6 |
| 112.9 | 1.070 | 41.5 |
| 116.6 | 1.144 | 41.3 |

Tested By TMS Date 7/19/2010 Input Checked By MPS Date 7-22-10



DCN. CT-S28 DATE 6-25-96 REVISION 1

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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 9.4-9.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |

Visual Description: BROWN SILTY SAND (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 6.9 | *Stage No.* | 1 |
| | | *Test No* | 1 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.93 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.42 |
| Initial Sample Volume (in^3) | 38.11 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 37.39 |
| Length After Consolidation (in) | 5.90 |
| Area After Consolidation (in^2) | 6.342 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.02 | 1.43 | 0.22 | 8.11 | 6.7 | 1.215 | 0.16 | 7.40 | 0.72 |
| 0.04 | 2.57 | 0.35 | 9.11 | 6.5 | 1.392 | 0.14 | 7.83 | 1.28 |
| 0.13 | 6.95 | 1.04 | 12.81 | 5.9 | 2.187 | 0.15 | 9.33 | 3.48 |
| 0.23 | 8.52 | 1.38 | 14.04 | 5.5 | 2.542 | 0.17 | 9.78 | 4.26 |
| 0.49 | 9.61 | 1.86 | 14.65 | 5.0 | 2.906 | 0.20 | 9.84 | 4.80 |
| 0.62 | 9.74 | 2.02 | 14.62 | 4.9 | 2.997 | 0.21 | 9.75 | 4.87 |
| 0.78 | 9.94 | 2.10 | 14.74 | 4.8 | 3.073 | 0.22 | 9.77 | 4.97 |
| 1.16 | 10.05 | 2.38 | 14.57 | 4.5 | 3.223 | 0.24 | 9.54 | 5.02 |
| 1.57 | 10.17 | 2.56 | 14.51 | 4.3 | 3.342 | 0.26 | 9.43 | 5.08 |
| 2.18 | 10.26 | 2.78 | 14.38 | 4.1 | 3.487 | 0.28 | 9.25 | 5.13 |
| 2.67 | 10.45 | 2.80 | 14.55 | 4.1 | 3.549 | 0.28 | 9.32 | 5.22 |
| 3.17 | 10.50 | 2.84 | 14.56 | 4.1 | 3.585 | 0.28 | 9.31 | 5.25 |
| 3.47 | 10.59 | 2.82 | 14.67 | 4.1 | 3.596 | 0.27 | 9.37 | 5.29 |
| 4.18 | 10.82 | 2.85 | 14.88 | 4.1 | 3.671 | 0.27 | 9.47 | 5.41 |
| 4.99 | 11.20 | 2.78 | 15.32 | 4.1 | 3.721 | 0.26 | 9.72 | 5.60 |
| 5.74 | 11.27 | 2.73 | 15.44 | 4.2 | 3.703 | 0.25 | 9.80 | 5.63 |
| 6.49 | 11.58 | 2.48 | 16.00 | 4.4 | 3.622 | 0.22 | 10.21 | 5.79 |
| 7.51 | 11.56 | 2.62 | 15.84 | 4.3 | 3.701 | 0.23 | 10.06 | 5.78 |
| 8.26 | 11.95 | 2.47 | 16.38 | 4.4 | 3.698 | 0.21 | 10.40 | 5.97 |
| 10.06 | 12.21 | 2.33 | 16.77 | 4.6 | 3.671 | 0.20 | 10.67 | 6.10 |
| 11.30 | 12.40 | 2.18 | 17.12 | 4.7 | 3.625 | 0.18 | 10.92 | 6.20 |
| 12.07 | 12.54 | 2.07 | 17.37 | 4.8 | 3.595 | 0.17 | 11.10 | 6.27 |
| 13.08 | 12.85 | 1.98 | 17.76 | 4.9 | 3.612 | 0.16 | 11.34 | 6.42 |
| 14.35 | 13.09 | 1.86 | 18.13 | 5.0 | 3.595 | 0.15 | 11.58 | 6.54 |
| 15.30 | 13.06 | 1.73 | 18.23 | 5.2 | 3.524 | 0.14 | 11.70 | 6.53 |
| 16.88 | 13.34 | 1.58 | 18.65 | 5.3 | 3.509 | 0.12 | 11.98 | 6.67 |
| 18.15 | 13.47 | 1.47 | 18.90 | 5.4 | 3.478 | 0.11 | 12.17 | 6.73 |
| 19.40 | 13.73 | 1.30 | 19.33 | 5.6 | 3.454 | 0.10 | 12.46 | 6.87 |

DRAFT

Tested By TMS Date 7/19/2010 Input Checked By MM Date 7-22-10


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# CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-528)

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INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.9-9.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |

Visual Description: BROWN SILTY SAND (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 2 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 60.8 |
| Back Pressure(psi) | 40.0 |
| Eff. Cons. Pressure(ps | 20.8 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

| | | |
|---|---|---|
| $\overline{P}$ | = | 12.45 |
| Q | = | 7.85 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.996 | Diameter 1 | 2.867 |
| Length 2 | 5.969 | Diameter 2 | 2.861 |
| Length 3 | 5.988 | Diameter 3 | 2.852 |
| Avg Leng.= | 5.984 | Avg. Diam.= | 2.860 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 15.8 |
| Final Change (ml) | 8.2 |
| Initial Dial Reading (D.R.), mils | 89 |
| D.R. After Saturation, mils | 149 |
| D.R. After Consolidation, mils | 166 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 8.7 | 0.000 | 40.0 |
| 11.6 | 0.001 | 40.0 |
| 17.2 | 0.002 | 40.0 |
| 55.1 | 0.004 | 40.7 |
| 84.5 | 0.009 | 42.1 |
| 108.1 | 0.024 | 46.6 |
| 113.2 | 0.031 | 48.2 |
| 114.7 | 0.041 | 50.1 |
| 113.2 | 0.063 | 52.6 |
| 111.0 | 0.086 | 54.1 |
| 105.9 | 0.122 | 55.3 |
| 103.4 | 0.152 | 55.8 |
| 109.6 | 0.182 | 56.2 |
| 105.4 | 0.201 | 56.3 |
| 105.9 | 0.242 | 56.4 |
| 104.0 | 0.290 | 56.7 |
| 99.7 | 0.333 | 56.6 |
| 107.0 | 0.394 | 56.8 |
| 111.7 | 0.454 | 56.8 |
| 108.2 | 0.498 | 56.7 |
| 111.8 | 0.558 | 56.8 |
| 116.3 | 0.603 | 56.9 |
| 116.5 | 0.647 | 56.8 |
| 112.4 | 0.707 | 56.8 |
| 121.4 | 0.782 | 56.9 |
| 119.0 | 0.841 | 56.7 |
| 116.5 | 0.929 | 56.8 |
| 122.7 | 1.006 | 56.5 |
| 118.9 | 1.079 | 56.7 |
| 122.2 | 1.155 | 56.7 |

Tested By TMS Date 7/19/2010 Input Checked By MPS Date 7-22-10



DCN CT-S28 DATE 6-25-98 REVISION 1

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-528)

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INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 3 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.9-9.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-01 | | |

Visual Description: BROWN SILTY SAND (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 20.8 | *Stage No.* | 1 |
| | | *Test No* | 2 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.98 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.42 |
| Initial Sample Volume (in^3) | 38.44 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 36.79 |
| Length After Consolidation (in) | 5.91 |
| Area After Consolidation (in^2) | 6.228 |

| Strain (%) | Deviation Stress | Δ U | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.01 | 0.47 | -0.03 | 21.30 | 20.8 | 1.023 | -0.07 | 21.07 | 0.23 |
| 0.03 | 1.37 | 0.01 | 22.16 | 20.8 | 1.066 | 0.01 | 21.47 | 0.68 |
| 0.07 | 7.45 | 0.69 | 27.56 | 20.1 | 1.370 | 0.09 | 23.84 | 3.73 |
| 0.15 | 12.15 | 2.08 | 30.87 | 18.7 | 1.649 | 0.18 | 24.80 | 6.07 |
| 0.41 | 15.89 | 6.59 | 30.10 | 14.2 | 2.118 | 0.43 | 22.15 | 7.94 |
| 0.52 | 16.68 | 8.25 | 29.23 | 12.6 | 2.329 | 0.51 | 20.89 | 8.34 |
| 0.69 | 16.90 | 10.07 | 27.63 | 10.7 | 2.575 | 0.61 | 19.18 | 8.45 |
| 1.06 | 16.60 | 12.55 | 24.85 | 8.2 | 3.012 | 0.78 | 16.55 | 8.30 |
| 1.46 | 16.19 | 14.08 | 22.91 | 6.7 | 3.408 | 0.90 | 14.82 | 8.09 |
| 2.06 | 15.29 | 15.30 | 20.79 | 5.5 | 3.781 | 1.03 | 13.14 | 7.64 |
| 2.57 | 14.82 | 15.85 | 19.77 | 5.0 | 3.994 | 1.10 | 12.36 | 7.41 |
| 3.08 | 15.70 | 16.20 | 20.30 | 4.6 | 4.413 | 1.06 | 12.45 | 7.85 |
| 3.40 | 15.00 | 16.30 | 19.50 | 4.5 | 4.335 | 1.12 | 12.00 | 7.50 |
| 4.10 | 14.97 | 16.37 | 19.40 | 4.4 | 4.375 | 1.13 | 11.92 | 7.48 |
| 4.90 | 14.55 | 16.65 | 18.70 | 4.1 | 4.509 | 1.18 | 11.42 | 7.28 |
| 5.64 | 13.78 | 16.58 | 18.01 | 4.2 | 4.264 | 1.24 | 11.11 | 6.89 |
| 6.67 | 14.73 | 16.77 | 18.76 | 4.0 | 4.654 | 1.17 | 11.40 | 7.37 |
| 7.69 | 15.26 | 16.82 | 19.23 | 4.0 | 4.839 | 1.14 | 11.60 | 7.63 |
| 8.43 | 14.62 | 16.71 | 18.71 | 4.1 | 4.575 | 1.18 | 11.40 | 7.31 |
| 9.44 | 14.99 | 16.82 | 18.97 | 4.0 | 4.770 | 1.16 | 11.47 | 7.50 |
| 10.21 | 15.52 | 16.87 | 19.45 | 3.9 | 4.950 | 1.12 | 11.69 | 7.76 |
| 10.96 | 15.41 | 16.85 | 19.36 | 4.0 | 4.897 | 1.13 | 11.66 | 7.70 |
| 11.96 | 14.66 | 16.83 | 18.63 | 4.0 | 4.688 | 1.18 | 11.30 | 7.33 |
| 13.24 | 15.70 | 16.86 | 19.65 | 3.9 | 4.980 | 1.11 | 11.80 | 7.85 |
| 14.24 | 15.18 | 16.70 | 19.28 | 4.1 | 4.702 | 1.13 | 11.69 | 7.59 |
| 15.73 | 14.58 | 16.79 | 18.59 | 4.0 | 4.633 | 1.19 | 11.30 | 7.29 |
| 17.02 | 15.19 | 16.53 | 19.47 | 4.3 | 4.556 | 1.12 | 11.87 | 7.60 |
| 18.27 | 14.47 | 16.71 | 18.56 | 4.1 | 4.533 | 1.19 | 11.33 | 7.23 |
| 19.55 | 14.66 | 16.73 | 18.74 | 4.1 | 4.600 | 1.18 | 11.40 | 7.33 |

Tested By TMS Date 7/19/2010 Input Checked By MMS Date 7-22-10



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# CONSOLIDATED UNDRAINED TRIAXIAL TEST
# WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-528)

| | | | |
|---|---|---|---|
| Client | MACTEC | | |
| Client Reference | WEATHERSPOON PLANT | | |
| Project No. | 2010-692-01 | | |
| Lab ID | 2010-692-01-02 | Specific Gravity (assumed) | 2.7 |

Visual Description: TAN SILTY SAND (UNDISTURBED)

## SAMPLE CONDITION SUMMARY

| | | | |
|---|---|---|---|
| Boring No. | NB-4 | NB-4 | NB-4 |
| Depth (ft) | 8.4-8.9 | 8.9-9.4 | 9.4-9.9 |
| Sample No. | NA | NA | NA |
| Test No. | T1 | T2 | T3 |
| Deformation Rate (in/min) | 0.004 | 0.004 | 0.004 |
| Back Pressure (psi) | 40.0 | 40.0 | 39.9 |
| Consolidation Time (days) | 1 | 1 | 1 |
| Initial State (w%) | 17.8 | 17.8 | 17.8 |
| Total Unit Weight (pcf) | 119.2 | 124.5 | 125.6 |
| Dry Unit Weight (pcf) | 101.2 | 105.6 | 106.6 |
| Final State (w%) | 19.1 | 19.2 | 19.1 |
| Initial State Void Ratio,e | 0.666 | 0.595 | 0.582 |
| Void Ratio at Shear, e | 0.630 | 0.562 | 0.528 |



Tested By TMS Date 7/15/2010 Input Checked By [illegible] Date 7-19-10

 DCN CT-S29 DATE 12-9-08 REVISION 2 \\SERVER\Data Drive\Data Sheets\[illegible]\Sheet1

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# MOHR TOTAL STRENGTH ENVELOPE

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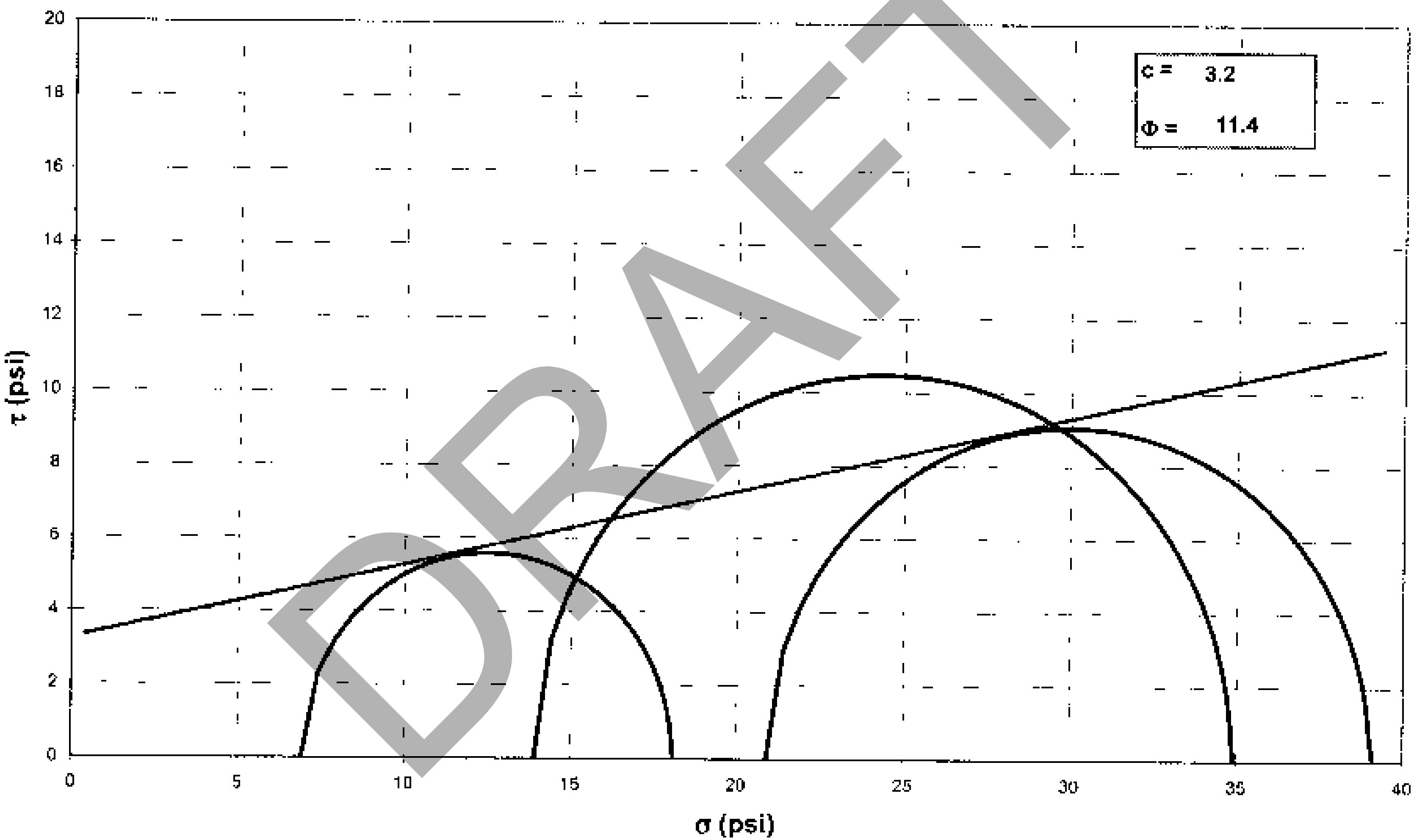
| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | BNB-4 |
| Client Ref. No. | WEATHERSPOON PLANT | Depth(ft.) | 8.4-8.9 |
| Project no. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | Visual Description | BROWN CLAY |






NOTE GRAPH NOT TO SCALE

*Tested By:* TMS *Date:* 7/15/2010 *Approved By:* MJT *Date:* 7-14-10

\\SERVER\Data Drive\2010 PROJECTS\2010-692 MACTEC\[2010-692-01-02 MOHR.XLS]Sheet1

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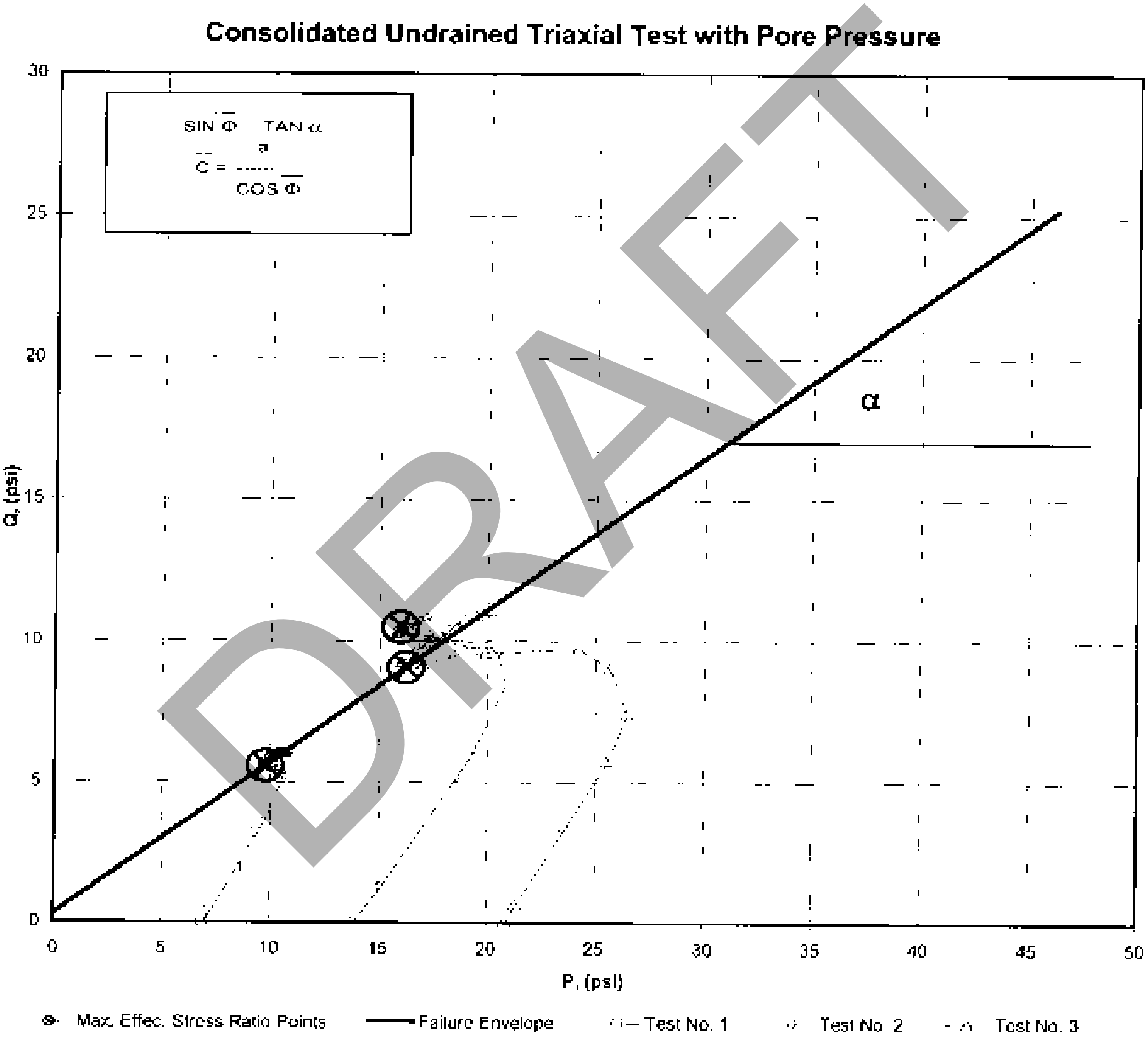
**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8-10 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |




| | | | | | |
|---|---|---|---|---|---|
| a | = | 0.32 | C̄ | = | 0.38 |
| α | = | 28.3 | Φ̄ | = | 32.65 |

Tested By TMS Date 7/15/2010 Approved By [signature] Date 7-19-10


DCN CT-S28 DATE 6-25-98 REVISION 1

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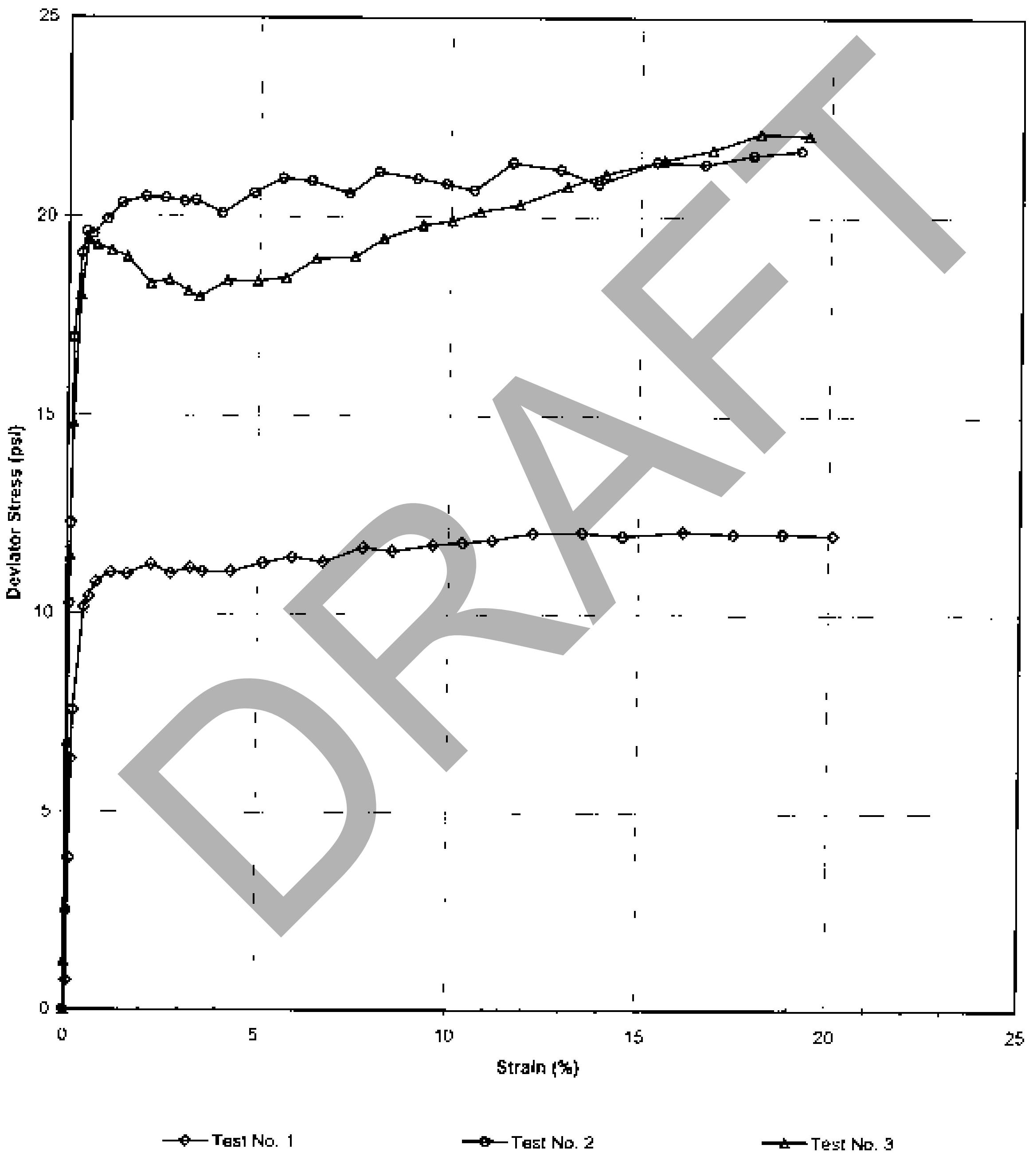
# CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-.4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8-10 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |
| Visual Description: | TAN SILTY SAND (UNDISTURBED) | | |




Tested By TMS Date 7/15/2010 Approved By MDS Date 7-19-10





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## CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.4-8.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 1 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 46.9 |
| Back Pressure(psi) | 40.0 |
| Eff. Cons. Pressure(psi) | 6.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 9.76

Q = 5.58

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.745 | Diameter 1 | 2.870 |
| Length 2 | 5.735 | Diameter 2 | 2.869 |
| Length 3 | 5.723 | Diameter 3 | 2.845 |
| Avg Leng.= | 5.734 | Avg. Diam.= | 2.861 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 22.3 |
| Final Change (ml) | 1.7 |
| Initial Dial Reading (D.R.), mils | 109 |
| D.R. After Saturation, mils | 145 |
| D.R. After Consolidation, mils | 149 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 12.6 | 0.000 | 40.0 |
| 17.3 | 0.004 | 40.0 |
| 36.9 | 0.006 | 40.4 |
| 52.8 | 0.008 | 40.7 |
| 60.7 | 0.011 | 40.8 |
| 77.4 | 0.026 | 41.4 |
| 79.1 | 0.033 | 41.6 |
| 81.6 | 0.043 | 41.8 |
| 83.4 | 0.066 | 42.1 |
| 83.5 | 0.090 | 42.4 |
| 85.6 | 0.126 | 42.5 |
| 84.4 | 0.155 | 42.7 |
| 85.7 | 0.185 | 42.7 |
| 85.3 | 0.203 | 42.7 |
| 85.9 | 0.245 | 42.8 |
| 88.0 | 0.292 | 42.8 |
| 89.6 | 0.336 | 42.8 |
| 89.5 | 0.381 | 42.7 |
| 92.9 | 0.442 | 42.7 |
| 92.9 | 0.485 | 42.6 |
| 94.9 | 0.546 | 42.6 |
| 96.0 | 0.591 | 42.6 |
| 97.3 | 0.635 | 42.5 |
| 99.5 | 0.696 | 42.5 |
| 101.0 | 0.770 | 42.4 |
| 101.5 | 0.830 | 42.4 |
| 104.0 | 0.920 | 42.3 |
| 105.0 | 0.995 | 42.2 |
| 106.6 | 1.069 | 42.2 |
| 107.9 | 1.145 | 42.1 |

Tested By TMS Date 7/15/2010 Input Checked By MM Date 7-19-10



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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.4-8.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 6.9 | *Stage No.* | 1 |
| | | *Test No* | 1 |



**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.73 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.43 |
| Initial Sample Volume (in^3) | 36.87 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 36.07 |
| Length After Consolidation (in) | 5.69 |
| Area After Consolidation (in^2) | 6.335 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.06 | 0.73 | 0.01 | 7.62 | 6.9 | 1.107 | 0.02 | 7.25 | 0.37 |
| 0.10 | 3.83 | 0.35 | 10.38 | 6.5 | 1.585 | 0.09 | 8.47 | 1.92 |
| 0.15 | 6.33 | 0.65 | 12.58 | 6.2 | 2.013 | 0.11 | 9.41 | 3.16 |
| 0.19 | 7.57 | 0.82 | 13.65 | 6.1 | 2.245 | 0.11 | 9.87 | 3.78 |
| 0.45 | 10.17 | 1.44 | 15.63 | 5.5 | 2.863 | 0.15 | 10.55 | 5.09 |
| 0.58 | 10.44 | 1.56 | 15.76 | 5.3 | 2.955 | 0.15 | 10.56 | 5.22 |
| 0.76 | 10.81 | 1.77 | 15.94 | 5.1 | 3.104 | 0.17 | 10.54 | 5.40 |
| 1.15 | 11.04 | 2.10 | 15.84 | 4.8 | 3.302 | 0.20 | 10.32 | 5.52 |
| 1.58 | 11.01 | 2.37 | 15.55 | 4.5 | 3.429 | 0.22 | 10.04 | 5.51 |
| 2.22 | 11.26 | 2.53 | 15.63 | 4.4 | 3.577 | 0.23 | 10.00 | 5.63 |
| 2.73 | 11.02 | 2.67 | 15.25 | 4.2 | 3.604 | 0.25 | 9.74 | 5.51 |
| 3.25 | 11.17 | 2.72 | 15.34 | 4.2 | 3.673 | 0.25 | 9.76 | 5.58 |
| 3.56 | 11.07 | 2.74 | 15.23 | 4.2 | 3.663 | 0.26 | 9.69 | 5.53 |
| 4.30 | 11.07 | 2.75 | 15.22 | 4.1 | 3.668 | 0.26 | 9.68 | 5.54 |
| 5.13 | 11.29 | 2.75 | 15.44 | 4.1 | 3.722 | 0.25 | 9.79 | 5.64 |
| 5.90 | 11.44 | 2.76 | 15.58 | 4.1 | 3.763 | 0.25 | 9.86 | 5.72 |
| 6.70 | 11.32 | 2.72 | 15.50 | 4.2 | 3.706 | 0.25 | 9.84 | 5.66 |
| 7.75 | 11.68 | 2.72 | 15.87 | 4.2 | 3.793 | 0.24 | 10.03 | 5.84 |
| 8.53 | 11.59 | 2.62 | 15.88 | 4.3 | 3.707 | 0.23 | 10.08 | 5.80 |
| 9.59 | 11.74 | 2.62 | 16.03 | 4.3 | 3.741 | 0.23 | 10.16 | 5.87 |
| 10.39 | 11.80 | 2.55 | 16.15 | 4.3 | 3.714 | 0.22 | 10.25 | 5.90 |
| 11.16 | 11.87 | 2.50 | 16.27 | 4.4 | 3.699 | 0.22 | 10.33 | 5.94 |
| 12.23 | 12.04 | 2.48 | 16.47 | 4.4 | 3.722 | 0.21 | 10.45 | 6.02 |
| 13.53 | 12.06 | 2.37 | 16.59 | 4.5 | 3.662 | 0.20 | 10.56 | 6.03 |
| 14.58 | 11.98 | 2.36 | 16.52 | 4.5 | 3.639 | 0.20 | 10.53 | 5.99 |
| 16.15 | 12.09 | 2.28 | 16.72 | 4.6 | 3.616 | 0.19 | 10.67 | 6.05 |
| 17.47 | 12.03 | 2.22 | 16.72 | 4.7 | 3.570 | 0.19 | 10.70 | 6.02 |
| 18.78 | 12.04 | 2.19 | 16.76 | 4.7 | 3.556 | 0.19 | 10.74 | 6.02 |
| 20.11 | 12.01 | 2.08 | 16.82 | 4.8 | 3.494 | 0.18 | 10.82 | 6.00 |

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# CONSOLIDATED UNDRAINED TRIAXIAL TEST
# WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.9-9.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 2 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 53.9 |
| Back Pressure(psi) | 40.0 |
| Eff. Cons. Pressure(ps | 13.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

| | | |
|---|---|---|
| $\overline{P}$ | = | 15.96 |
| Q | = | 10.48 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.956 | Diameter 1 | 2.848 |
| Length 2 | 5.954 | Diameter 2 | 2.827 |
| Length 3 | 5.941 | Diameter 3 | 2.841 |
| Avg Leng.= | 5.950 | Avg. Diam.= | 2.839 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 19.8 |
| Final Change (ml) | 4.2 |
| Initial Dial Reading (D.R.), mils | 106 |
| D.R. After Saturation, mils | 134 |
| D.R. After Consolidation, mils | 141 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 2.3 | 0.000 | 40.0 |
| 17.8 | 0.003 | 40.0 |
| 66.3 | 0.004 | 40.5 |
| 78.9 | 0.006 | 40.6 |
| 108.0 | 0.008 | 41.5 |
| 121.6 | 0.020 | 43.0 |
| 125.2 | 0.027 | 43.6 |
| 125.0 | 0.037 | 44.5 |
| 127.8 | 0.059 | 45.9 |
| 130.9 | 0.083 | 46.8 |
| 132.7 | 0.119 | 47.5 |
| 133.2 | 0.149 | 47.9 |
| 133.3 | 0.179 | 48.1 |
| 133.9 | 0.196 | 48.2 |
| 132.8 | 0.237 | 48.4 |
| 137.3 | 0.286 | 48.4 |
| 140.7 | 0.331 | 48.4 |
| 141.4 | 0.375 | 48.3 |
| 140.8 | 0.434 | 48.3 |
| 145.6 | 0.479 | 48.4 |
| 146.1 | 0.539 | 48.2 |
| 146.4 | 0.584 | 48.3 |
| 146.5 | 0.628 | 48.2 |
| 153.0 | 0.688 | 48.0 |
| 154.0 | 0.763 | 47.9 |
| 153.1 | 0.821 | 47.9 |
| 160.0 | 0.912 | 47.8 |
| 161.9 | 0.986 | 47.6 |
| 166.1 | 1.061 | 47.5 |
| 169.6 | 1.136 | 47.4 |

Tested By TMS Date 7/5/2010 Input Checked By *MMS* Date *7-19-10*



DCN: CT-S28 DATE 6-25-98 REVISION 1



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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.9-9.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 13.9 | *Stage No.* | 1 |
| | | *Test No* | 2 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.95 |
| Initial Sample Diameter (in.) | 2.84 |
| Initial Sample Area (in^2) | 6.33 |
| Initial Sample Volume (in^3) | 37.66 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 36.87 |
| Length After Consolidation (in) | 5.92 |
| Area After Consolidation (in^2) | 6.233 |

| Strain (%) | Deviation Stress | Δ U | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.06 | 2.48 | 0.04 | 16.35 | 13.9 | 1.179 | 0.01 | 15.11 | 1.24 |
| 0.08 | 10.26 | 0.47 | 23.69 | 13.4 | 1.764 | 0.05 | 18.56 | 5.13 |
| 0.09 | 12.28 | 0.63 | 25.54 | 13.3 | 1.925 | 0.05 | 19.41 | 6.14 |
| 0.14 | 16.93 | 1.52 | 29.30 | 12.4 | 2.368 | 0.09 | 20.84 | 8.46 |
| 0.34 | 19.08 | 2.96 | 30.02 | 10.9 | 2.743 | 0.16 | 20.48 | 9.54 |
| 0.46 | 19.62 | 3.62 | 29.90 | 10.3 | 2.909 | 0.19 | 20.09 | 9.81 |
| 0.63 | 19.56 | 4.46 | 29.00 | 9.4 | 3.073 | 0.24 | 19.22 | 9.78 |
| 0.99 | 19.92 | 5.85 | 27.97 | 8.0 | 3.475 | 0.30 | 18.01 | 9.96 |
| 1.40 | 20.34 | 6.75 | 27.49 | 7.1 | 3.846 | 0.34 | 17.32 | 10.17 |
| 2.02 | 20.50 | 7.54 | 26.86 | 6.4 | 4.225 | 0.38 | 16.61 | 10.25 |
| 2.52 | 20.47 | 7.94 | 26.43 | 6.0 | 4.433 | 0.40 | 16.20 | 10.24 |
| 3.02 | 20.38 | 8.14 | 26.14 | 5.8 | 4.535 | 0.41 | 15.95 | 10.19 |
| 3.32 | 20.41 | 8.22 | 26.10 | 5.7 | 4.593 | 0.41 | 15.89 | 10.21 |
| 4.01 | 20.09 | 8.36 | 25.63 | 5.5 | 4.626 | 0.43 | 15.59 | 10.05 |
| 4.83 | 20.60 | 8.36 | 26.14 | 5.5 | 4.721 | 0.42 | 15.84 | 10.30 |
| 5.59 | 20.96 | 8.42 | 26.44 | 5.5 | 4.826 | 0.41 | 15.96 | 10.48 |
| 6.34 | 20.90 | 8.34 | 26.46 | 5.6 | 4.760 | 0.41 | 16.01 | 10.45 |
| 7.34 | 20.58 | 8.34 | 26.14 | 5.6 | 4.705 | 0.42 | 15.85 | 10.29 |
| 8.10 | 21.13 | 8.36 | 26.67 | 5.5 | 4.812 | 0.41 | 16.10 | 10.56 |
| 9.11 | 20.96 | 8.18 | 26.68 | 5.7 | 4.663 | 0.40 | 16.20 | 10.48 |
| 9.87 | 20.84 | 8.25 | 26.48 | 5.6 | 4.689 | 0.41 | 16.07 | 10.42 |
| 10.61 | 20.68 | 8.16 | 26.42 | 5.7 | 4.601 | 0.41 | 16.08 | 10.34 |
| 11.63 | 21.36 | 8.04 | 27.22 | 5.9 | 4.648 | 0.39 | 16.54 | 10.68 |
| 12.89 | 21.19 | 7.95 | 27.14 | 6.0 | 4.558 | 0.39 | 16.55 | 10.59 |
| 13.88 | 20.83 | 7.92 | 26.82 | 6.0 | 4.483 | 0.39 | 16.40 | 10.42 |
| 15.42 | 21.39 | 7.78 | 27.51 | 6.1 | 4.493 | 0.37 | 16.82 | 10.70 |
| 16.67 | 21.33 | 7.63 | 27.60 | 6.3 | 4.404 | 0.37 | 16.93 | 10.67 |
| 17.93 | 21.56 | 7.52 | 27.94 | 6.4 | 4.380 | 0.36 | 17.16 | 10.78 |
| 19.20 | 21.68 | 7.37 | 28.21 | 6.5 | 4.322 | 0.35 | 17.37 | 10.84 |

Tested By TMS Date 7/5/2010 Input Checked By MMS Date 7-16-10



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# CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.4-8.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 3 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 60.8 |
| Back Pressure(psi) | 39.9 |
| Eff. Cons. Pressure(ps | 20.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 16.21
Q = 9.06

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.956 | Diameter 1 | 2.869 |
| Length 2 | 5.943 | Diameter 2 | 2.868 |
| Length 3 | 5.943 | Diameter 3 | 2.834 |
| Avg Leng.= | 5.947 | Avg. Diam.= | 2.857 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 14.8 |
| Final Change (ml) | 9.2 |
| Initial Dial Reading (D.R.), mils | 122 |
| D.R. After Saturation, mils | 160 |
| D.R. After Consolidation, mils | 169 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 17.1 | 0.000 | 39.9 |
| 24.7 | 0.001 | 40.0 |
| 59.4 | 0.003 | 40.5 |
| 88.6 | 0.005 | 40.9 |
| 109.5 | 0.008 | 41.7 |
| 130.0 | 0.019 | 44.1 |
| 138.9 | 0.030 | 46.2 |
| 138.4 | 0.043 | 48.2 |
| 137.9 | 0.066 | 50.4 |
| 137.4 | 0.090 | 51.8 |
| 133.9 | 0.126 | 52.9 |
| 135.1 | 0.155 | 53.4 |
| 133.8 | 0.185 | 53.7 |
| 133.3 | 0.203 | 53.6 |
| 136.8 | 0.245 | 53.9 |
| 137.8 | 0.292 | 54.0 |
| 139.3 | 0.336 | 54.0 |
| 143.5 | 0.381 | 54.0 |
| 145.2 | 0.442 | 53.7 |
| 149.4 | 0.485 | 53.7 |
| 153.3 | 0.546 | 53.6 |
| 155.1 | 0.591 | 53.5 |
| 157.9 | 0.635 | 53.4 |
| 160.8 | 0.696 | 53.1 |
| 166.2 | 0.770 | 53.0 |
| 170.3 | 0.830 | 52.9 |
| 175.6 | 0.920 | 52.6 |
| 180.0 | 0.995 | 52.2 |
| 185.6 | 1.069 | 51.9 |
| 187.9 | 1.145 | 51.7 |

Tested By TMS Date 7/15/2010 Input Checked By MW Date 7-16-10


DCN CT-S28 DATE 6-25-98 REVISION 1

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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB- 4 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 8.4-8.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-02 | | |

Visual Description: TAN SILTY SAND (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 20.9 | *Stage No.* | 1 |
| | | *Test No* | 3 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.95 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.41 |
| Initial Sample Volume (in^3) | 38.13 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 36.83 |
| Length After Consolidation (in) | 5.90 |
| Area After Consolidation (in^2) | 6.243 |



| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma_1}$ | $\overline{\sigma_3}$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.01 | 1.23 | 0.13 | 22.00 | 20.8 | 1.059 | 0.11 | 21.38 | 0.61 |
| 0.04 | 6.78 | 0.61 | 27.06 | 20.3 | 1.334 | 0.09 | 23.67 | 3.39 |
| 0.08 | 11.46 | 1.05 | 31.31 | 19.9 | 1.577 | 0.09 | 25.58 | 5.73 |
| 0.14 | 14.79 | 1.82 | 33.88 | 19.1 | 1.775 | 0.13 | 26.48 | 7.40 |
| 0.32 | 18.03 | 4.22 | 34.71 | 16.7 | 2.081 | 0.24 | 25.69 | 9.01 |
| 0.51 | 19.42 | 6.34 | 33.98 | 14.6 | 2.334 | 0.34 | 24.27 | 9.71 |
| 0.73 | 19.29 | 8.27 | 31.92 | 12.6 | 2.527 | 0.44 | 22.28 | 9.65 |
| 1.11 | 19.15 | 10.53 | 29.52 | 10.4 | 2.847 | 0.57 | 19.94 | 9.57 |
| 1.53 | 18.99 | 11.88 | 28.01 | 9.0 | 3.105 | 0.65 | 18.51 | 9.49 |
| 2.14 | 18.31 | 13.03 | 26.18 | 7.9 | 3.327 | 0.73 | 17.02 | 9.15 |
| 2.63 | 18.41 | 13.48 | 25.84 | 7.4 | 3.481 | 0.75 | 16.63 | 9.21 |
| 3.13 | 18.12 | 13.75 | 25.27 | 7.1 | 3.536 | 0.78 | 16.21 | 9.06 |
| 3.44 | 17.97 | 13.72 | 25.15 | 7.2 | 3.504 | 0.79 | 16.17 | 8.99 |
| 4.15 | 18.38 | 14.03 | 25.26 | 6.9 | 3.675 | 0.79 | 16.06 | 9.19 |
| 4.95 | 18.38 | 14.06 | 25.22 | 6.8 | 3.686 | 0.79 | 16.03 | 9.19 |
| 5.70 | 18.46 | 14.07 | 25.29 | 6.8 | 3.704 | 0.79 | 16.06 | 9.23 |
| 6.46 | 18.94 | 14.06 | 25.78 | 6.8 | 3.768 | 0.77 | 16.31 | 9.47 |
| 7.48 | 18.99 | 13.85 | 26.04 | 7.1 | 3.692 | 0.75 | 16.55 | 9.49 |
| 8.23 | 19.45 | 13.84 | 26.51 | 7.1 | 3.756 | 0.73 | 16.78 | 9.73 |
| 9.26 | 19.80 | 13.71 | 26.99 | 7.2 | 3.752 | 0.71 | 17.09 | 9.90 |
| 10.02 | 19.90 | 13.56 | 27.24 | 7.3 | 3.710 | 0.70 | 17.29 | 9.95 |
| 10.77 | 20.13 | 13.50 | 27.53 | 7.4 | 3.721 | 0.69 | 17.47 | 10.07 |
| 11.80 | 20.31 | 13.17 | 28.04 | 7.7 | 3.629 | 0.67 | 17.88 | 10.16 |
| 13.06 | 20.77 | 13.07 | 28.60 | 7.8 | 3.653 | 0.65 | 18.22 | 10.39 |
| 14.07 | 21.09 | 12.99 | 29.00 | 7.9 | 3.665 | 0.63 | 18.46 | 10.54 |
| 15.59 | 21.44 | 12.65 | 29.68 | 8.2 | 3.600 | 0.61 | 18.96 | 10.72 |
| 16.86 | 21.70 | 12.25 | 30.35 | 8.6 | 3.510 | 0.58 | 19.50 | 10.85 |
| 18.12 | 22.11 | 12.03 | 30.98 | 8.9 | 3.492 | 0.56 | 19.93 | 11.05 |
| 19.40 | 22.06 | 11.81 | 31.14 | 9.1 | 3.428 | 0.55 | 20.11 | 11.03 |

Tested By TMS Date 7/15/2010 Input Checked By *MM* Date *7-19-10*



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# CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-528)

| | | | |
|---|---|---|---|
| Client | MACTEC | | |
| Client Reference | WEATHERSPOON PLANT | | |
| Project No. | 2010-692-01 | | |
| Lab ID | 2010-692-01-03 | Specific Gravity (assumed) | 2.7 |

Visual Description: TAN SANDY SILT (UNDISTURBED)

## SAMPLE CONDITION SUMMARY

| | | | |
|---|---|---|---|
| Boring No. | NB-6 | NB-6 | NB-6 |
| Depth (ft) | 13.4-13.9 | 13.9-14.4 | 14.4-14.9 |
| Sample No. | NA | NA | NA |
| Test No. | T1 | T2 | T3 |
| Deformation Rate (in/min) | 0.004 | 0.004 | 0.004 |
| Back Pressure (psi) | 39.9 | 40.0 | 39.9 |
| Consolidation Time (days) | 1 | 1 | 1 |
| Initial State (w%) | 38.8 | 38.8 | 38.8 |
| Total Unit Weight (pcf) | 129.0 | 127.7 | 130.2 |
| Dry Unit Weight (pcf) | 92.9 | 92.0 | 93.8 |
| Final State (w%) | 17.5 | 19.0 | 18.5 |
| Initial State Void Ratio,e | 0.813 | 0.832 | 0.797 |
| Void Ratio at Shear, e | 0.798 | 0.799 | 0.779 |

DRAFT

Tested By TMS Date 7/15/2010 Input Checked By MPS Date 7-22-10



DCN: CT-529 DATE 12-9-08 REVISION BR-Data Drive\2010 PROJECTS\2010-692 MACTEC\[2010-692-01-03 triaxsum.xls]Sheet1

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# MOHR TOTAL STRENGTH ENVELOPE

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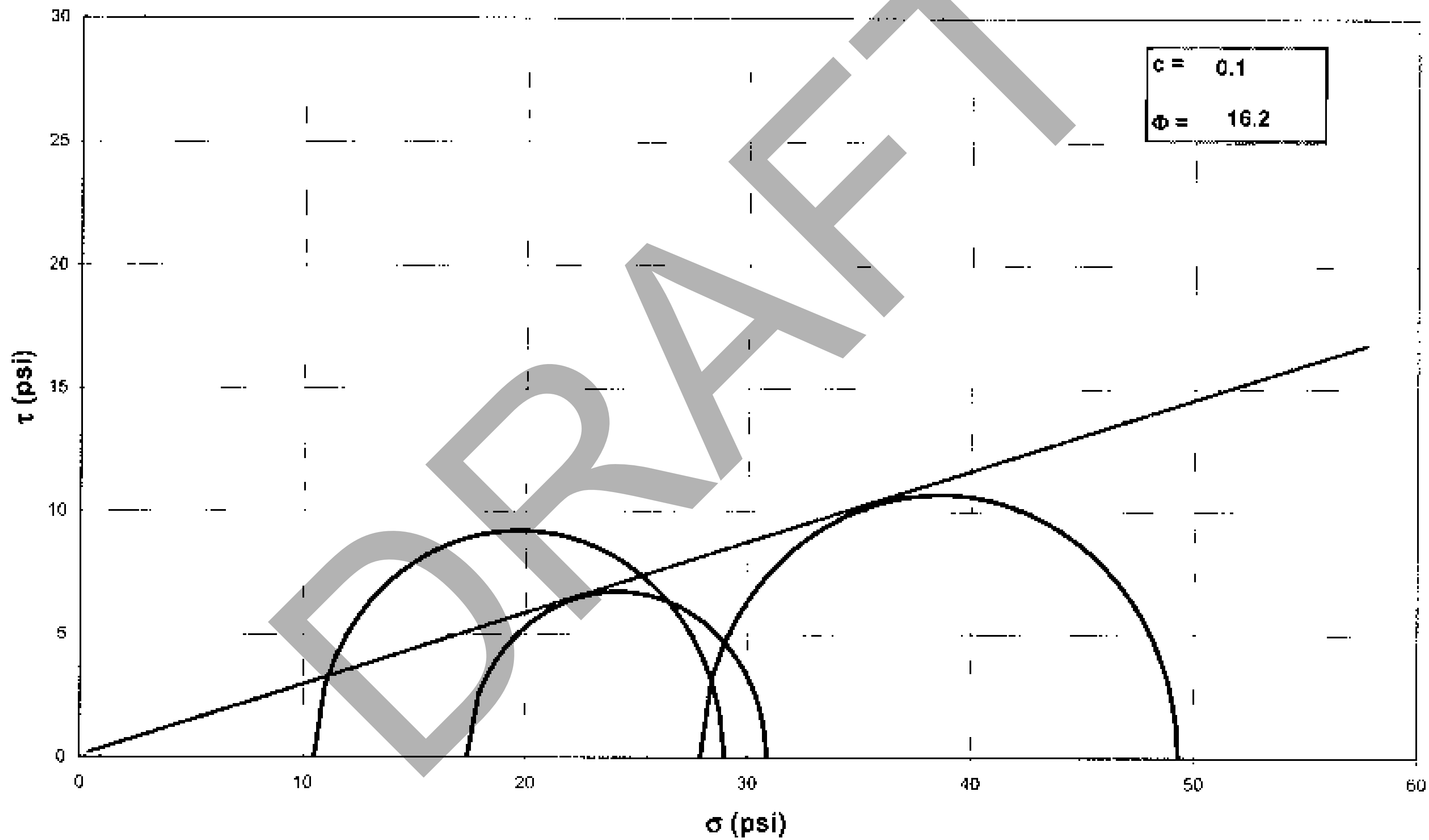
| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Ref. No. | WEATHERSPOON PLANT | Depth(ft.) | 13-15 |
| Project no. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | Visual Description | TAN SANDY SILT |






NOTE: GRAPH NOT TO SCALE

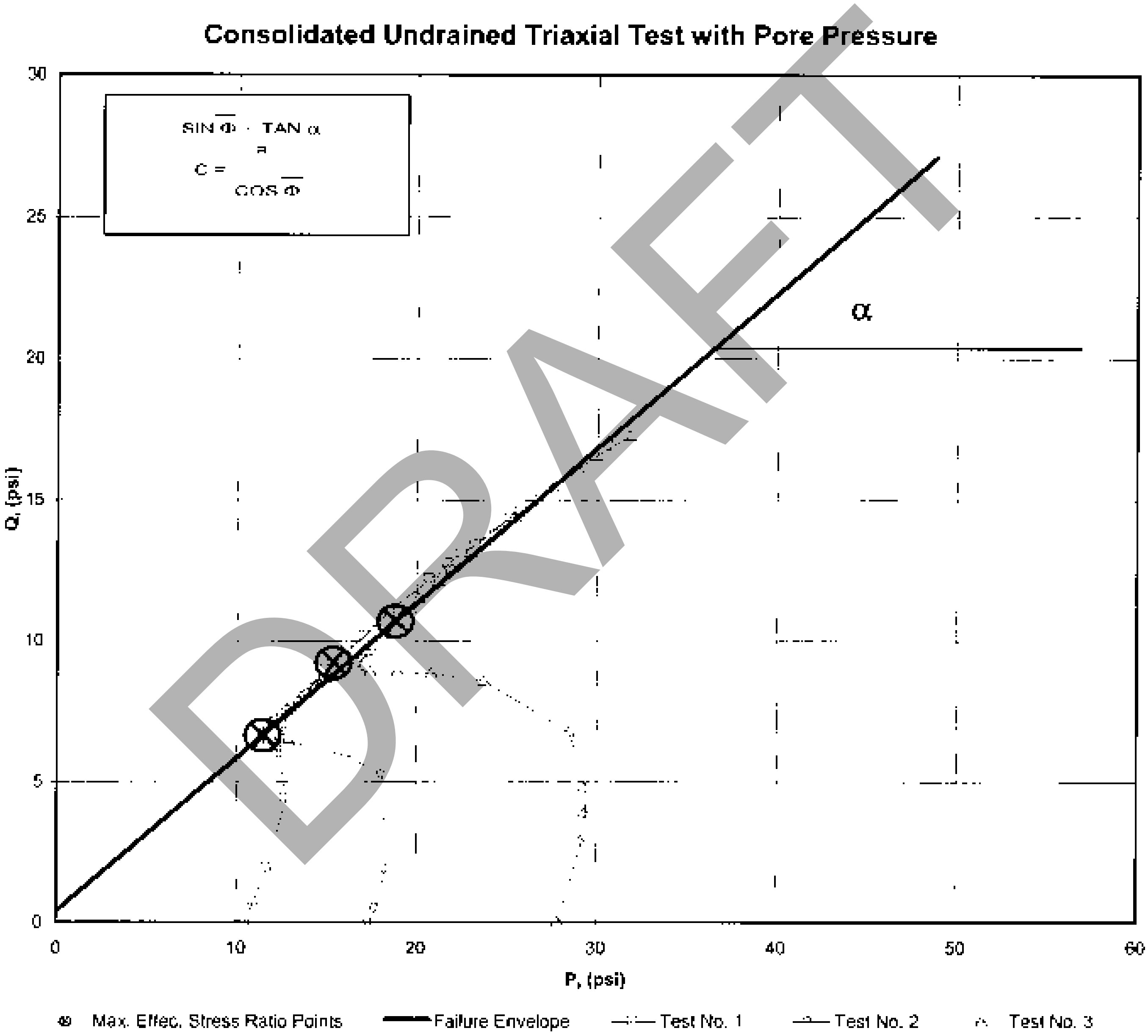
*Tested By:* JCM *Date:* 4/17/2001 *Approved By:* MM *Date:* 7-22-10

\\SERVER\Data Drive\2010 PROJECTS\2010-692 MACTEC\[2010-692-01-03 SIGMATRIAX.xls]SHEET1

# CONSOLIDATED UNDRAINED TRIAXIAL TEST
# WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13-15 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |




| | | | | | |
|---|---|---|---|---|---|
| a | = | 0.39 | $\overline{C}$ | = | 0.47 |
| α | = | 28.7 | $\overline{\Phi}$ | = | 33.20 |

Tested By TMS Date 7/15/2010 Approved By MPT Date 7-22-10





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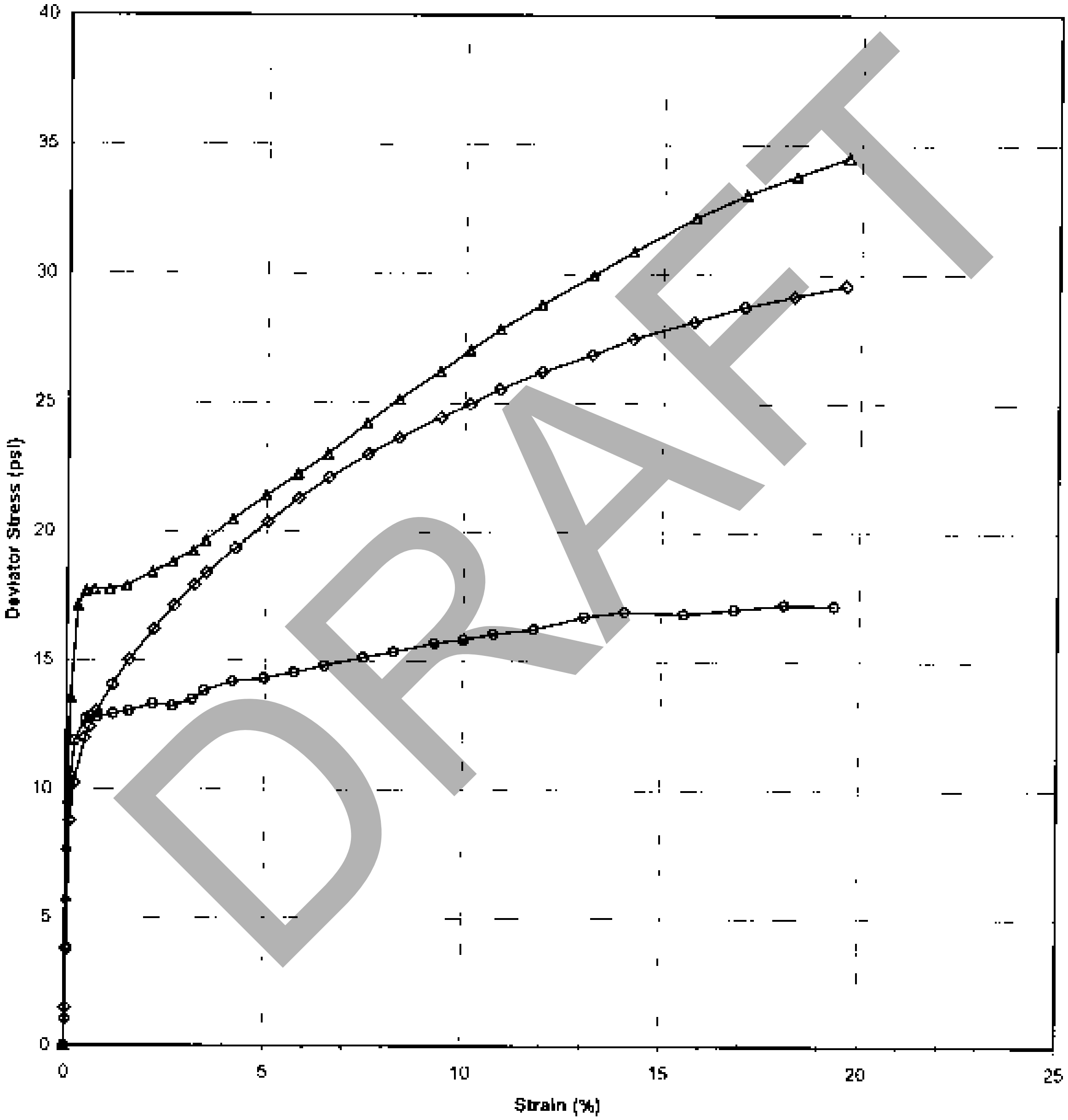
**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13-15 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |
| Visual Description: | TAN SANDY SILT (UNDISTURBED) | | |

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13.4-13.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 1 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 50.4 |
| Back Pressure(psi) | 39.9 |
| Eff. Cons. Pressure(psi) | 10.5 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 15.39

Q = 9.21

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.855 | Diameter 1 | 2.857 |
| Length 2 | 5.847 | Diameter 2 | 2.856 |
| Length 3 | 5.849 | Diameter 3 | 2.857 |
| Avg Leng.= | 5.850 | Avg. Diam.= | 2.857 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 20.9 |
| Final Change (ml) | 3.1 |
| Initial Dial Reading (D.R.), mils | 152 |
| D.R. After Saturation, mils | 159 |
| D.R. After Consolidation, mils | 162 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 12.3 | 0.000 | 39.9 |
| 21.8 | 0.001 | 40.2 |
| 36.7 | 0.002 | 40.6 |
| 68.4 | 0.006 | 42.0 |
| 77.7 | 0.012 | 42.9 |
| 89.0 | 0.027 | 44.2 |
| 92.0 | 0.034 | 44.4 |
| 95.9 | 0.045 | 44.4 |
| 102.9 | 0.068 | 44.9 |
| 109.5 | 0.092 | 44.9 |
| 117.9 | 0.128 | 44.7 |
| 124.5 | 0.158 | 44.6 |
| 130.3 | 0.187 | 44.4 |
| 133.9 | 0.205 | 44.2 |
| 141.0 | 0.246 | 43.9 |
| 148.8 | 0.294 | 43.5 |
| 156.1 | 0.339 | 43.3 |
| 162.9 | 0.384 | 42.9 |
| 170.8 | 0.442 | 42.6 |
| 176.6 | 0.488 | 42.2 |
| 184.0 | 0.549 | 41.9 |
| 189.0 | 0.592 | 41.5 |
| 194.8 | 0.636 | 41.4 |
| 201.8 | 0.697 | 41.0 |
| 209.4 | 0.771 | 40.6 |
| 216.4 | 0.831 | 40.3 |
| 225.2 | 0.921 | 39.9 |
| 232.8 | 0.996 | 39.6 |
| 239.5 | 1.070 | 39.3 |
| 246.5 | 1.145 | 38.8 |

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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13.4-13.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 10.5 | *Stage No.* | 1 |
| | | *Test No* | 1 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.85 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.41 |
| Initial Sample Volume (in^3) | 37.50 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 37.17 |
| Length After Consolidation (in) | 5.84 |
| Area After Consolidation (in^2) | 6.365 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.01 | 1.49 | 0.27 | 11.71 | 10.2 | 1.145 | 0.19 | 10.97 | 0.74 |
| 0.03 | 3.83 | 0.71 | 13.62 | 9.8 | 1.391 | 0.19 | 11.70 | 1.92 |
| 0.11 | 8.79 | 2.12 | 17.18 | 8.4 | 2.049 | 0.25 | 12.78 | 4.40 |
| 0.20 | 10.25 | 3.05 | 17.71 | 7.5 | 2.375 | 0.31 | 12.58 | 5.13 |
| 0.47 | 12.00 | 4.26 | 18.24 | 6.2 | 2.921 | 0.37 | 12.24 | 6.00 |
| 0.59 | 12.45 | 4.51 | 18.43 | 6.0 | 3.079 | 0.37 | 12.21 | 6.22 |
| 0.77 | 13.03 | 4.55 | 18.99 | 6.0 | 3.190 | 0.36 | 12.47 | 6.52 |
| 1.16 | 14.06 | 4.99 | 19.56 | 5.5 | 3.554 | 0.37 | 12.53 | 7.03 |
| 1.58 | 15.02 | 4.95 | 20.57 | 5.5 | 3.708 | 0.34 | 13.06 | 7.51 |
| 2.19 | 16.22 | 4.79 | 21.93 | 5.7 | 3.842 | 0.30 | 13.82 | 8.11 |
| 2.70 | 17.14 | 4.68 | 22.96 | 5.8 | 3.945 | 0.28 | 14.39 | 8.57 |
| 3.20 | 17.95 | 4.48 | 23.97 | 6.0 | 3.979 | 0.26 | 15.00 | 8.97 |
| 3.50 | 18.43 | 4.33 | 24.60 | 6.2 | 3.986 | 0.24 | 15.39 | 9.21 |
| 4.22 | 19.37 | 4.01 | 25.85 | 6.5 | 3.986 | 0.21 | 16.17 | 9.68 |
| 5.04 | 20.36 | 3.56 | 27.31 | 6.9 | 3.932 | 0.18 | 17.13 | 10.18 |
| 5.81 | 21.28 | 3.37 | 28.41 | 7.1 | 3.984 | 0.16 | 17.77 | 10.64 |
| 6.57 | 22.09 | 3.05 | 29.55 | 7.5 | 3.965 | 0.14 | 18.50 | 11.05 |
| 7.57 | 23.01 | 2.67 | 30.84 | 7.8 | 3.939 | 0.12 | 19.33 | 11.50 |
| 8.35 | 23.65 | 2.25 | 31.90 | 8.2 | 3.867 | 0.10 | 20.07 | 11.82 |
| 9.39 | 24.44 | 2.00 | 32.94 | 8.5 | 3.875 | 0.08 | 20.72 | 12.22 |
| 10.13 | 24.95 | 1.59 | 33.85 | 8.9 | 3.801 | 0.07 | 21.38 | 12.47 |
| 10.89 | 25.55 | 1.52 | 34.52 | 9.0 | 3.846 | 0.06 | 21.75 | 12.77 |
| 11.94 | 26.22 | 1.13 | 35.59 | 9.4 | 3.797 | 0.04 | 22.48 | 13.11 |
| 13.21 | 26.87 | 0.68 | 36.69 | 9.8 | 3.736 | 0.03 | 23.26 | 13.44 |
| 14.23 | 27.50 | 0.43 | 37.57 | 10.1 | 3.731 | 0.02 | 23.82 | 13.75 |
| 15.77 | 28.17 | 0.02 | 38.65 | 10.5 | 3.689 | 0.00 | 24.56 | 14.09 |
| 17.05 | 28.74 | -0.33 | 39.57 | 10.8 | 3.653 | -0.01 | 25.20 | 14.37 |
| 18.31 | 29.16 | -0.65 | 40.30 | 11.1 | 3.616 | -0.02 | 25.73 | 14.58 |
| 19.61 | 29.58 | -1.06 | 41.14 | 11.6 | 3.558 | -0.04 | 26.35 | 14.79 |

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13.9-14.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 2 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 57.4 |
| Back Pressure(psi) | 40 |
| Eff. Cons. Pressure(ps | 17.4 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

| | | |
|---|---|---|
| $\overline{P}$ | = | 11.45 |
| Q | = | 6.66 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 6.229 | Diameter 1 | 2.876 |
| Length 2 | 6.213 | Diameter 2 | 2.863 |
| Length 3 | 6.233 | Diameter 3 | 2.864 |
| Avg Leng.= | 6.225 | Avg. Diam.= | 2.868 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 12.9 |
| Final Change (ml) | 11.1 |
| Initial Dial Reading (D.R.), mils | 98 |
| D.R. After Saturation, mils | 100 |
| D.R. After Consolidation, mils | 109 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 13.6 | 0.000 | 40.0 |
| 20.1 | 0.001 | 40.1 |
| 37.5 | 0.002 | 40.9 |
| 80.5 | 0.008 | 44.6 |
| 89.3 | 0.014 | 47.2 |
| 94.9 | 0.030 | 50.3 |
| 95.5 | 0.038 | 50.9 |
| 95.5 | 0.049 | 51.3 |
| 96.7 | 0.073 | 52.2 |
| 97.8 | 0.098 | 52.5 |
| 100.1 | 0.135 | 52.6 |
| 100.0 | 0.166 | 52.5 |
| 102.2 | 0.197 | 52.6 |
| 104.7 | 0.216 | 52.6 |
| 107.7 | 0.260 | 52.5 |
| 109.4 | 0.309 | 52.5 |
| 111.8 | 0.356 | 52.2 |
| 114.3 | 0.403 | 52.3 |
| 117.6 | 0.465 | 52.1 |
| 120.0 | 0.512 | 52.0 |
| 123.6 | 0.576 | 51.9 |
| 125.5 | 0.622 | 51.7 |
| 128.0 | 0.669 | 51.7 |
| 130.7 | 0.732 | 51.6 |
| 135.9 | 0.810 | 51.3 |
| 138.9 | 0.874 | 51.3 |
| 140.5 | 0.967 | 51.1 |
| 143.8 | 1.046 | 51.0 |
| 147.4 | 1.124 | 50.8 |
| 149.1 | 1.203 | 50.5 |

Tested By TMS Date 7/15/2010 Input Checked By MM Date 7-22-10



DCN CT-S28 DATE 6-25-98 REVISION 7

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**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 13.9-14.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 17.4 | *Stage No.* | 1 |
| | | *Test No* | 2 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 6.23 |
| Initial Sample Diameter (in.) | 2.87 |
| Initial Sample Area (in^2) | 6.46 |
| Initial Sample Volume (in^3) | 40.21 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 39.49 |
| Length After Consolidation (in) | 6.21 |
| Area After Consolidation (in^2) | 6.355 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.02 | 1.02 | 0.15 | 18.28 | 17.3 | 1.059 | 0.15 | 17.77 | 0.51 |
| 0.04 | 3.76 | 0.94 | 20.22 | 16.5 | 1.228 | 0.26 | 18.34 | 1.88 |
| 0.12 | 10.52 | 4.56 | 23.36 | 12.8 | 1.819 | 0.45 | 18.10 | 5.26 |
| 0.22 | 11.88 | 7.20 | 22.09 | 10.2 | 2.165 | 0.62 | 16.14 | 5.94 |
| 0.49 | 12.74 | 10.33 | 19.80 | 7.1 | 2.802 | 0.84 | 13.44 | 6.37 |
| 0.61 | 12.82 | 10.89 | 19.33 | 6.5 | 2.969 | 0.88 | 12.92 | 6.41 |
| 0.79 | 12.79 | 11.30 | 18.89 | 6.1 | 3.096 | 0.91 | 12.50 | 6.40 |
| 1.17 | 12.93 | 12.16 | 18.17 | 5.2 | 3.470 | 0.97 | 11.70 | 6.47 |
| 1.57 | 13.04 | 12.47 | 17.97 | 4.9 | 3.648 | 0.99 | 11.45 | 6.52 |
| 2.18 | 13.32 | 12.61 | 18.10 | 4.8 | 3.782 | 0.98 | 11.45 | 6.66 |
| 2.67 | 13.24 | 12.51 | 18.12 | 4.9 | 3.708 | 0.97 | 11.51 | 6.62 |
| 3.17 | 13.50 | 12.64 | 18.26 | 4.8 | 3.833 | 0.97 | 11.51 | 6.75 |
| 3.47 | 13.85 | 12.61 | 18.64 | 4.8 | 3.888 | 0.94 | 11.72 | 6.92 |
| 4.18 | 14.19 | 12.50 | 19.10 | 4.9 | 3.895 | 0.91 | 12.00 | 7.10 |
| 4.97 | 14.33 | 12.46 | 19.26 | 4.9 | 3.903 | 0.90 | 12.10 | 7.16 |
| 5.73 | 14.56 | 12.19 | 19.77 | 5.2 | 3.797 | 0.86 | 12.49 | 7.28 |
| 6.49 | 14.82 | 12.28 | 19.94 | 5.1 | 3.892 | 0.85 | 12.53 | 7.41 |
| 7.48 | 15.14 | 12.09 | 20.45 | 5.3 | 3.849 | 0.82 | 12.88 | 7.57 |
| 8.24 | 15.37 | 12.00 | 20.78 | 5.4 | 3.845 | 0.80 | 13.09 | 7.69 |
| 9.27 | 15.70 | 11.86 | 21.24 | 5.5 | 3.835 | 0.78 | 13.39 | 7.85 |
| 10.01 | 15.85 | 11.69 | 21.56 | 5.7 | 3.775 | 0.76 | 13.64 | 7.92 |
| 10.76 | 16.07 | 11.66 | 21.81 | 5.7 | 3.800 | 0.75 | 13.77 | 8.03 |
| 11.78 | 16.26 | 11.55 | 22.11 | 5.8 | 3.780 | 0.73 | 13.98 | 8.13 |
| 13.04 | 16.74 | 11.34 | 22.79 | 6.1 | 3.762 | 0.70 | 14.43 | 8.37 |
| 14.06 | 16.94 | 11.27 | 23.08 | 6.1 | 3.763 | 0.69 | 14.61 | 8.47 |
| 15.56 | 16.87 | 11.11 | 23.15 | 6.3 | 3.683 | 0.68 | 14.72 | 8.43 |
| 16.84 | 17.04 | 10.96 | 23.48 | 6.4 | 3.645 | 0.66 | 14.96 | 8.52 |
| 18.10 | 17.24 | 10.78 | 23.86 | 6.6 | 3.603 | 0.64 | 15.24 | 8.62 |
| 19.36 | 17.19 | 10.51 | 24.08 | 6.9 | 3.494 | 0.63 | 15.49 | 8.60 |

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 14.4-14.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 3 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 67.8 |
| Back Pressure(psi) | 39.9 |
| Eff. Cons. Pressure(ps | 27.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

| | |
|---|---|
| $\overline{P}$ = | 18.82 |
| Q = | 10.70 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.809 | Diameter 1 | 2.869 |
| Length 2 | 5.792 | Diameter 2 | 2.865 |
| Length 3 | 5.801 | Diameter 3 | 2.838 |
| Avg Leng.= | 5.801 | Avg. Diam.= | 2.857 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 18.7 |
| Final Change (ml) | 5.3 |
| Initial Dial Reading (D.R.), mils | 110. |
| D.R. After Saturation, mils | 113 |
| D.R. After Consolidation, mils | 126 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 18.4 | 0.000 | 39.9 |
| 55.2 | 0.001 | 41.5 |
| 68.0 | 0.002 | 42.3 |
| 79.5 | 0.003 | 43.2 |
| 104.8 | 0.006 | 46.1 |
| 127.8 | 0.016 | 52.6 |
| 131.6 | 0.027 | 55.8 |
| 132.3 | 0.040 | 57.7 |
| 132.8 | 0.062 | 59.2 |
| 134.2 | 0.087 | 59.9 |
| 138.4 | 0.124 | 60.2 |
| 141.6 | 0.153 | 60.1 |
| 145.1 | 0.183 | 60.2 |
| 148.0 | 0.201 | 60.2 |
| 154.2 | 0.240 | 59.9 |
| 161.7 | 0.289 | 59.7 |
| 168.4 | 0.335 | 59.2 |
| 175.0 | 0.379 | 59.2 |
| 185.1 | 0.436 | 58.7 |
| 192.9 | 0.482 | 58.4 |
| 202.5 | 0.542 | 57.9 |
| 209.8 | 0.586 | 57.5 |
| 217.3 | 0.630 | 57.2 |
| 226.6 | 0.690 | 56.7 |
| 238.0 | 0.765 | 56.1 |
| 247.4 | 0.823 | 55.7 |
| 261.6 | 0.914 | 55.0 |
| 272.2 | 0.987 | 54.4 |
| 281.9 | 1.061 | 53.8 |
| 291.8 | 1.137 | 53.2 |

Tested By TMS Date 7/15/2010 Input Checked By MWJ Date 7-22-10

 DCN: CT-S28 DATE 6-25-98 REVISION 1

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**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | NB-6 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 14.4-14.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-03 | | |

Visual Description: TAN SANDY SILT (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 27.9 | *Stage No.* | 1 |
| | | *Test No* | 3 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.80 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.41 |
| Initial Sample Volume (in^3) | 37.20 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 36.81 |
| Length After Consolidation (in) | 5.78 |
| Area After Consolidation (in^2) | 6.364 |

| Strain (%) | Deviation Stress | Δ U | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.02 | 5.78 | 1.62 | 32.06 | 26.3 | 1.220 | 0.29 | 29.17 | 2.89 |
| 0.04 | 7.79 | 2.40 | 33.30 | 25.5 | 1.306 | 0.32 | 29.40 | 3.90 |
| 0.05 | 9.60 | 3.32 | 34.18 | 24.6 | 1.390 | 0.36 | 29.38 | 4.80 |
| 0.10 | 13.56 | 6.20 | 35.26 | 21.7 | 1.625 | 0.47 | 28.48 | 6.78 |
| 0.28 | 17.15 | 12.70 | 32.35 | 15.2 | 2.128 | 0.76 | 23.78 | 8.57 |
| 0.47 | 17.71 | 15.89 | 29.73 | 12.0 | 2.475 | 0.92 | 20.87 | 8.86 |
| 0.69 | 17.78 | 17.81 | 27.87 | 10.1 | 2.762 | 1.03 | 18.98 | 8.89 |
| 1.08 | 17.79 | 19.31 | 26.37 | 8.6 | 3.071 | 1.12 | 17.48 | 8.89 |
| 1.51 | 17.92 | 19.98 | 25.84 | 7.9 | 3.264 | 1.15 | 16.88 | 8.96 |
| 2.14 | 18.46 | 20.33 | 26.04 | 7.6 | 3.437 | 1 14 | 16.81 | 9.23 |
| 2.65 | 18.85 | 20.23 | 26.51 | 7.7 | 3.457 | 1.11 | 17.09 | 9.42 |
| 3.16 | 19.28 | 20.32 | 26.87 | 7.6 | 3.543 | 1.09 | 17.22 | 9.64 |
| 3.47 | 19 66 | 20.27 | 27.28 | 7.6 | 3.578 | 1.06 | 17.45 | 9.83 |
| 4.15 | 20.46 | 20.02 | 28.34 | 7.9 | 3.596 | 1.01 | 18.11 | 10.23 |
| 4.99 | 21.39 | 19.78 | 29.52 | 8.1 | 3.633 | 0.95 | 18.82 | 10.70 |
| 5.79 | 22.21 | 19.35 | 30.77 | 8.6 | 3.597 | 0.90 | 19.66 | 11.11 |
| 6.55 | 23.01 | 19.26 | 31.65 | 8.6 | 3.662 | 0.86 | 20.15 | 11.50 |
| 7.54 | 24.22 | 18.77 | 33.35 | 9.1 | 3.653 | 0.80 | 21.24 | 12.11 |
| 8.33 | 25.14 | 18.47 | 34.57 | 9.4 | 3.666 | 0.76 | 22.00 | 12.57 |
| 9.37 | 26.22 | 18.00 | 36.11 | 9.9 | 3.649 | 0.71 | 23.01 | 13.11 |
| 10.12 | 27.04 | 17.57 | 37.37 | 10.3 | 3.617 | 0.67 | 23.85 | 13.52 |
| 10.88 | 27.85 | 17.26 | 38.49 | 10.6 | 3.618 | 0.64 | 24.56 | 13.93 |
| 11.92 | 28.81 | 16.84 | 39.87 | 11.1 | 3.605 | 0.60 | 25.47 | 14.41 |
| 13.22 | 29.95 | 16.22 | 41.63 | 11.7 | 3.564 | 0.56 | 26.66 | 14.97 |
| 14.22 | 30.87 | 15.78 | 42.99 | 12.1 | 3.548 | 0.53 | 27.55 | 15.44 |
| 15.80 | 32.18 | 15.07 | 45.01 | 12.8 | 3.508 | 0.48 | 28.92 | 16.09 |
| 17.07 | 33.07 | 14.48 | 46.49 | 13.4 | 3.464 | 0.45 | 29.96 | 16.54 |
| 18.35 | 33.80 | 13.93 | 47.77 | 14.0 | 3.420 | 0.42 | 30.87 | 16.90 |
| 19.66 | 34.52 | 13.33 | 49.08 | 14.6 | 3.369 | 0.40 | 31.83 | 17.26 |

Tested By TMS Date 7/15/2010 Input Checked By MH Date 7-22-10

# CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | |
|---|---|
| Client | MACTEC |
| Client Reference | WEATHERSPOON PLANT |
| Project No. | 2010-692-01 |
| Lab ID | 2010-692-01-04 |
| Specific Gravity (assumed) | 2.7 |
| Visual Description: | TAN SANDY CLAY (UNDISTURBED) |

## SAMPLE CONDITION SUMMARY

| | | | |
|---|---|---|---|
| Boring No. | SB-2 | SB-2 | SB-2 |
| Depth (ft) | 3.8-4.3 | 4.9-5.4 | 4.4-4.9 |
| Sample No. | NA | NA | NA |
| Test No. | T1 | T2 | T3 |
| Deformation Rate (in/min) | 0.004 | 0.004 | 0.004 |
| Back Pressure (psi) | 40 | 40 | 40 |
| Consolidation Time (days) | 1 | 1 | 1 |
| Initial State (w%) | 19.9 | 13.7 | 14.9 |
| Total Unit Weight (pcf) | 131.3 | 133.0 | 132.0 |
| Dry Unit Weight (pcf) | 109.5 | 116.9 | 114.9 |
| Final State (w%) | 15.6 | 16.2 | 15.9 |
| Initial State Void Ratio,e | 0.539 | 0.442 | 0.466 |
| Void Ratio at Shear, e | 0.507 | 0.368 | 0.437 |

Tested By TMS Date 7/16/2010 Input Checked By MWS Date 7-21-10



DCN: CT-S28 DATE 12-5-08 REVISION: SERVER:Data Drive\2010 PROJECTS\2010-692 MACTEC\[2010-692-01-04 triaxum.xls]Sheet1

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# MOHR TOTAL STRENGTH ENVELOPE

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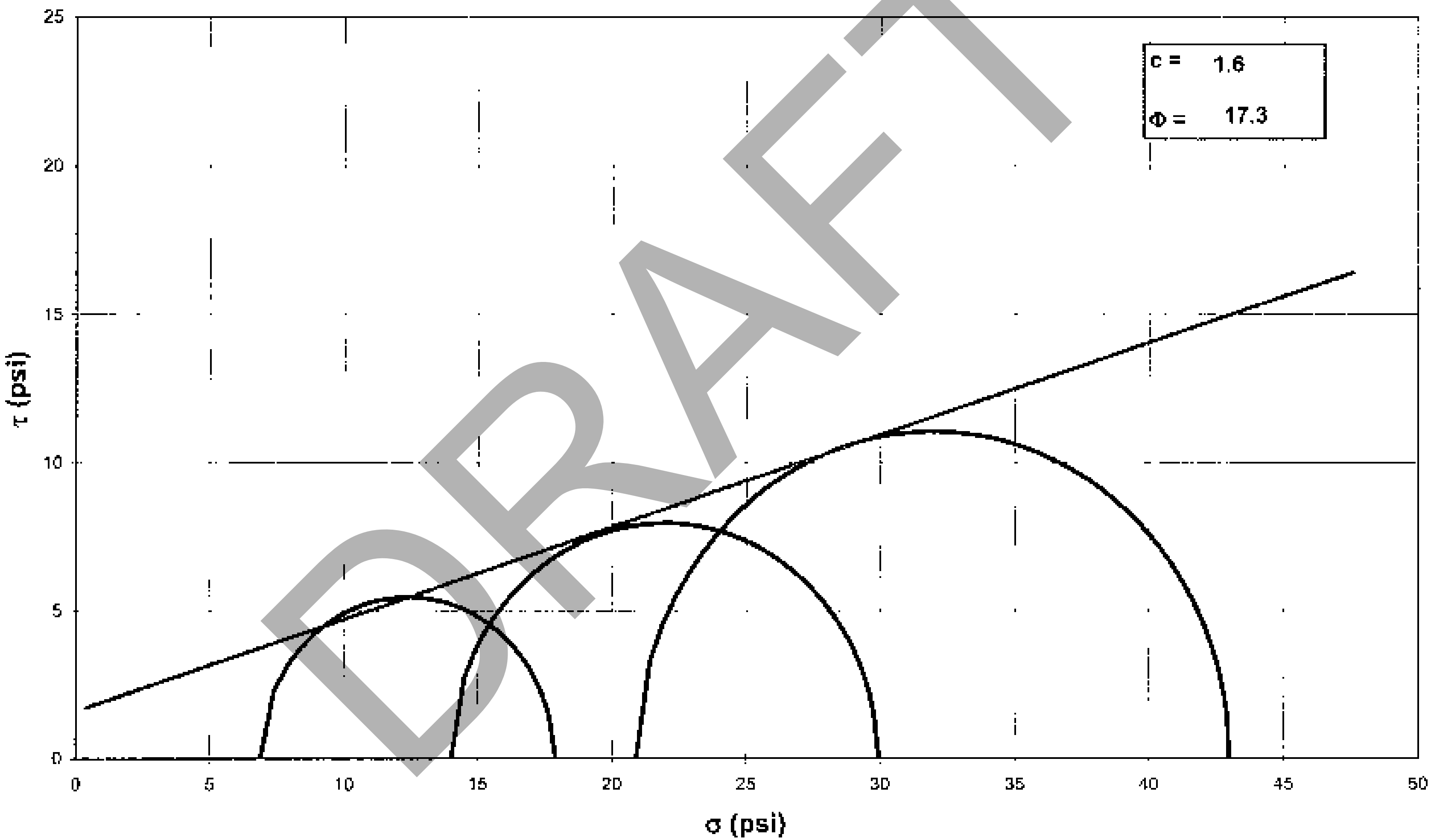
| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Ref. No. | WEATHERSPOON PLANT | Depth(ft.) | 3.5-5.5 |
| Project no. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | Visual Description | TAN SANDY CLAY |




NOTE: GRAPH NOT TO SCALE

*Tested By:* TMS *Date:* 7/15/2010 *Approved By:* MM *Date:* 7-22-10

#N/A

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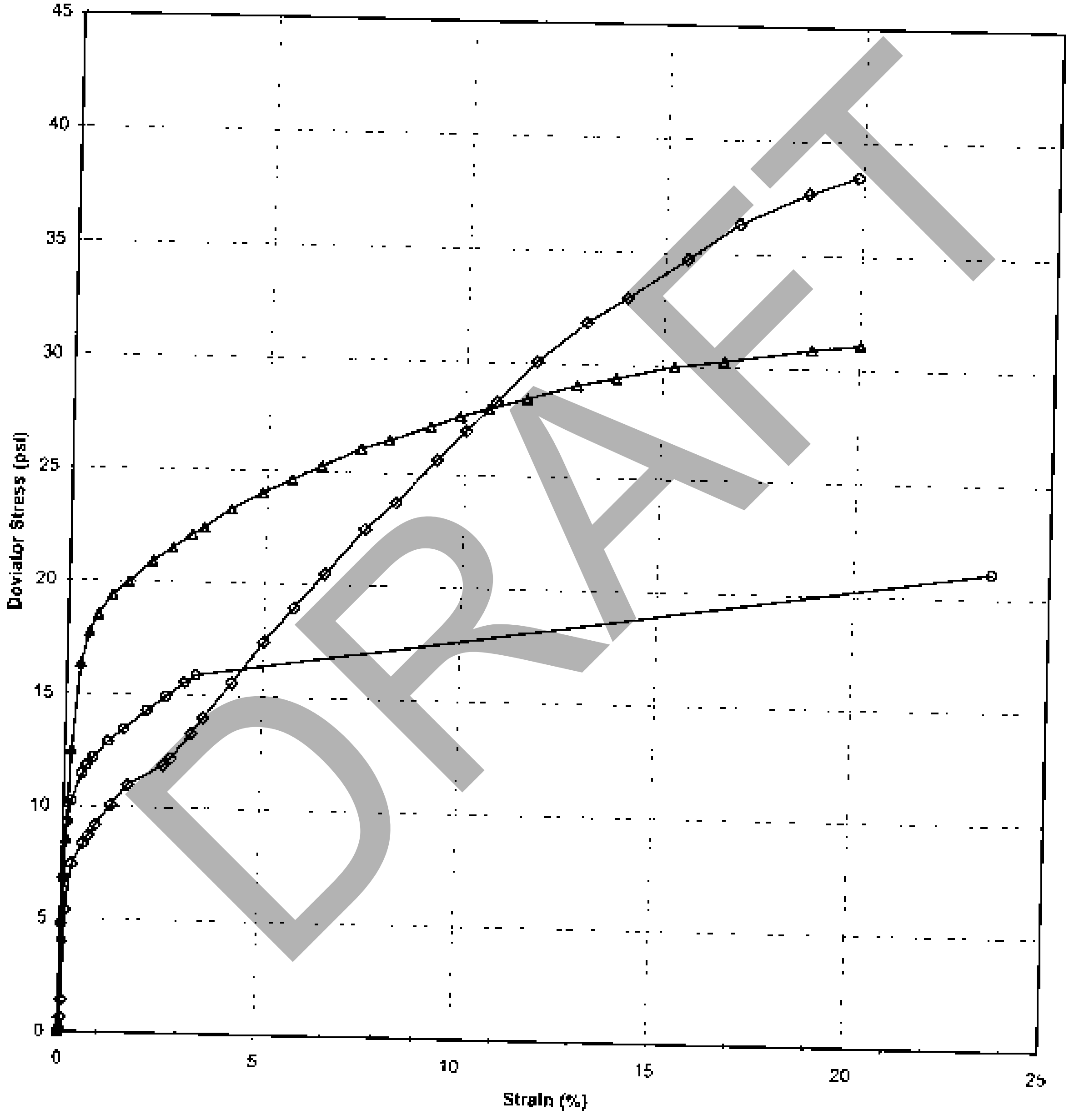
# CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 3.5-5.5 |
| Project No | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |
| Visual Description: | TAN SANDY CLAY (UNDISTURBED) | | |

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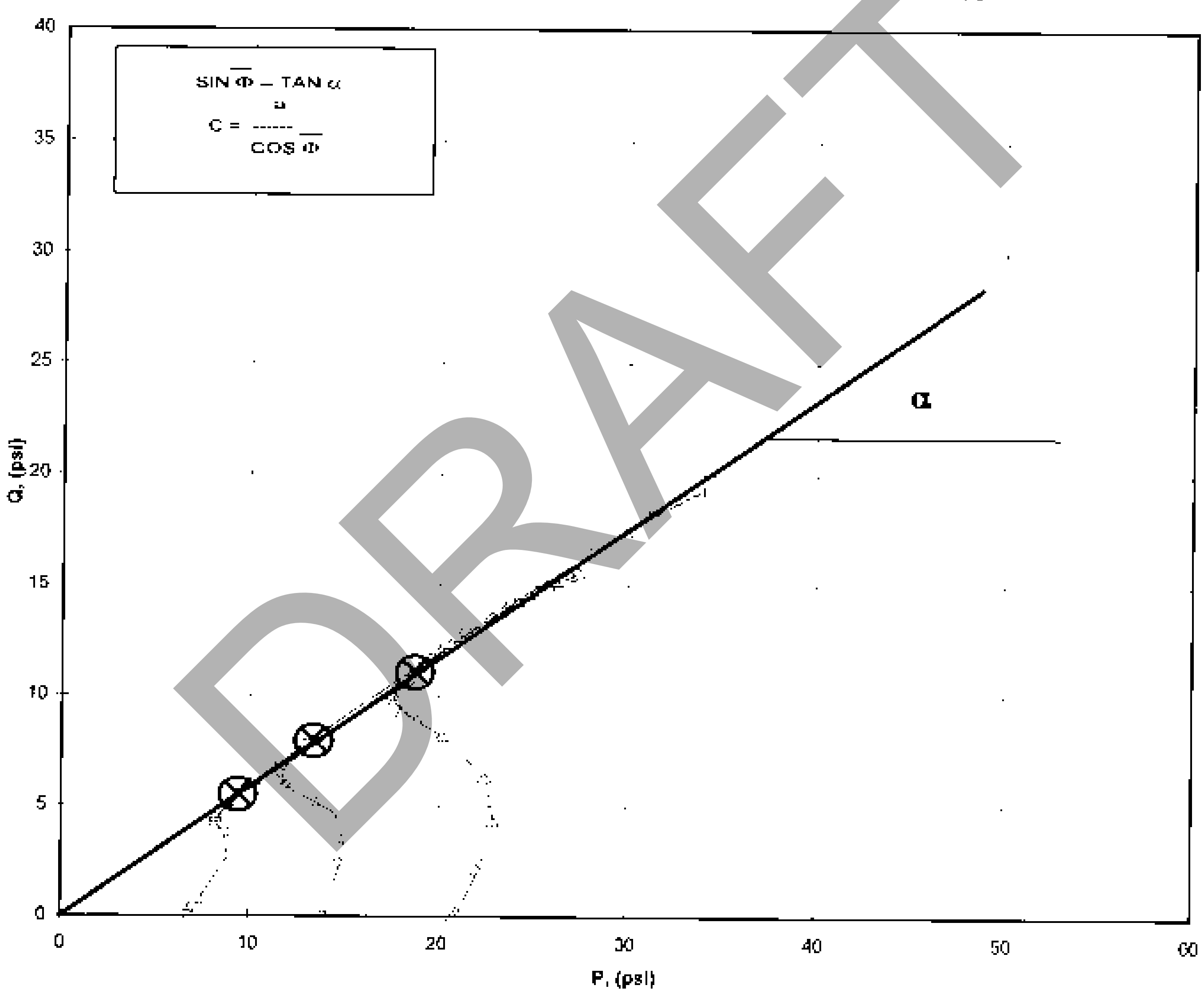
**CONSOLIDATED UNDRAINED TRIAXIAL TEST**
**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 3.5-5.5 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |




| | | | | | |
|---|---|---|---|---|---|
| a | = | 0.00 | $\overline{C}$ | = | 0.00 |
| α | = | 30.3 | $\overline{\Phi}$ | = | 35.68 |

Tested By TMS Date 7/16/2010 Approved By [signature] Date 7-21-10


DCN: CT S28 DATE 6-25-98 REVISION 1

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 3.8-4.3 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 1 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 46.9 |
| Back Pressure(psi) | 40 |
| Eff. Cons. Pressure(psi) | 6.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 9.41
Q = 5.49

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 5.972 | Diameter 1 | 2.853 |
| Length 2 | 5.977 | Diameter 2 | 2.856 |
| Length 3 | 5.982 | Diameter 3 | 2.860 |
| Avg Leng.= | 5.977 | Avg. Diam.= | 2.856 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 14.9 |
| Final Change (ml) | 9.1 |
| Initial Dial Reading (D.R.), mils | 112 |
| D.R. After Saturation, mils | 125 |
| D.R. After Consolidation, mils | 133 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 13.5 | 0.000 | 40.0 |
| 17.5 | 0.002 | 40.1 |
| 22.3 | 0.003 | 40.3 |
| 47.5 | 0.006 | 40.7 |
| 60.6 | 0.014 | 41.9 |
| 66.5 | 0.031 | 42.8 |
| 68.9 | 0.038 | 42.9 |
| 71.9 | 0.049 | 43.0 |
| 77.8 | 0.072 | 43.0 |
| 83.8 | 0.096 | 43.0 |
| 90.1 | 0.149 | 42.6 |
| 92.3 | 0.161 | 42.6 |
| 100.1 | 0.191 | 42.4 |
| 104.8 | 0.209 | 42.2 |
| 115.8 | 0.251 | 41.7 |
| 128.9 | 0.298 | 41.2 |
| 140.1 | 0.343 | 40.6 |
| 151.5 | 0.388 | 40.1 |
| 166.7 | 0.447 | 39.4 |
| 176.1 | 0.492 | 38.8 |
| 191.4 | 0.553 | 38.2 |
| 202.1 | 0.597 | 37.6 |
| 212.9 | 0.642 | 37.2 |
| 228.3 | 0.702 | 36.5 |
| 244.1 | 0.776 | 35.7 |
| 255.2 | 0.837 | 35.1 |
| 272.6 | 0.927 | 34.3 |
| 288.7 | 1.004 | 33.6 |
| 305.1 | 1.108 | 32.9 |
| 315.7 | 1.183 | 32.3 |

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# CONSOLIDATED UNDRAINED TRIAXIAL TEST
## WITH PORE PRESSURE READINGS
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 3.8-4.3 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 6.9 | *Stage No.* | 1 |
| | | *Test No* | 1 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 5.98 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.41 |
| Initial Sample Volume (in^3) | 38.30 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 37.49 |
| Length After Consolidation (in) | 5.96 |
| Area After Consolidation (in^2) | 6.295 |

DRAFT

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.03 | 0.63 | 0.11 | 7.42 | 6.8 | 1.093 | 0.18 | 7.10 | 0.32 |
| 0.05 | 1.40 | 0.26 | 8.04 | 6.6 | 1.210 | 0.19 | 7.34 | 0.70 |
| 0.09 | 5.39 | 0.72 | 11.58 | 6.2 | 1.872 | 0.14 | 8.88 | 2.70 |
| 0.24 | 7.46 | 1.94 | 12.42 | 5.0 | 2.506 | 0.27 | 8.69 | 3.73 |
| 0.51 | 8.37 | 2.84 | 12.43 | 4.1 | 3.060 | 0.35 | 8.25 | 4.19 |
| 0.64 | 8.73 | 2.94 | 12.69 | 4.0 | 3.206 | 0.35 | 8.32 | 4.37 |
| 0.82 | 9.19 | 3.04 | 13.05 | 3.9 | 3.382 | 0.34 | 8.45 | 4.60 |
| 1.20 | 10.08 | 3.04 | 13.94 | 3.9 | 3.614 | 0.31 | 8.90 | 5.04 |
| 1.61 | 10.98 | 2.98 | 14.91 | 3.9 | 3.799 | 0.28 | 9.41 | 5.49 |
| 2.51 | 11.85 | 2.61 | 16.14 | 4.3 | 3.762 | 0.23 | 10.22 | 5.93 |
| 2.70 | 12.18 | 2.62 | 16.46 | 4.3 | 3.846 | 0.22 | 10.37 | 6.09 |
| 3.20 | 13.30 | 2.37 | 17.84 | 4.5 | 3.936 | 0.18 | 11.18 | 6.65 |
| 3.50 | 13.99 | 2.16 | 18.73 | 4.7 | 3.954 | 0.16 | 11.73 | 7.00 |
| 4.21 | 15.57 | 1.66 | 20.81 | 5.2 | 3.972 | 0.11 | 13.02 | 7.78 |
| 5.00 | 17.42 | 1.15 | 23.16 | 5.7 | 4.032 | 0.07 | 14.45 | 8.71 |
| 5.75 | 18.95 | 0.64 | 25.21 | 6.3 | 4.026 | 0.03 | 15.73 | 9.47 |
| 6.52 | 20.48 | 0.09 | 27.29 | 6.8 | 4.009 | 0.00 | 17.05 | 10.24 |
| 7.51 | 22.50 | -0.62 | 30.02 | 7.5 | 3.991 | -0.03 | 18.77 | 11.25 |
| 8.27 | 23.69 | -1.23 | 31.82 | 8.1 | 3.916 | -0.05 | 19.97 | 11.85 |
| 9.28 | 25.64 | -1.77 | 34.31 | 8.7 | 3.957 | -0.07 | 21.49 | 12.82 |
| 10.02 | 26.95 | -2.41 | 36.26 | 9.3 | 3.896 | -0.09 | 22.78 | 13.48 |
| 10.77 | 28.26 | -2.81 | 37.97 | 9.7 | 3.912 | -0.10 | 23.84 | 14.13 |
| 11.79 | 30.10 | -3.48 | 40.48 | 10.4 | 3.899 | -0.12 | 25.43 | 15.05 |
| 13.03 | 31.85 | -4.26 | 43.02 | 11.2 | 3.854 | -0.14 | 27.09 | 15.93 |
| 14.06 | 32.99 | -4.95 | 44.83 | 11.8 | 3.784 | -0.15 | 28.34 | 16.49 |
| 15.56 | 34.75 | -5.70 | 47.35 | 12.6 | 3.757 | -0.17 | 29.98 | 17.38 |
| 16.86 | 36.34 | -6.35 | 49.59 | 13.3 | 3.742 | -0.18 | 31.42 | 18.17 |
| 18.60 | 37.70 | -7.14 | 51.74 | 14.0 | 3.686 | -0.20 | 32.89 | 18.85 |
| 19.86 | 38.47 | -7.67 | 53.04 | 14.6 | 3.640 | -0.21 | 33.81 | 19.23 |

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## CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 4.9-5.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 2 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 54 |
| Back Pressure(psi) | 40 |
| Eff. Cons. Pressure(ps | 14.0 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

$\overline{P}$ = 13.40

Q = 7.95

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 6.277 | Diameter 1 | 2.846 |
| Length 2 | 6.278 | Diameter 2 | 2.868 |
| Length 3 | 6.239 | Diameter 3 | 2.861 |
| Avg Leng.= | 6.265 | Avg. Diam.= | 2.858 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 29.7 |
| Final Burette Reading (ml) | 0.0 |
| Final Change (ml) | 29.7 |

| | |
|---|---|
| Initial Dial Reading (D.R.), mils | 127 |
| D.R. After Saturation, mils | 140 |
| D.R. After Consolidation, mils | 155 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 14.2 | 0.000 | 40.0 |
| 43.5 | 0.001 | 41.6 |
| 55.9 | 0.003 | 42.4 |
| 71.0 | 0.007 | 44.1 |
| 77.0 | 0.012 | 45.6 |
| 84.6 | 0.028 | 47.5 |
| 86.9 | 0.035 | 47.9 |
| 89.4 | 0.046 | 48.3 |
| 94.0 | 0.068 | 48.7 |
| 97.8 | 0.093 | 48.9 |
| 103.4 | 0.129 | 48.9 |
| 107.9 | 0.158 | 48.8 |
| 112.2 | 0.188 | 48.7 |
| 114.8 | 0.205 | 48.6 |
| 183.0 | 1.467 | 46.1 |
| 183.0 | 1.467 | 46.1 |



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**WITH PORE PRESSURE READINGS**
ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

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| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 4.9-5.4 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 14.0 | *Stage No.* | 1 |
| | | *Test No* | 2 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 6.26 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.42 |
| Initial Sample Volume (in^3) | 40.20 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 38.14 |
| Length After Consolidation (in) | 6.24 |
| Area After Consolidation (in^2) | 6.115 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.02 | 4.79 | 1.58 | 17.21 | 12.4 | 1.385 | 0.34 | 14.82 | 2.39 |
| 0.04 | 6.81 | 2.37 | 18.44 | 11.6 | 1.586 | 0.36 | 15.03 | 3.41 |
| 0.11 | 9.28 | 4.06 | 19.21 | 9.9 | 1.933 | 0.45 | 14.58 | 4.64 |
| 0.19 | 10.24 | 5.57 | 18.67 | 8.4 | 2.215 | 0.56 | 13.55 | 5.12 |
| 0.44 | 11.45 | 7.48 | 17.97 | 6.5 | 2.756 | 0.67 | 12.25 | 5.73 |
| 0.56 | 11.82 | 7.89 | 17.93 | 6.1 | 2.933 | 0.69 | 12.02 | 5.91 |
| 0.73 | 12.19 | 8.30 | 17.90 | 5.7 | 3.138 | 0.70 | 11.80 | 6.10 |
| 1.10 | 12.90 | 8.72 | 18.17 | 5.3 | 3.443 | 0.70 | 11.73 | 6.45 |
| 1.49 | 13.46 | 8.85 | 18.61 | 5.1 | 3.615 | 0.68 | 11.88 | 6.73 |
| 2.06 | 14.28 | 8.85 | 19.43 | 5.1 | 3.775 | 0.64 | 12.29 | 7.14 |
| 2.53 | 14.94 | 8.78 | 20.15 | 5.2 | 3.862 | 0.61 | 12.69 | 7.47 |
| 3.01 | 15.55 | 8.65 | 20.89 | 5.3 | 3.907 | 0.57 | 13.12 | 7.77 |
| 3.29 | 15.91 | 8.55 | 21.35 | 5.4 | 3.921 | 0.55 | 13.40 | 7.95 |
| 23.52 | 21.11 | 6.08 | 29.04 | 7.9 | 3.664 | 0.30 | 18.48 | 10.56 |
| 23.52 | 21.11 | 6.08 | 29.04 | 7.9 | 3.664 | 0.30 | 18.48 | 10.56 |



Tested By TMS Date 7/16/2010 Input Checked By MWS Date 7-21-10



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## CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

geotechnics
INTEGRITY IN TESTING

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 4.4-4.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | |
|---|---|
| *Stage No.* | 1 |
| *Test No* | 3 |

**PRESSURES (psi)**

| | |
|---|---|
| Cell Pressure(psi) | 60.9 |
| Back Pressure(psi) | 40.0 |
| Eff. Cons. Pressure(ps | 20.9 |
| Pore Pressure Response (%) | 97 |

**MAXIMUM OBLIQUITY POINTS**

| | | |
|---|---|---|
| $\overline{P}$ | = | 18.72 |
| Q | = | 11.05 |

**INITIAL SAMPLE DIMENSIONS (in)**

| | | | |
|---|---|---|---|
| Length 1 | 6.045 | Diameter 1 | 2.855 |
| Length 2 | 6.017 | Diameter 2 | 2.862 |
| Length 3 | 6.030 | Diameter 3 | 2.848 |
| Avg Leng.= | 6.031 | Avg. Diam.= | 2.855 |

**VOLUME CHANGE**

| | |
|---|---|
| Initial Burette Reading (ml) | 24.0 |
| Final Burette Reading (ml) | 12.9 |
| Final Change (ml) | 11.1 |
| Initial Dial Reading (D.R.), mils | 125 |
| D.R. After Saturation, mils | 130 |
| D.R. After Consolidation, mils | 142 |

| LOAD (LBS) | DEFORMATION (INCHES) | PORE PRESSURE (PSI) |
|---|---|---|
| 9.6 | 0.000 | 40.0 |
| 11.9 | 0.001 | 40.0 |
| 35.8 | 0.003 | 40.8 |
| 63.6 | 0.005 | 42.2 |
| 88.3 | 0.010 | 44.6 |
| 112.8 | 0.021 | 48.8 |
| 121.7 | 0.033 | 50.9 |
| 127.0 | 0.046 | 52.0 |
| 132.8 | 0.067 | 52.9 |
| 137.1 | 0.091 | 53.2 |
| 143.8 | 0.127 | 53.4 |
| 148.4 | 0.157 | 53.2 |
| 153.0 | 0.187 | 53.2 |
| 155.5 | 0.205 | 53.1 |
| 162.1 | 0.246 | 52.9 |
| 168.3 | 0.293 | 52.7 |
| 173.8 | 0.338 | 52.5 |
| 179.2 | 0.383 | 52.3 |
| 186.4 | 0.441 | 52.0 |
| 190.6 | 0.485 | 51.8 |
| 197.3 | 0.547 | 51.6 |
| 202.0 | 0.592 | 51.4 |
| 206.2 | 0.636 | 51.2 |
| 211.8 | 0.695 | 50.9 |
| 219.3 | 0.771 | 50.6 |
| 224.3 | 0.830 | 50.4 |
| 232.4 | 0.919 | 50.1 |
| 237.8 | 0.995 | 49.8 |
| 248.5 | 1.129 | 49.3 |
| 254.3 | 1.204 | 49.0 |

Tested By TMS Date 7/16/2010 Input Checked By MM Date 7-21-10



DCN: CT-S28 DATE 6-25-98 REVISION 1

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INTEGRITY IN TESTING

## CONSOLIDATED UNDRAINED TRIAXIAL TEST WITH PORE PRESSURE READINGS

ASTM D4767-95 / AASHTO T297-94 (SOP-S28)

| | | | |
|---|---|---|---|
| Client | MACTEC | Boring No. | SB-2 |
| Client Reference | WEATHERSPOON PLANT | Depth(ft.) | 4.4-4.9 |
| Project No. | 2010-692-01 | Sample No. | NA |
| Lab ID | 2010-692-01-04 | | |

Visual Description: TAN SANDY CLAY (UNDISTURBED)

| | | | |
|---|---|---|---|
| *Effective Confining Pressure (psi)* | 20.9 | *Stage No.* | 1 |
| | | *Test No* | 3 |

**INITIAL DIMENSIONS**

| | |
|---|---|
| Initial Sample Length (in.) | 6.03 |
| Initial Sample Diameter (in.) | 2.86 |
| Initial Sample Area (in^2) | 6.40 |
| Initial Sample Volume (in^3) | 38.61 |

**VOLUME CHANGE**

| | |
|---|---|
| Volume After Consolidation (in^3) | 37.83 |
| Length After Consolidation (in) | 6.01 |
| Area After Consolidation (in^2) | 6.291 |

| Strain (%) | Deviation Stress | $\Delta U$ | $\overline{\sigma}_1$ | $\overline{\sigma}_3$ | Effective Principle Stress Ratio | $\overline{A}$ | $\overline{P}$ | Q |
|---|---|---|---|---|---|---|---|---|
| 0.01 | 0.38 | 0.01 | 21.27 | 20.9 | 1.018 | 0.02 | 21.08 | 0.19 |
| 0.04 | 4.17 | 0.80 | 24.27 | 20.1 | 1.208 | 0.20 | 22.18 | 2.09 |
| 0.08 | 8.58 | 2.24 | 27.24 | 18.7 | 1.460 | 0.27 | 22.95 | 4.29 |
| 0.16 | 12.50 | 4.64 | 28.76 | 16.3 | 1.769 | 0.38 | 22.51 | 6.25 |
| 0.35 | 16.36 | 8.84 | 28.42 | 12.1 | 2.356 | 0.56 | 20.24 | 8.18 |
| 0.54 | 17.72 | 10.88 | 27.74 | 10.0 | 2.768 | 0.63 | 18.88 | 8.86 |
| 0.76 | 18.52 | 12.02 | 27.40 | 8.9 | 3.087 | 0.67 | 18.14 | 9.26 |
| 1.11 | 19.37 | 12.91 | 27.37 | 8.0 | 3.424 | 0.69 | 17.68 | 9.69 |
| 1.52 | 19.97 | 13.24 | 27.62 | 7.7 | 3.607 | 0.68 | 17.64 | 9.98 |
| 2.11 | 20.89 | 13.37 | 28.42 | 7.5 | 3.774 | 0.66 | 17.97 | 10.44 |
| 2.62 | 21.49 | 13.24 | 29.15 | 7.7 | 3.806 | 0.64 | 18.40 | 10.75 |
| 3.11 | 22.10 | 13.23 | 29.77 | 7.7 | 3.881 | 0.62 | 18.72 | 11.05 |
| 3.40 | 22.41 | 13.11 | 30.20 | 7.8 | 3.878 | 0.60 | 18.99 | 11.21 |
| 4.09 | 23.26 | 12.95 | 31.21 | 8.0 | 3.924 | 0.57 | 19.58 | 11.63 |
| 4.86 | 24.01 | 12.75 | 32.16 | 8.2 | 3.946 | 0.55 | 20.15 | 12.00 |
| 5.62 | 24.64 | 12.50 | 33.04 | 8.4 | 3.933 | 0.52 | 20.72 | 12.32 |
| 6.36 | 25.24 | 12.34 | 33.81 | 8.6 | 3.947 | 0.50 | 21.19 | 12.62 |
| 7.34 | 26.05 | 12.00 | 34.95 | 8.9 | 3.928 | 0.47 | 21.93 | 13.03 |
| 8.07 | 26.46 | 11.82 | 35.54 | 9.1 | 3.913 | 0.46 | 22.31 | 13.23 |
| 9.10 | 27.13 | 11.59 | 36.44 | 9.3 | 3.913 | 0.44 | 22.88 | 13.56 |
| 9.85 | 27.58 | 11.37 | 37.10 | 9.5 | 3.895 | 0.43 | 23.32 | 13.79 |
| 10.58 | 27.95 | 11.23 | 37.62 | 9.7 | 3.892 | 0.41 | 23.64 | 13.97 |
| 11.56 | 28.43 | 10.92 | 38.41 | 10.0 | 3.848 | 0.40 | 24.20 | 14.21 |
| 12.82 | 29.07 | 10.64 | 39.32 | 10.3 | 3.834 | 0.38 | 24.79 | 14.53 |
| 13.81 | 29.42 | 10.41 | 39.91 | 10.5 | 3.805 | 0.36 | 25.20 | 14.71 |
| 15.28 | 30.00 | 10.08 | 40.82 | 10.8 | 3.772 | 0.35 | 25.82 | 15.00 |
| 16.54 | 30.27 | 9.80 | 41.37 | 11.1 | 3.727 | 0.33 | 26.24 | 15.14 |
| 18.77 | 30.85 | 9.27 | 42.49 | 11.6 | 3.652 | 0.31 | 27.06 | 15.43 |
| 20.02 | 31.11 | 9.02 | 42.98 | 11.9 | 3.620 | 0.30 | 27.43 | 15.55 |

Tested By TMS Date 7/16/2010 Input Checked By [signature] Date 7-22-10



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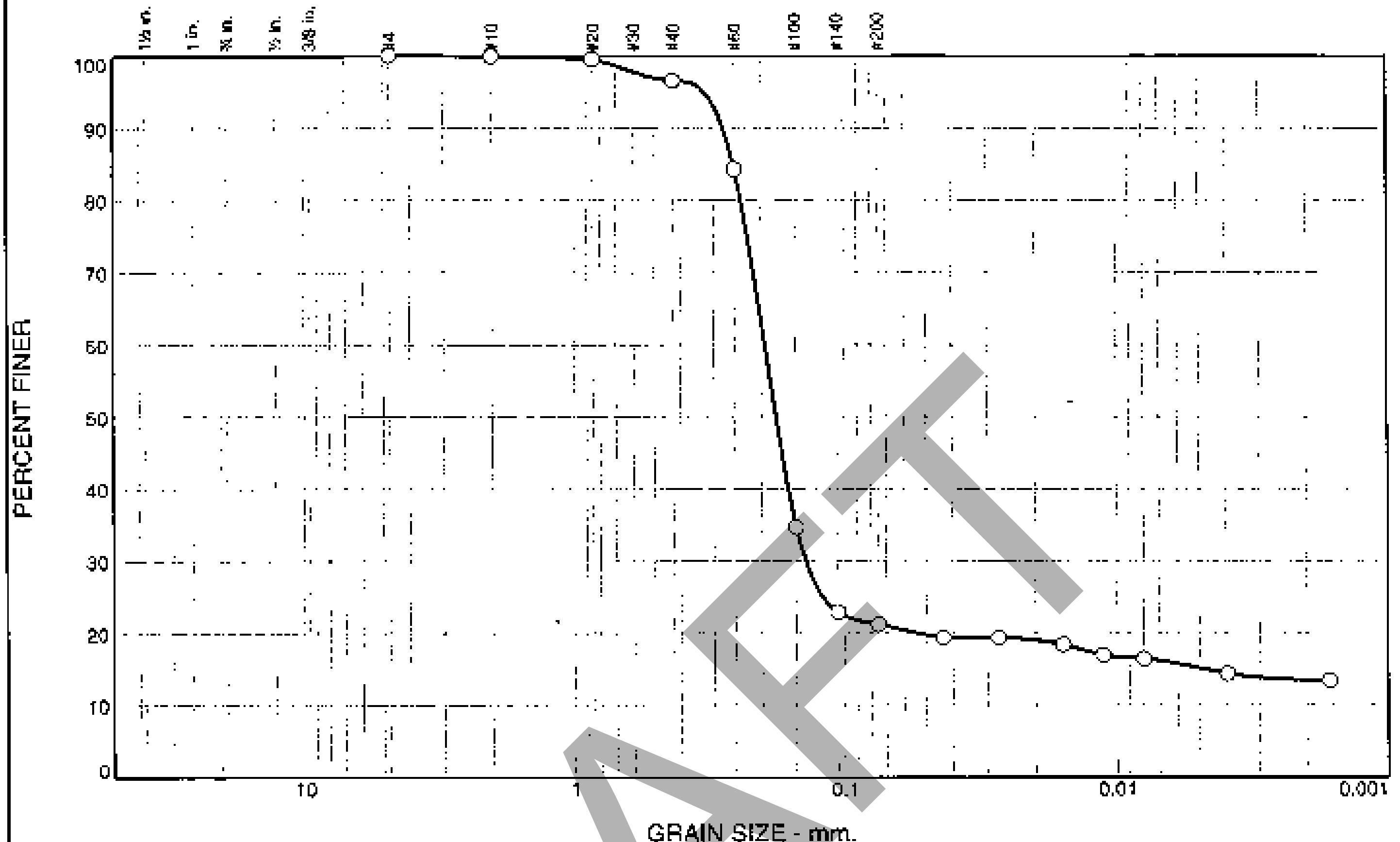
# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 75.4 | 7.7 | 13.5 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 100.0 | | |
| #20 | 99.6 | | |
| #40 | 96.6 | | |
| #60 | 84.3 | | |
| #100 | 34.7 | | |
| #140 | 22.9 | | |
| #200 | 21.2 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Silty SAND with roots

**Atterberg Limits**

PL= 15 LL= 18 PI= 3

**Coefficients**

$D_{85}$= 0.2526 $D_{60}$= 0.1947 $D_{50}$= 0.1775
$D_{30}$= 0.1387 $D_{15}$= 0.0048 $D_{10}$=
$C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

Specific Gravity is assumed

**Source of Sample:** Boring NB-3 **Depth:** 8-10'
**Sample Number:** UD-1

**Date:** 7/13/10

**MACTEC Engineering and Consulting, Inc.**

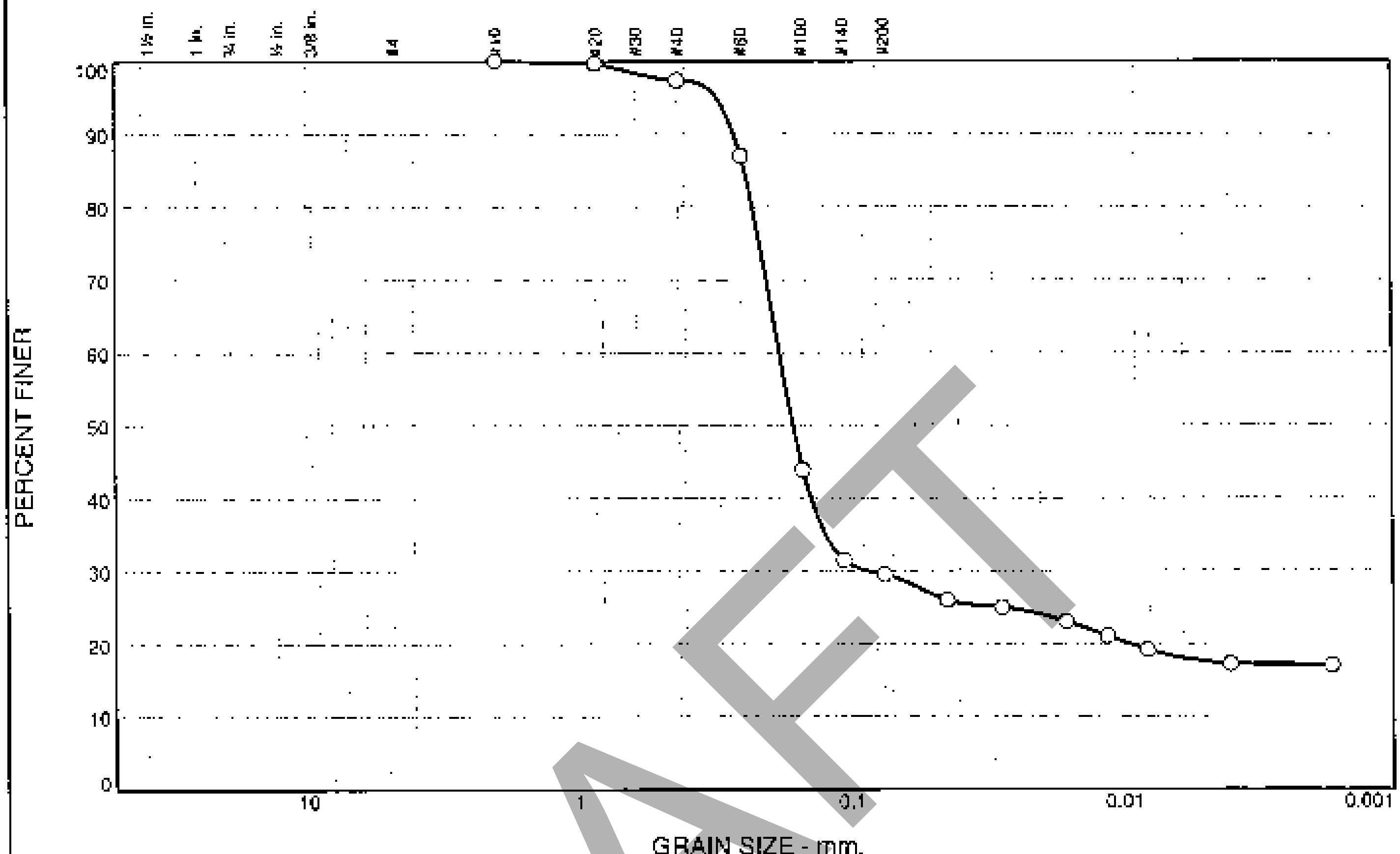
**Raleigh, North Carolina**

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No:** 6464100111.01 **Figure**

**Tested By:** CS **Checked By:** IAM

DRAFT

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 2.6 | 67.9 | 12.4 | 17.1 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 99.7 | | |
| #40 | 97.4 | | |
| #60 | 87.0 | | |
| #100 | 43.9 | | |
| #140 | 31.5 | | |
| #200 | 29.5 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Silty Clayey SAND

**Atterberg Limits**

PL= 14 LL= 20 PI= 6

**Coefficients**

$D_{85}$= 0.2426 $D_{60}$= 0.1821 $D_{50}$= 0.1627
$D_{30}$= 0.0875 $D_{15}$= $D_{10}$=
$C_u$= $C_c$=

**Classification**

USCS= SC-SM AASHTO= A-2-4(0)

**Remarks**

Specific Gravity is assumed
ND = Not Determined

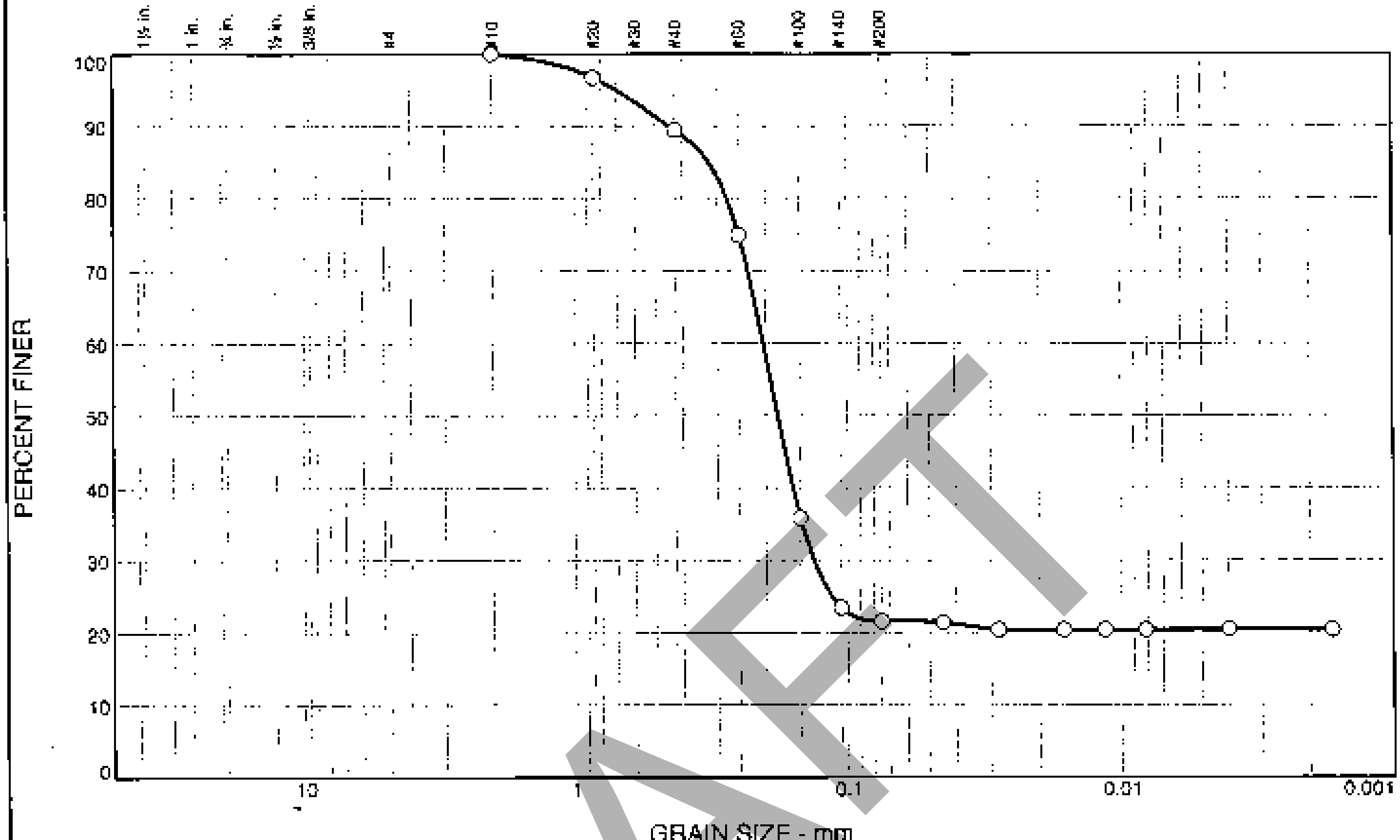
**Source of Sample:** Boring NB-4 **Depth:** 8-10'
**Sample Number:** UD-1 **Date:** 7/22/10

**MACTEC Engineering and Consulting, Inc.**
**Raleigh, North Carolina**

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No:** 6464100111.01 **Figure**

**Tested By:** CS **Checked By:** IAM

# Particle Size Distribution Report




| % +3" | % Gravel Coarse | % Gravel Fine | % Sand Coarse | % Sand Medium | % Sand Fine | % Fines Silt | % Fines Clay |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 | 10.7 | 67.7 | 1.2 | 20.4 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #10 | 100.0 | | |
| #20 | 96.7 | | |
| #40 | 89.3 | | |
| #60 | 74.9 | | |
| #100 | 35.9 | | |
| #140 | 23.5 | | |
| #200 | 21.6 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Silty Clayey SAND

**Atterberg Limits**

PL= 14 LL= 20 PI= 6

**Coefficients**

$D_{85}$= 0.3212 $D_{60}$= 0.2044 $D_{50}$= 0.1814
$D_{30}$= 0.1340 $D_{15}$= $D_{10}$=
$C_u$= $C_c$=

**Classification**

USCS= SC-SM AASHTO= A-2-4(0)

**Remarks**

Specific Gravity is assumed

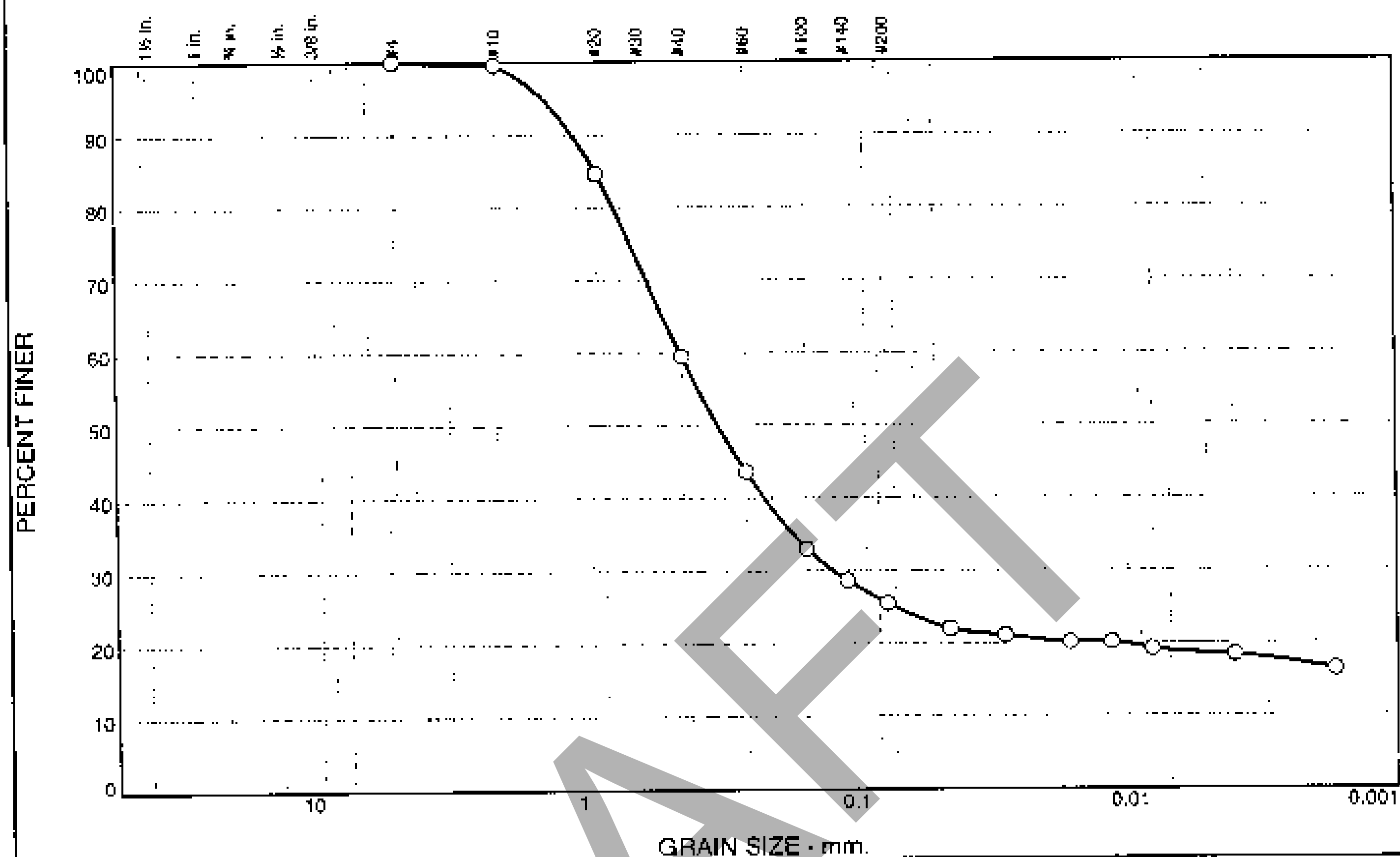
**Source of Sample:** Boring NB-6 **Depth:** 13-15'
**Sample Number:** UD-1 **Date:** 7/13/10

**MACTEC Engineering and Consulting, Inc.**
**Raleigh, North Carolina**

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No:** 6464100111.01 **Figure**

**Tested By:** CS **Checked By:** IAM

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.4 | 40.2 | 33.9 | 8.7 | 16.8 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #4 | 100.0 | | |
| #10 | 99.6 | | |
| #20 | 84.7 | | |
| #40 | 59.4 | | |
| #60 | 43.6 | | |
| #100 | 33.0 | | |
| #140 | 28.6 | | |
| #200 | 25.5 | | |

* (no specification provided)

**Material Description**

Yellowish Brown Clayey SAND

**Atterberg Limits**

PL= 12 LL= 24 PI= 12

**Coefficients**

$D_{85}$= 0.8590 $D_{60}$= 0.4317 $D_{50}$= 0.3166
$D_{30}$= 0.1202 $D_{15}$= $D_{10}$=
$C_u$= $C_c$=

**Classification**

USCS= SC AASHTO= A-2-6(0)

**Remarks**

Specific Gravity is assumed
ND = Not Determined

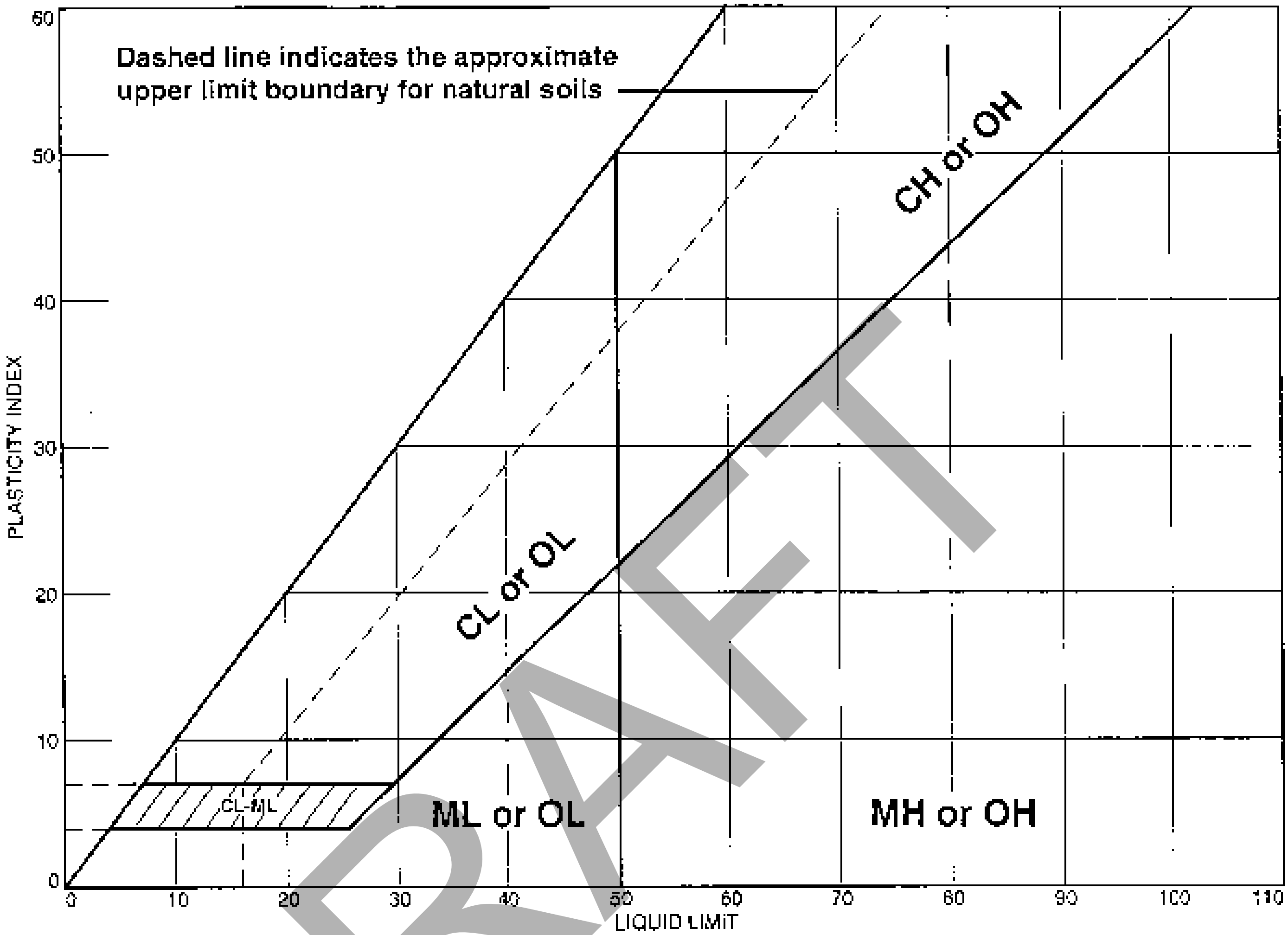
**Source of Sample:** Boring SB-2 **Depth:** 3.5-5.5'
**Sample Number:** UD-1 **Date:** 7/13/10

**MACTEC Engineering and Consulting, Inc.**
**Raleigh, North Carolina**

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No:** 6464100111.01 **Figure**

**Tested By:** CS **Checked By:** IAM

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Brown Fine SAND (visual) | 14 | NP | NP | ND | ND | SP (visual) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 6468100111.03 **Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

● **Sample Source:** Boring NB-1 **Depth:** 8.5-10.0' **Sample No.:** Jar 5

**Remarks:**
● ND = Not Determined
Moisture Contents & Atterburg Limits Only

**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Figure**

**Tested By:** CS

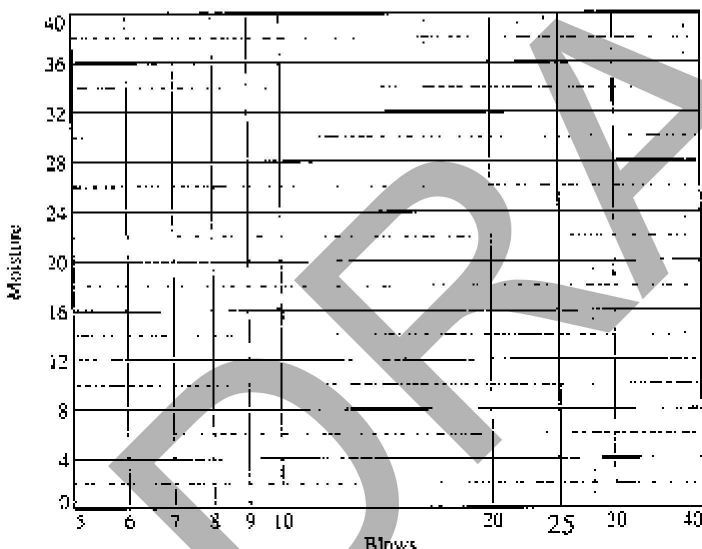
# LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring NB-1
**Depth:** 8.5-10.0' **Sample Number:** Jar 5
**Material Description:** Brown Fine SAND (visual)
**%<#40:** ND **%<#200:** ND **USCS:** SP (visual) **AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** ND = Not Determined
Moisture Contents & Atterburg Limits Only

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 26.87 | | | | | |
| Dry+Tare | 25.31 | | | | | |
| Tare | 15.49 | | | | | |
| # Blows | 10 | | | | | |
| Moisture | 15.9 | | | | | |




Liquid Limit= 14
Plastic Limit= NP
Plasticity Index= NP
Natural Moisture= 18.9

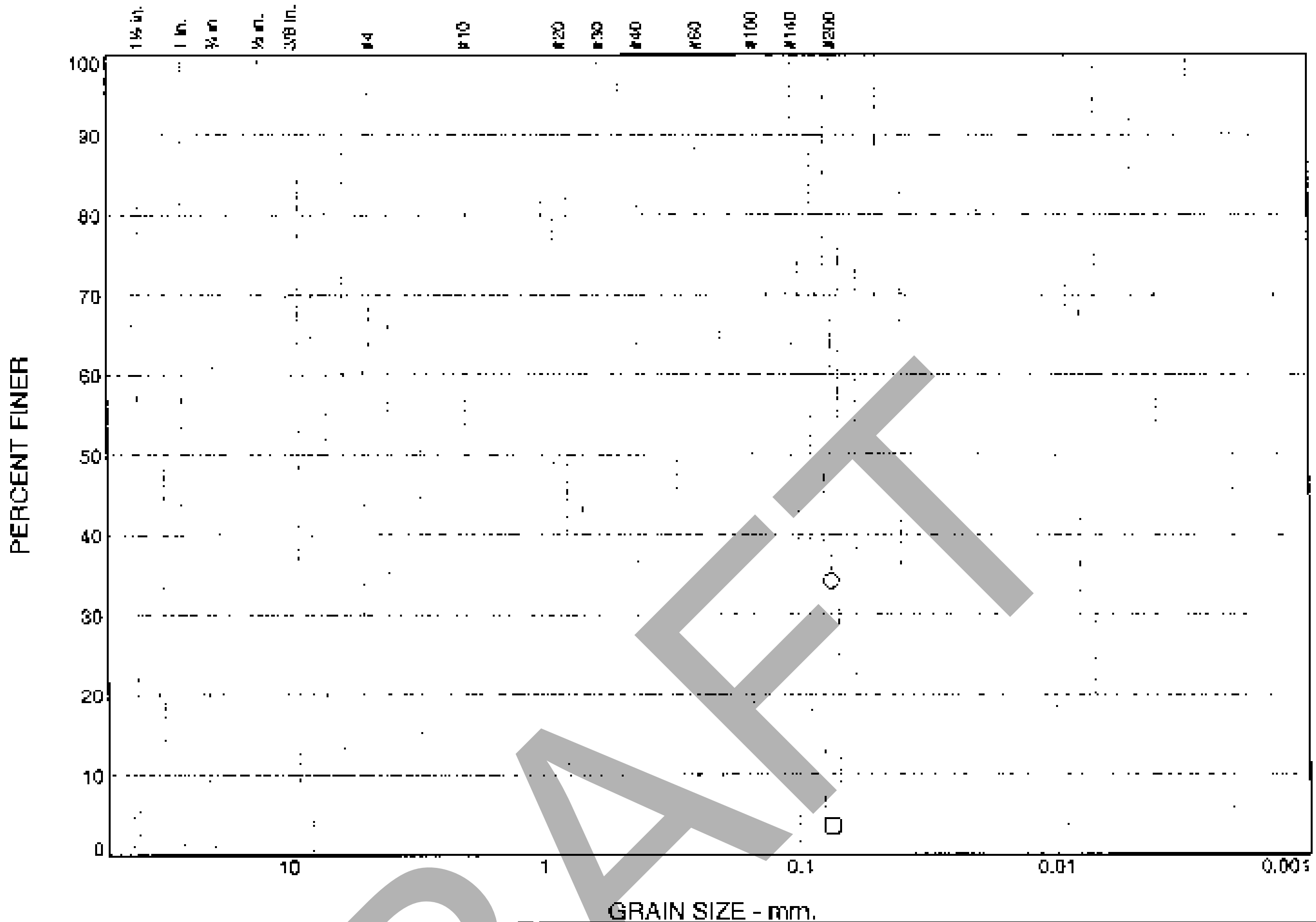
## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | | | | |
| Dry+Tare | | | | |
| Tare | | | | |
| Moisture | | | | |

## Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 99.01 | 91.14 | 49.44 | 18.9 |

# Particle Size Distribution Report ASTM D 6913-04e1




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | | | | | | 34.2 | |
| □ | | | | | | 3.6 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

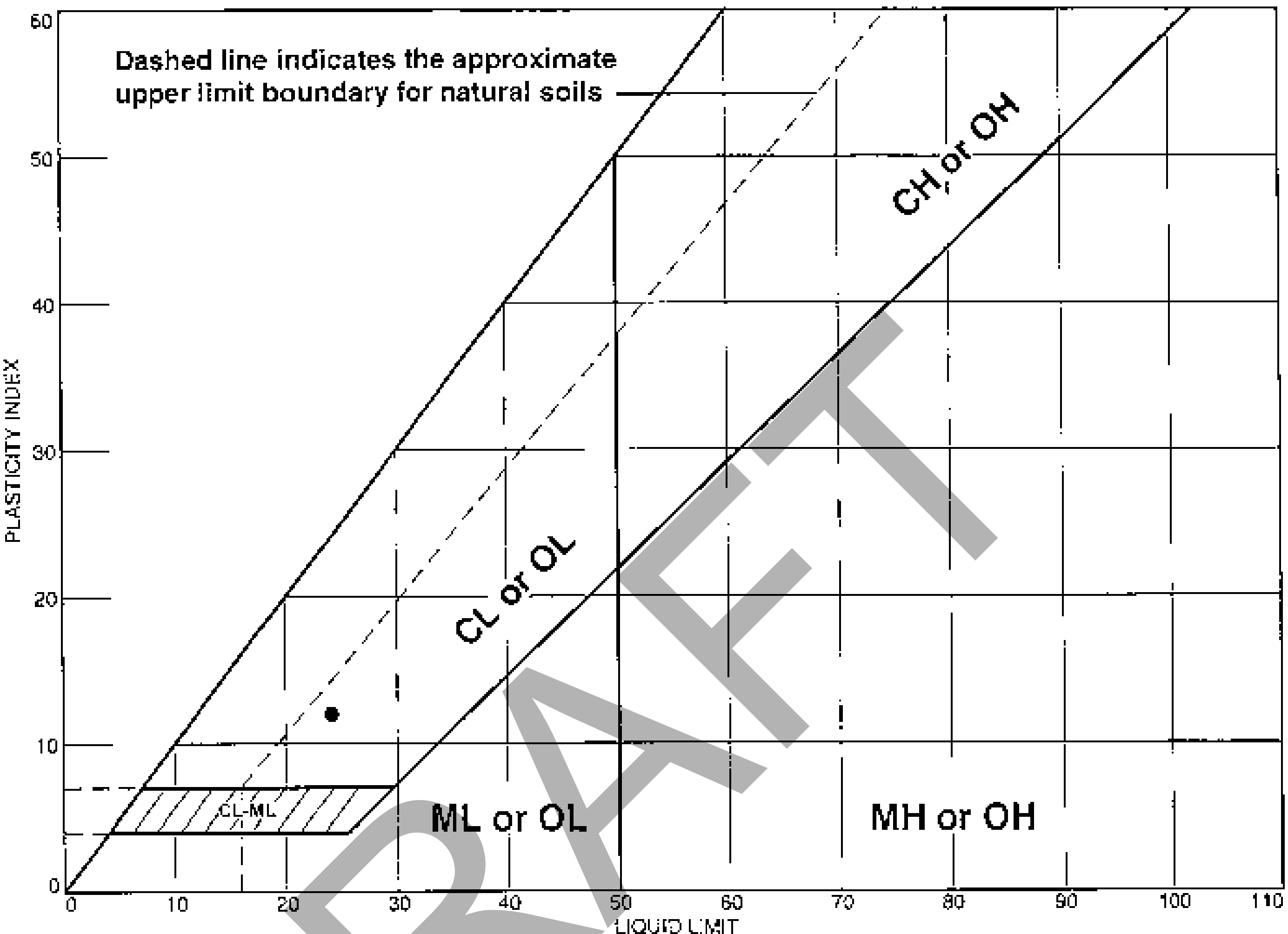
## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring NB-3 | Jar 5 | 8.5-10.0" | Yellowish Brown Clayey SAND (visual) | SC (visual) |
| □ | Boring NB-3 | Jar 9 | 28.5-30.0" | Tan to White Fine SAND (visual) | SP (visual) |
| | | | | | |
| | | | | | |
| | | | | | |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br>Raleigh, North Carolina | Client: Progress Energy<br>Project: Weatherspoon Plant Dike Study<br>Project No.: 6468100111.03 Figure |

Tested By: CS

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Yellowish Brown Clayey SAND (visual) | 24 | 12 | 12 | | 34.2 | SC (visual) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 6468100111.03 **Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

● **Sample Source:** Boring NB-3 **Depth:** 8.5-10.0' **Sample No.:** Jar 5

**Remarks:**

● ND = Not Determined

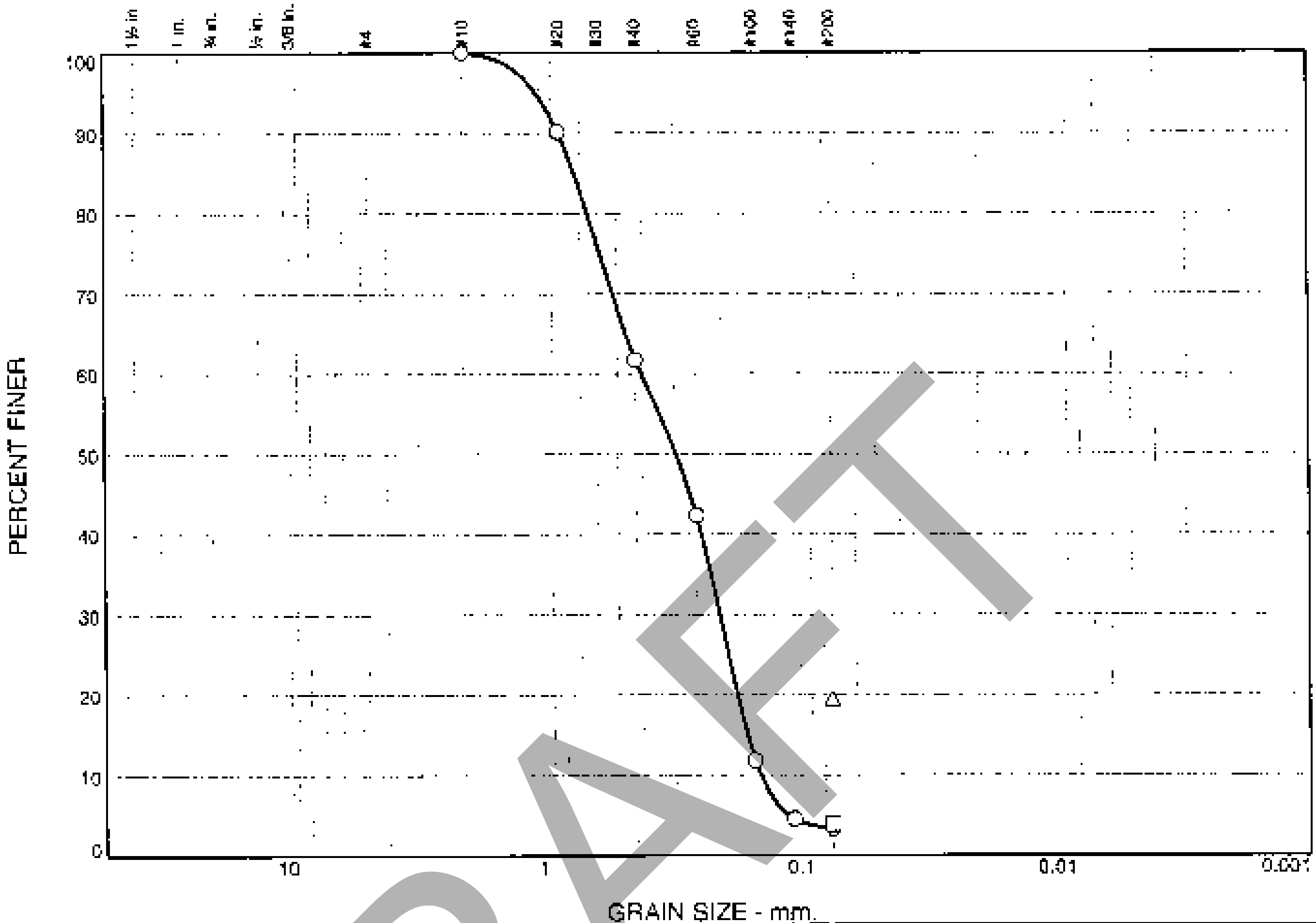
**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Figure**

**Tested By:** CS

# Particle Size Distribution Report ASTM D 6913-04e1






| | % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.0 | 38.3 | 58.4 | 3.3 | |
| □ | | | | | | | 3.9 | |
| △ | | | | | | | 19.5 | |
| | | | | | | | | |
| | | | | | | | | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring NB-4 | Jar 3 | 3.5-5.0" | Light Gray & Brown Fine SAND (visual) | SP |
| □ | Boring NB-4 | Jar 7 | 18.5-20.0 | Brown Fine to Medium SAND (visual) | SP (visual) |
| △ | Boring NB-4 | Jar 9 | 28.5 -30.0 | Grayish Brown Clayey Fine to Medium SAND (visual) | SC (visual) |
| | | | | | |
| | | | | | |

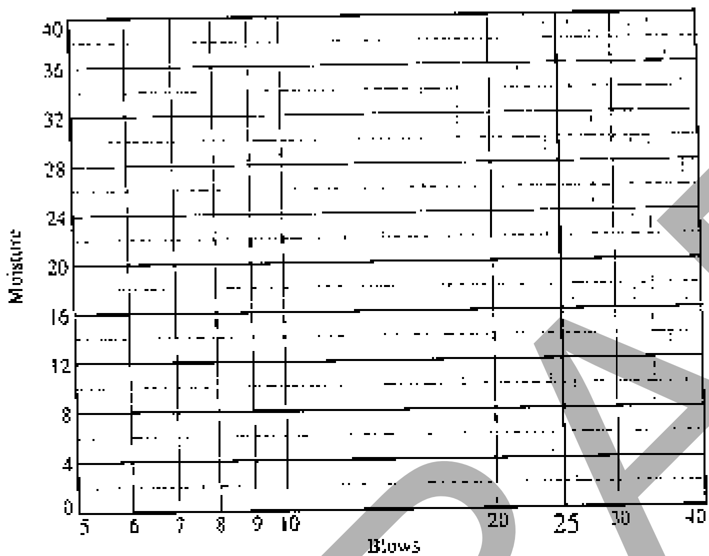
| | |
|---|---|
| **MACTEC Engineering and Consulting, Inc.**<br>Raleigh, North Carolina | **Client:** Progress Energy<br>**Project:** Weatherspoon Plant Dike Study<br>**Project No.:** 6468100111.03 **Figure** |

**Tested By:** CS

8/26/2010

# LIQUID AND PLASTIC LIMIT TEST DATA

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring NB-4
**Depth:** 18.5-20.0
**Sample Number:** Jar 7
**Material Description:** Brown Fine to Medium SAND (visual)
**%<#200:** 3.9
**USCS:** SP (visual)
**AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** ND = Not Determined
Moisture Contents & Wash 200

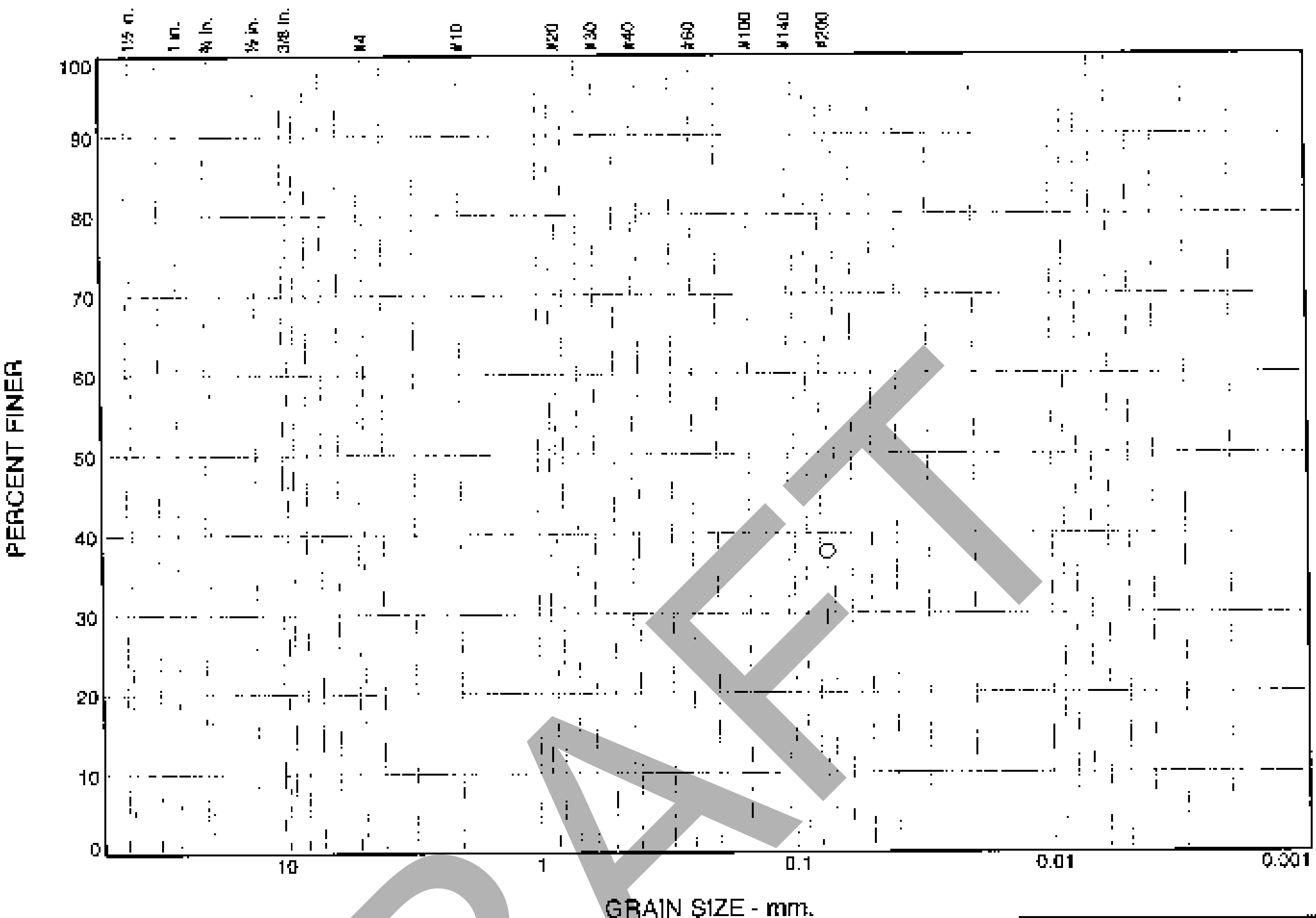



**Liquid Limit=**
**Plastic Limit=**
**Plasticity Index=**
**Natural Moisture=** 40.9

**Natural Moisture Data**

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 219.92 | 164.9 | 30.39 | 40.9 |

# Particle Size Distribution Report ASTM D 6913-04e1




DRAFT

| | +3" | % Gravel Coarse | % Gravel Fine | % Sand Coarse | % Sand Medium | % Sand Fine | % Fines Silt | % Fines Clay |
|---|---|---|---|---|---|---|---|---|
| ○ | | | | | | | 37.7 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

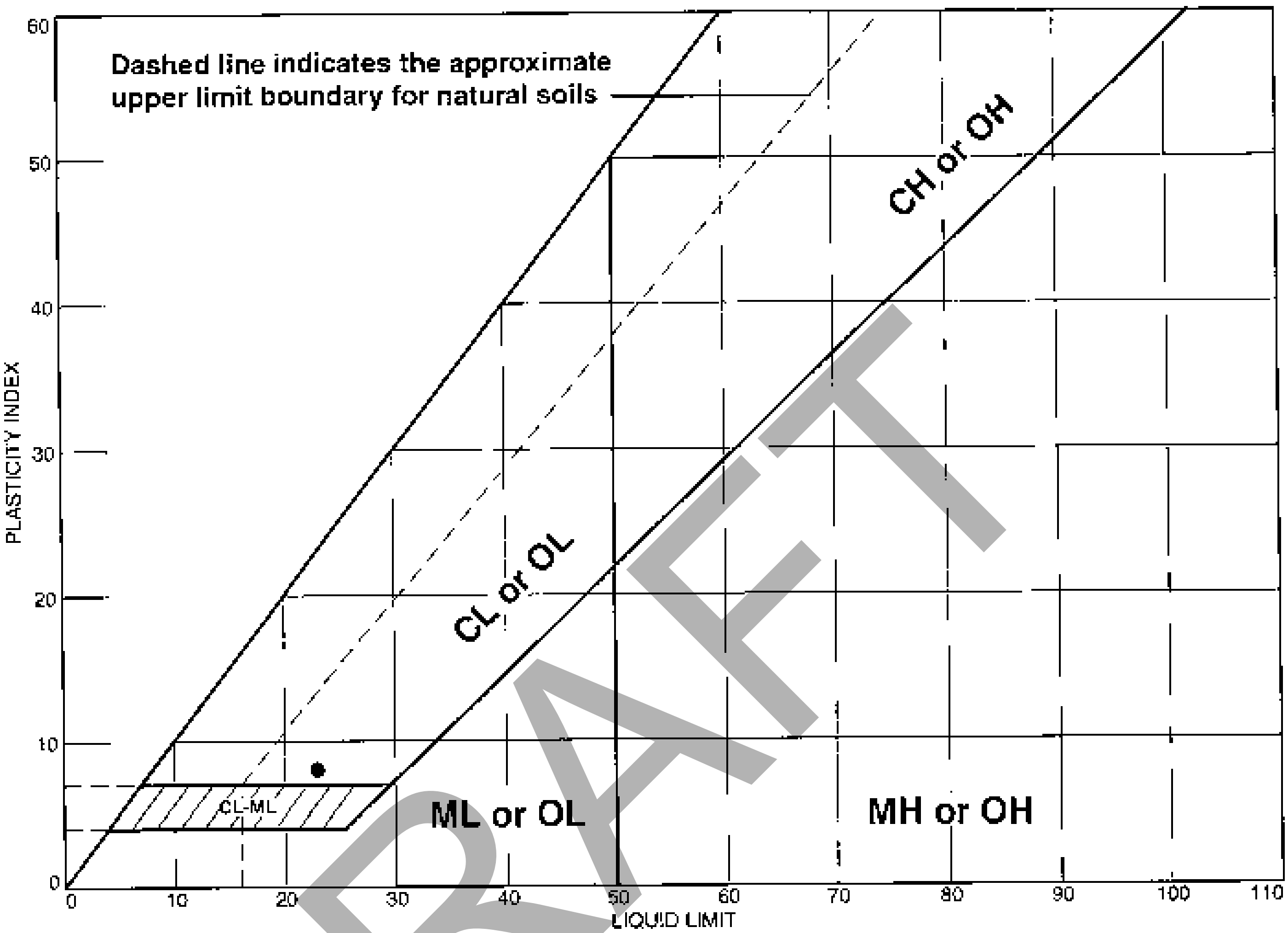
## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring NB-5 | Jar 8 | 23.5-25.0" | Orange Brown Clayey SAND (SC) | SC |
| | | | | | |
| | | | | | |
| | | | | | |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br><br>Raleigh, North Carolina | Client: Progress Energy<br>Project: Weatherspoon Plant Dike Study<br><br>Project No.: 6468100111.03 Figure |

Tested By: CS

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)






| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Orange Brown Clayey SAND (SC) | 23 | 15 | 8 | | 37.7 | SC |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 6468100111.03 **Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

● **Sample Source:** Boring NB-5 **Depth:** 23.5-25.0" **Sample No.:** Jar 8

**Remarks:**
● ND = Not Determined

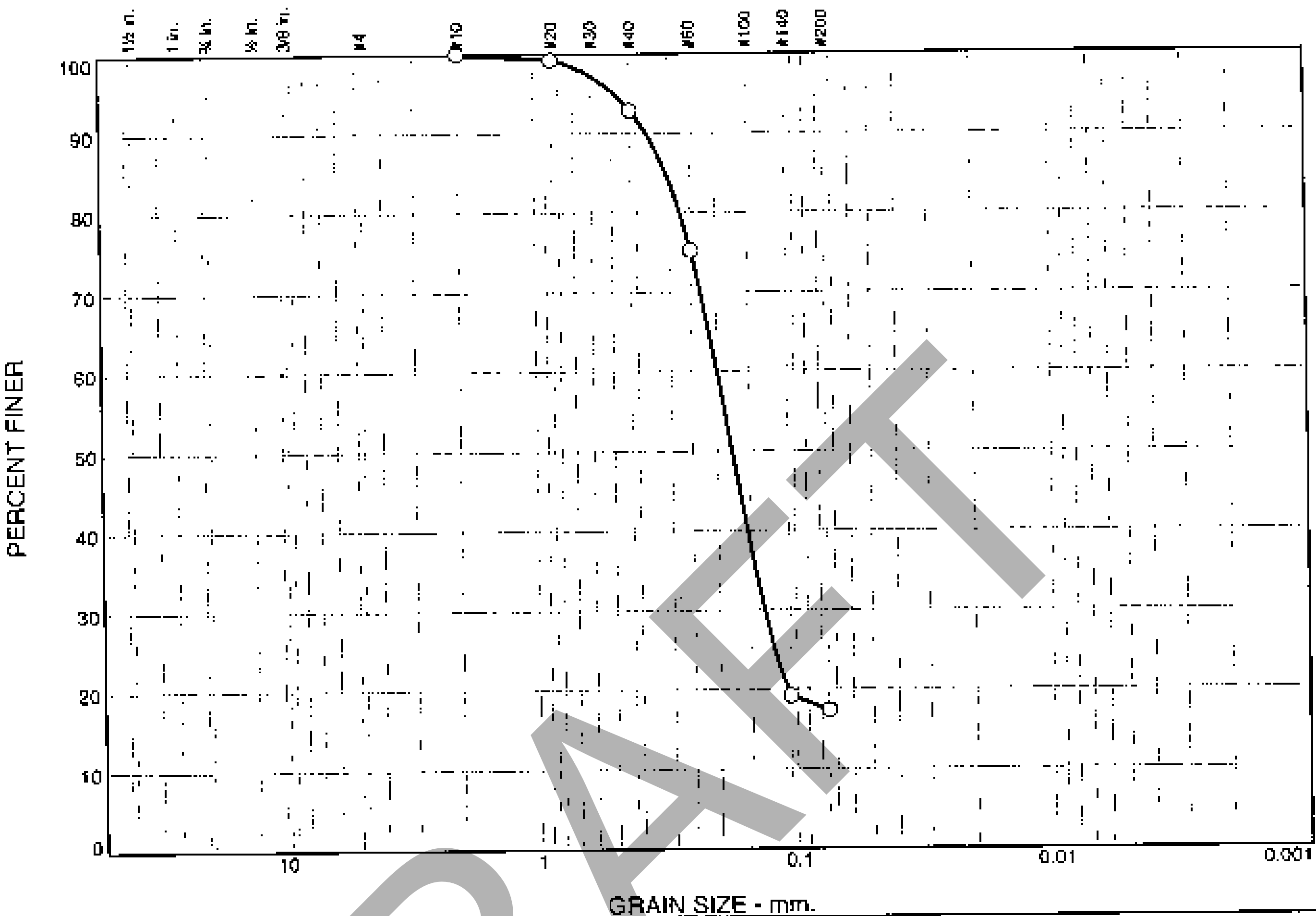
**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Figure**

**Tested By:** CS

# Particle Size Distribution Report ASTM D 6913-04e1




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ 0.0 | 0.0 | 0.0 | 0.0 | 7.1 | 75.5 | 17.4 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring NB-7 | Jar 3 | 3.5-5.0" | Brown Silty SAND (visual) | SM |

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

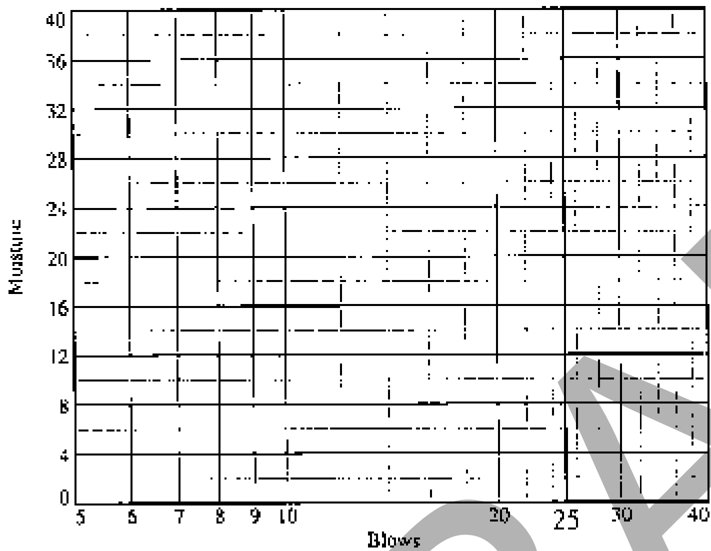
**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 Figure

Tested By: CS

## LIQUID AND PLASTIC LIMIT TEST DATA

6/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring NB-7
**Depth:** 3.5-5.0" **Sample Number:** Jar 3
**Material Description:** Brown Silty SAND (visual)
**%<#40:** 92.9 **%<#200:** 17.4 **USCS:** SM **AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** Moisture Contents # Wash 200 W/ Sieve



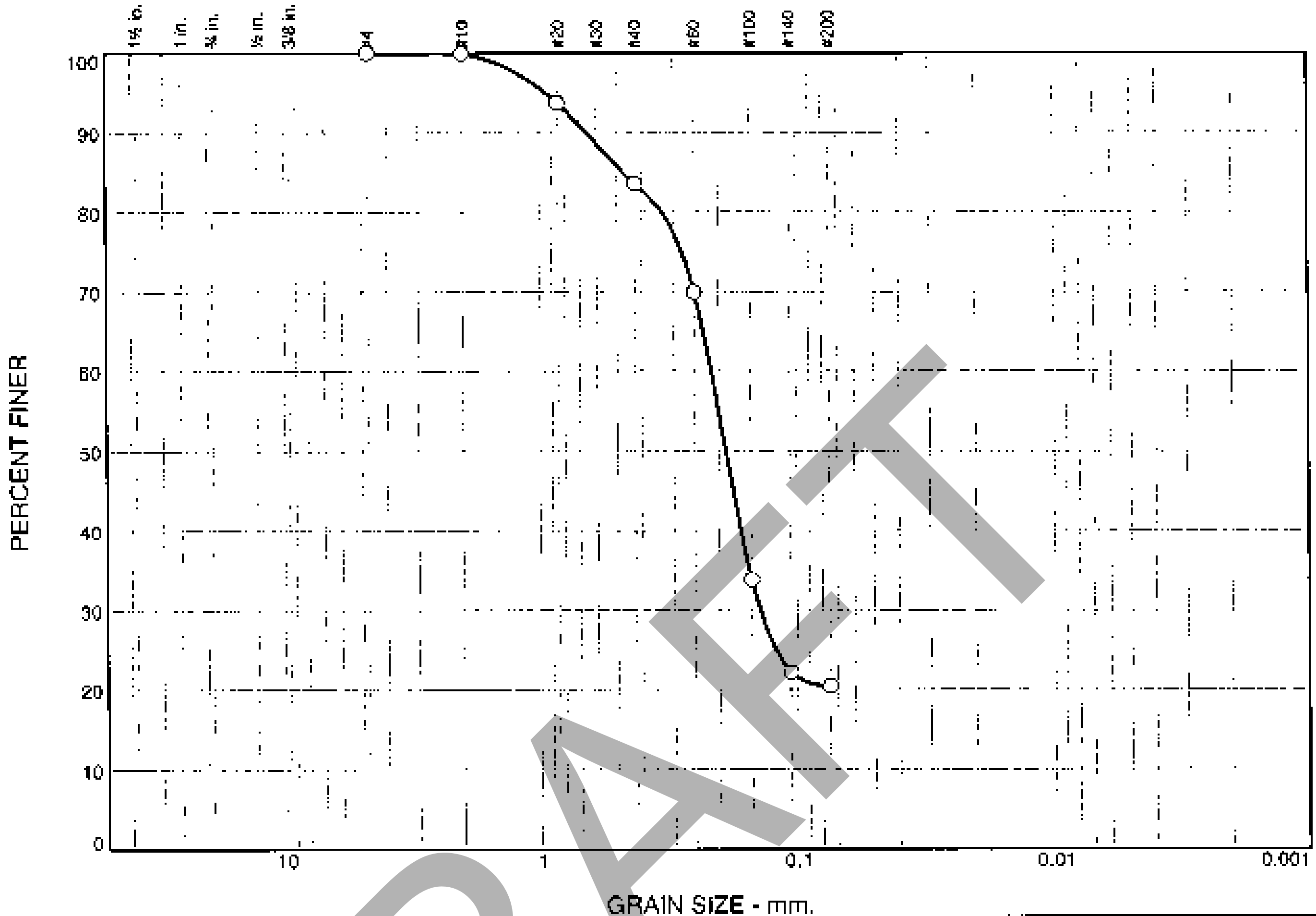

**Liquid Limit=** ______
**Plastic Limit=** ______
**Plasticity Index=** ______
**Natural Moisture=** 7.8



### Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 183.49 | 172.44 | 30.19 | 7.8 |

# Particle Size Distribution Report ASTM D 6913-04e1






| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| % +3" | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ 0.0 | 0.0 | 0.0 | 0.1 | 16.4 | 63.1 | 20.4 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring NB-8 | Jar 4 | 6.0-7.5" | Brown & Gray Clayey SAND (visual) | SC (visual) |

**MACTEC Engineering and Consulting, Inc.**

Raleigh, North Carolina

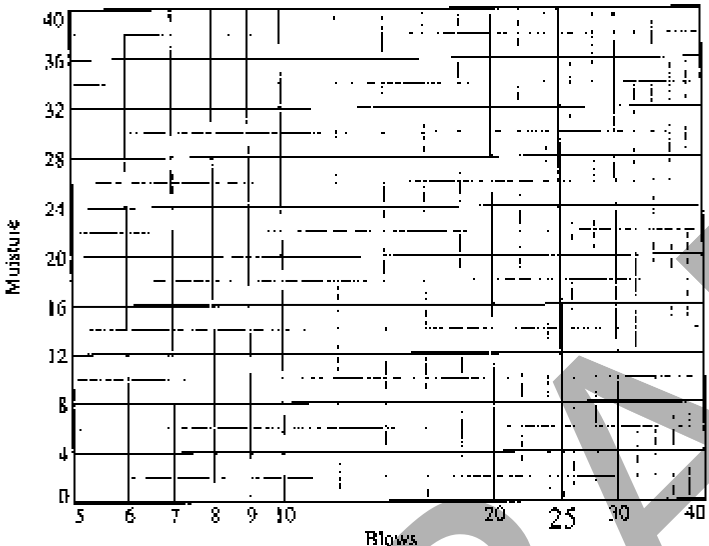
**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 **Figure**

**Tested By:** CS

8/26/2010

## LIQUID AND PLASTIC LIMIT TEST DATA

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring NB-8
**Depth:** 6.0-7.5'
**Sample Number:** Jar 4
**Material Description:** Brown & Gray Clayey SAND (visual)
**%<#40:** 83.5
**%<#200:** 20.4
**USCS:** SC (visual)
**AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** Moisture Contents & Wash 200 W/Sieve



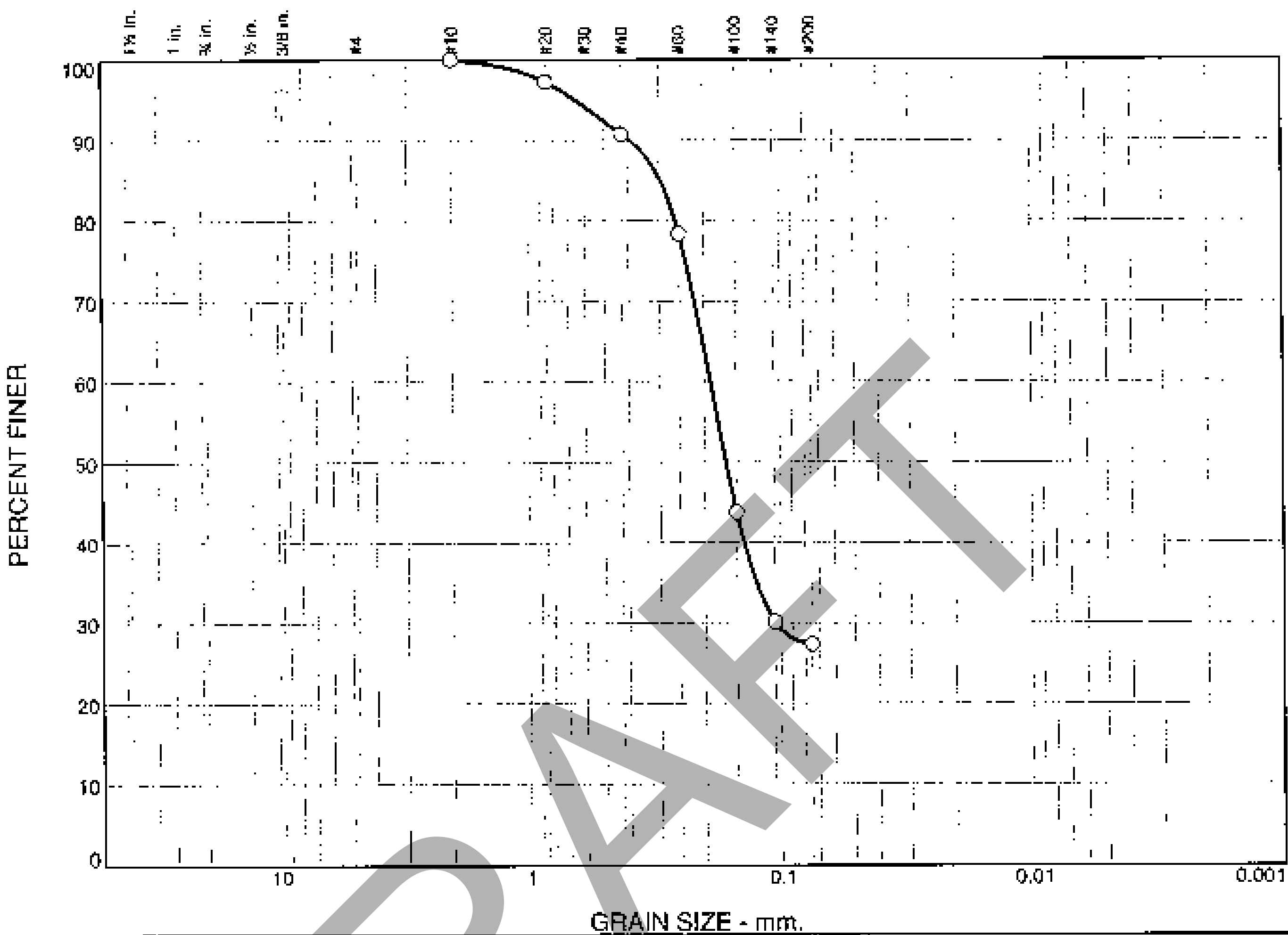

**Liquid Limit=** ______
**Plastic Limit=** ______
**Plasticity Index=** ______
**Natural Moisture=** 13.9



### Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 106.33 | 99.50 | 50.45 | 13.9 |

# Particle Size Distribution Report ASTM D 6913-04e1




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ 0.0 | 0.0 | 0.0 | 0.0 | 9.3 | 63.3 | 27.4 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-1 | Jar 3 | 3.5-5.0" | Gray & Tan Clayey SAND (visual) | SC (visual) |

**MACTEC Engineering and Consulting, Inc.**

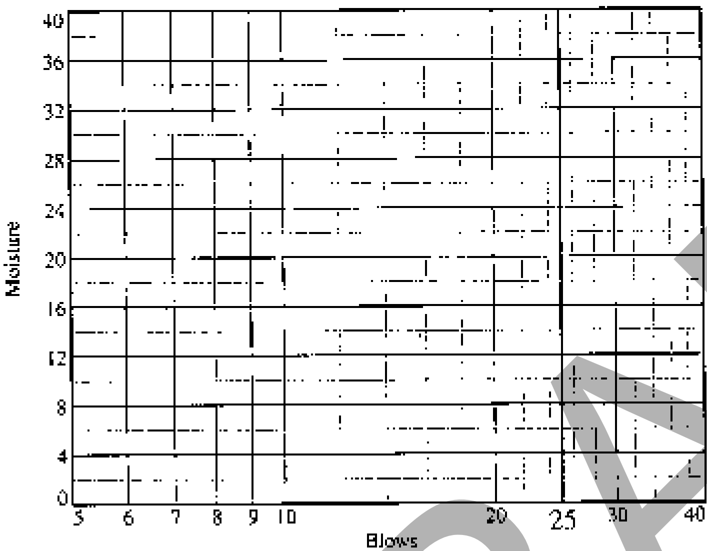
**Raleigh, North Carolina**

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 **Figure**

## LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-1
**Depth:** 3.5-5.0"
**Sample Number:** Jar 3
**Material Description:** Gray & Tan Clayey SAND (visual)
**%<#40:** 90.7 **%<#200:** 27.4 **USCS:** SC (visual)
**Tested by:** CS
**Testing Remarks:** Moisture Contents & Wash 200 W/Sieve



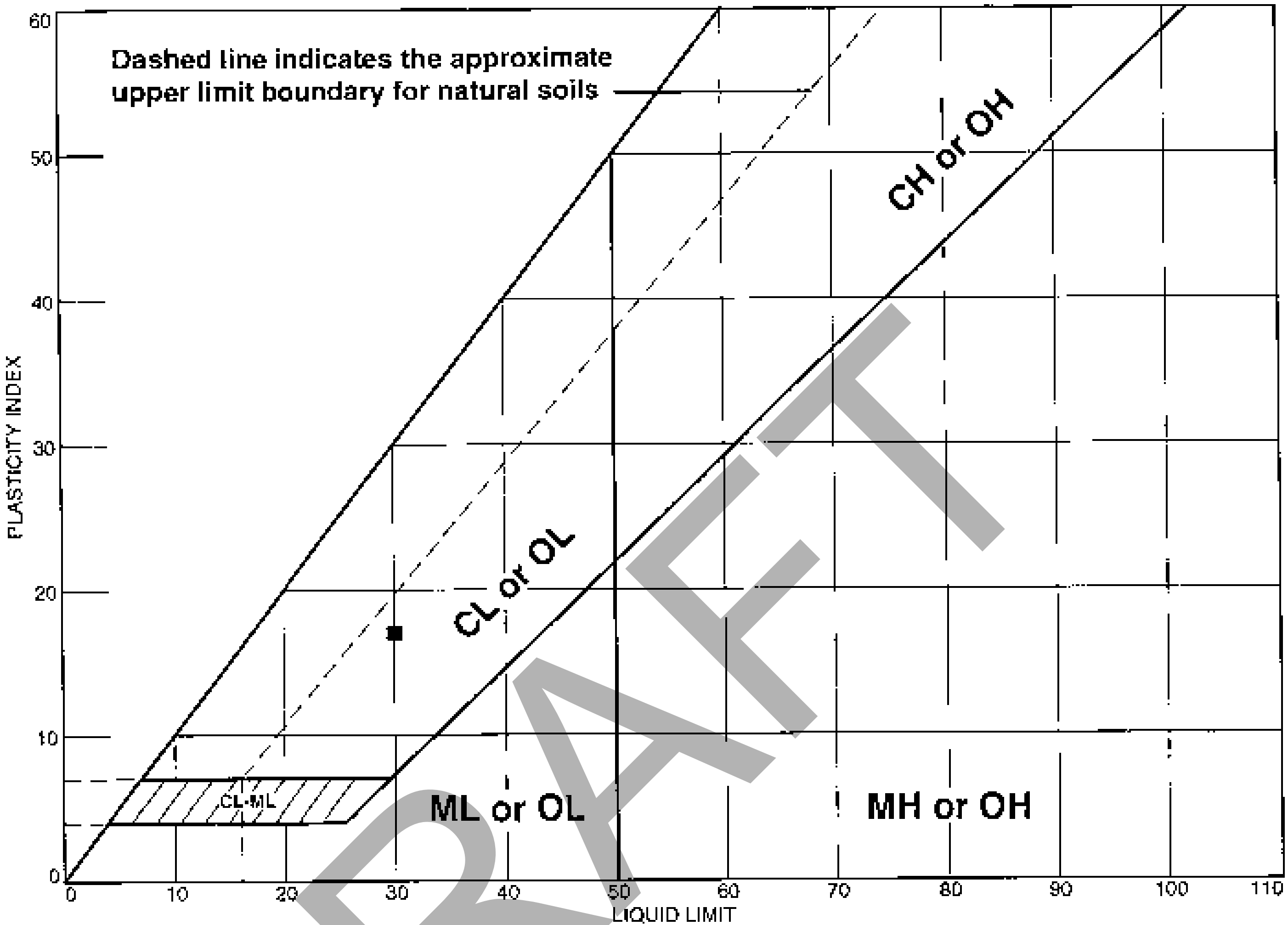

**Liquid Limit=** ______
**Plastic Limit=** ______
**Plasticity Index=** ______
**Natural Moisture=** 11.7



### Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 138.47 | 129.28 | 50.44 | 11.7 |

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Gray & Tan Clayey SAND (visual) | | | | 90.7 | 27.4 | SC (visual) |
| ■ | Reddish Brown Clayey Fine to Medium SAND (visual) | 30 | 13 | 17 | ND | ND | SC (visual) |

**Project No.** 6468100111.03 **Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

● **Source of Sample:** Boring SB-1 **Depth:** 3.5-5.0" **Sample Number:** Jar 3

■ **Sample Source:** Boring SB-1 **Depth:** 18.5-20.0" **Sample No.:** Jar 7

**Remarks:**
● Moisture Contents & Wash 200 W/ Sieve
■ Moisture Contents & Atterburg Limits

**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Figure**

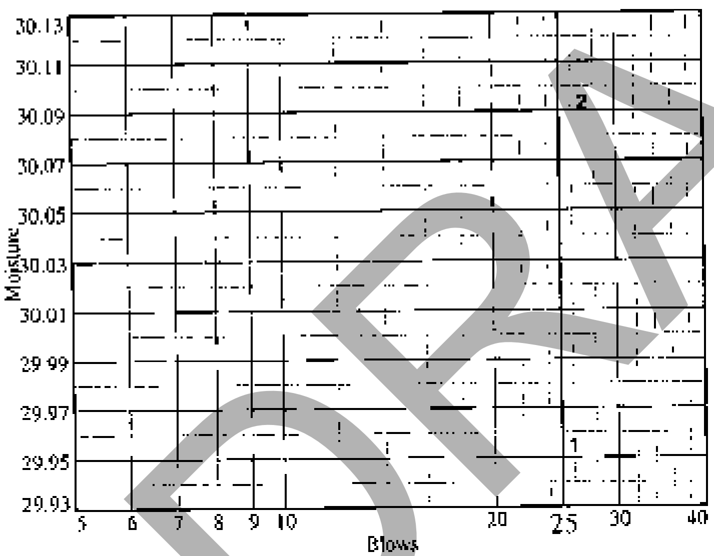
**Tested By:** CS

# LIQUID AND PLASTIC LIMIT TEST DATA

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-1
**Depth:** 18.5-20.0' **Sample Number:** Jar 7
**Material Description:** Reddish Brown Clayey Fine to Medium SAND (visual)
**%<#40:** ND **%<#200:** ND **USCS:** SC (visual) **AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** Moisture Contents & Atterburg Limits

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 27.02 | 26.39 | | | | |
| Dry+Tare | 24.36 | 23.82 | | | | |
| Tare | 15.48 | 15.28 | | | | |
| # Blows | 26 | 27 | | | | |
| Moisture | 30.0 | 30.1 | | | | |




Liquid Limit= 30
Plastic Limit= 13
Plasticity Index= 17
Natural Moisture= 16.6
Liquidity Index= 0.2

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 22.51 | 22.44 | | |
| Dry+Tare | 21.7 | 21.69 | | |
| Tare | 15.50 | 15.57 | | |
| Moisture | 13.1 | 12.3 | | |

## Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 126.54 | 115.70 | 50.38 | 16.6 |

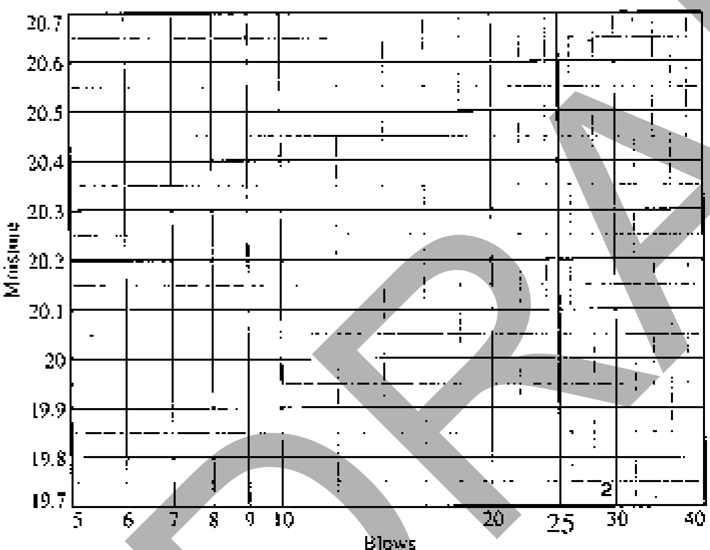
## LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-3
**Depth:** 3.5-5'
**Sample Number:** Jar 3
**Material Description:** Reddish Brown Clayey SAND
**%<#200:** 30.3
**USCS:** SC
**AASHTO:** ND
**Tested by:** CS

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 26.25 | 26.54 | | | | |
| Dry+Tare | 24.43 | 24.75 | | | | |
| Tare | 15.61 | 15.68 | | | | |
| # Blows | 28 | 29 | | | | |
| Moisture | 20.6 | 19.7 | | | | |




Liquid Limit= 21
Plastic Limit= 12
Plasticity Index= 9
Natural Moisture= 13.4
Liquidity Index= 0.2

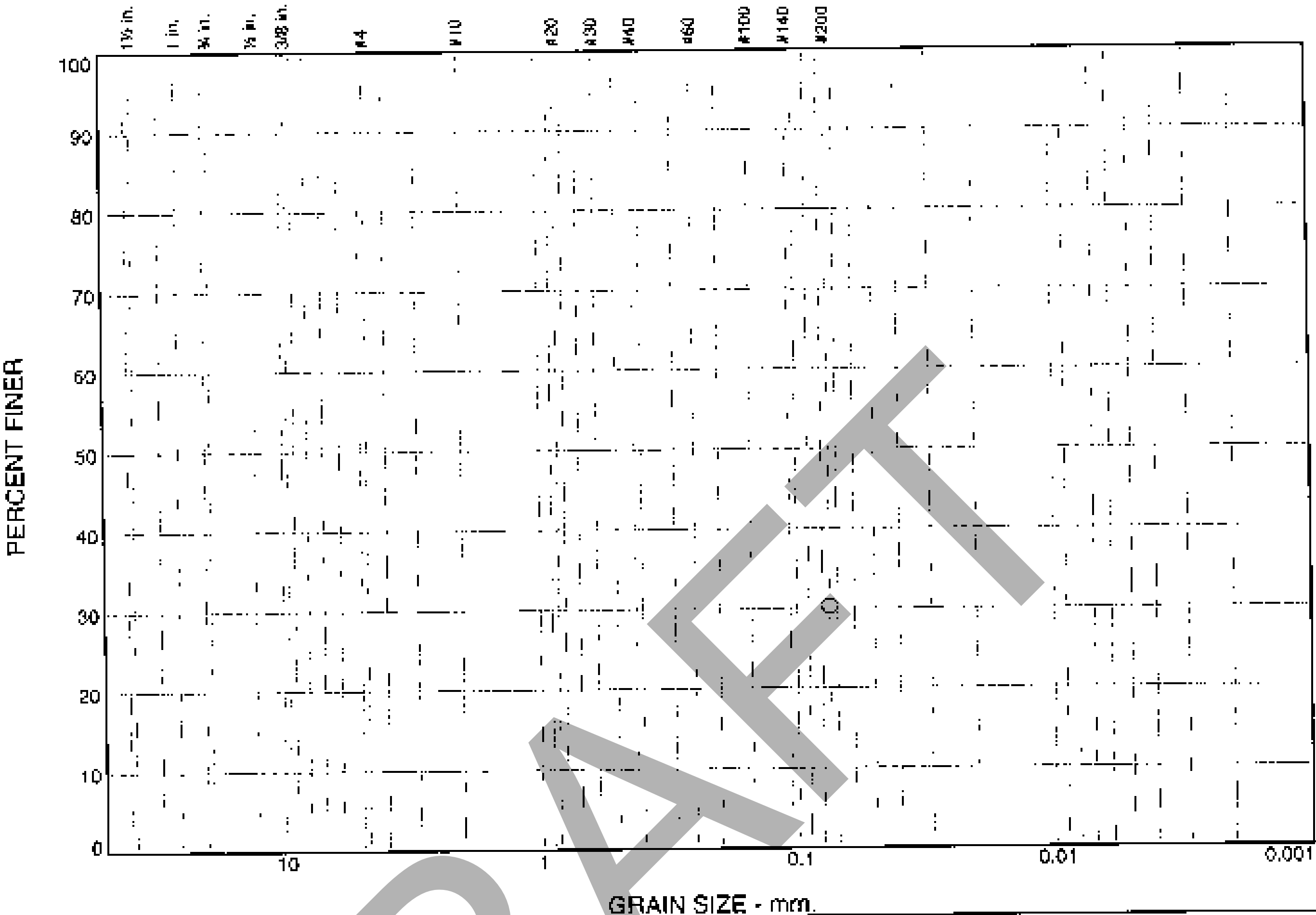
### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 22.05 | 22.00 | | |
| Dry+Tare | 21.32 | 21.34 | | |
| Tare | 15.45 | 15.56 | | |
| Moisture | 12.4 | 11.4 | | |

### Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 138.00 | 125.04 | 28.33 | 13.4 |

# Particle Size Distribution Report ASTM D 6913-04e1




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | | | | | | 30.3 | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

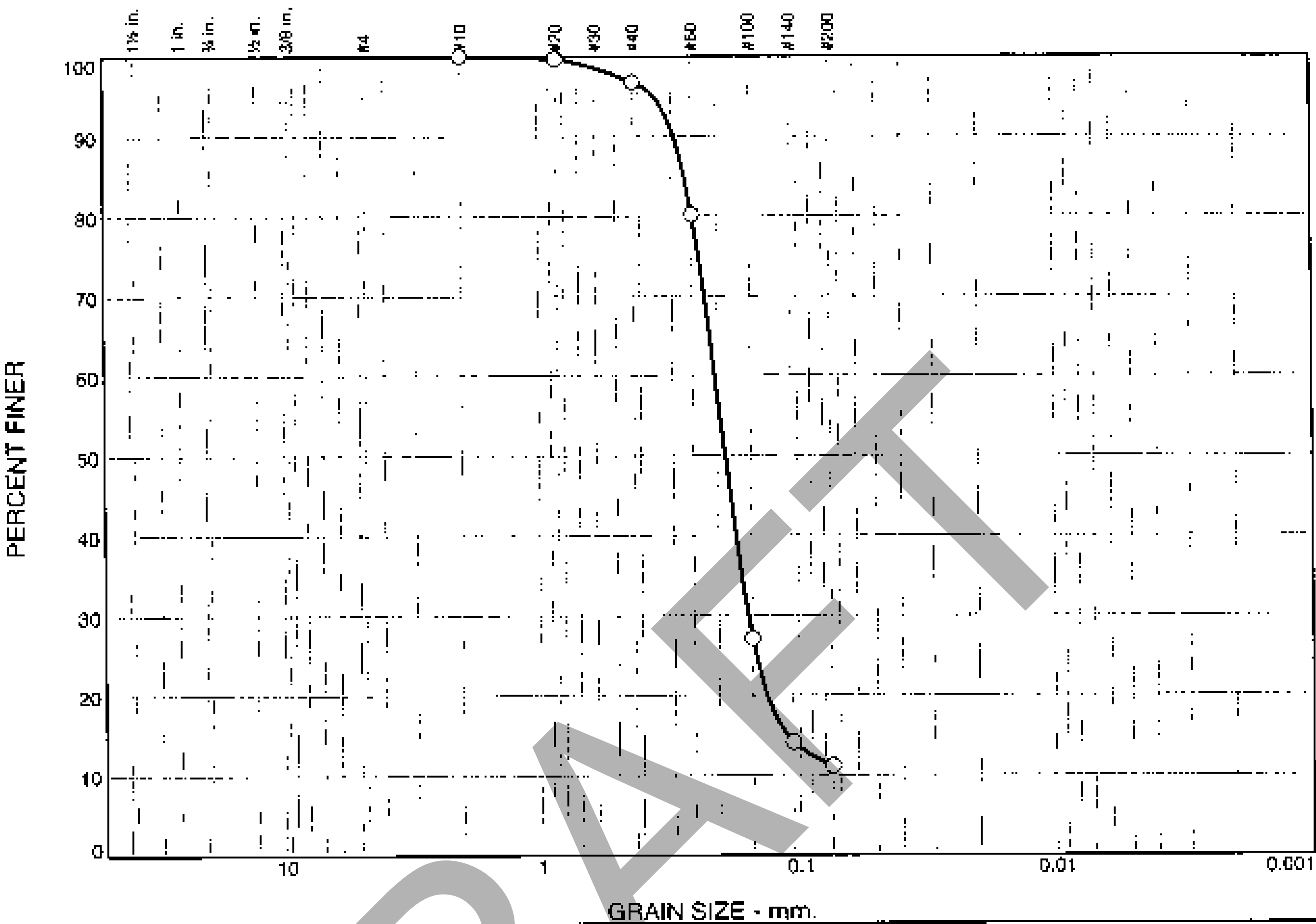
## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-3 | Jar 3 | 3.5-5" | Reddish Brown Clayey SAND | SC |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br>Raleigh, North Carolina | Client: Progress Energy<br>Project: Weatherspoon Plant Dike Study<br>Project No.: 6468100111.03 Figure |

Tested By: CS

# Particle Size Distribution Report ASTM D 6913-04e1




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ 0.0 | 0.0 | 0.0 | 0.0 | 3.2 | 85.7 | 11.1 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-4 | Jar 4 | 6.0-7.5' | Brown and Black Silty Fine SAND (visual) | SM |

**MACTEC Engineering and Consulting, Inc.**

Raleigh, North Carolina

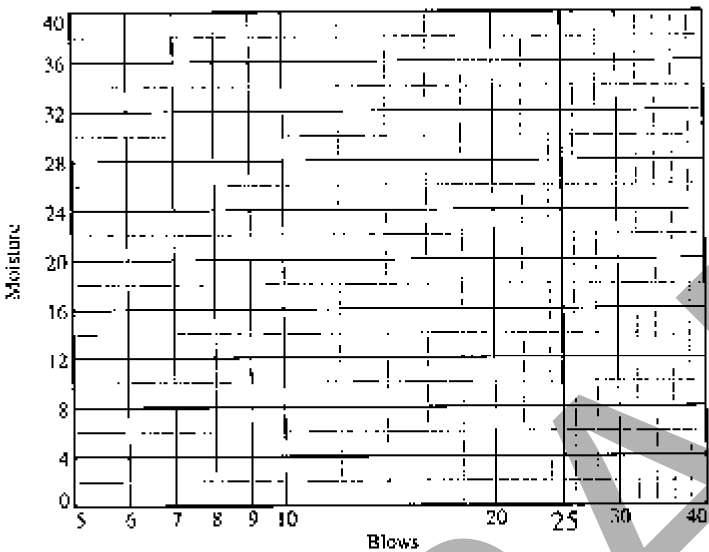
**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 **Figure**

**Tested By:** CS

## LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-4
**Depth:** 6.0-7.5'
**Sample Number:** Jar 4
**Material Description:** Brown and Black Silty Fine SAND (visual)
**%<#40:** 96.8
**%<#200:** 11.1
**USCS:** SM
**Tested by:** CS



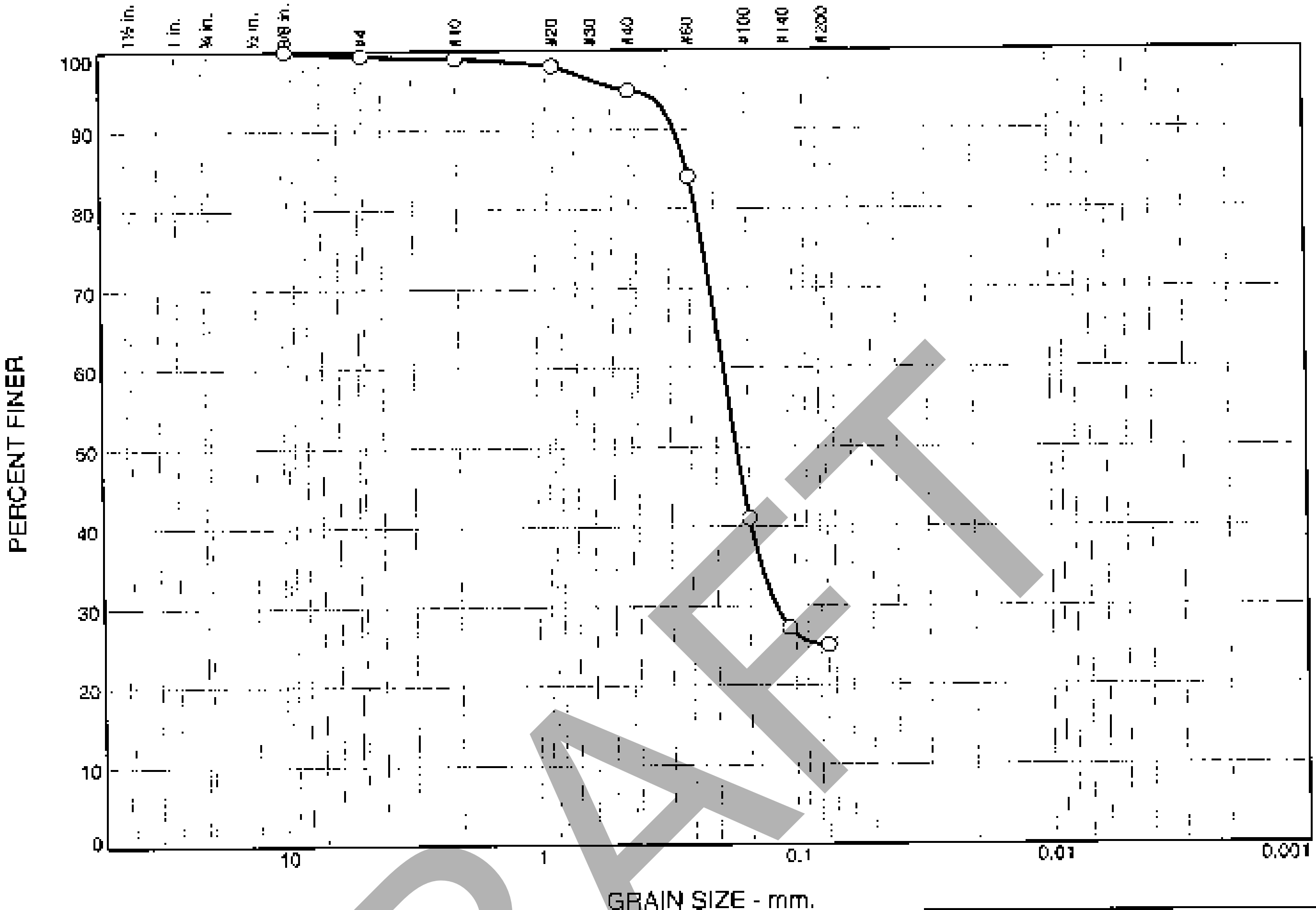

**Liquid Limit=** ____
**Plastic Limit=** ____
**Plasticity Index=** ____
**Natural Moisture=** 24.0



**Natural Moisture Data**

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 131.65 | 115.86 | 49.97 | 24.0 |

# Particle Size Distribution Report ASTM D 6913-04e1




| | % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| O | 0.0 | 0.0 | 0.6 | 0.3 | 4.2 | 69.9 | 25.0 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| O | Boring SB-5 | Jar 3 | 3.5-5.0" | Mixed Brown Clayey SAND (visual) | SC (visual) |

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

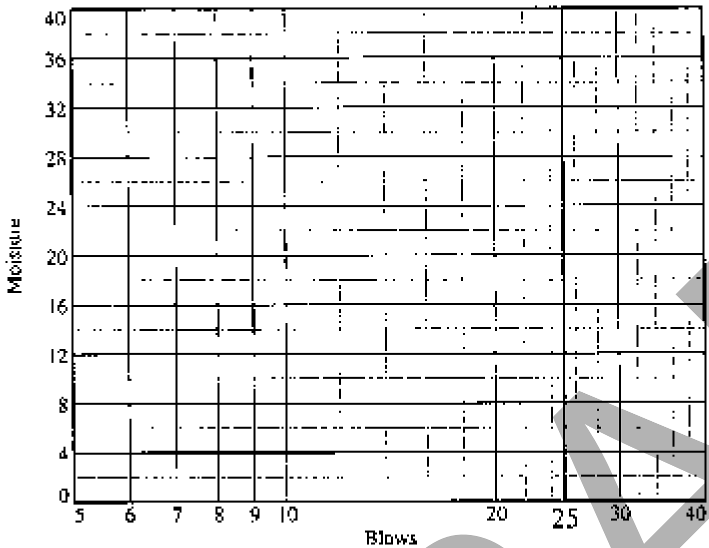
**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 **Figure**

Tested By: CS

## LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-5
**Depth:** 3.5-5.0"
**Sample Number:** Jar 3
**Material Description:** Mixed Brown Clayey SAND (visual)
**%<#40:** 94.9
**%<#200:** 25.0
**USCS:** SC (visual)
**Tested by:** CS




**Liquid Limit=** ________
**Plastic Limit=** ________
**Plasticity Index=** ________
**Natural Moisture=** 12.3

### Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 102.34 | 96.64 | 50.46 | 12.3 |

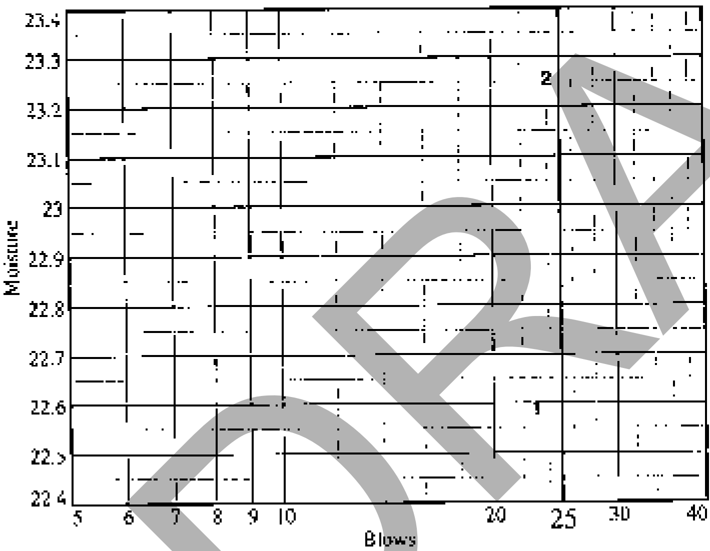
# LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-5
**Depth:** 6.0-7.5"  **Sample Number:** Jar 4
**Material Description:** Olive Yellow Fine Clycy Fine to Medium SAND (visual)
**USCS:** SC (visual)  **AASHTO:** ND
**Tested by:** CS
**Testing Remarks:** Moisture Contents & Atterburg Limits

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 26.96 | 26.36 | | | | |
| Dry+Tare | 24.85 | 24.36 | | | | |
| Tare | 15.51 | 15.76 | | | | |
| # Blows | 23 | 24 | | | | |
| Moisture | 22.6 | 23.3 | | | | |




Liquid Limit= 23
Plastic Limit= 12
Plasticity Index= 11
Natural Moisture= 15.4
Liquidity Index= 0.3

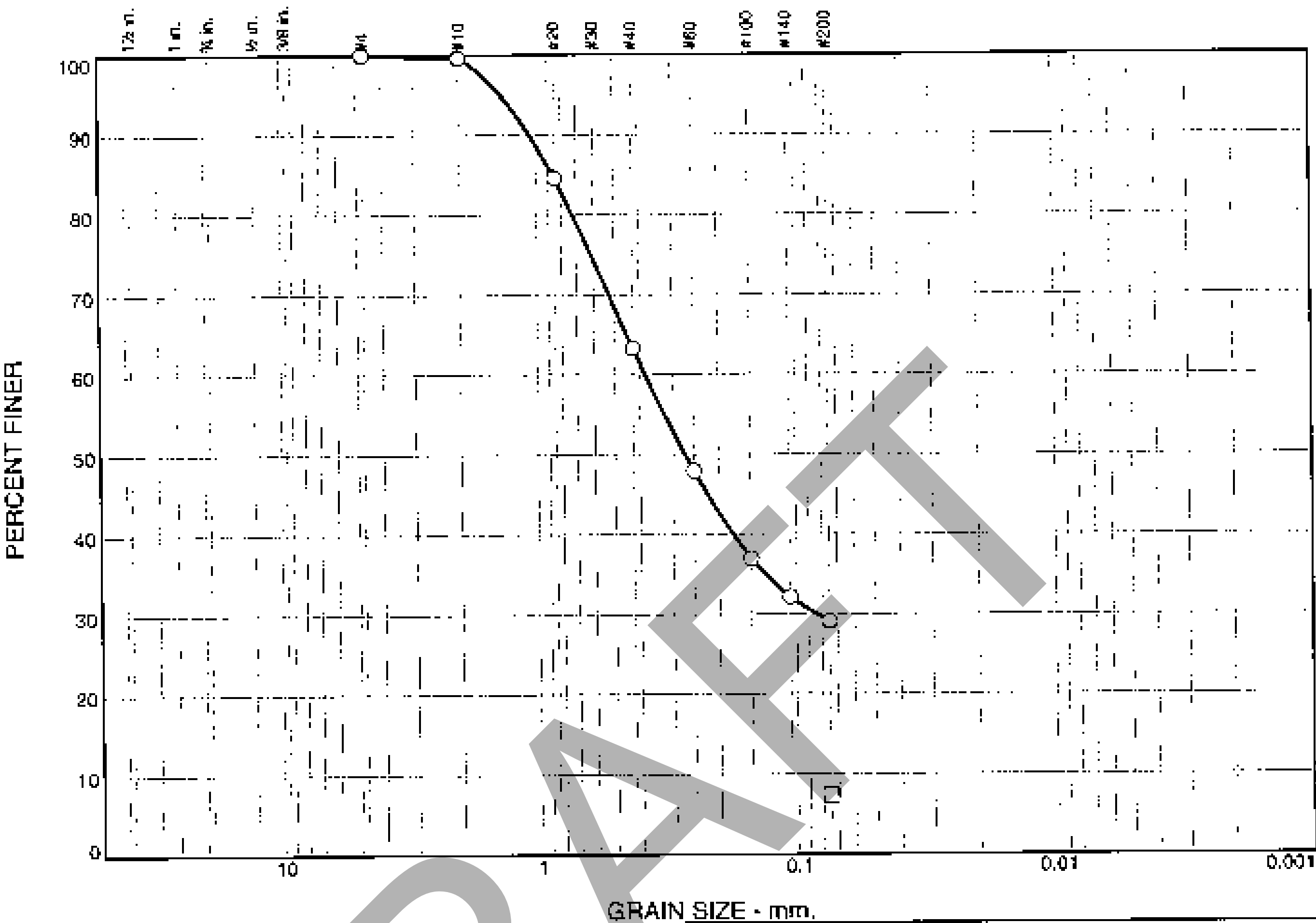
## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 18.89 | 18.73 | | |
| Dry+Tare | 18.07 | 17.95 | | |
| Tare | 11.16 | 11.22 | | |
| Moisture | 11.9 | 11.6 | | |

## Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 145.66 | 133.01 | 50.64 | 15.4 |

# Particle Size Distribution Report ASTM D 6913-04e1






| | | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.4 | 36.3 | 34.2 | 29.1 | |
| □ | | | | | | | 7.4 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-7 | Jar 3 | 3.5-5.0" | Yellowish Brown Clayey SAND | SC |
| □ | Boring SB-7 | Jar 9 | 28.5-30.0" | Light Gray to White Fine SAND (visual) | SP (visual) |

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

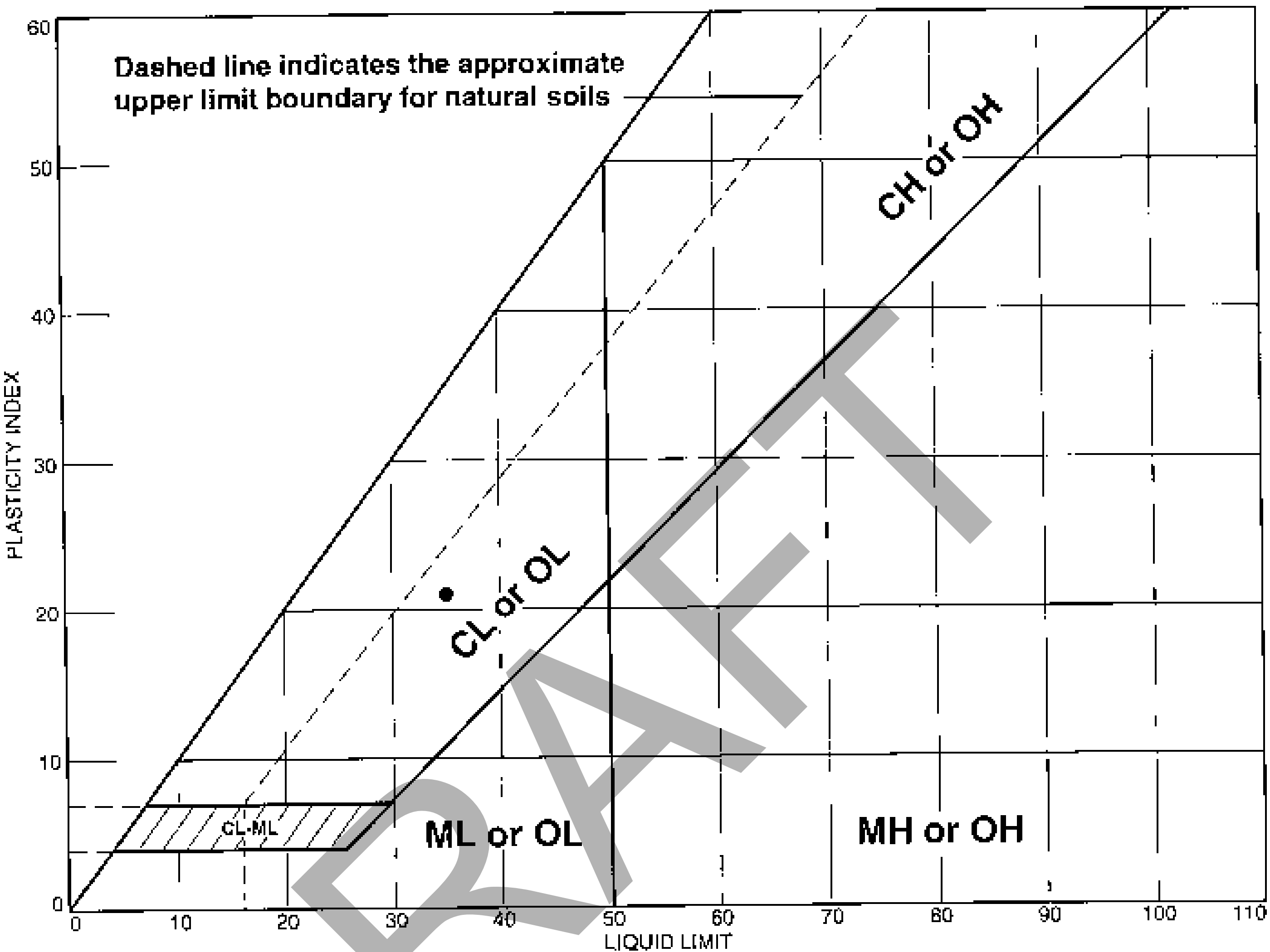
**Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

**Project No.:** 6468100111.03 **Figure**

Tested By: CS

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Yellowish Brown Clayey SAND | 35 | 14 | 21 | 63.3 | 29.1 | SC |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project No.** 6468100111.03 **Client:** Progress Energy

**Project:** Weatherspoon Plant Dike Study

● **Sample Source:** Boring SB-7 **Depth:** 3.5-5.0" **Sample No.:** Jar 3

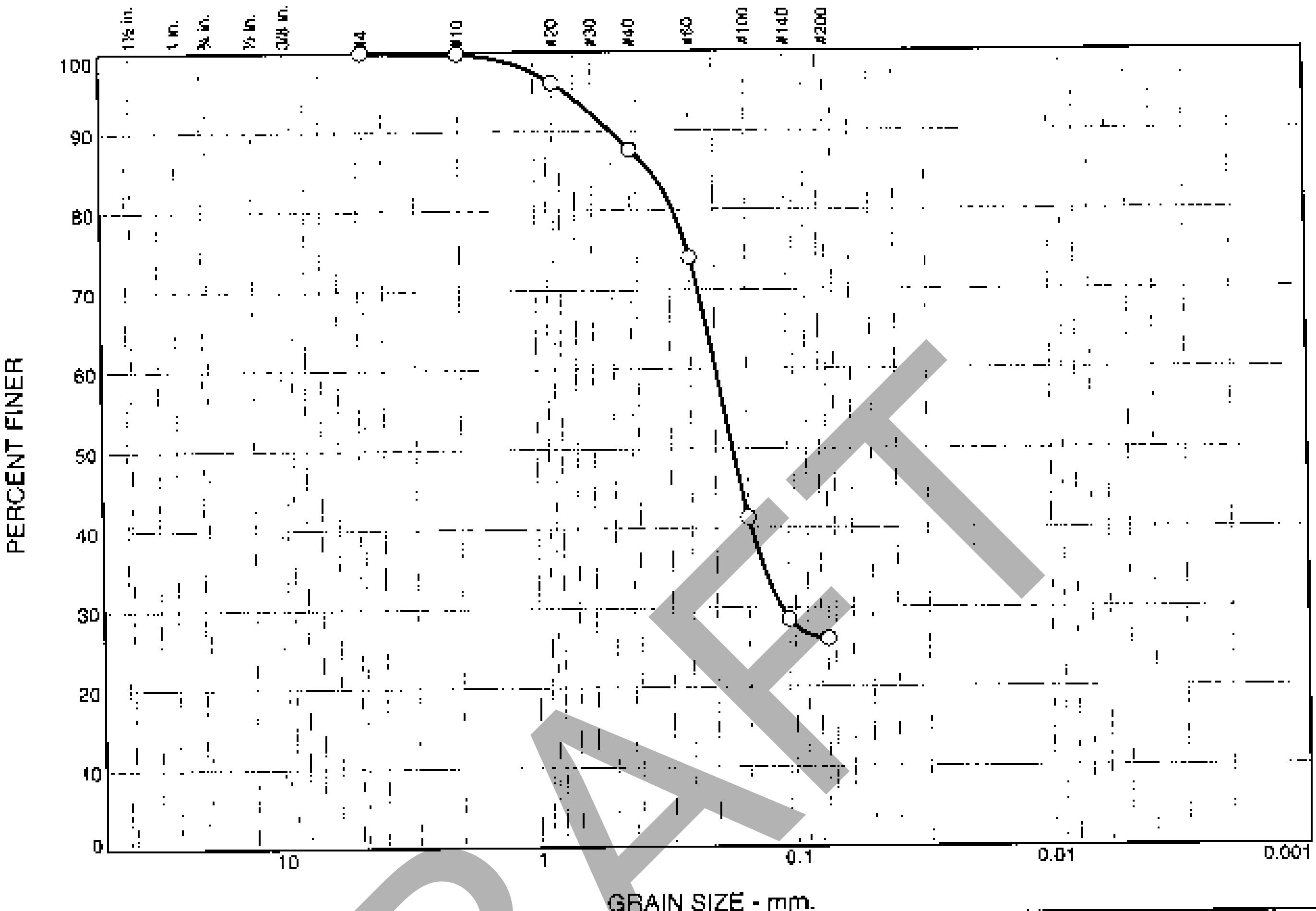
**Remarks:**

**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Figure**

# Particle Size Distribution Report ASTM D 6913-04e1




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ 0.0 | 0.0 | 0.0 | 0.2 | 12.2 | 61.5 | 26.1 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-8 | Jar 3 | 3.5-5.0" | Olive Yellow Clayey SAND | SC |

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project No.:** 6468100111.03 **Figure**

Tested By: CS

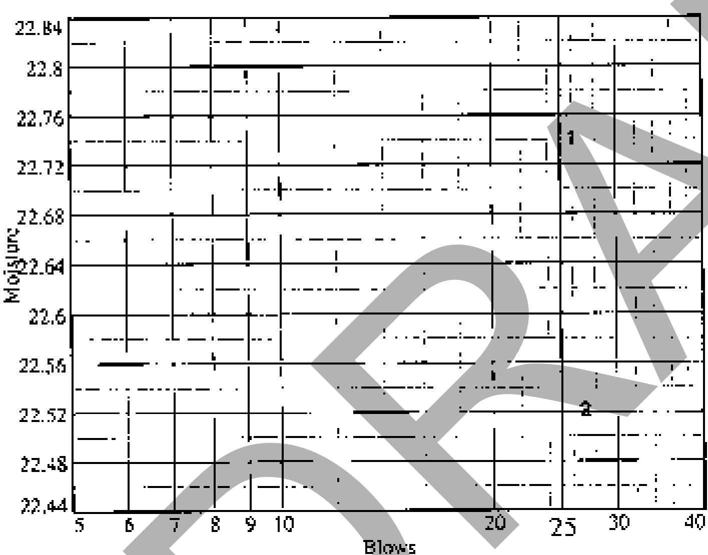
# LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-8
**Depth:** 3.5-5.0" **Sample Number:** Jar 3
**Material Description:** Olive Yellow Clayey SAND
**%<#40:** 87.6 **%<#200:** 26.1 **USCS:** SC **AASHTO:** A-2-4(0)
**Tested by:** CS

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 27.36 | 25.12 | | | | |
| Dry+Tare | 25.17 | 23.37 | | | | |
| Tare | 15.54 | 15.60 | | | | |
| # Blows | 26 | 27 | | | | |
| Moisture | 22.7 | 22.5 | | | | |




Liquid Limit= 23
Plastic Limit= 14
Plasticity Index= 9
Natural Moisture= 15.7
Liquidity Index= 0.2

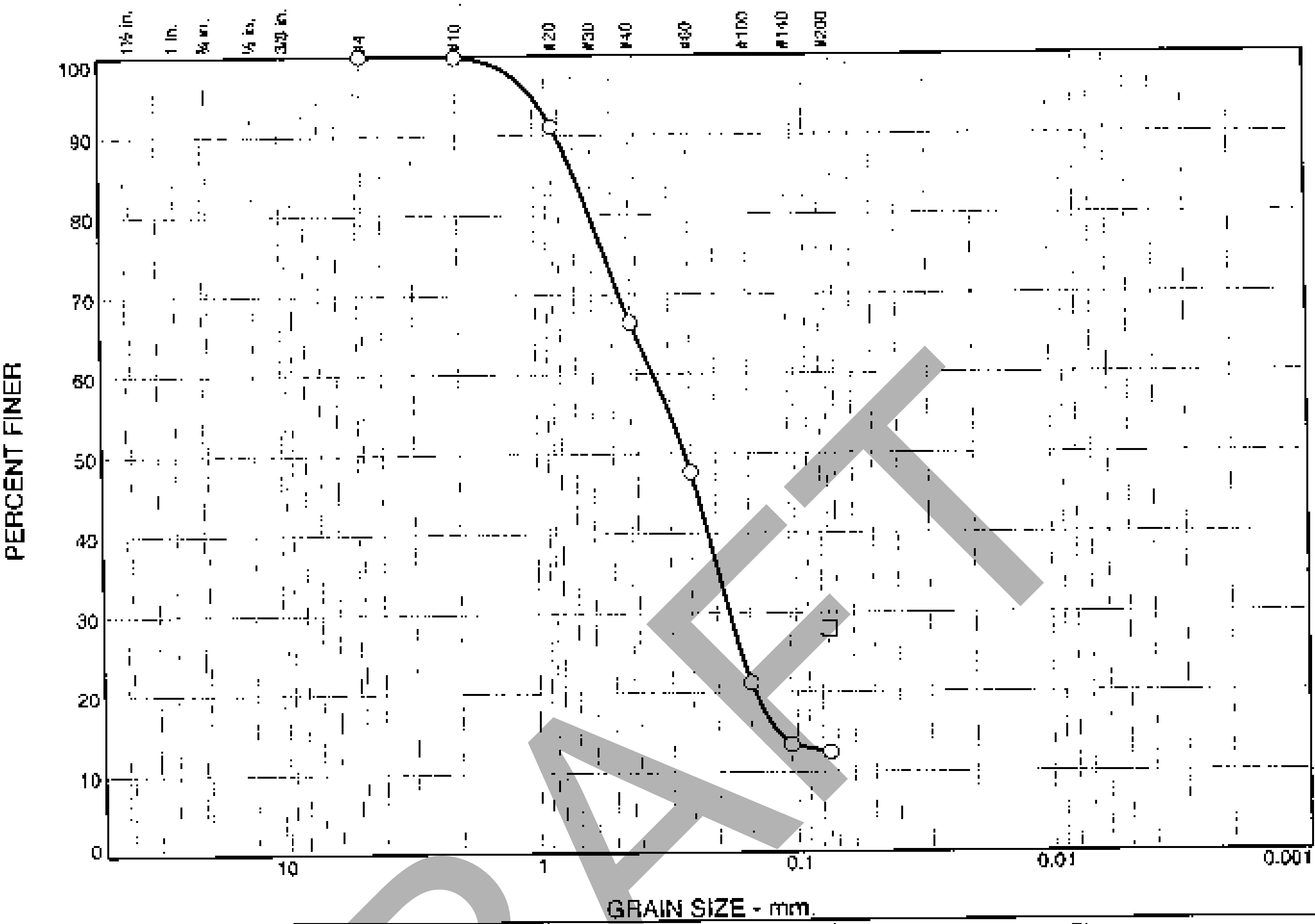
## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 21.66 | 23.32 | | |
| Dry+Tare | 20.92 | 22.34 | | |
| Tare | 15.57 | 15.51 | | |
| Moisture | 13.8 | 14.3 | | |

## Natural Moisture Data

| Wet+Tare | Dry+Tare | Tare | Moisture |
|---|---|---|---|
| 97.44 | 91.08 | 50.49 | 15.7 |

# Particle Size Distribution Report ASTM D 6913-04e1




| | % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.2 | 33.3 | 54.0 | 12.5 | |
| □ | | | | | | | 28.0 | |
| | | | | | | | | |
| | | | | | | | | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | Boring SB-9 | Jar 2 | 1.5-3.0" | Reddish Brown Silty SAND (visual) | SM (visual) |
| □ | Boring SB-9 | Jar 7 | 18.5-20.0" | Light Brown Clayey Fine SAND | SC |
| | | | | | |
| | | | | | |
| | | | | | |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br>Raleigh, North Carolina | **Client:** Progress Energy<br>**Project:** Weatherspoon Plant Dike Study<br>**Project No.:** 6468100111.03 **Figure** |

Tested By: CS

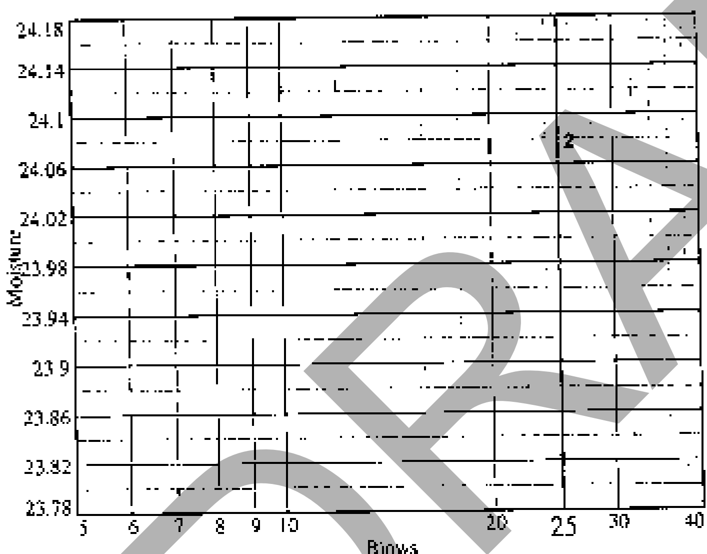
# LIQUID AND PLASTIC LIMIT TEST DATA

8/26/2010

**Client:** Progress Energy
**Project:** Weatherspoon Plant Dike Study
**Project Number:** 6468100111.03
**Location:** Boring SB-9
**Depth:** 18.5-20.0'
**Sample Number:** Jar 7
**Material Description:** Light Brown Clayey Fine SAND
**%<#200:** 28.0 **USCS:** SC
**Tested by:** CS

**Liquid Limit Data**

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 25.70 | 26.94 | | | | |
| Dry+Tare | 23.73 | 24.72 | | | | |
| Tare | 15.46 | 15.50 | | | | |
| # Blows | 25 | 26 | | | | |
| Moisture | 23.8 | 24.1 | | | | |




Liquid Limit= 24
Plastic Limit= 12
Plasticity Index= 12
Natural Moisture= ND

**Plastic Limit Data**

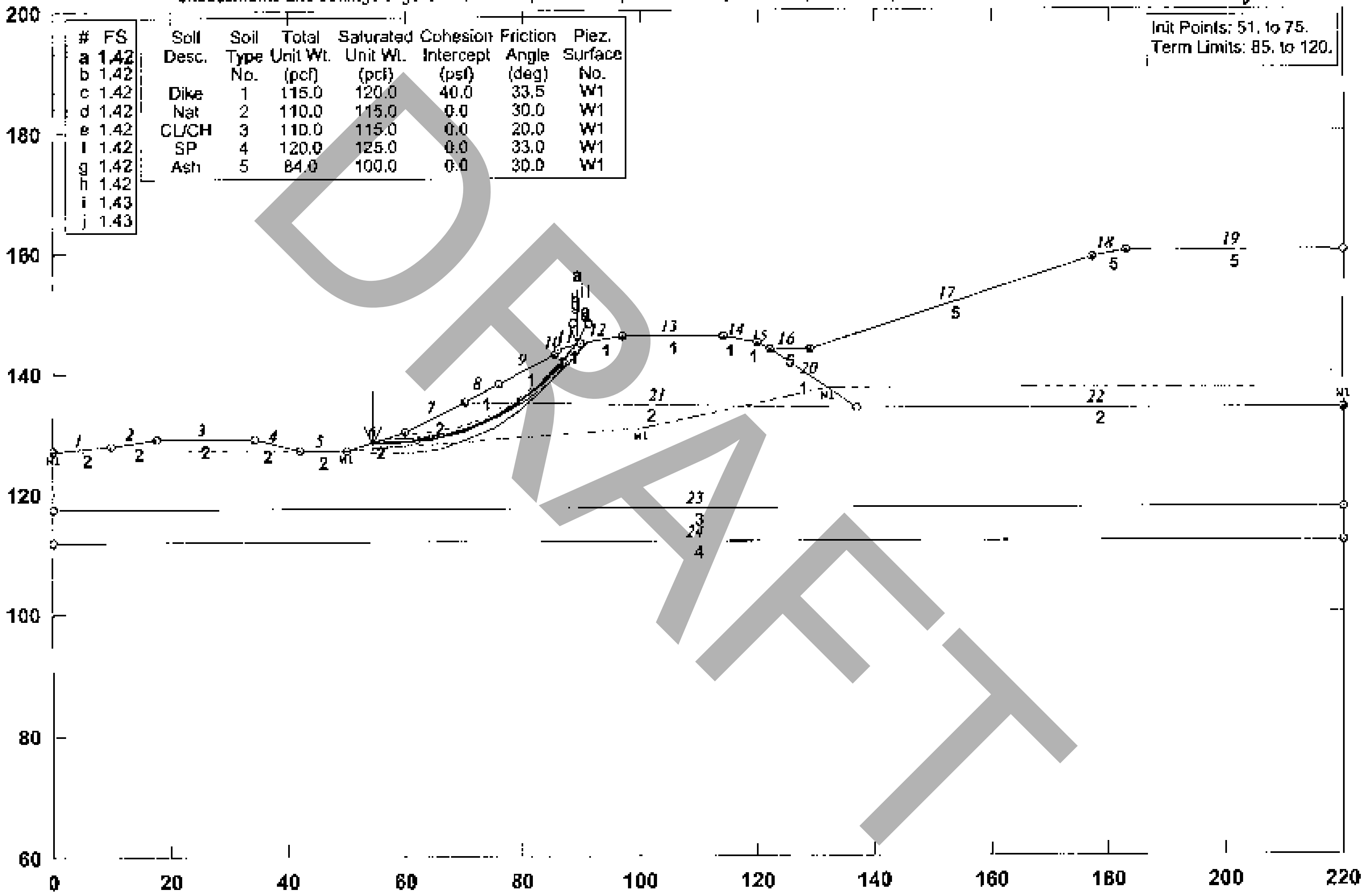
| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 23.19 | 22.55 | | |
| Dry+Tare | 22.37 | 21.78 | | |
| Tare | 15.51 | 15.64 | | |
| Moisture | 12.0 | 12.5 | | |

# APPENDIX D 1

## Stability Analysis Output Plots – North Dike

**Progress Energy -Weather Spoon Ash Pond North_Sec#1_Failure within Slope**

c:\documents and settings\scgollamudi\desktop\weather spoon stability\n-1\n-1a.pl2 Run By: Sharat Gollamudi 8/30/2010 07:42AM




| # | FS |
|---|---|
| a | 1.42 |
| b | 1.42 |
| c | 1.42 |
| d | 1.42 |
| e | 1.42 |
| f | 1.42 |
| g | 1.42 |
| h | 1.42 |
| i | 1.43 |
| j | 1.43 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| CL/CH | 3 | 110.0 | 115.0 | 0.0 | 20.0 | W1 |
| SP | 4 | 120.0 | 125.0 | 0.0 | 33.0 | W1 |
| Ash | 5 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

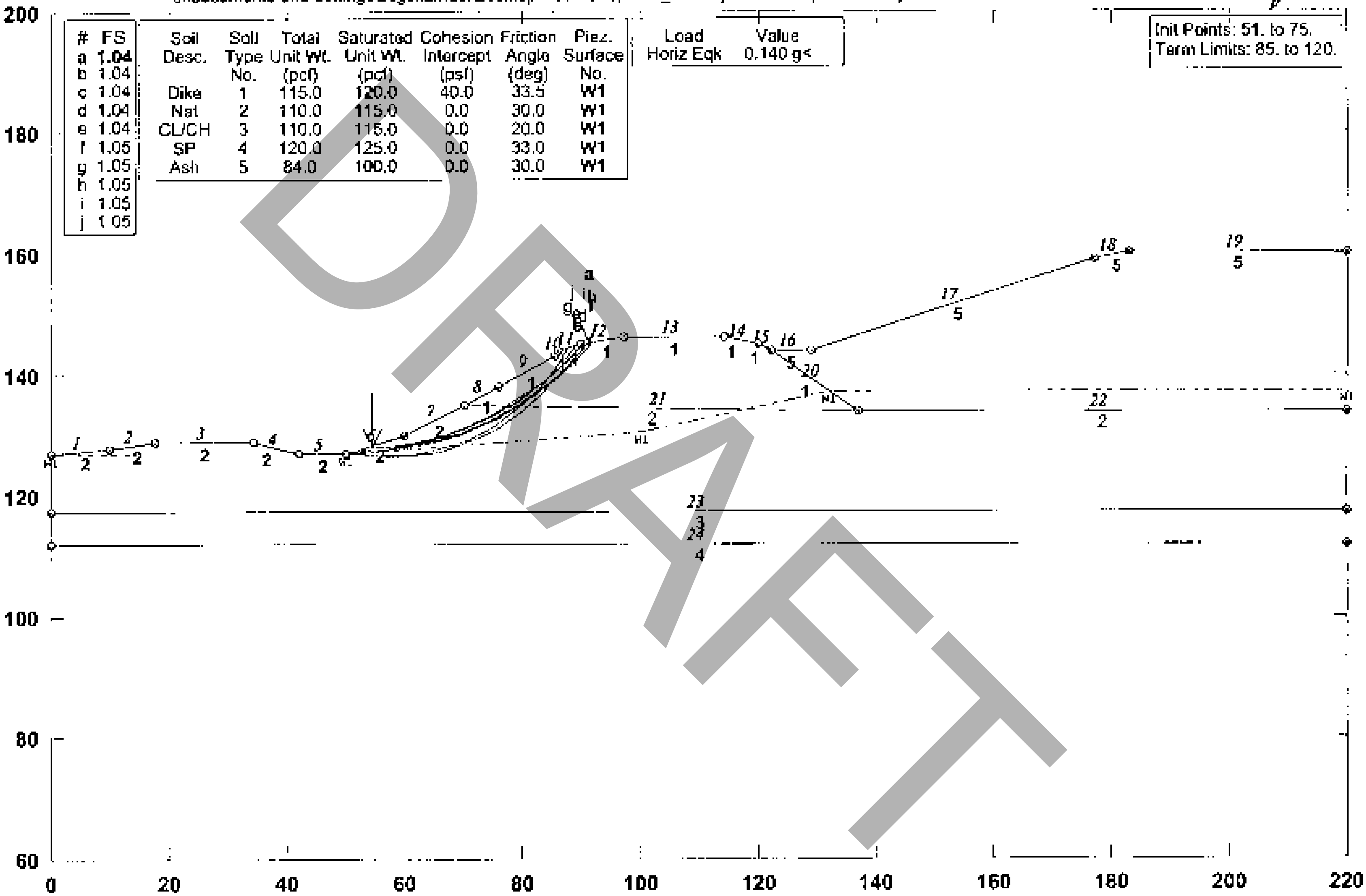
PCSTABL5M/si FSmin=1.42

Safety Factors Are Calculated By The Modified Bishop Method

STED

**Progress Energy -Weather Spoon Ash Pond North_Sec#1_Failure within Slope_Seismic**

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-1\n-1as.pl2 Run By: Sharat Gollamudi 8/30/2010 07:44AM

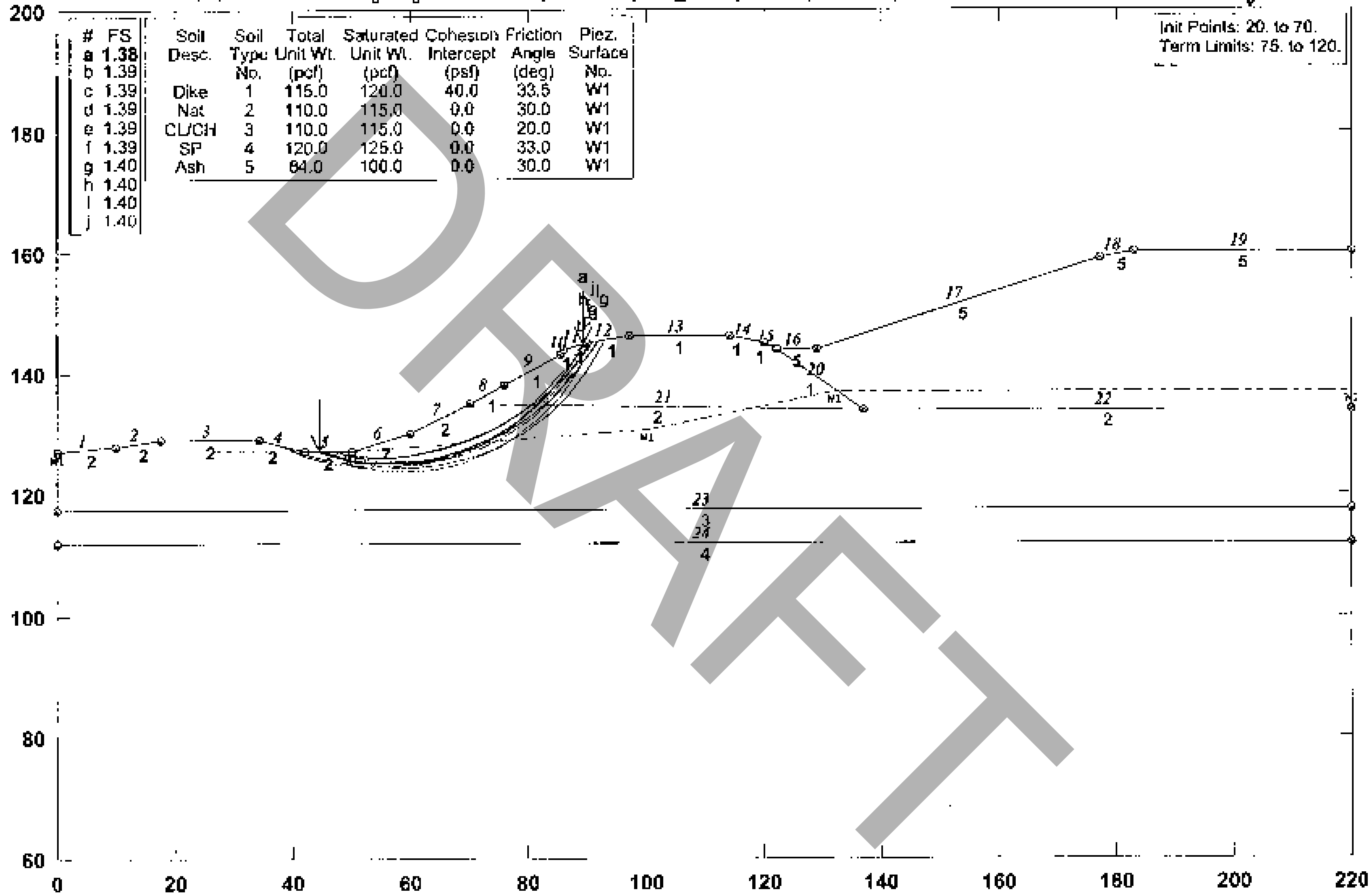



PCSTABL5M/sf FSmin=1.04
Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy -Weather Spoon Ash Pond North Dike - Section 1

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-1\n-1.pl2 Run By: Sharat Gollamudi 8/30/2010 07:40AM



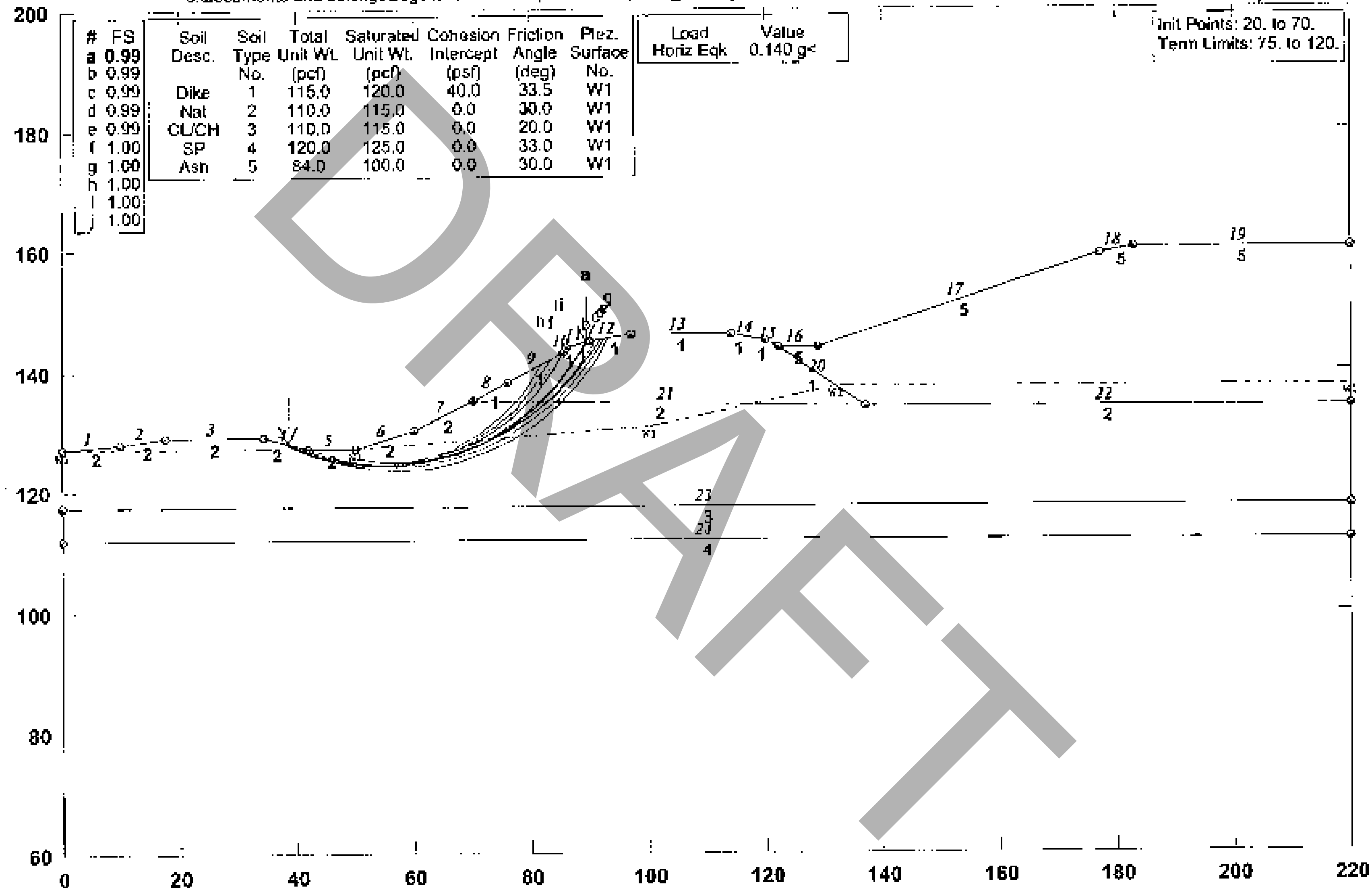

PCSTABL5M/si FSmin=1.38

Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy -Weather Spoon Ash Pond North Section 1 - Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-1\n-1s.pl2 Run By: Sharat Gollamudi 9/30/2010 07:45AM




| # | FS |
|---|---|
| a | 0.99 |
| b | 0.99 |
| c | 0.99 |
| d | 0.99 |
| e | 0.99 |
| f | 1.00 |
| g | 1.00 |
| h | 1.00 |
| i | 1.00 |
| j | 1.00 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| CL/CH | 3 | 110.0 | 115.0 | 0.0 | 20.0 | W1 |
| SP | 4 | 120.0 | 125.0 | 0.0 | 33.0 | W1 |
| Ash | 5 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |

PCSTABL5M/si FSmin=0.99

Safety Factors Are Calculated By The Modified Bishop Method

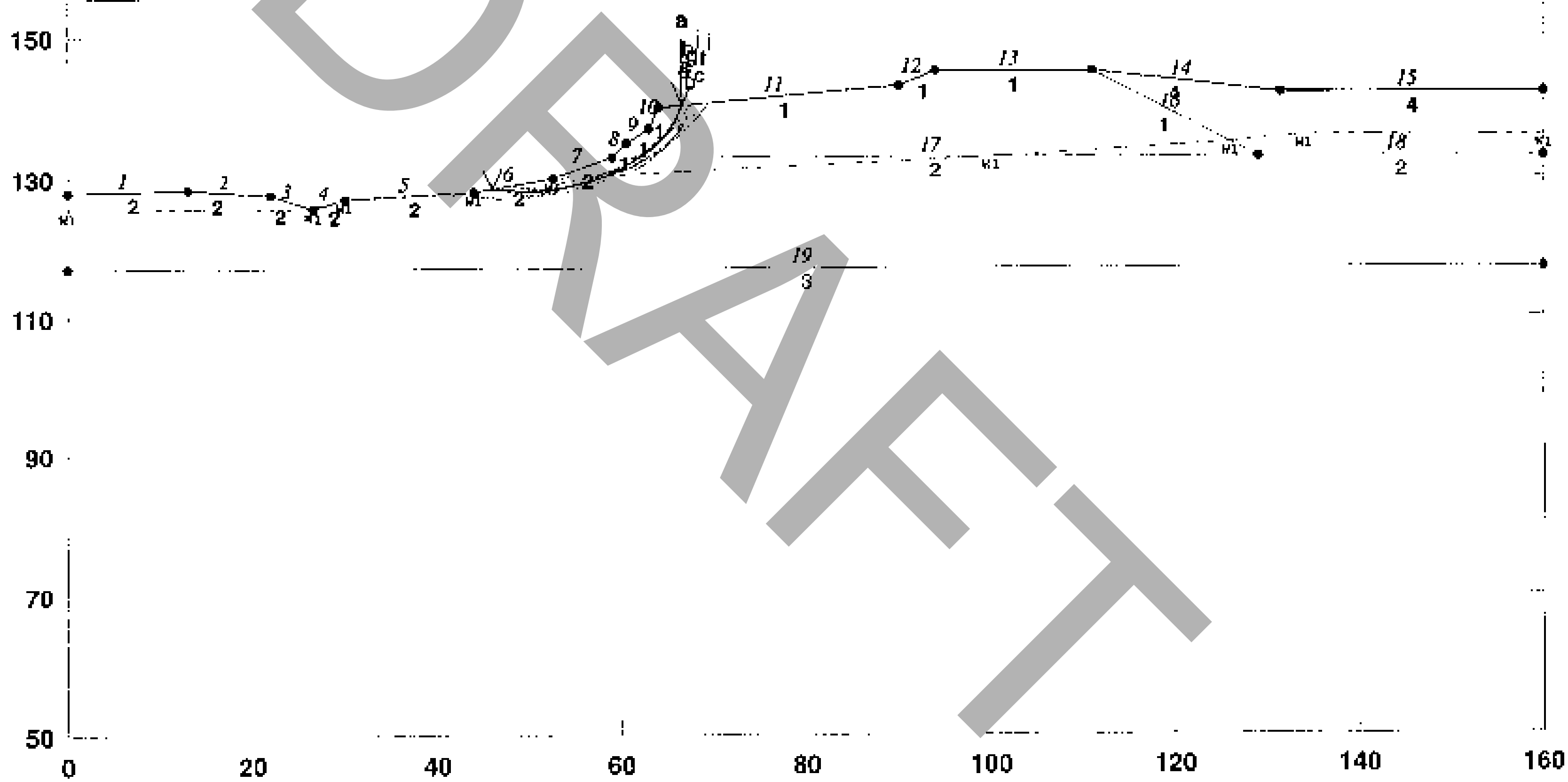
STED

## Progress Energy - Weatherspoon Plant North Dike - Section 2

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-2\n-2.pl2 Run By: Sharat Gollamudi 9/21/2010 03:55PM

| # | FS |
|---|---|
| a | **1.07** |
| b | 1.07 |
| c | 1.08 |
| d | 1.09 |
| e | 1.10 |
| f | **1.10** |
| g | 1.10 |
| h | 1.10 |
| i | 1.10 |
| j | 1.10 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |



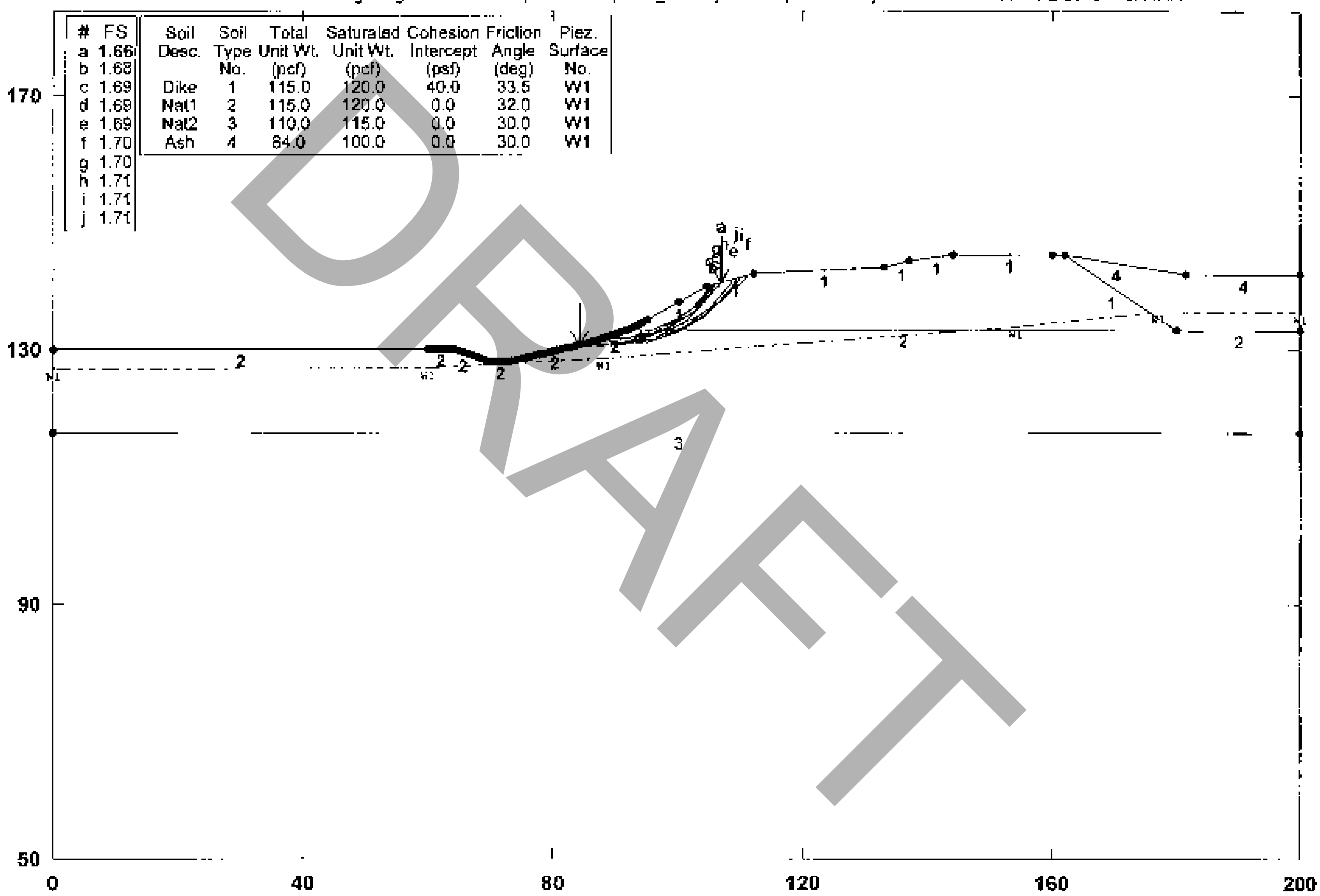

PCSTABL5M/si FSmin=1.07

Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon Plant North_Sec#3 -Measured H20_Static

c:\documents and settings\acgollamudi\desktop\weather spoon _stability\n-3\n-3.pl2 Run By: Sharat Gollamudi 9/2/2010 10:44AM




PCSTABL5M/sl FSmin=1.66

Safety Factors Are Calculated By The Modified Bishop Method

STED

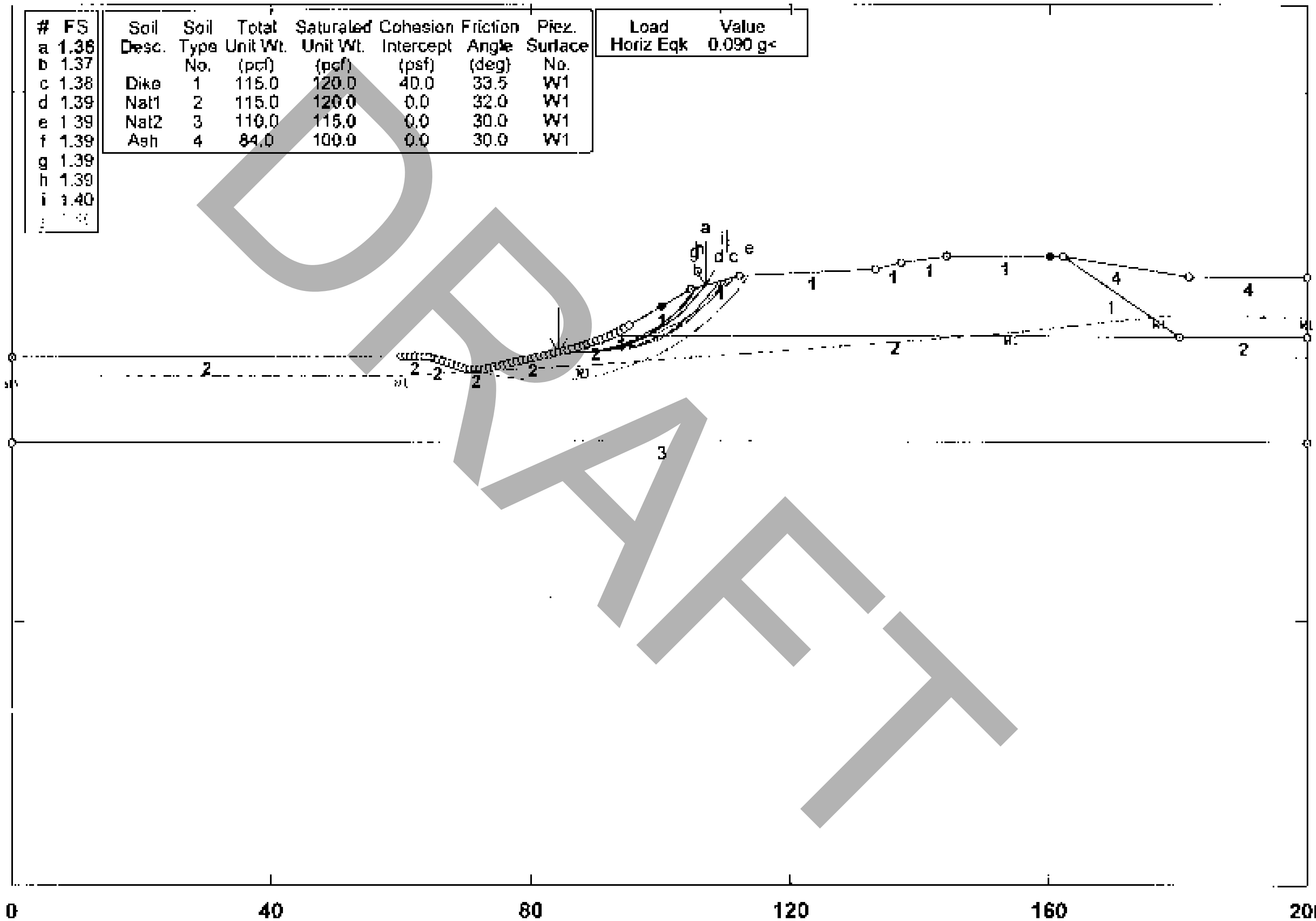
# Progress Energy - Weatherspoon Plant North_Sec#3 -Measured H20_Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-3\n-3s.pl2   Run By: Sharat Gollamudi   9/2/2010   10:45AM

| # | FS |
|---|---|
| a | 1.36 |
| b | 1.37 |
| c | 1.38 |
| d | 1.39 |
| e | 1.39 |
| f | 1.39 |
| g | 1.39 |
| h | 1.39 |
| i | 1.40 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.090 g< |




**PCSTABL5M/si FSmin=1.36**

**Safety Factors Are Calculated By The Modified Bishop Method**

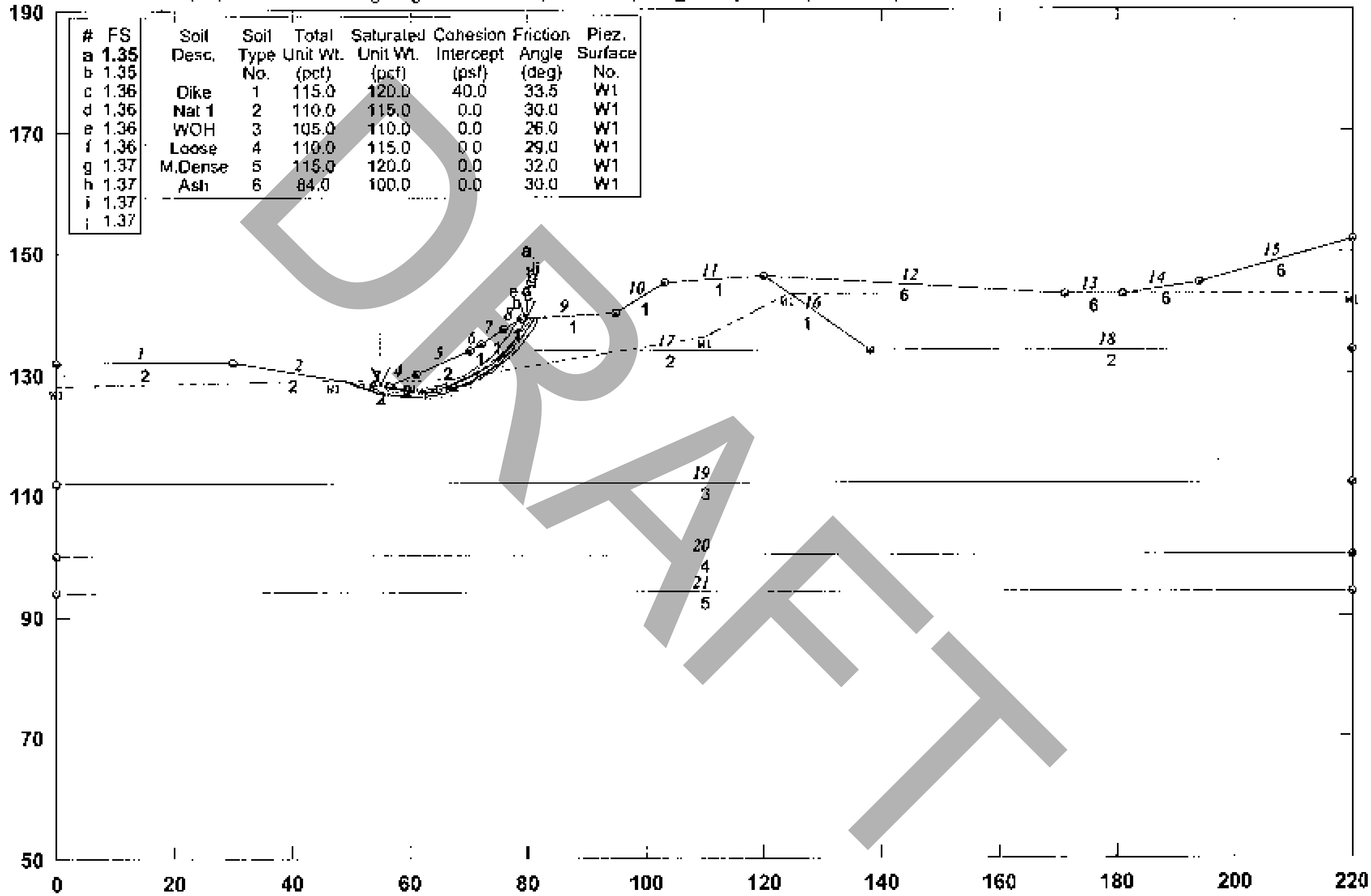
**STED**

## Progress Energy - Weatherspoon Ash Pond-North Dike Sec# 4- Lower Slope- Local

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-4\n-4.pl2 Run By: Sharat Gollamudi 8/28/2010 03:55PM

| # | FS |
|---|---|
| a | **1.35** |
| b | 1.35 |
| c | 1.36 |
| d | 1.36 |
| e | 1.36 |
| f | 1.36 |
| g | 1.37 |
| h | 1.37 |
| i | 1.37 |
| j | 1.37 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| WOH | 3 | 105.0 | 110.0 | 0.0 | 26.0 | W1 |
| Loose | 4 | 110.0 | 115.0 | 0.0 | 29.0 | W1 |
| M.Dense | 5 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Ash | 6 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=1.35

Safety Factors Are Calculated By The Modified Bishop Method

STED

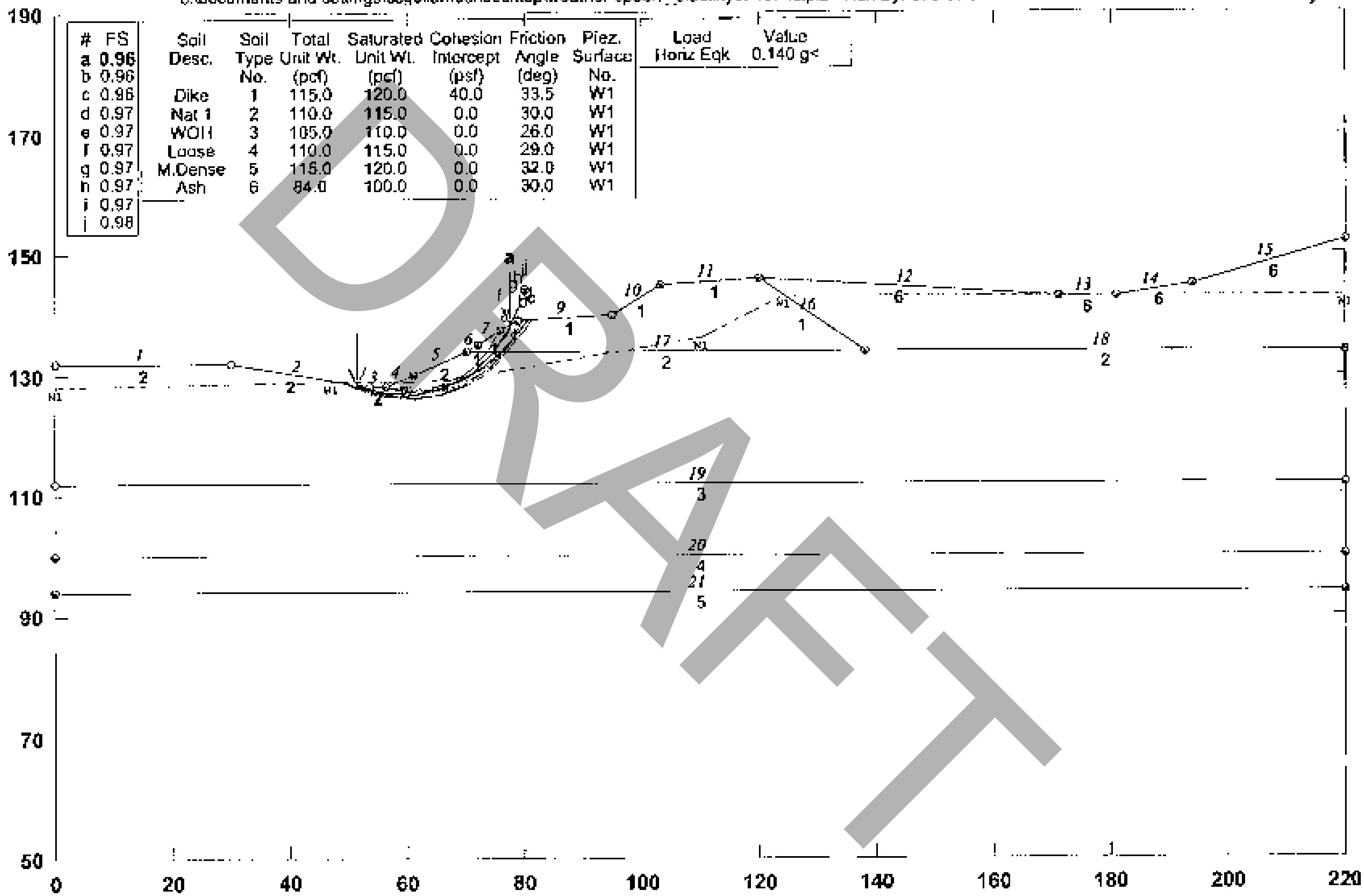
**Progress Energy - Weatherspoon Ash Pond-North_Sec# 4-_Lower Slope- Local_Seismic**

c:\documents and settings\sgollamudi\desktop\weather spoon _stability\n-4\n-4s.pl2 Run By: Sharat Gollamudi 8/28/2010 03:57PM

| # | FS |
|---|---|
| a | 0.96 |
| b | 0.96 |
| c | 0.96 |
| d | 0.97 |
| e | 0.97 |
| f | 0.97 |
| g | 0.97 |
| h | 0.97 |
| i | 0.97 |
| j | 0.98 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| WOH | 3 | 105.0 | 110.0 | 0.0 | 26.0 | W1 |
| Loose | 4 | 110.0 | 115.0 | 0.0 | 29.0 | W1 |
| M.Dense | 5 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Ash | 6 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |



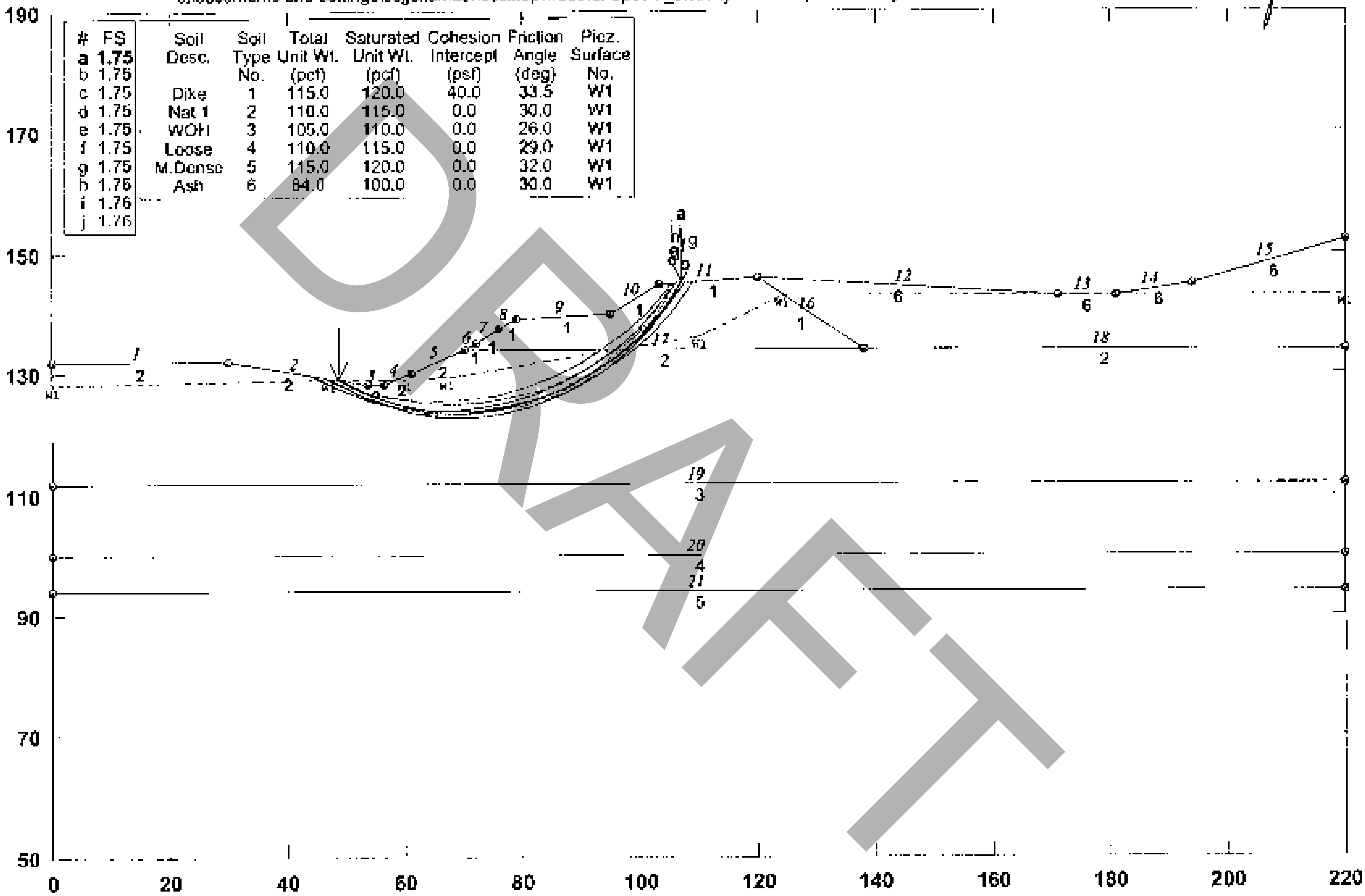

**PCSTABL5M/si FSmin=0.96**

**Safety Factors Are Calculated By The Modified Bishop Method**

**STED**

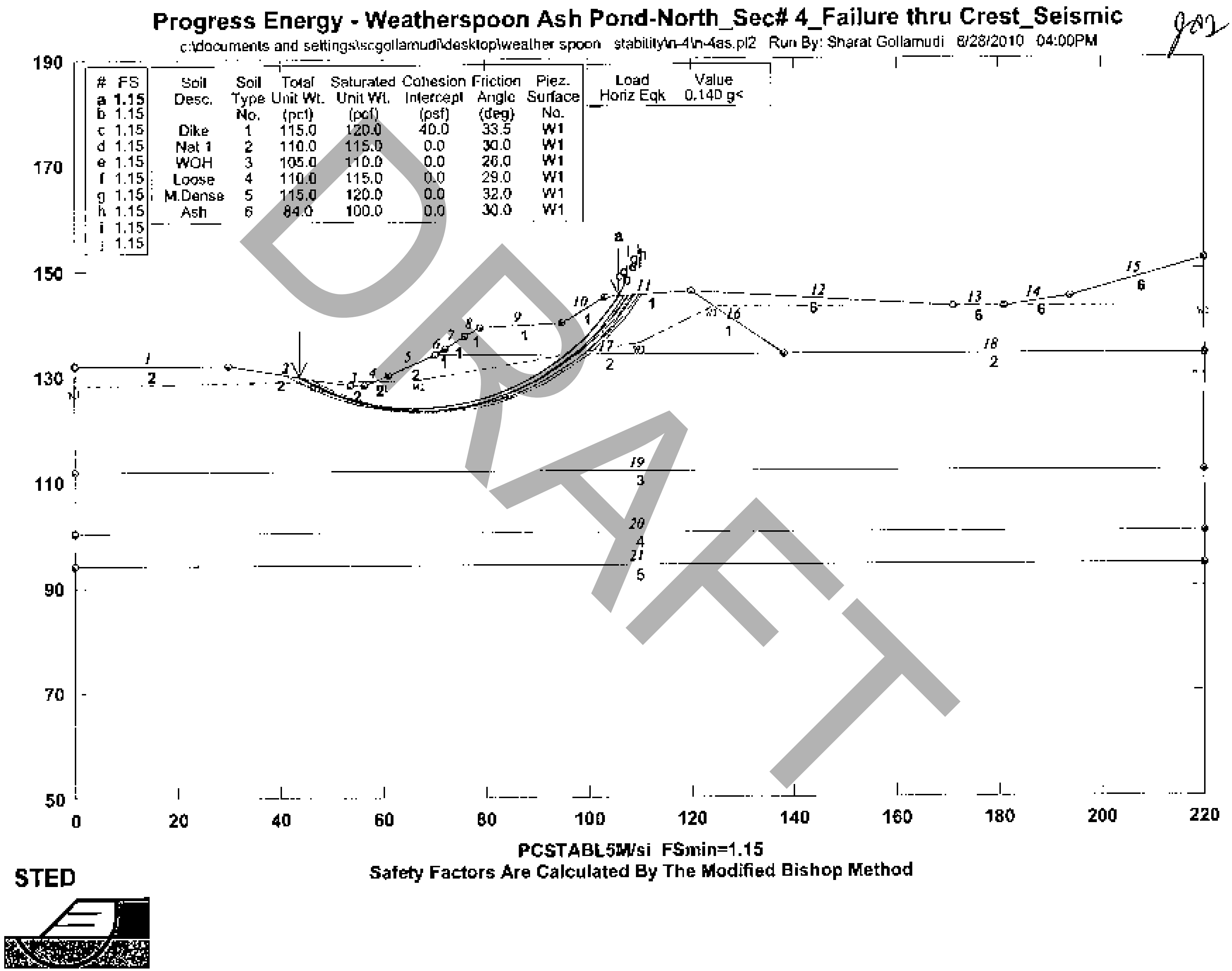
**Progress Energy - Weatherspoon Ash Pond-North Dike Sec# 4_Failure thru Crest**

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-4\n-4a.pl2 Run By: Sharat Gollamudi 8/28/2010 03:58PM




PCSTABL5M/si FSmin=1.75
Safety Factors Are Calculated By The Modified Bishop Method

STED

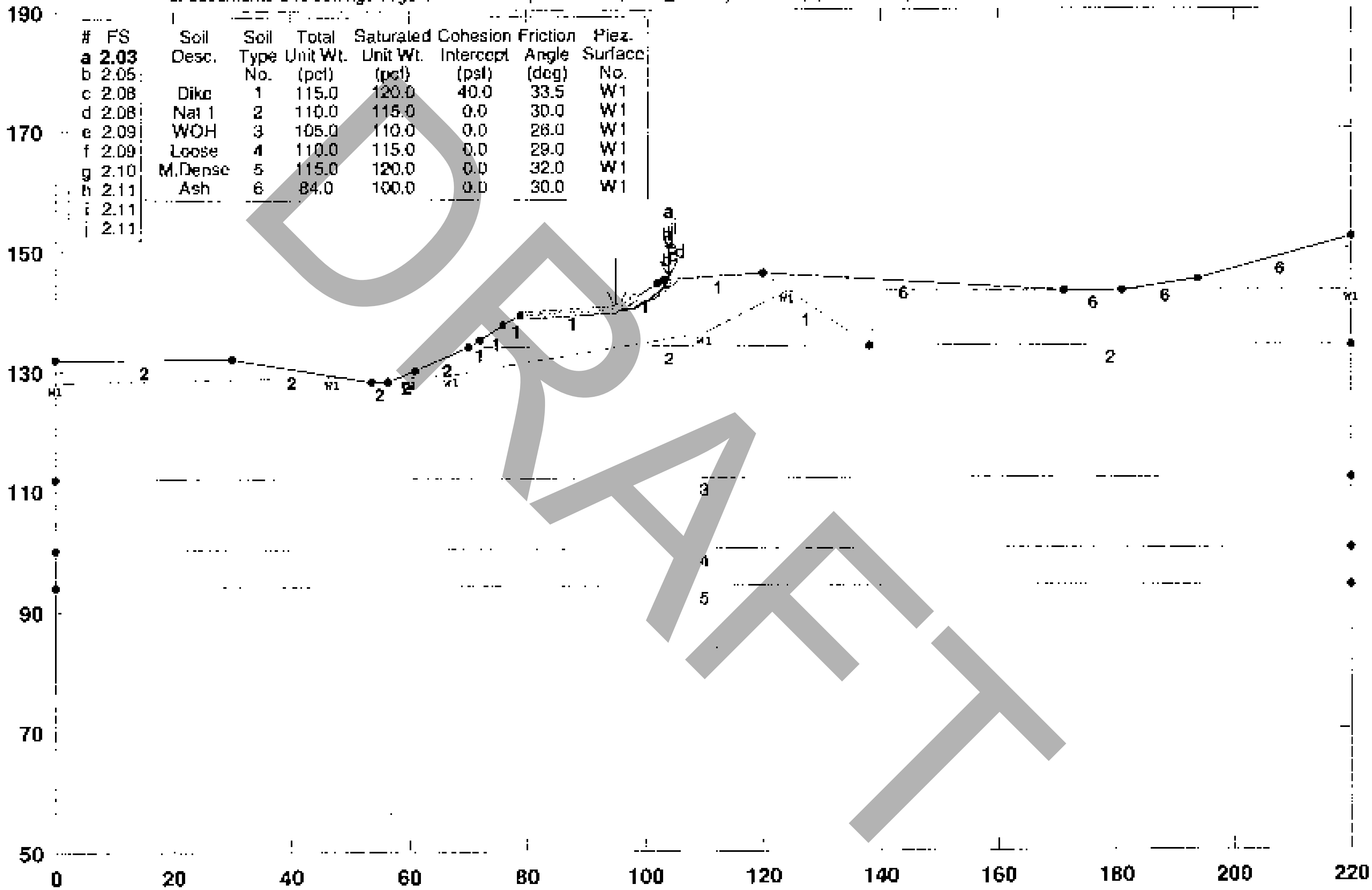

Progress Energy - Weatherspoon Ash Pond-North_Sec# 4_Failure thru Crest_Seismic
c:\documents and settings\scgollamudi\desktop\weather spoon stability\n-4\n-4as.pl2 Run By: Sharat Gollamudi 6/28/2010 04:00PM
# FS
a 1.15
b 1.15
c 1.15
d 1.15
e 1.15
f 1.15
g 1.15
h 1.15
i 1.15
j 1.15
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike 1 115.0 120.0 40.0 33.5 W1
Nat 1 2 110.0 115.0 0.0 30.0 W1
WOH 3 105.0 110.0 0.0 26.0 W1
Loose 4 110.0 115.0 0.0 29.0 W1
M.Dense 5 115.0 120.0 0.0 32.0 W1
Ash 6 84.0 100.0 0.0 30.0 W1
Load Horiz Eqk
Value 0.140 g<
190
170
150
130
110
90
70
50
0
20
40
60
80
100
120
140
160
180
200
220
PCSTABL5M/si FSmin=1.15
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

# Progress Energy - Weatherspoon Ash Pond-North Dike Sec# 4- Upper Slope- Local

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-4\n-4up.pl2 Run By: Sharat Gollamudi 9/27/2010 10:11AM

| # | FS |
|---|---|
| a | **2.03** |
| b | 2.05 |
| c | 2.08 |
| d | 2.08 |
| e | 2.09 |
| f | 2.09 |
| g | 2.10 |
| h | 2.11 |
| i | 2.11 |
| j | 2.11 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| WOH | 3 | 105.0 | 110.0 | 0.0 | 26.0 | W1 |
| Loose | 4 | 110.0 | 115.0 | 0.0 | 29.0 | W1 |
| M.Dense | 5 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Ash | 6 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=2.03

Safety Factors Are Calculated By The Modified Bishop Method

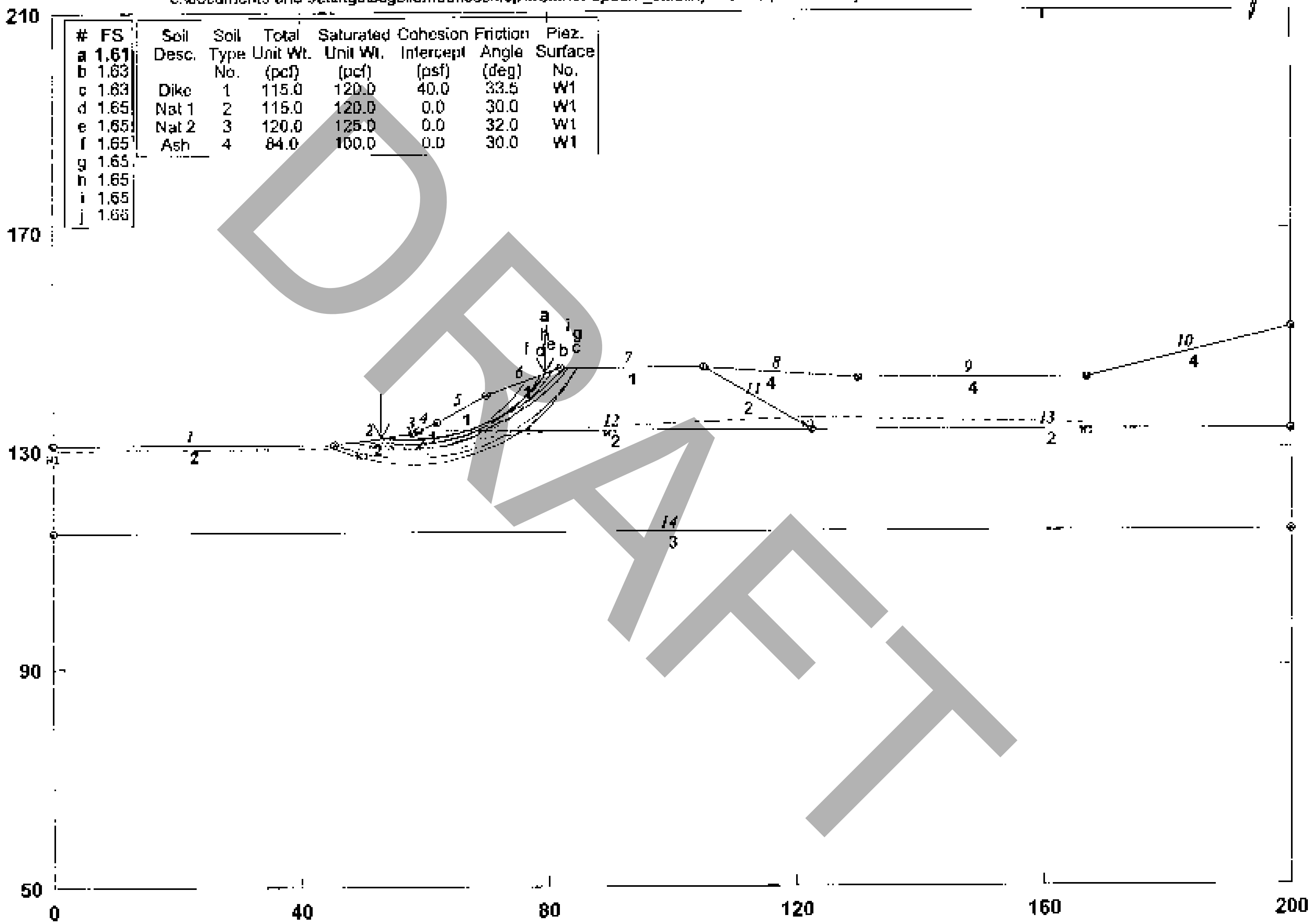
STED

## Progress Energy- Weatherspoon Ash Pond- North Dike Sec # 5

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-5\n-5.pl2 Run By: Sharat Gollamudi 8/28/2010 04:08PM

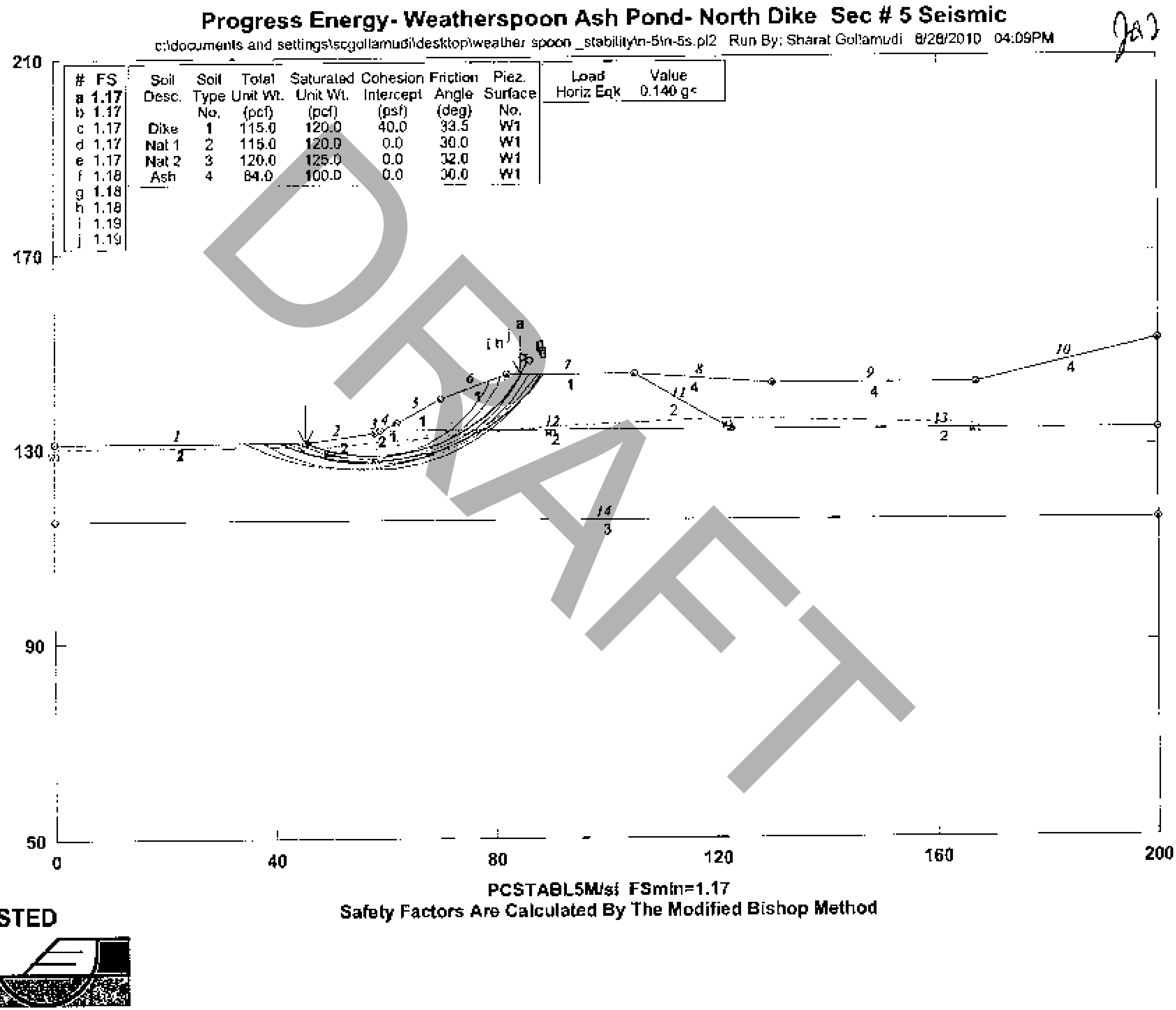
| # | FS |
|---|---|
| a | 1.61 |
| b | 1.63 |
| c | 1.63 |
| d | 1.65 |
| e | 1.65 |
| f | 1.65 |
| g | 1.65 |
| h | 1.65 |
| i | 1.65 |
| j | 1.66 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 3 | 120.0 | 125.0 | 0.0 | 32.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=1.61
Safety Factors Are Calculated By The Modified Bishop Method

STED

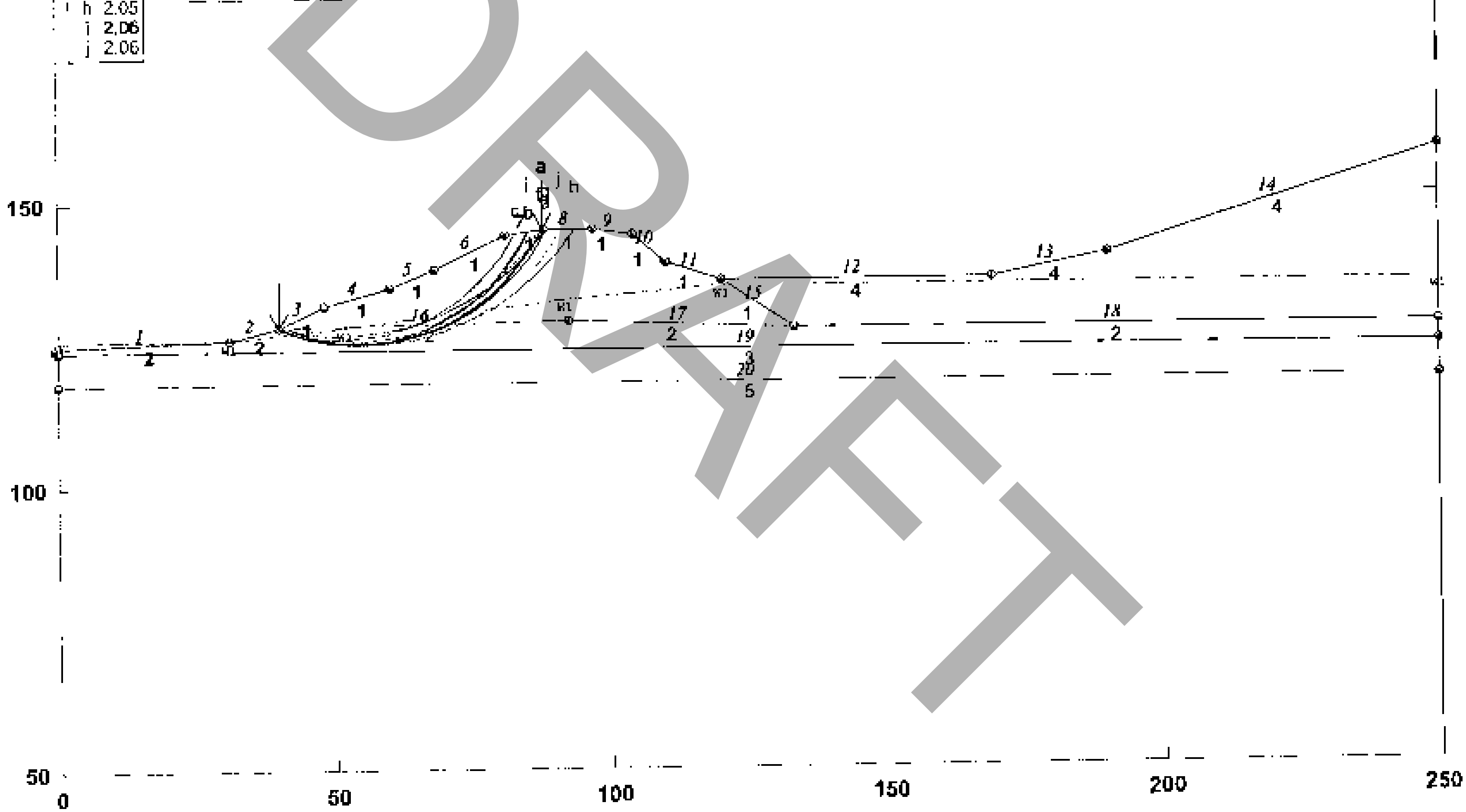

Progress Energy- Weatherspoon Ash Pond- North Dike Sec # 5 Seismic
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-5\n-5s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:09PM
# FS
a 1.17
b 1.17
c 1.17
d 1.17
e 1.17
f 1.18
g 1.18
h 1.18
i 1.19
j 1.19
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike 1 115.0 120.0 40.0 33.5 W1
Nat 1 2 115.0 120.0 0.0 30.0 W1
Nat 2 3 120.0 125.0 0.0 32.0 W1
Ash 4 84.0 100.0 0.0 30.0 W1
Load Horiz Eqk Value 0.140 g<
210
170
130
90
50
0
40
80
120
160
200
PCSTABL5M/si FSmin=1.17
Safety Factors Are Calculated By The Modified Bishop Method
STED

# Progress Energy- Weatherspoon- North_Sec#6 _Fail within Dike

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-6\n-6a.pl2  Run By: Sharat Gollamudi  8/28/2010  04:20PM

| # | FS |
|---|---|
| a | **2.00** |
| b | 2.00 |
| c | 2.04 |
| d | 2.04 |
| e | 2.04 |
| f | 2.05 |
| g | 2.05 |
| h | 2.05 |
| i | 2.06 |
| j | 2.06 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 3 | 110.0 | 115.0 | 500.0 | 0.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Shell | 5 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

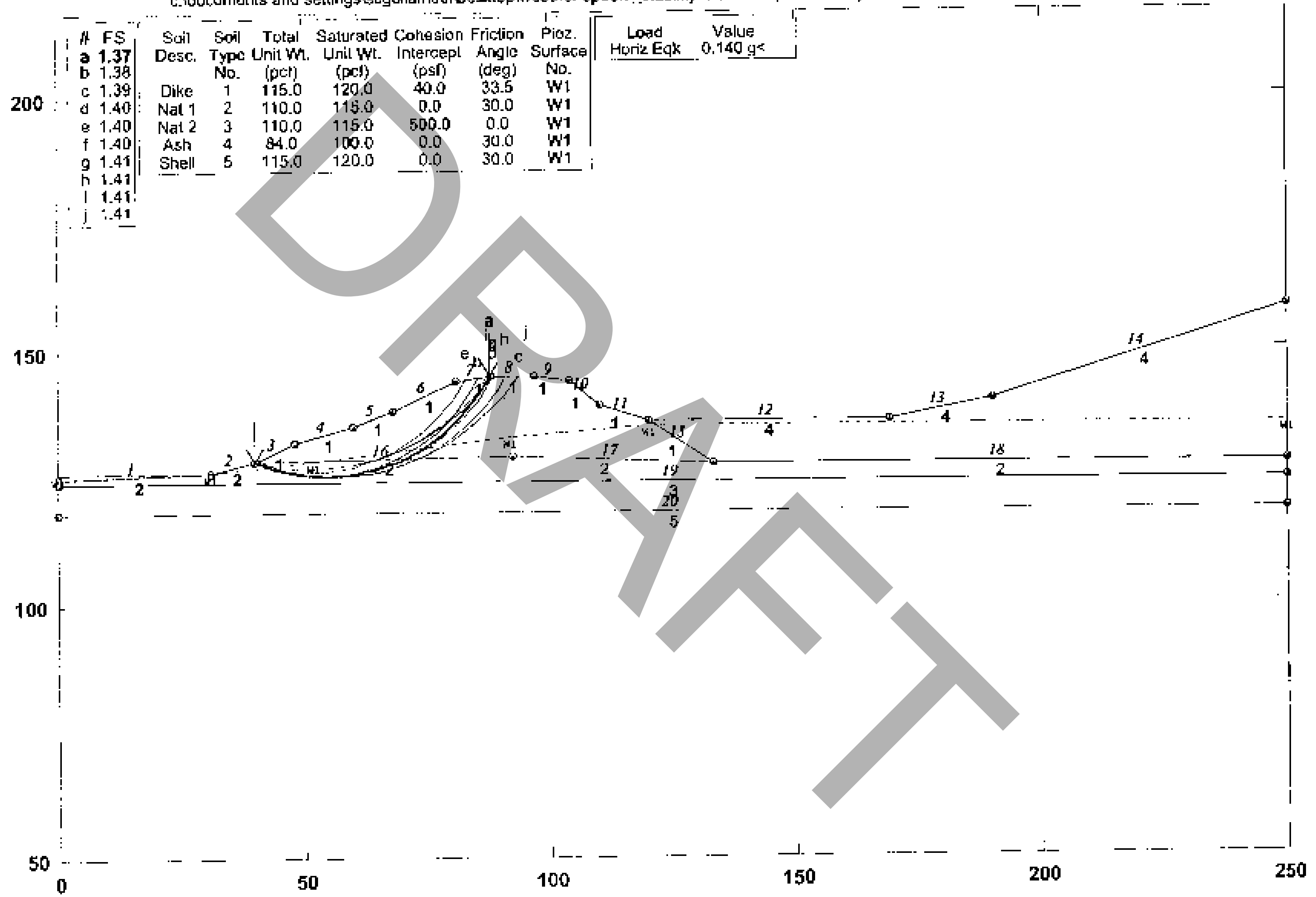



PCSTABL5M/si  FSmin=2.00
Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy- Weatherspoon- North_Sec#6 _Fail within Dike Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-6\n-6as.pl2 Run By: Sharat Gollamudi 8/28/2010 04:20PM




PCSTABL5M/si FSmin=1.37
Safety Factors Are Calculated By The Modified Bishop Method

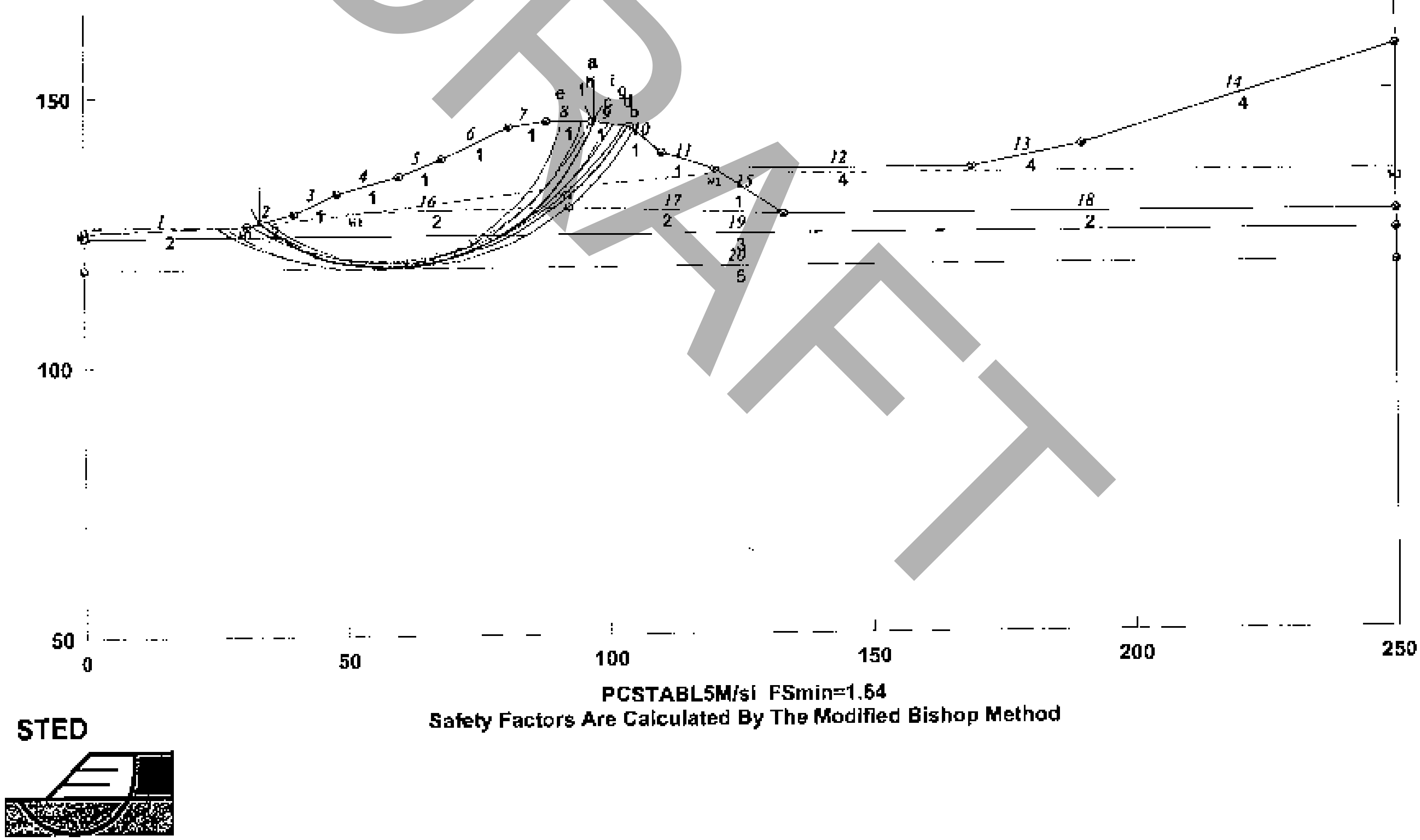
STED

## Progress Energy- Weatherspoon North Dike - Sec # 6 - Deep Failure

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-6\n-6.pl2 Run By: Sharat Gollamudi 6/28/2010 04:13PM

| # | FS |
|---|---|
| a | 1.64 |
| b | 1.67 |
| c | 1.68 |
| d | 1.68 |
| e | 1.69 |
| f | 1.69 |
| g | 1.70 |
| h | 1.70 |
| i | 1.71 |
| j | 1.71 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 3 | 110.0 | 115.0 | 500.0 | 0.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Shell | 5 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=1.64
Safety Factors Are Calculated By The Modified Bishop Method

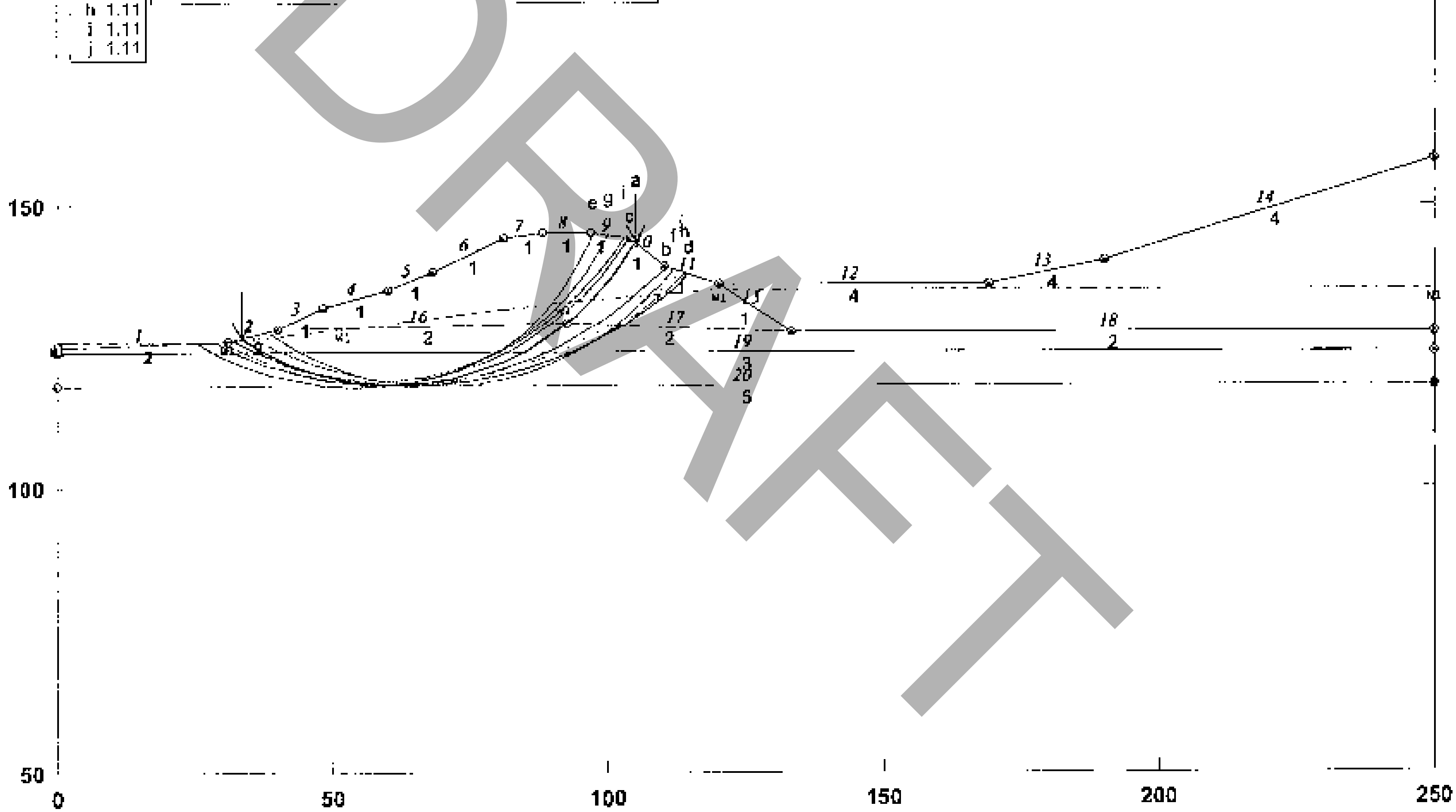
## Progress Energy- Weatherspoon North Sec # 6 - Deep Failure Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-6\n-6s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:16PM

| # | FS |
|---|---|
| a | **1.07** |
| b | 1.09 |
| c | 1.09 |
| d | 1.10 |
| e | 1.10 |
| f | 1.10 |
| g | 1.11 |
| h | 1.11 |
| i | 1.11 |
| j | 1.11 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 3 | 110.0 | 115.0 | 500.0 | 0.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Shell | 5 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |




PCSTABL5M/si FSmin=1.07
Safety Factors Are Calculated By The Modified Bishop Method

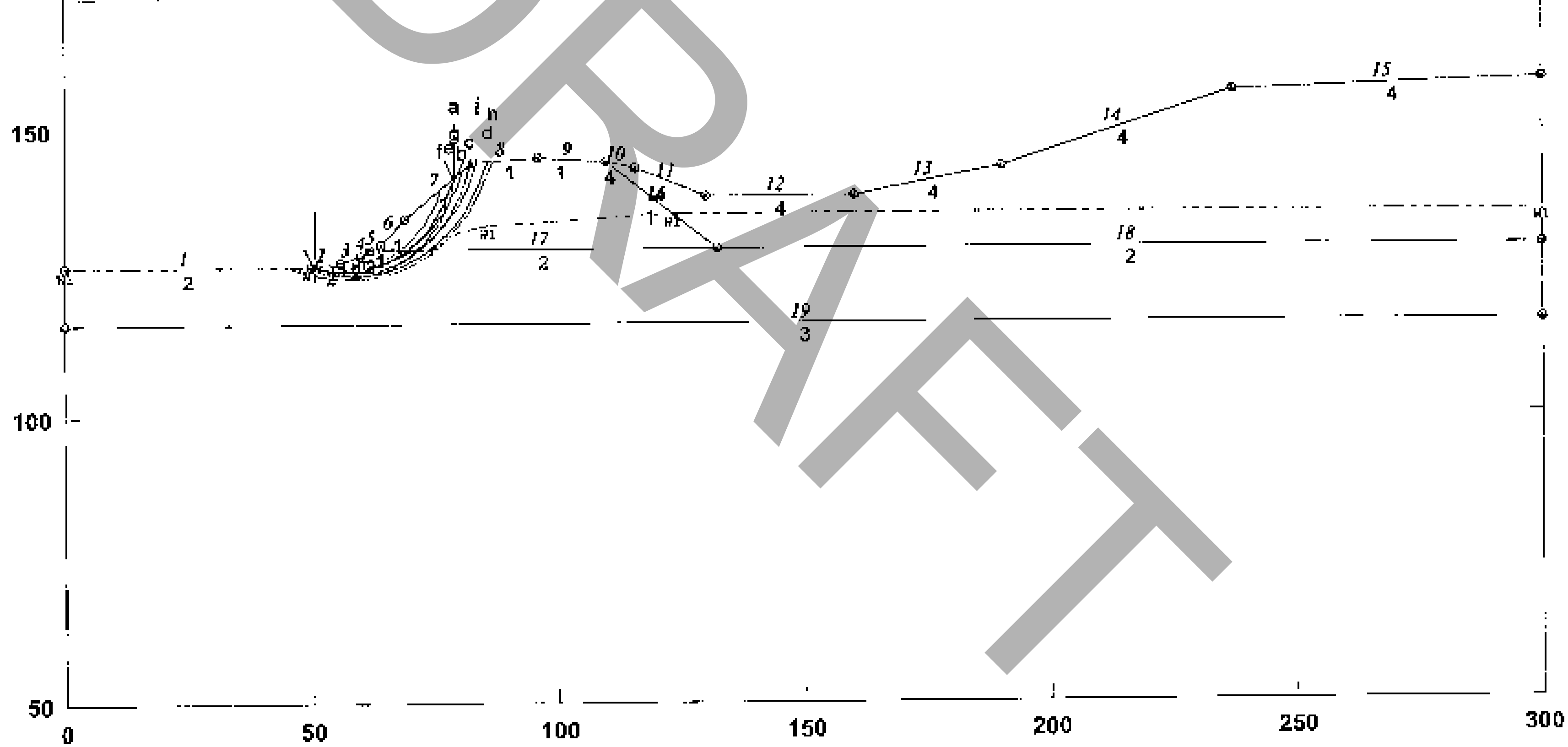
STED

## Progress Energy- Weatherspoon Ash Pond- North Dike - Section 7

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-7\n-7.pl2 Run By: Sharat Gollamudi 8/28/2010 04:22PM

| # | FS |
|---|---|
| a | 1.08 |
| b | 1.09 |
| c | 1.10 |
| d | 1.10 |
| e | 1.10 |
| f | 1.10 |
| g | 1.11 |
| h | 1.11 |
| i | 1.12 |
| j | 1.12 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat 1 | 2 | 115.0 | 120.0 | 0.0 | 31.0 | W1 |
| Nat 2 | 3 | 110.0 | 115.0 | 0.0 | 24.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

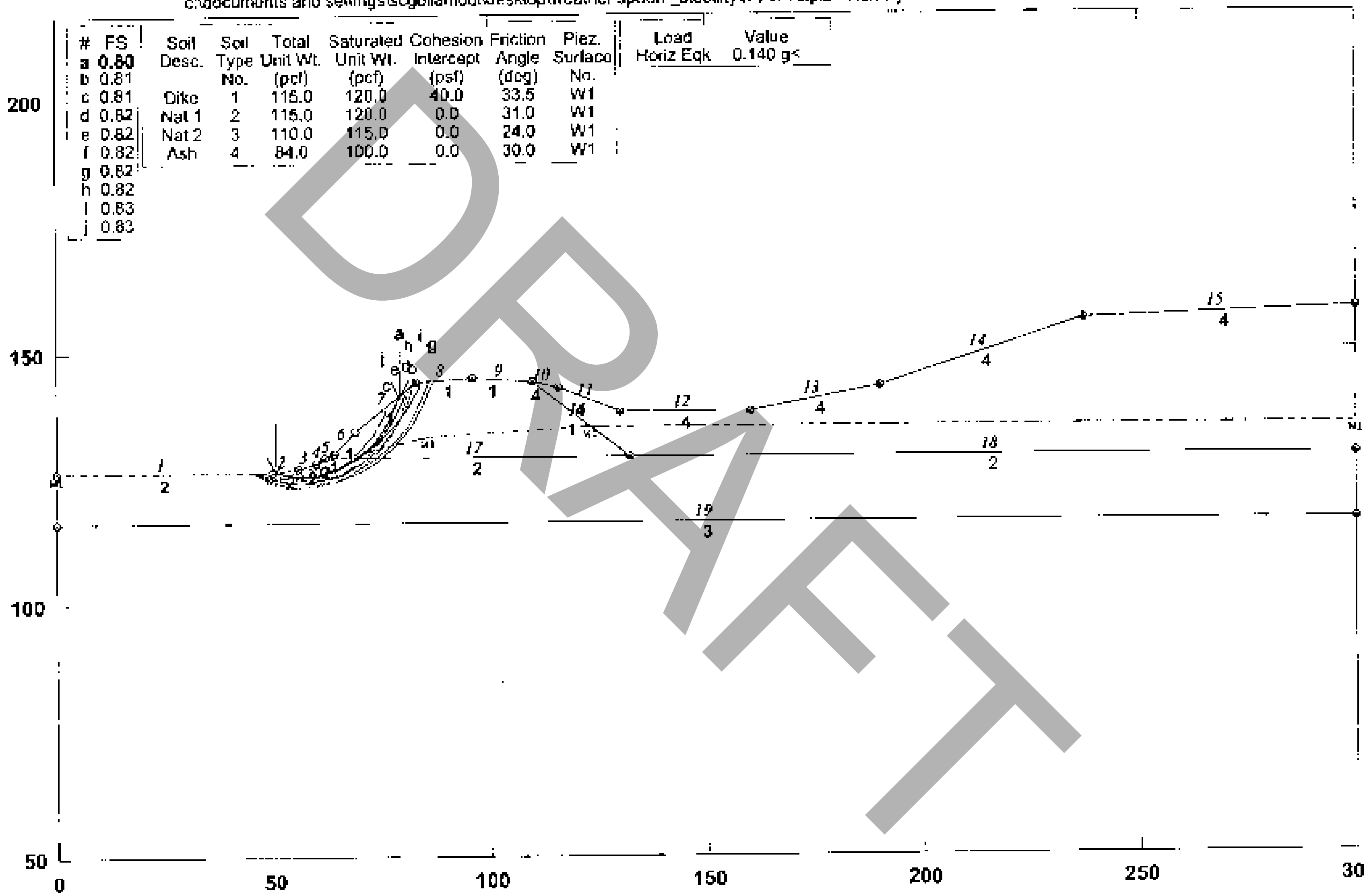



PCSTABL5M/si FSmin=1.08
Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy- Weatherspoon Ash Pond- North Dike - Section 7 - Seismic

c:\documents and settings\sgollamudi\desktop\weather spoon _stability\n-7\n-7s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:23PM




PCSTABL5M/si FSmin=0.80

Safety Factors Are Calculated By The Modified Bishop Method

STED

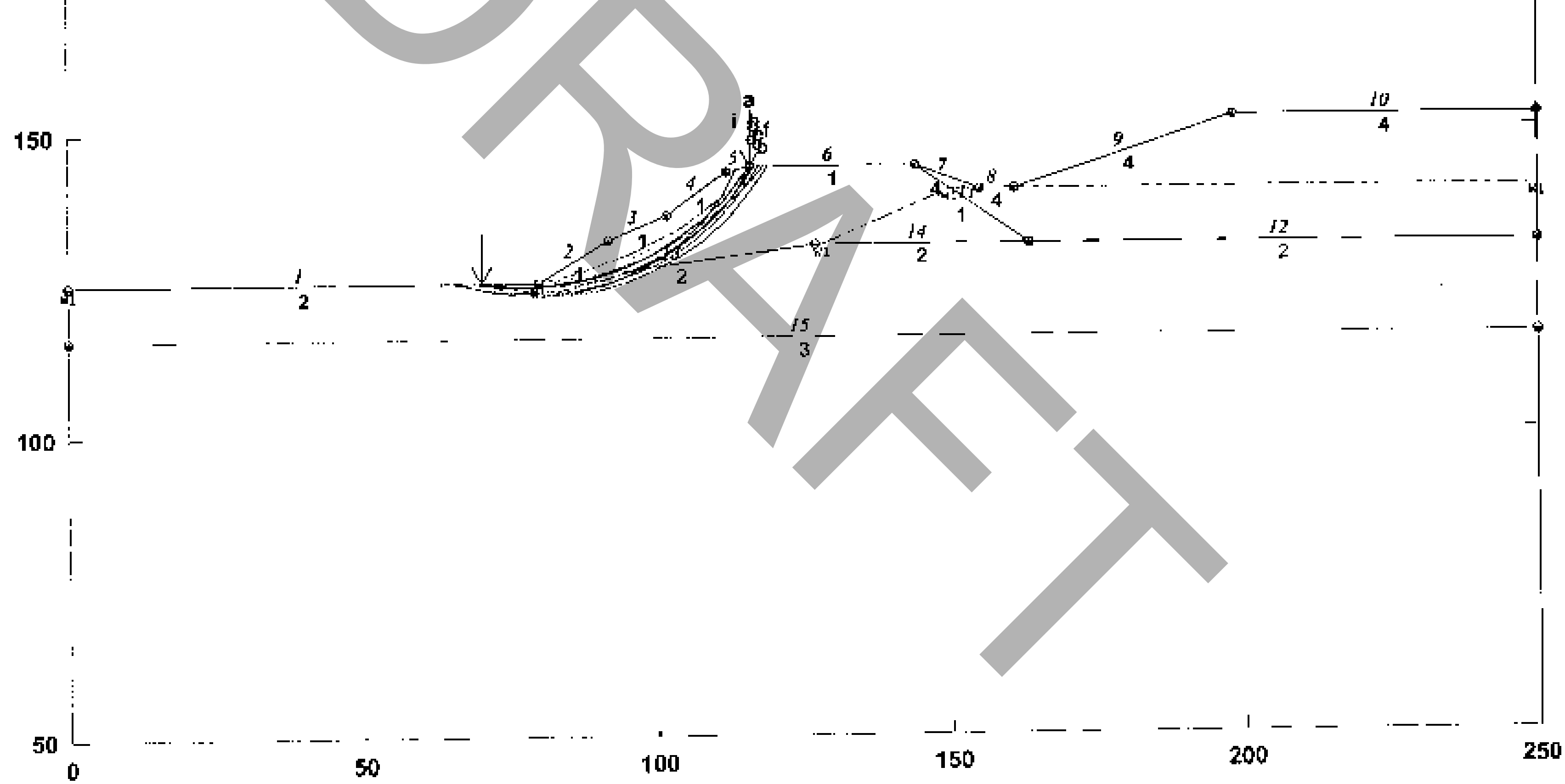
DRAFT

# Progress Energy - Weatherspoon Ash Pond-North Dike - Section 8

c:\documents and settings\scgollamudi\desktop\weather spoon stability\n-8\n-8.pl2 Run By: Sharat Gollamudi 8/28/2010 04:25PM

| # | FS |
|---|---|
| a | 1.60 |
| b | 1.61 |
| c | 1.61 |
| d | 1.61 |
| e | 1.63 |
| f | 1.63 |
| g | 1.63 |
| h | 1.63 |
| i | 1.64 |
| j | 1.64 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 120.0 | 125.0 | 0.0 | 37.0 | W1 |
| Nat2 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=1.60
Safety Factors Are Calculated By The Modified Bishop Method

STED

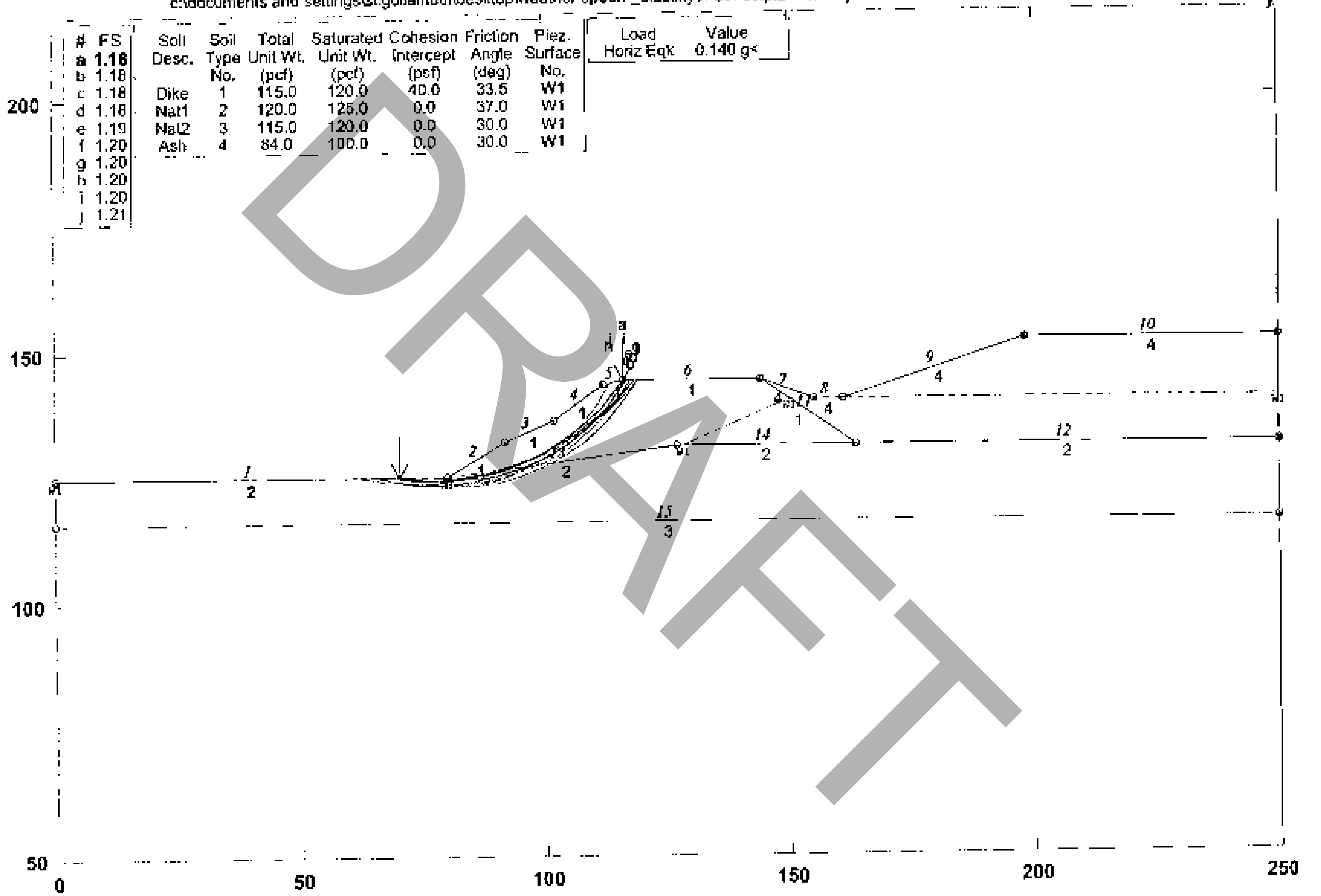
# Progress Energy - Weatherspoon Ash Pond-North Dike - Section 8 Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-8\n-8s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:28PM

| # | FS |
|---|---|
| a | 1.18 |
| b | 1.18 |
| c | 1.18 |
| d | 1.18 |
| e | 1.19 |
| f | 1.20 |
| g | 1.20 |
| h | 1.20 |
| i | 1.20 |
| j | 1.21 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 120.0 | 125.0 | 0.0 | 37.0 | W1 |
| Nat2 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |



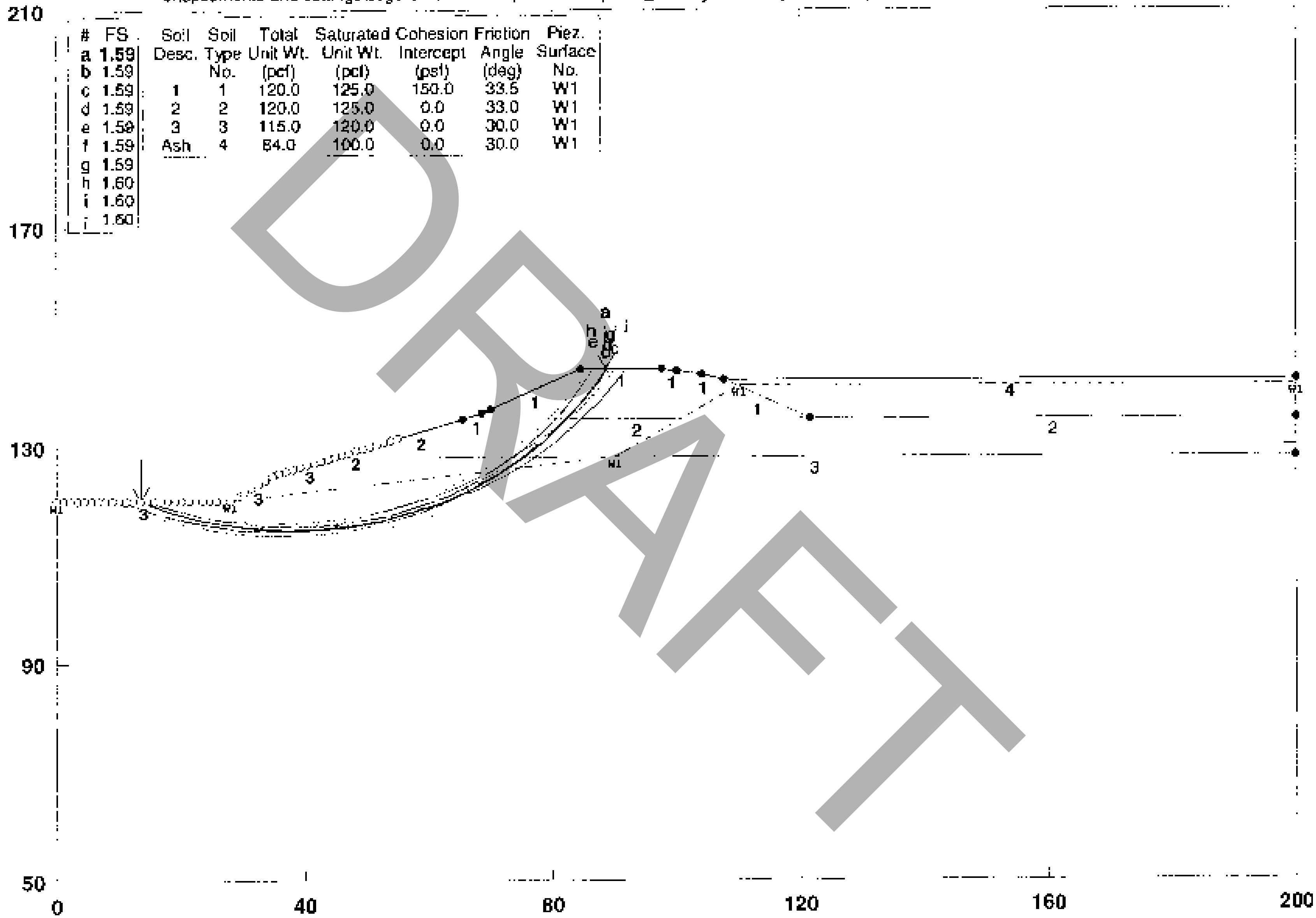

PCSTABL5M/si FSmin=1.18

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy -Weatherspoon Ash Pond- Dike Section N-9

c:\dpcuments and settings\sgollamudi\desktop\weather spoon _stability\sb-9\a-9.pl2 Run By: Sharat Gollamudi 9/21/2010 05:29PM



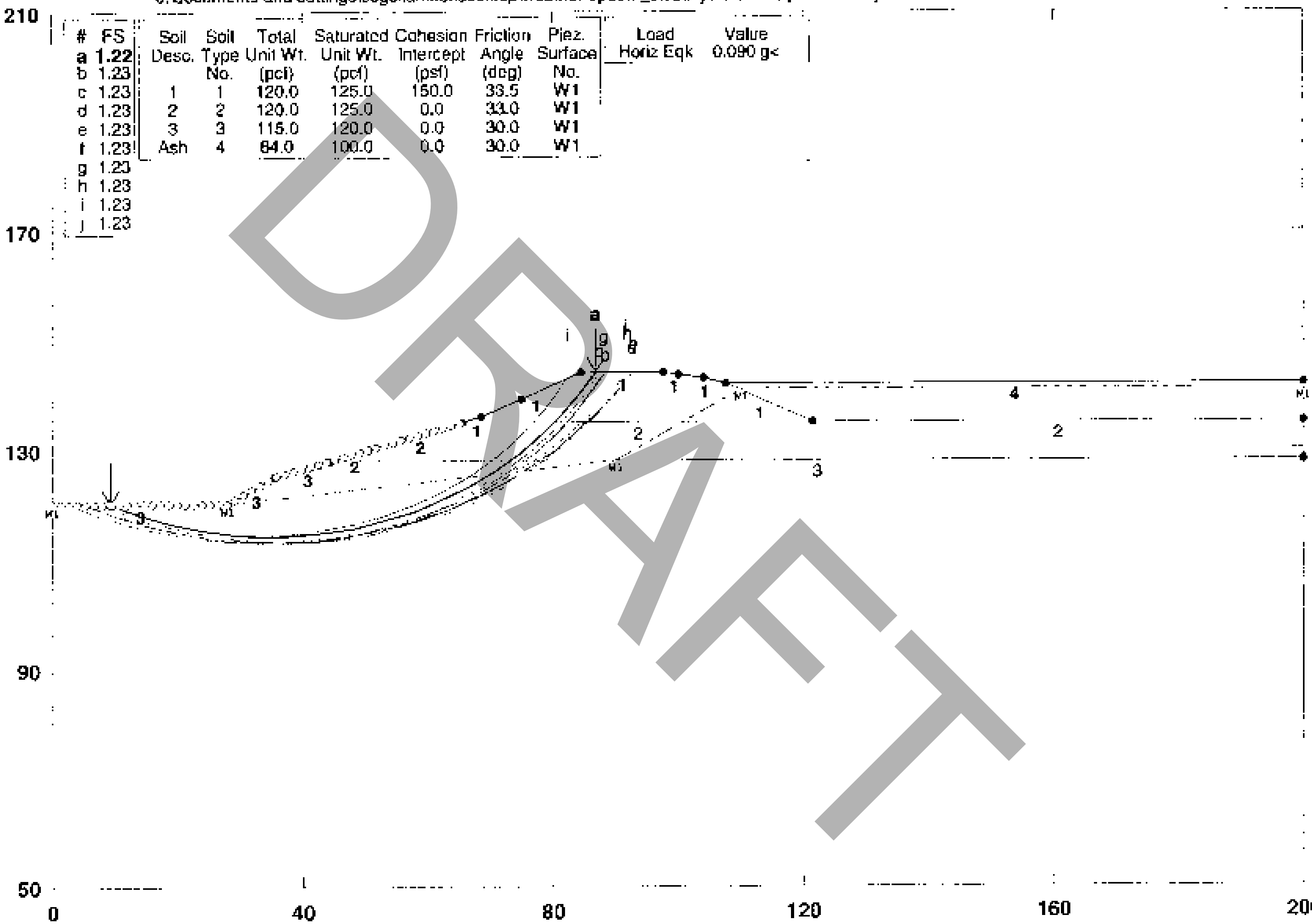

PCSTABL5M/si FSmin=1.59

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy -Weatherspoon Ash Pond- Dike Section N-9-Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-9\s-9s.pl2   Run By: Sharat Gollamudi   9/21/2010   05:30PM




| # | FS |
|---|---|
| a | 1.22 |
| b | 1.23 |
| c | 1.23 |
| d | 1.23 |
| e | 1.23 |
| f | 1.23 |
| g | 1.23 |
| h | 1.23 |
| i | 1.23 |
| j | 1.23 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 33.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.090 g< |

PCSTABL5M/si FSmin=1.22

Safety Factors Are Calculated By The Modified Bishop Method

STED

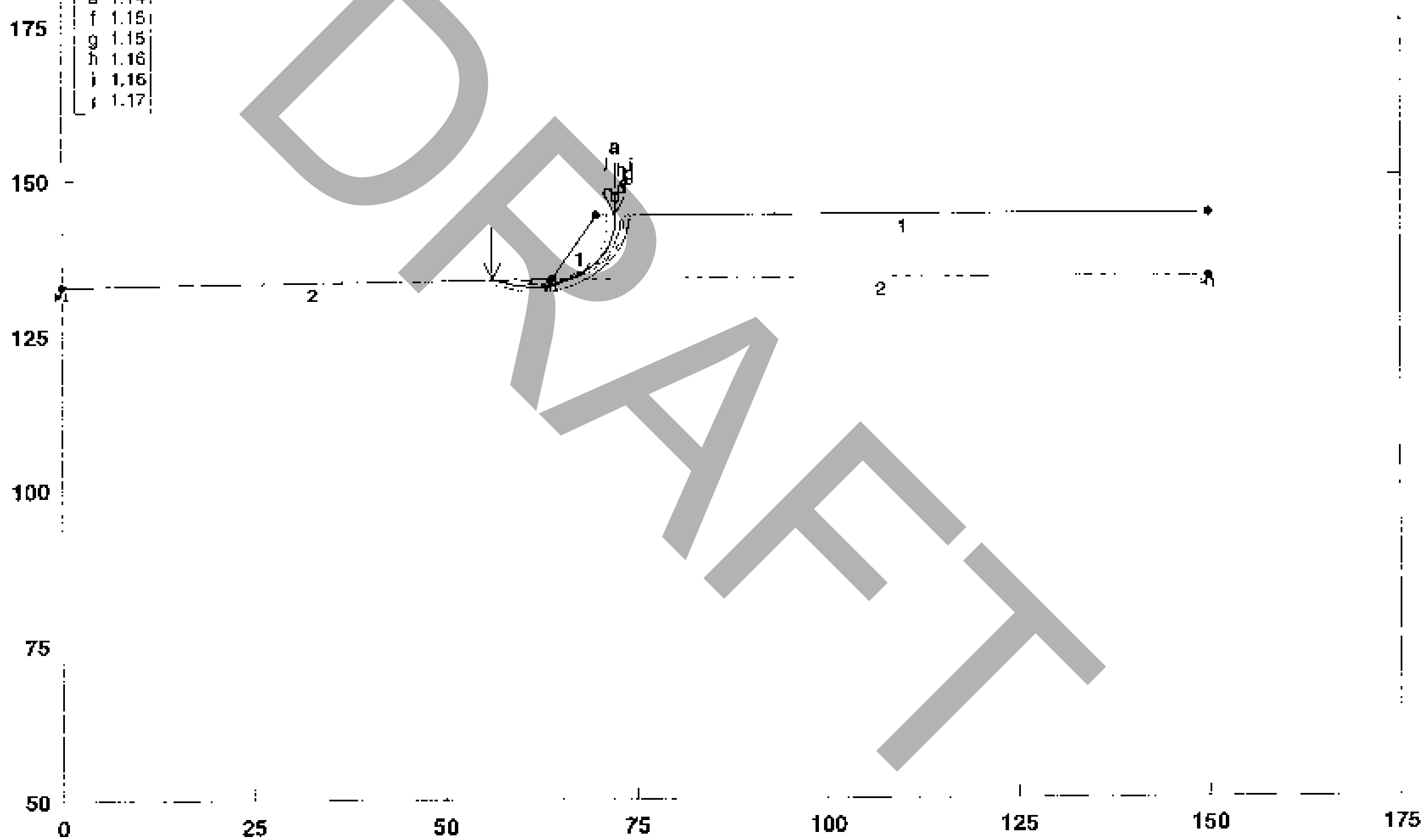
## Progress Energy - Weatherspoon Dike- Section N-10 - Existing 60-Degree Slope

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-a\na-org.pl2 Run By: Sharat Gollamudi 9/22/2010 02:59PM

| # | FS |
|---|---|
| a | 1.11 |
| b | 1.12 |
| c | 1.13 |
| d | 1.13 |
| e | 1.14 |
| f | 1.15 |
| g | 1.15 |
| h | 1.16 |
| i | 1.16 |
| j | 1.17 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 95.0 | 30.0 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |

Init Points: 50. to 65.
Term Limits: 69. to 85.




PCSTABL5M/si FSmin=1.11
Safety Factors Are Calculated By The Modified Bishop Method

STED

# APPENDIX D 2

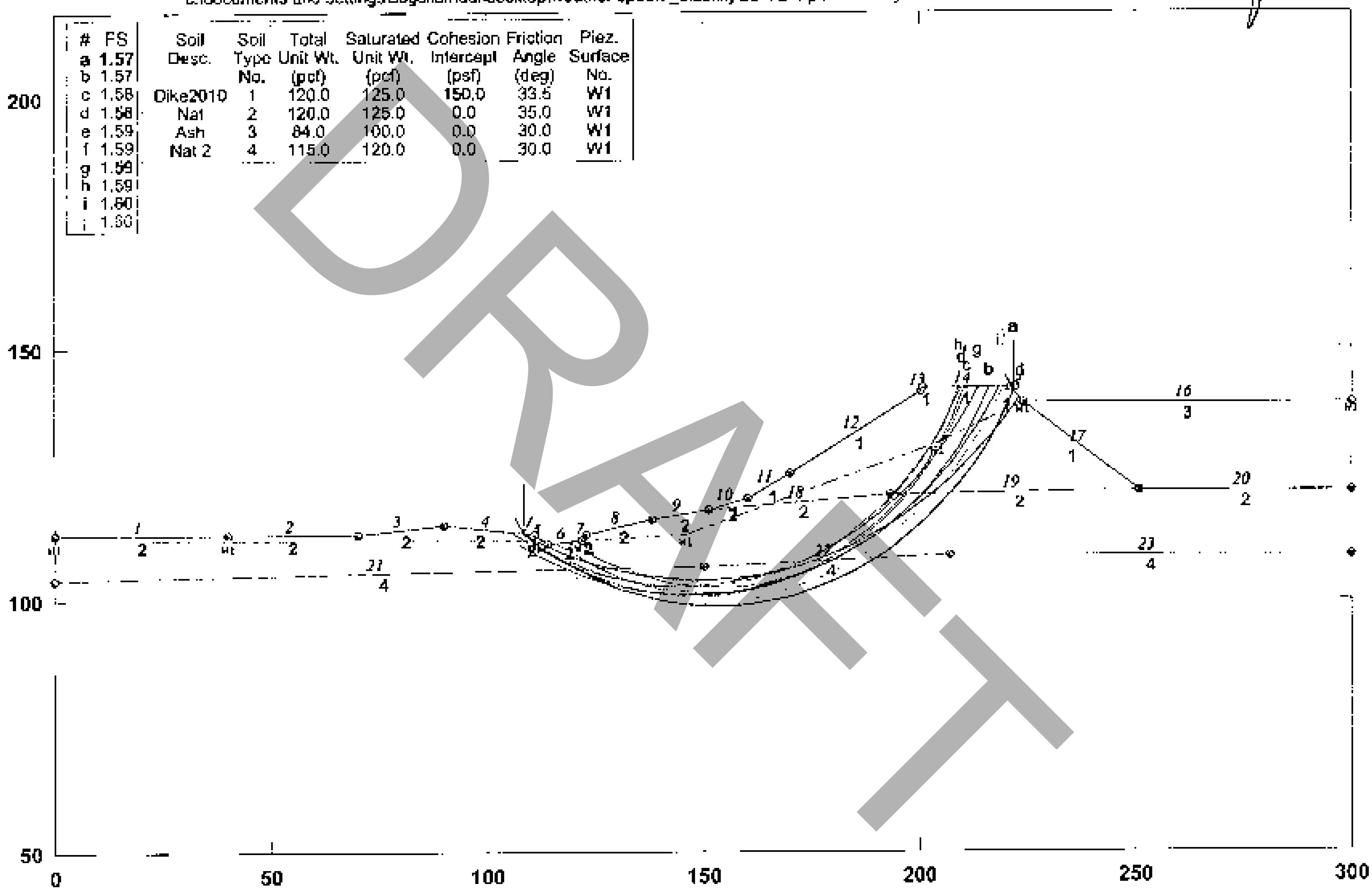
## Stability Analysis Output Plots – South Dike

# Progress Energy - Weatherspoon Ash Pond South Dike - Section 1 - Deep Failure

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-1\s-1.pl2 Run By: Sharat Gollamudi 8/28/2010 04:31PM

| # | FS |
|---|---|
| a | **1.57** |
| b | 1.57 |
| c | 1.58 |
| d | 1.58 |
| e | 1.59 |
| f | 1.59 |
| g | 1.59 |
| h | 1.59 |
| i | 1.60 |
| j | 1.60 |

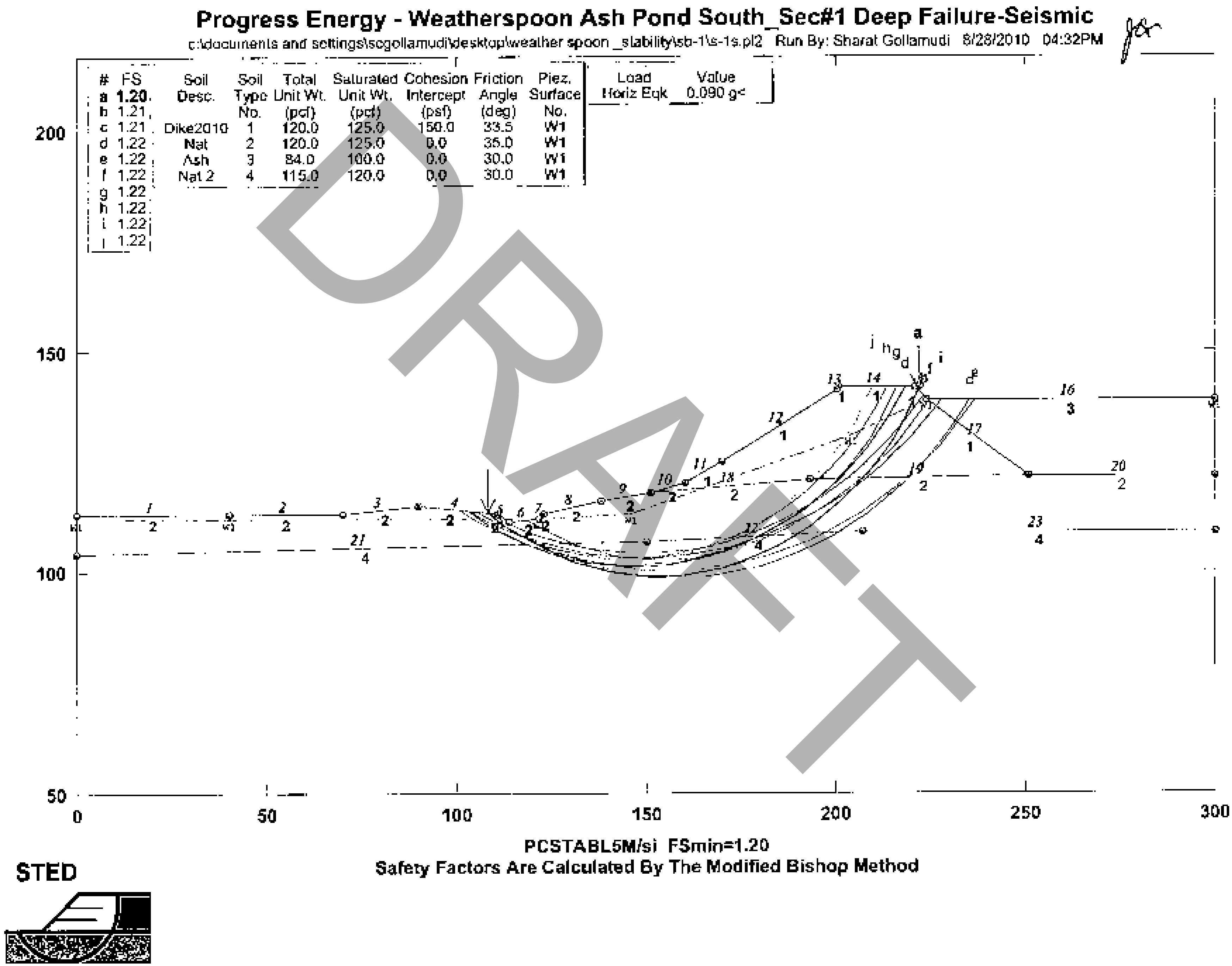
| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |




PCSTABL5M/si FSmin=1.57

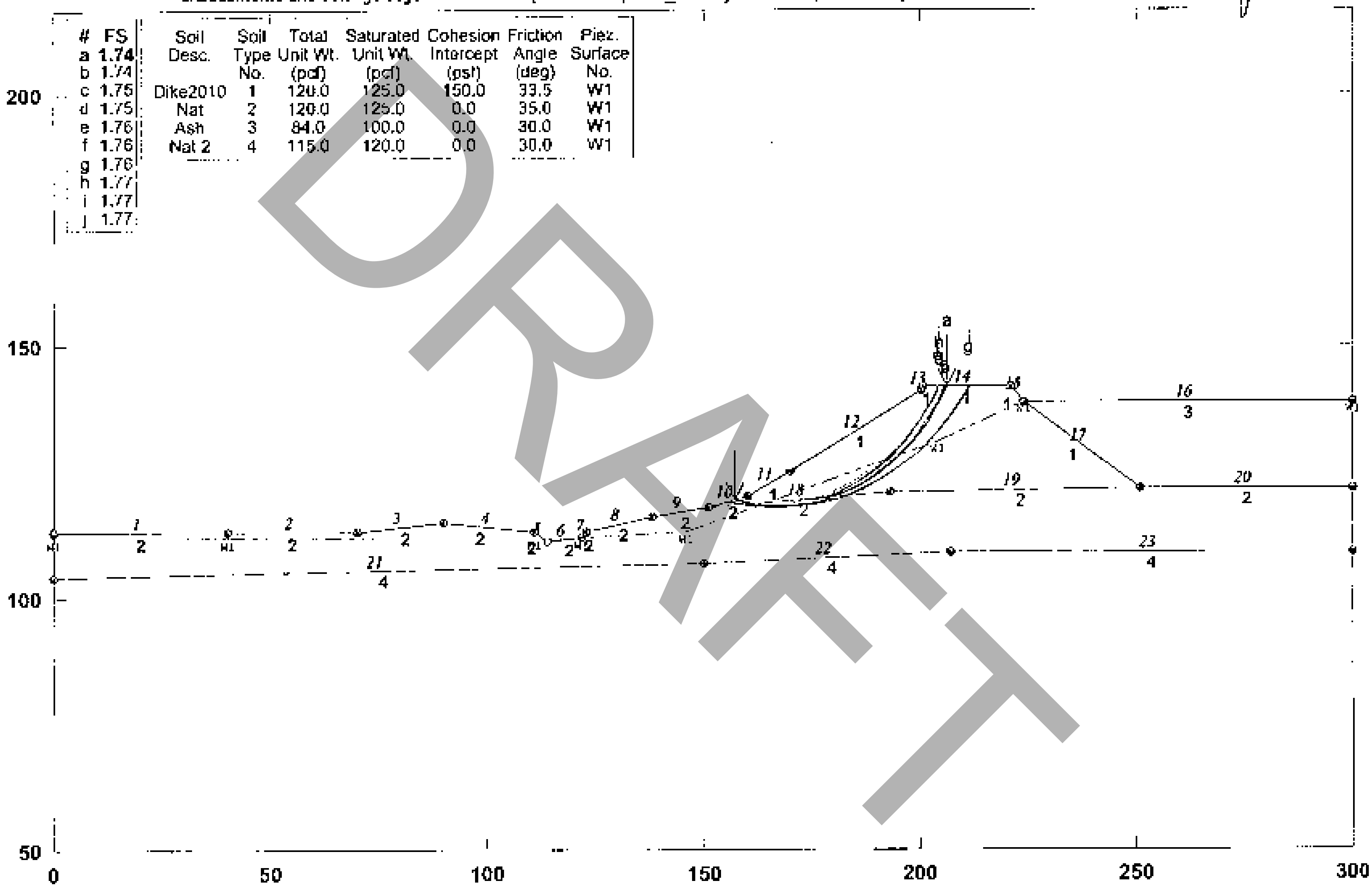
Safety Factors Are Calculated By The Modified Bishop Method

STED


Progress Energy - Weatherspoon Ash Pond South_Sec#1 Deep Failure-Seismic
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-1\s-1s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:32PM
# FS
a 1.20
b 1.21
c 1.21
d 1.22
e 1.22
f 1.22
g 1.22
h 1.22
i 1.22
j 1.22
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1
Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1
Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1
Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1
Load | Value
Horiz Eqk | 0.090 g<
200
150
100
50
0
50
100
150
200
250
300
PCSTABL5M/si FSmin=1.20
Safety Factors Are Calculated By The Modified Bishop Method
STED

## Progress Energy - Weatherspoon Ash Pond South_Sec#1_Failure within Dike

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-1\s-1a.pl2 Run By: Sharat Gollamudi 8/28/2010 04:41PM




| # | FS |
|---|---|
| a | 1.74 |
| b | 1.74 |
| c | 1.75 |
| d | 1.75 |
| e | 1.76 |
| f | 1.76 |
| g | 1.76 |
| h | 1.77 |
| i | 1.77 |
| j | 1.77 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

PCSTABL5M/si FSmin=1.74

Safety Factors Are Calculated By The Modified Bishop Method

STED

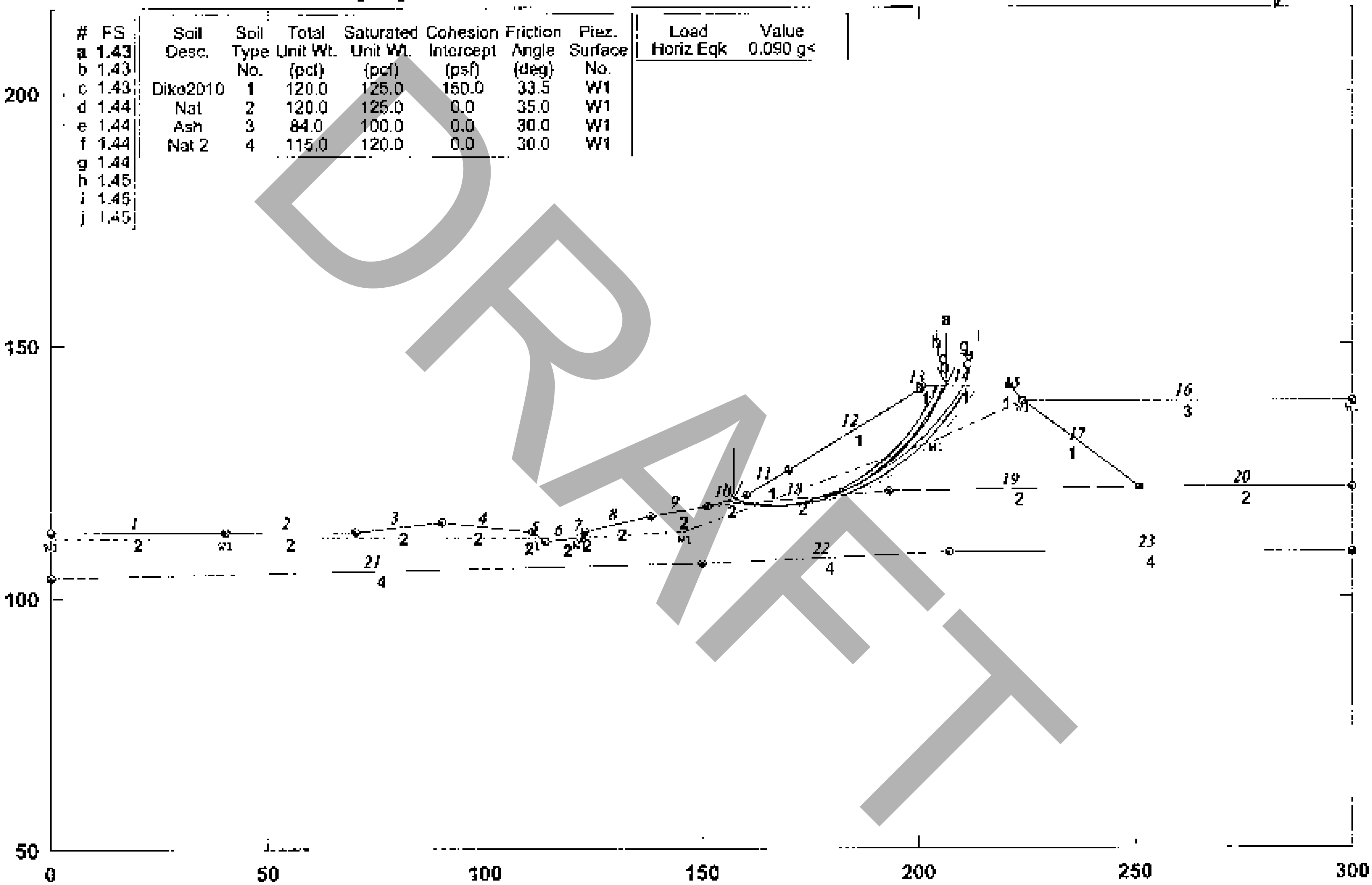
# Progress Energy - Weatherspoon Ash Pond South_Sec#1_Failure within Dike-Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-1\s-1as.pl2 Run By: Sharat Gollamudi 8/28/2010 04:39PM

| # | FS |
|---|---|
| a | 1.43 |
| b | 1.43 |
| c | 1.43 |
| d | 1.44 |
| e | 1.44 |
| f | 1.44 |
| g | 1.44 |
| h | 1.45 |
| i | 1.45 |
| j | 1.45 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

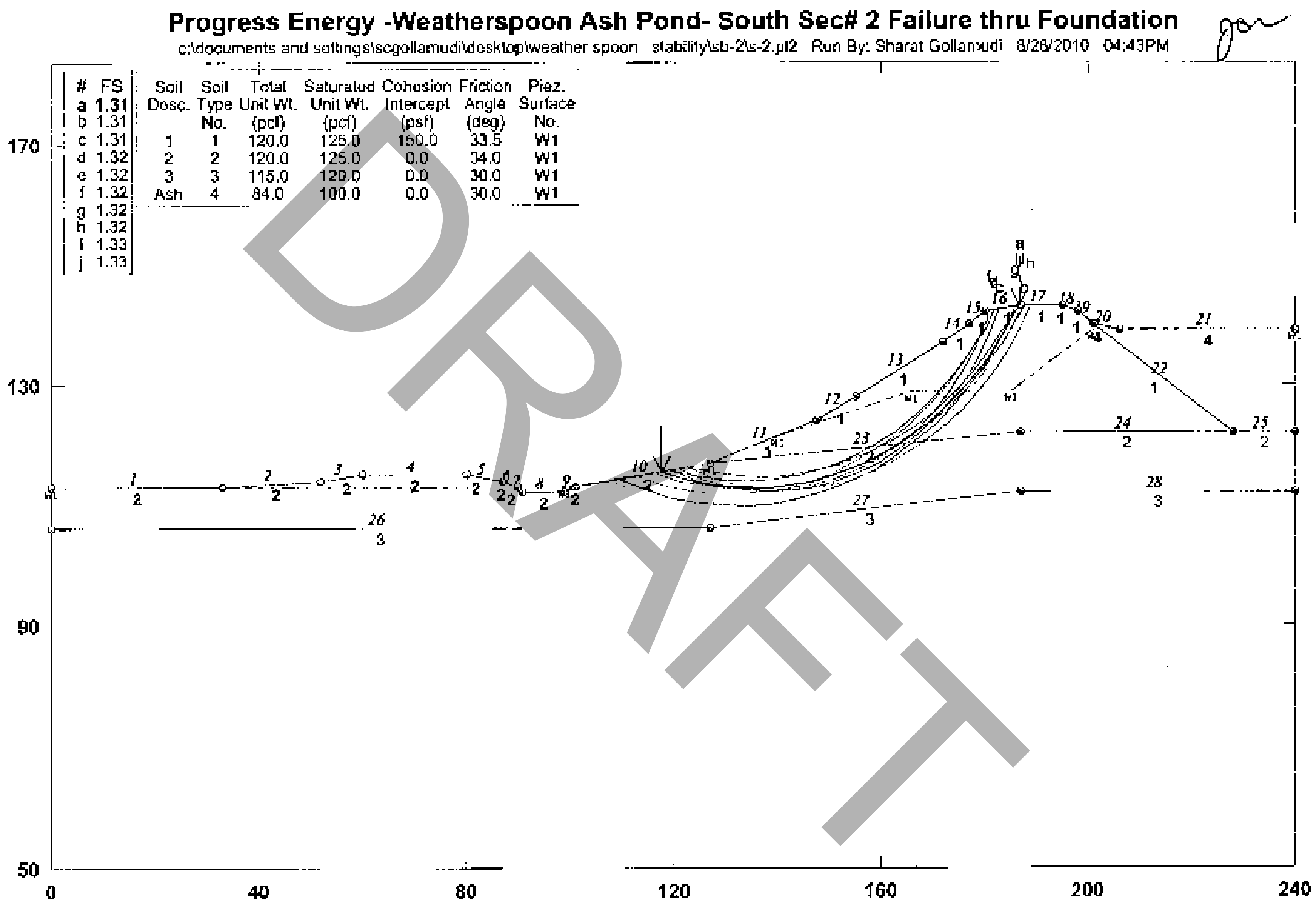
| Load | Value |
|---|---|
| Horiz Eqk | 0.090 g< |



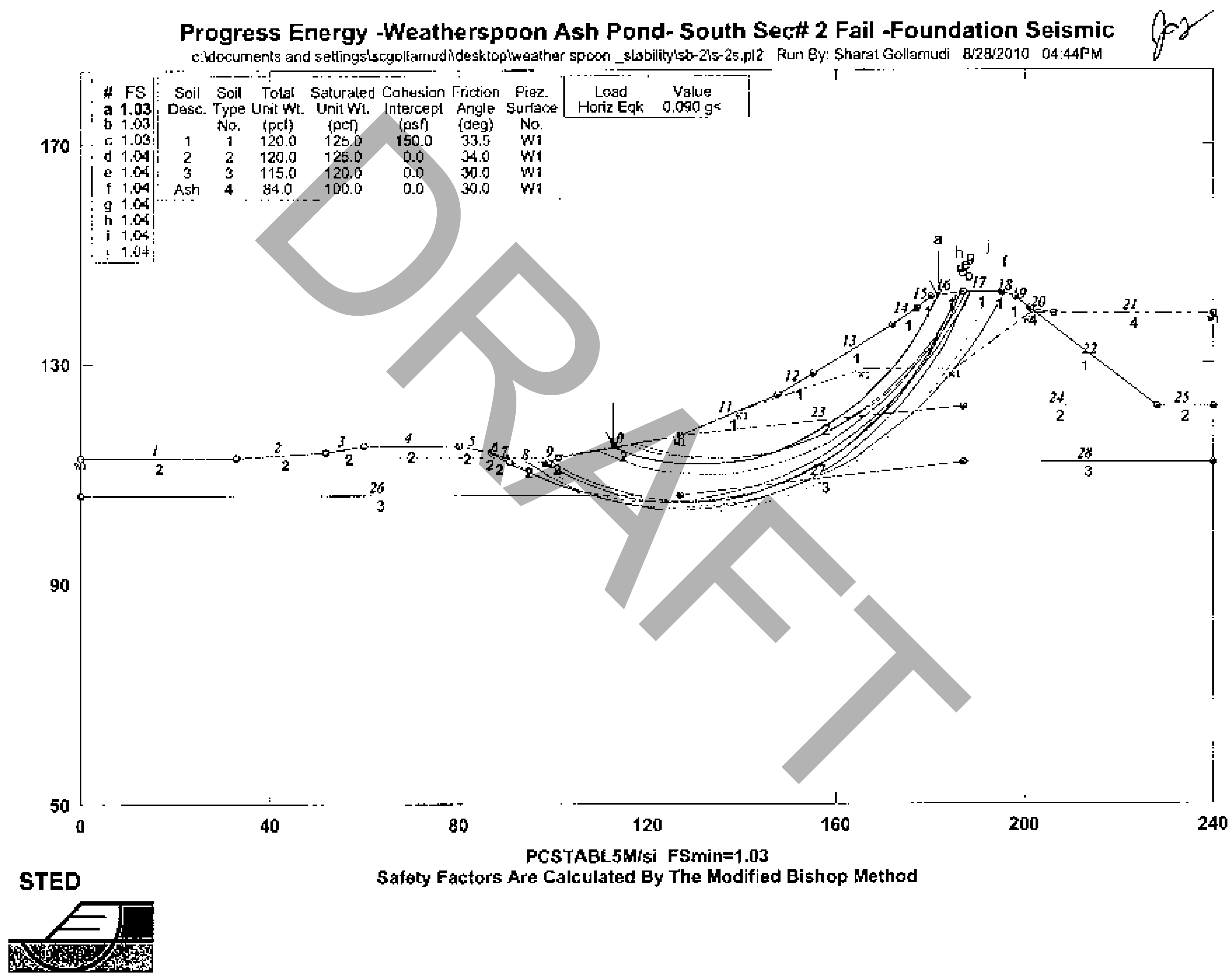

PCSTABL5M/si FSmin=1.43

Safety Factors Are Calculated By The Modified Bishop Method

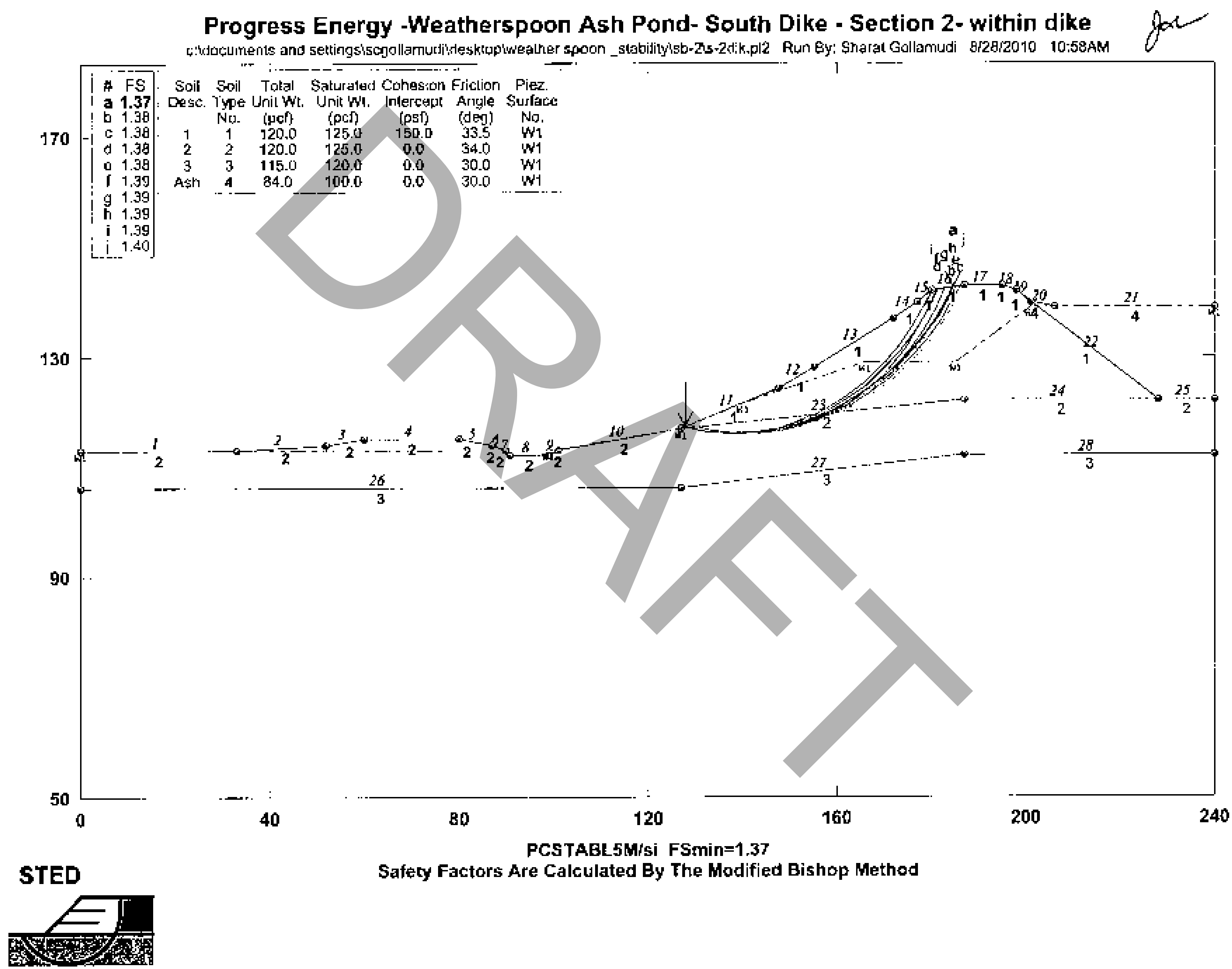
STED




PCSTABL5M/si FSmin=1.31
Safety Factors Are Calculated By The Modified Bishop Method



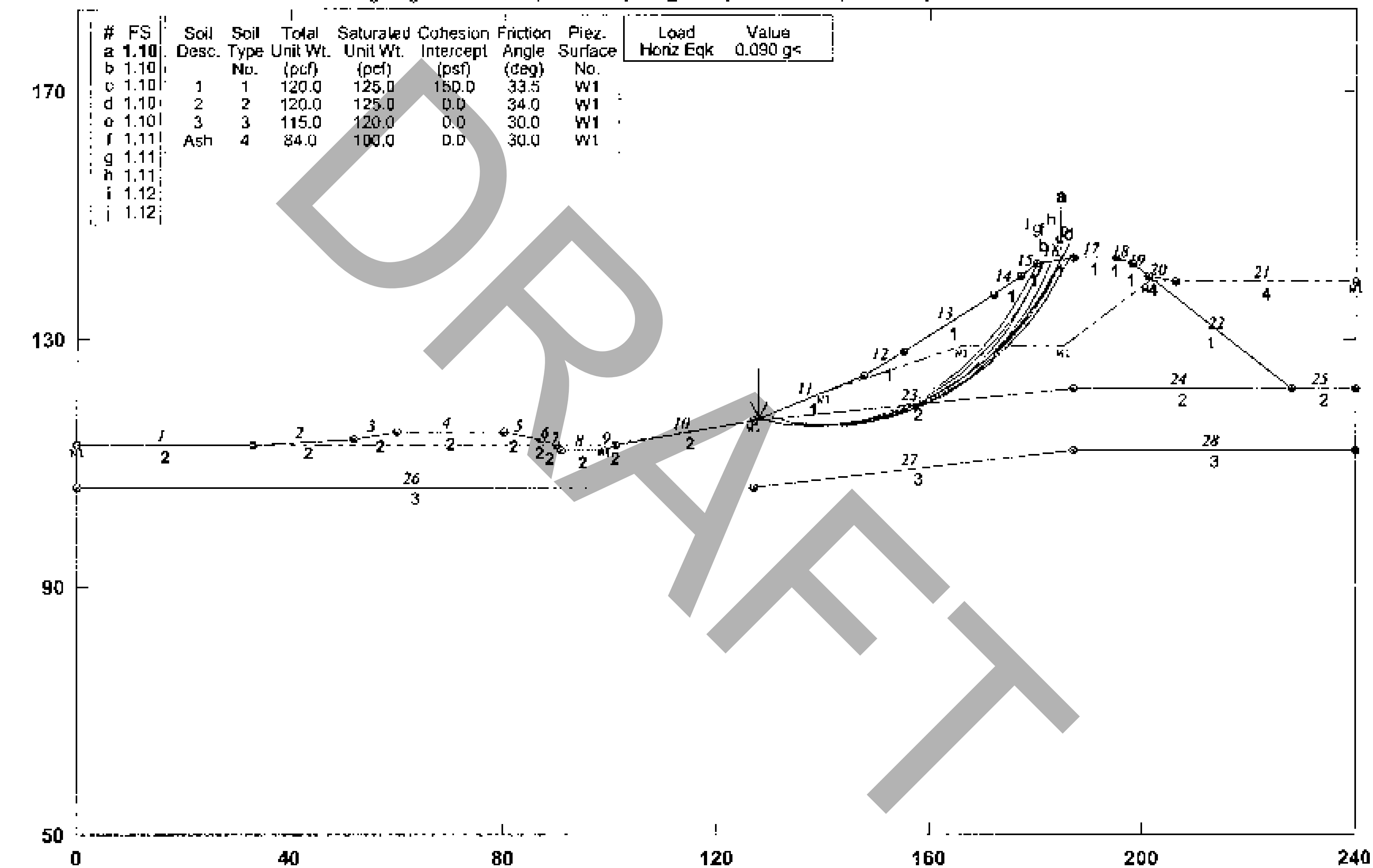
Progress Energy -Weatherspoon Ash Pond- South Sec# 2 Fail -Foundation Seismic
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2s.pl2 Run By: Sharat Gollamudi 8/28/2010 04:44PM
# FS
a 1.03
b 1.03
c 1.03
d 1.04
e 1.04
f 1.04
g 1.04
h 1.04
i 1.04
j 1.04
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1
2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1
3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1
Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1
Load | Value
Horiz Eqk | 0.090 g<
170
130
90
50
0
40
80
120
160
200
240
PCSTABL5M/si FSmin=1.03
Safety Factors Are Calculated By The Modified Bishop Method
STED



Progress Energy -Weatherspoon Ash Pond- South Dike - Section 2- within dike
c:\documents and settings\sgollamudi\desktop\weather spoon _stability\sb-2s-2dik.pl2 Run By: Sharat Gollamudi 8/28/2010 10:58AM
# FS
a 1.37
b 1.38
c 1.38
d 1.38
e 1.38
f 1.39
g 1.39
h 1.39
i 1.39
j 1.40
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1
2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1
3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1
Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1
170
130
90
50
0
40
80
120
160
200
240
PCSTABL5M/si FSmin=1.37
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

# Progress Energy -Weatherspoon Ash Pond- South - Section 2- within dike -Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2dik-s.pl2 Run By: Sharat Gollamudi 8/28/2010 05:00PM



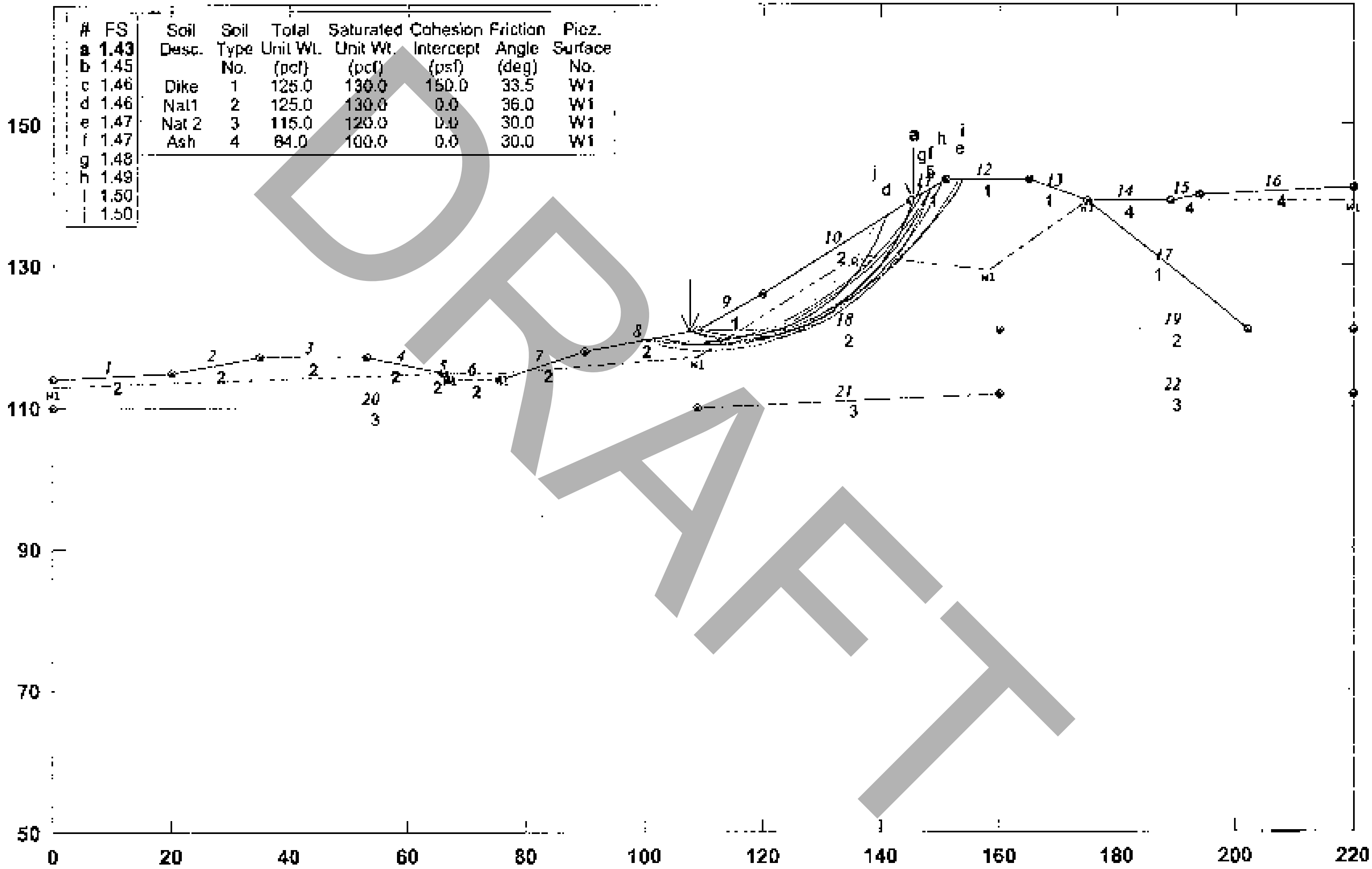

PCSTABL5M/si FSmin=1.10

Safety Factors Are Calculated By The Modified Bishop Method

STED

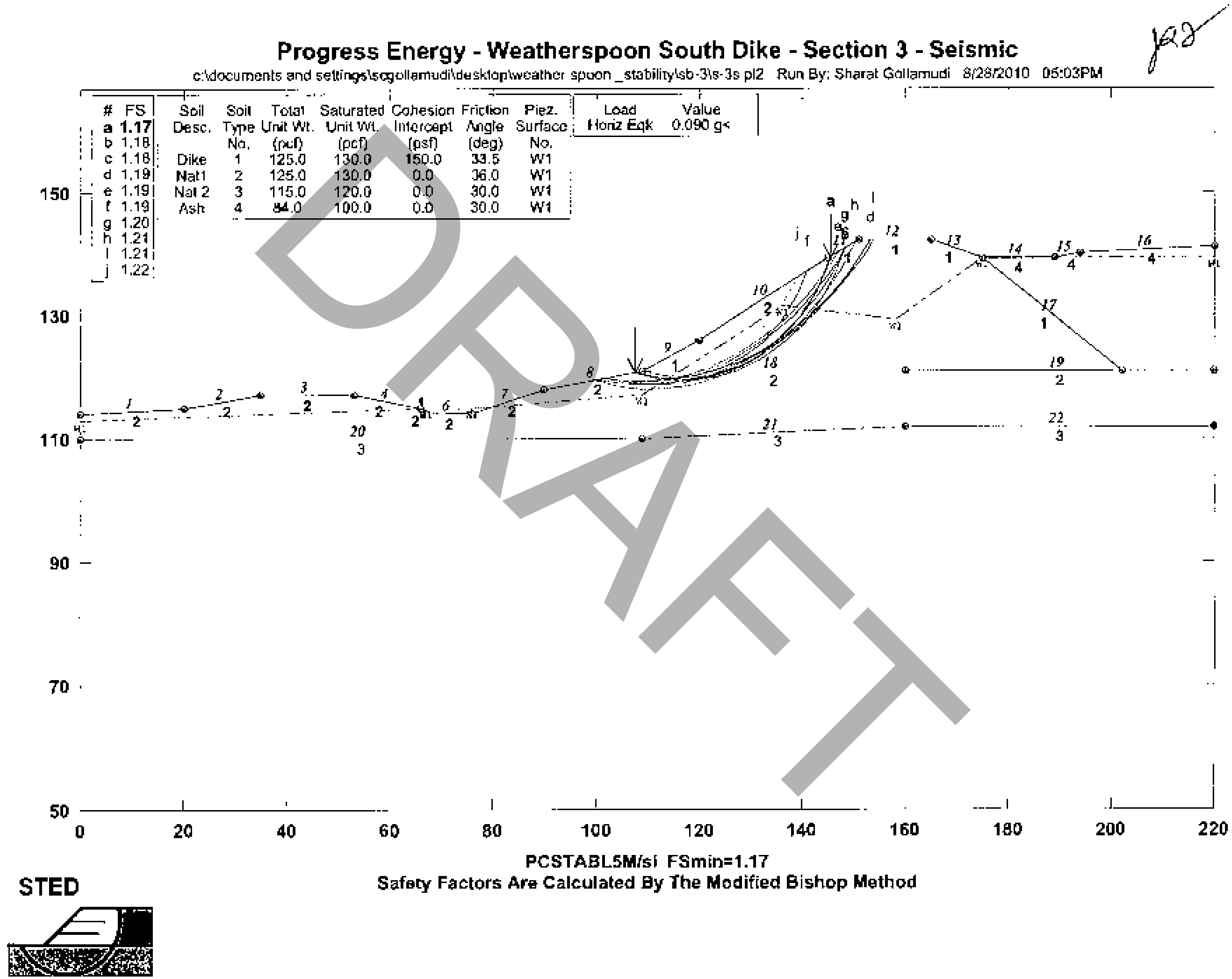
# Progress Energy - Weatherspoon South Dike - Section 3

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-3\s-3.pl2 Run By: Sharat Gollamudi 8/28/2010 05:01PM



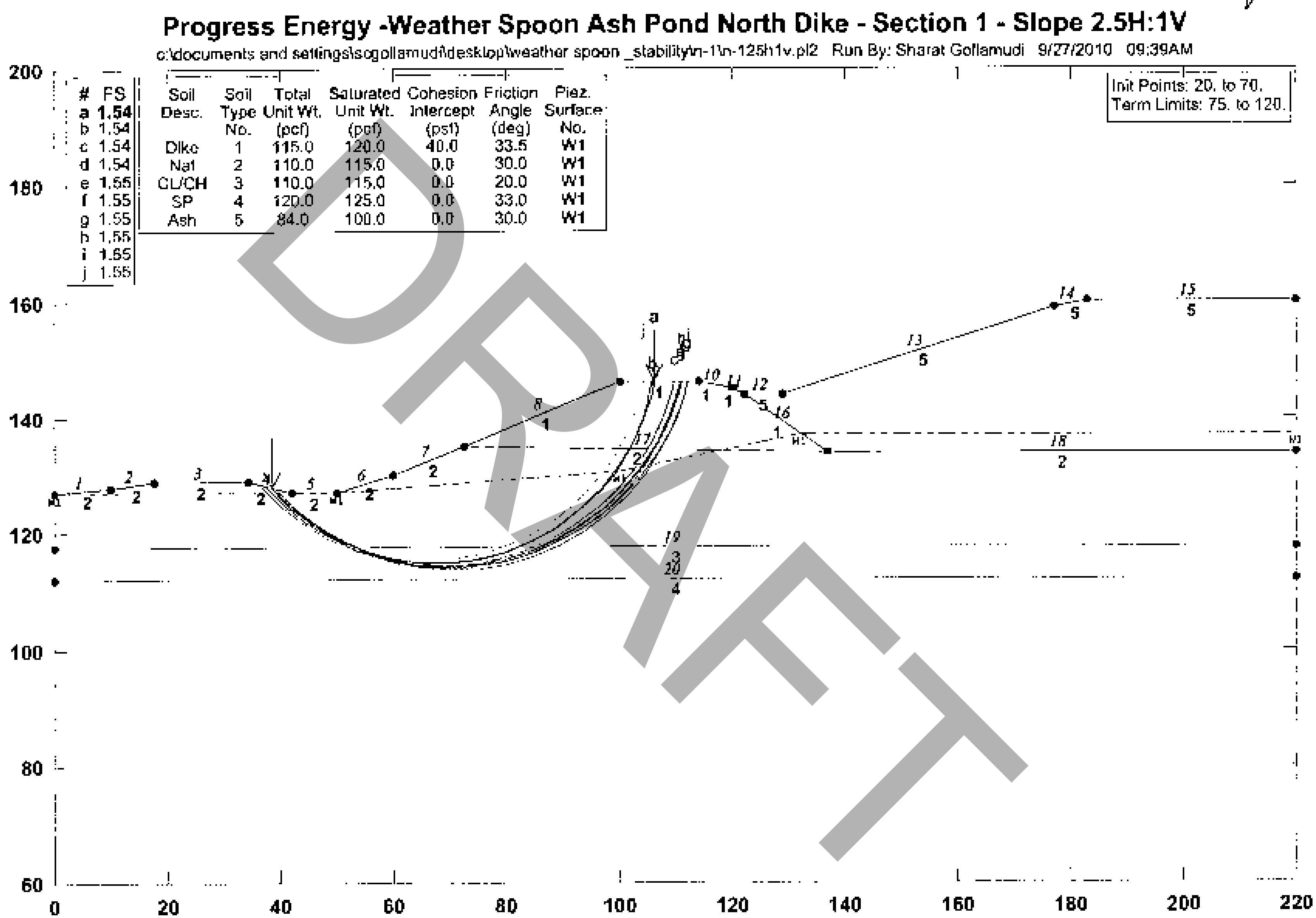

PCSTABL5M/si FSmin=1.43
Safety Factors Are Calculated By The Modified Bishop Method

STED


Progress Energy - Weatherspoon South Dike - Section 3 - Seismic
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-3\s-3s pl2 Run By: Sharat Gollamudi 8/28/2010 05:03PM
# FS
a 1.17
b 1.18
c 1.18
d 1.19
e 1.19
f 1.19
g 1.20
h 1.21
i 1.21
j 1.22
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike 1 125.0 130.0 150.0 33.5 W1
Nat1 2 125.0 130.0 0.0 36.0 W1
Nat 2 3 115.0 120.0 0.0 30.0 W1
Ash 4 84.0 100.0 0.0 30.0 W1
Load Value
Horiz Eqk 0.090 g<
150
130
110
90
70
50
0 20 40 60 80 100 120 140 160 180 200 220
PCSTABL5M/si FSmin=1.17
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

# APPENDIX D 3

## Stability Analysis of Improvements



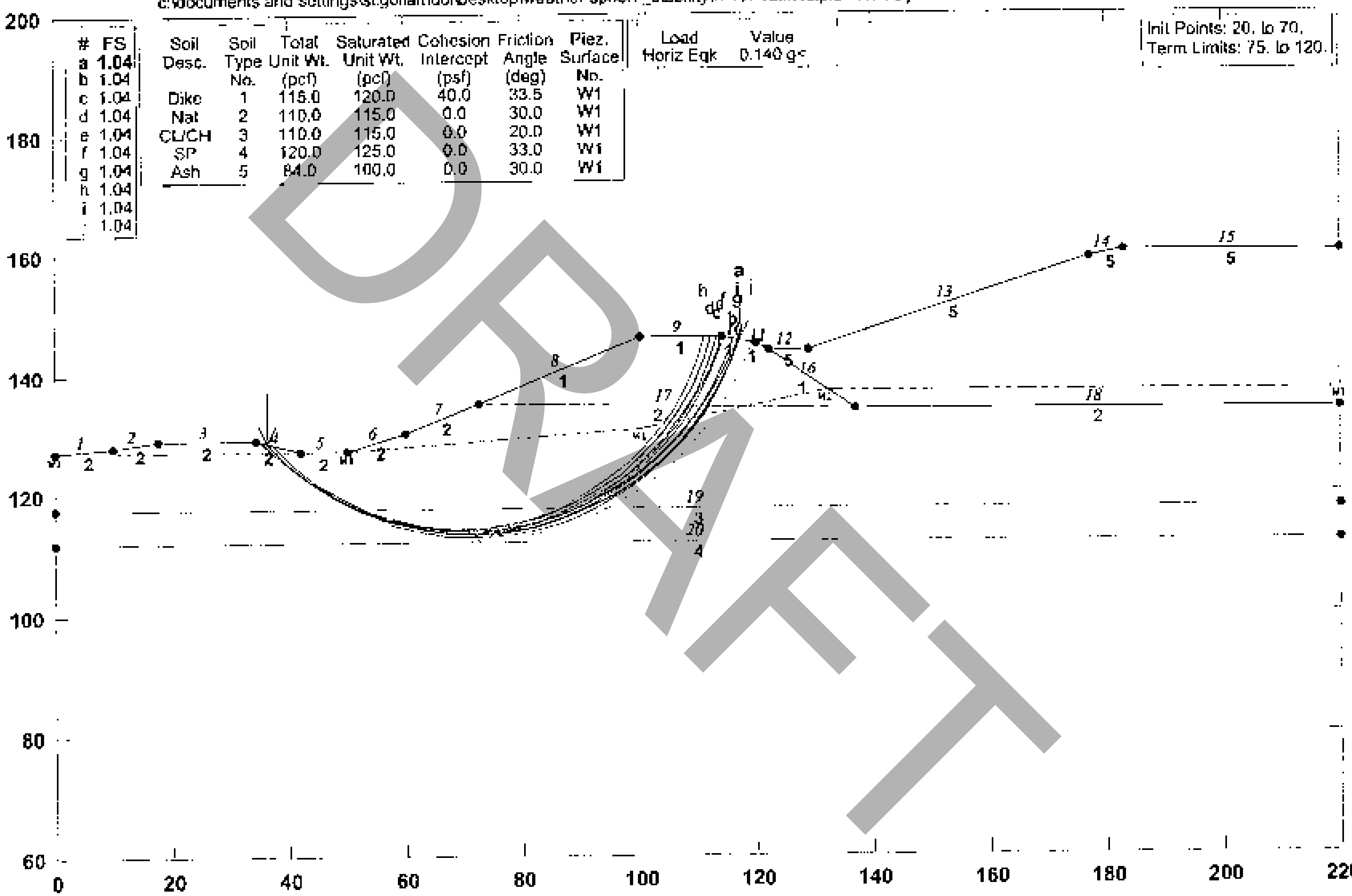

PCSTABL5M/si FSmin=1.54

Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy -Weather Spoon Ash Pond-North Dike_Sec 1 Slope 2.5H:1V-Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-1\n-125h1s.pl2 Run By: Sharat Gollamudi 9/27/2010 01:48PM



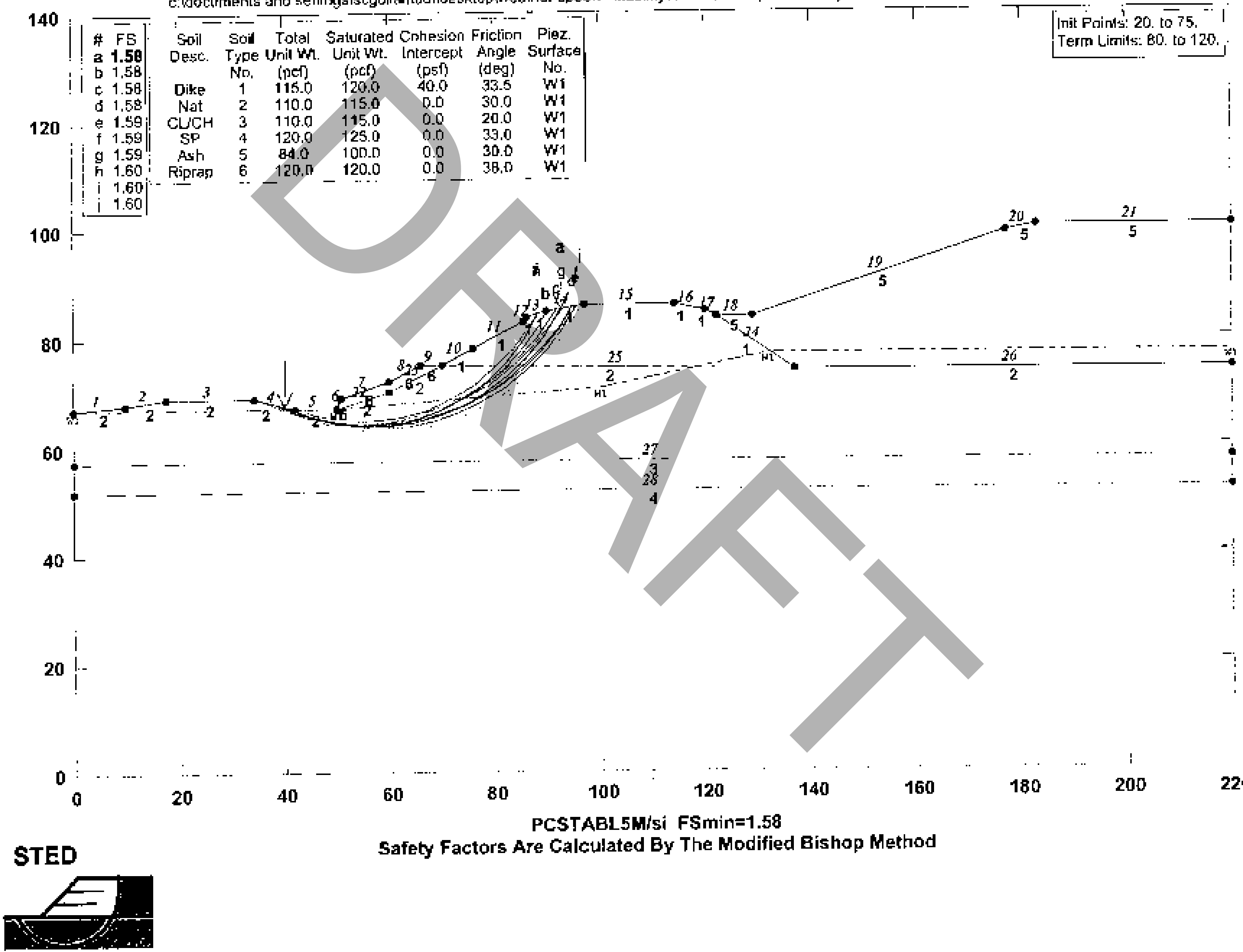

PCSTABL5M/si FSmin=1.04

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy -Weather Spoon Ash Pond Section N1 - 2' Thick Riprap at Toe

c:\documents and settings\scgollamudi\desktop\weather spoon stability\n-1\n-1berm.pl2 Run By: Sharat Gollamudi 9/24/2010 02:08PM

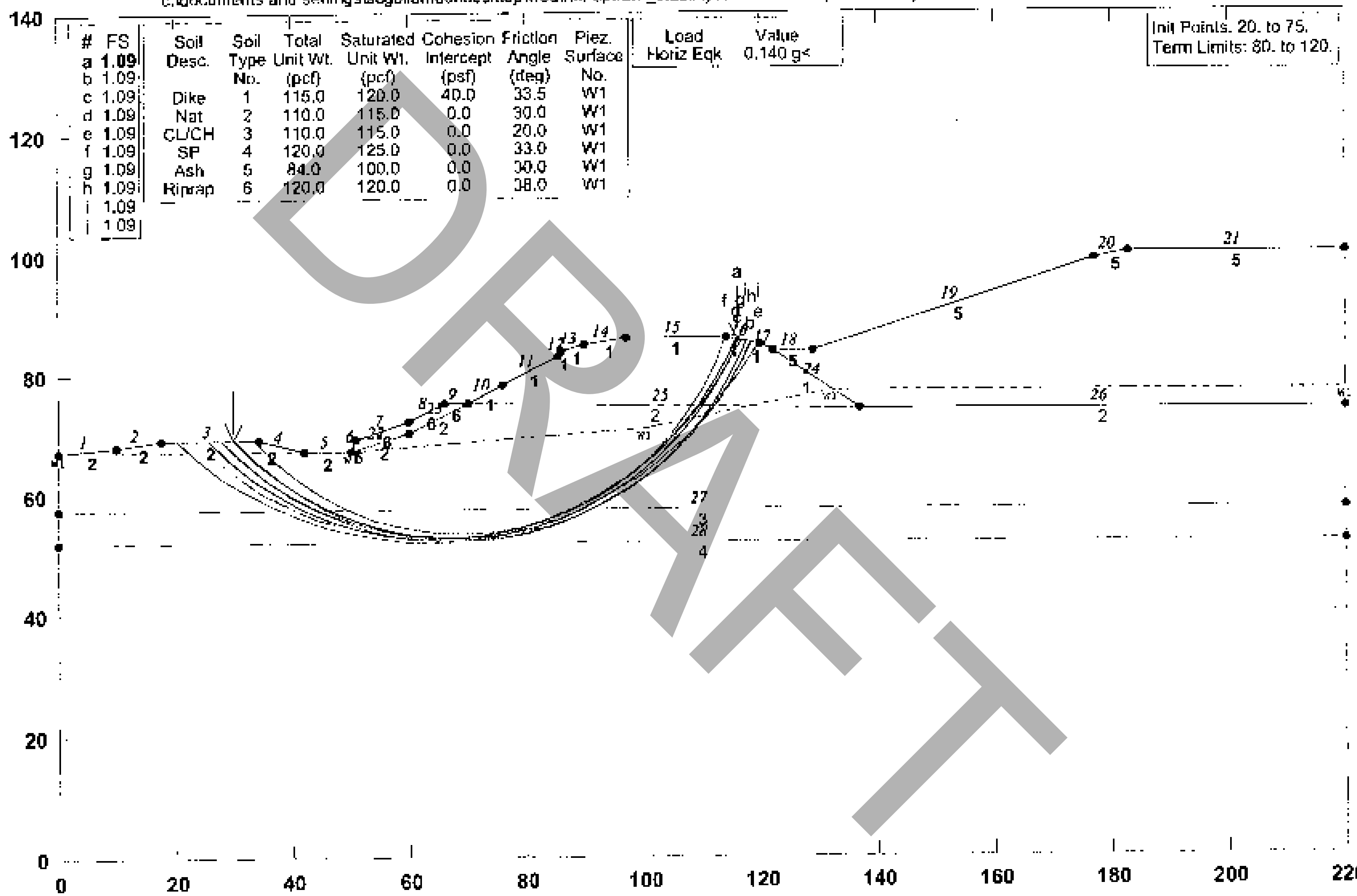



PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

**Progress Energy -Weather Spoon Ash Pond Sec#N1 - 2' Thick Riprap at Toe -Seismic**

c:\documents and settings\sogollamudi\desktop\weather spoon _stability\n-1\n-1berms.pl2  Run By: Sharat Gollamudi  9/27/2010  01:54PM




PCSTABL5M/si FSmin=1.09

Safety Factors Are Calculated By The Modified Bishop Method

STED

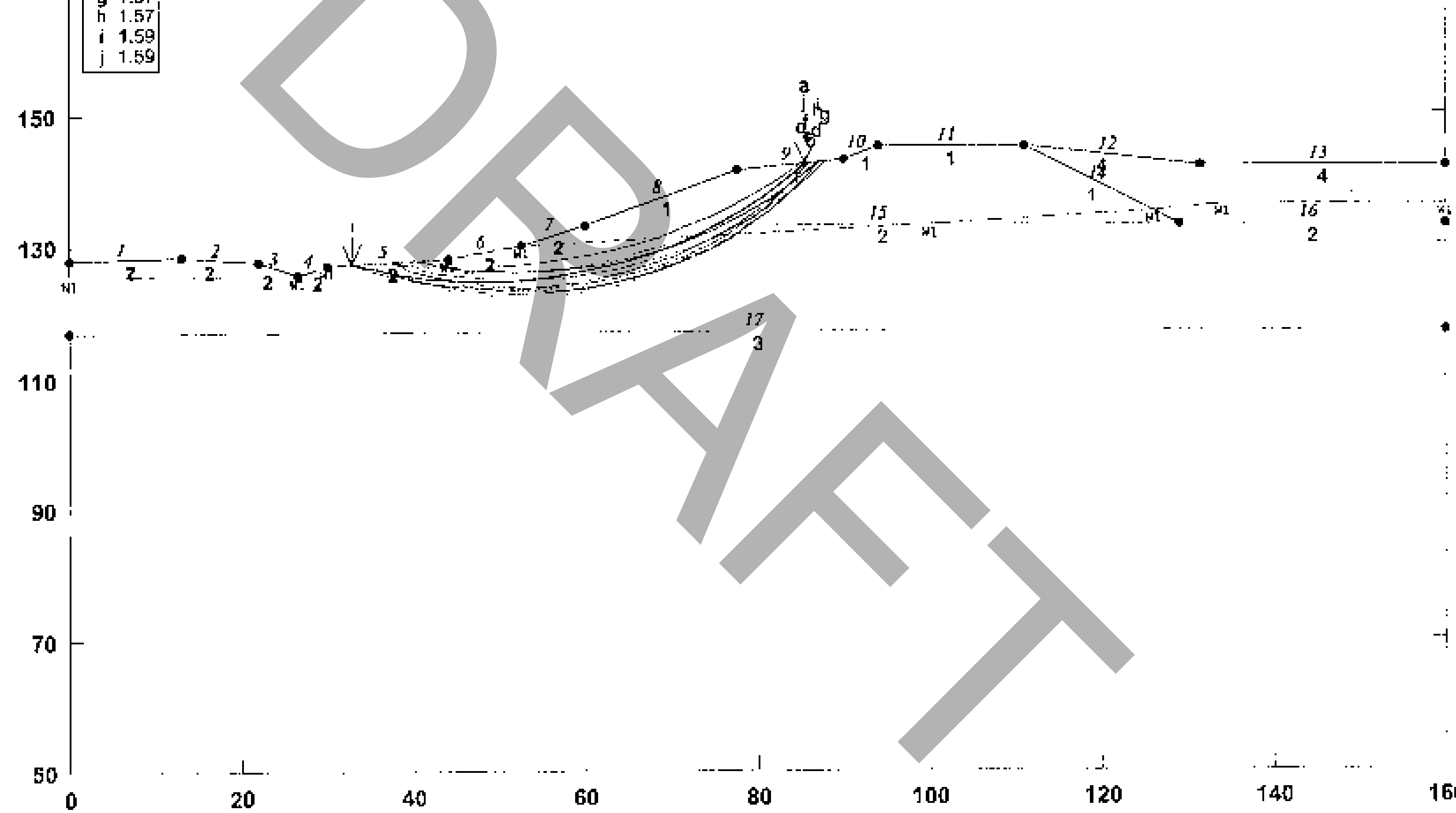
# Progress Energy - Weatherspoon Plant North Dike - Section 2 - Slope 2.5H:1V

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-2\n-2fla.pl2  Run By: Sharat Gollamudi  9/27/2010  09:04AM

| # | FS |
|---|---|
| a | **1.54** |
| b | 1.56 |
| c | 1.56 |
| d | 1.57 |
| e | 1.57 |
| f | 1.57 |
| g | 1.57 |
| h | 1.57 |
| i | 1.59 |
| j | 1.59 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

Init Points: 10. to 80.
Term Limits: 85. to 120.




PCSTABL5M/si FSmin=1.54
Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Plant Sec#N-2 - Slope 2.5H:1V- Seismic

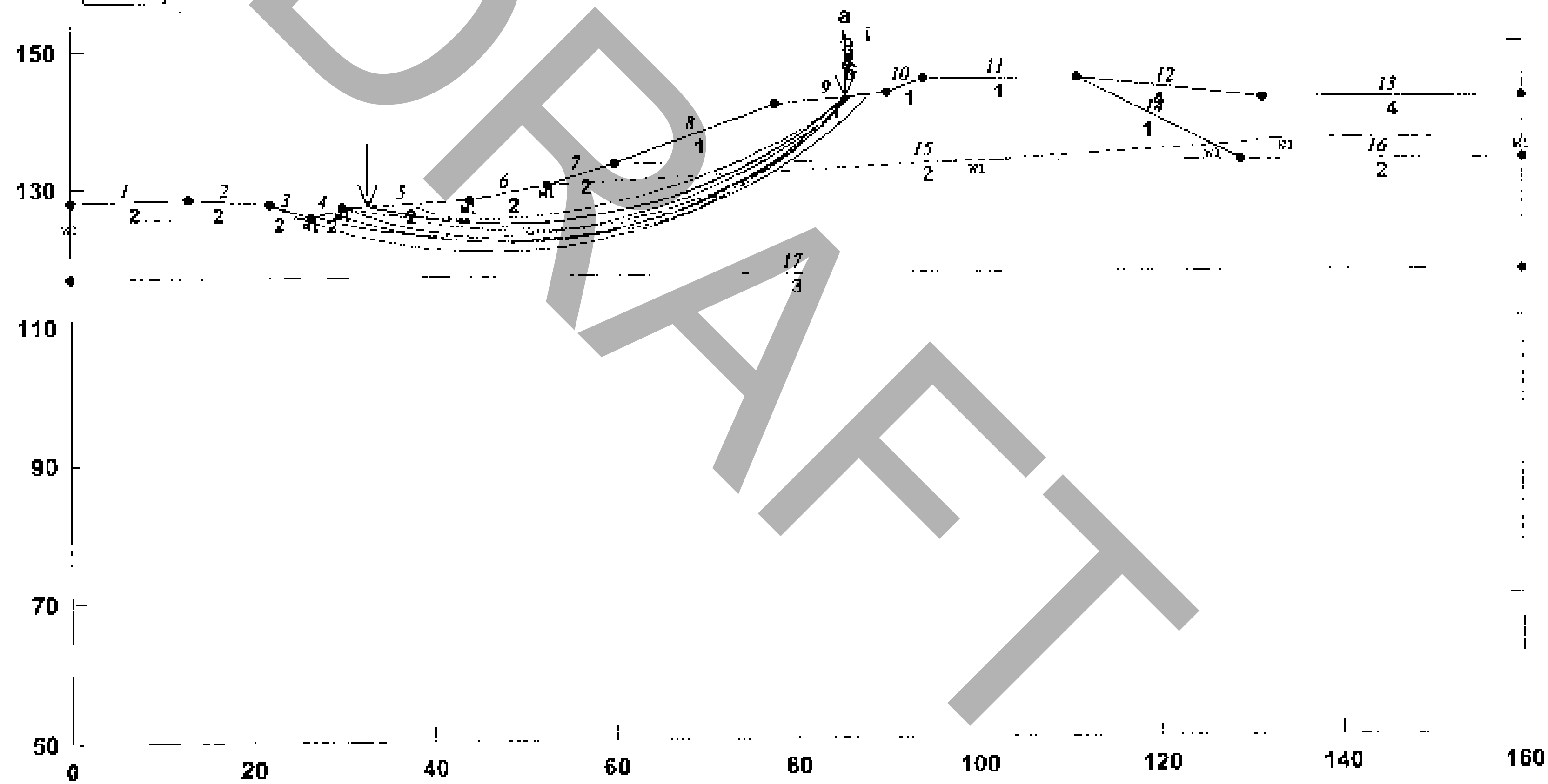
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-2\n-20a-s.pl2 Run By: Sharat Gollamudi 9/27/2010 01:57PM

| # | FS |
|---|---|
| a | 1.04 |
| b | 1.04 |
| c | 1.05 |
| d | 1.05 |
| e | 1.06 |
| f | 1.06 |
| g | 1.07 |
| h | 1.07 |
| i | 1.07 |
| j | 1.07 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |

Init Points: 10. to 80.
Term Limits: 85. to 120.




PCSTABL5M/si FSmin=1.04
Safety Factors Are Calculated By The Modified Bishop Method

STED

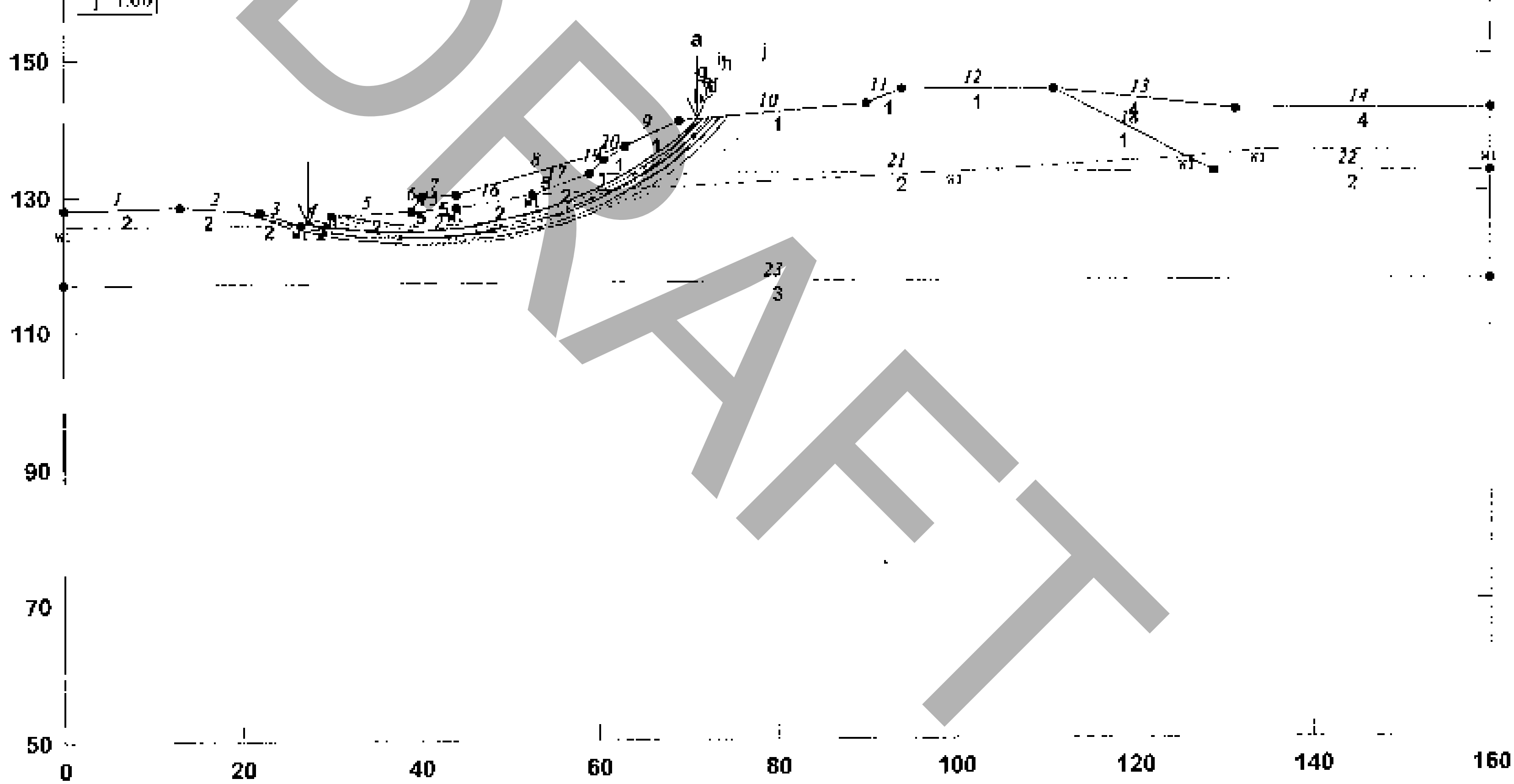
# Progress Energy - Weatherspoon Plant North Dike - Section 2 -Riprap

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-2\n-2ripra.pl2 Run By: Sharat Gollamudi 9/27/2010 09:07AM

| # | FS |
|---|---|
| a | **1.62** |
| b | 1.63 |
| c | 1.63 |
| d | 1.64 |
| e | 1.64 |
| f | 1.65 |
| g | 1.66 |
| h | 1.66 |
| i | 1.66 |
| j | 1.66 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

Init Points: 10. to 60.
Term Limits: 65. to 120.




PCSTABL5M/si FSmin=1.62
Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon Plant North Dike - Section 2 -Riprap-Seismic

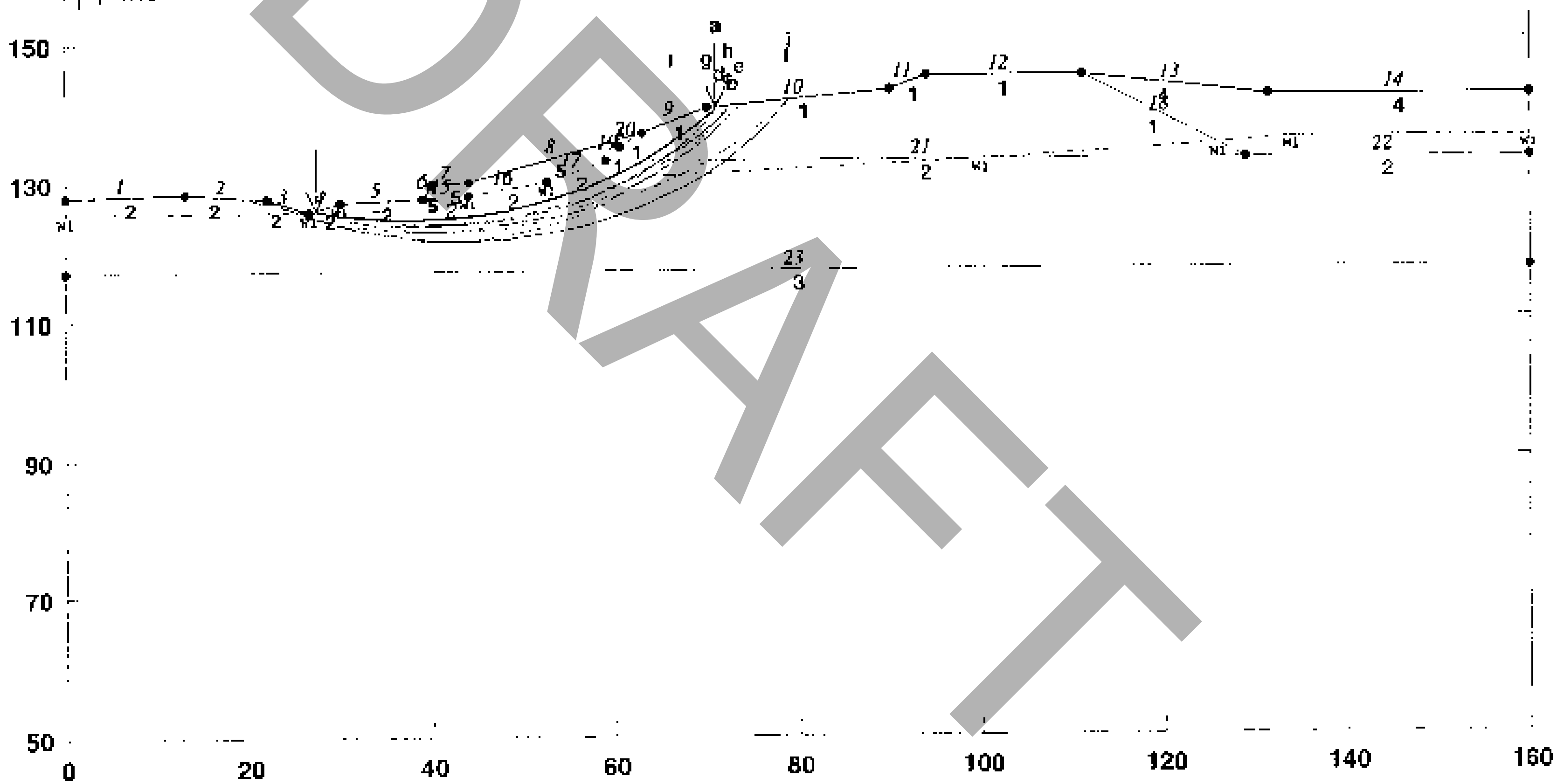
c:\documents and settings\sgollamudi\desktop\weather spoon _stability\n-2\n-2riprs.pl2 Run By: Sharat Gollamudi 9/27/2010 02:39PM

| # | FS |
|---|---|
| a | 1.09 |
| b | 1.10 |
| c | 1.10 |
| d | 1.10 |
| e | 1.11 |
| f | 1.12 |
| g | 1.13 |
| h | 1.13 |
| i | 1.13 |
| j | 1.13 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |

Init Points: 10. to 60.
Term Limits: 65. to 120.




PCSTABL5M/si FSmin=1.09

Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon Plant North Dike - Section 2 - Platipus

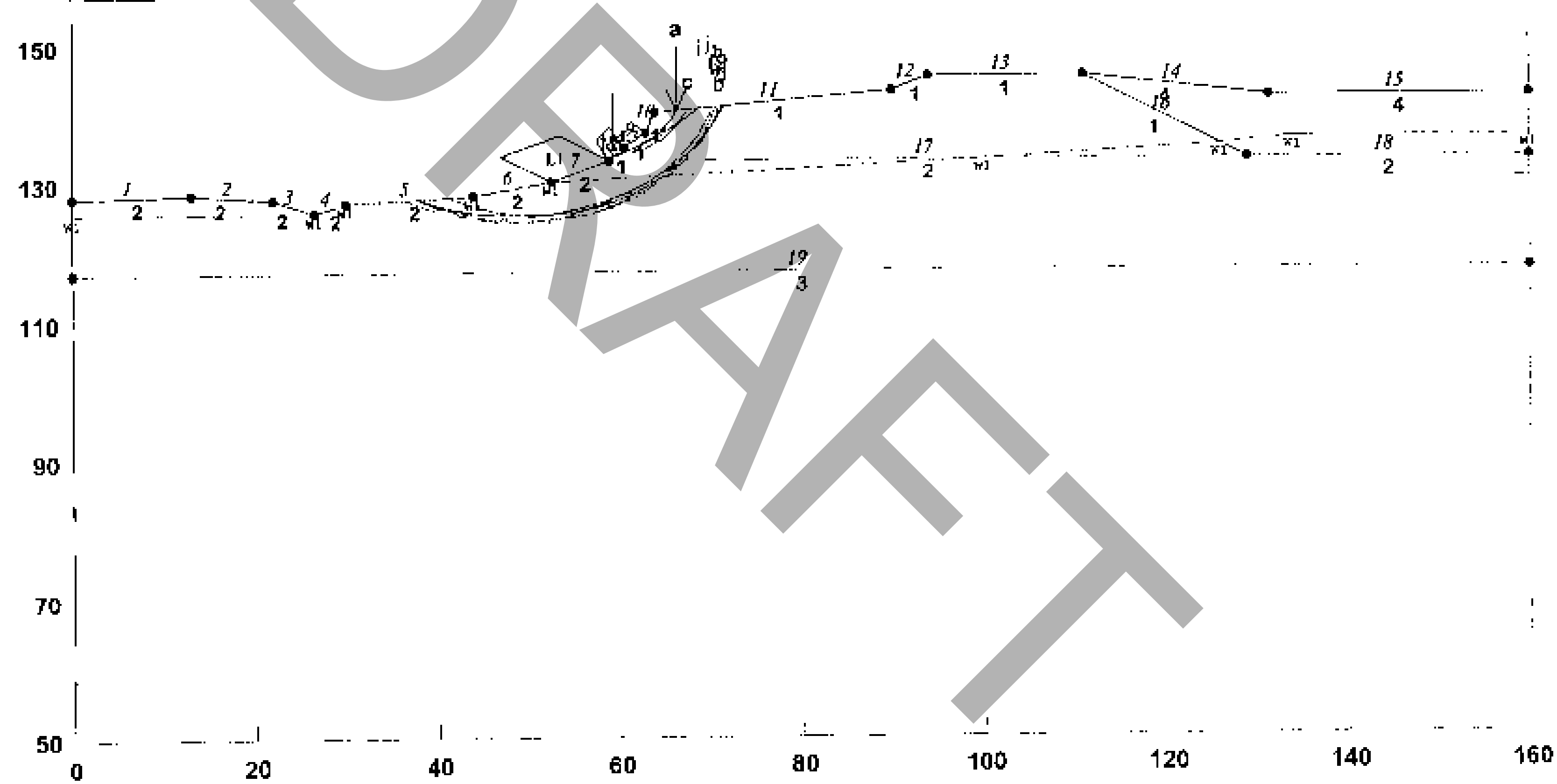
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-2\n-2-mod.pl2  Run By: Sharat Gollamudi  9/21/2010  04:13PM

| # | FS |
|---|---|
| a | **1.53** |
| b | 1.55 |
| c | 1.56 |
| d | 1.56 |
| e | 1.56 |
| f | 1.56 |
| g | 1.56 |
| h | 1.56 |
| i | 1.56 |
| j | 1.56 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| L1 | 250 psf |
| L2 | 100 psf |
| L3 | 50 psf |

Init Points: 30. to 62.
Term Limits: 66. to 100.




PCSTABL5M/si FSmin=1.53
Safety Factors Are Calculated By The Modified Bishop Method

STED

JAY

# Progress Energy - Weatherspoon Plant North Dike - Section 2 - Platipus-Seismi

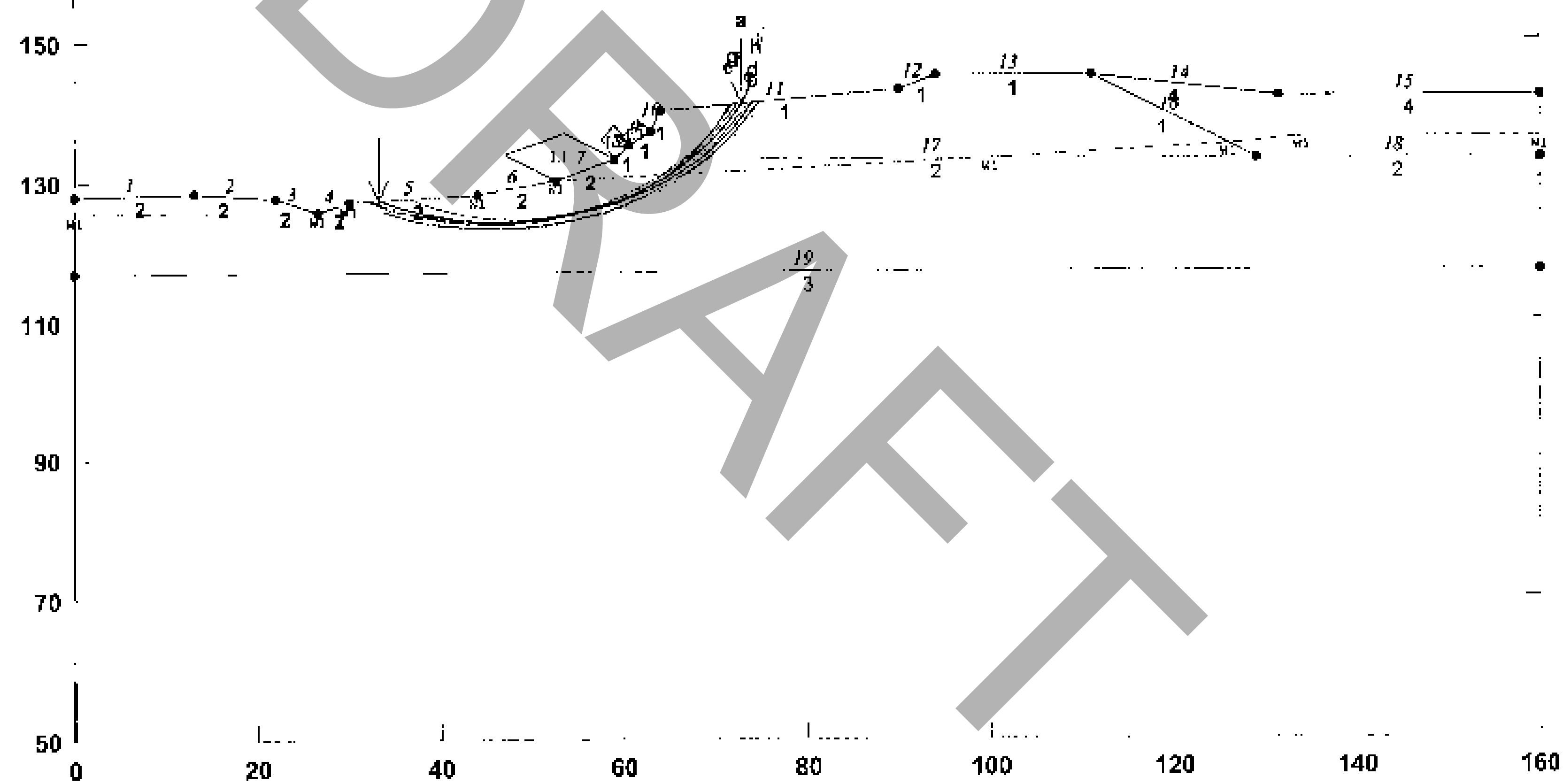
c:\documents and settings\scgollamudi\desktop\weather spoon_stability\n-2\n-2-mods.pl2 Run By: Sharat Gollamudi 9/27/2010 02:13PM

| # | FS |
|---|---|
| a | 1.09 |
| b | 1.09 |
| c | 1.09 |
| d | 1.09 |
| e | 1.09 |
| f | 1.09 |
| g | 1.10 |
| h | 1.10 |
| i | 1.10 |
| j | 1.10 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 40.0 | 33.5 | W1 |
| Nat1 | 2 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |
| Nat2 | 3 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| L1 | 250 psf |
| L2 | 100 psf |
| L3 | 50 psf |
| Horiz Eqk | 0.140 g< |

Init Points: 30. to 62.
Term Limits: 66. to 100.



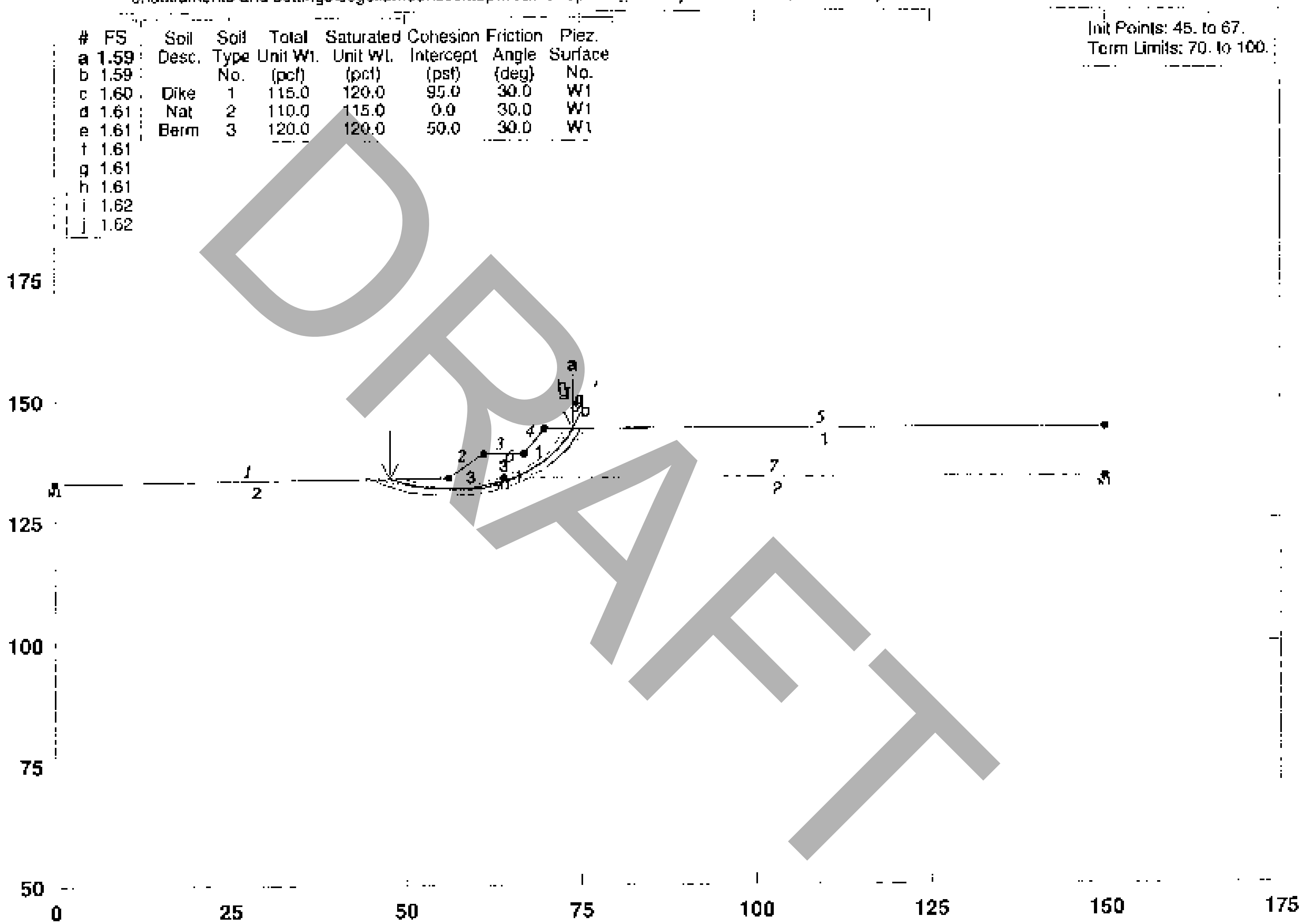

PCSTABL5M/si FSmin=1.09

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Dike- Section N-10 - 60-deg Slope - Berm

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-a\na-berm.pl2 Run By: Sharat Gollamudi 9/27/2010 03:27PM




| # | FS |
|---|---|
| a | **1.59** |
| b | 1.59 |
| c | 1.60 |
| d | 1.61 |
| e | 1.61 |
| f | 1.61 |
| g | 1.61 |
| h | 1.61 |
| i | 1.62 |
| j | 1.62 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 95.0 | 30.0 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Berm | 3 | 120.0 | 120.0 | 50.0 | 30.0 | W1 |

**PCSTABL5M/si FSmin=1.59**

**Safety Factors Are Calculated By The Modified Bishop Method**

**STED**

# Progress Energy - Weatherspoon Dike- Sec#N-10- 60-deg Slope - Berm-Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\n-a\na-berms.pl2 Run By: Sharat Gollamudi 9/27/2010 03:28PM

| # | FS |
|---|---|
| a | **1.15** |
| b | 1.16 |
| c | 1.16 |
| d | 1.16 |
| e | 1.17 |
| f | 1.17 |
| g | 1.18 |
| h | 1.18 |
| i | 1.18 |
| j | 1.19 |

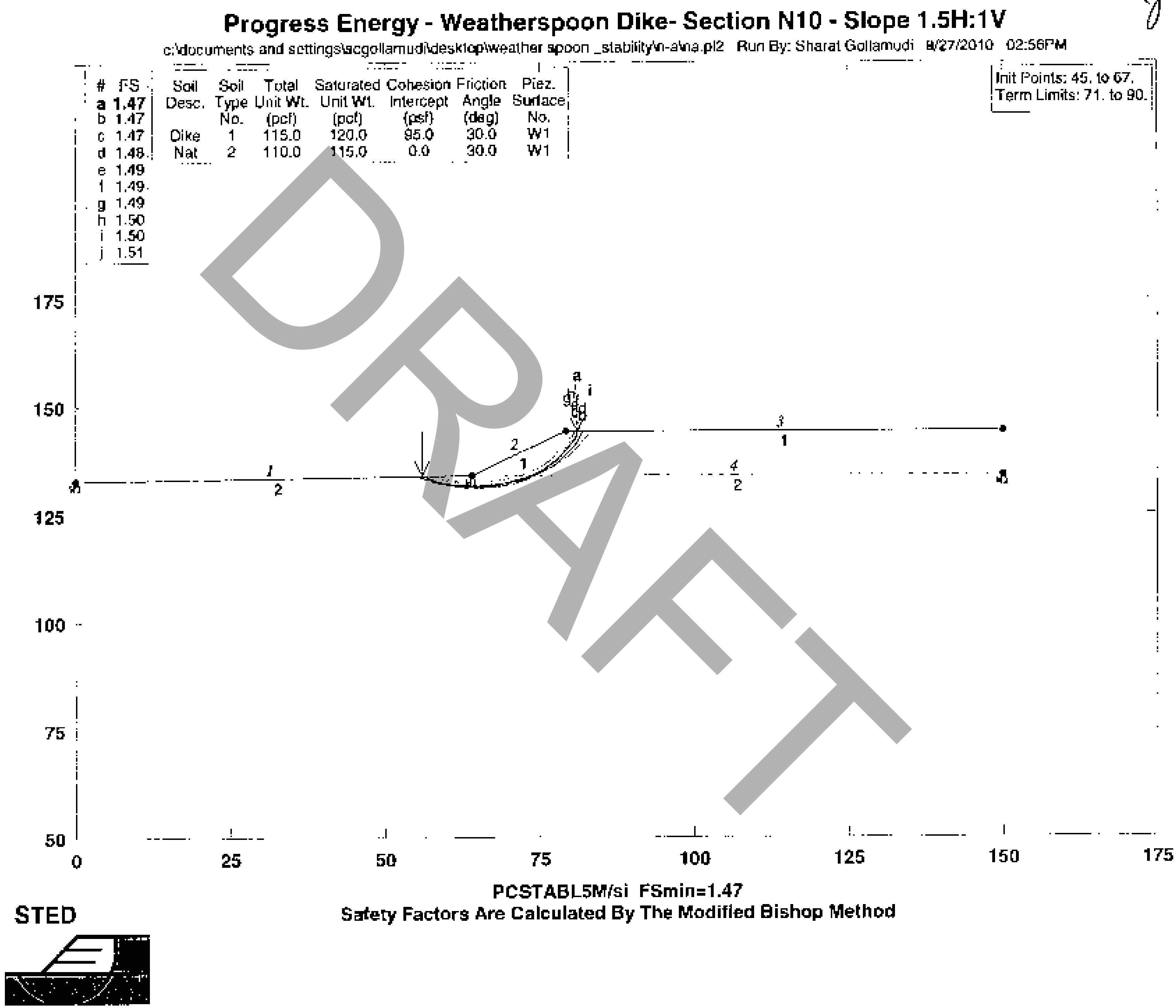
| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 95.0 | 30.0 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |
| Berm | 3 | 120.0 | 120.0 | 50.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |

Init Points: 45. to 67.
Term Limits: 70. to 100.


PCSTABL5M/si FSmin=1.15
Safety Factors Are Calculated By The Modified Bishop Method

STED


Progress Energy - Weatherspoon Dike- Section N10 - Slope 1.5H:1V
c:\documents and settings\acgollamudi\desktop\weather spoon _stability\n-a\na.pl2 Run By: Sharat Gollamudi 8/27/2010 02:56PM
# FS
a 1.47
b 1.47
c 1.47
d 1.48
e 1.49
f 1.49
g 1.49
h 1.50
i 1.50
j 1.51
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike | 1 | 115.0 | 120.0 | 95.0 | 30.0 | W1
Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1
Init Points: 45. to 67.
Term Limits: 71. to 90.
175
150
125
100
75
50
0
25
50
75
100
125
150
175
PCSTABL5M/si FSmin=1.47
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

# Progress Energy - Weatherspoon Dike- Section N10 - Slope 1.5H:1V-Seismic

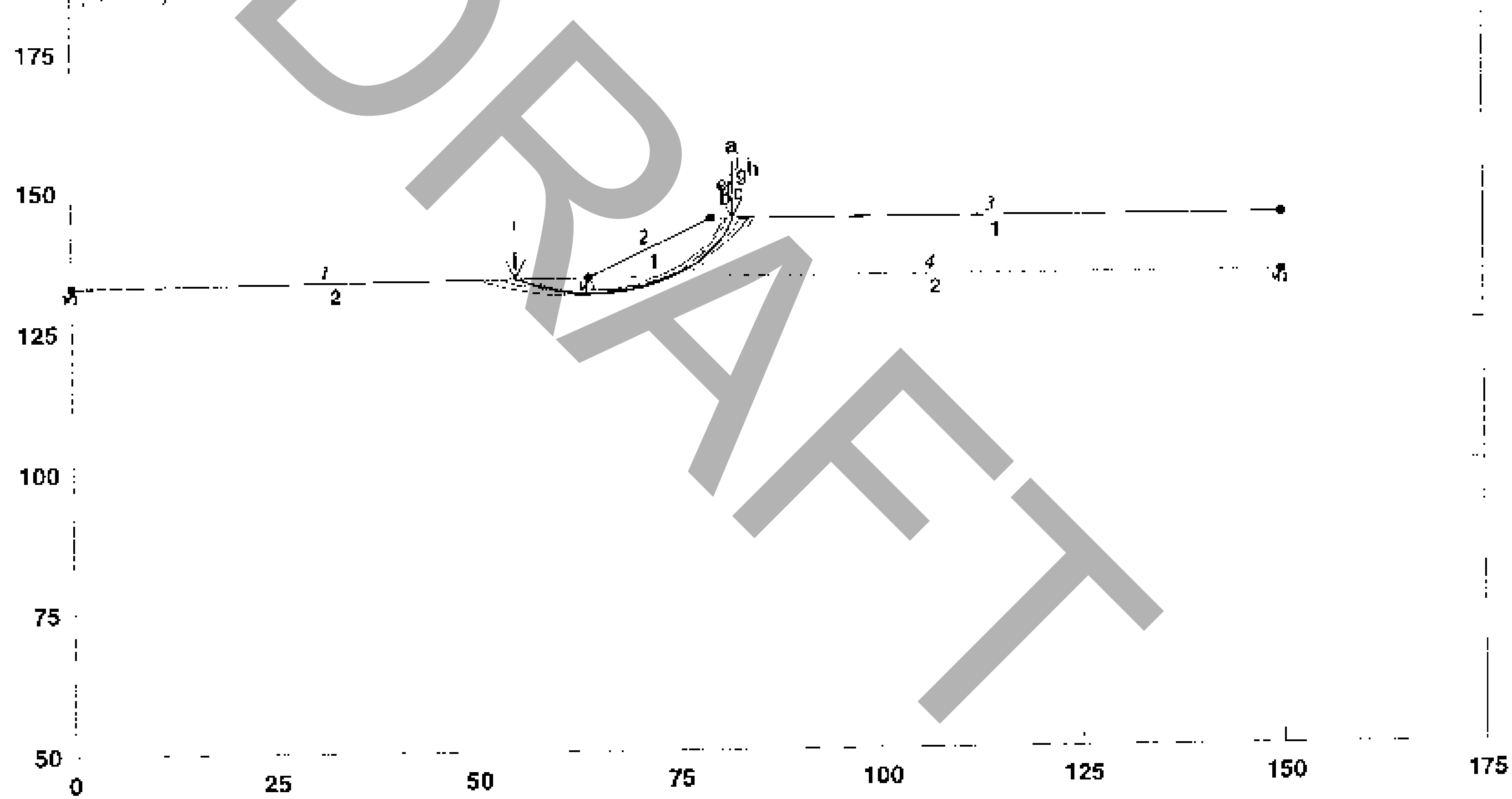
c:\documents and settings\scgollamudi\desktop\weather spoon_stability\n-a\nas.pl2 Run By: Sharat Gollamudi 9/27/2010 02:57PM

| # | FS |
|---|---|
| a | 1.09 |
| b | 1.09 |
| c | 1.09 |
| d | 1.10 |
| e | 1.10 |
| f | 1.10 |
| g | 1.10 |
| h | 1.10 |
| i | 1.10 |
| j | 1.11 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 115.0 | 120.0 | 95.0 | 30.0 | W1 |
| Nat | 2 | 110.0 | 115.0 | 0.0 | 30.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.140 g< |

Init Points: 45. to 67.
Term Limits: 71. to 90.




PCSTABL5M/si FSmin=1.09
Safety Factors Are Calculated By The Modified Bishop Method

STED

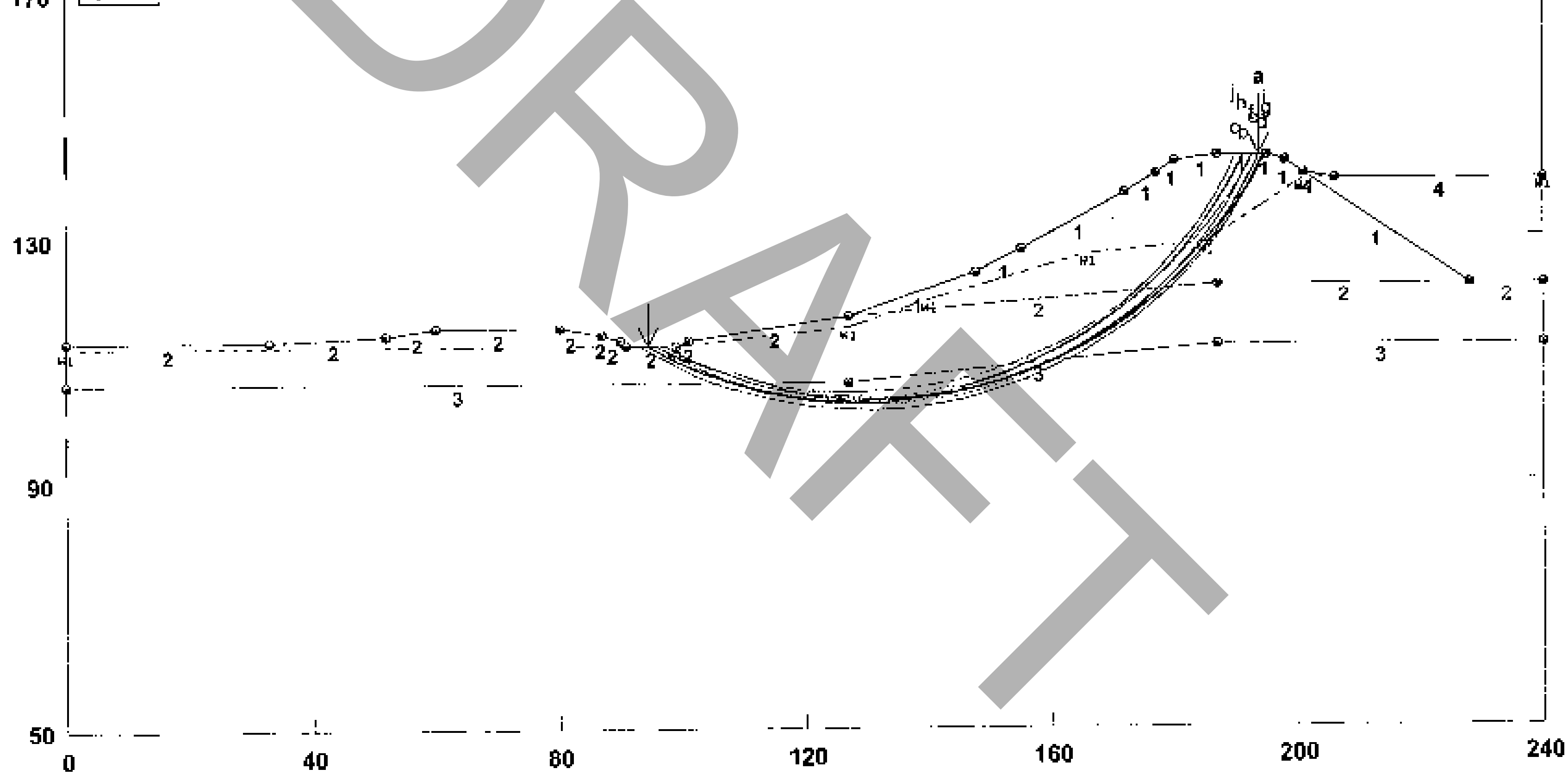
# Progress Energy -Weatherspoon Ash Pond- South_Sec#2_Found_Lower h2o by 2'

c:\documents and settings\scgollamudi\desktop\weather spoon_stability\sb-2\s-2cfoun.pl2 Run By: Sharat Gollamudi 8/30/2010 09:21AM

| # | FS |
|---|---|
| a | 1.46 |
| b | 1.46 |
| c | 1.46 |
| d | 1.46 |
| e | 1.46 |
| f | 1.46 |
| g | 1.46 |
| h | 1.47 |
| i | 1.47 |
| j | 1.47 |

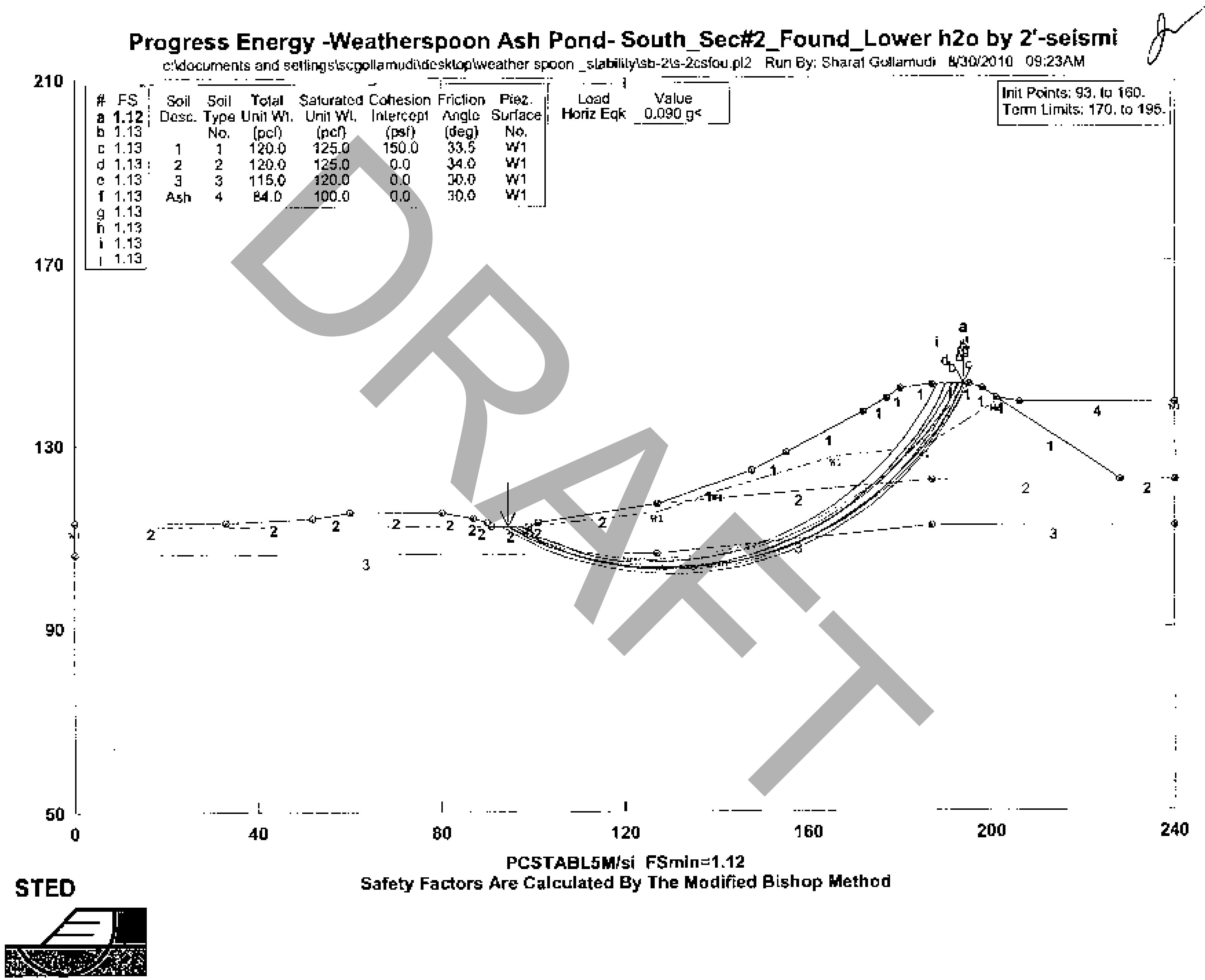
| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

Init Points: 93. to 160.
Term Limits: 170. to 195.



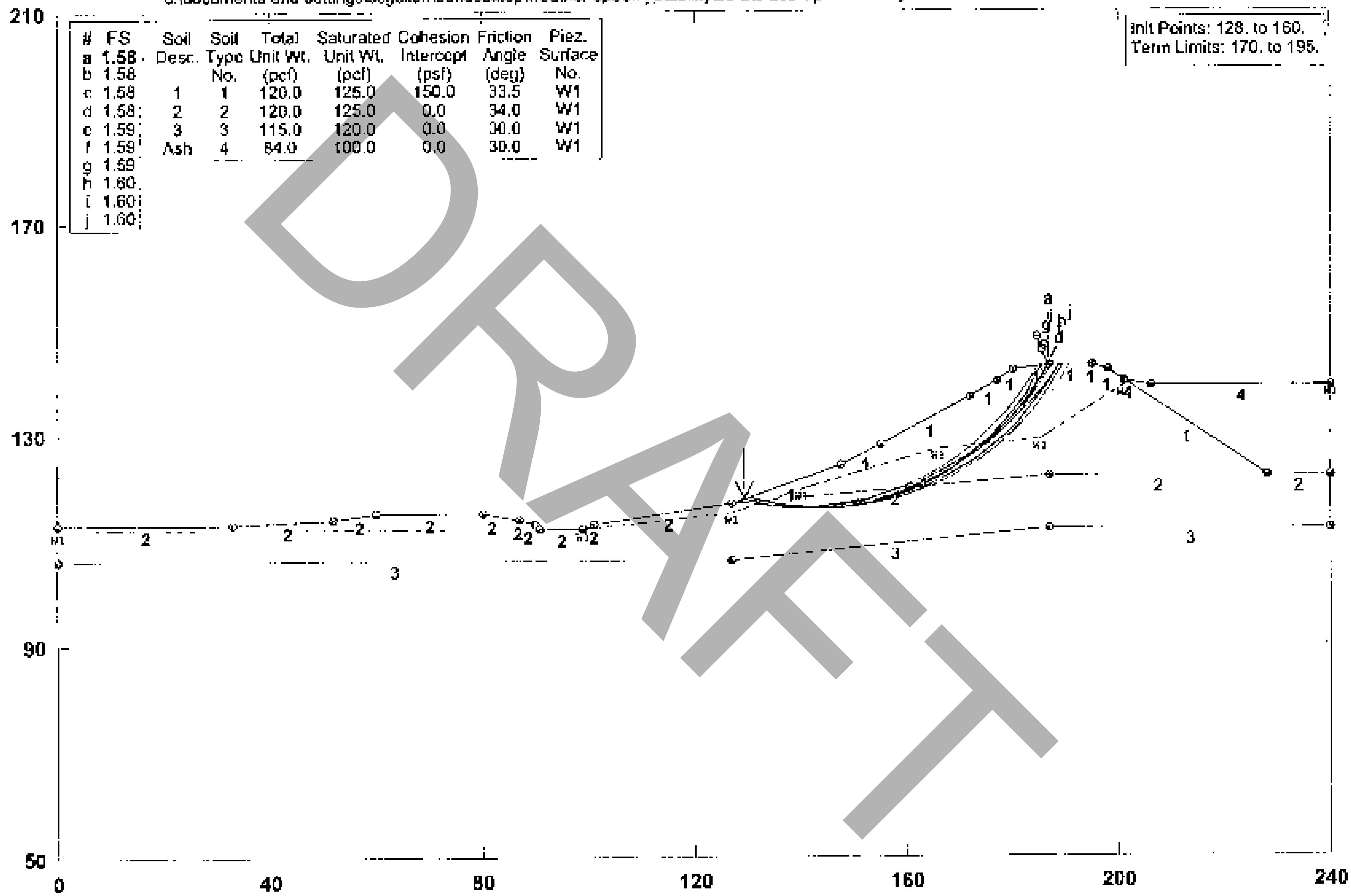

PCSTABL5M/si FSmin=1.46
Safety Factors Are Calculated By The Modified Bishop Method

STED


Progress Energy -Weatherspoon Ash Pond- South_Sec#2_Found_Lower h2o by 2'-seismi
c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2csfou.pl2 Run By: Sharat Gollamudi 8/30/2010 09:23AM
# FS
a 1.12
b 1.13
c 1.13
d 1.13
e 1.13
f 1.13
g 1.13
h 1.13
i 1.13
j 1.13
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1
2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1
3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1
Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1
Load Horiz Eqk
Value 0.090 g<
Init Points: 93. to 160.
Term Limits: 170. to 195.
210
170
130
90
50
0
40
80
120
160
200
240
PCSTABL5M/si FSmin=1.12
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

**Progress Energy -Weatherspoon Ash Pond- South_Sec#2_Dike_Lower h2o by 2'**

c:\documents and settings\scgollamudi\desktop\weather spoon , stability\sb-2\s-2cdik.pl2 Run By: Sharat Gollamudi 8/30/2010 09:20AM

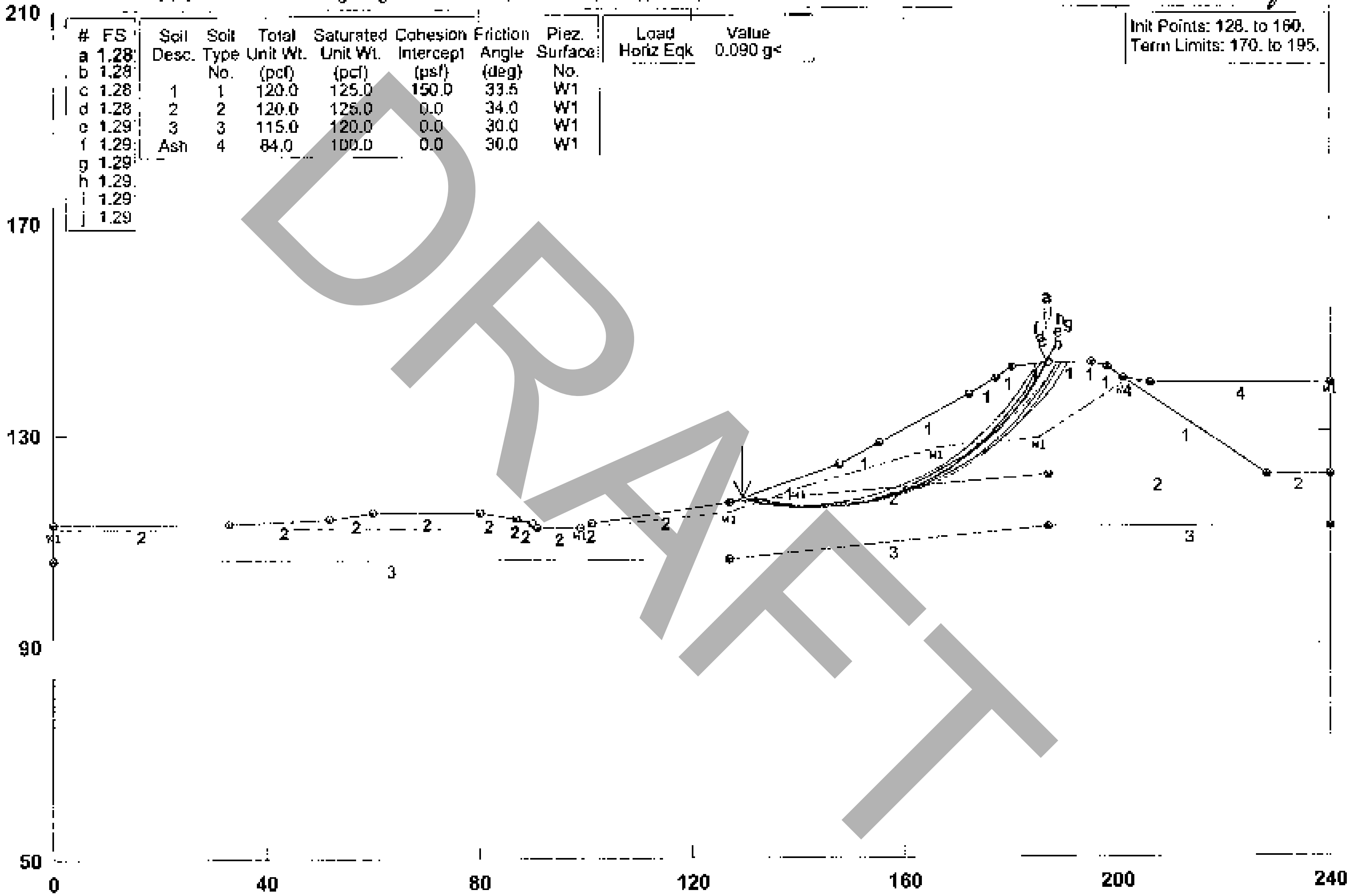



**PCSTABL5M/si FSmin=1.58**
**Safety Factors Are Calculated By The Modified Bishop Method**

**STED**

**Progress Energy -Weatherspoon Ash Pond- South_Sec#2_Dike_Lower h2o by 2' -seismi**

c:\documents and settings\scgollamudi\desktop\weather spoon_stability\sb-2\s-2csdik.pl2 Run By: Sharat Gollamudi 6/30/2010 09:21AM




| # | FS |
|---|---|
| a | 1.28 |
| b | 1.28 |
| c | 1.28 |
| d | 1.28 |
| e | 1.29 |
| f | 1.29 |
| g | 1.29 |
| h | 1.29 |
| i | 1.29 |
| j | 1.29 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

**PCSTABL5M/si FSmin=1.28**

**Safety Factors Are Calculated By The Modified Bishop Method**

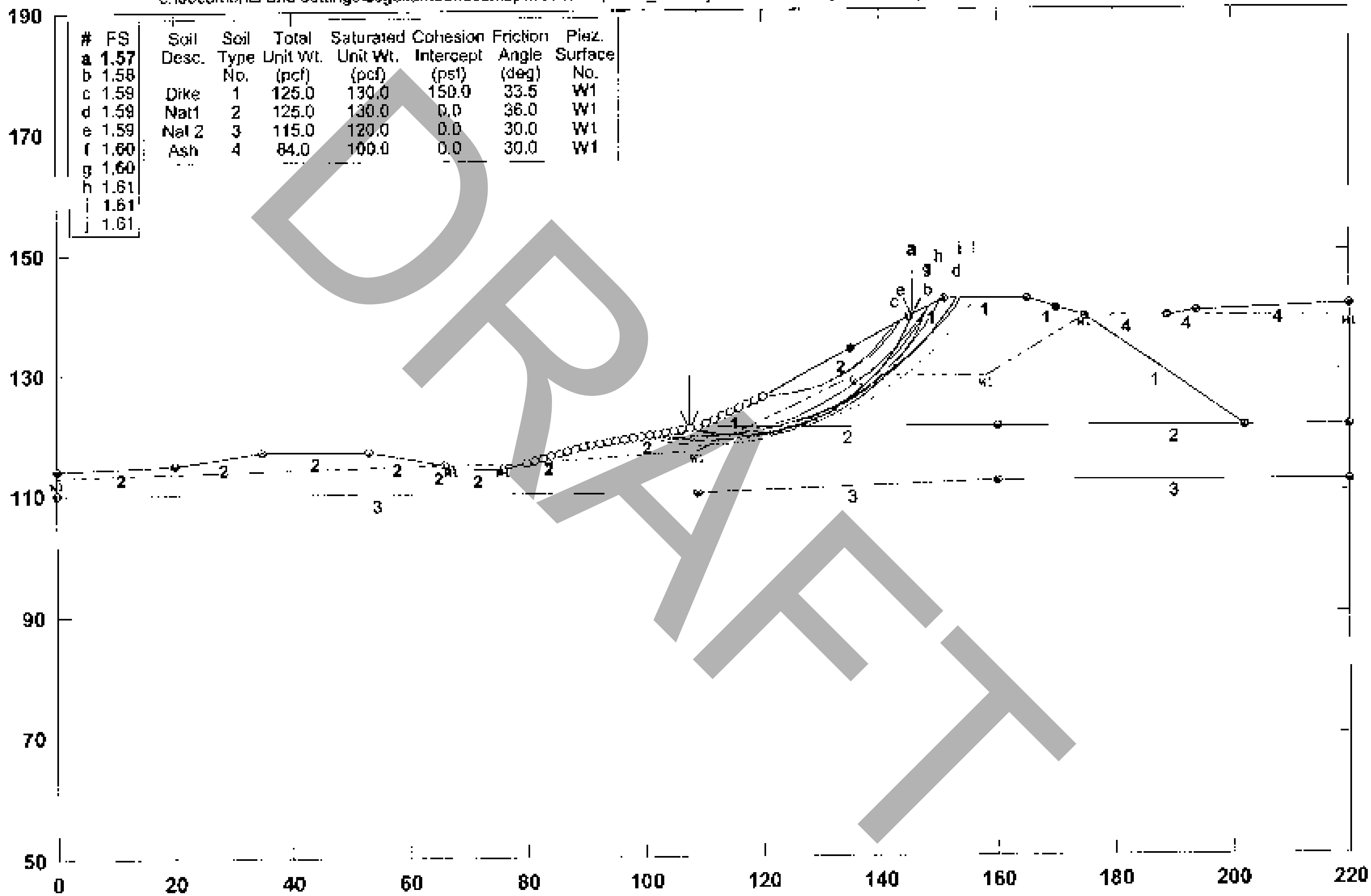
**STED**

## Progress Energy - Weatherspoon South Dike _Sec#3 _lower_H2o by 2'

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-3\s-3 -mod.pl2 Run By: Sharat Gollamudi 8/29/2010 05:39PM

| # | FS |
|---|---|
| a | 1.57 |
| b | 1.58 |
| c | 1.59 |
| d | 1.59 |
| e | 1.59 |
| f | 1.60 |
| g | 1.60 |
| h | 1.61 |
| i | 1.61 |
| j | 1.61 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike | 1 | 125.0 | 130.0 | 150.0 | 33.5 | W1 |
| Nat1 | 2 | 125.0 | 130.0 | 0.0 | 36.0 | W1 |
| Nat 2 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |

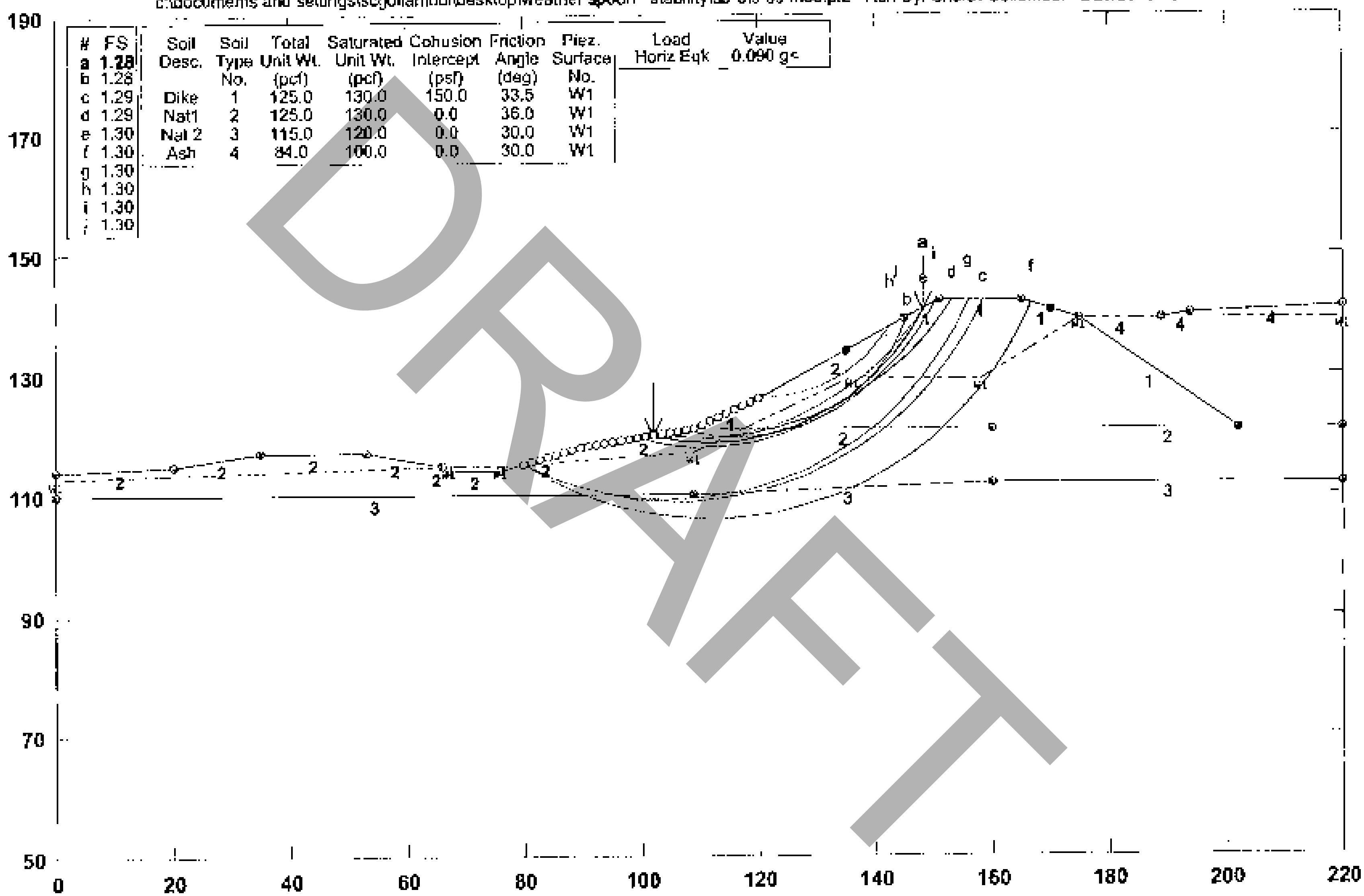



PCSTABL5M/si FSmin=1.57
Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon South Dike _Sec#3 _lower_H2o by 2'-Seism

c:\documents and settings\scgollamudi\desktop\weather spoon stability\sb-3\s-3s-mod.pl2 Run By: Sharat Gollamudi 8/29/2010 05:40PM




PCSTABL5M/si FSmin=1.28

Safety Factors Are Calculated By The Modified Bishop Method

STED

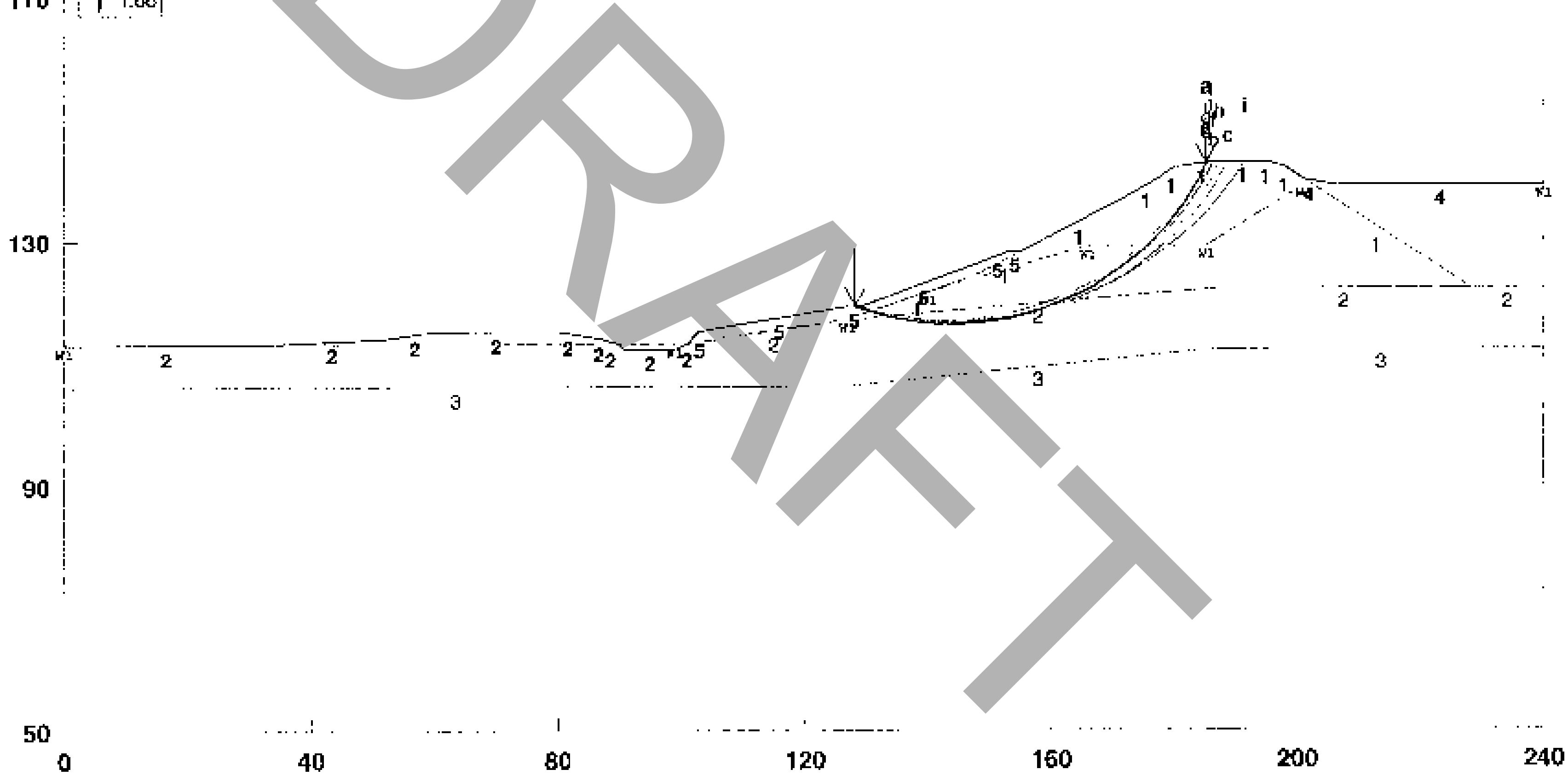
## Progress Energy -Weatherspoon Ash Pond-South #2_within_dike_Riprap extend ditch

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2fdik.pl2 Run By: Sharat Gollamudi 9/15/2010 03:23PM

| # | FS |
|---|---|
| a | **1.62** |
| b | 1.63 |
| c | 1.63 |
| d | 1.63 |
| e | 1.64 |
| f | 1.64 |
| g | 1.65 |
| h | 1.65 |
| i | 1.65 |
| j | 1.66 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

Init Points: 128. to 160.
Term Limits: 170. to 200.



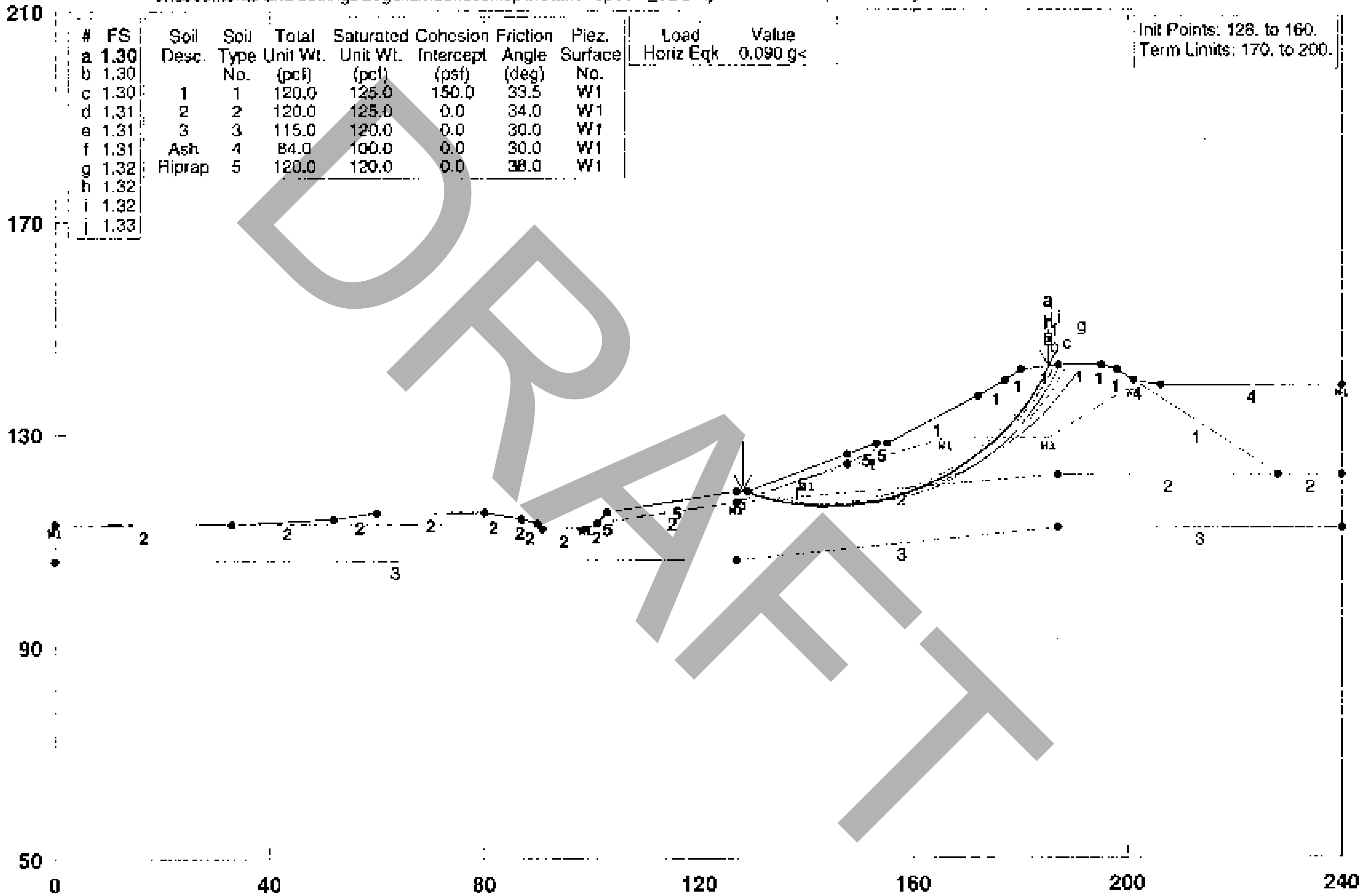

PCSTABL5M/si FSmin=1.62
**Safety Factors Are Calculated By The Modified Bishop Method**

STED

DRAFT

# Progress Energy -Weatherspoon Ash Pond-South_#2_within_dike_Riprap -Seismic

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2fdiks.pl2 Run By: Sharat Gollamudi 9/22/2010 03:33PM




| # | FS |
|---|---|
| a | 1.30 |
| b | 1.30 |
| c | 1.30 |
| d | 1.31 |
| e | 1.31 |
| f | 1.31 |
| g | 1.32 |
| h | 1.32 |
| i | 1.32 |
| j | 1.33 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.090 g< |

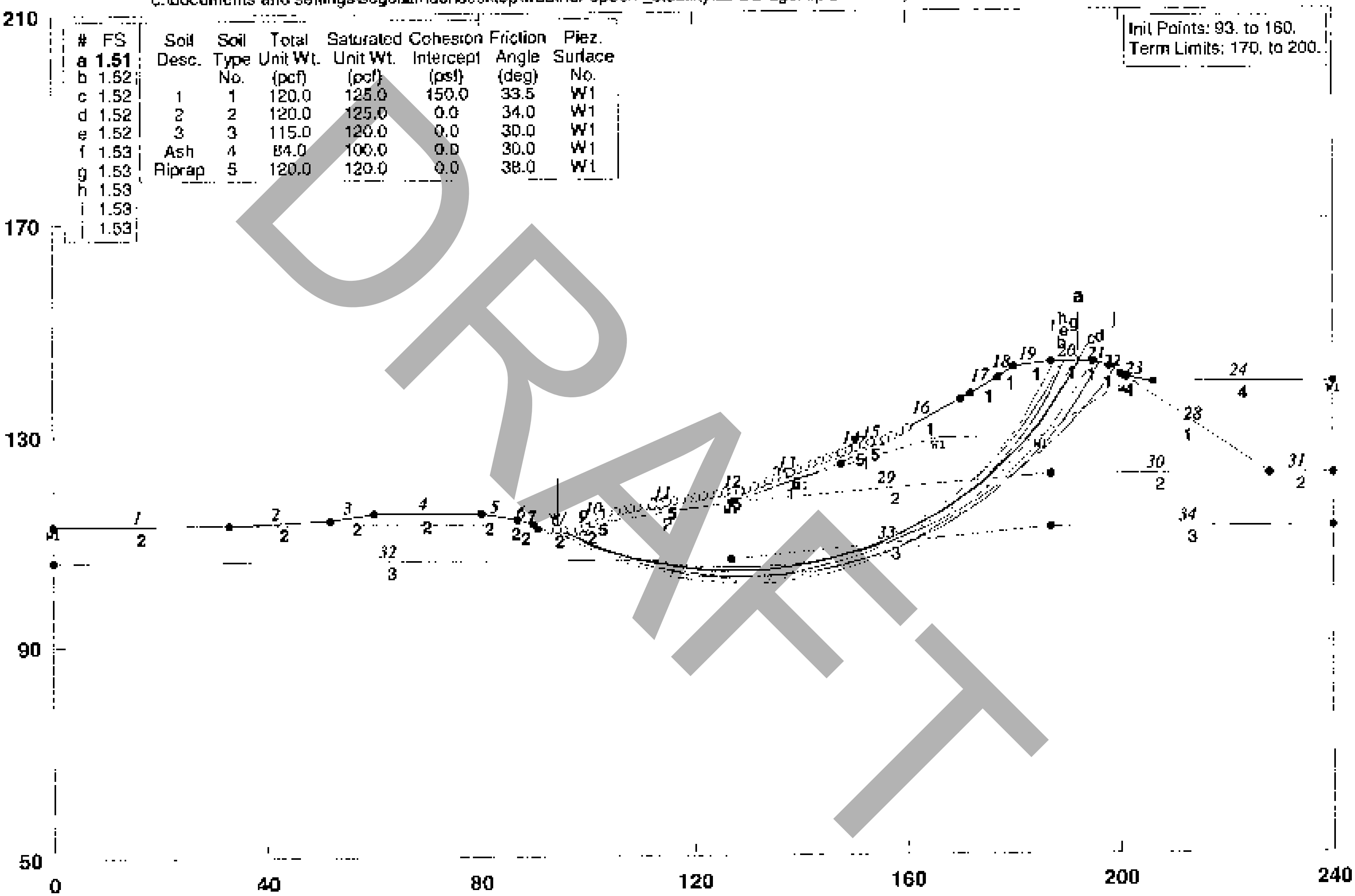
**PCSTABL5M/si FSmin=1.30**

**Safety Factors Are Calculated By The Modified Bishop Method**

STED

# Progress Energy -Weatherspoon Ash Pond-South_#2_Foundation_Riprap extend ditch

c:\documents and settings\scgollamudi\desktop\weather spoon _stability\sb-2\s-2gdik.pl2 Run By: Sharat Gollamudi 9/15/2010 03:25PM




| # | FS |
|---|---|
| a | **1.51** |
| b | 1.52 |
| c | 1.52 |
| d | 1.52 |
| e | 1.52 |
| f | 1.53 |
| g | 1.53 |
| h | 1.53 |
| i | 1.53 |
| j | 1.53 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

PCSTABL5M/si FSmin=1.51

Safety Factors Are Calculated By The Modified Bishop Method

STED

JAS

# Progress Energy -Weatherspoon Ash Pond-South_#2_Foundation_Riprap -Seismic

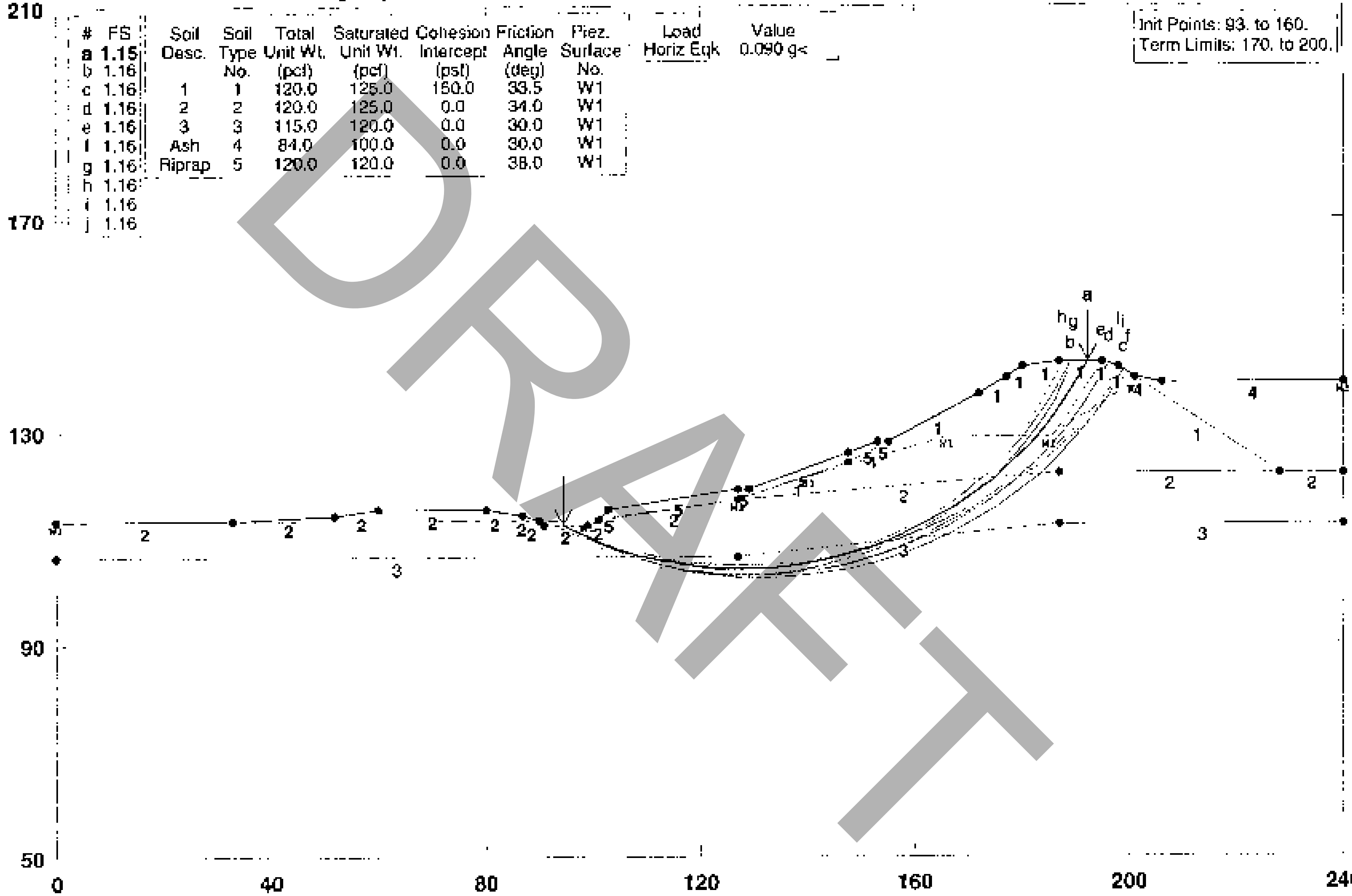
c:\documents and settings\sgollamudi\desktop\weather spoon _stability\sb-2\s-2gdiks.pl2 Run By: Sharat Gollamudi 9/22/2010 03:35PM

| # | FS |
|---|---|
| a | 1.15 |
| b | 1.16 |
| c | 1.16 |
| d | 1.16 |
| e | 1.16 |
| f | 1.16 |
| g | 1.16 |
| h | 1.16 |
| i | 1.16 |
| j | 1.16 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| 1 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| 2 | 2 | 120.0 | 125.0 | 0.0 | 34.0 | W1 |
| 3 | 3 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |
| Ash | 4 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Riprap | 5 | 120.0 | 120.0 | 0.0 | 38.0 | W1 |

| Load | Value |
|---|---|
| Horiz Eqk | 0.090 g< |

Init Points: 93. to 160.
Term Limits: 170. to 200.




PCSTABL5M/si FSmin=1.15
Safety Factors Are Calculated By The Modified Bishop Method

STED

# APPENDIX E

**Seismic Site Class Calculations**

# AASHTO Earthquake Ground Motion Parameters - Version 2.10
# (AASHTO GM-2.1)
# Seismic Design Parameters for
# 2007 AASHTO Seismic Design Guidelines

**Project: Progress Energy Weatherspoon Plant, Lumberton, NC**
**Date and Time: 8/28/2010 1:41:55 PM**

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
Latitude = 34.590822
Longitude = -078.970900
Site Class B
Data are based on a 0.05 deg grid spacing.

| Period (sec) | Sa (g) | |
|---|---|---|
| 0.0 | 0.095 | PGA - Site Class B |
| 0.2 | 0.214 | Ss - Site Class B |
| 1.0 | 0.067 | S1 - Site Class B |

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 34.590822
Longitude = -078.970900
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class C - Fpga = 1.20, Fa = 1.20, Fv = 1.70
Data are based on a 0.05 deg grid spacing.

| Period (sec) | Sa (g) | |
|---|---|---|
| 0.0 | 0.113 | As - Site Class C |
| 0.2 | 0.256 | SDs - Site Class C |
| 1.0 | 0.113 | SD1 - Site Class C |

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 34.590822
Longitude = -078.970900
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.60, Fa = 1.60, Fv = 2.40
Data are based on a 0.05 deg grid spacing.

| Period (sec) | Sa (g) | |
|---|---|---|
| 0.0 | 0.151 | As - Site Class D |
| 0.2 | 0.342 | SDs - Site Class D |
| 1.0 | 0.160 | SD1 - Site Class D |

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 34.590822
Longitude = -078.970900
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class E - Fpga = 2.50, Fa = 2.50, Fv = 3.50
Data are based on a 0.05 deg grid spacing.

| Period (sec) | Sa (g) | |
|---|---|---|
| 0.0 | 0.236 | As - Site Class E |
| 0.2 | 0.534 | SDs - Site Class E |
| 1.0 | 0.233 | SD1 - Site Class E |

**Purpose** - The ground motion parameters obtained in this analysis are for use with the design procedures described in AASHTO Guidelines for the Seismic Design of Highway Bridges (2007) The user may calculate seismic design parameters and response spectra (both for period and displacement), for Site Class A through E.

**Description** - This program allows the user to obtain seismic design parameters for sites in the 50 states of the United States, Puerto Rico and the U.S. Virgin Islands. In most cases the user may perform an analysis for a site by specifying location by either latitude-longitude (recommended) or zip code. However, locations in Puerto and the Virgin Islands may only be specified by latitude-longitude.

Ground motion maps are included in PDF format. These maps may be opened using a map viewer that is part of the software package.

**Data** - The 2007 AASHTO maps are based on 5% in 50 year probabilistic data from the U.S. Geological Survey data sets for the following regions: 48 conterminous states (2002), Alaska (2006), Hawaii (1998), Puerto Rico and the Virgin Islands (2003). These were the most recent data available at the time of preparation of the AASHTO maps. The AASHTO maps are labelled with a probability of exceedance of 7% in 75 years which is approximately equal to the 5% in 50 year data.

**International Building Code Site Class Calculation - Manual Hammer**



**Project:** Weatherspoon Plant
**Location:** Lumberton, NC
**Project No.:** 6468-10-0111
**Date:** 8/28/2010
**Input by:** Sharat Gollamudi

**South Dike**

| Boring No. | | SB-1 | SB-2 | SB-3 |
|---|---|---|---|---|
| Sample Depth | | Field SPT | Field SPT | Field SPT |
| From | To | | | |
| 0 | 1.5 | 15 | 9 | 23 |
| 1.5 | 3 | 16 | 21 | 23 |
| 3.5 | 5 | 14 | 3 | 12 |
| 6.5 | 8 | 8 | 16 | 14 |
| 8.5 | 10 | 14 | 13 | 27 |
| 10 | 15 | 28 | 15 | 20 |
| 15 | 20 | 6 | 12 | 45 |
| 20 | 25 | 27 | 57 | 66 |
| 25 | 30 | 41 | 26 | 50 |
| 30 | 35 | 8 | 4 | 8 |
| 35 | 40 | 8 | 4 | 8 |
| 40 | 45 | 15 | 25 | 15 |
| 45 | 50 | 15 | 15 | 15 |
| 50 | 55 | 15 | 15 | 15 |
| 55 | 60 | 15 | 15 | 15 |
| 60 | 65 | 15 | 15 | 15 |
| 65 | 70 | 15 | 15 | 15 |
| 70 | 75 | 50 | 50 | 50 |
| 75 | 80 | 50 | 50 | 50 |
| 80 | 85 | 50 | 50 | 50 |
| 85 | 90 | 50 | 50 | 50 |
| 90 | 95 | 50 | 50 | 50 |

*N-values below the boring termination depth were estimated based on general geology of the project site

| | SB-1 | SB-2 | SB-3 |
|---|---|---|---|
| Navg | 17 | 14 | 20 |
| Site Class | D | E | D |

| Site Class | Vs | N | Su |
|---|---|---|---|
| A | >5,000 | N/A | N/A |
| B | 2500 to 5000 | N/A | N/A |
| C | 1200 to 2500 | >50 | >2000 |
| D | 600 to 1200 | 15 to 50 | 1000 to 2000 |
| E | <600 | <15 | <1000 |

**Site Coefficients and adjusted maximum considered earthquake spectral response acceleration parameters**

| | | | | |
|---|---|---|---|---|
| $F_a$ | = | Site coefficient for CLASS D | = 1.6 | (AASHTO/USGS GM-2.1 software) |
| $F_v$ | = | Site coefficient for CLASS D | = 2.4 | (AASHTO/USGS GM-2.1 software) |
| $S_s$ | = | Mapped Spectral accelerations for short periods | = 0.214 | (AASHTO/USGS GM-2.1 software) |
| $S_1$ | = | Mapped Spectral response for 1-sec period | = 0.067 | (AASHTO/USGS GM-2.1 software) |
| $S_{MS}$ | = | $F_aS_s$ | = 0.342 | (Eq.16-37 International building code 2006) |
| $S_{M1}$ | = | $F_vS_1$ | = 0.161 | (Eq.16-38 International building code 2006) |
| $S_{DS}$ | = | $2/3(S_{MS})$ | = 0.228 | (Eq.16-39 International building code 2006) |

Peak ground acceleration = $S_{DS}/2.5$ = 0.091

## International Building Code Site Class Calculation - Manual Hammer



Project: Weatherspoon Plant
Location: Lumberton, NC
Project No.: 6468-10-0111
Date: 9/28/2010
Input by: Sharat Gollamudi

**North Dike**

| Boring No. | | NB-1 | NB-3 | NB-4 | NB-5 | NB-6 | NB-7 | NB-8 |
|---|---|---|---|---|---|---|---|---|
| Sample Depth | | Field SPT | Field SPT | Field SPT | Field SPT | Field SPT | Field SPT | Field SPT |
| From | To | | | | | | | |
| 0 | 1.5 | 28 | 29 | 14 | 16 | 25 | 21 | 26 |
| 1.5 | 3 | 16 | 31 | 8 | 12 | 20 | 23 | 22 |
| 3.5 | 5 | 13 | 15 | 5 | 5 | 14 | 20 | 14 |
| 6.5 | 8 | 17 | 8 | 4 | 4 | 12 | 23 | 14 |
| 8.5 | 10 | 8 | 15 | 13 | 4 | 9 | 20 | 14 |
| 10 | 15 | 8 | 6 | 6 | 9 | 3 | 22 | 14 |
| 15 | 20 | 4 | 21 | 3 | 4 | 8 | 11 | 55 |
| 20 | 25 | 8 | 12 | 2 | 3 | 4 | 15 | 28 |
| 25 | 30 | 1 | 16 | 2 | 3 | 6 | 4 | 11 |
| 30 | 35 | 16 | 4 | 1 | 14 | 7 | 1 | 4 |
| 35 | 40 | 17 | 5 | 1 | 19 | 9 | 10 | 4 |
| 40 | 45 | 17 | 7 | 1 | 19 | 9 | 10 | 4 |
| 45 | 50 | 17 | 2 | 5 | 19 | 9 | 10 | 4 |
| 50 | 55 | 17 | 2 | 19 | 19 | 15 | 15 | 15 |
| 55 | 60 | 17 | 15 | 19 | 19 | 15 | 15 | 15 |
| 60 | 65 | 17 | 15 | 19 | 19 | 15 | 15 | 15 |
| 65 | 70 | 17 | 15 | 19 | 19 | 15 | 15 | 50 |
| 70 | 75 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 75 | 80 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 80 | 85 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 85 | 90 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 90 | 95 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

*N-values below the boring termination depth were estimated based on general geology of the project site

| | NB-1 | NB-3 | NB-4 | NB-5 | NB-6 | NB-7 | NB-8 |
|---|---|---|---|---|---|---|---|
| Navg | 9 | 8 | 4 | 10 | 10 | 9 | 12 |
| Site Class | E | E | E | E | E | E | E |

| Site Class | Vs | N | Su |
|---|---|---|---|
| A | >5000 | N/A | N/A |
| B | 2500 to 5000 | N/A | N/A |
| C | 1200 to 2500 | >50 | >2000 |
| D | 600 to 1200 | 15 to 50 | 1000 to 2000 |
| E | <600 | <15 | <1000 |

**Site Coefficients and adjusted maximum considered earthquake spectral response acceleration parameters**

| | | | | |
|---|---|---|---|---|
| $F_a$ | = | Site coefficient for CLASS E | = 2.5 | (AASHTO/USGS GM-2.1 software) |
| $F_v$ | = | Site coefficient for CLASS E | = 3.5 | (AASHTO/USGS GM-2.1 software) |
| $S_s$ | = | Mapped Spectral accelerations for short periods | = 0.214 | (AASHTO/USGS GM-2.1 software) |
| $S_1$ | = | Mapped Spectral response for 1-sec period | = 0.067 | (AASHTO/USGS GM-2.1 software) |
| $S_{MS}$ | = | $F_aS_s$ | = 0.535 | (Eq.16-37 International building code 2006) |
| $S_{M1}$ | = | $F_vS_1$ | = 0.235 | (Eq.16-38 International building code 2006) |
| $S_{DS}$ | = | $2/3(S_{MS})$ | = 0.357 | (Eq.16-39 International building code 2006) |

Peak ground acceleration = $S_{DS}/2.5$ = 0.143

# F-1

## TEST BORING RECORDS AND LABORATORY TEST RESULTS FROM LAW ENGINEERING TESTING COMPANY 1978 EXPORATION

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/10/78 |
| BORING NO: AP-1 | TYPE: I | DATE FINISHED: 10/10/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Loose Brown Silty Fine SAND | SM | 1 | 2-3-3 | | ▽ | |
| 5 | | | Firm Gray Silty Fine SAND | | 2 | 8-9-9 | | | |
| | | | | | (3) | No Rec. | | | |
| 10 | | | Loose Tan Clayey Silty Fine SAND | SM/SC | 4 | 4-4-5 | | | |
| | | | Very Loose Brown Clayey Silty Fine SAND | | | | | | |
| 15 | | | SAND - Sample Not Recovered | | 5 | WOH-2 / 12" | | | |
| | | | | | (6) | No Rec. | | | |
| 20 | | | Boring Terminated @ 17.0' | | | | | | |

NOTES:

Rig Broke Down At 17.0' - Drilling Stopped

WOH = Weight Of Hammer

ENGINEER:

Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/4/78 |
| BORING NO: AP-2 | TYPE: I | DATE FINISHED: 10/6/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Topsoil | OL | | | | | |
| | | | Tan Silty Fine SAND | SM | 1 | 1-4-2 | | ▼ | |
| 5 | | | Gray Silty Fine Sandy CLAY | CL | 2 | 3-5-6 | | | |
| | | | | | (3) | 24" Rec. | | | |
| 10 | | | Gray Silty Fine SAND With Some Clay | SM | 4 | 1-1-1 | | | |
| 15 | | | Gray Silty Fine Sandy CLAY And Shells | CL | 5 | 3-4-2 | | | |
| | | | | | (6) | 24" Rec. | | | |
| | | | Gray Silty Fine SAND With Shells | SM | 7 | 12-9-5 | | | |
| 20 | | | Gray Silty Clayey Fine To Coarse SAND | SC | 8 | 6-7-10 | | | |
| 25 | | | | | 9 | 12-12-13 | | | |
| | | | * | | (10) | 24" Rec. | | | |
| | | | Gray Silty Clayey Fine To Medium SAND | | 11 | 18-14-17 | | | |
| 30 | | | ** | CH | 12 | 9-13-18 | | | |
| | | | Boring Terminated @ 30.0' | | | | | | |
| 35 | | | *Gray Clayey Coarse SAND And Shells | | | | | | |
| 40 | | | **Gray Silty Plastic CLAY And Some Sand | | | | | | |

NOTES:

Drilling Stopped At 18.5' On 10/4/78 Due To Pump Breakdown - Resumed 10/6/78

ENGINEER:

Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/10/78 |
| BORING NO: AP-3 | TYPE: I | DATE FINISHED: 10/10/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Brown Silty Fine SAND | SM | 1 | 3-2-3 | | ▽ | 4" Casing Installed To 5.0' |
| 5 | | | Light Gray Silty Clayey Fine SAND | SC | 2 | 6-8-8 | | | |
| | | | | | (3) | 24" Rec. | | | 25% Water Loss At 9.0-12.5' |
| | | | Gray Clayey Silty Fine SAND | SM/SC | 4 | 4-3-4 | | | |
| 10 | | | Gray Clayey Silty Fine To Medium SAND And Shells | | 5 | 2-WOH/12" | | | |
| 15 | | | | | 6 | 3-3-2 | | | |
| | | | | | (7) | No Rec. | | | |
| 20 | | | Gray Silty Fine To Medium SAND | SM | 8 | 14-18-25 | | | |
| 25 | | | | | 9 | 14-17-20 | | | |
| | | | | | (10) | 12" Rec. | | | |
| | | | | | 11 | 22-25-26 | | | |
| 30 | | | | | 12 | 18-12-14 | | | |
| | | | Boring Terminated @ 30.0' | | | | | | |

NOTES:

WOH = Weight Of Hammer

ENGINEER:

Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/9/78 |
| BORING NO: AP-4 | TYPE: I | DATE FINISHED: 10/9/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Brown Silty Fine SAND | | 1 | 5-5-8 | | | |
| 5 | | | Washed White Silty Very Fine SAND | SM | 2 | 12-18-19 | | | |
| | | | | | (3) | No Rec. | | ▼ | |
| 10 | | | Tan Silty Fine SAND | | 4 | 5-4-4 | | | |
| 15 | | | Tan Clayey Silty Fine SAND | SM/SC | 5 | WOH/18" | | | |
| | | | | | (6) | No Rec. | | | |
| 20 | | | Tan Clayey Silty Fine SAND And Shells | | 7 | WOH-1 12" | | | |
| 25 | | | Black Layered Seams Of Micaceous SILT | ML | 8 | 7-9-13 | | | |
| | | | | | (9) | 15" Rec. | | | |
| | | | | | 10 | 9-10-13 | | | |
| 30 | | | | | 11 | 9-13-17 | | | |
| | | | Boring Terminated @ 30.0' | | | | | | |

NOTES:

WOH = Weight Of Hammer

ENGINEER:

Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/9/78 |
| BORING NO: AP-5 | TYPE: I | DATE FINISHED: 10/9/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Brown Silty Fine SAND | | 1 | 2-2-3 | | ▽ | 4" Casing Installed To 5.0' |
| 5 | | | Tan Silty Fine SAND | SM | 2 | 8-13-17 | | | |
| | | | | | (3) | No Rec. | | ▼ | |
| 10 | | | | | 4 | 9-12-17 | | | |
| 15 | | | Tan Silty Very Fine SAND | SM/ML | 5 | 2-3-1 | | | |
| | | | | | (6) | No Rec. | | | |
| 20 | | | Black Clayey Silty Fine SAND | SM/SC | 7 | WOH/18" | | | |
| 25 | | | Gray Silty Fine SAND And Shells | SM | 8 | 8-9-8 | | C | |
| | | | | | (9) | No Rec. | | | |
| 30 | | | Light Gray Clayey Silty Fine SAND And Shells | SM/SC | 10 | 2-3-3 | | | |
| | | | Boring Terminated @ 30.0' | | | | | | |

NOTES:

WOH = Weight Of Hammer

ENGINEER:

Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-105

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/3/78 |
| BORING NO: AP-6 | TYPE: IV | DATE FINISHED: 10/3/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Red Fine Sandy CLAY | CL | 1 | | | ▼ | 7 Days |
| 5 | | | | | | | | ▽ | |
| | | | Red Brown SAND | SP/SM | 2 | | | | |
| 10 | | | | | | | | | |
| | | | Tan Silty Fine SAND | SM | 3 | | | | |
| 15 | | | | | | | | | |
| | | | Boring Terminated @ 15.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | | |
|---|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 | OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 | |
| BORING NO: AP-8 | TYPE: IV | DATE FINISHED: 10/5/78 | |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ▽ C | 5 Days |
| 5 | | | Light Gray Silty Very Fine SAND (Running Sand) | SM | 1 | 20/0" | | | |
| 10 | | | | | 2 | 30/3" | | | |
| | | | Boring Terminated @ 10.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-9 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ▼ | 5 Days |
| 5 | | | Light Gray Silty Sandy CLAY | CL | 1 | 4-5-7 | | ▽ | |
| 10 | | | | | 2 | 2-3-6 | | | |
| | | | Gray Clayey SAND And Shells | | | | | | |
| 15 | | | | SC | 3 | 2-4-8 | | | |
| | | | Light Gray Silty Clayey SAND And Shells With Some Cemented Sand | | | | | | |
| 20 | | | | | 4 | 5-4-7 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | | |
|---|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 | |
| LOCATION: | | DATE STARTED: 10/3/78 | |
| BORING NO: AP-10 | TYPE: IV | DATE FINISHED: 10/3/78 | |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–5 | | | Red Clayey Fine SAND | SC | 1 | | | ▼ | 7 Days |
| 5–10 | | | Brown Clayey Fine SAND | SC | 2 | | | ▽ | |
| 10–20 | | | Gray Clayey Silty Fine SAND (Wet) | SM/SC | | | | | |
| 20 | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/3/78 |
| BORING NO: AP-13 | TYPE: IV | DATE FINISHED: 10/3/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–5 | | | Tan Silty Fine SAND With Some Clay | SM | 1 | | | ▼ ▽ | 7 Days |
| 5–15 | | | Tan Silty Fine SAND | SM | | | | | Jar Sample Obtained 5.0-10.0' |
| 15–20 | | | Purple Fine Sandy CLAY | CL | | | | | Jar Sample Obtained 10.0-15.0' |
| 20 | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-103

## CLASSIFICATION OF BORINGS

| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
|---|---|---|
| LOCATION: | | DATE STARTED: 10/3/78 |
| BORING NO: AP-14 | TYPE: IV | DATE FINISHED: 10/3/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–5 | | | Red Silty Fine SAND | SM | 1 | | | ▽ | C 7 Days |
| 5–20 | | | Tan Silty Fine SAND | SM | | | | | Jar Sample Obtained 5.0-10.0'<br>Jar Sample Obtained 10.0-15.0'<br>Jar Sample Obtained 15.0-20.0' |
| 20 | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-15 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Light Gray Silty SAND | SM | ◇1 | | | | |
| 5 | | | | | 2 | 4-2-2 | | ▼ ▽ | 5 Days |
| 10 | | | Yellow And White Silty Clayey SAND | | 3 | 2-1-3 | | | |
| | | | | SC | | | | | |
| 15 | | | Gray Silty Clayey SAND And Shells | | 4 | 5-6-7 | | | |
| 20 | | | | | 5 | 7-6-4 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCO-109

# CLASSIFICATION OF BORINGS

| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
|---|---|---|
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-16 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Topsoil | OL | | | | | |
| | | | Tan Silty Fine SAND With Trace Of Clay | SM | ◇1 | | | | |
| 5 | | | | | 2 | 6-6-9 | | ▼ | 5 Days |
| | | | White Slightly Silty Clayey Fine SAND | SC | ◇3 | | | ▽ | |
| 10 | | | | | 4 | 5-5-4 | | | |
| | | | Gray Slightly Silty Medium SAND And Shells | SP/SM | | | | | |
| 15 | | | | | 5 | 5-5-6 | | | |
| | | | Gray Slightly Silty Medium SAND And Shells | | | | | | |
| 20 | | | | | 6 | 2-1/12" | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-17 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–9 | | | Light Gray Slightly Clayey Silty SAND | SM | 1 | 12-13-14 | | ▼ C | 5 Days |
| 9–12 | | | Light Gray Silty Plastic CLAY | CH | 2 | 3-1-6 | | | |
| 12–17 | | | Light Gray Silty Fine SAND | SM | 3 | 5-4-1 | | | |
| 17–20 | | | Gray Silty Sandy CLAY And Shells | CL | 4 | 6-7-8 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
|---|---|---|
| LOCATION: | | DATE STARTED: 10/3/78 |
| BORING NO: AP-~~18~~ 19 | TYPE: IV | DATE FINISHED: 10/3/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–5 | | | Gray Brown Silty Fine SAND With Trace Of Clay And Topsoil | | 1 | | | ▼ | 7 Days |
| 5–10 | | | Tan Silty Fine SAND With Trace Of Clay | | 2 | | | ▽ C | |
| 10–20 | | | Tan Silty Fine SAND | SM | | | | | Jar Sample Obtained 10.0-15.0' <br> Jar Sample Obtained 15.0-20.0' |
| 20 | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCO-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-21 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–7 | | | Brown And Gray Silty Fine SAND | SM | ◇1 | | | ▼ | 5 Days |
| 5 | | | | | 2 | 5-3-5 No Rec. | | ▽ | |
| 7–12 | | | Light Gray Fine Sandy CLAY | CL | 3 | 1-1-1 No Rec. | | c | 5 Days |
| 12–20 | | | Light Gray Clayey SAND And Shells | SC | 4 | 8-6-8 | | | |
| 20 | | | | | 5 | 6-3-2 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCO-109

# CLASSIFICATION OF BORINGS

| | | | |
|---|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 | |
| LOCATION: | | DATE STARTED: 10/3/78 | |
| BORING NO: AP-22 | TYPE: IV | DATE FINISHED: 10/3/78 | |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Brown Topsoil | OL | | | | ▼ | 7 Days |
| | | | Peat | PT | | | | | |
| 5 | | | | | 1 | | | ▽ | |
| | | | | | 2 | | | | |
| 10 | | | Gray Silty Fine SAND | SM | | | | | |
| | | | Shells Encountered Below 10.0' | | | | | | Jar Sample Obtained 10.0-15.0' |
| 15 | | | | | | | | | Jar Sample Obtained 15.0-20.0' |
| 20 | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING
▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | | |
|---|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 | |
| LOCATION: | | DATE STARTED: 10/5/78 | |
| BORING NO: AP-23 | TYPE: IV | DATE FINISHED: 10/5/78 | |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Topsoil (Stockpiled) | OL | | | | ▼ | 5 Days |
| 5 | | | Red, Brown, And Tan Clayey SAND | SC | 1 | 5-5-5 | | | |
| | | | | | ◇2 | | | | |
| | | | | | | | | c | 5 Days |
| 10 | | | Yellow, Tan, And White Silty SAND | SM | 3 | 8-7-7 | | c | Time Of Boring |
| 15 | | | White Very Silty Very Fine SAND | SM/ML | 4 | 4-3-3 | | | |
| | | | Yellow Clayey SAND | SC | | 2-2-2 | | | |
| 20 | | | | | 5 | No Rec. | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

∇ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/5/78 |
| BORING NO: AP-24 | TYPE: IV | DATE FINISHED: 10/5/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Topsoil | OL | | | | | |
| 5 | | | Washed White Very Fine SAND | SP | ◇1, 2 | 8-7-7 | | ▼ ▽ | 5 Days |
| 10 | | | Tan Clayey Silty SAND With Trace Of Clay Seams | | ◇3, 4 | 4-5-4 | | | |
| 15 | | | Brown Silty Fine SAND With Trace Of Clay | SM | 5 | 2-1-1 | | | |
| 20 | | | Gray Clayey Silty Fine To Medium SAND And Shells | | 6 | 8-7-8 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |



NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING
▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

# CLASSIFICATION OF BORINGS

| | | | |
|---|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 | |
| LOCATION: | | DATE STARTED: 10/5/78 | |
| BORING NO: AP-25 | TYPE: IV | DATE FINISHED: 10/5/78 | |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Tan And Gray Very Fine Sandy CLAY | | ◇1 | | | | |
| 5 | | | | CL | 2 | 6-8-9 | | ▼ | 5 Days |
| | | | | | | | | ▽ | |
| | | | Tan Silty Plastic CLAY | | ◇3 | | | | |
| 10 | | | | CH | 4 | 2-2-1 | | | |
| 15 | | | Gray Silty Sandy CLAY And Shells | | 5 | 2-1-1 | | | |
| | | | | CL | | | | | |
| 20 | | | | | 6 | 3-3-4 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING
▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/6/78 |
| BORING NO: AP-26 | TYPE: IV | DATE FINISHED: 10/6/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Dark Brown And Tan Silty Fine SAND | SM | ◇1 | | | | |
| 5 | | | | | 2 | 8-8-8 | | | |
| | | | Tan Silty Fine SAND With Clay Seams (Fill) | SM/SC | ◇3 | | | | |
| 10 | | | | | 4 | 9-9-10 | | | |
| | | | Tan Silty Fine SAND With Trace Of Clay (Fill) | | ◇5 | | | ▼ | 4 Days |
| 15 | | | | | 6 | 8-9-12 | | c | |
| | | | Brown Silty Fine SAND | SM | | | | | |
| 20 | | | | | 7 | 8-3-3 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

## CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/4/78 |
| BORING NO: AP-27 | TYPE: IV | DATE FINISHED: 10/4/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | Topsoil | OL | | | | | |
| | | | Brown Silty Fine SAND | SM | ◇1 | | | | |
| 5 | | | | | 2 | 9-7-5 | | | |
| | | | Dense Brown Silty Fine SAND | | ◇3 | | | | |
| 10 | | | | | 4 | 7-10-15 | | | Hole Dry At 6 Days |
| | | | Dark Brown Silty Very Fine SAND | SM/ML | ◇5 | | | | |
| 15 | | | | | 6 | 3-3-7 | | c | Time Of Boring |
| | | | Gray Silty Loose Fine SAND With Trace Of Clay Seams | SM | | | | | |
| 20 | | | | | 7 | 4-3-4 | | | |
| | | | Boring Terminated @ 20.0' | | | | | | |

NOTES:

ENGINEER: Law Engineering Testing Company

GROUND WATER LEVEL AT COMPLETION OF BORING

GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCO-109

# CLASSIFICATION OF BORINGS

| | | |
|---|---|---|
| SITE: Ash Pond - CP&L Plant | SURFACE ELEV.: | SHEET 1 OF 1 |
| LOCATION: | | DATE STARTED: 10/4/78 |
| BORING NO: AP-28 | TYPE: IV | DATE FINISHED: 10/4/78 |

| DEPTH | ELEV. | PROFILE | CLASSIFICATION | U.S.C.S. | SAMPLE TYPE & NO. | PENETRATION RESISTANCE OR % ROCK RECOVERY | R.Q.D. (%) | WATER CONT. (%) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 0–21.5 | | | Ash Particles | | | | | ▼ (approx. 4.5) | 6 Days |
| | | | | | 1 | 5-4-2 | | | |
| | | | | | 2 | 1-1/12" | | | |
| | | | | | 3 | WOH/18" | | | |
| | | | | | 4 | WOH/18" | | | |
| 21.5 | | | Boring Terminated @ 21.5' | | | | | | |

NOTES:

WOH = Weight Of Hammer

ENGINEER: Law Engineering Testing Company

▽ GROUND WATER LEVEL AT COMPLETION OF BORING

▼ GROUND WATER LEVEL AT 24 HRS. OR LATER

FORM PPCD-109

LAW ENGINEERING TESTING COMPANY
3301 WINTON ROAD
RALEIGH, NORTH CAROLINA
SOIL DATA SUMMARY-JOB NO. RA-1365



| BORING NO. | DEPTH, FEET | SAMPLE TYPE | CLASSIFICATION | UNIT WEIGHT, pcf | | % FINER NO. 200 SIEVE | SPECIFIC GRAVITY | VOID RATIO | NATURAL MOISTURE | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WET | DRY | | | | | LL | PL | PI |
| AP-2 | 6.0-8.0 | UD | SM | 123.3 | 99.0 | | 2.62 | 0.653 | 24.6 | 24 | NP | NP |
| AP-2 | 15.0-17.0 | UD | SM | 114.4 | 94.5 | | | | 21.1 | 24 | NP | NP |
| AP-2 | 25.0-27.0 | UD | SM | 120.3 | 99.9 | | 2.67 | 0.669 | 20.4 | 30 | NP | NP |
| AP-3 | 5.0-7.0 | UD | SM | 123.7 | 103.8 | | 2.67 | 0.607 | 19.2 | 23 | NP | NP |
| AP-3 | 25.0-27.0 | UD | SM | 114.0 | 96.9 | 14.1 | 2.65 | 0.710 | 17.6 | NP | NP | NP |
| AP-4 | 25.0-27.0 | UD | CH | 97.5 | 58.2 | | 2.69 | 1.882 | 67.4 | 117 | 38 | 79 |
| AP-6 | 0.0-5.5 | BAG | SM | | | | | | 12.6 | NP | NP | NP |
| AP-6 | 5.5-10.5 | BAG | SM | | | 17.1 | | | | | | |
| AP-10 | 0.0-5.0 | BAG | SM | | | | | | 14.0 | NP | NP | NP |
| AP-14 | 0.0-5.0 | BAG | SM | | | 8.7 | | | | | | |
| AP-16 | 1.5-7.0 | SS | SM | | | 22.2 | | | | | | |
| AP-16 | 7.0-11.5 | SS | SM | | | 36.1 | | | 15.1 | 23 | NP | NP |
| AP-18 | 5.0-10.0 | BAG | SM | | | 20.5 | | | | | | |
| AP-19 | 0.0-5.0 | BAG | SM | | | 14.7 | | | | | | |
| AP-19 | 5.0-10.0 | BAG | SM | | | 33.9 | | | | | | |
| AP-20 | 0.0-5.0 | BAG | SM | | | 16.7 | | | | | | |
| AP-21 | 0.0-7.0 | BAG | SM | | | 11.5 | | | 16.4 | | | |

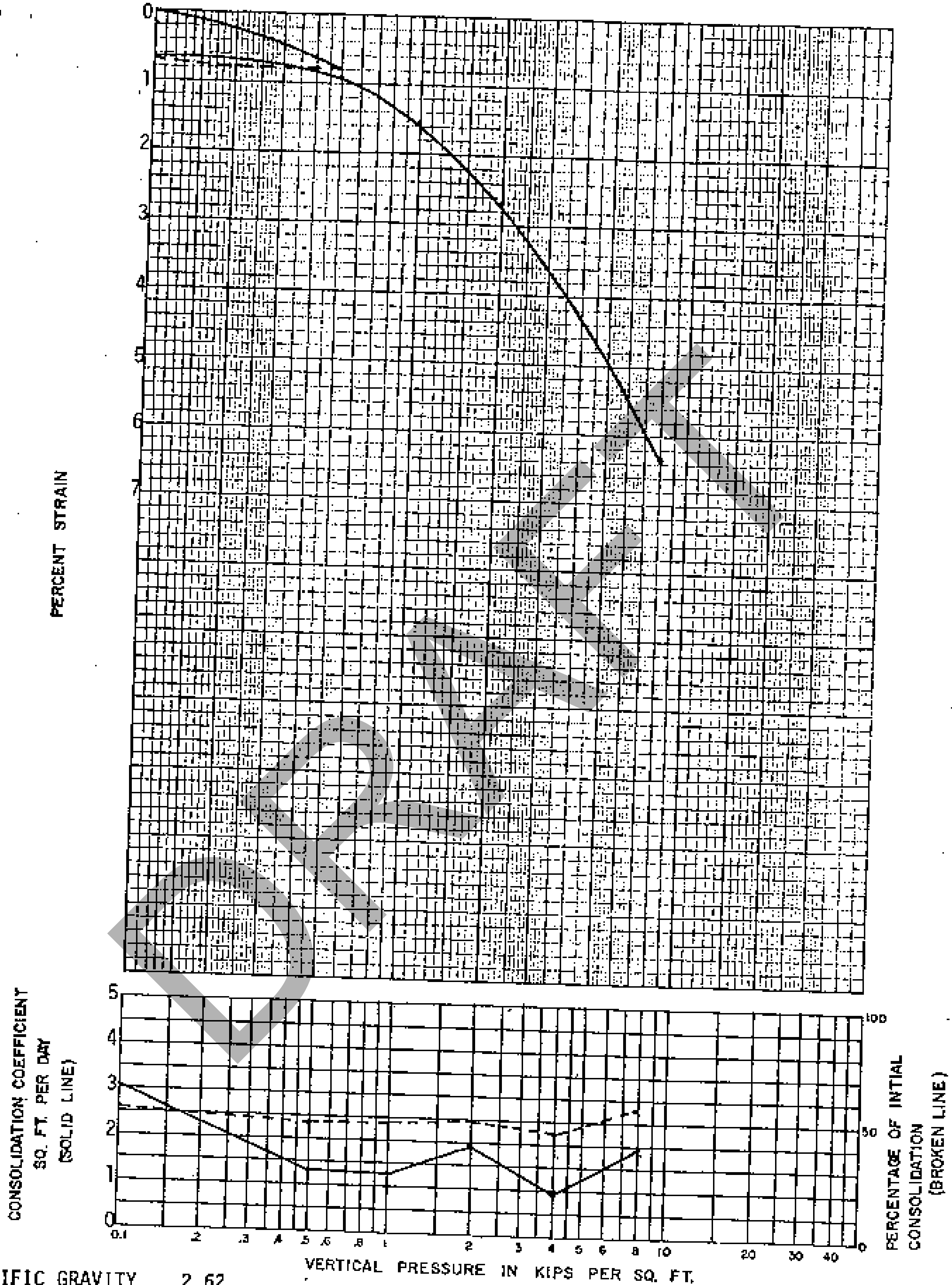
SS- SPLIT SPOON
UD- UNDISTURBED SAMPLE

LAW ENGINEERING TESTING COMPANY
3301 WINTON ROAD
RALEIGH, NORTH CAROLINA
SOIL DATA SUMMARY-JOB NO. RA-1365



| BORING NO. | DEPTH, FEET | SAMPLE TYPE | CLASSIFICA-TION | UNIT WEIGHT, pcf | | % FINER NO. 200 SIEVE | SPECIFIC GRAVITY | VOID RATIO | NATURAL MOISTURE | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WET | DRY | | | | | LL | PL | PI |
| AP-23 | 5.0-9.0 | SS | SM | | | | | | 12.6 | 26 | NP | NP |
| AP-25 | 0.0-7.5 | SS | CL | | | | | | 11.2 | 31 | 17 | 13 |
| AP-28 | 8.5-10.0 | SS | ASH | | | 3.4 | | | | | | |

SS- SPLIT SPOON
UD- UNDISTURBED SAMPLE



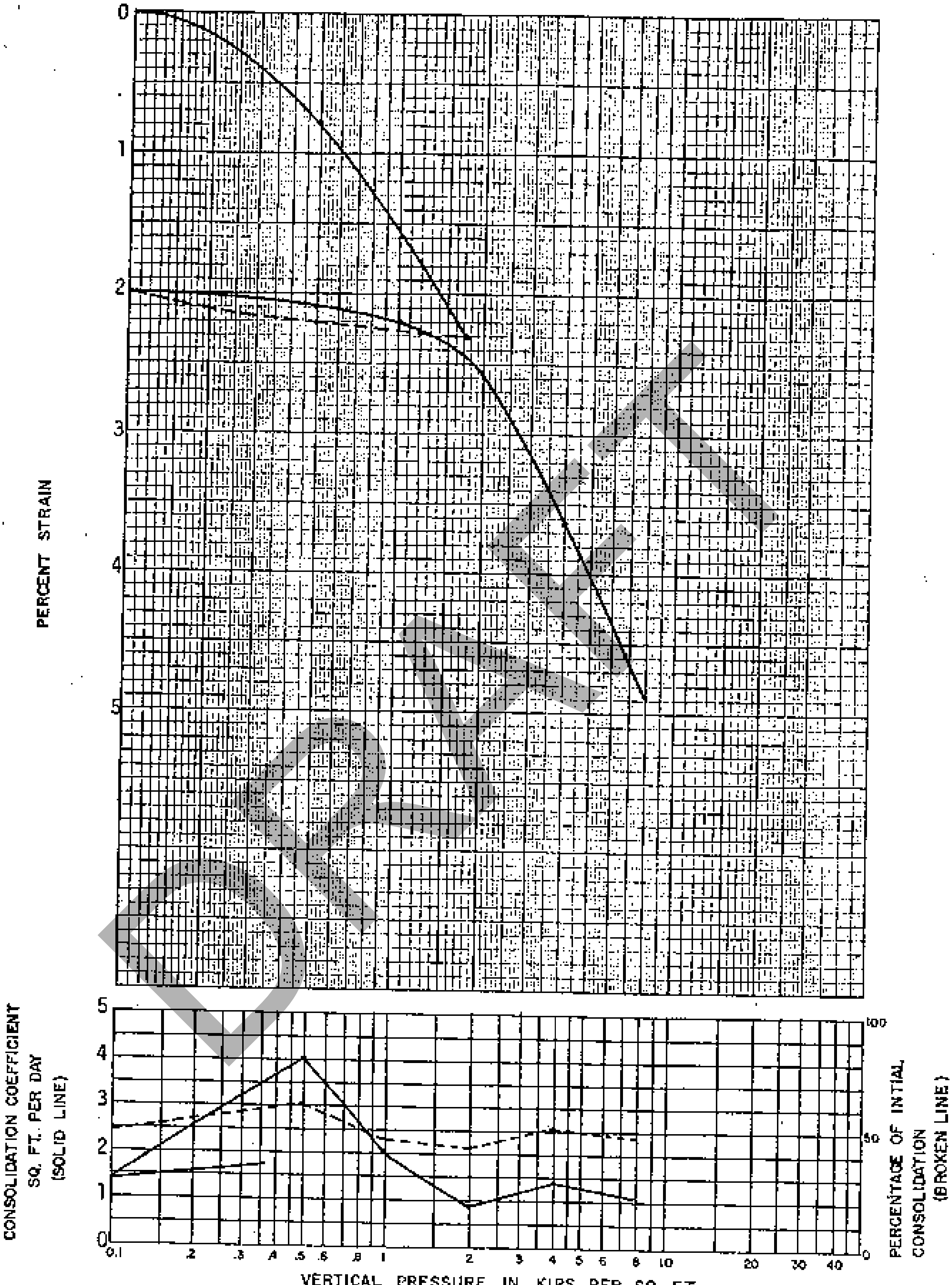



SPECIFIC GRAVITY 2.62
COMPRESSION INDEX 0.11 @ 8 K/SF
UNIT WEIGHT (W)123.3 (D)99.0 PCF
WATER CONTENT 24.6%
SATURATION 98.9%
INITIAL VOID RATIO 0.653

## CONSOLIDATION TEST

BORING NO. AP-2 SAMPLE NO. 3
ELEV. or DEPTH 6-8' JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY






SPECIFIC GRAVITY 2.67

COMPRESSION INDEX 0.07 @ 8 K/SF

UNIT WEIGHT (W)120.3 (D)99.9 PCF

WATER CONTENT 20.4%

SATURATION 81.6%

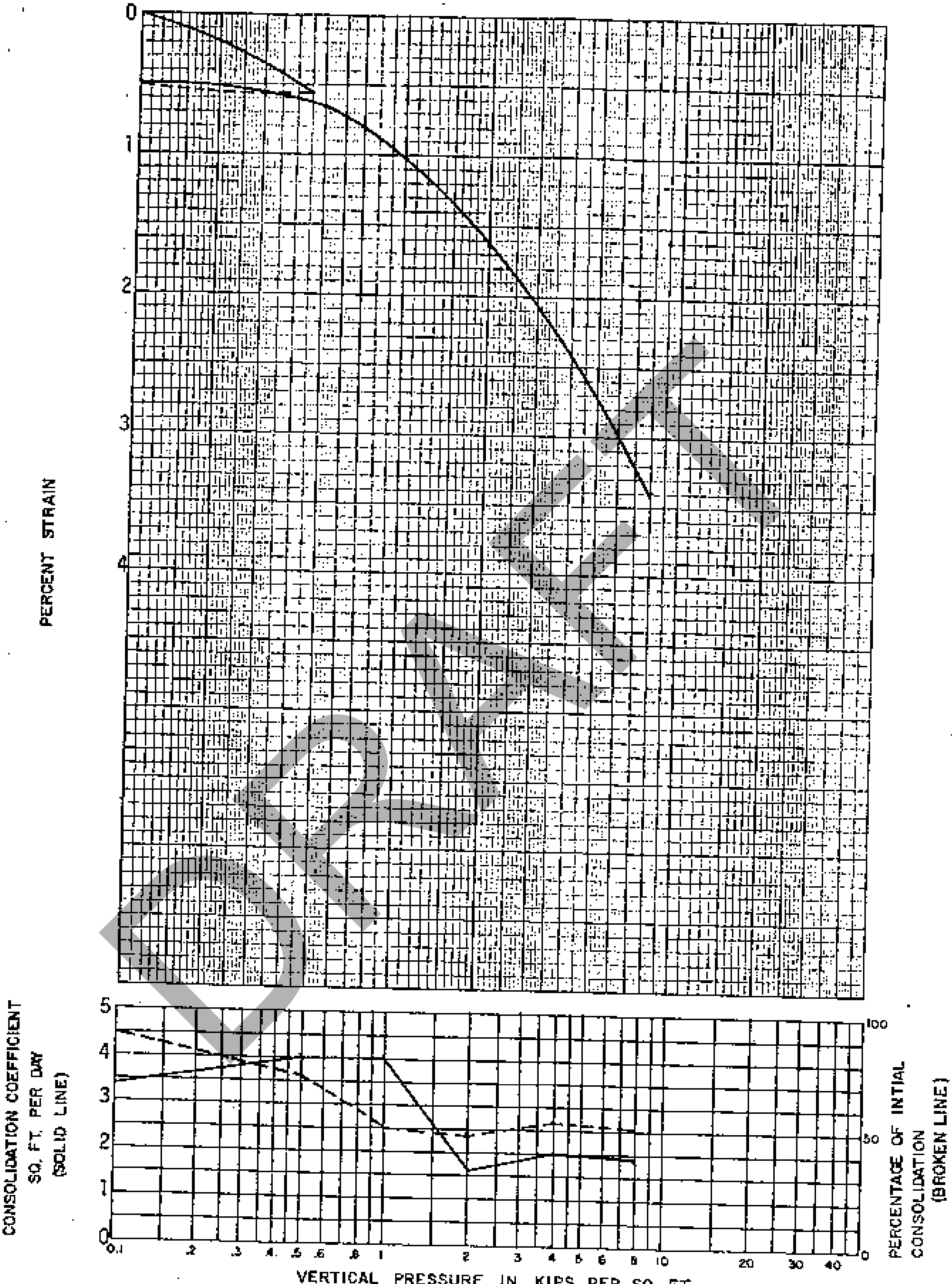
INITIAL VOID RATIO 0.669

## CONSOLIDATION TEST

BORING NO. AP-2 SAMPLE NO. 10

ELEV. or DEPTH 25-27' JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



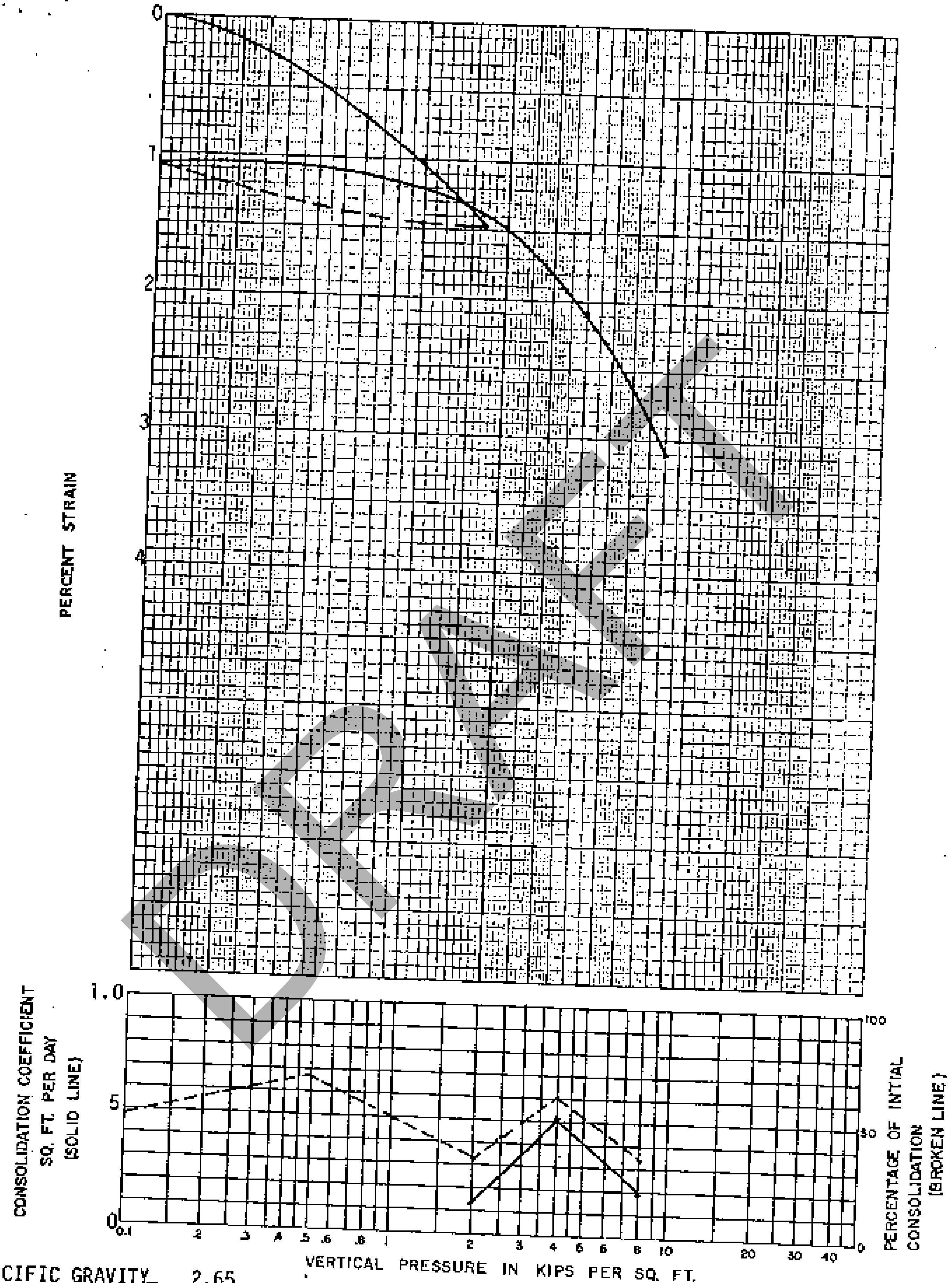



SPECIFIC GRAVITY 2.67
COMPRESSION INDEX 0.05 @ 8 K/SF
UNIT WEIGHT (W)123.7 (D)103.8 PCF
WATER CONTENT 19.2%
SATURATION 84.7%
INITIAL VOID RATIO 0.607

# CONSOLIDATION TEST

BORING NO. AP-3 SAMPLE NO. 3
ELEV. or DEPTH 5-7' JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



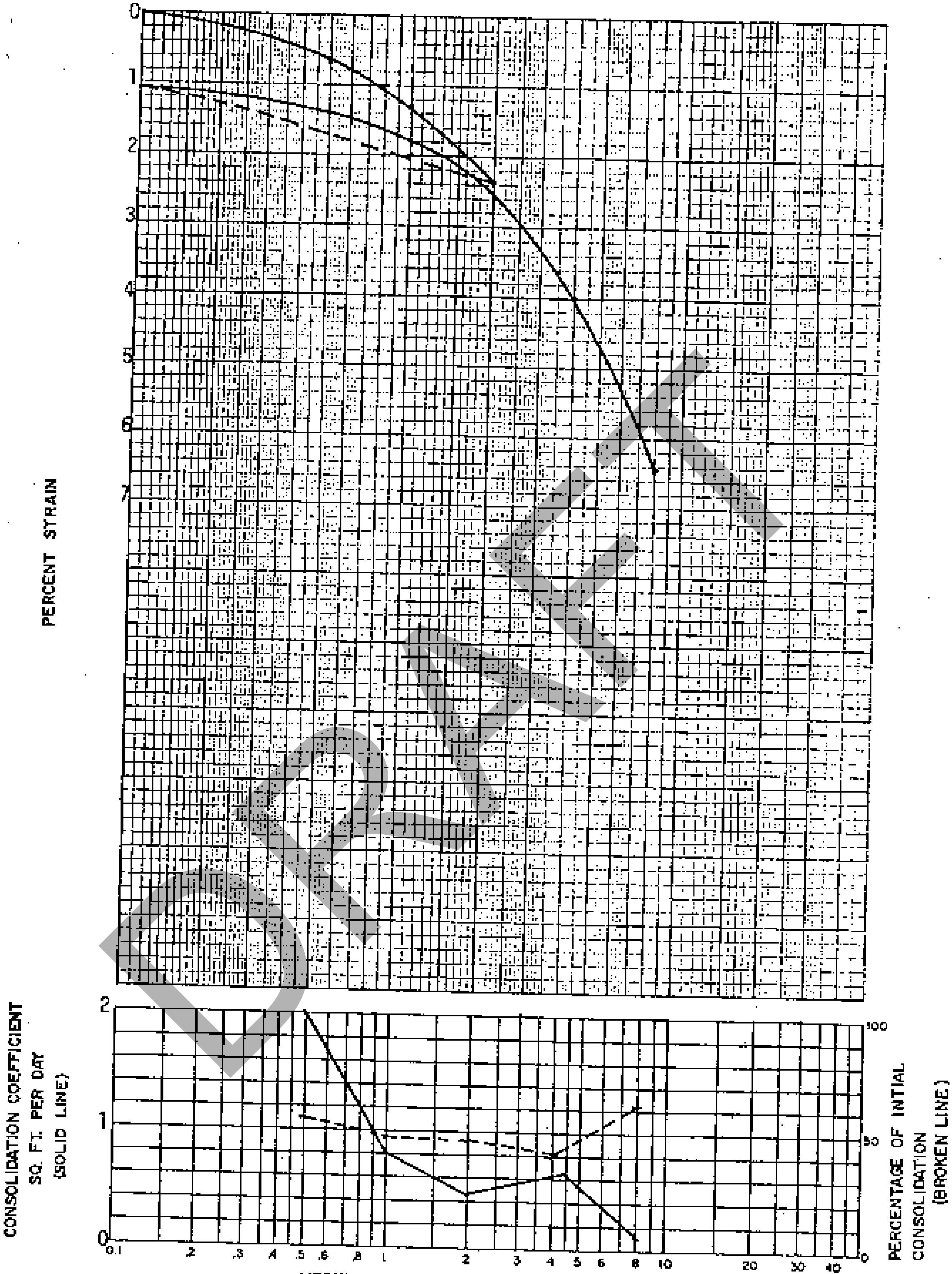



SPECIFIC GRAVITY 2.65
COMPRESSION INDEX 0.06 @ 8 K/SF
UNIT WEIGHT (W) 114.0 (D) 96.9 PCF
WATER CONTENT 17.6%
SATURATION 66.1%
INITIAL VOID RATIO 0.710

# CONSOLIDATION TEST

BORING NO. AP-3 SAMPLE NO. 10
ELEV. or DEPTH 25-27' JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

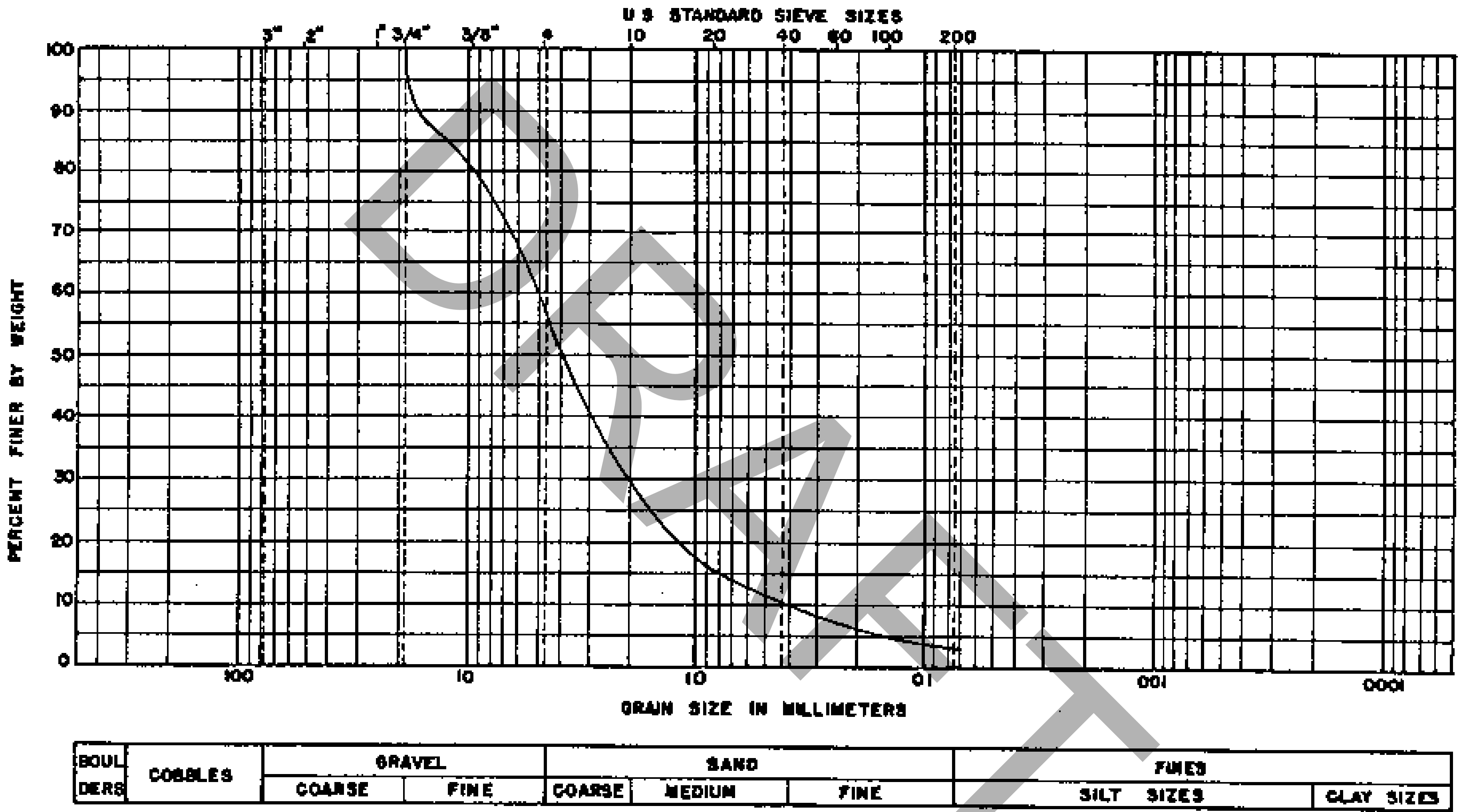



SPECIFIC GRAVITY 2.69
COMPRESSION INDEX 0.24 @ 8 K/SF
UNIT WEIGHT (W)97.5 (D)58.2 PCF
WATER CONTENT 67.4%
SATURATION 96.4%
INITIAL VOID RATIO 1.882

# CONSOLIDATION TEST

BORING NO. AP-4 SAMPLE NO. 9
ELEV. or DEPTH 25-27' JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

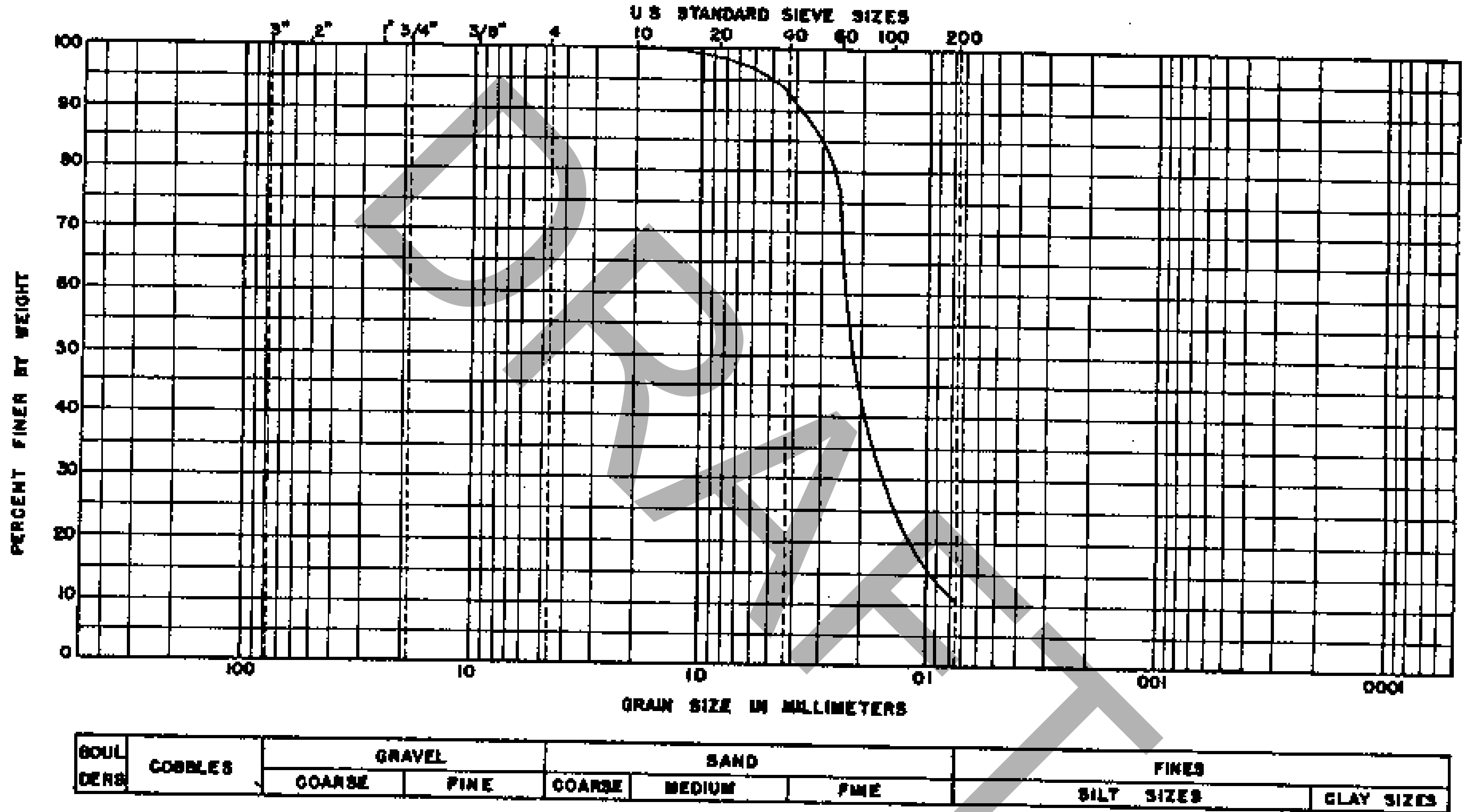



| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-28 2 | 8.5-10.0' | | | | | Ash Particles |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

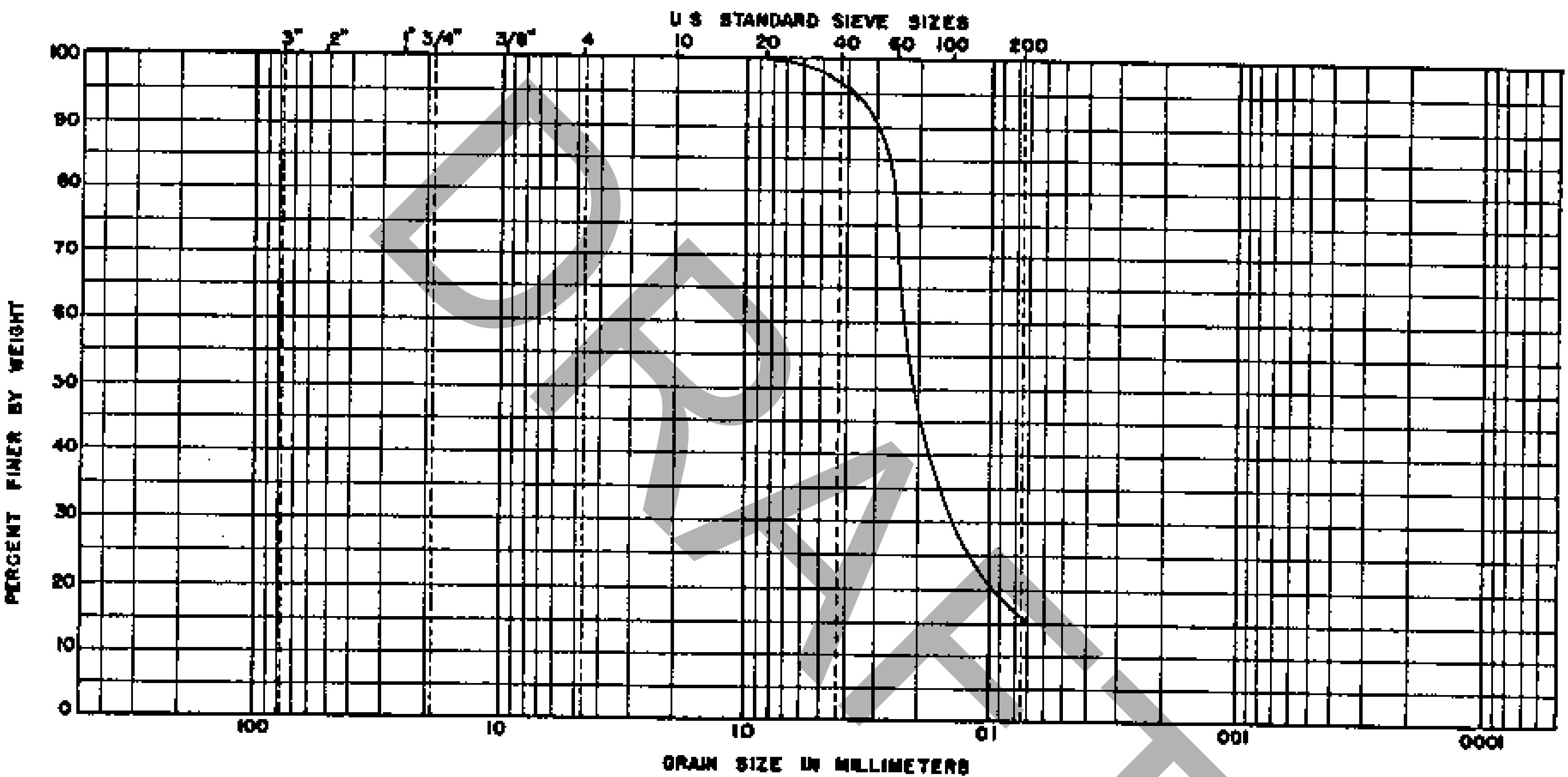



| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-21 | 0.0-7.0' | 16.4 | | | | Brown And Gray Silty Fine To Medium SAND (SM) |

## GRAIN SIZE DISTRIBUTION

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



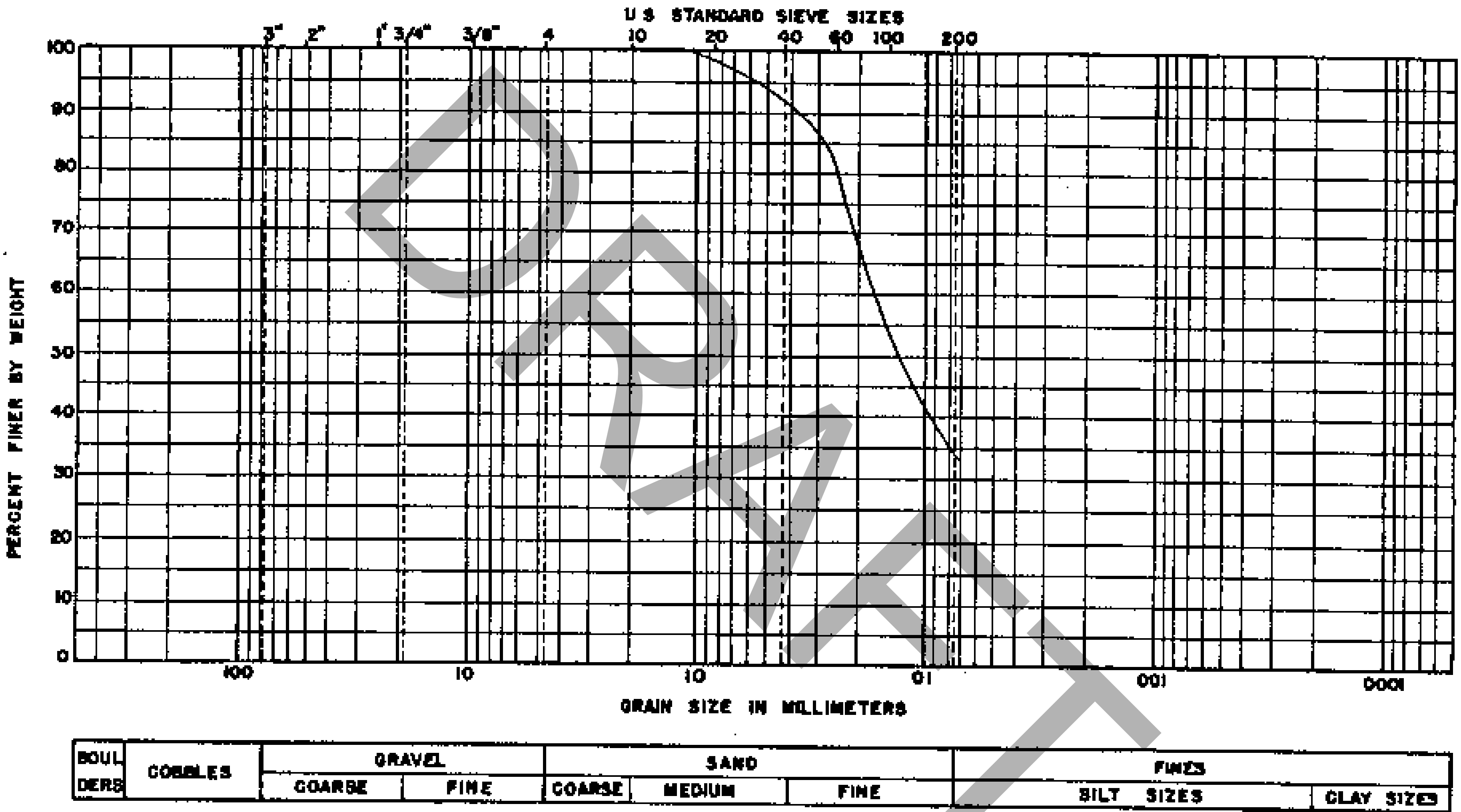

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| BORING NO | ELEV OR DEPTH | NAT WC | L L | PL | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-20 | 0.0-5.0' | | | | | Tan Silty Fine SAND (SM) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

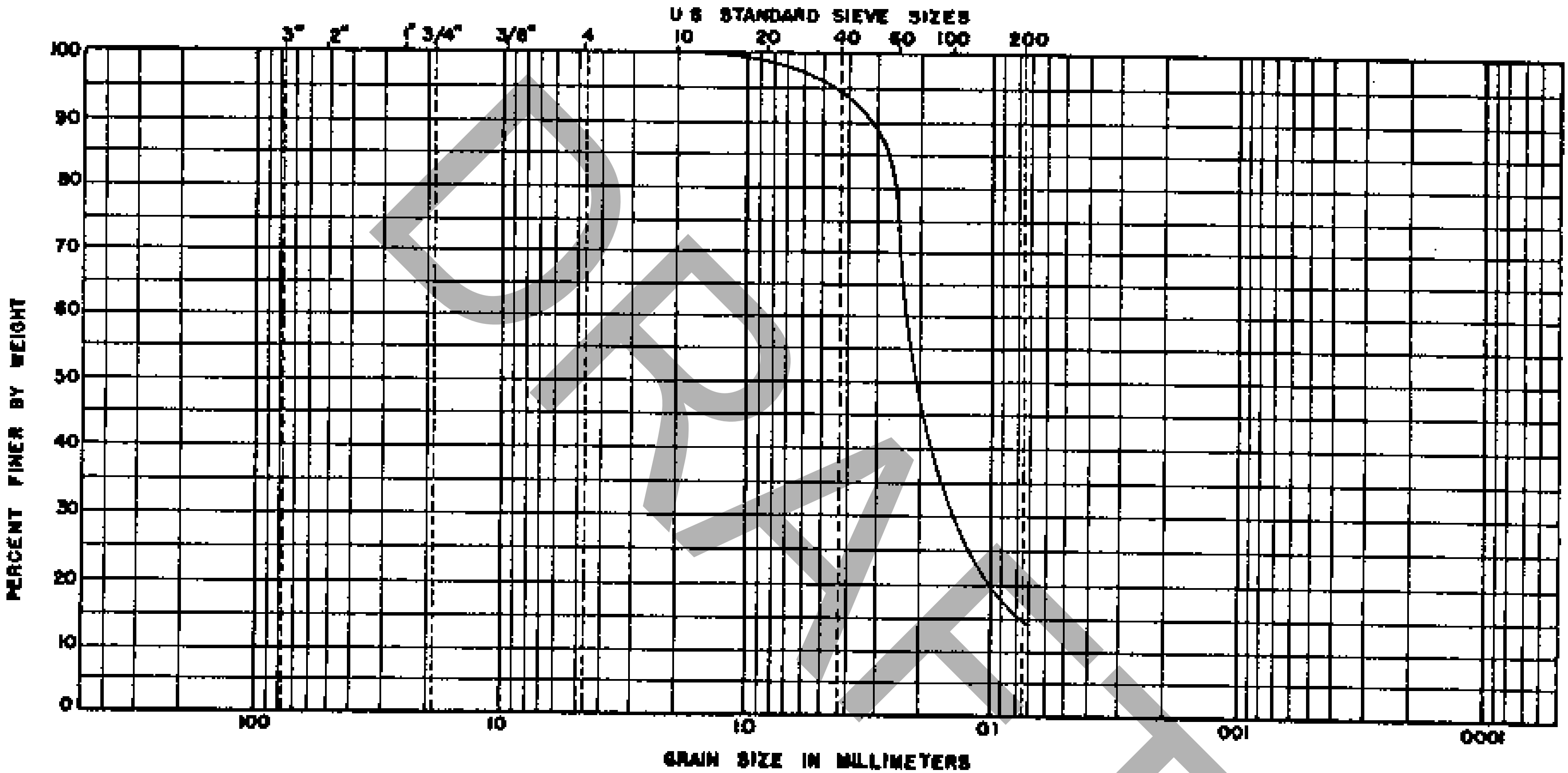



| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-19 | 5.0-10.0' | | | | | Gray Silty Fine To Medium SAND (SM) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



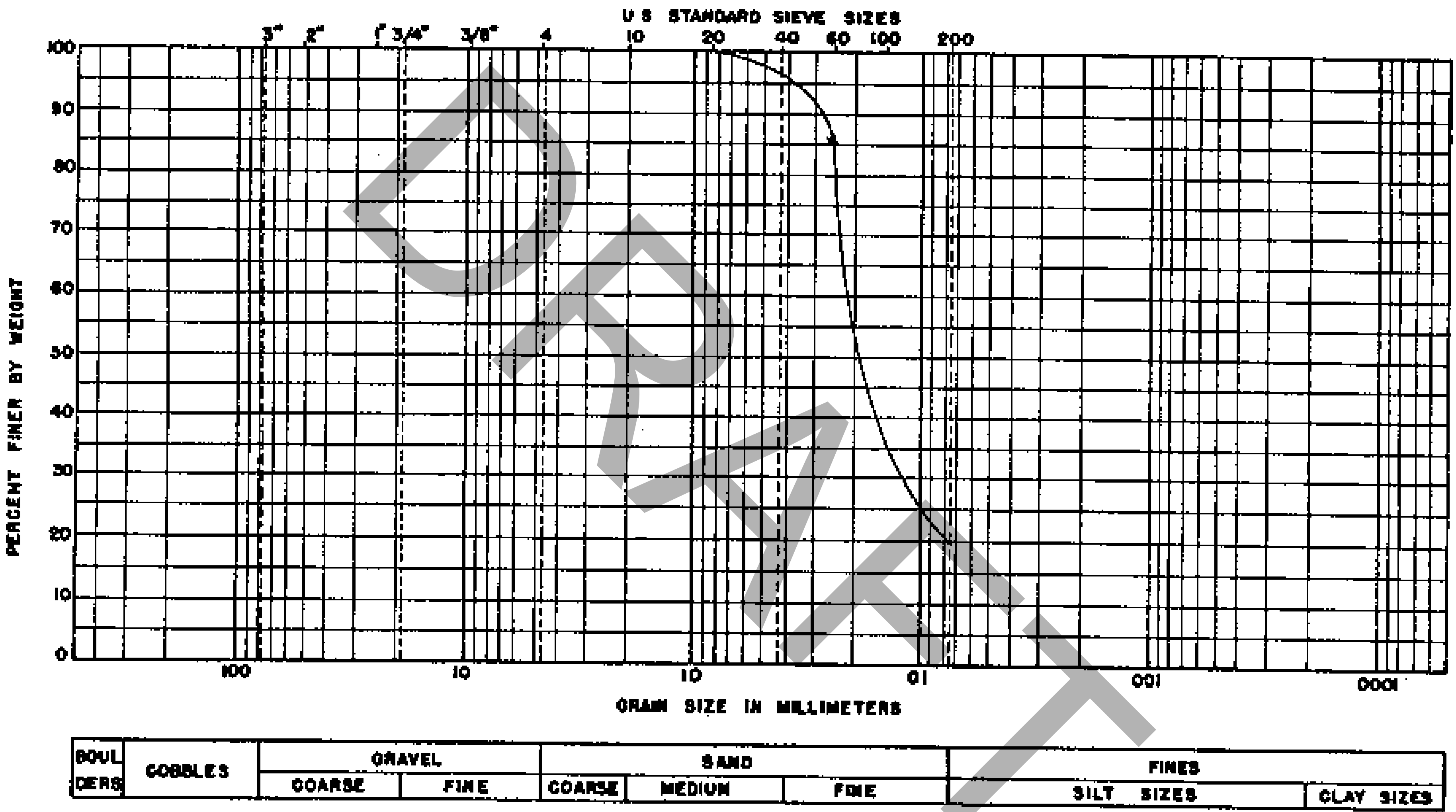

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-19 | 0.0-5.0' | | | | | Brown Silty Fine SAND (SM) |

## GRAIN SIZE DISTRIBUTION

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

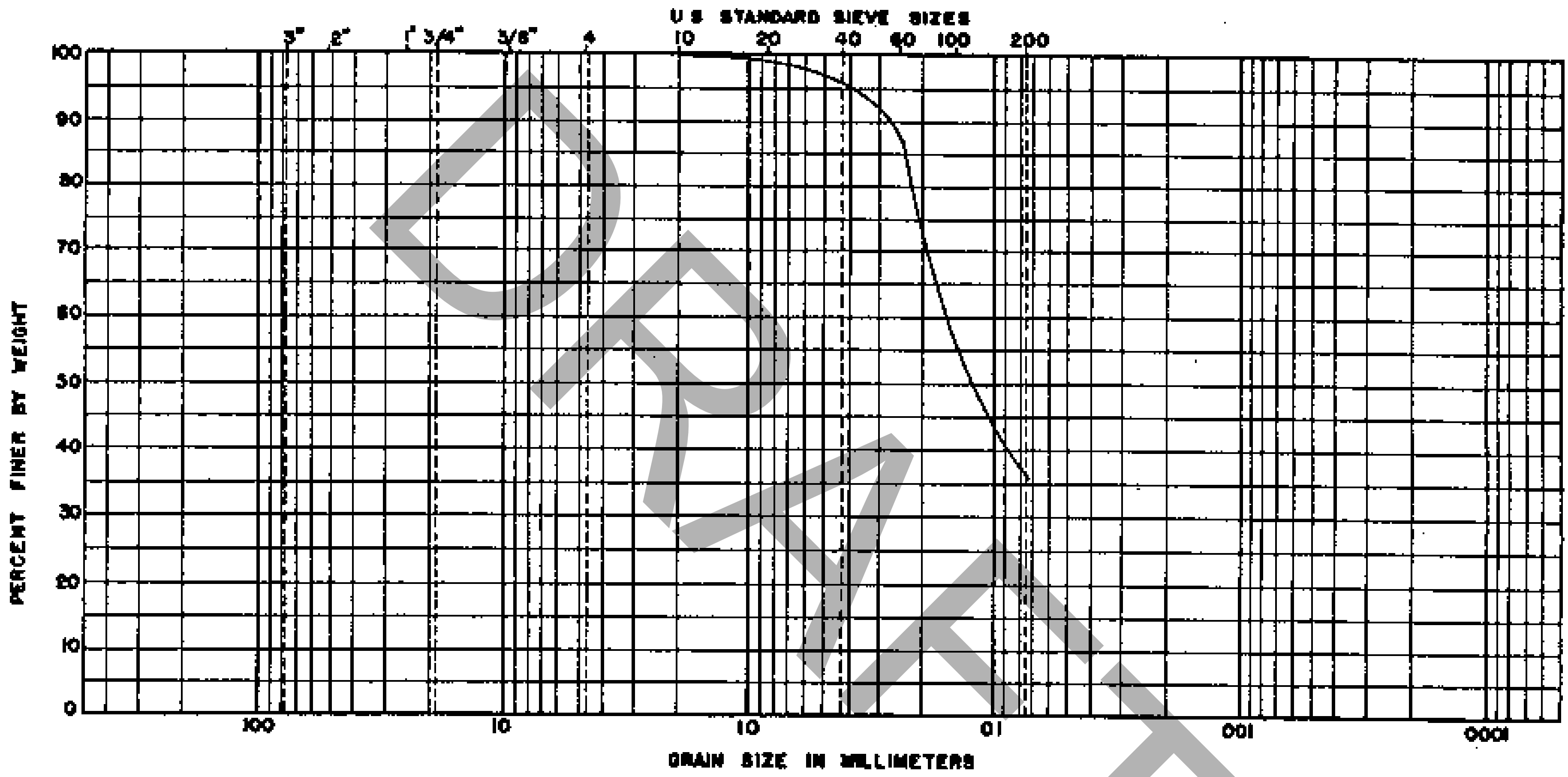



| BORING NO | ELEV OR DEPTH | NAT WC | LL | PL | PI | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-18 | 5.0-10.0' | | | | | Tan Silty Fine SAND (SM) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



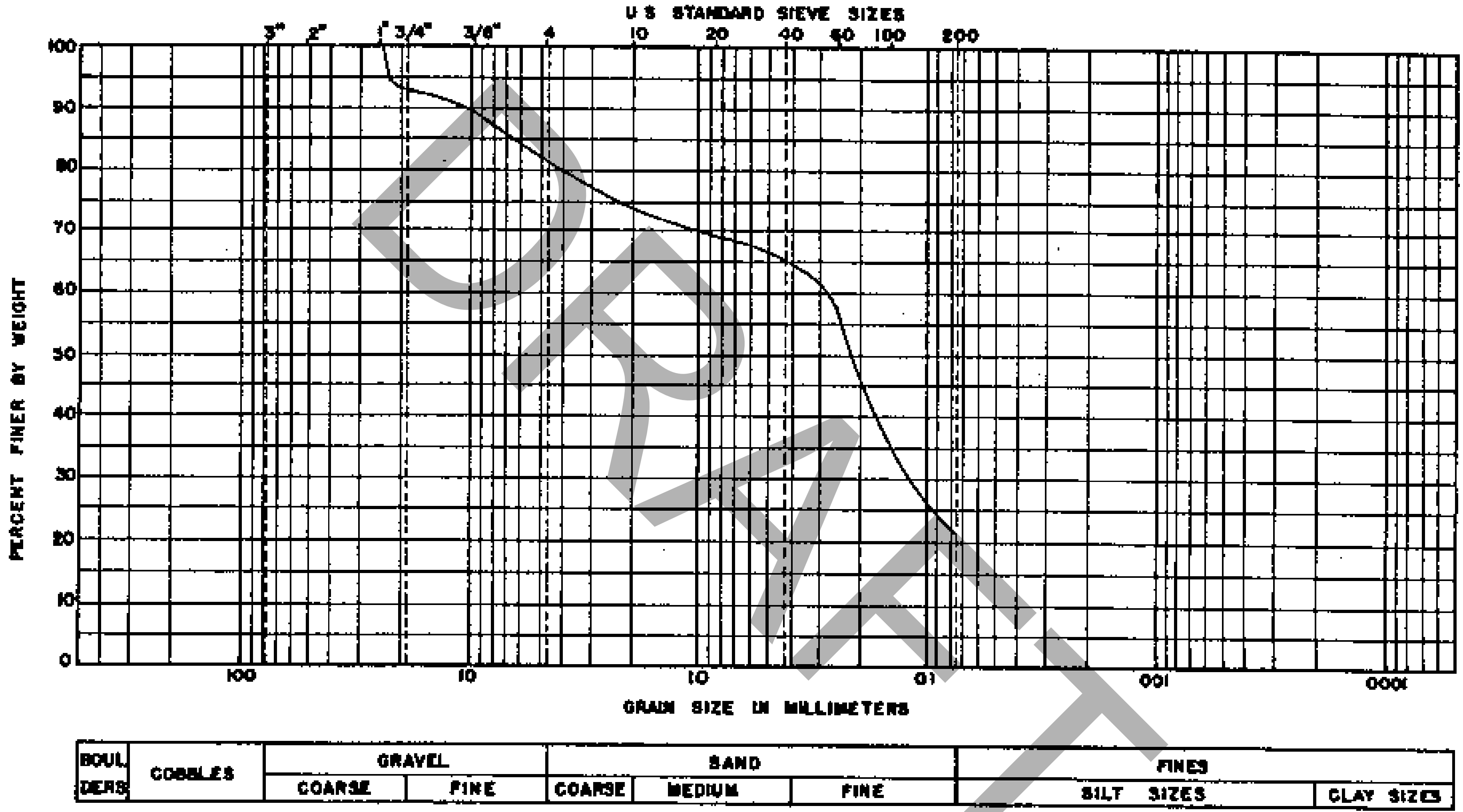

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-16 | 7.0-11.5' | 15.1 | 23 | NP | NP | Light Gray To White Clayey Silty Fine SAND (SM/SC) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

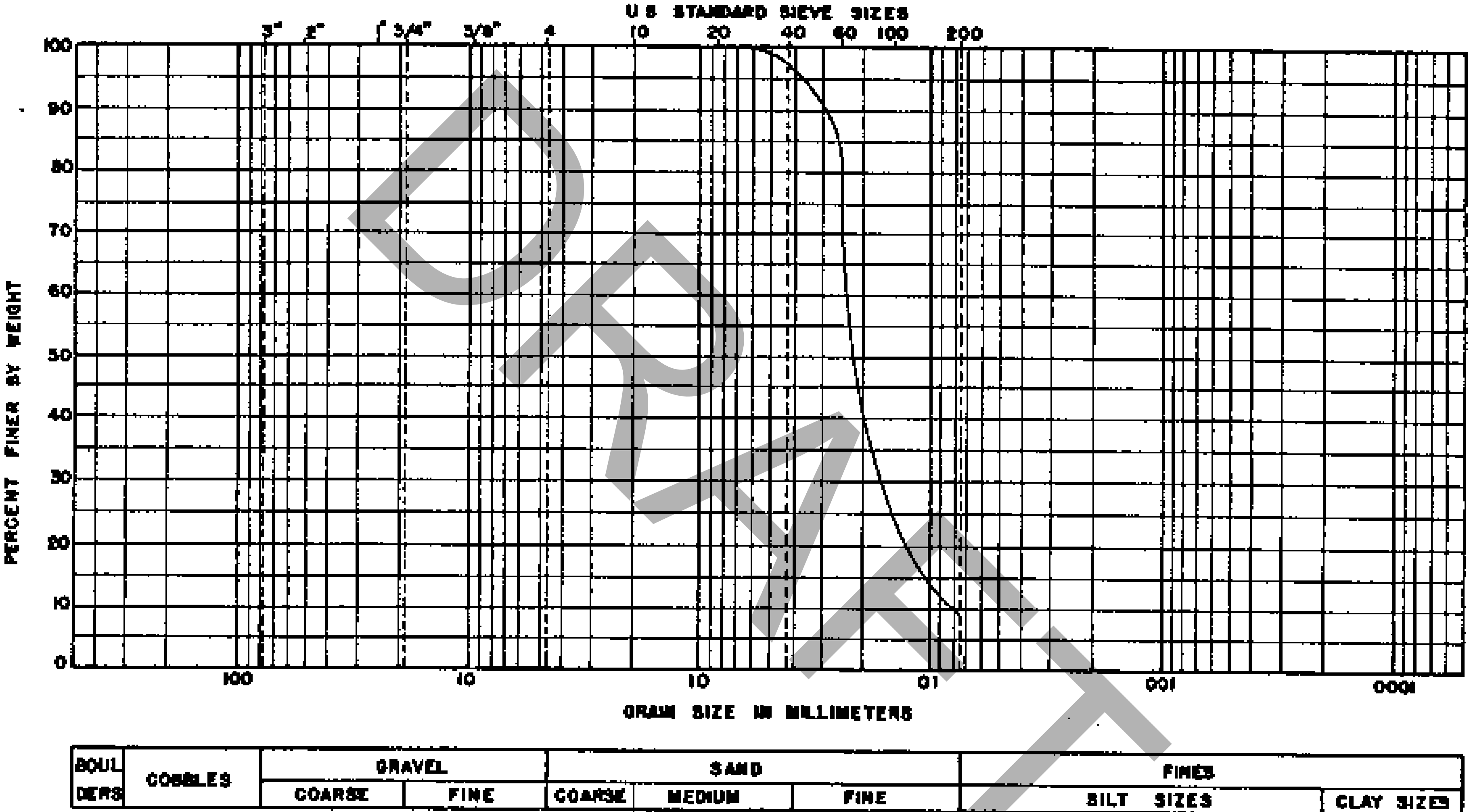



| BORING NO | ELEV OR DEPTH | NAT WC | L L | PL | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-16 | 1.5-7.0' | | | | | Tan Silty Fine To Coarse SAND With Fine Gravel (SM) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY

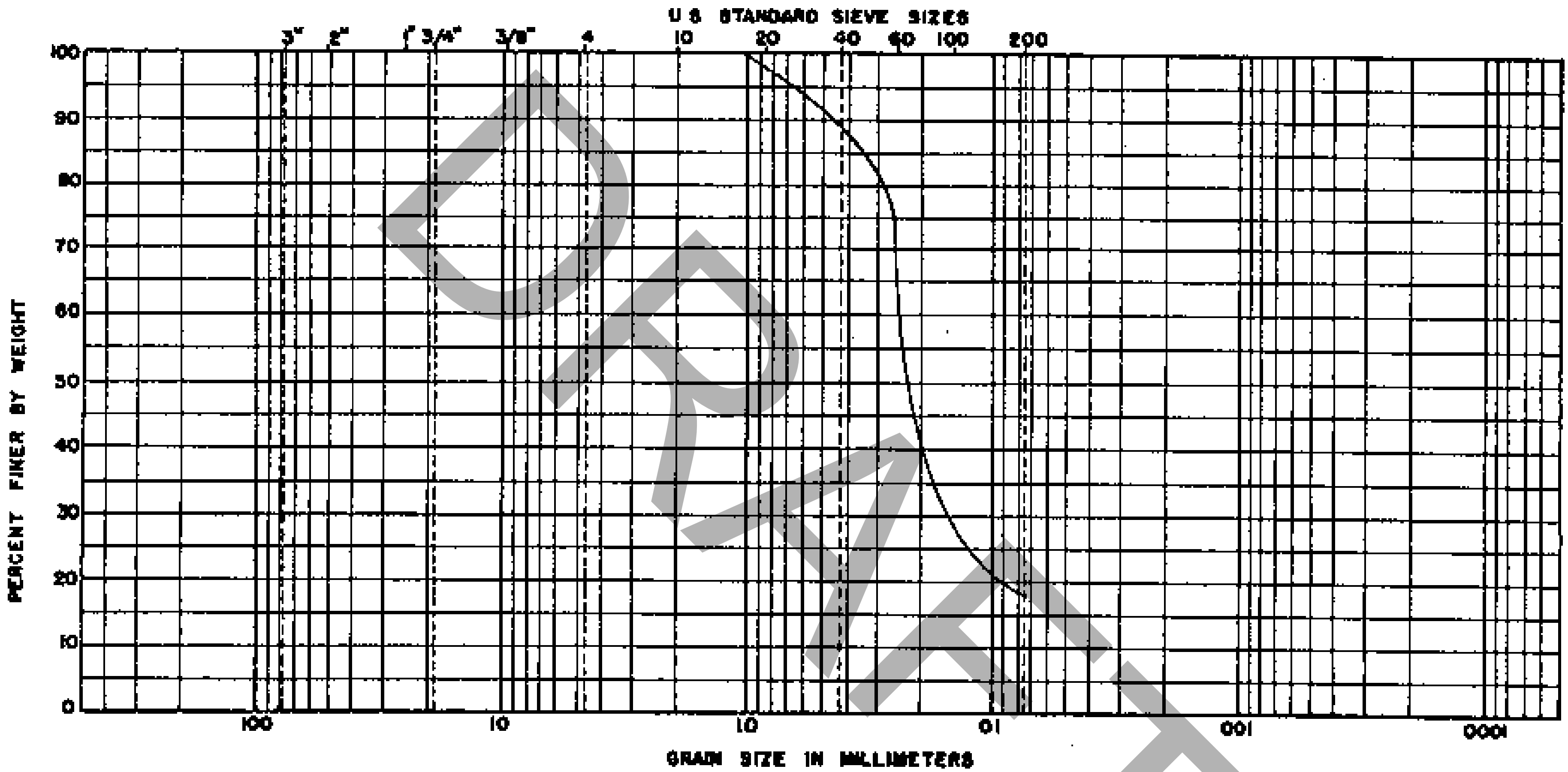



| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-14 | 0.0-5.0' | | | | | Red Slightly Silty Fine SAND (SM) |

**GRAIN SIZE DISTRIBUTION**

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY



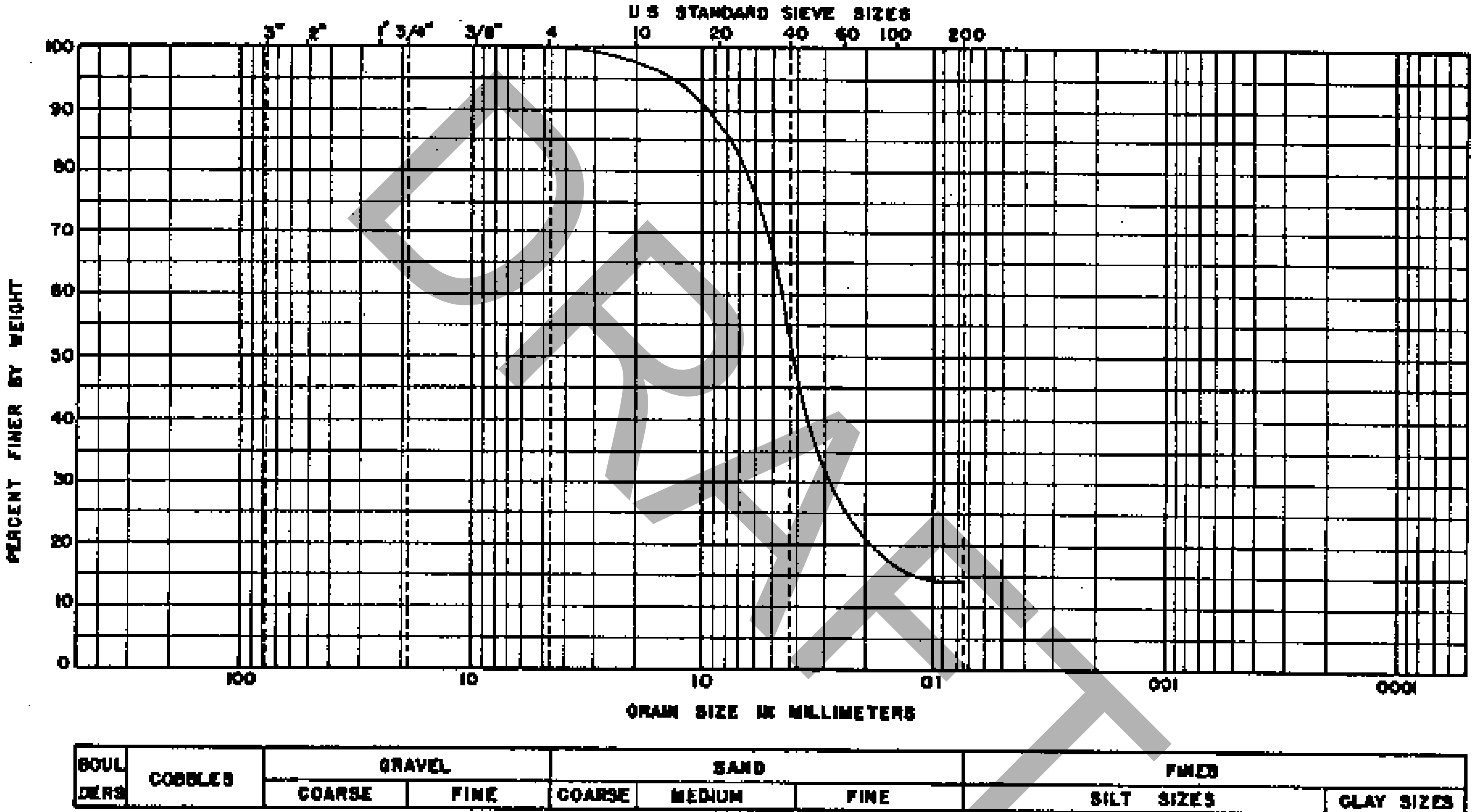

| BOULDERS | COBBLES | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | SILT SIZES | CLAY SIZES |

| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-6 | 5.5-10.5' | | | | | Reddish-Brown And Gray Slightly Silty Fine To Medium SAND (SM) |

## GRAIN SIZE DISTRIBUTION

JOB NO. RA-1365

LAW ENGINEERING TESTING COMPANY




| BORING NO | ELEV OR DEPTH | NAT WC | L L | P L | P I | DESCRIPTION OR CLASSIFICATION |
|---|---|---|---|---|---|---|
| AP-3 UD-10 | 25.0-27.0' | 17.6 | NP | NP | NP | Gray Silty Fine To Medium SAND (SM) |

## GRAIN SIZE DISTRIBUTION

JOB NO. BA-1365

LAW ENGINEERING TESTING COMPANY

# COMPACTION TEST

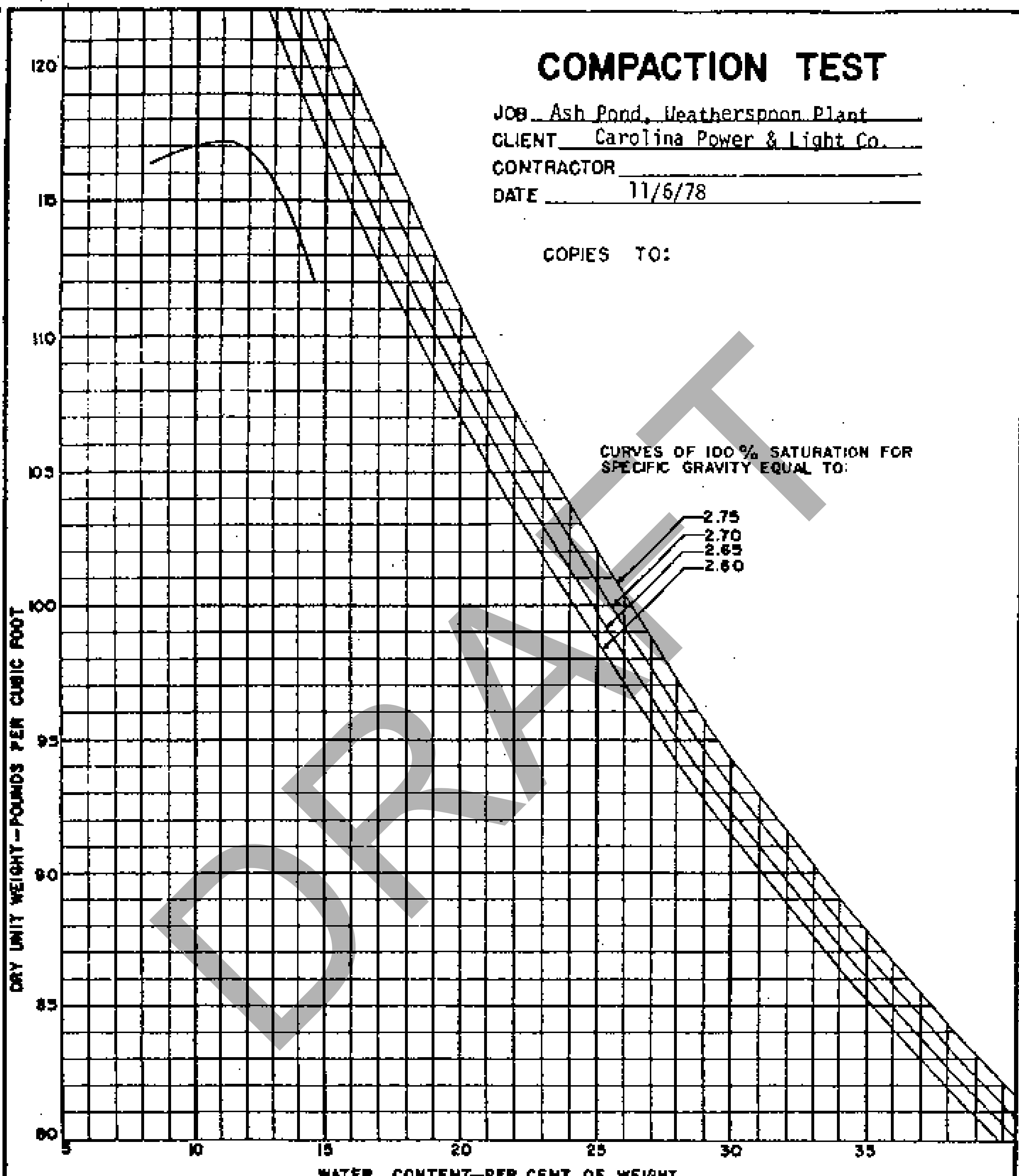
JOB Ash Pond, Weatherspoon Plant

CLIENT Carolina Power & Light Co.

CONTRACTOR

DATE 11/6/78

COPIES TO:





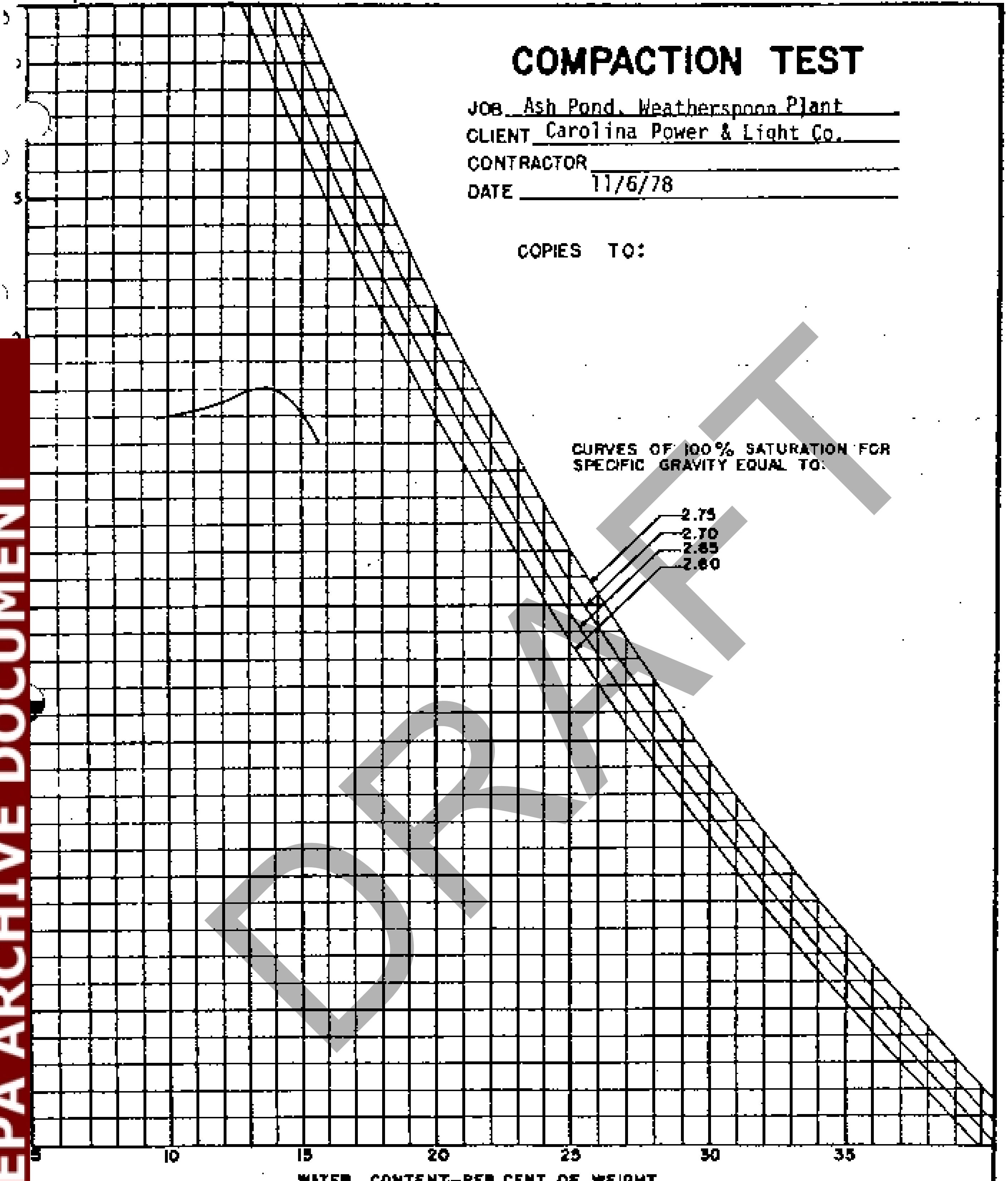

| MOISTURE DENSITY RELATION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| AP-10 0-5.0' | ASTM D-698C | 117.2 | 11.2 | Reddish Brown Silty SAND With Some Gravel (SM) |

LAW ENGINEERING TESTING CO. BY

# COMPACTION TEST

JOB Ash Pond, Weatherspoon Plant
CLIENT Carolina Power & Light Co.
CONTRACTOR
DATE 11/6/78

COPIES TO:




| ...URE ...ITY ...TION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| ...14 ...0' | ASTM D-698C | 108.1 | 13.7 | Red Slightly Silty Fine SAND (SM) |

ENGINEERING TESTING CO. BY

# COMPACTION TEST

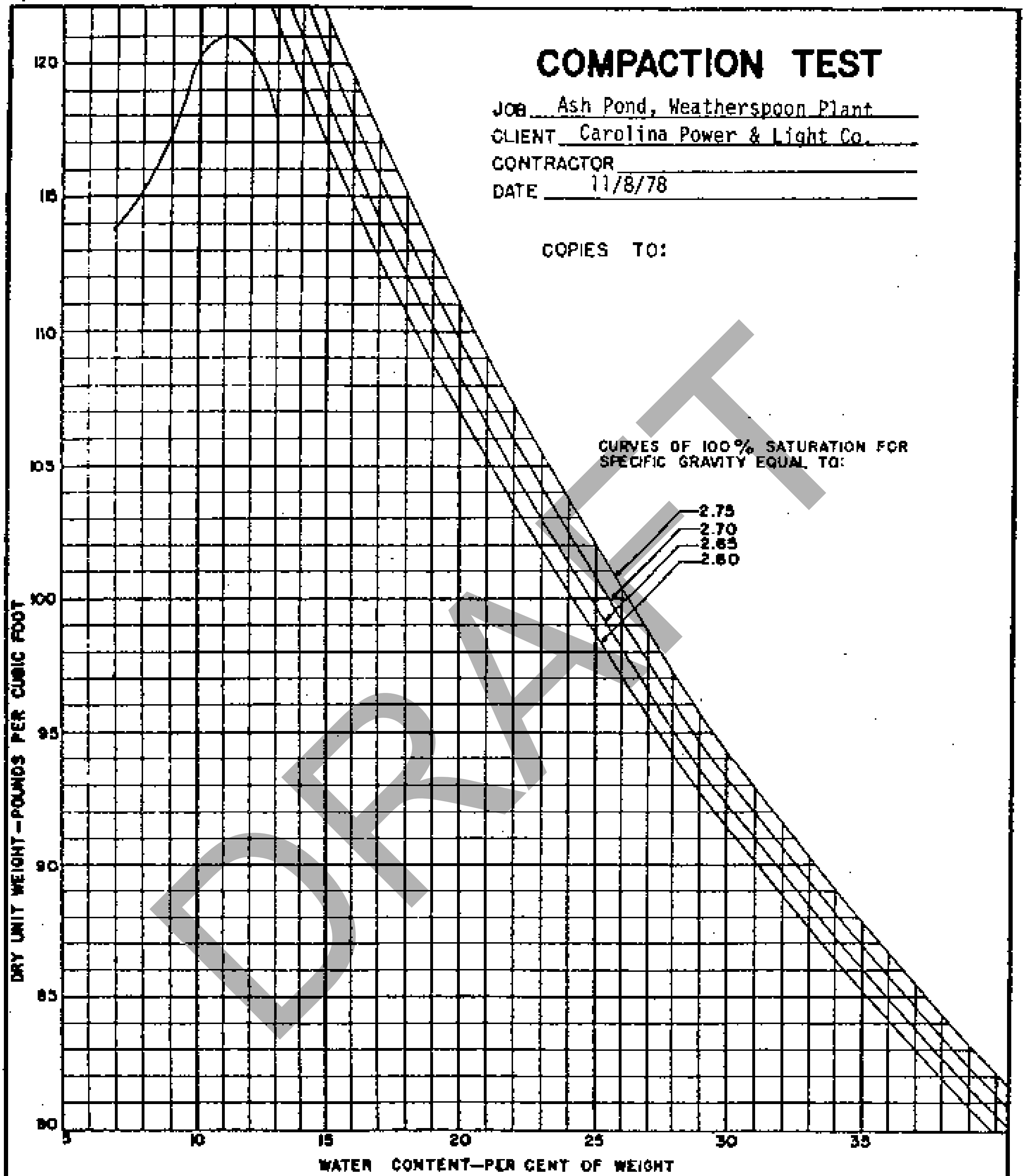
JOB Ash Pond, Weatherspoon Plant

CLIENT Carolina Power & Light Co.

CONTRACTOR

DATE 11/8/78

COPIES TO:



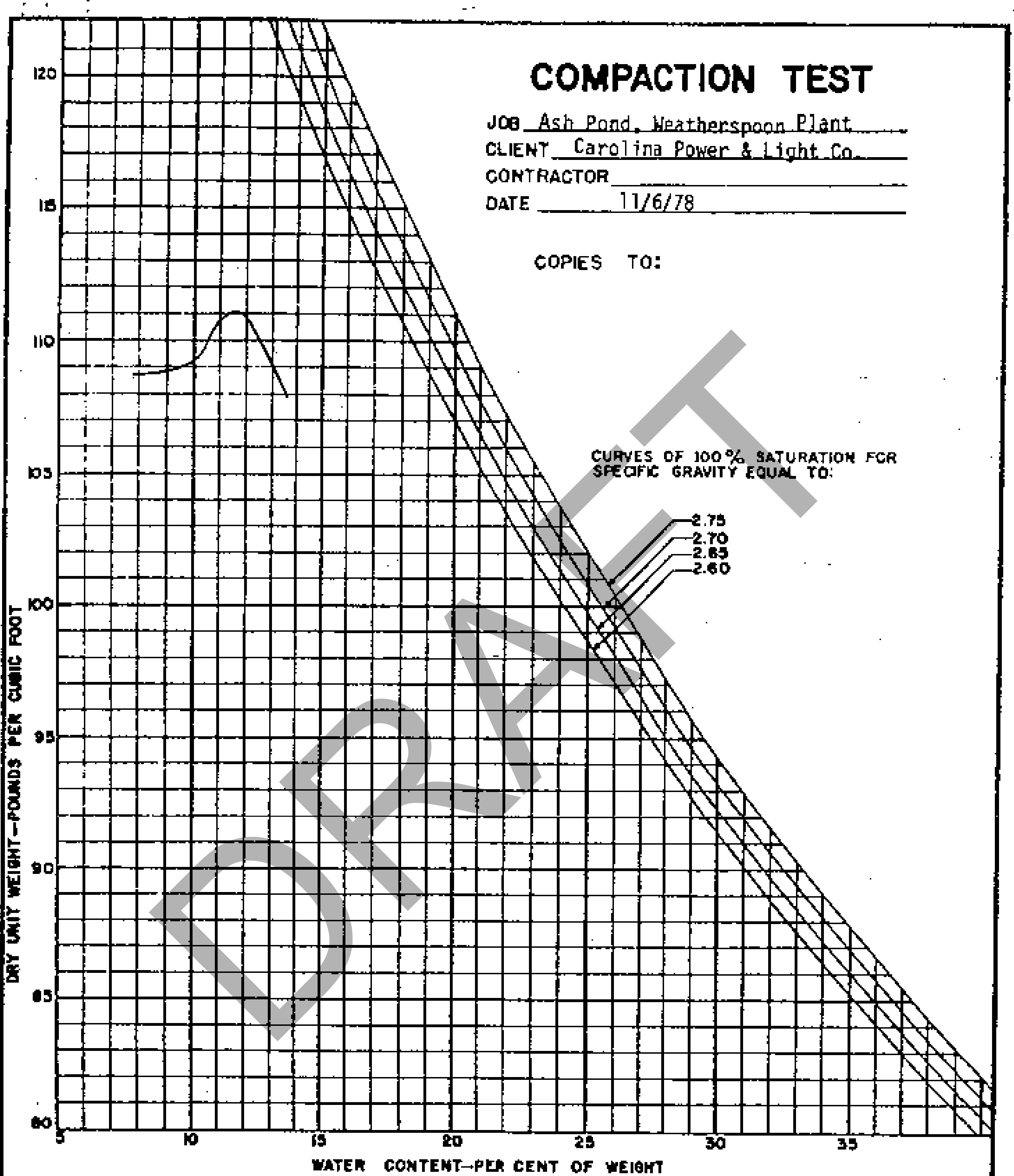

| MOISTURE DENSITY RELATION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| AP-19<br>5-10.0' | ASTM<br>D-698C | 121.0 | 11.0 | Gray Silty Fine SAND (SM) |

LAW ENGINEERING TESTING CO. BY

# COMPACTION TEST

JOB Ash Pond, Weatherspoon Plant
CLIENT Carolina Power & Light Co.
CONTRACTOR
DATE 11/6/78

COPIES TO:



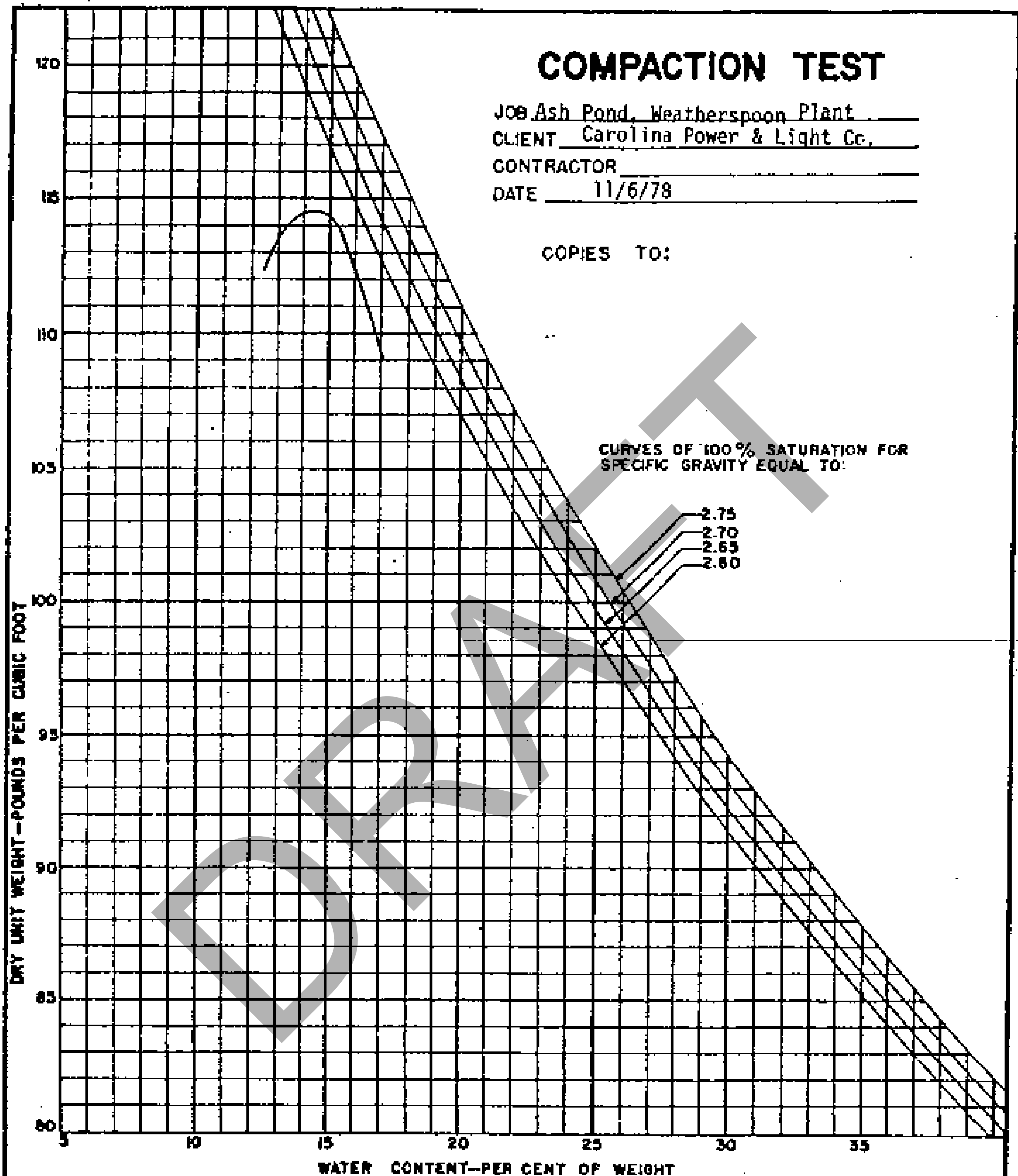

| MOISTURE DENSITY RELATION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| AP-21 0-5.0' | ASTM D-698C | 111.1 | 11.6 | Brown And Gray Silty Fine To Medium SAND (SM) |

LAW ENGINEERING TESTING CO. BY

# COMPACTION TEST

JOB Ash Pond, Weatherspoon Plant
CLIENT Carolina Power & Light Co.
CONTRACTOR
DATE 11/6/78

COPIES TO:





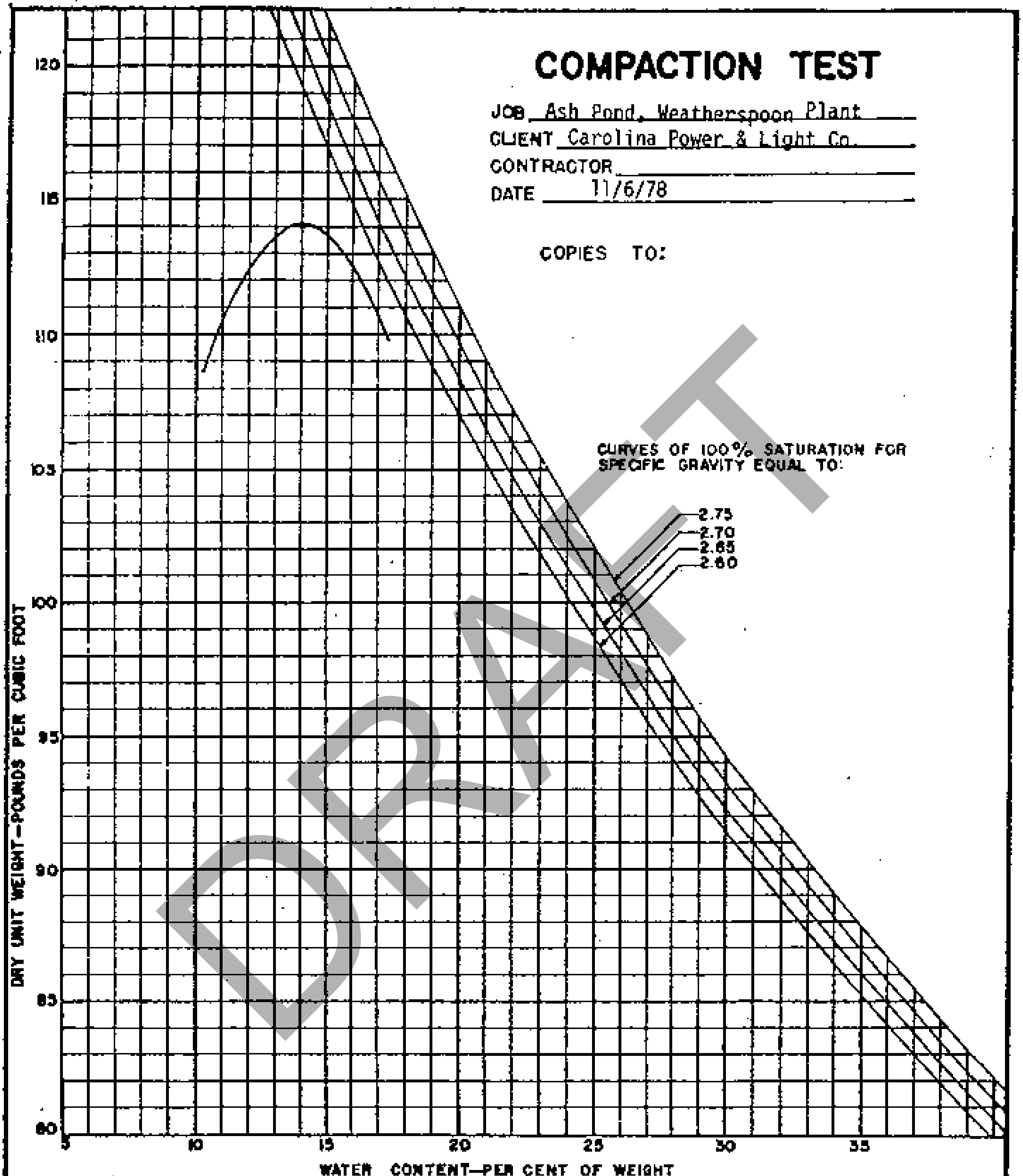

| MOISTURE DENSITY RELATION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| AP-23 5-9.0' | ASTM D-698C | 114.5 | 14.6 | Red, Brown, And Tan Silty Fine To Medium SAND With A Trace Of Clay (SM) |

LAW ENGINEERING TESTING CO. BY

# COMPACTION TEST

JOB Ash Pond, Weatherspoon Plant
CLIENT Carolina Power & Light Co.
CONTRACTOR
DATE 11/6/78

COPIES TO:



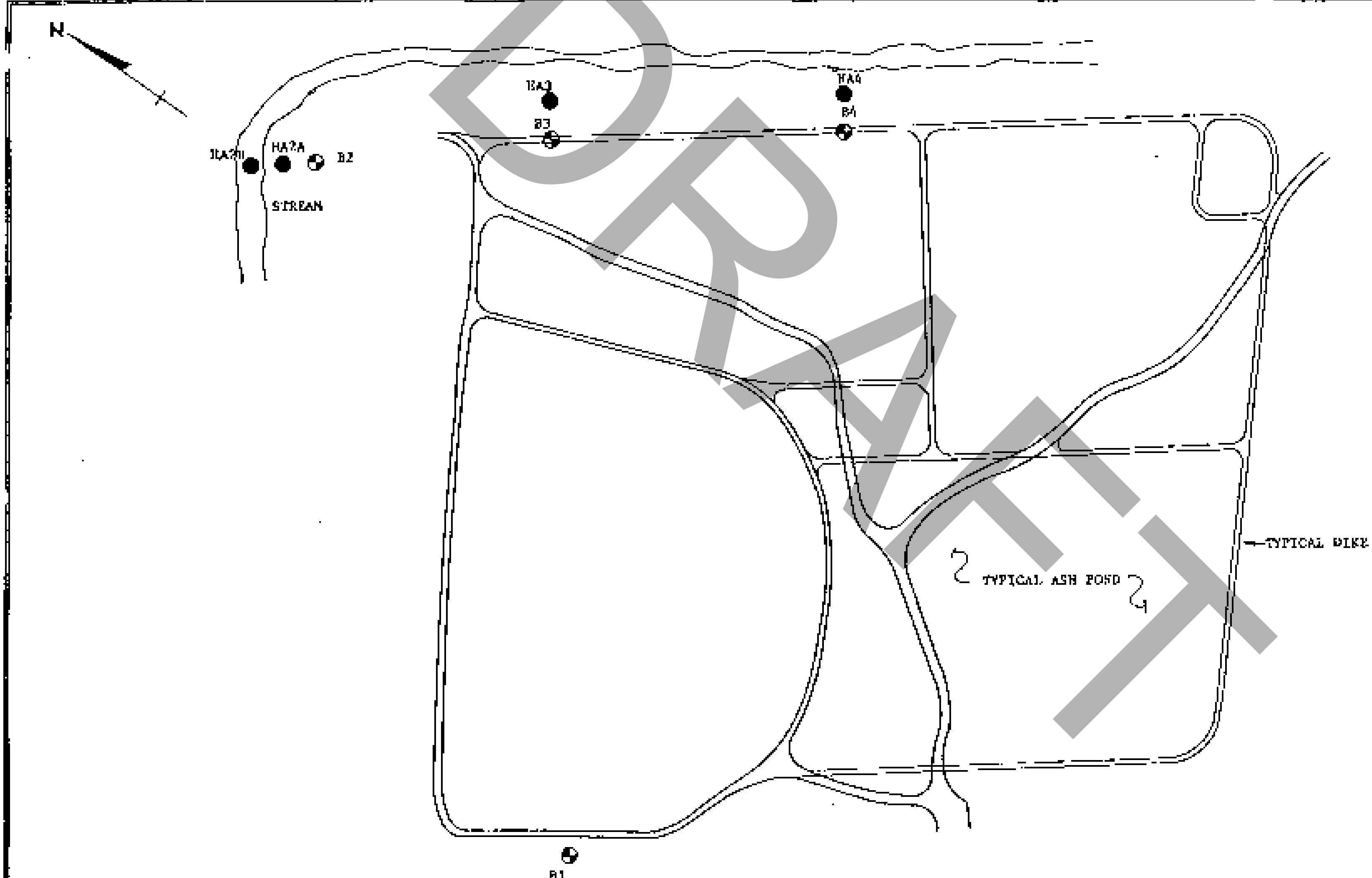

| MOISTURE DENSITY RELATION | METHOD OF TEST | MAX. DRY DENSITY PCF | OPTIMUM MOISTURE CONTENT % | SOIL DESCRIPTION OR CLASSIFICATION AND SAMPLE LOCATION |
|---|---|---|---|---|
| AP-25 0-7.5' | ASTM D-698C | 114.1 | 14.1 | Tan And Gray Silty Clayey Fine SAND (SC/SM) |



LAW ENGINEERING TESTING CO. BY

# F-2

**BORING LOCATION PLAN AND BORING LOGS FROM LAW ENGINEERING 1988 EXPORATION**

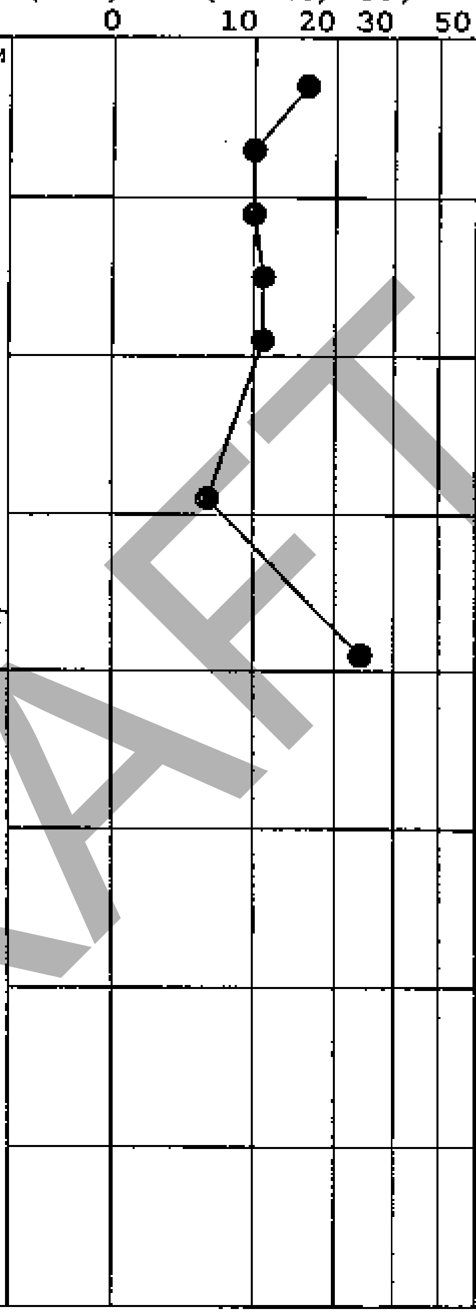



| | |
|---|---|
| BORING LOCATION DIAGRAM | LAW ENGINEERING RALEIGH, NORTH CAROLINA |
| CAROLINA POWER & LIGHT COMPANY WEATHERSPOON PLANT | SCALE: NTS · Drawn: DW · Checked: CPA · Date: 6-8-88 · Job No. J3419 · Dwg. No. 2 |
| LUMBERTON, NORTH CAROLINA | |

# TEST BORING RECORD

| DEPTH (FT.) | DESCRIPTION | | ELEVATION (FT.) | BLOWS PER SIX IN. | REC. (IN.) |
|---|---|---|---|---|---|
| 0.0 | Firm to loose moist tan to dark tan silty fine SAND (fill). | SM | | 9-7-9 | 13 |
| | | | | 4-4-6 | 8 |
| | | | | 5-5-5 | 5 |
| | | | | 5-5-6 | 6 |
| | | | | 5-5-6 | 9 |
| | | | | 2-3-3 | 18 |
| 18.0 | Very firm wet fine SAND. | SP | | 9-11-13 | 18 |
| 20.0 | Boring terminated at 20 feet. | | | | |

PENETRATION (BLOWS/FT.)




REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER J3419
BORING NUMBER B-1
DATE 6/2/88

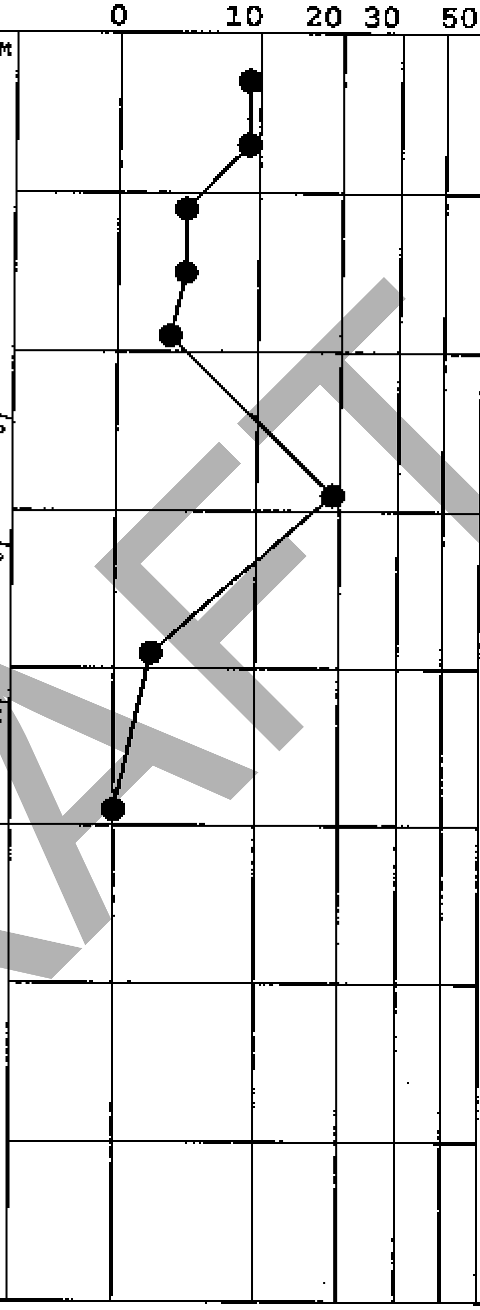
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

# TEST BORING RECORD

| DEPTH (FT.) | DESCRIPTION | | ELEVATION (FT.) | BLOWS PER SIX IN. | REC. (IN.) |
|---|---|---|---|---|---|
| 0.0 | Loose to very loose moist reddish tan or dark tan silty fine SAND fill. | SM | | 9-5-4 | 4 |
| | | | | 3-4-5 | 5 |
| | | | | 3-2-2 | 2 |
| | | | | 1-2-2 | 1 |
| | | | | 1-1-2 | 2 |
| 12.0 | Firm moist red and tan fine SAND. | SP | | 4-8-11 | 18 |
| 16.0 | Very loose wet pink fine SAND. | SP | | 1-1-1 | 1 |
| 21.0 | Very soft wet brown CLAY. | CH | | * WOH | 18 |
| 25.0 | Boring terminated at 25 feet. | | | | |
| | * WOH = Weight of Hammer | | | | |

PENETRATION (BLOWS/FT.)






REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER J3419
BORING NUMBER B-2
DATE 6/2/88

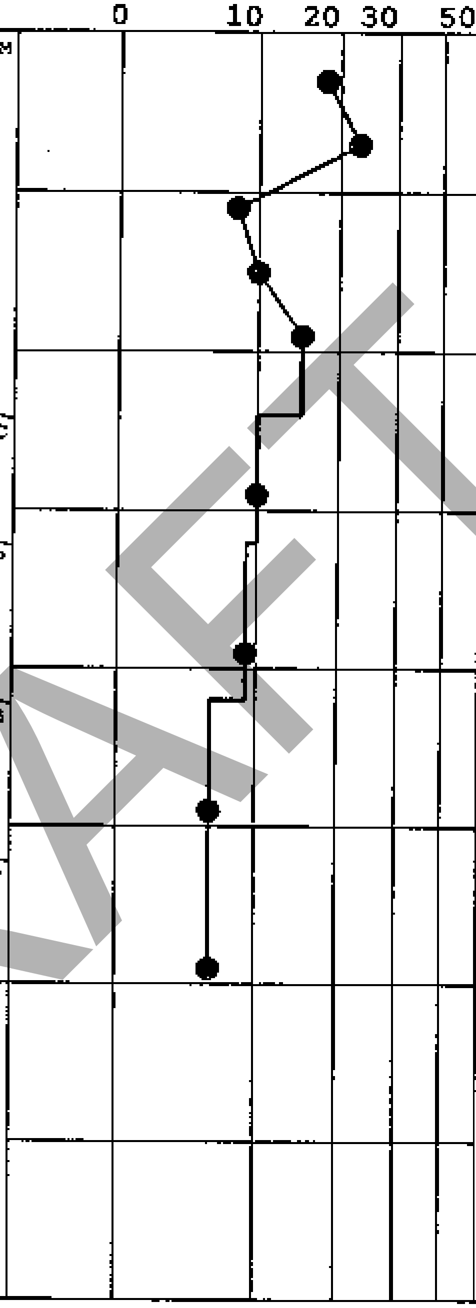
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

# TEST BORING RECORD

| DEPTH (FT.) | DESCRIPTION | | ELEVATION (FT.) |
|---|---|---|---|
| 0.0 | Very firm to loose moist orange or dark tan silty fine SAND (fill). | SM | |
| 12.0 | Loose moist reddish tan clayey SAND (possible fill). | SC | |
| 16.0 | Loose moist gray fine SAND. | SP | |
| 21.0 | Loose wet dark brown slightly organic silty fine SAND. | SM | |
| 26.0 | Loose wet light tan fine SAND. | SP | |
| 30.0 | Boring terminated at 30 feet. | | |

PENETRATION (BLOWS/FT.)




| BLOWS PER SIX IN. | REC. (IN.) |
|---|---|
| 4-9-9 | 10 |
| 8-11-12 | 10 |
| 3-4-4 | 4 |
| 4-5-5 | 2 |
| 6-8-7 | 6 |
| 3-5-5 | 18 |
| 6-5-4 | 18 |
| 2-3-3 | 18 |
| 1-3-3 | 18 |



REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

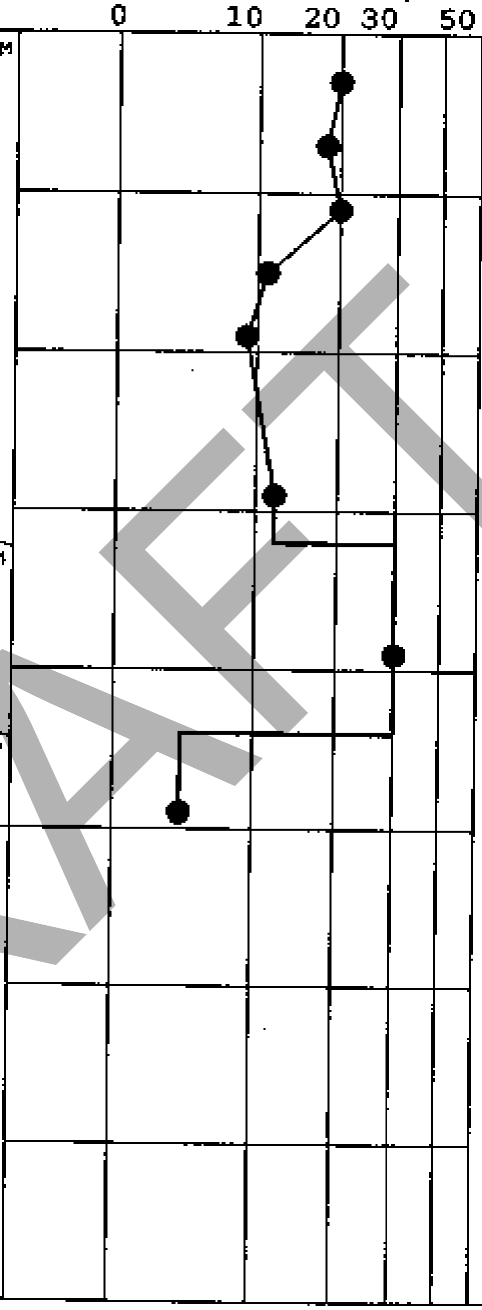
JOB NUMBER J3419
BORING NUMBER B-3
DATE 6/2/88

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

# TEST BORING RECORD

| DEPTH (FT.) | DESCRIPTION | | ELEVATION (FT.) | PENETRATION (BLOWS/FT.) 0 10 20 30 50 | BLOWS PER SIX IN. | REC. (IN.) |
|---|---|---|---|---|---|---|
| 0.0 | Firm to loose moist tan silty fine SAND (fill). | SM | | | 8-10-10 | 11 |
| | | | | | 5-9-9 | 10 |
| | | | | | 5-9-11 | 10 |
| | | | | | 4-5-6 | 4 |
| | | | | | 4-3-6 | 7 |
| | | | | | 6-7-5 | 18 |
| 16.0 | Very firm very moist red and tan silty fine to coarse SAND. | SM | | | 10-14-16 | 18 |
| 22.0 | Very loose wet light tan slightly silty very coarse SAND. | SP | | | 1-2-2 | 18 |
| 25.0 | Boring terminated at 25 feet. | | | | | |





REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER J3419
BORING NUMBER B-4
DATE 6/2/88

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

HAND AUGER BORINGS
CP&L WEATHERSPOON
LAW JOB NO. J3419

| LOCATION | DEPTH FROM TO | TYPE | COMMENTS |
|---|---|---|---|
| HA1 | 0 - 2 | SP | Tan to brown fine SAND<br>Auger refusal @ 2' |
| HA2A | 0 - 0.5 | SM | Brown organic silty SAND |
| | 0 - 3.0 | SM | Tan or gray silty SAND |
| | 3 - 6.0 | CL | Reddish tan sandy CLAY |
| HA2B | 0 - 3 | SW | Wet tan to light tan fine to coarse SAND |
| HA3 | 0 - 1.5 | SM | Tan silty fine SAND (fill?) |
| | 1.5 - 3.0 | SM | Tan silty fine SAND with roots |
| | 3.0 - 4.0 | SM | Dark brown organic silty fine SAND |
| | 4.0 - 5.0 | SM | Tan silty fine SAND |
| HA4 | 0 - 5' | SM | Tan or gray silty fine SAND |

LAW ENGINEERING TESTING COMPANY
3301 WINTON ROAD
RALEIGH, NORTH CAROLINA
SOIL DATA SUMMARY-JOB NO. J-3419

| BORING NO. | DEPTH, FEET | SAMPLE TYPE | CLASSIFICATION | UNIT WEIGHT, pcf | | % FINER NO. 200 SIEVE | SPECIFIC GRAVITY | VOID RATIO | NATURAL MOISTURE | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | WET | DRY | | | | | LL | PL | PI |
| B-2 | 22.5'-25' | SS | CH | | | | | | 80.6 | 83 | 26 | 57 |

SS- SPLIT SPOON
UD- UNDISTURBED SAMPLE

# F-3

## LAW ENGINEERING REPORT "SEEPAGE AND STABILITY ANALYSIS, ASH POND DIKE" JANUARY 21, 1993 (SELECTED PORTIONS)

LAW ENGINEERING

GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS

January 21, 1993

Carolina Power & Light Co.
P. O. Box 1551
One Hannover Square (OHS-7B1)
Raleigh, North Carolina 27602

Attention: Mr. Angel Santiago

SUBJECT: **SEEPAGE AND SLOPE STABILITY ANALYSIS
ASH POND DIKE
W.H. WEATHERSPOON STEAM ELECTRIC PLANT
LUMBERTON, NORTH CAROLINA
LAW ENGINEERING JOB NO. 472-05567-03**

Dear Mr. Santiago:

Law Engineering is pleased to submit this report of our geotechnical analysis for the proposed project. Our services were provided in accordance with Law Engineering Proposal No. 47292-4809. This report presents a review of the information provided to us, a discussion of the site and subsurface conditions, water levels, results of our analyses and recommendations. The Appendix contains a boring location plan, profiles of observation wells, in-situ hydraulic conductivity test results, stability analyses, and the results of our field and laboratory tests.

The assessment of site environmental conditions or the presence of contaminants in the soil, rock, surface water or groundwater of the site was beyond the scope of this exploration.

## PROJECT INFORMATION

Project information has been provided by Mr. Angel Santiago of Carolina Power & Light Company. We have drawings entitled "Ash Pond Area" and "Ash Pond-Sections & Details" which were prepared by Carolina Power & Light Company and dated December 1, 1978 and November 30, 1978, respectively. The proposed site is located at the W. H. Weatherspoon Steam Electric Plant in Lumberton, North Carolina.

3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

An earlier preliminary report dated March 30, 1992 was performed by Law Engineering (Job #472-05567-02) which addressed observations and phreatic levels from hand auger borings along the ash pond dike. The March 1992 report noted seepage which was occurring along the south and southwest toe of the ash pond dike. Because of the continuation of seepage, further investigation was authorized by Carolina Power & Light Company.

## FIELD EXPLORATION AND LABORATORY TESTING PROGRAM

In order to determine the esh pond dike materials and to aid in developing seepage and stability analyses, 10 soil test borings were drilled to depths ranging from 3 to 30 feet below existing grades on the crest and outside slopes of the ash pond dike. The crest borings were performed by a trailer-mounted power drilling rig using hollow stem auger drilling procedures. Samples were taken by driving a 1 3/8 inch I.D. split-spoon sampler in general accordance with ASTM D-1586 specifications at 2.5 feet to 5.0 feet intervals. A 2-foot continuous soil sample was obtained in boring 3A from 14 to 16 feet to be used for triaxial shear strength testing.

The geotechnical engineer performed seven hand augers on the side slopes. Three of these hand auger borings were located mid-slope and three near the toe at or near visible seepage. Temporary observation wells were installed in each of the borings/probes to assist in developing three separate cross-sections showing a phreatic surface. One additional hand auger boring was performed mid-slope and below the secondary settlement basin. Boring locations and three cross-sections are included in the Appendix.

The boring locations were selected by representatives of Law Engineering and are shown on Drawing No. 2 in the Appendix. The borings were located in the field by Law Engineering personnel by taping distances and estimating right angles from existing site features. Vertical control on each well was established by Law Engineering one week after installation. A reference point, randomly selected, was used as a Temporary Bench Mark at elevation 145 feet MSL (reference to design drawings "Ash Pond-Sections & Details"). These locations should be considered accurate only to the degree implied by the methods used.

All semples obtained in the field were logged by the field geotechnical engineer and visually classified in accordance with the Unified Soil Classification System. Representative portions of select samples were collected and returned to our laboratory.

Logs of all borings showing visual descriptions of all soil strata and the sampling and field test data are included in the Appendix. Information sheets describing the Unified Soil Classification System and the terms and symbols used on the soil boring logs are also included.

Water levels in the observation wells were obtained by plant personnel on December 31, 1992 (24 hour levels). One week (January 6, 1993) readings were taken by Law Engineering personnel. In addition, three in-situ hydraulic conductivity test (slug test-rising head permeability tests) were performed on wells #2A, 3A and 3B. The results of these tests (see Appendix) were used in seepage quantity calculations.

The evaluation and recommendations presented in this report were developed from an interpretation of the general subsurface conditions within the dike based on information obtained from the soil borings and wells. The stratification lines indicated on the boring logs represent the approximate boundaries between soil types; in-situ, the transitions may be gradual. Variations in soil conditions and water levels between borings can also occur.

## LABORATORY TESTING

Laboratory analysis was conducted on representative soil samples to aid in classification and to estimate pertinent engineering properties of the dike soils. Natural moisture contents, Atterberg limits, and grain size tests were conducted. In addition, a triaxial shear test was performed on a remolded sample of the soil obtained in boring 3A from 14 to 16 feet. All testing was done in general accordance with applicable ASTM specifications. The results of these tests are included in the Appendix of this report.

## SITE AND SUBSURFACE CONDITIONS

The ash pond is located in Lumberton, North Carolina at the W. H. Weatherspoon Steam Electric Plant, as shown on Drawing No. 1 in the Appendix. The portion of the dike evaluated is located along the south section of the ash pond and is covered with vegetation consisting of grass and weeds. Seepage was noticeable on December 30, 1992 and January 6, 1993 along the south section and emerging from the toe and up-slope with approximate elevations ranging from 119 feet to 126 feet. We understand that within the ash pond, solids occur approximately 5 to 6 feet below pool elevations.

The typical subsurface conditions encountered in the borings may be summarized by strata as follows:

| STRATUM DESIGNATION | STRATUM DEPTH | STRATUM DESCRIPTION | USCS CLASSIFICATION |
|---|---|---|---|
| Earthen Dike Fill | Crest to 17 feet | Brown clayey fine to medium SAND | SC |
| | 17 feet to 24 feet | Gray and brown silty very fine SAND | SP/SM |
| Natural Ground | 24 feet to 30 feet | Gray silty very fine SAND | SP/SM |

## RESULTS

### Phreatic Surfaces

Weter levels were checked in the wells at the completion of drilling operations at each boring location, after 24 hours, and after one week. The levels shown on the crest boring records indicate water at depths ranging from 15 to 20 feet below the existing ground surface which corresponds to site elevations of 125 to 130 feet. These dike crest water levels represent total head screened and sealed as indicated in the well construction records. Water levels measured in the shallower side slope wells indicated total saturation occurring within 2 feet and 1/2 foot of the surface from the mid-slope and toe respectively.

Cross sections in Drawing #2 illustrates inconsistent phreatic surfaces from wells A to C. The head levels in the B wells in each cross section appear to be higher than expected. These wells are likely to be filling from saturated conditions in the surface soils. A more likely phreatic surface would be represented by a line drawn from the ash pond pool elevation, to the measured water level in the deep crest wells and extending to the seepage exit point near the "C" wells.

Fluctuations in the location of the phreatic surface may occur depending on variations in precipitation, ash slurry discharge rates, pond evaporation and surface water runoff on the dike.

Hydraulic Conductivity

Based on the results of our in-situ hydraulic conductivity tests (slug tests), we calculated k values ranging from $1.5 \times 10^{-3}$ to $1.6 \times 10^{-4}$ cm/s. It should be noted that these tests represent the lower portion (15 to 18 feet below the center of the crest) of the saturated zone of the dike. The lower portions of the dike consist of less clayey soils (SP/SM) and are likely to have higher permeabilities than the upper clayey sands (SC).

Seepage

Site observations indicate that seepage is occurring in the bottom 10 feet of the outside dike slope and is most prevalent between wells W-2 to W-4. Some iron oxide staining was noted in the seepage water at the toe of the dike. Iron oxide staining indicates that water exiting at the toe of the dike is an indication of seepage through the dike rather than surface water drainage.

A flow net was constructed and discharge values calculated. Input parameters were varied to achieve a range of results. The results indicate discharge values (q) ranging from 0.010 gallons per minute (gpm) to 0.022 gpm per foot of dike length. Exit gradients for lateral discharge were calculated at .5 ft/ft to .8 ft/ft. No visual signs of high seepage velocities or soil loss such as sand boils, cavities, or murky seepage water were observed.

Slope Stability

During our visits and exploration to the site, the dike crest and side slopes were observed for tension cracks, soil sloughing and bulging. No such visual indicators of slope stability were observed on our two visits (December 30, 1992 and January 6, 1993).

Several computer modeled slope stability analyses were performed for the worse case dike section. The dike section at our well set, 3A to 3C, was used because it was the steepest section. Strength values were estimated from average SPT values and soil types obtained in the borings. The triaxial test results were used for comparison. Based on our stability analyses, again varying input parameters, we obtained the following results with raspect to factor of safety against a deep circular failure:

| RUN # | SOIL #1 PARAMETERS ** | | | SOIL #2 PARAMETERS ** | | | FS AGAINST CIRCULAR FAILURE* |
|---|---|---|---|---|---|---|---|
| | γ | φ | c | γ | φ | c | |
| WSP3D | 115 | 31.6 | 317 | 115 | 34 | 0 | 1.35 |
| WSP3E | 115 | 31.6 | 317 | 115 | 34 | 50 | 1.46 |
| WSP3F | 115 | 30 | 400 | 115 | 34 | 0 | 1.38 |
| WSP3G | 115 | 30 | 400 | 115 | 34 | 0 | 1.42*** |

* Stable 6 - Bishop Method of Slices
** γ = unit weight (pcf)
φ = friction angle (°)
c = cohesion (psf)
*** Failure plane limited to EL 108 FT.

Based on these results and our observations of the saturated zone in the deeper crest borings, we believe that the dike profile is more likely to mimic a lower phreatic condition thereby providing a FS against circular failure of approximately 1.4.

## CONCLUSIONS/RECOMMENDATIONS

After reviewing all of our field data, laboratory and field tests, and calculations, we believe that the south ash pond dike is safe against a circular slope stability failure. Furthermore, the seepage appears to be the result of a two system outflow. The up slope (higher seepage) appears to be discharge from saturated (from precipitation) dike soils near the surface. Some seepage may be transmitting laterally from the surface waters of the ash pond across the section of the dike to the noticeable discharge points. The seepage relative to the deep crest borings (lower phreatic surface) is likely to be exiting in proximity to the observed seepage and iron staining. However, although seepage is occurring along the lower dike face, we believe that:

(1) Seepage is of a minor quantity,
(2) There are no signs of soil loss,
(3) There are no visual signs of dike instability.

Observations of the existing surface soils on the outside slope indicate soft, wet conditions with some erosional rills and vegetation loss. In order to minimize erosion of the slope and further deterioration along the dike toe, we suggest the following steps be considered. We recommend that areas showing noticeable seepage, loss of vegetation, and erosion be smooth graded (light dozer blading) from the toe to the upper extent of problem areas (about mid-slope). This area may include an area from W-1 to 100 feet east of W-4 and approximately 10 to 15 feet up slope from the toe. After this is accomplished, a filter fabric such as a heavy weight (10 to 16 oz.) continuous filament polyester non-woven needle-punched fabric should be placed directly on the graded soil slope. Large stone, boulders, or rip-rap should be placed in a 2 foot thick lift over the fabric. Larger material (6" to 12") will provide better control of erosion as well as a barrier to prevent horse and ATV traffic. Large material would also provide a more resistant and permanent surface.

## CLOSURE/REMARKS

These preliminary analyses and recommendations are, of necessity, based on the concepts made available to us at the time of writing of this report and on-site conditions, surface and subsurface, that existed at the time of the exploratory borings. Further assumption has been made that the limited exploratory borings, in relation to both the areal extent of the site and depth, are representative of conditions across the site.

After reviewing our recommendations, we suggest that:

1. We be retained to review any plans and specifications for remedial actions.

2. A quelified geotechnical engineer or his representative be present at the site during the earthwork construction phases to see that this work is in accordance with the epproved plans and specifications. This is particularly important during soil preparation placement of drainage material and placement of protective stone cover material.

We have appreciated being of service to you in the subsurface exploration phase of this project and are prepared to assist you further as needed. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact this office.

Very truly yours,

LAW ENGINEERING, INC.

Mark E. Landis, P.G.
Senior Engineering Geologist
North Carolina License No. 1169

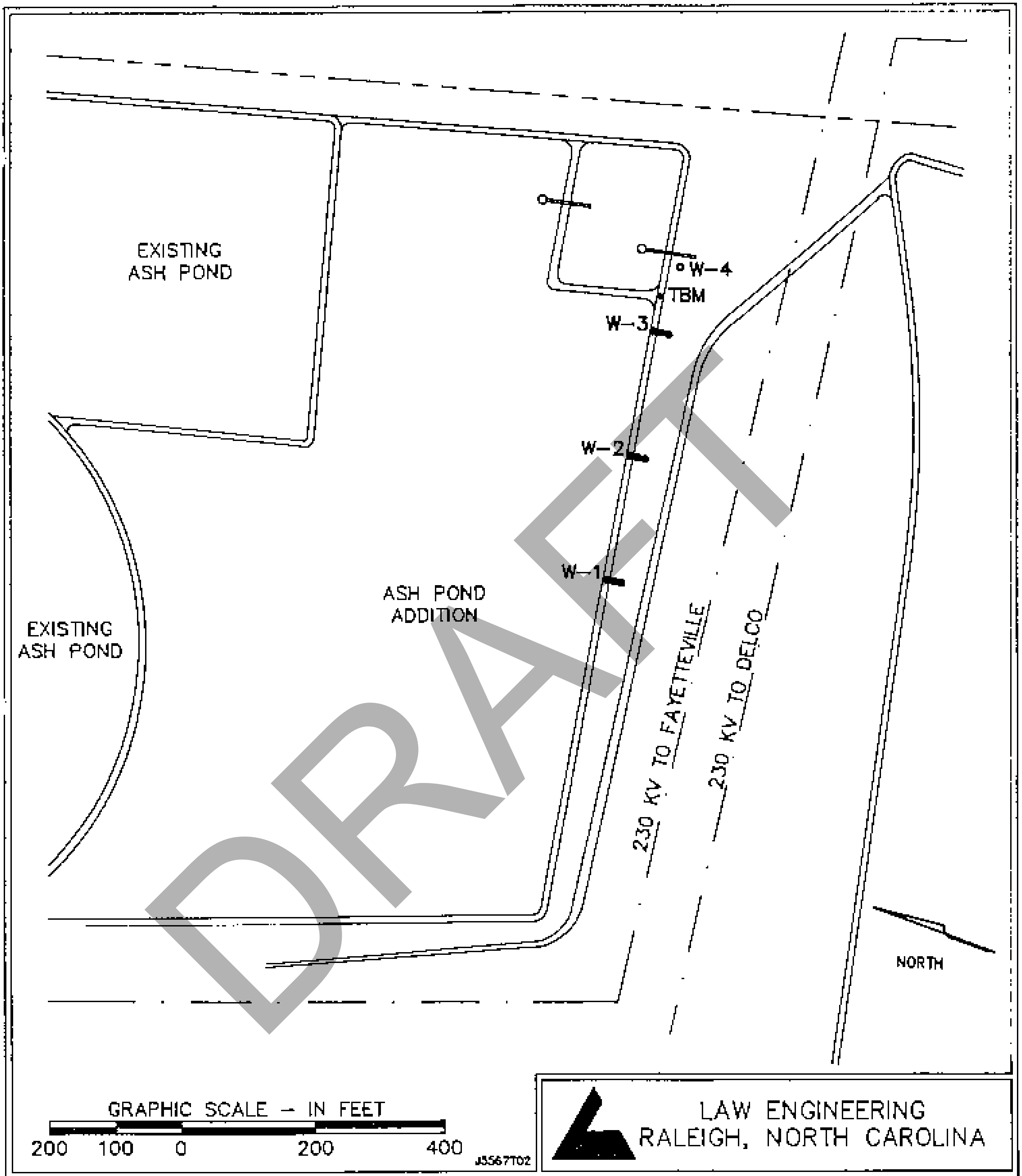
NORTH CAROLINA LICENSED SEAL 1169 GEOLOGIST MARK ETHERIDGE LANDIS

Barney C. Hale, P.E.
Principal Geotechnical Engineer
Registered, North Carolina 11285

MEL/BCH/pap/tag

Attachments

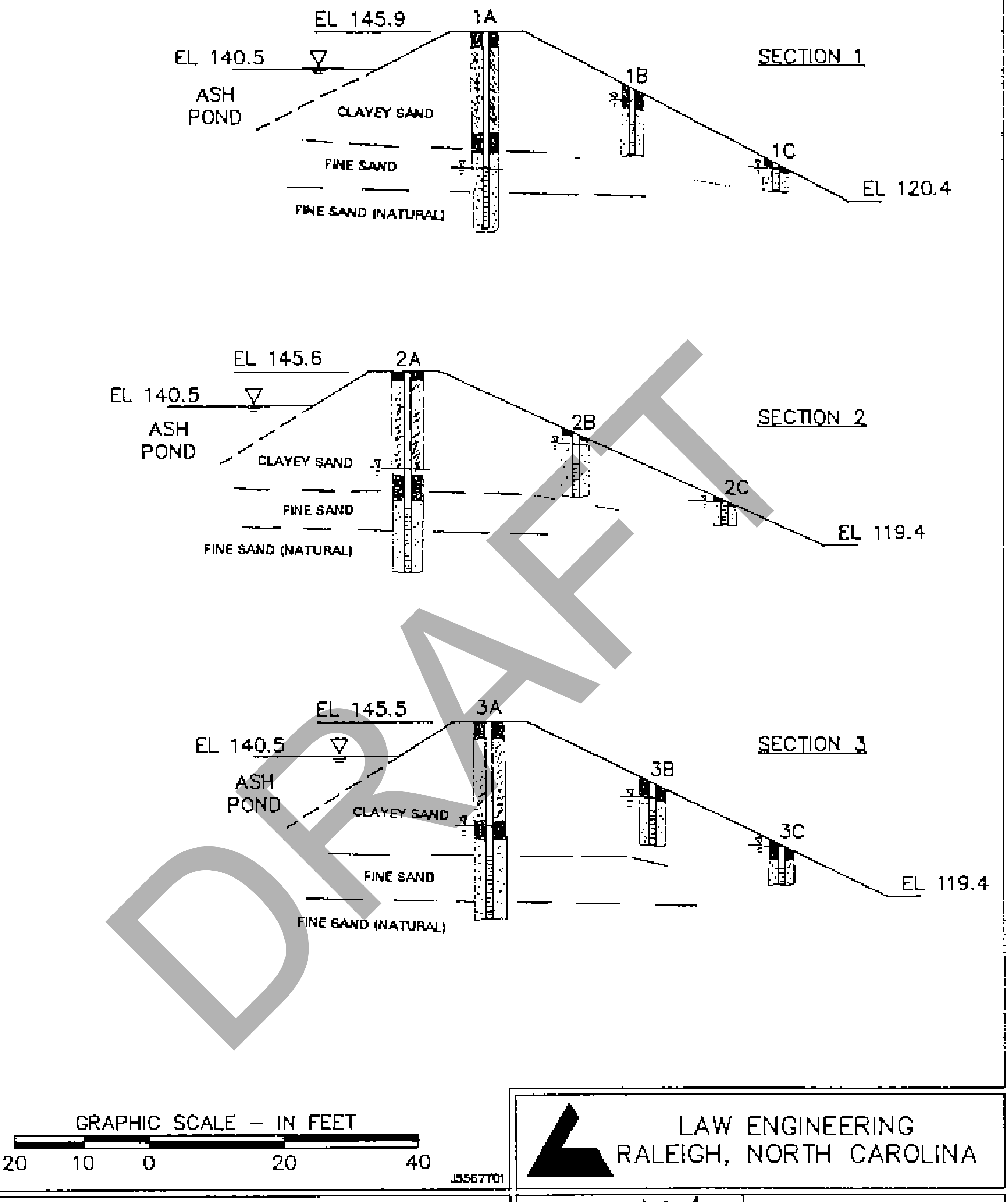
# APPENDIX




LAW ENGINEERING
RALEIGH, NORTH CAROLINA

| | | |
|---|---|---|
| WELL LOCATION MAP<br>CP&L WEATHERSPOON ASH POND DIKE<br>WEATHERSPOON STEAM ELECTRIC PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: WBJ | DATE: JAN. 1993 |
| | DFT CHECK: KCP | SCALE: 1"=200' |
| | ENG CHECK: MJ | JOB: 472-05567-03 |
| | APPROVAL: MJ | DWG: 1 |

REFERENCE: RCD 12/80






LAW ENGINEERING
RALEIGH, NORTH CAROLINA

CROSS SECTIONS AT WELLS
CP&L WEATHERSPOON ASH POND DIKE
WEATHERSPOON STEAM ELECTRIC PLANT
LUMBERTON, NORTH CAROLINA

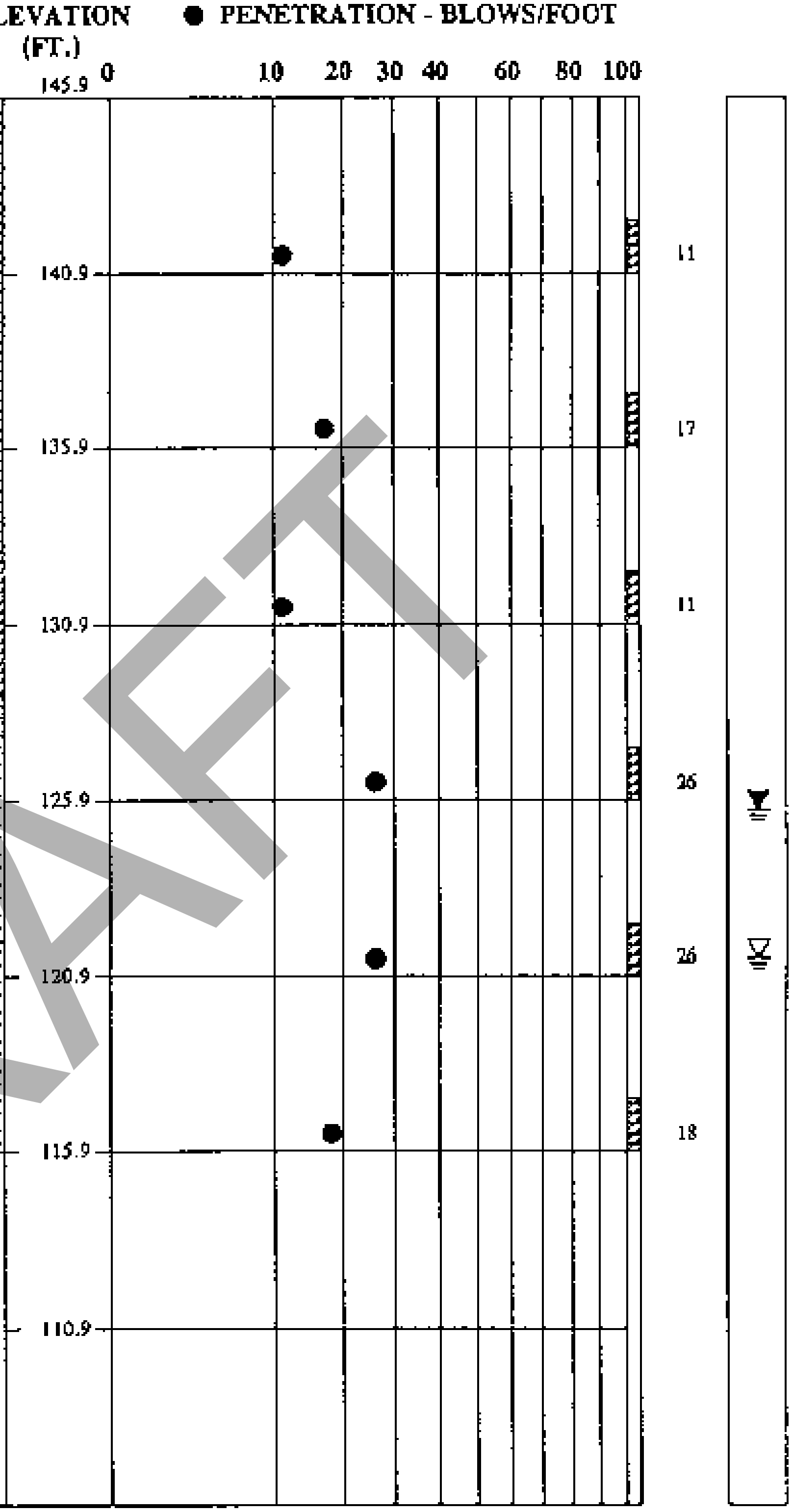
| | |
|---|---|
| DRAWN: WBJ | DATE: JAN. 1993 |
| DFT CHECK: WCP | SCALE: 1"=20' |
| ENG CHECK: MZ | JOB: 472-05567-03 |
| APPROVAL: MZ | DWG: 2 |

REFERENCE:

TABLE 1

| Well # | PVC | Stickup | Well Depth (ft) | Bottom Screen | Water Levels TOB (12/30/92) Top of PVC | Below Ground | 24 hrs(12/31/92) Top of PVC | Below Ground | 1 Week (1/6/93) Top of PVC | Below Ground |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 29.5 | 0.0 | 29.5 | 10.0 | 24.5 | 24.5 | 21.0 | 21.0 | 20.3 | 20.3 |
| 1B | 10.3 | 0.3 | 10.0 | 5.0 | 5.9 | 5.6 | 4.0 | 3.7 | 2.2 | 1.9 |
| 1C | 5.0 | 1.0 | 4.0 | 4.0 | 3.3 | 2.3 | 3.1 | 2.1 | 1.7 | 0.7 |
| 2A | 30.0 | 0.0 | 30.0 | 10.0 | 14.9 | 14.9 | 14.3 | 14.3 | 14.7 | 14.7 |
| 2B | 9.9 | 0.4 | 9.5 | 5.0 | 4.4 | 4.0 | 4.1 | 3.7 | 2.0 | 1.6 |
| 2C | 5.0 | 1.5 | 3.5 | 3.5 | 2.0 | 0.5 | 2.0 | 0.5 | 1.6 | 0.1 |
| 3A | 29.5 | 0.3 | 29.3 | 10.0 | 20.6 | 20.4 | 16.4 | 16.2 | 15.1 | 14.9 |
| 3B | 10.0 | 0.7 | 9.3 | 5.0 | 5.3 | 4.6 | 3.3 | 2.6 | 2.5 | 1.8 |
| 3C | 7.5 | 1.6 | 5.9 | 2.5 | 5.3 | 3.7 | 1.9 | 0.3 | 2.0 | 0.4 |
| 4 | 7.5 | 3.0 | 4.5 | 2.5 | 5.0 | 2.0 | 4.8 | 1.8 | 4.1 | 1.1 |
| | | | | | | 12/30/92 | | | | 1/6/93 |
| ASH POND (height below dike crest) | | | | | | −4.0 | | | | −4.5 |
| SECONDARY BASIN (height below dike crest) | | | | | | −8.5 | | | | −9.0 |

| DEPTH (FT.) | DESCRIPTION | ELEVATION (FT.) |
|---|---|---|
| 0.0 | | 145.9 |
| 0.4 | Topsoil: Dike Crest 5' | |
| | Slightly silty clayey medium SAND (SC) Moist | |
| | | 140.9 |
| 7.0 | Brown very clayey fine to medium SAND (SC) Moist | |
| | | 135.9 |
| | | 130.9 |
| 17.0 | Dark gray silty very fine to fine SAND (SP) Dry to Moist | |
| | | 125.9 |
| 24.0 | Natural gray slightly silty fine SAND (SP) Moist | |
| | | 120.9 |
| 30.0 | | 115.9 |
| | | 110.9 |




**REMARKS:**

Boring terminated at 30.0 feet.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

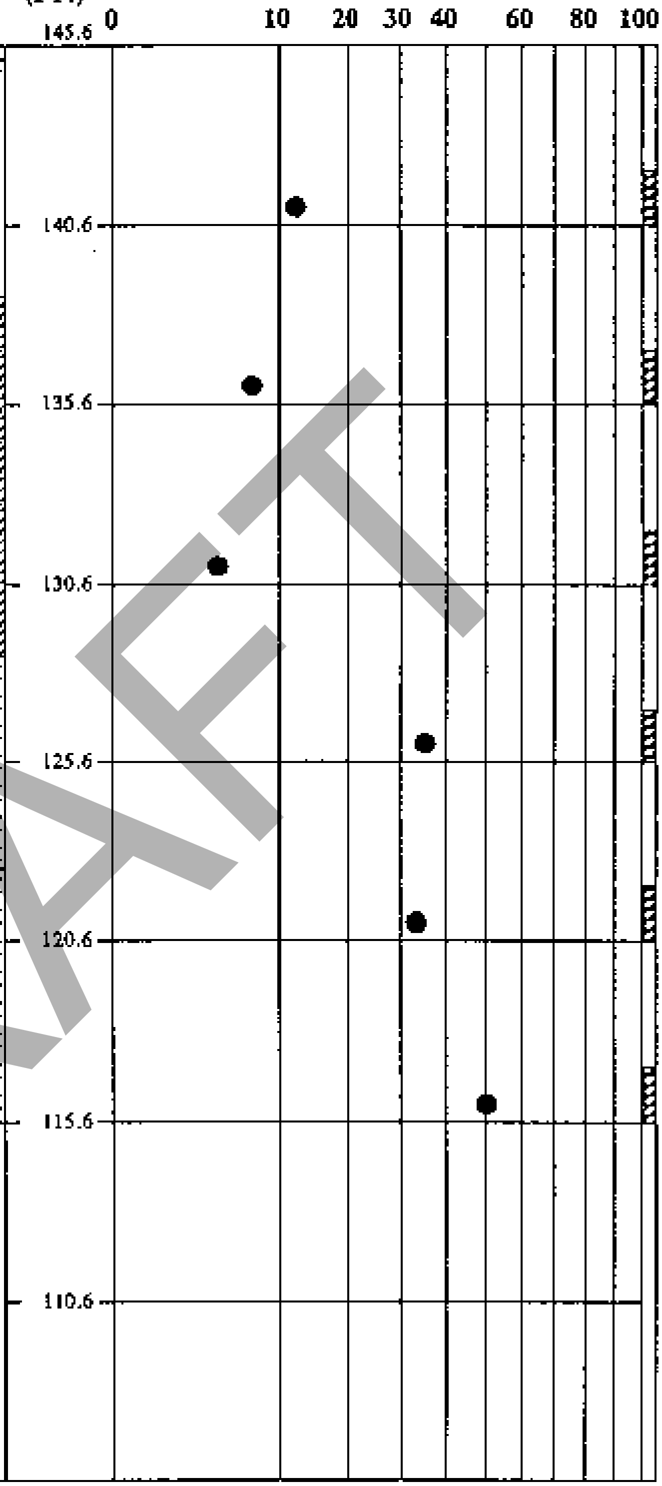
**TEST BORING RECORD**

| | |
|---|---|
| BORING NUMBER | W1292-1A |
| DATE DRILLED | December 30, 1992 |
| PROJECT NUMBER | 472-05567-03 |
| PROJECT | Weatherspoon Ash Pond |
| PAGE 1 OF 1 | |

LAW ENGINEERING

| DEPTH (FT.) | DESCRIPTION | ELEVATION (FT.) |
|---|---|---|
| 0.0 | | 145.6 |
| 0.4 | Topsoil: Rootmat gray silty sand | |
| | Brown silty fine to medium SAND (SM) Moist | 140.6 |
| 7.0 | Brown and gray clayey fine to medium SAND (SC) Moist | 135.6 |
| | | 130.6 |
| 17.0 | Black and gray slightly silty fine SAND (SP/SM) Moist | 125.6 |
| 23.0 | Tan and gray very fine to fine SAND (SP), trace silt Moist to Wet Natural about 23' to 25' | 120.6 |
| 30.0 | | 115.6 |
| | | 110.6 |

● PENETRATION - BLOWS/FOOT




| Elevation (FT.) | Blows/Foot |
|---|---|
| ~141 | 12 |
| ~136 | 7 |
| ~131 | 4 |
| ~126 | 35 |
| ~121 | 33 |
| ~116 | 50 |

**REMARKS:**

Boring terminated at 30.0 feet.

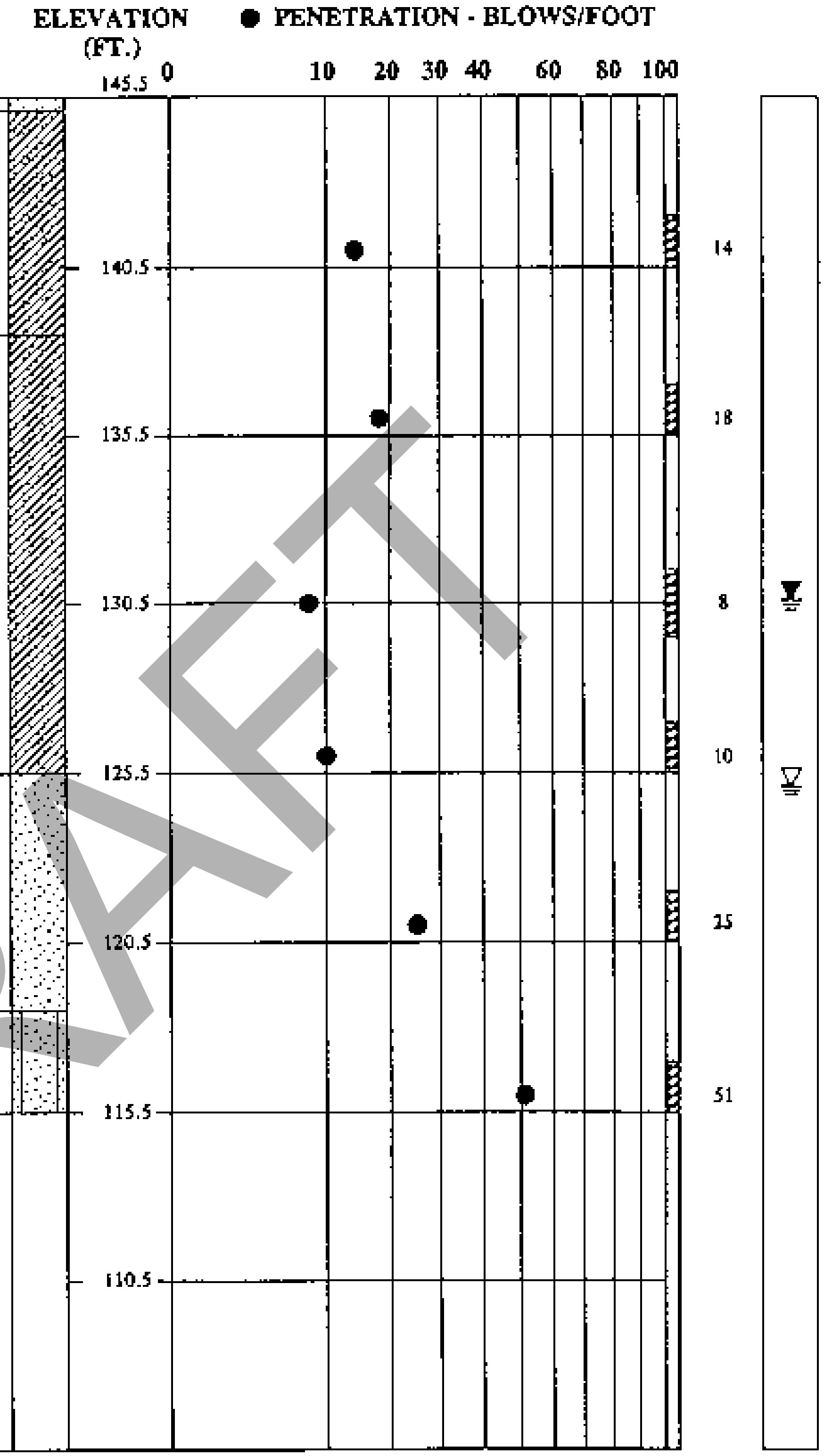
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

**TEST BORING RECORD**

| | |
|---|---|
| BORING NUMBER | W1292-2A |
| DATE DRILLED | December 30, 1992 |
| PROJECT NUMBER | 472-05567-03 |
| PROJECT | Weatherspoon Ash Pond |
| PAGE 1 OF 1 | |

LAW ENGINEERING

| DEPTH (FT.) | DESCRIPTION |
|---|---|
| 0.0 – 0.4 | 5" Topsoil |
| 0.4 – 7.0 | Brown very clayey fine to medium SAND (SC)<br>Moist |
| 7.0 – 20.0 | Brown clayey fine to medium SAND (SC) |
| 20.0 – 27.0 | Gray to brown slightly silty very fine to fine SAND (SP)<br>Moist |
| 27.0 – 30.0 | Gray very fine silty SAND (SM/SP), with remnants of roots<br>Moist |




REMARKS:

Boring terminated at 30.0 feet.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

**TEST BORING RECORD**

| | |
|---|---|
| BORING NUMBER | W1292-3A |
| DATE DRILLED | December 30, 1992 |
| PROJECT NUMBER | 472-05567-03 |
| PROJECT | Weatherspoon Ash Pond |
| PAGE 1 OF 1 | |

LAW ENGINEERING

## UNIFIED SOIL CLASSIFICATION

(Including Identification and Description)

| MAJOR DIVISIONS | | | GROUP SYMBOLS | TYPICAL NAMES | FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 in. and basing fractions on estimated weights) | | |
|---|---|---|---|---|---|---|---|
| COARSE-GRAINED SOILS More than half of material is larger than No. 200 sieve size. The No. 200 sieve is about the smallest particle visible to the naked eye. | GRAVELS More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼-in. size may be used as equivalent to the No. 4 sieve size) | Clean Gravels (Little or no fines) | GW | Well-graded gravels, gravel-sand mixtures little or no fines | Wide range in grain sizes and substantial amounts of all intermediate particle sizes | | |
| | | | GP | Poorly graded gravels or gravel-sand mixtures little or no fines | Predominantly one size or a range of sizes with some intermediate sizes missing | | |
| | | Gravels with Fines (Appreciable amount of fines) | GM | Silty gravel, gravel-sand-silts mixture | Nonplastic fines or fines with low plasticity (for identification procedures see ML below) | | |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures | Plastic fines (for identification procedures see CL below) | | |
| | SANDS More than half of coarse fraction is smaller than No. 4 sieve size | Clean Sands (Little or no fines) | SW | Well-graded sands, gravelly sands, little or no fines | Wide range in grain size and substantial amounts of all intermediate particle sizes. | | |
| | | | SP | Poorly graded sands or gravelly sands, little or no fines | Predominantly one size or a range of sizes with some intermediate sizes missing | | |
| | | Sands with Fines (Appreciable amount of fines) | SM | Silty sands, sand-silt mixtures | Nonplastic fines or fines with low plasticity (for identification procedures see ML below). | | |
| | | | SC | Clayey sands, sand-clay mixtures | Plastic fines (for identification procedures see CL below) | | |
| FINE-GRAINED SOILS More than half of material is smaller than No. 200 sieve size | | | | | IDENTIFICATION PROCEDURES On Fraction Smaller than No. 40 Sieve Size | | |
| | | | | | Dry Strength (Crushing characteristics) | Dilatancy (Reaction to shaking) | Toughness (Consistency near PL) |
| | SILTS AND CLAYS Liquid limit is less than 50 | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity | None to slight | Quick to slow | None |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | Medium to high | None to very slow | Medium |
| | | | OL | Organic silts and organic silty clays of low plasticity | Slight to medium | Slow | Slight |
| | SILTS AND CLAYS Liquid limit is greater than 50 | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | Slight to medium | Slow to none | Slight to medium |
| | | | CH | Inorganic clays of high plasticity, fat clays | High to very High | None | High |
| | | | OH | Organic clays of medium to high plasticity, organic silts | Medium to high | None to very slow | Slight to medium |
| HIGHLY ORGANIC SOILS | | | Pt | Peat and other highly organic soils | Readily identified by color, odor, spongy feel and frequently by fibrous texture. | | |

## CORRELATION OF PENETRATION RESISTANCE (ASTM D 1586) WITH RELATIVE DENSITY AND CONSISTENCY

| | PENETRATION RESISTANCE, N Blows per foot | RELATIVE DENSITY |
|---|---|---|
| SANDS AND GRAVELS | 0 — 4 | Very Loose |
| | 5 — 10 | Loose |
| | 11 — 20 | Firm |
| | 21 — 30 | Very Firm |
| | 31 — 50 | Dense |
| | Over 50 | Very Dense |

| | PENETRATION RESISTANCE, N Blows per foot | CONSISTENCY |
|---|---|---|
| SILTS AND CLAYS | 0 — 2 | Very Soft |
| | 3 — 4 | Soft |
| | 5 — 8 | Firm |
| | 9 — 15 | Stiff |
| | 16 — 30 | Very Stiff |
| | 31 + | Hard |

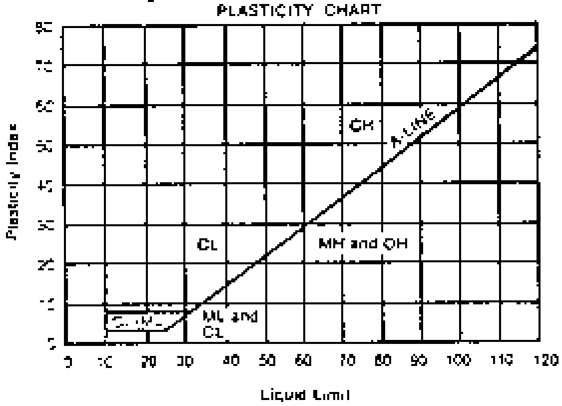
## PARTICLE SIZE IDENTIFICATION

BOULDER - Greater than 12 inches
COBBLES - 3 inches to 12 inches
GRAVEL - Coarse - ¾ inch to 3 inches
- Fine - 4.76 mm to ¾ inch

SAND - Coarse - 2 mm to 4.76 mm
Medium - 0.42 mm to 2 mm
Fine - 0.074 mm to 0.42 mm

SILT & CLAY - Less than 0.074 mm

## PLASTICITY CHART




## SOIL LABORATORY TEST DATA SYMBOLS FOR BORING LOGS

$\gamma_w$ = Wet Unit Weight
$\gamma_d$ = Dry Unit Weight
e = Void Ratio
$q_u$ = Unconfined Compressive Strength
$C_c$ = Compression Index
c = Cohesion, Total Stress
c' = Cohesion, Effective Stress
$\Phi$ = Friction Angle, Degrees, Total Stress
$\Phi'$ = Friction Angle, Degrees, Effective Stress

W = Moisture Content (%)
LL = Liquid Limit (%)
PL = Plastic Limit (%)
PI = Plasticity Index (%) (LL-PL)

TRIAXIAL = Triaxial Shear Test
CONSOL = Consolidation Test
GS = Grain Size Distribution Test

## CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

| | NO. OF BLOWS, N | RELATIVE DENSITY |
|---|---|---|
| SANDS: | 0-4 | Very Loose |
| | 5-10 | Loose |
| | 11-30 | Firm |
| | 31-50 | Dense |
| | OVER 50 | Very Dense |

| | | CONSISTENCY |
|---|---|---|
| SILTS & CLAYS: | 0-2 | Very Soft |
| | 3-4 | Soft |
| | 5-8 | Firm |
| | 9-15 | Stiff |
| | 16-30 | Very stiff |
| | 31-50 | Hard |
| | OVER 50 | Very Hard |

### PARTICAL SIZE IDENTIFICATION

| | | |
|---|---|---|
| BOULDERS: | | Greater than 300 mm |
| COBBLES: | | 75 mm to 300 mm |
| GRAVEL: | Coarse - | 19.0 mm to 75 mm |
| | Fine - | 4.75 mm to 19.0 mm |
| SANDS: | Coarse - | 2.00 mm to 4.75 mm |
| | Medium - | 0.425 mm to 2.00 mm |
| | Fine - | 0.075 mm to 0.425 mm |
| SILTS & CLAYS: | | Less than 0.075 mm |

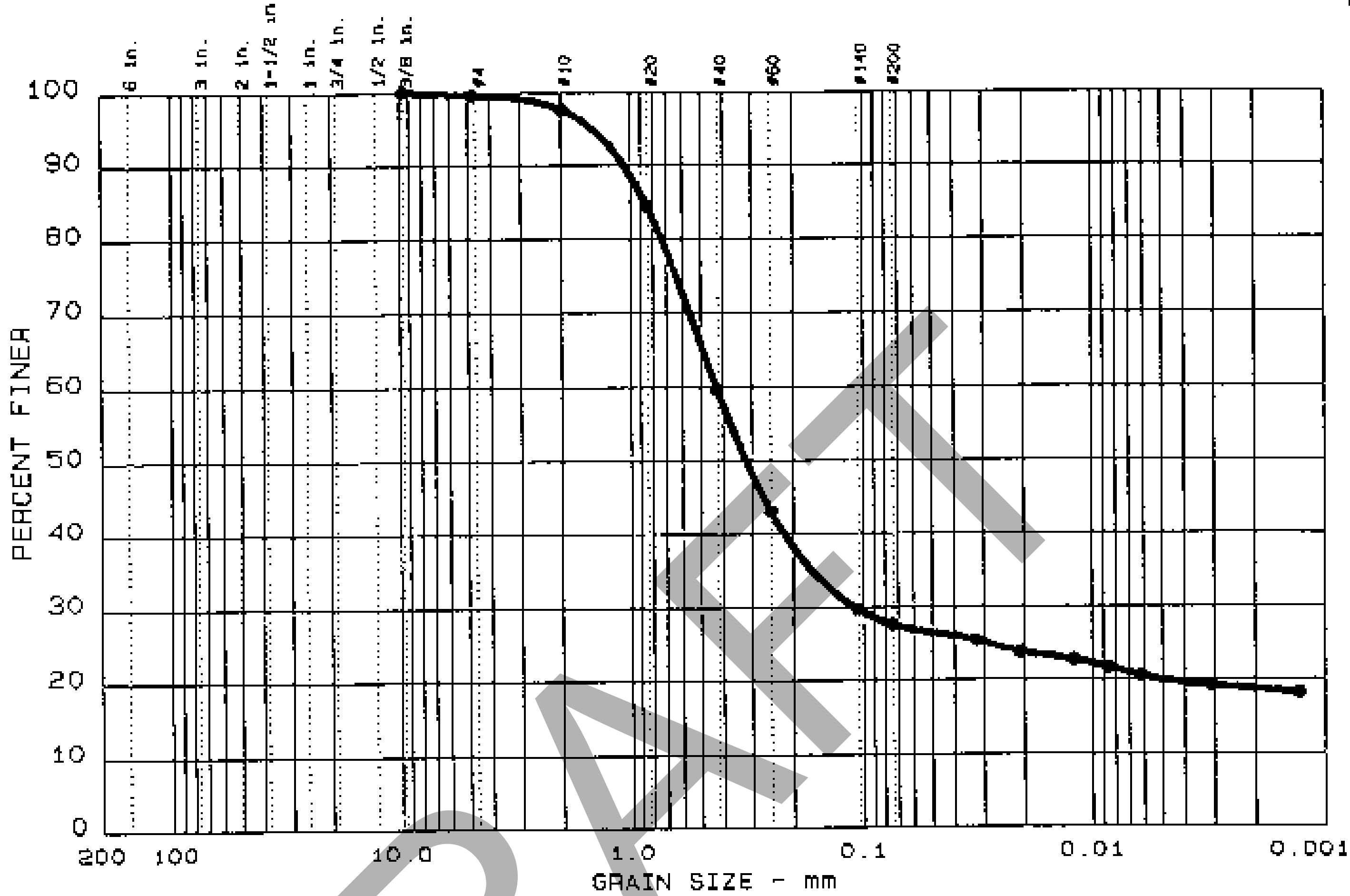
## KEY TO DRILLING SYMBOLS

- Undisturbed Sample
- Split Spoon Sample
- Water Table 24 HR.
- Water Table at Time of Drilling
- M = 82% Moisture Content
- Loss of Drilling Water

## KEY TO SOIL CLASSIFICATIONS

- FILL
- CL - Low plasticity inorganic clays
- CH - High plasticity inorganic clays
- ML - Low plasticity inorganic silts and very fine sands
- MH - High plasticity inorganic silts
- SP - Poorly graded sands
- SW - Well graded sands
- GP - Poorly graded gravels
- PARTIALLY WEATHERED ROCK - A transitional material between soil and rock which retains the relict structure of the parent rock
- GW - Well graded gravels
- OL - Low plasticity organic silts and clays
- OH - High plasticity organic silts and clays
- SM - Silty sands
- GM - Silty gravels
- SC - Clayey sands
- GC - Clayey gravels
- SP-SM - Typical Dual Classification

# GRAIN SIZE DISTRIBUTION TEST REPORT






| | %+75mm | % GRAVEL | % SAND | % SILT | % CLAY |
|---|---|---|---|---|---|
| ● | 0.0 | 0.4 | 72.0 | 7.6 | 20.0 |
| | | | | | |
| | | | | | |

| | LL | PI | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 34 | 13 | 0.85 | 0.42 | 0.32 | 0.109 | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| ● SS W-3 14-16' | SC | A-2-6 |

Project No.: 472-5567-03
Project: WEATHERSPOON DAM
● Location: SS

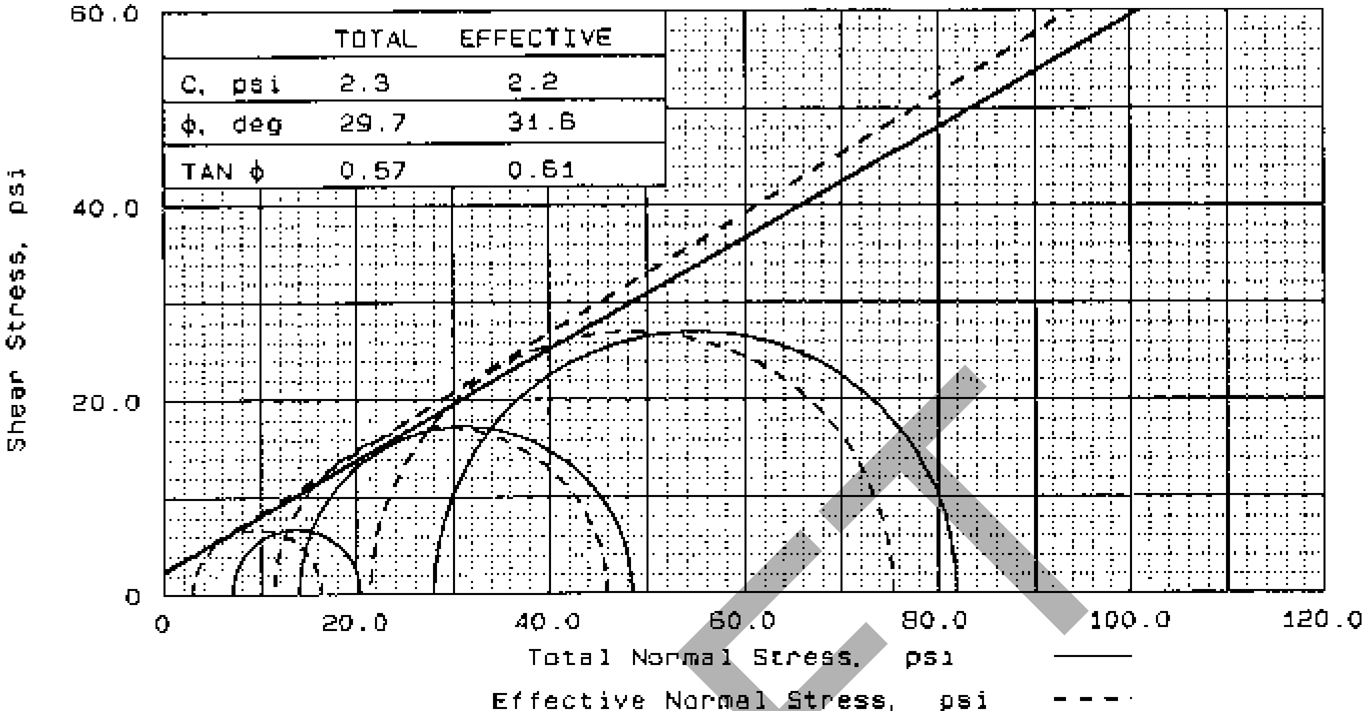
Date: 1-12-93

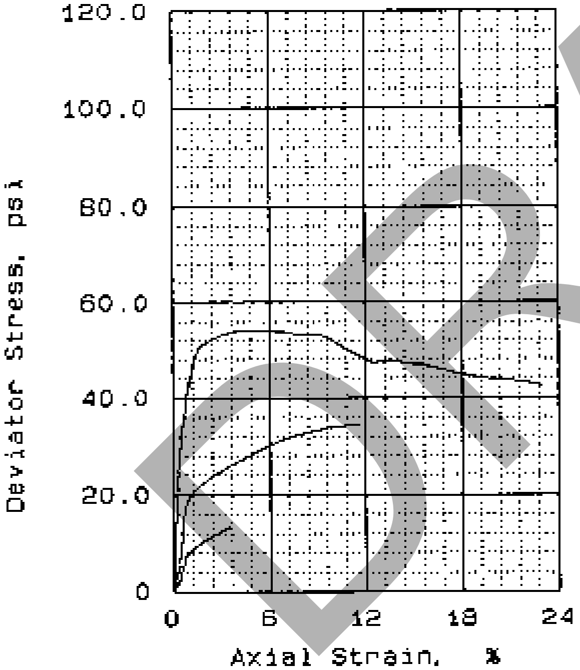
GRAIN SIZE DISTRIBUTION TEST REPORT
**LAW ENGINEERING**

Remarks:
NATURAL MOISTURE - 17.0%

Figure No. 01

| | TOTAL | EFFECTIVE |
|---|---|---|
| C, psi | 2.3 | 2.2 |
| ϕ, deg | 29.7 | 31.6 |
| TAN ϕ | 0.57 | 0.61 |




| SAMPLE NO. | | 1 | 2 | 3 |
|---|---|---|---|---|
| INITIAL | WATER CONTENT, % | 16.7 | 16.7 | 16.7 |
| | DRY DENSITY, pcf | 113.9 | 114.0 | 113.9 |
| | SATURATION, % | 97.5 | 97.7 | 97.6 |
| | VOID RATIO | 0.453 | 0.452 | 0.452 |
| | DIAMETER, in | 1.48 | 1.51 | 1.60 |
| | HEIGHT, in | 3.03 | 2.94 | 2.61 |
| AT TEST | WATER CONTENT, % | 16.7 | 16.7 | 16.7 |
| | DRY DENSITY, pcf | 113.9 | 114.0 | 113.9 |
| | SATURATION, % | 97.5 | 97.8 | 97.7 |
| | VOID RATIO | 0.453 | 0.452 | 0.452 |
| | DIAMETER, in | 1.48 | 1.50 | 1.59 |
| | HEIGHT, in | 3.02 | 2.93 | 2.61 |
| BACK PRESSURE, psi | | 35.0 | 35.0 | 35.0 |
| CELL PRESSURE, psi | | 42.0 | 49.0 | 63.0 |
| FAILURE STRESS, psi | | 13.4 | 34.5 | 54.1 |
| PORE PRESSURE, psi | | 39.1 | 37.6 | 41.6 |
| STRAIN RATE, %/min. | | 0.661 | 0.681 | 0.700 |
| ULTIMATE STRESS, psi | | | | |
| PORE PRESSURE, psi | | | | |
| $\bar{\sigma}_1$ FAILURE, psi | | 16.3 | 45.9 | 75.5 |
| $\bar{\sigma}_3$ FAILURE, psi | | 2.9 | 11.4 | 21.4 |

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE:
DESCRIPTION: REMOLDED SS

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

FIG. NO.

CLIENT:

PROJECT: WEATHERSPOON DAM

SAMPLE LOCATION: REMOLDED SS

PROJ. NO.: 4725667-03 DATE: 1-19-93

TRIAXIAL COMPRESSION TEST

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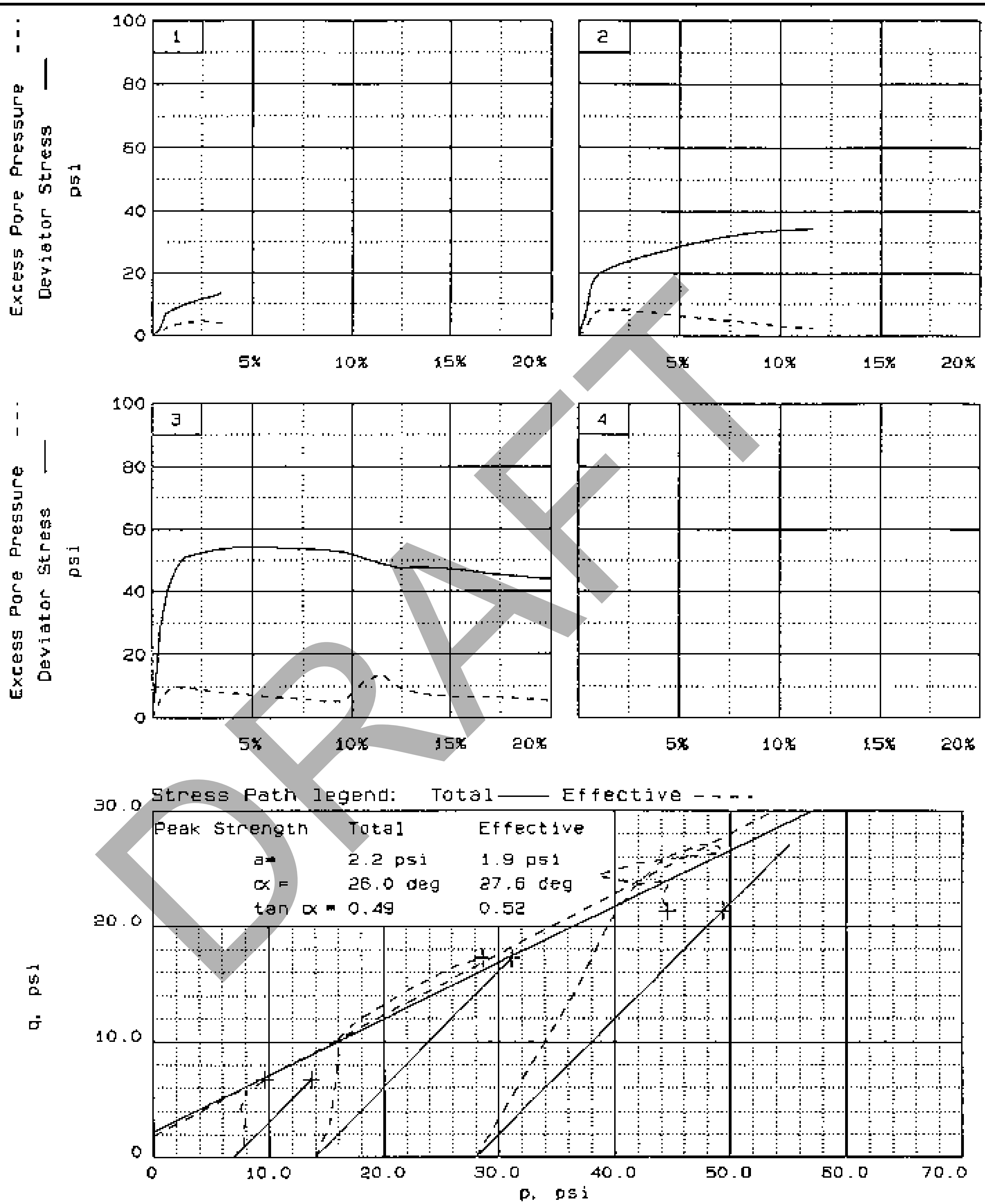




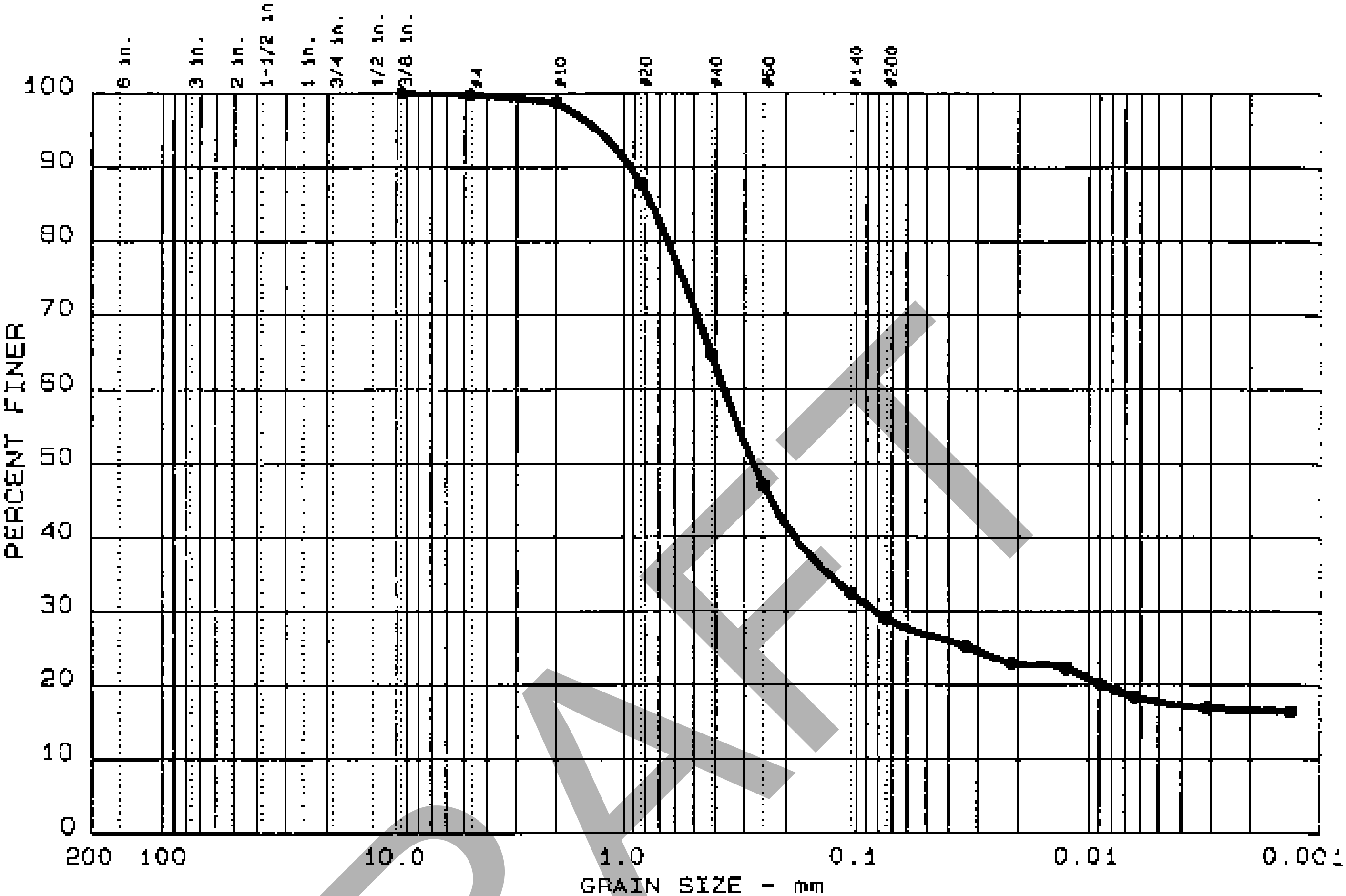

Client:

Project: WEATHERSPOON DAM

Location: REMOLDED SS

File: 5667A Project No.: 4725667-03 Page 2/2 Fig. No. ____

# GRAIN SIZE DISTRIBUTION TEST REPORT




| | Test | %+75mm | % GRAVEL | % SAND | % SILT | % CLAY |
|---|---|---|---|---|---|---|
| ● | 19 | 0.0 | 0.1 | 70.8 | 11.4 | 17.7 |
| | | | | | | |
| | | | | | | |

| | LL | PI | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 29 | 11 | 0.76 | 0.37 | 0.28 | 0.083 | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| ● SS, 9' | SC | A-2-6 |

Project No.: 472-5567-03
Project: WEATHERSPOON ASH POND DIKE
● Location: W-2AG14

Date: 01-19-93

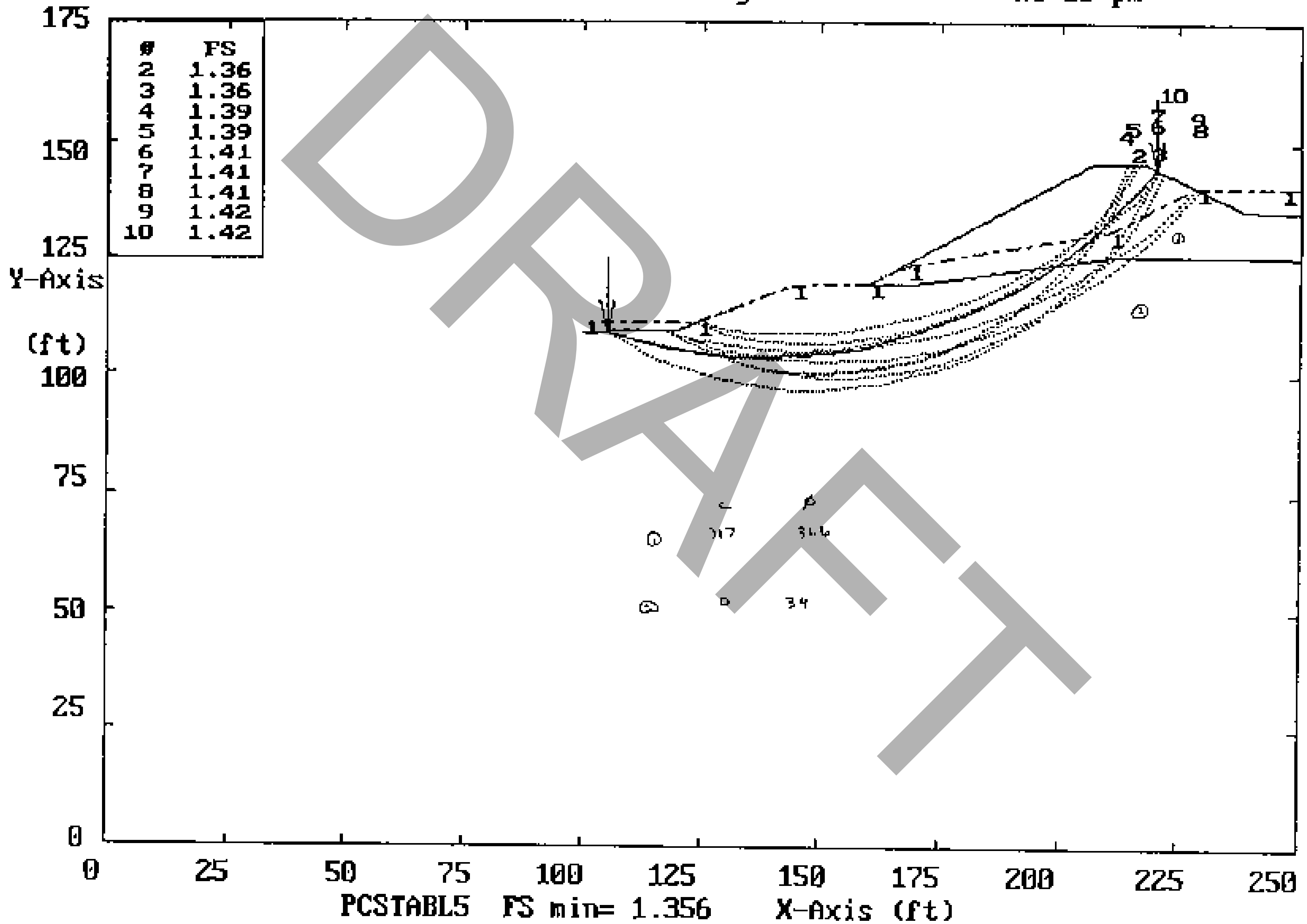
Remarks:

NATURAL MOISTURE= 12.1%

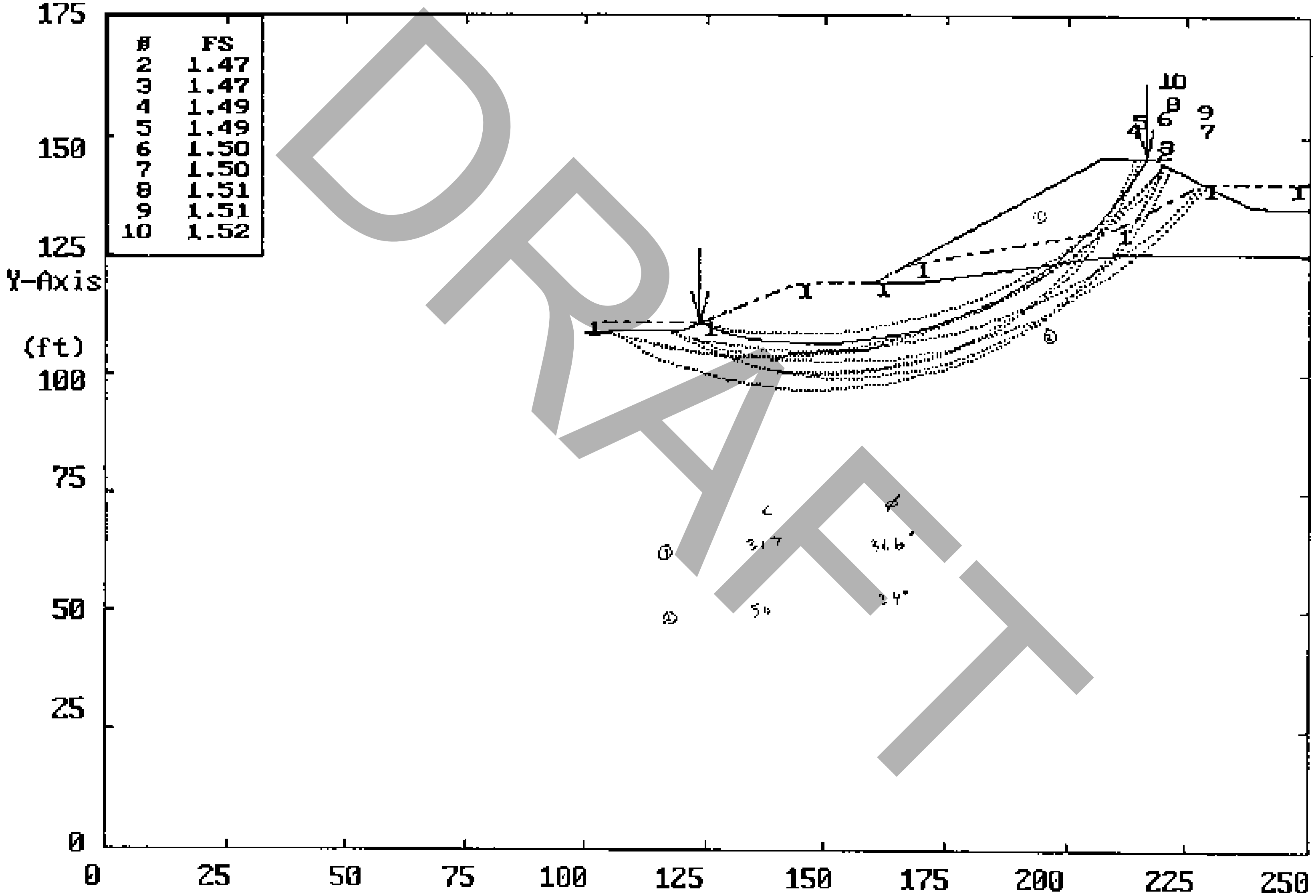
GRAIN SIZE DISTRIBUTION TEST REPORT
**LAW ENGINEERING**

Figure No. ND

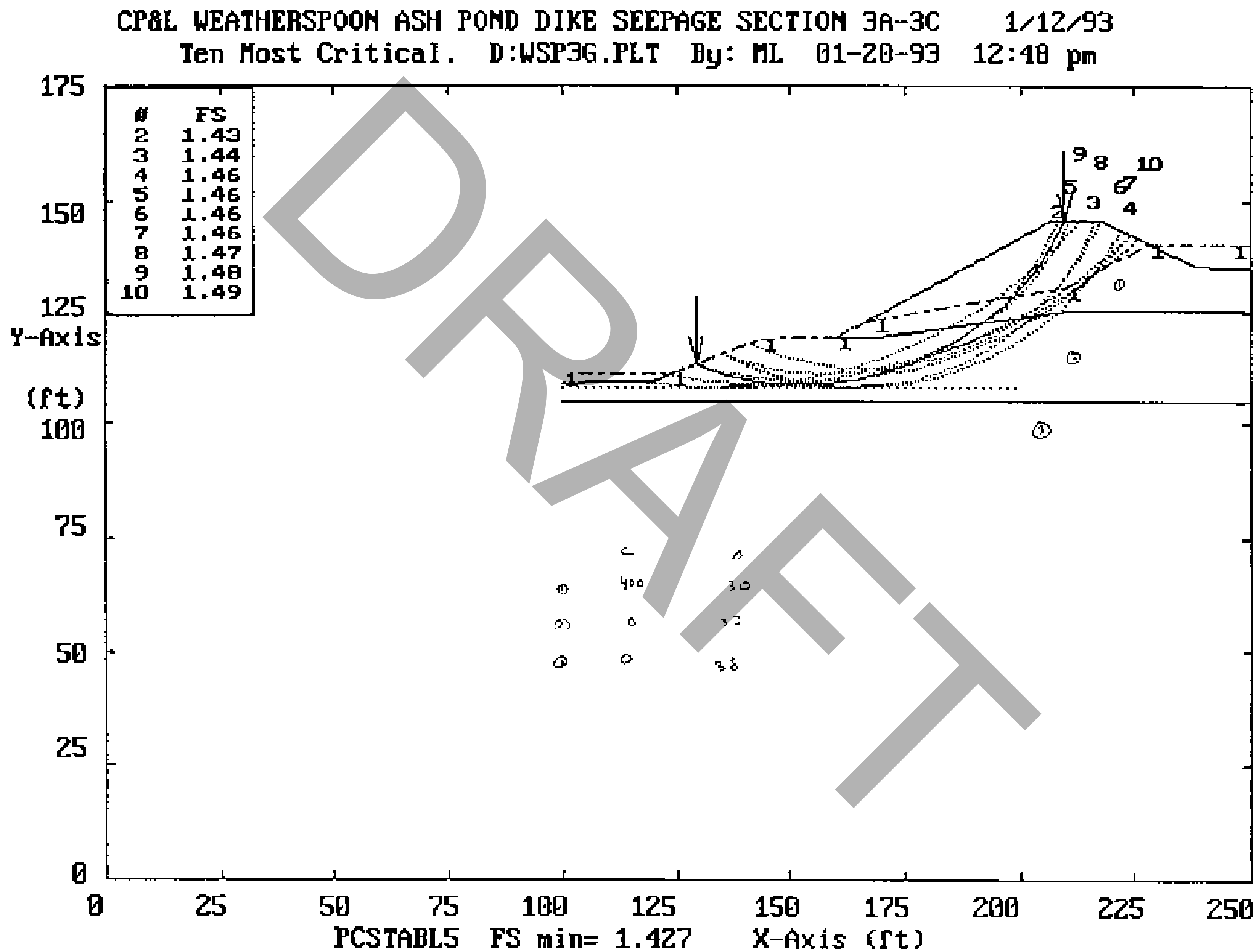
CP&L WEATHERSPOON ASH POND DIKE SEEPAGE SECTION 3A-3C 1/12/93
Ten Most Critical. D:WSP3D.PLT By: ML 01-20-93 12:13 pm



CP&L WEATHERSPOON ASH POND DIKE SEEPAGE SECTION 3A-3C 1/12/93
Ten Most Critical. D:WSP3E.PLT By: ML 01-20-93 12:30 pm

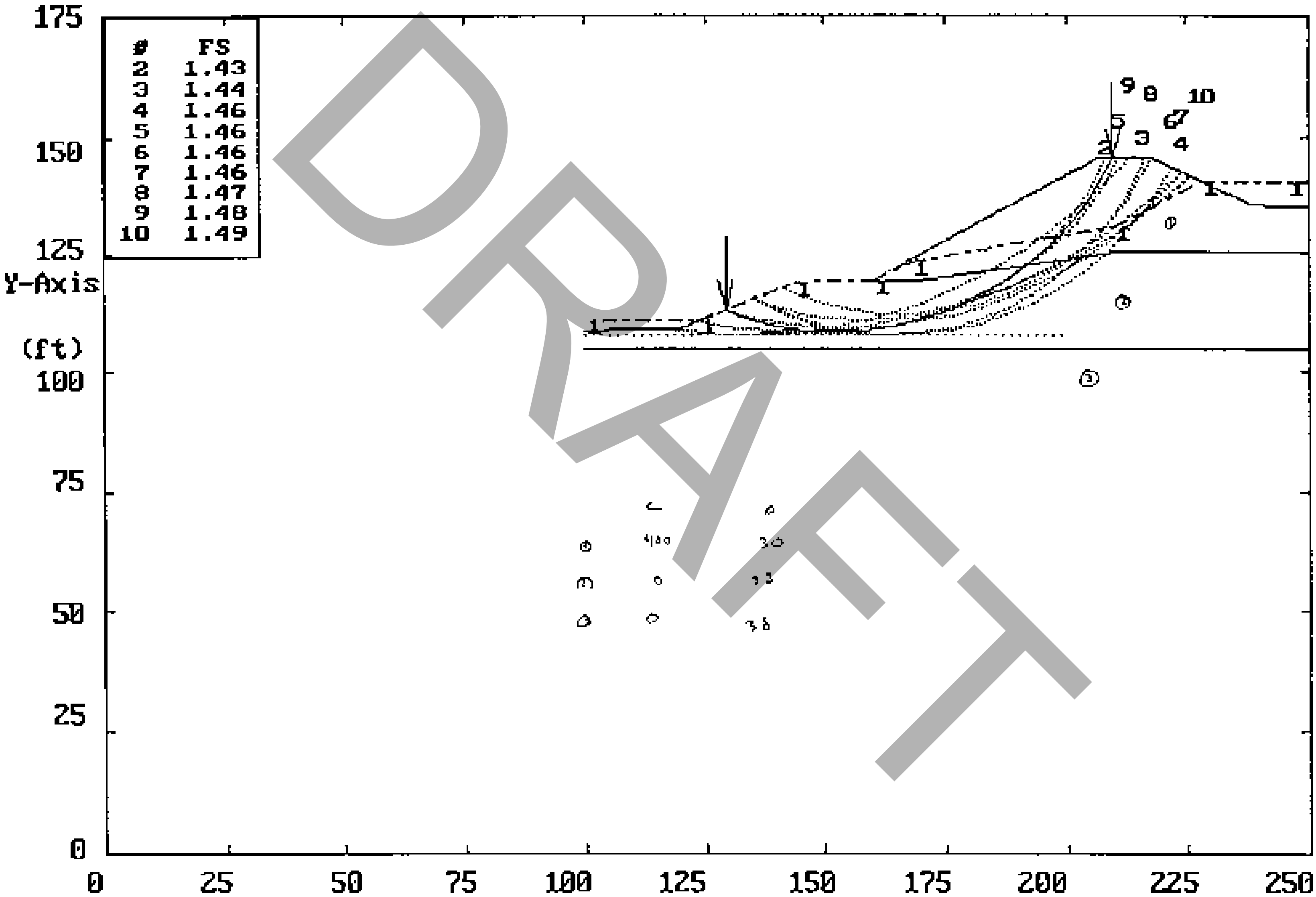



PCSTABL5 FS min= 1.465



CP&L WEATHERSPOON ASH POND DIKE SEEPAGE SECTION 3A-3C 1/12/93
Ten Most Critical. D:WSP3G.PLT By: ML 01-20-93 12:40 pm
# FS
2 1.43
3 1.44
4 1.46
5 1.46
6 1.46
7 1.46
8 1.47
9 1.48
10 1.49
Y-Axis (ft)
175
150
125
100
75
50
25
0
0
25
50
75
100
125
150
175
200
225
250
PCSTABL5 FS min= 1.427 X-Axis (ft)

CP&L WEATHERSPOON ASH POND DIKE SEEPAGE SECTION 3A-3C 1/12/93
Ten Most Critical. D:WSP3G.PLT By: ML 01-20-93 12:48 pm



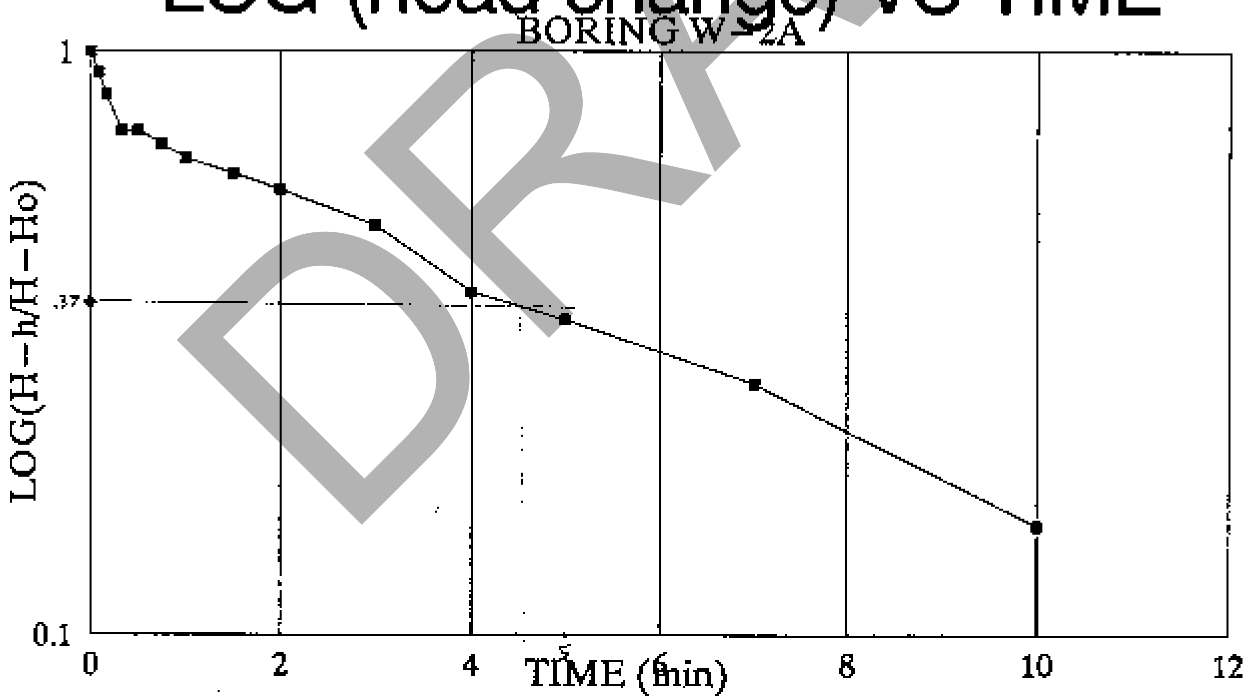

PCSTABL5 FS min= 1.427 X-Axis (ft)

SLUG TEST BORING# W-2A DATE 1-6-93

water level @To= 16.6

| READING # | TIME (MIN) t | HEAD (ft) h | INITIAL HEAD CHANG Hi=H-Ho | HEAD CHANGE H=H-h | (H-h) / (H-Ho) | LOG |
|---|---|---|---|---|---|---|
| 0 | 0 | 19.2 | 2.6 | 2.60 | 1.00 | 0.000 |
| 1 | 0.083333 | 19 | " | 2.40 | 0.92 | -0.035 |
| 2 | 0.166667 | 18.8 | " | 2.20 | 0.85 | -0.073 |
| 3 | 0.333333 | 18.5 | " | 1.90 | 0.73 | -0.136 |
| 4 | 0.5 | 18.5 | " | 1.90 | 0.73 | -0.136 |
| 5 | 0.75 | 18.4 | " | 1.80 | 0.69 | -0.160 |
| 6 | 1 | 18.3 | " | 1.70 | 0.65 | -0.185 |
| 7 | 1.5 | 18.2 | " | 1.60 | 0.62 | -0.211 |
| 8 | 2 | 18.1 | " | 1.50 | 0.58 | -0.239 |
| 9 | 3 | 17.9 | " | 1.30 | 0.50 | -0.301 |
| 10 | 4 | 17.6 | " | 1.00 | 0.38 | -0.415 |
| 11 | 5 | 17.5 | " | 0.90 | 0.35 | -0.461 |
| 12 | 7 | 17.3 | " | 0.70 | 0.27 | -0.570 |
| 13 | 10 | 17 | " | 0.40 | 0.15 | -0.813 |

# LOG (head change) VS TIME



LAW ENGINEERING

3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

JOB NO. 472-5567-03 SHEET 1 OF 2

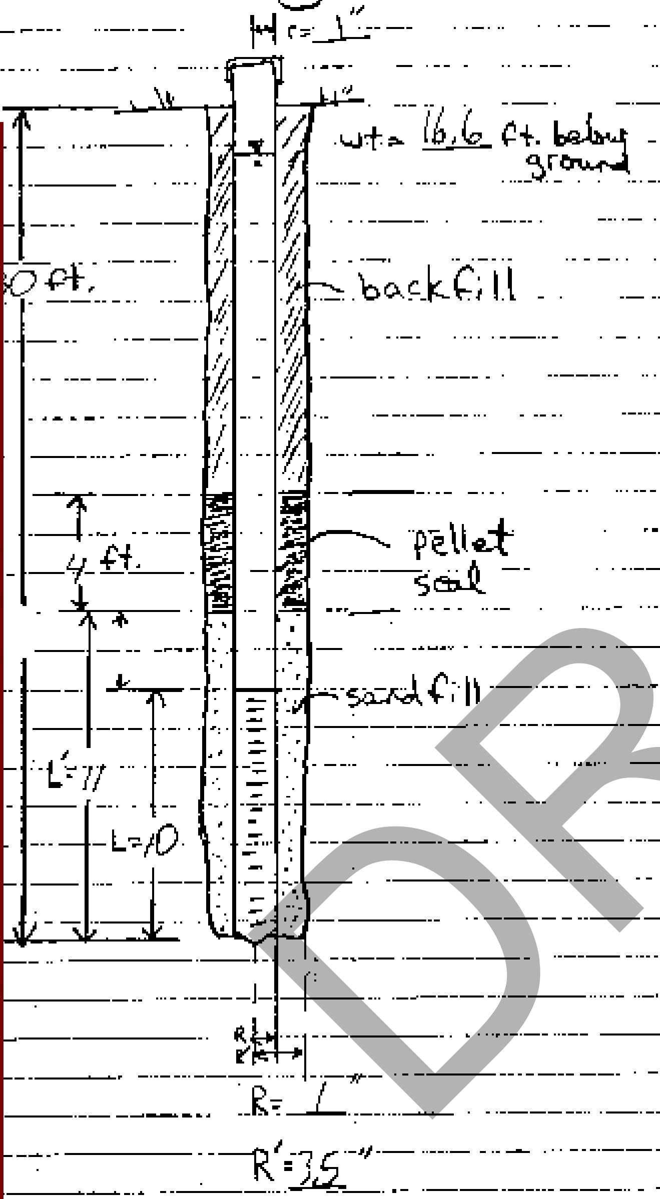
JOB NAME Weathespoon Ash Pond Dike

SUBJECT Hydraulic Conductivity

BY ML DATE

CHECKED BY DATE

Boring # 2A Date of slug test 1-6-93




"Hvorslev method"

$$K = \frac{r^2 \ln (L/R)}{2 L T_0}$$

r = 1" casing radius

L = 10" length well screen in sandy soils

L' = 11" length well screen in fine-grain soils

R = 1" radius well screen (sandy soils)

R' = 3.5" radius well screen (fine gr. soils)

$T_0$ = 4.6 min = 276 sec.

time w.l. to rise or fall to .37 of initial change

$$K' = \frac{(1)^2 \ln\left(\frac{11\times12}{3.5}\right)}{2(11)(276)} \times 2.54\ cm/in$$

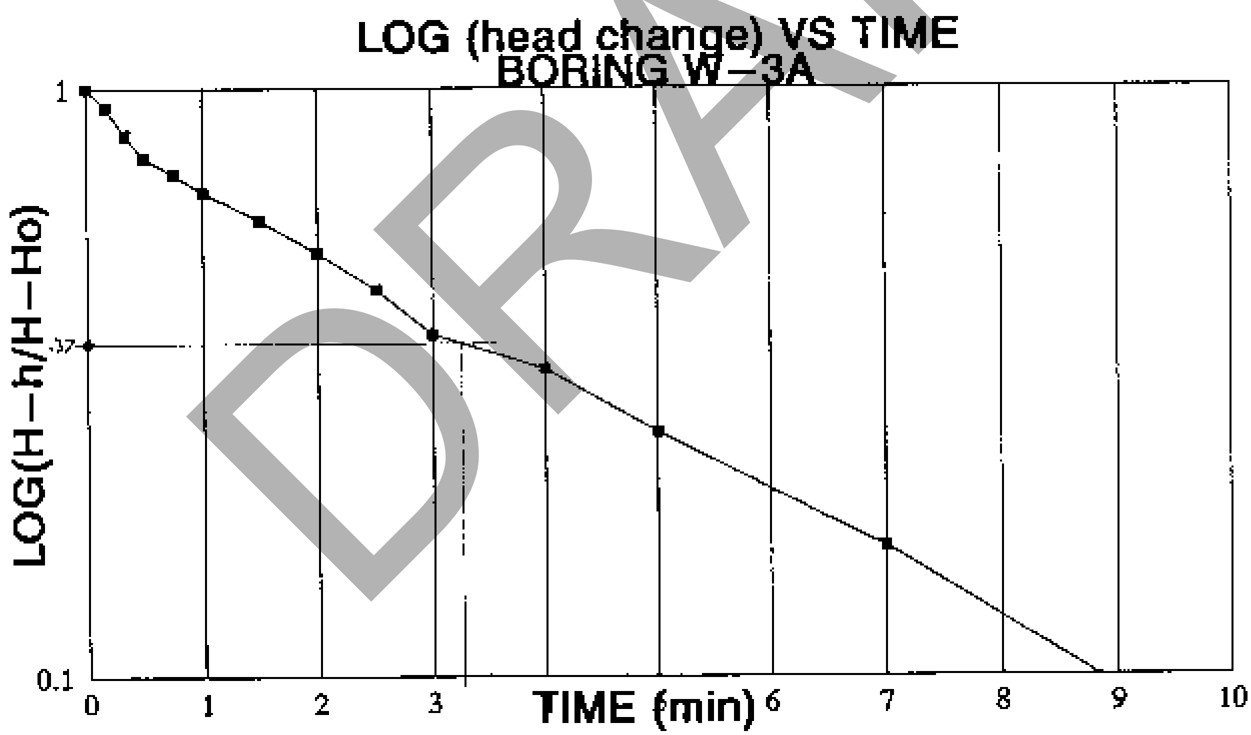
$$K = 1.52 \times 10^{-3}\ cm/sec.$$

$$K = \frac{1 \ln\left(\frac{10\times12}{1}\right)}{2(10\times12)(276)} \times 2.54 = 1.84 \times 10^{-4}\ cm/s$$

SLUG TEST BORING# W-3A DATE 1-6-93

water level @To= 17.0

| READING # | TIME (MIN) t | HEAD (ft) h | INITIAL HEAD CHANG Hi=H-Ho | HEAD CHANGE H=H-h | (H-h) / (H-Ho) | LOG |
|---|---|---|---|---|---|---|
| 0 | 0 | 21.2 | 4.2 | 4.20 | 1.00 | 0.000 |
| 1 | 0.166667 | 20.9 | " | 3.90 | 0.93 | -0.032 |
| 2 | 0.333333 | 20.5 | " | 3.50 | 0.83 | -0.079 |
| 3 | 0.5 | 20.2 | " | 3.20 | 0.76 | -0.118 |
| 4 | 0.75 | 20 | " | 3.00 | 0.71 | -0.146 |
| 5 | 1 | 19.8 | " | 2.80 | 0.67 | -0.176 |
| 6 | 1.5 | 19.5 | " | 2.50 | 0.60 | -0.225 |
| 7 | 2 | 19.2 | " | 2.20 | 0.52 | -0.281 |
| 8 | 2.5 | 18.9 | " | 1.90 | 0.45 | -0.344 |
| 9 | 3 | 18.6 | " | 1.60 | 0.38 | -0.419 |
| 10 | 4 | 18.4 | " | 1.40 | 0.33 | -0.477 |
| 11 | 5 | 18.1 | " | 1.10 | 0.26 | -0.582 |
| 12 | 7 | 17.7 | " | 0.70 | 0.17 | -0.778 |
| 13 | 9 | 17.4 | " | 0.40 | 0.10 | -1.021 |




$T_0$ = 3.15

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919-876-0416

JOB NO. 472-5567-03 SHEET 1 OF 2

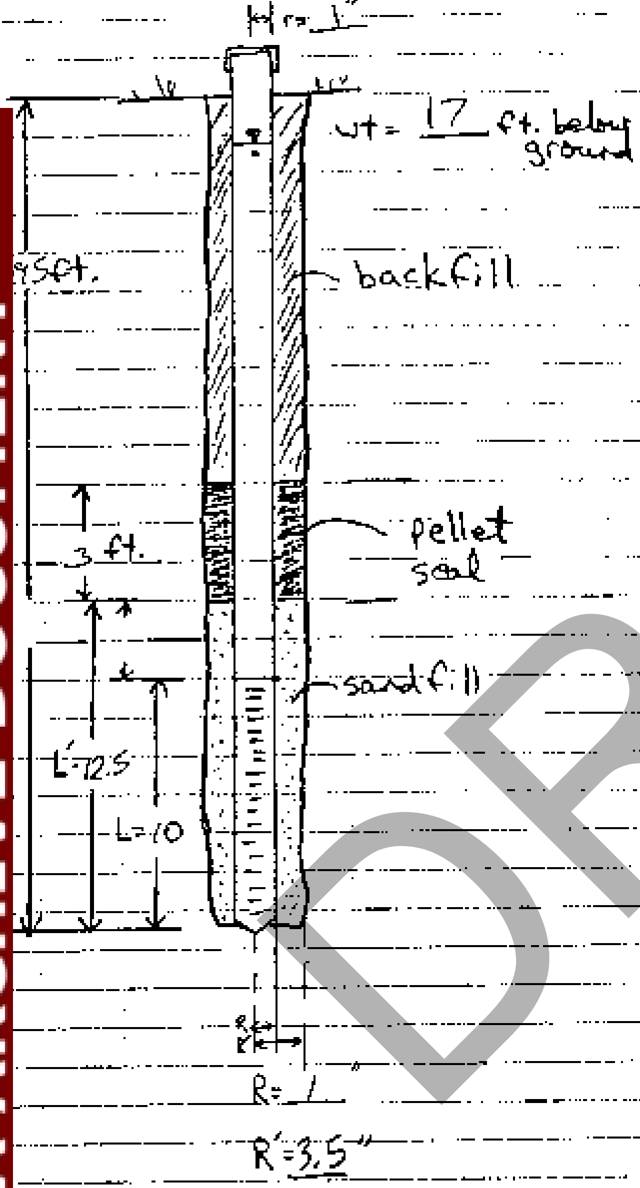
JOB NAME Weatherspoon Ash Pond Dike

SUBJECT Hydraulic Conductivity

BY ML DATE

CHECKED BY DATE

Boring # 3A Date of slug test 1-6-93




"Hvorslev method"

$$K = \frac{r^2 \ln(L/R)}{2 L T_0}$$

$r$ = 1" casing radius

$L$ = 10x12" length well screen in sandy soils

$L'$ = 12.5x12" length well screen in fine-grain soils

$R$ = 1" radius well screen (sandy soils)

$R'$ = 3.5" radius well screen (fine gr. soils)

$T_0$ = 3.25 min = 195 sec.
time W.L. to rise or fall to .37 of initial change

$$K = \frac{(1)^2 \ln\left(\frac{120}{1}\right)}{2(120)(195)} \times 2.54\ \text{cm/in}$$

$$K = 2.60 \times 10^{-4}\ \text{cm/sec.}$$

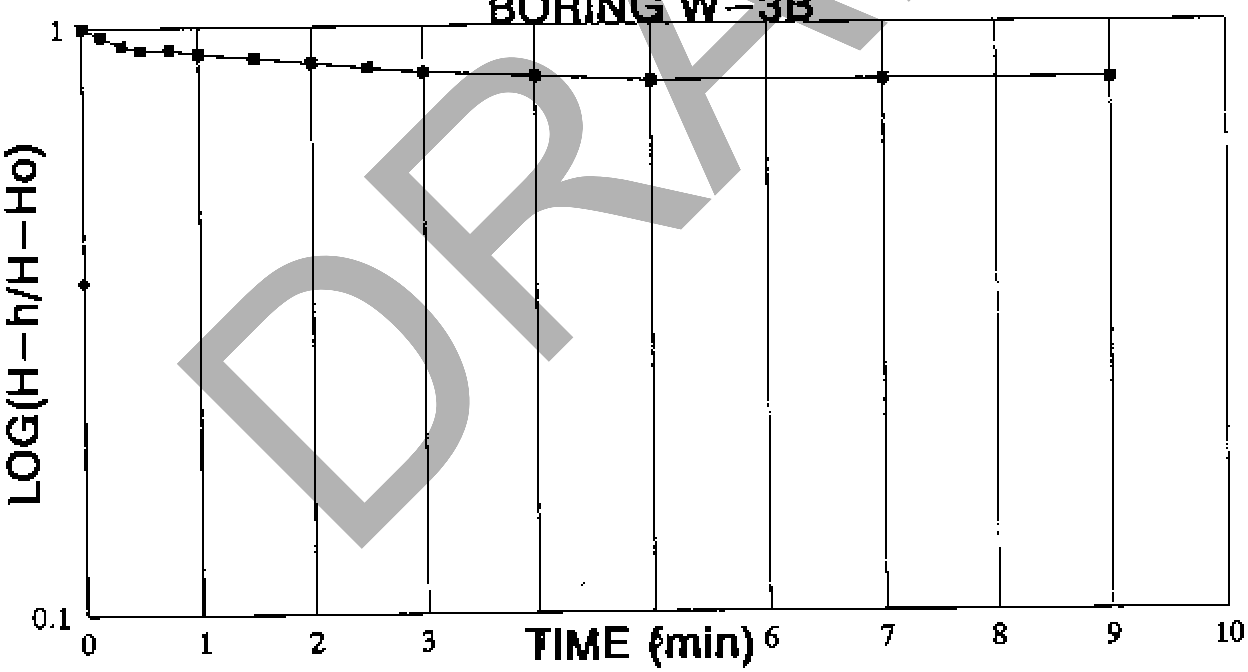
$$K' = \frac{1^2 \ln \frac{12.5 \times 12}{3.5} \times 2.54}{2(12.5 \times 12)\,195} = 1.63 \times 10^{-4}\ \text{cm/s}$$

SLUG TEST BORING# W-3B DATE 1-6-93

water level @To= 4.5

| READING # | TIME (MIN) t | HEAD (ft) h | INITIAL HEAD CHANG Hi=H-Ho | HEAD CHANGE H=H-h | (H-h) / (H-Ho) | LOG |
|---|---|---|---|---|---|---|
| 0 | 0 | 10.5 | 6 | 6.00 | 1.00 | 0.000 |
| 1 | 0.166667 | 10.3 | " | 5.80 | 0.97 | -0.015 |
| 2 | 0.333333 | 10.1 | " | 5.60 | 0.93 | -0.030 |
| 3 | 0.5 | 10 | " | 5.50 | 0.92 | -0.038 |
| 4 | 0.75 | 10 | " | 5.50 | 0.92 | -0.038 |
| 5 | 1 | 9.9 | " | 5.40 | 0.90 | -0.046 |
| 6 | 1.5 | 9.8 | " | 5.30 | 0.88 | -0.054 |
| 7 | 2 | 9.7 | " | 5.20 | 0.87 | -0.062 |
| 8 | 2.5 | 9.6 | " | 5.10 | 0.85 | -0.071 |
| 9 | 3 | 9.5 | " | 5.00 | 0.83 | -0.079 |
| 10 | 4 | 9.4 | " | 4.90 | 0.82 | -0.088 |
| 11 | 5 | 9.3 | " | 4.80 | 0.80 | -0.097 |
| 12 | 7 | 9.3 | " | 4.80 | 0.80 | -0.097 |
| 13 | 9 | 9.3 | " | 4.80 | 0.80 | -0.097 |
| 14 | 12 | 9.2 | " | 4.70 | 0.78 | -0.106 |

LOG (head change) VS TIME
BORING W-3B



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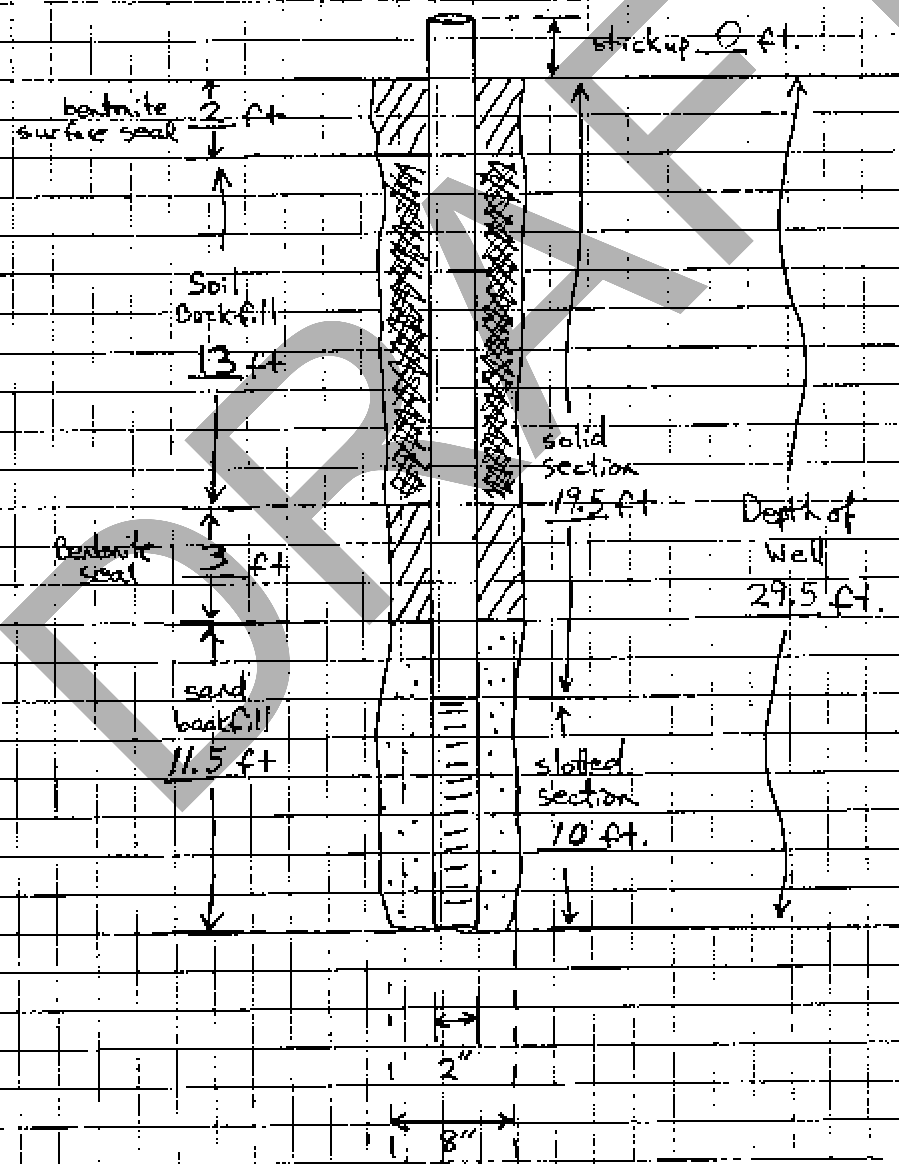
RALEIGH, NC 27619
919-876-0416

JOB NO. 472-5567-03 SHEET 1 OF 1
JOB NAME Weatherspoon Ash Pond Dike
SUBJECT Well Construction Top of Dike
BY ML DATE 1/12/92
CHECKED BY ______ DATE ______

# Typical Well Construction

## Well # 1A



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RALEIGH, NC 27619
919-876-0416

JOB NO. 472-5567-03 SHEET 1 OF 1

JOB NAME Weatherspoon Ash Pond Dike

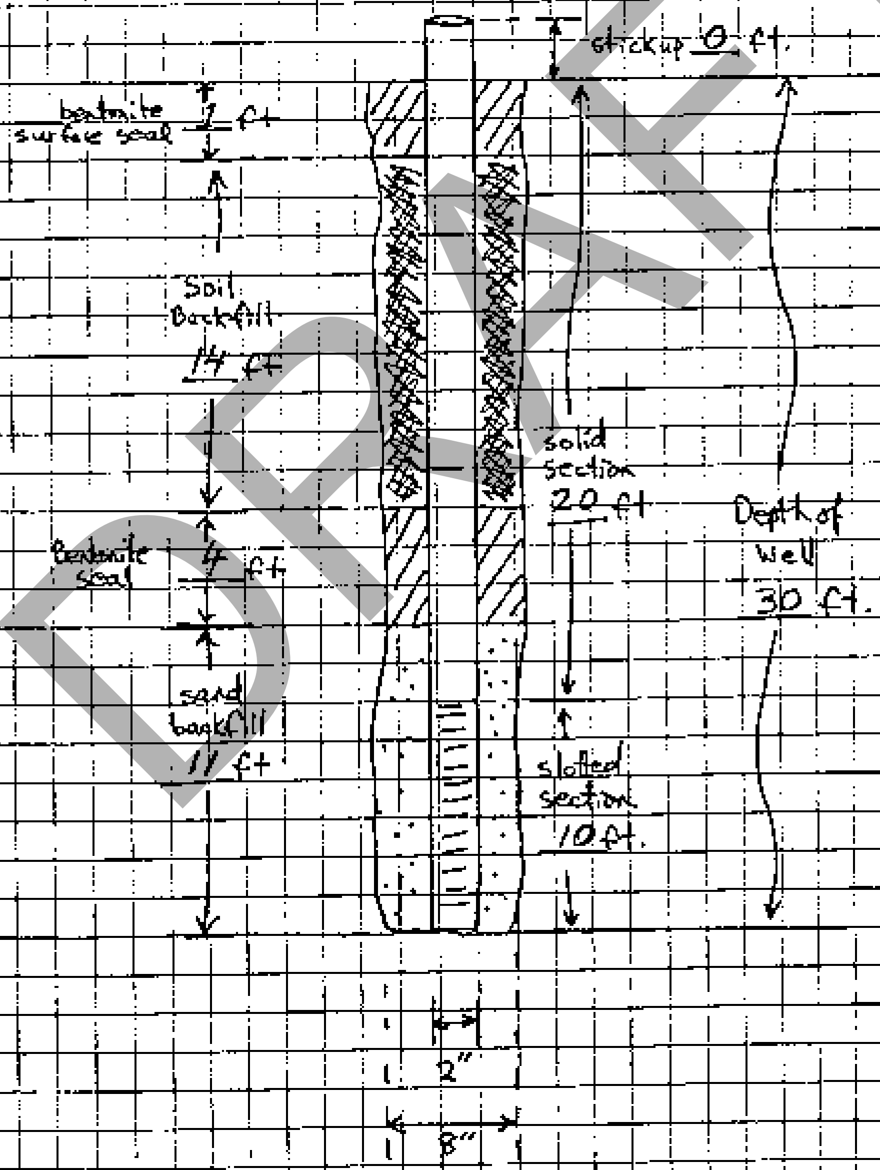
SUBJECT Well Construction Top of Dike

BY ML DATE 1/12/93

CHECKED BY ______ DATE ______

Typical Well Construction

Well # 2A



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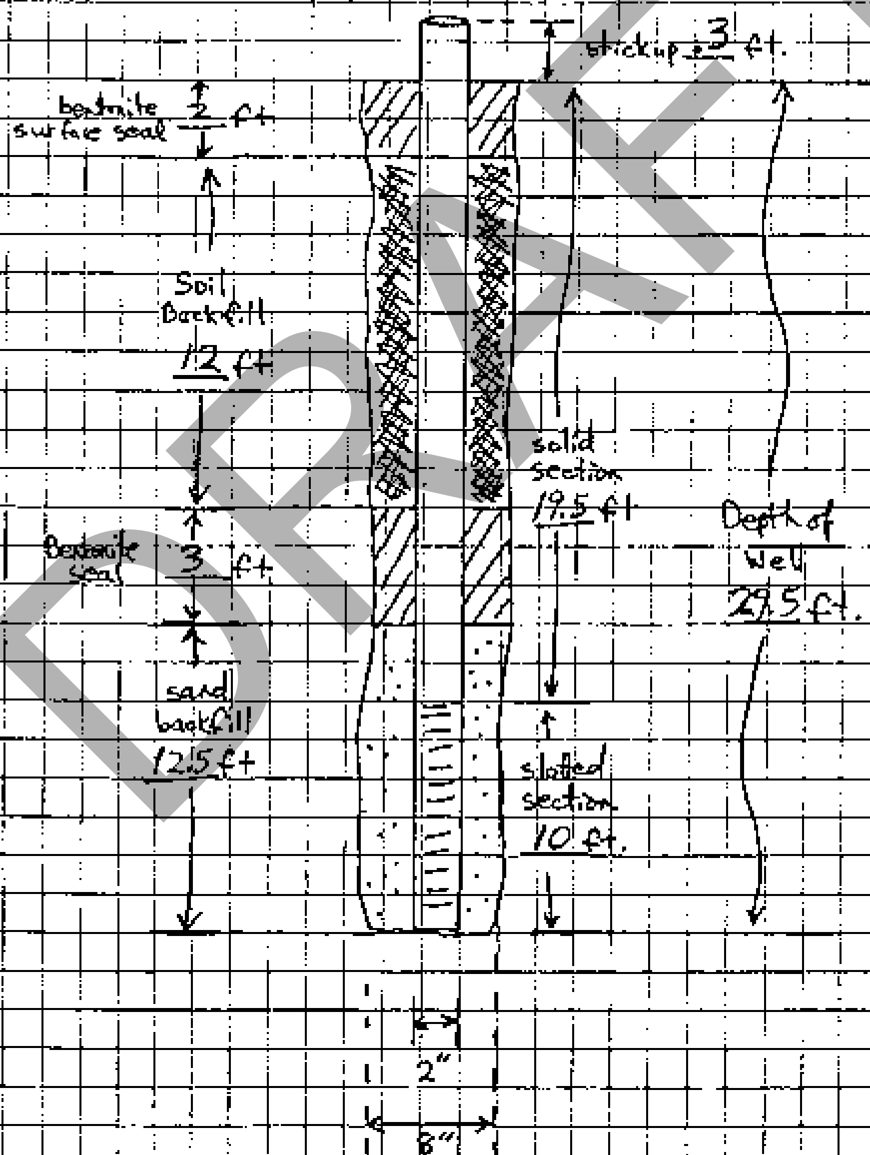
3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0418
GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

JOB NO. 472-5567-03 SHEET 1 OF 1
JOB NAME Weatherspoon Ash Pond Dike
SUBJECT Well Construction Top of Dike
BY ML DATE 1/12/93
CHECKED BY ______ DATE ______

# Typical Well Construction

## Well # 3A



LAW ENGINEERING

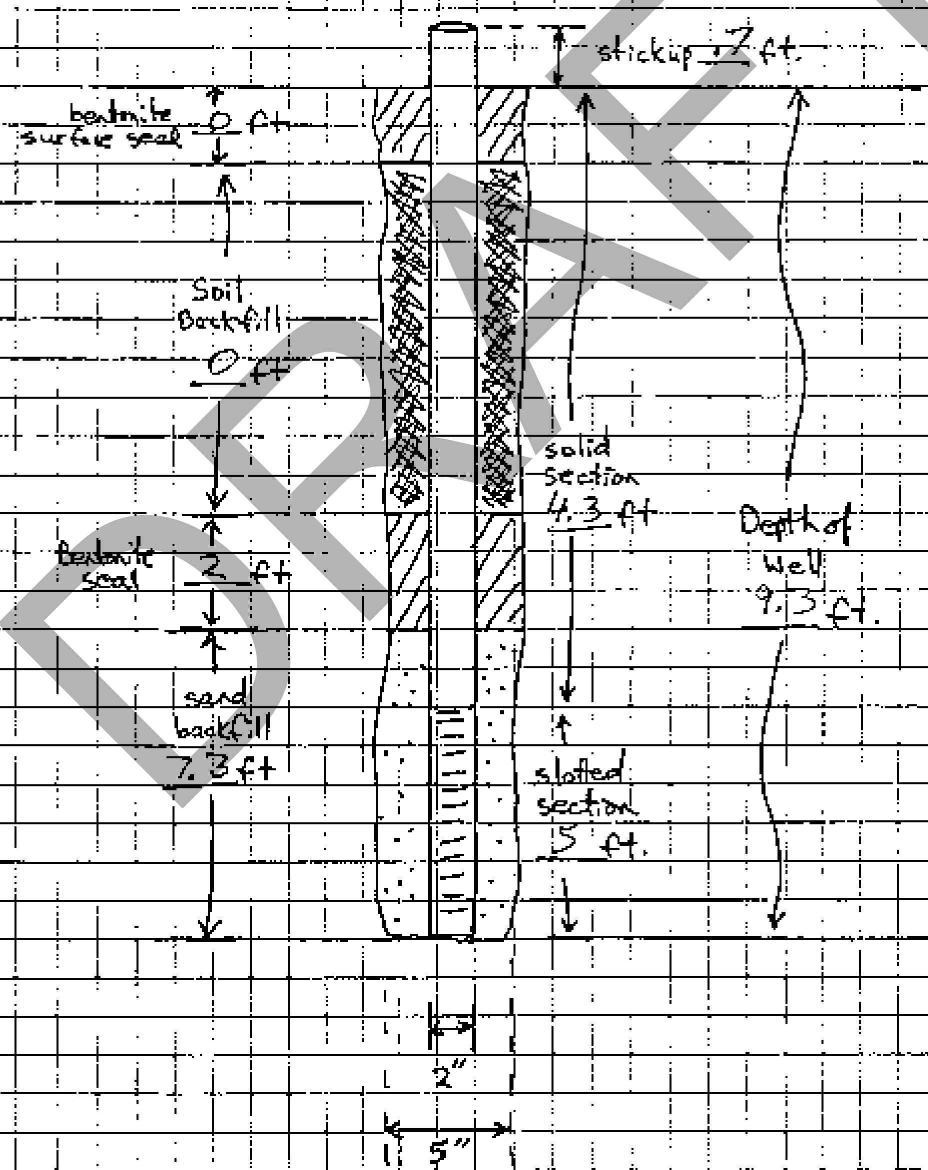
3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

JOB NO. 472-5567-03 SHEET 1 OF 1
JOB NAME Weatherspoon Ash Pond Dike
SUBJECT Well Constr. Sideslope of Dike
BY ML DATE 1/12/93
CHECKED BY ______ DATE ______

Typical Well Construction

Well # 3B



MACTEC

engineering and constructing a better tomorrow

January 14, 2011

Mr. Bill Forster
Progress Energy
7001 Pinecrest Road
Raleigh, North Carolina 27613

**SUBJECT: SUPPLEMENTAL REPORT OF GEOTECHNICAL EVALUATION
1979 ASH POND DIKES
PROGRESS ENERGY - WEATHERSPOON PLANT
MACTEC PROJECT NO. 6468-10-0111**

Dear Mr. Forster:

MACTEC Engineering and Consulting, Inc. (MACTEC) submitted a report dated September 27, 2010 for the geotechnical evaluation of the dikes surrounding the ash facilities at the Weatherspoon Plant. The North Carolina Department of Environment and Natural Resources (NCDENR) issued a letter dated November 5, 2010 to Progress Energy noting areas where they believed additional information was needed on the 1979 Ash Pond Dam. MACTEC was requested to provide the additional exploration and analysis. The results of this additional investigation for 1979 Ash Pond Dam are presented in this letter report.

## FIELD EXPLORATION

To achieve the objectives of this study MACTEC has conducted a geotechnical exploration consisting of three additional soil borings; one near SB-8, and two between soil borings SB-2 and SB-3 (200 feet apart). The locations of soil borings SB-10, SB-11 and SB-12 are shown on Drawing 1, which also includes locations of the previous borings. The location for boring SB-12 was selected at the visually wettest toe road area along the eastside dike. MACTEC installed twelve temporary water level observation casings at various locations on the top, toe and slope of the dike in the vicinity of the three soil borings.

The boring locations were identified in the field by MACTEC personnel utilizing a Trimble GPS unit. The soil borings were performed by a trailer mounted CME 45C drill rig. Mud-rotary drilling procedures were used. Standard penetration testing (SPT) was performed at 2.5-foot intervals by driving a 1-3/8 inch ID split-spoon sampler in general accordance with ASTM D 1586. The split-spoon sampler is driven into the soil a distance of 24 inches by a manual hammer weighing 140-pounds from a free fall height of 30 inches. The number of blows required to drive each 6-inches of the sampler were noted, and the number of blows from the middle two increments are added to obtain the Standard Penetration Resistance (N-Value).

Samples were taken from the split-spoon sampler, described and identified based on visual-manual procedures. A representative portion of each sample was sealed in a glass jar with a moisture tight lid, labeled and returned to MACTEC's laboratory for further visual-manual identification and/or laboratory testing. Intact samples were obtained at targeted depth intervals based on the SPT work and field observations of the samples. An adjacent borehole was drilled for the intact sampling. The methods described in ASTM D 1587 for thin walled tube sampling were used.

A field engineer observed all drilling operations, logged all recovered soil samples, recorded SPT blow counts and measured ground water levels if encountered. Each of the soil samples was described in accordance Unified Soil Classification System (USCS). Detailed descriptions of the soil samples recovered from the borings are presented on the attached boring logs. The stratification lines indicated on the boring logs represent the approximate boundaries between soil types; in-situ, the transitions may be gradual. Variations in soil conditions between borings can also occur.

To allow checks for water levels over time, temporary water level casings (1-inch diameter PVC pipes with slotted sections) were installed with a GeoProbe adjacent to the soil test borings and at the toe of the dikes. The ends of 1-inch PVC pipes were set in the open hole, a sand pack placed to within 2 feet of the ground surface and a bentonite seal used to fill the remainder of the borehole. In addition six temporary casings were installed by hand in the auger holes performed on the dike slopes.

## SUBSURFACE CONDITIONS

Dike Fill: The soils encountered in the borings are similar to those found in the previous investigation and described in the geotechnical report dated September 27, 2010. The soils comprising the dike are predominately silty or clayey sands with USCS symbols of SP, SM, SC and SC-SM. N-values ranged from a single low value of 4 bpf to a maximum value of 26 bpf with most values greater than 10 bpf. Overall, the N-values are interpreted as indicating a compacted condition. The thickness of dike material is estimated to be 17.5 and 18 feet, respectively in borings SB-10 and SB-11 performed on the south dike section. The dike material is estimated to be approximately 9.5 feet thick in boring SB-12 performed on the east section.

Natural Ground: Natural soils are mainly sands and silty sands with USCS symbols of SP and SM. Dense to very dense consistencies were indicated by N-values greater than 30 bpf in all three borings. Borings SB-10 and SB-11 were terminated in the dense sand layer, while boring SB-12 was extended into medium dense sands, encountered below approximately elevation 122 feet.

Water Levels: Water levels were checked in the temporary observation casings two times after the installation. Table 1 on the next page summarizes the information. Water levels in the casings on the dike crest ranged from 12.1 feet to 19.3 feet below the crest. These depths correspond to elevations between approximately 124 and 130 feet.

The hand auger borings on the slope that were near the upper part of the dike slope generally encountered water at depths of 5.9 to 8.2 feet below the ground surface. Hand auger borings in the lower part of the dike slope encountered water water at depths of 4 to 6.5 feet below the ground surface, except SB-11 HA2 performed in the lower portion of the slope did not encounter water to a depth of 6.9 feet.

Temporary observation casings installed at the toe of the south dike encountered water at depths of 2 to 2.6 feet below the ground surface. Water was encountered at a depth of 7.9 feet in temporary observation casing SB-12 HA2 installed in the east dike section.

At the time of field exploration, standing water was observed in rutted areas near the toe of east dike section near boring SB-12. In addition, surface wetness was observed above the toe of the dike in this area as shown on Drawing 6, however, there was no evidence of water movement. South dike sections near borings SB-10 and SB-11 were generally dry and no indications of seepage were noted.

**Table 1: Measured Groundwater Summary**

| Analysis Section | Boring | Location | Approx. Ground Elevation, ft | Groundwater Elevations | |
|---|---|---|---|---|---|
| | | | | 12/4/2010 | 12/23/2010 |
| S-10 | SB-10 | Crest | 143.3 | 124.0 | 124.4 |
| | SB-10 HA1 | Slope | 130.9 | 122.7 | 123.3 |
| | SB-10 HA2 | Slope | 125.2 | 118.7 | 119.2 |
| | SB-10B | Toe | 119.2 | 116.6 | 117.0 |
| S-11 | SB-11 | Crest | 143.4 | 127.4 | 126.1 |
| | SB-11 HA1 | Slope | 134.5 | 128.1 | 127.7 |
| | SB-11 HA2 | Slope | 125.9 | dry at 119.0 | *dry at 120.1 |
| | SB-11B | Toe | 118.5 | 116.5 | 116.8 |
| S-12 | SB-12 | Crest | 142.3 | 130.2 | 132.6 |
| | SB-12 HA1 | Slope | 135.9 | 130.0 | 130.2 |
| | SB-12 HA2 | Slope | 132.0 | 128.7 | 128.0 |
| | SB-12B | Toe | 127.9 | 120.0 | 120.4 |

dry at xxx.x - groundwater not encountered above boring termination/cave-in elevation listed.

* PVC pipe disturbed during water level measurements on 12/4/2010.



## SLOPE STABILITY ANALYSIS

Under the agreement between the North Carolina Utilities Commission and Progress Energy, the guidelines of the United States Army Corps of Engineers (USACOE) were applicable to evaluations of the dam safety. Effective January 1, 2010, state regulation of ash ponds is transferred to the NCDENR, Land Quality Section, Dam Safety Program. For this study, the requirements from both agencies pertaining to slope stability factors of safety have been considered:

NCDENR: Based on North Carolina Administrative Code (NCAC) - Title 15A Department of Environment and Natural Resources of Subchapter 2K - Dam Safety

- Minimum factor of safety for steady state conditions at current pool or design flood elevation is 1.5.
- Minimum factor of safety for rapid draw-down conditions from current pool elevation is 1.25.

USACOE: Based on USACOE Engineering Manual (EM) 1110-2-1902

- Minimum factor of safety for maximum surcharge pool (design flood) is 1.4
- Minimum factor of safety for seismic conditions from current pool elevation is 1.0

## MATERIAL PROPERTIES FOR STABILITY ANALYSIS

Based on the field exploration and laboratory data, the cross section was stratified into distinct soil layers. Material properties of each of these layers are described in the following subsections.

Dike Fill: Data from the borings performed during this phase indicated higher N-values than those previously performed on the south dike. Based on the N-values and triaxial test data from prior investigations included in the September 2010 report, effective strength parameters of $\Phi = 33.5^{\circ}$ and c = 150 psf, were judged appropriate and are consistent with earlier analyses.

Dike Foundation Soils: As mentioned earlier in this report, dense to very dense soils indicated by N-values greater than 30 bpf were observed in all three borings performed during this phase. The design soil parameters at each of the analyzed sections were typically interpreted using the empirical correlation $\Phi = 28 + N_{avg}/4$ for cohesionless soils with some modifications based on judgment. The parameters used in the analysis are shown on the stability analysis sections (Drawings 3 through 6) and on stability analysis output plots attached with this report.

## SEISMIC LOADS

No additional load on the ground surface is considered for static slope stability analysis. For pseudo-static representation of earthquake effects, a seismic coefficient as determined in the previous report of 0.091g was used to scale the horizontal component of earthquake force relative to the sliding mass. It is assumed that earthquake force does not change the pre-earthquake static pore pressure in the slope. Calculations for determining site class and Peak Ground Acceleration (PGA) are included in September 2010 report.

## ANALYSIS METHODOLOGY AND RESULTS

**Southside Dike Section:** MACTEC previously analyzed the 1979 Ash Pond perimeter dike on the southside at the locations of borings SB-1, SB-2 and SB-3 shown on Drawing 1. For this supplemental study, MACTEC performed analysis at sections S-10 and S-11 shown on Drawing 1. The analysis included both static and seismic conditions.

The phreatic line for the analysis was developed from the measured water levels in observation casings installed in the machine-drilled and hand augered borings. The stability analysis sections and circles with the minimum factors of safety (static analysis) results are shown on Drawings 3 and 4. The nature of the analysis performed and the resulting minimum factors of safety are provided in Table 2 below. Plots of the stability analysis results and the summary of input data are attached with this report.

**Table 2: Factors of Safety against Slope Failure – Southside Dike Sections**

| Section Identification | Description of Analysis | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| Southside Dike -Section S-10 | Exterior Slope, Phreatic Surface developed from measured water level. Failure constrained to be within the dike | 1.92 | 1.58 |
| | Exterior Slope, Phreatic Surface developed from measured water level. Failure extending into foundation soils. | 1.54 | 1.19 |
| Southside Dike -Section S-11 | Exterior Slope, Phreatic Surface developed from saturated soil zone in the boring and measured water level. Failure constrained to be within the dike | 1.67 | 1.36 |
| | Exterior Slope, Phreatic Surface developed from saturated soil zone in the boring and measured water level. Failure extending into foundation soils | 1.47 | 1.15 |



**Eastside Dike Section:** MACTEC previously reviewed data from boring SB-8 on the eastside dike section. Based on the conditions being better than in other sections analyzed, and the dike height being lower, MACTEC judged that a stability analysis was not necessary. For the present study MACTEC has conducted a slope stability analysis at the boring SB-12 location shown as S-12 on Drawing 1. The analysis included both static and seismic conditions.

The phreatic line for the analysis was developed from the measured water levels in observation casings installed in the machine-drilled and hand augered borings. The water level in the casing at the toe of the slope (SB-12B) was measured at a depth of 7.9 feet below existing ground. However, field observations indicated wet soils and standing water at the ground surface. The area is topographically low; the observed wetness is interpreted as collected rainfall runoff. As a conservative approach, an additional analysis was performed with the phreatic line exiting above the toe of the dike.

The stability analysis sections and circles with the minimum factors of safety (static analysis) results are shown on Drawings 5 and 6 for measured and interpreted phreatic lines, respectively. The nature of the analysis performed and the associated minimum factors of safety are provided in Table 3 below. Plots of the stability analysis results and the summary of input data are attached with this report.

**Table 3: Factors of Safety against Slope Failure – Eastside Dike Section**

| Section Identification | Description of Analysis | Factor of Safety | |
|---|---|---|---|
| | | Static | Seismic |
| Eastside Dike -Section S-12 | Exterior Slope, Phreatic Surface developed from measured water level. Failure constrained to be within the dike. | 2.18 | 1.73 |
| | Exterior Slope, Phreatic Surface developed from measured water level. Failure extending into foundation soils. | 2.15 | 1.56 |
| | Exterior Slope, Phreatic Surface developed from visual observations in the field with water level exiting above the toe of the dike. Failure constrained to be within the dike. | 1.87 | 1.45 |
| | Exterior Slope, Phreatic Surface developed from visual observations in the field with water level exiting above the toe of the dike. Failure extending into foundation soils. | 1.84 | 1.31 |

## CONCLUSIONS AND RECOMMENDATIONS

The stability analysis results indicate that the additional dike sections analyzed in this report meet the minimum factor of safety for steady state conditions at current pool elevation. No seepage remedial measures are needed in the areas explored for this supplemental exploration. The area should continue to be observed during regular dike inspections.

At the eastside dike section, the water level reading in the observation well at the toe of the dike is at a depth of 7.9 feet below ground surface. Surface wetness observed in the field, which has been noted in earlier inspection reports, is interpreted as being from surface water. It should be noted that the area remains dry during periods of dry weather and there was no evidence of water movement, piping or soil boiling. This area appears topographically low, and the water is likely an accumulation of rainwater. Even so, an alternate stability analysis using a phreatic line exiting the dike above the toe indicates that minimum factor of safety criteria are met. No repairs are deemed necessary for this section of dike. The area has been observed during regular inspections by plant personnel and independent inspectors; these observations should continue.

## CLOSING

MACTEC is pleased to have performed this work for Progress Energy. Please provide your review comments as soon as possible. Contact Al Tice (919-831-8052) or Bob Miller (919-831-8019) if you have questions.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, Inc.

G. Sharatchand

Sharat Gollamudi, E.I.
Project Geotechnical Professional

J. Allan Tice

J. Allan Tice, P. E.
Senior Principal Engineer
Registered, North Carolina 6428

NORTH CAROLINA PROFESSIONAL SEAL 6428 ENGINEER J. ALLAN TICE

Attachments:

Drawing 1: Location Plan

Drawing 2: Legend for Sections

Drawing 3: Stability Analysis Section S-10

Drawing 4: Stability Analysis Section S-11

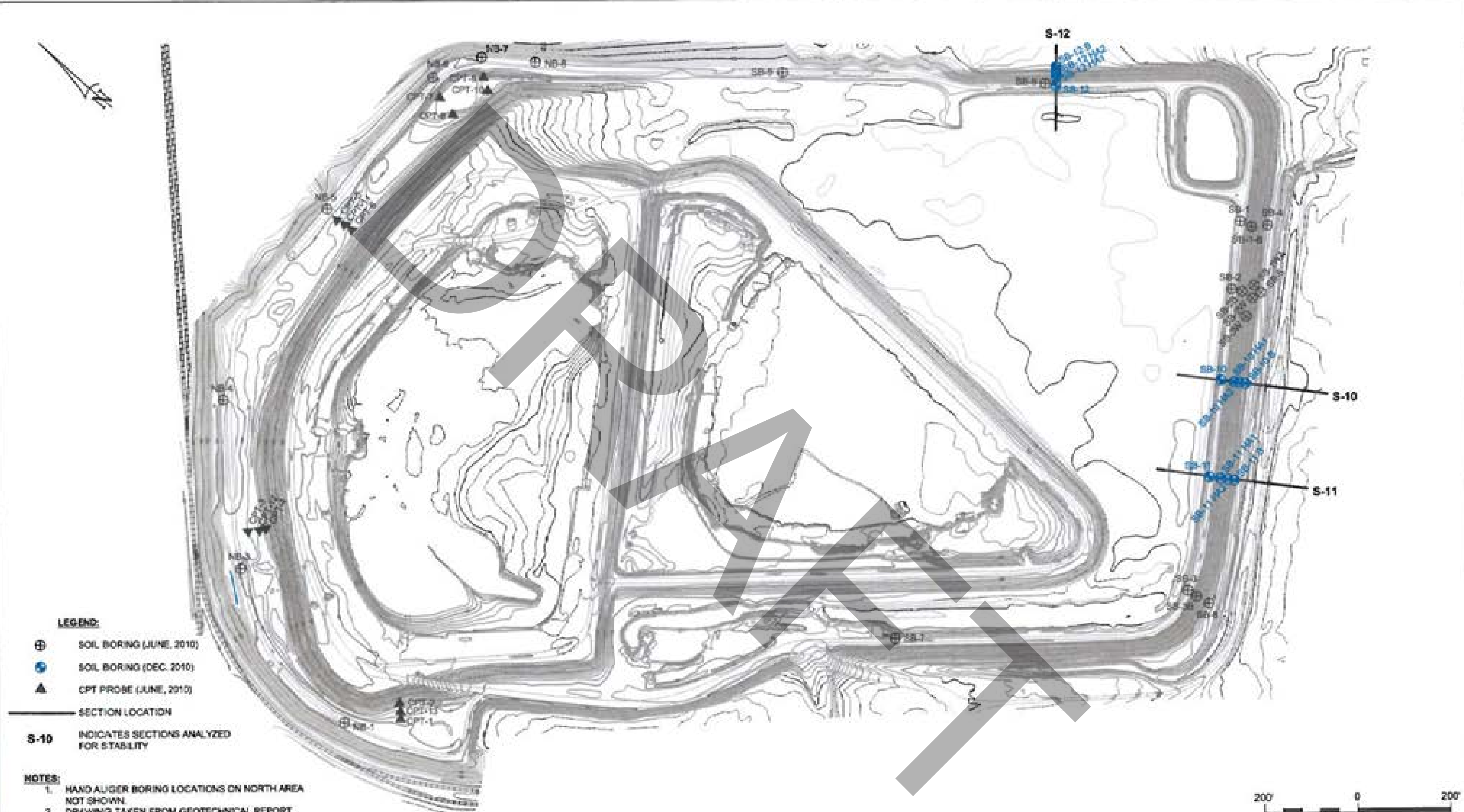
Drawing 5: Stability Analysis Section S-12

Drawing 6: Stability Analysis Section S-12- Alternate Analysis

Boring Log Reports

Laboratory Test Results

Stability Analysis Output Plots




**LEGEND:**

- ⊕ SOIL BORING (JUNE, 2010)
- ● SOIL BORING (DEC. 2010)
- ▲ CPT PROBE (JUNE, 2010)
- ——— SECTION LOCATION
- S-10 INDICATES SECTIONS ANALYZED FOR STABILITY

**NOTES:**

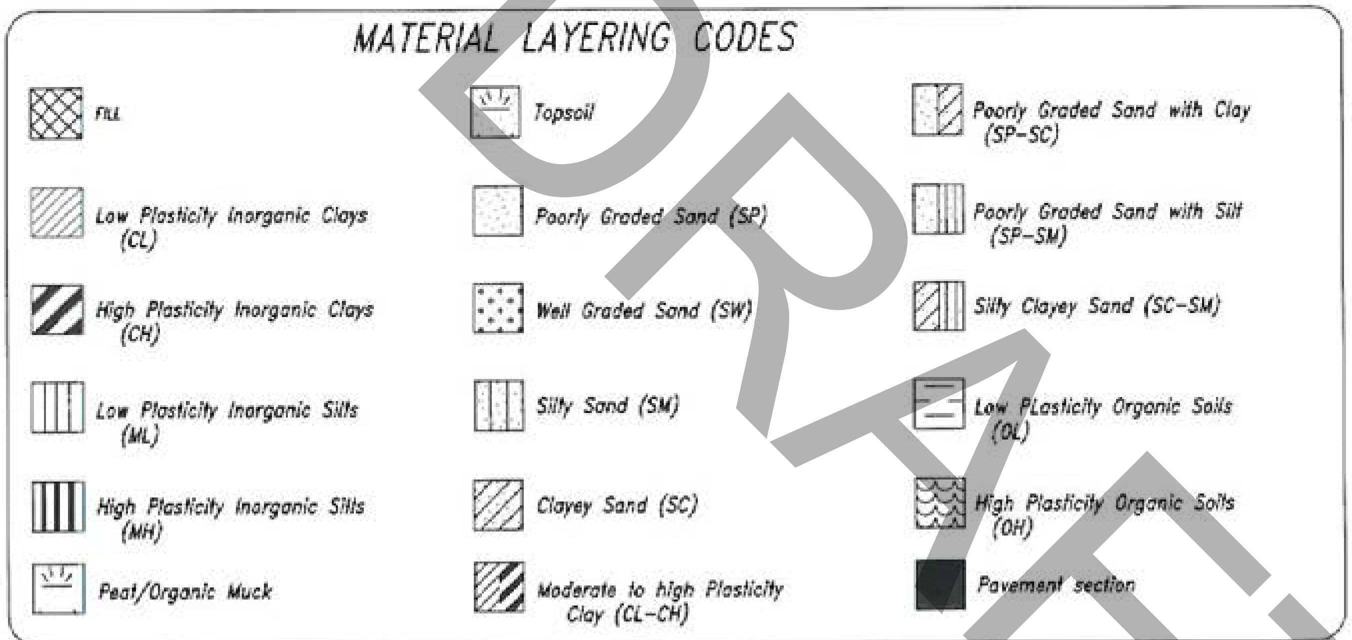
1. HAND AUGER BORING LOCATIONS ON NORTH AREA NOT SHOWN.
2. DRAWING TAKEN FROM GEOTECHNICAL REPORT DATED SEPTEMBER 27, 2010 AND MODIFIED TO SHOW SECTIONS S-10, S-11 AND S-12.

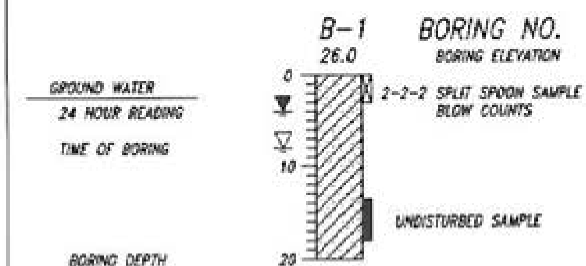
200' 0 200'
GRAPHIC SCALE - IN FEET

| MACTEC<br>MACTEC ENGINEERING AND CONSULTING, INC.<br>3301 ATLANTIC AVENUE<br>RALEIGH, NORTH CAROLINA | BORING LOCATION PLAN - SUPPLEMENTAL EXPLORATION<br>ASH POND, WEATHERSPOON PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: R.R.<br>ENG CHECK: S.G.<br>APPROVAL: [signature] | DATE: JANUARY 2011<br>SCALE: AS SHOWN<br>JOB No.: 6468-10-0111 | DRAWING<br>1 |
|---|---|---|---|---|

REFERENCE: TOPOGRAPHIC MAP FROM AERIAL METHODS; PREPARED BY McKIM AND CREED.

P:\6468\Progress Energy\Progress Energy Projects 2010\Weatherspoon\Project Deliverables\Drawings\Cross Sections 01-03-11.dwg Wed, 12 Jan 2011 - 2:27pm rrohle

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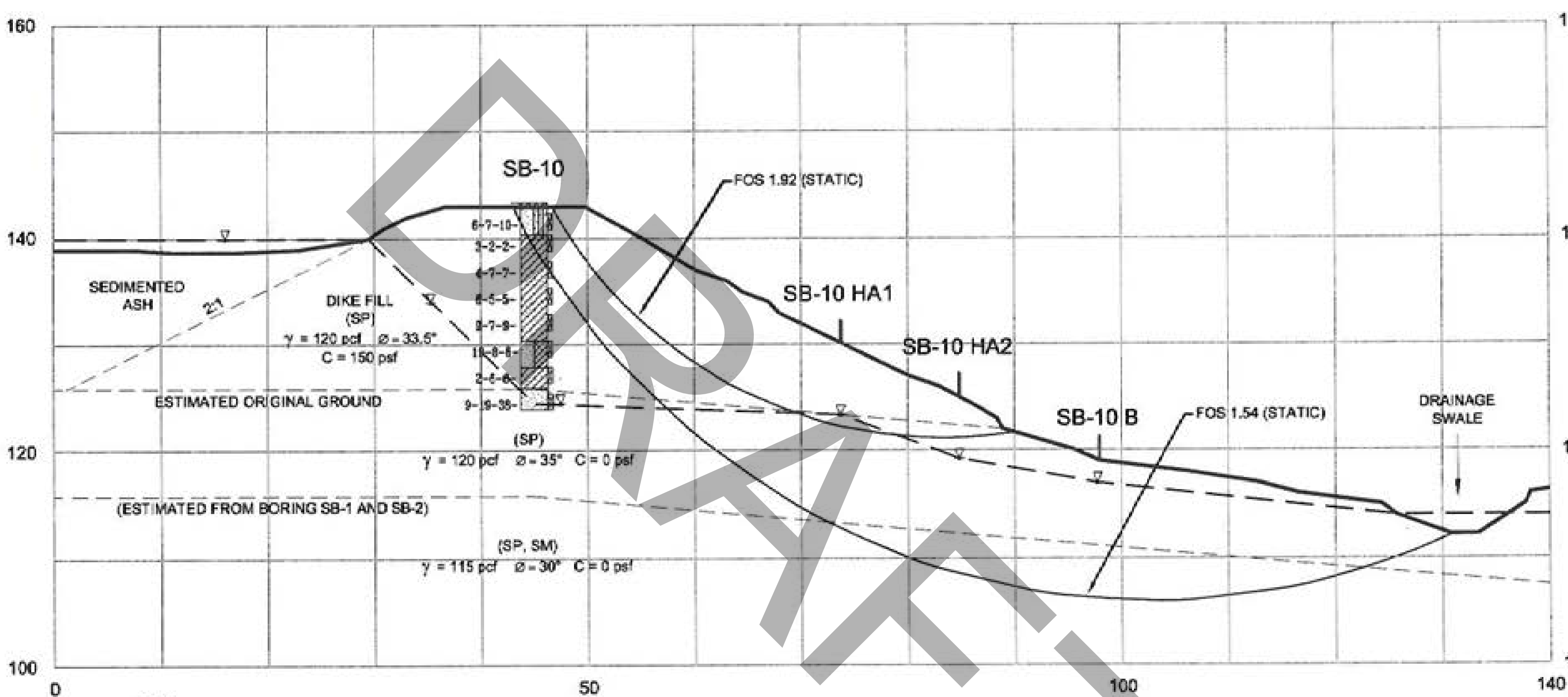
LEGEND FOR SECTIONS
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | JANUARY 2011 | DRAWING |
| ENG CHECK: | SG | SCALE: | | 2 |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 | |

REFERENCE:




NOTE:

SEE DRAWING 2 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

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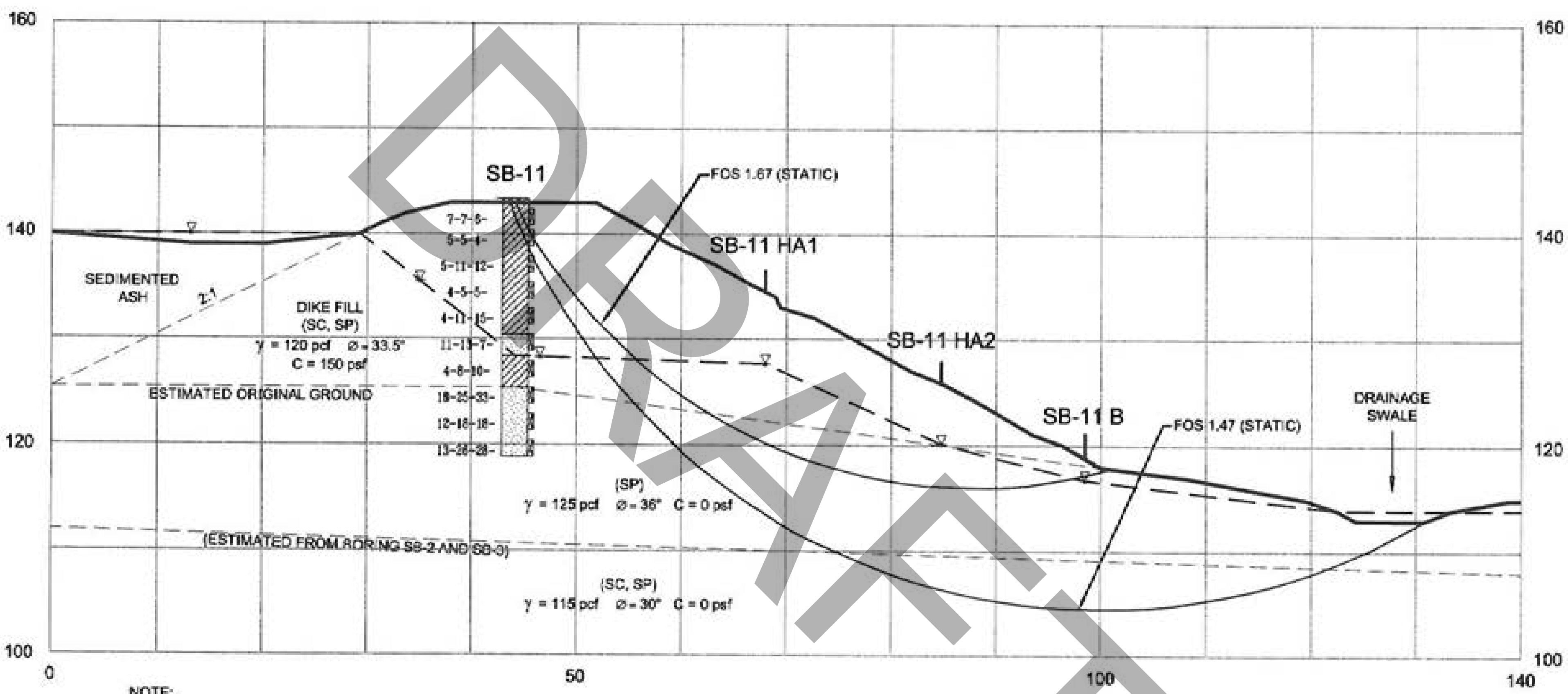
STABILITY ANALYSIS SECTION S-10
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | JANUARY 2011 | DRAWING |
| ENG CHECK: | SG | SCALE: | AS SHOWN | 3 |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTE:

SEE DRAWING 2 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

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RALEIGH, NORTH CAROLINA

**STABILITY ANALYSIS SECTION S-11**
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
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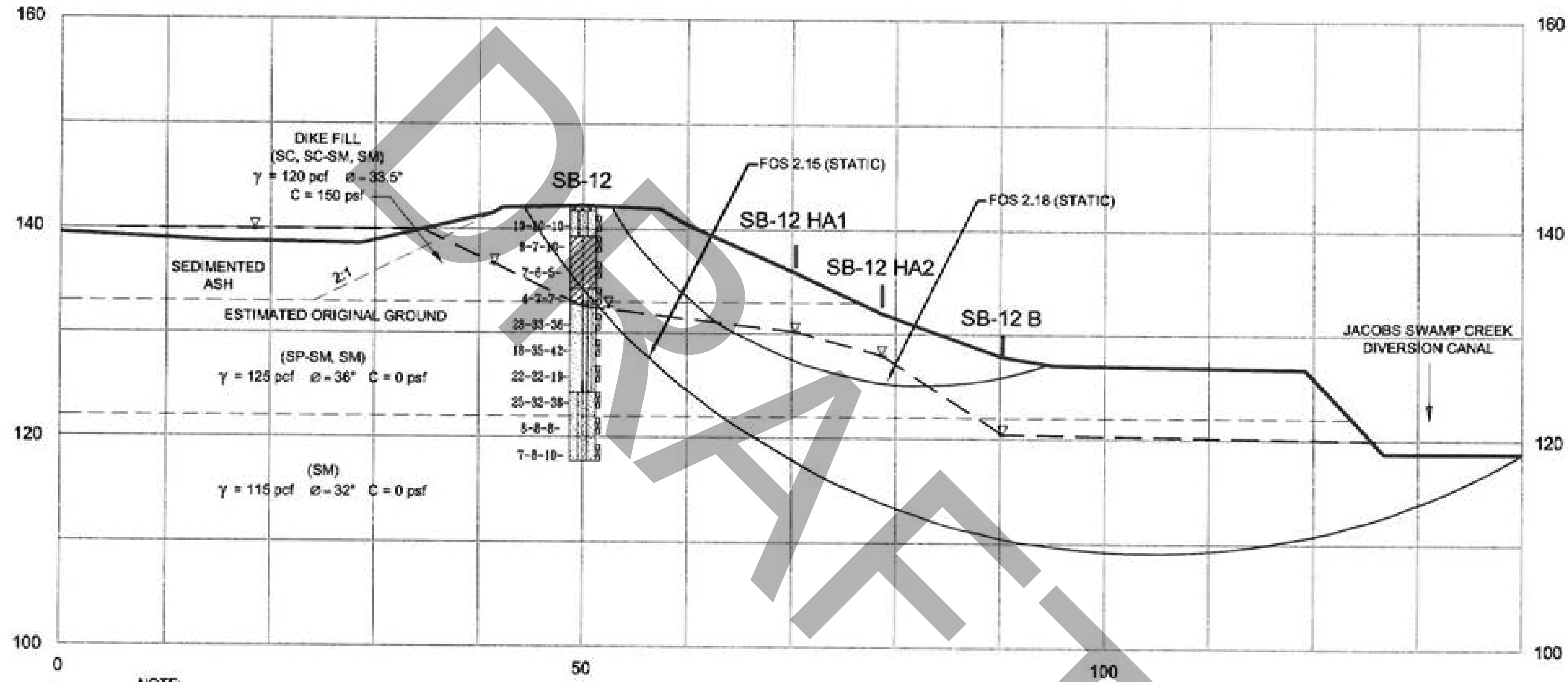
| ENG CHECK: | SG | SCALE: | AS SHOWN | 4 |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTE:

SEE DRAWING 2 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

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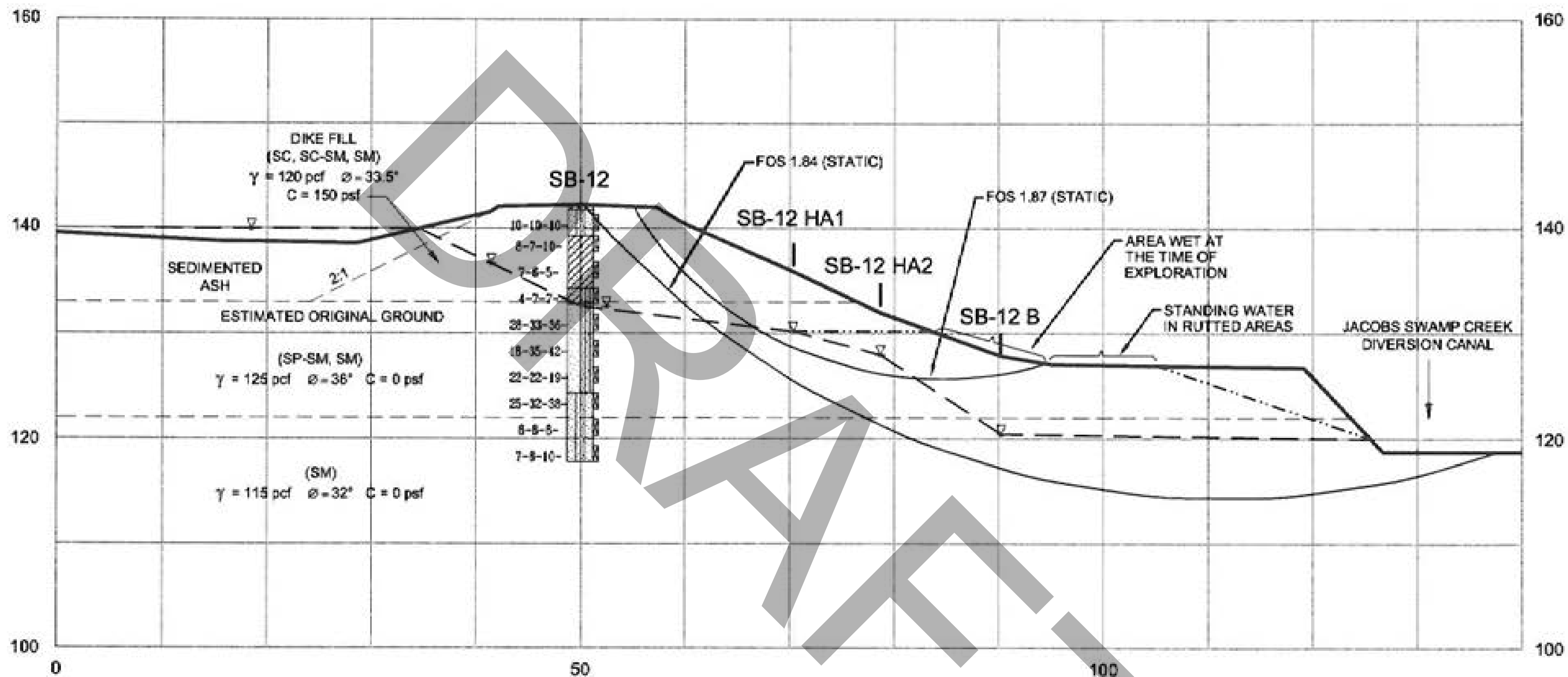
RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION S-12 (MEASURED WATER LEVELS)
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | JANUARY 2011 |
| ENG CHECK: | SG | SCALE: | AS SHOWN |
| APPROVAL: | JAJ | JOB No.: | 6468-10-0111 |

DRAWING 5

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.




NOTE:

SEE DRAWING 2 FOR LEGEND.

2:1 ESTIMATED INTERIOR DIKE SLOPE

POSSIBLE PHREATIC LINE INTERPRETED FROM VISUAL OBSERVATIONS IN FIELD

MEASURED PHREATIC LINE

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RALEIGH, NORTH CAROLINA

STABILITY ANALYSIS SECTION S-12 (INTERPRETED WATER LEVEL)
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | | |
|---|---|---|---|---|
| DRAWN: | R.R. | DATE: | JANUARY 2011 | DRAWING |
| ENG CHECK: | SG | SCALE: | AS SHOWN | 6 |
| APPROVAL: | [signature] | JOB No.: | 6468-10-0111 | |

REFERENCE: TOPOGRAPHIC MAP BY McKIM AND CREED; MACTEC FIELD DATA.

# Boring Log Reports



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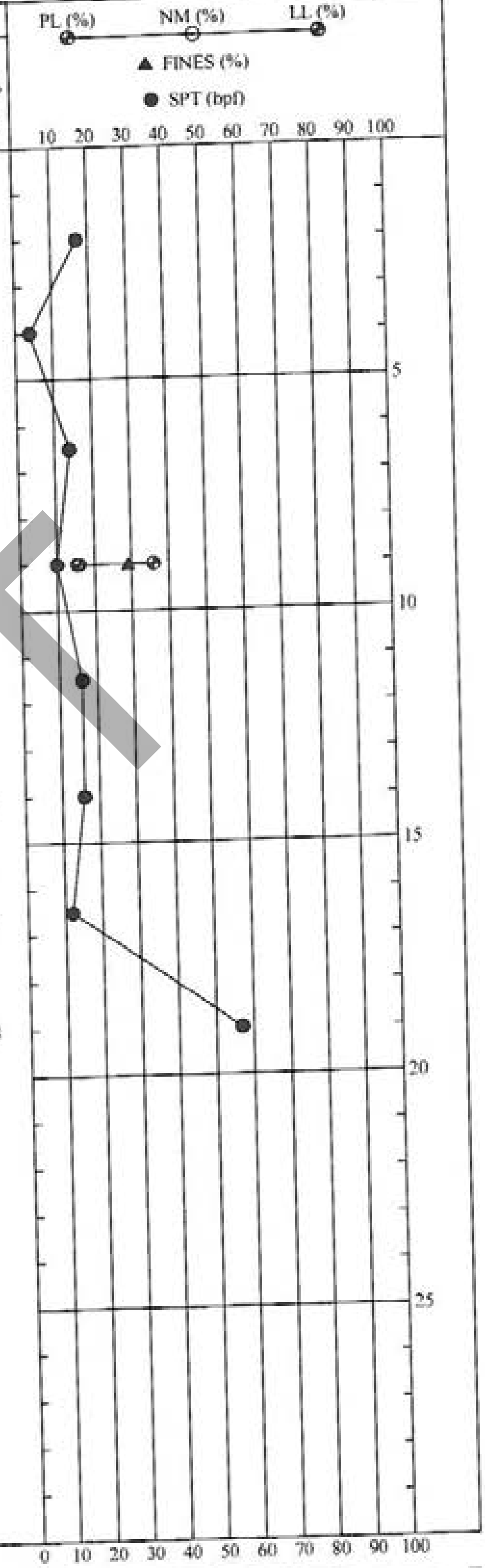
| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) |
|---|---|---|
| 0 | Fill-Crushed Stone/Gravel | 143.3 |
| | Fill- Medium dense, damp, dark borwn, slightly silty fine SAND (SP-SM) | |
| | Fill - Loose, moist, brown and gray, clayey fine to medium SAND (SC) | |
| 5 | Fill - Medium Dense | 138.3 |
| | Undisturbed sample taken from adjacent location, betweeen 8 and 10 feet | |
| 10 | | 133.3 |
| | Fill- Medium dense, moist, tan and gray brown, slightly clayey fine to medium SAND (SP-SC) | |
| 15 | | 128.3 |
| | Possible Fill - Medium dense, wet, brown and orange, clayey fine SAND (SC) | |
| | Estimated Original Ground - Very dense, wet, dark gray and tan, fine to medium sand (SP), trace silt | |
| 20 | Boring terminated at 19.5 ft. Boring backfilled immediately following completion of drilling. Groundwater level shown is measured in adjacent casing on 12/23/2010. | 123.3 |
| 25 | | 118.3 |
| 30 | | 113.3 |

**SAMPLES**

| IDENT | TYPE | N-COUNT or Rec%/RQD% (1st 6", 2nd 6", 3rd 6", 4th 6") |
|---|---|---|
| SS-1 | | 6-7-10 |
| SS-2 | | 3-2-2 |
| SS-3 | | 4-7-7 |
| SS-4 | | 6-5-5 |
| SS-5 | | 9-7-9 |
| SS-6 | | 19-8-8 |
| SS-7 | | 2-6-6 |
| SS-8 | | 9-19-38 |






| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Installed a 1-in. PVC slotted casing in an adjacent hole using Geoprobe 6625CPT/Seismic Rig to a depth of 25 ft. Slot interval: 20 to 25 ft. Filter sand: 2 to 25 ft. Groundwater was measured at a depth of 19.35 ft on 12/4/2010 and 18.93 ft on 12/23/2010 |

REVIEWED BY: [signature]

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-10

**Location:** Lumberton, North Carolina

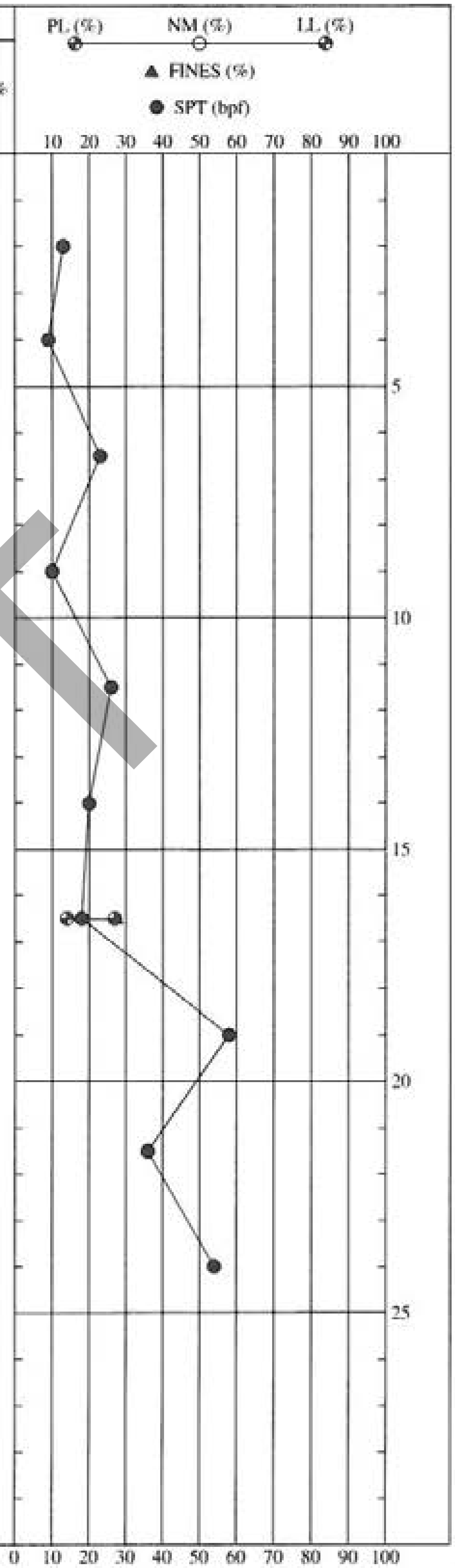
**Drilled:** December 3, 2010

**Project #:** 6468-10-0111

**Page** 1 **of** 1

MACTEC

| DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.) | ELEV (ft) | SAMPLES IDENT | N-COUNT or Rec%/RQD% (1st 6" / 2nd 6" / 3rd 6" / 4th 6") |
|---|---|---|---|---|
| 0 | Fill - Crushed Stone/Gravel | 143.4 | | |
| | Fill - Medium dense, moist, brown and orange, clayey fine to medium SAND (SC) | | SS-1 | 7-7-6 |
| | Fill - Loose | | SS-2 | 5-5-4 |
| 5 | Fill - Medium dense | 138.4 | SS-3 | 5-11-12 |
| | | | SS-4 | 4-5-5 |
| 10 | | 133.4 | SS-5 | 4-11-15 |
| | Fill - Medium dense, moist, brown, fine to medium SAND (SP), trace silt | | SS-6 | 11-13-7 |
| 15 | Possible Fill - Medium dense, wet, dark gray, brown, clayey fine to medium SAND (SC) | 128.4 | SS-7 | 4-8-10 |
| | Estimated Original Ground - Very dense, wet, dark gray and tan, fine SAND (SP), trace silt | | SS-8 | 18-25-33 |
| 20 | Dense | 123.4 | SS-9 | 12-18-18 |
| | Very dense | | SS-10 | 13-26-28 |
| 25 | Boring terminated at 24.5 ft. Boring backfilled immediately following completion of drilling. Groundwater level shown is measured in adjacent casing on 12/23/2010. | 118.4 | | |
| 30 | | 113.4 | | |




STD-NO STATION WEATHERSPOON.GPJ MACTEC GEO.GDT 1/12/11

| | |
|---|---|
| DRILLER: | G. Bridger-Carolina Drilling |
| EQUIPMENT: | CME45 Manual Hammer |
| METHOD: | Mud Rotary Drilling |
| HOLE DIA.: | 3" |
| REMARKS: | Installed a 1-in. PVC slotted casing in an adjacent hole using Geoprobe 6625CPT/Seismic Rig to a depth of 25 ft. Slot interval: 20 to 25 ft. Filter sand: 2 to 25 ft. Groundwater was measured at a depth of 16.02 ft on 12/4/2010 and 17.32 ft on 12/23/2010. |

REVIEWED BY: ______

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis

**Boring No.:** SB-11

**Location:** Lumberton, North Carolina

**Drilled:** December 3, 2010

**Project #:** 6468-10-0111



MACTEC

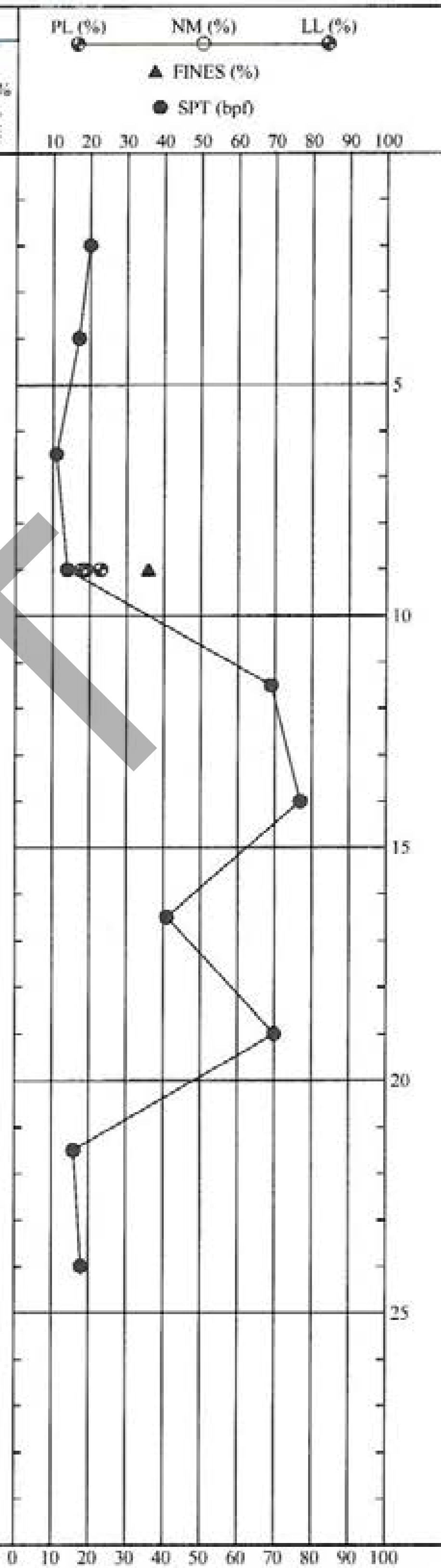
# SOIL CLASSIFICATION AND REMARKS

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

| Depth (ft) | Soil Classification and Remarks | Elev (ft) |
|---|---|---|
| 0 | Fill- Crushed stone/Gravel | 142.3 |
| | Fill - Medium dense, damp, dark gray brown, silty fine SAND (SM) | |
| | Fill - Medium dense, moist, dark gray brown, clayey fine SAND (SC) | |
| 5 | | 137.3 |
| | Fill - Medium dense, moist, dark gray brown, silty to clayey fine SAND (SC-SM), trace clay lenses | |
| 10 | Estimated orginial ground - Very dense, wet, gray to light tan, slightly silty fine SAND (SP-SM), trace decayed wood | 132.3 |
| 15 | Dense | 127.3 |
| | Very dense, wet, gray and brown, silty fine SAND (SM) | |
| 20 | Medium dense | 122.3 |
| 25 | Boring terminated at 24.5 ft. Boring backfilled immediately following completion of drilling. Groundwater level shown is measured in adjacent casing on 12/23/2010. | 117.3 |
| 30 | | 112.3 |

## SAMPLES

| Ident | N-COUNT or Rec%/RQD% (1st 6" - 2nd 6" - 3rd 6") |
|---|---|
| SS-1 | 10-10-10 |
| SS-2 | 8-7-10 |
| SS-3 | 7-6-5 |
| SS-4 | 4-7-7 |
| SS-5 | 28-33-36 |
| SS-6 | 18-35-42 |
| SS-7 | 22-22-19 |
| SS-8 | 25-32-38 |
| SS-9 | 8-8-8 |
| SS-10 | 7-8-10 |






DRILLER: G. Bridger-Carolina Drilling
EQUIPMENT: CME45 Manual Hammer
METHOD: Mud Rotary Drilling
HOLE DIA.: 3"
REMARKS: Installed a 1-in. PVC slotted casing in an adjacent hole using Geoprobe 6625CPT/Seismic Rig to a depth of 25 ft. Slot interval: 20 to 25 ft. Filter sand: 2 to 25 ft. Groundwater was measured at a depth of 12.1 ft on 12/4/2010 and 9.7 ft on 12/23/2010.

REVIEWED BY: 

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

## SOIL TEST BORING RECORD

**Project:** Weatherspoon Ash Pond Dikes, Stability Analysis
**Boring No.:** SB-12
**Location:** Lumberton, North Carolina
**Drilled:** December 3, 2010
**Project #:** 6468-10-0111
**Page** 1 **of** 1

MACTEC

| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name**: **Weatherspoon Dike Evaluation** | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB10-HA1 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 3 | Not taken | Damp, orange-yellow, slightly clayey fine to medium SAND |
| 3 to 5 | Not taken | Moist, gray, clayey SAND |
| 5 to 5.7 | Not taken | Moist, dark gray, slightly clayey fine to medium SAND |
| 5.7 to 7 | Not taken | Moist, dark to light gray, fine to medium SAND, trace clay |
| 7 to 8.24 | Not taken | Moist, gray, clayey SAND, trace clay lenses |
| Hand Auger terminated at 8.24 ft below ground surface. | | Note: Installed 1.25 inch PVC pipe to 8.24 ft, 3 ft of hand slotted PVC pipe and 6.61 ft solid riser pipe. Stickup 20 inches. Backfilled with auger cuttings. No water present immediately after installation. Water was measured at 8.24 ft below ground surface (bottom of pipe) on 12/4/2010 and 7.58 ft on 12/23/2010. |



| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name**: **Weatherspoon Dike Evaluation** | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB10-HA2 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 3.5 | Not taken | Damp, orange-yellow, clayey SAND (SC) |
| 3.5 to 5 | Not taken | Moist, dark gray, slightly clayey fine to medium SAND |
| 5 to 7.45 | Not taken | Moist to wet, light gray, fine to medium SAND, trace clay |
| Auger terminated at 7.45 ft below ground surface. | | Note: Installed 1.25 inch PVC pipe to7.45 ft, 3 ft of hand slotted PVC pipe and 7.2 ft solid riser pipe. Stickup 33 inches. Backfilled with auger cuttings. No water present immediately after installation. Water was measured at 6.52 ft below ground surface on 12/4/2010 and 6.00 ft on 12/23/2010. |

Prepared by: S.G Reviewed by: [signature]

MACTEC

| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB11-HA1 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 3 | Not taken | Damp, orange-yellow, clayey SAND |
| 3 to 5 | Not taken | Moist, gray, slightly clayey, fine to medium SAND |
| 5 to 6 | Not taken | Moist, gray fine SAND, trace silt |
| 6 to 8.26 | Not taken | Wet, light tan and brown clayey SAND |
| Hand Auger terminated at 8.26 ft below ground surface. | | Note: Installed 1.25 inch PVC pipe at 8.26 ft, 3 ft of hand slotted PVC pipe and 6.72 ft solid riser pipe. Stickup 17.5 inches. Backfilled with auger cuttings No water present immediately after installation. Water was measured at 6.36 ft below ground surface on on 12/4/2010 and 6.84 ft on 12/23/2010. |

| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name: Weatherspoon Dike Evaluation** | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB11-HA2 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 0.5 | Not taken | Damp, light tan fine SAND, trace silt |
| 0.5 to 3 | Not taken | Damp, orange-yellow, clayey SAND |
| 3 to 3.5 | Not taken | Moist, orange-yellow, sandy CLAY |
| 3.5 to 5 | Not taken | Moist, gray, slightly clayey fine to medium SAND |
| 5 to 6 | Not taken | Moist, gray, fine SAND, trace silt |
| 6 to 6.83 | Not taken | Moist, tan and brown, fine SAND, trace silt |
| Hand Auger terminated at 6.83 ft below ground surface. | | Note: Installed 1.25 inch PVC Piezometer at 6.83 ft, 3 ft of hand slotted PVC pipe and 6.58 ft solid riser pipe. Stickup 33 inches. Backfilled with auger cuttings. No water present immediately after installation or on 12/4/ 2010 and 12/23/2010. |

Prepared by: S.G. Reviewed by: [signature]

MACTEC

| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name:** Weatherspoon Dike Evaluation | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB12-HA1 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 2 | Not taken | Damp, orange-yellow, brown, clayey SAND |
| 2 to 5 | Not taken | Moist, dark brown, fine to medium SAND, trace silt |
| 5 to 6 | Not taken | Moist, brown, clayey SAND |
| 6 to 7.5 | Not taken | Wet, brown, slightly clayey fine to medium SAND |
| Hand Auger terminated at 7.5 ft below ground surface. | | Note: Installed 1.25 inch PVC Piezometer at 7.5 ft, 3 ft of hand slotted PVC pipe and 7.7 ft solid riser pipe. Stickup 38.4 inches. Backfilled with auger cuttings. No water present immediately after installation. Water was measured at 5.93 ft below ground surface on December 3, 2010 and 5.70 ft on 12/23/2010. |

| Hand Auger Boring Log | | |
|---|---|---|
| **Job Name:** Weatherspoon Dike Evaluation | | **Date:** December 3, 2010 |
| **Client:** Progress Energy | | **MACTEC Job No.** 6468-10-0111 |
| **Boring No.** SB12-HA2 | **Boring Location:** See drawing 1. | |
| **Depth (ft)** | **Blow Counts** | **Visual Soil Description** |
| 0 to 3 | Not taken | Damp, orange-yellow, brown, clayey SAND |
| 3 to 6 | Not taken | Wet, dark brown, slightly silty fine to medium SAND |
| 6 to 7.42 | Not taken | Wet, brown, slightly clayey fine to medium SAND |
| Hand Auger terminated at 7.42 ft below ground surface. | | Note: Installed 1.25 inch PVC Piezometer at 7.42 ft, 3 ft of hand slotted PVC pipe and 6.87 ft solid riser pipe. Stickup 29.4 inches. Backfilled with auger cuttings. No water present immediately after installation. Water was measured at 3.25 ft below ground surface on December 3, 2010 and 4.00 ft on 12/23/2010. |

Prepared by: S.G. Reviewed by: [signature]

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# Laboratory Test Results



MACTEC

# Particle Size Distribution Report ASTM D 422-63 (2007)


| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.3 | 40.5 | 30.0 | 29.2 | |

| | Source | Sample # | Depth/Elev. | Date Sampled | USCS | Material Description | NM % | LL | PL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | Boring SB-10 | SS4 | 8.0-9.5' | 12/8/10 | SC | Brownish Yellow Clayey medium to Fine SAND | 15.4 | 36 | 16 |

Client Progress Energy
Project Weatherspoon Dike Stability
Project No. 6468100111 Figure

**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Tested By:** CS

# Particle Size Distribution Report ASTM D 422-63 (2007)


| % Gravel Coarse | % Gravel Fine | % Sand Coarse | % Sand Medium | % Sand Fine | % Fines Silt | % Fines Clay |
|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 0.5 | 14.1 | 58.0 | 27.4 | |

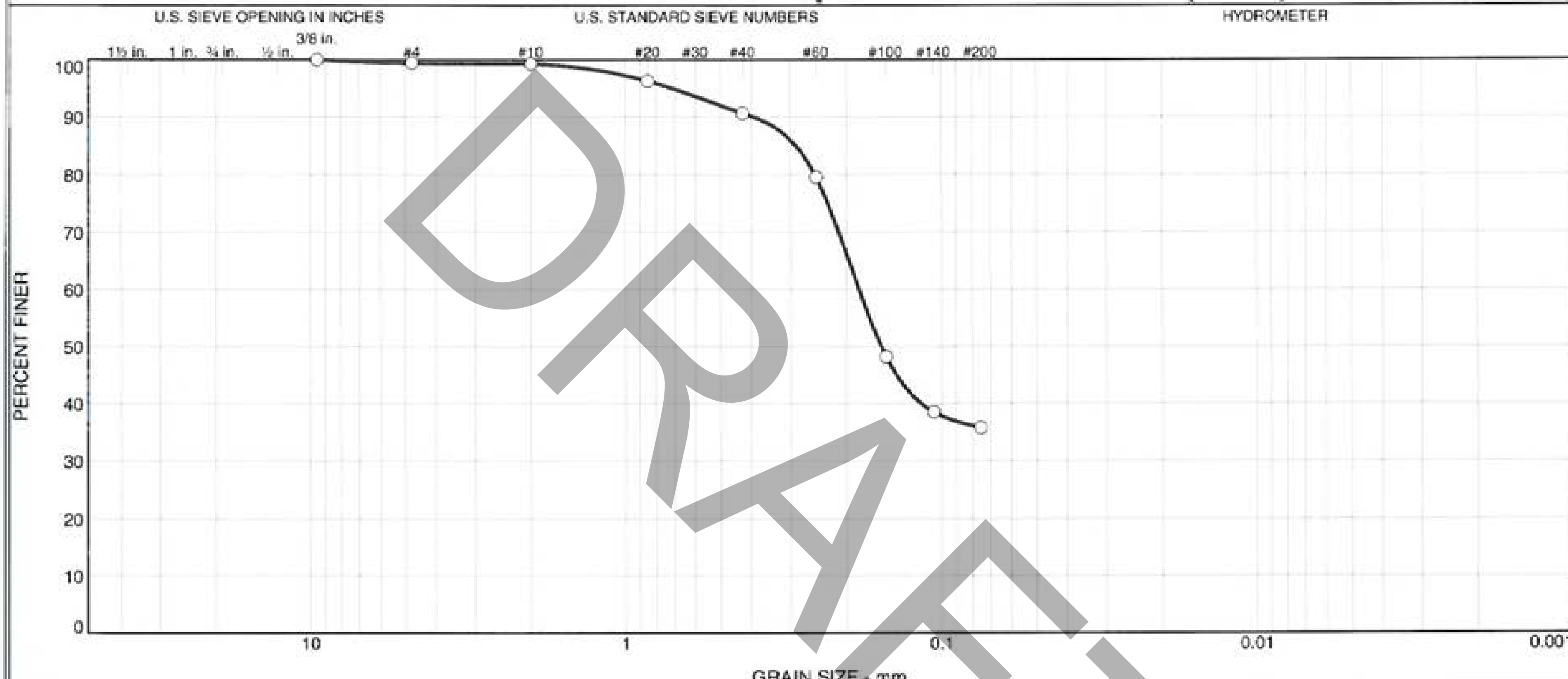
| Source | Sample # | Depth/Elev. | Date Sampled | USCS | Material Description | NM % | LL | PL |
|---|---|---|---|---|---|---|---|---|
| Boring SB-11 | SS-7 | 15.5-17.0' | 12/8/10 | SC | Reddish Gray Yellow Clayey medium To Fine SAND | ND | 27 | 14 |

Client Progress Energy
Project Weatherspoon Dike Stability
Project No. 6468100111 Figure

**MACTEC Engineering and Consulting, Inc.**
**Raleigh, North Carolina**

**Tested By:** CS

# Particle Size Distribution Report ASTM D 422-63 (2007)




| | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.6 | 0.1 | 8.6 | 54.9 | 35.8 | |

| | Source | Sample # | Depth/Elev. | Date Sampled | USCS | Material Description | NM % | LL | PL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | Boring SB-12 | SS-4 | 8.0-9.5' | 12/8/10 | SC-SM | Olive Gray Silty Clayey Fine SAND | 19.0 | 23 | 18 |

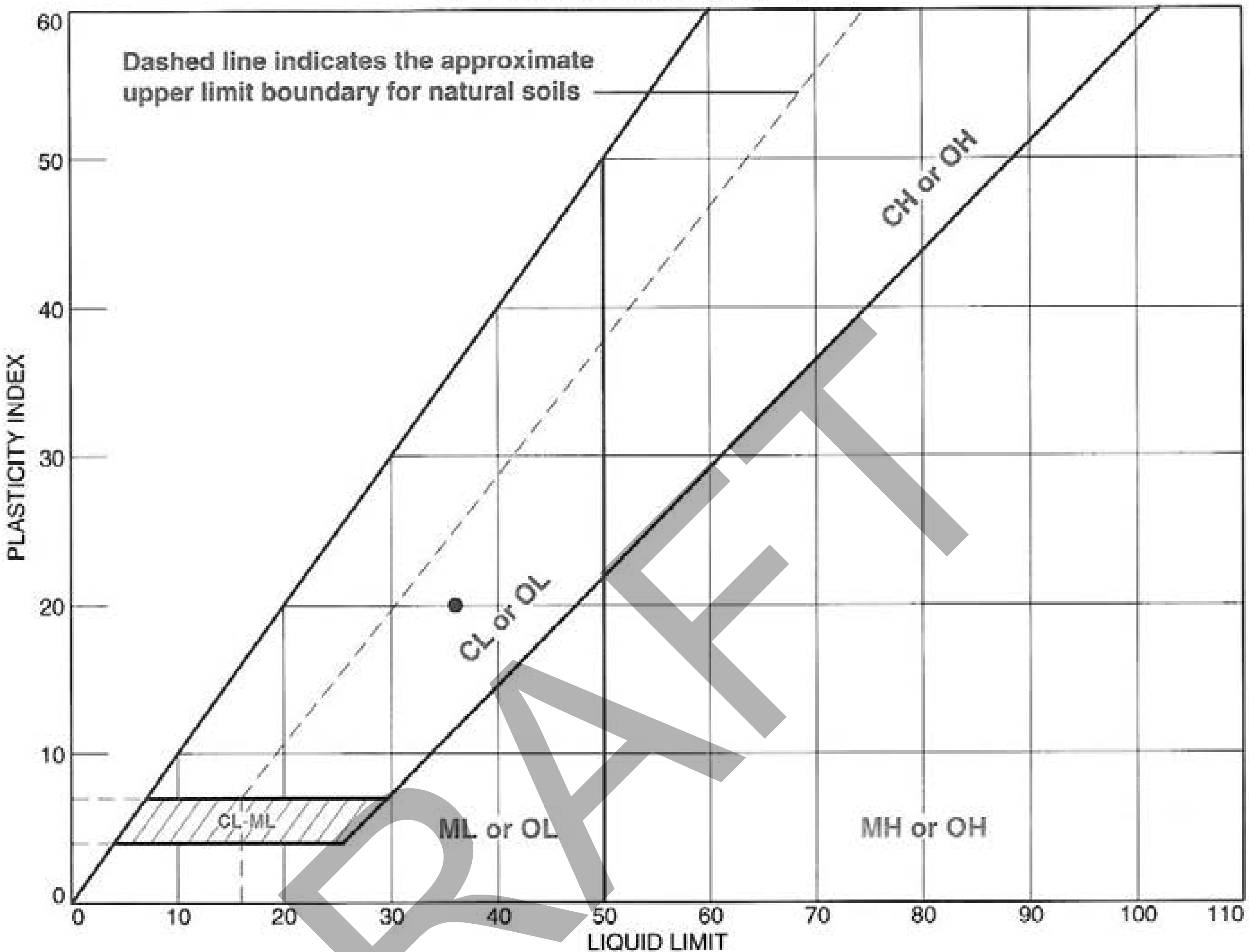
Client Progress Energy
Project Weatherspoon Dike Stability
Project No. 6468100111 Figure

**MACTEC Engineering and Consulting, Inc.**

**Raleigh, North Carolina**

**Tested By:** CS

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D2216-10, D4318-10 Method A



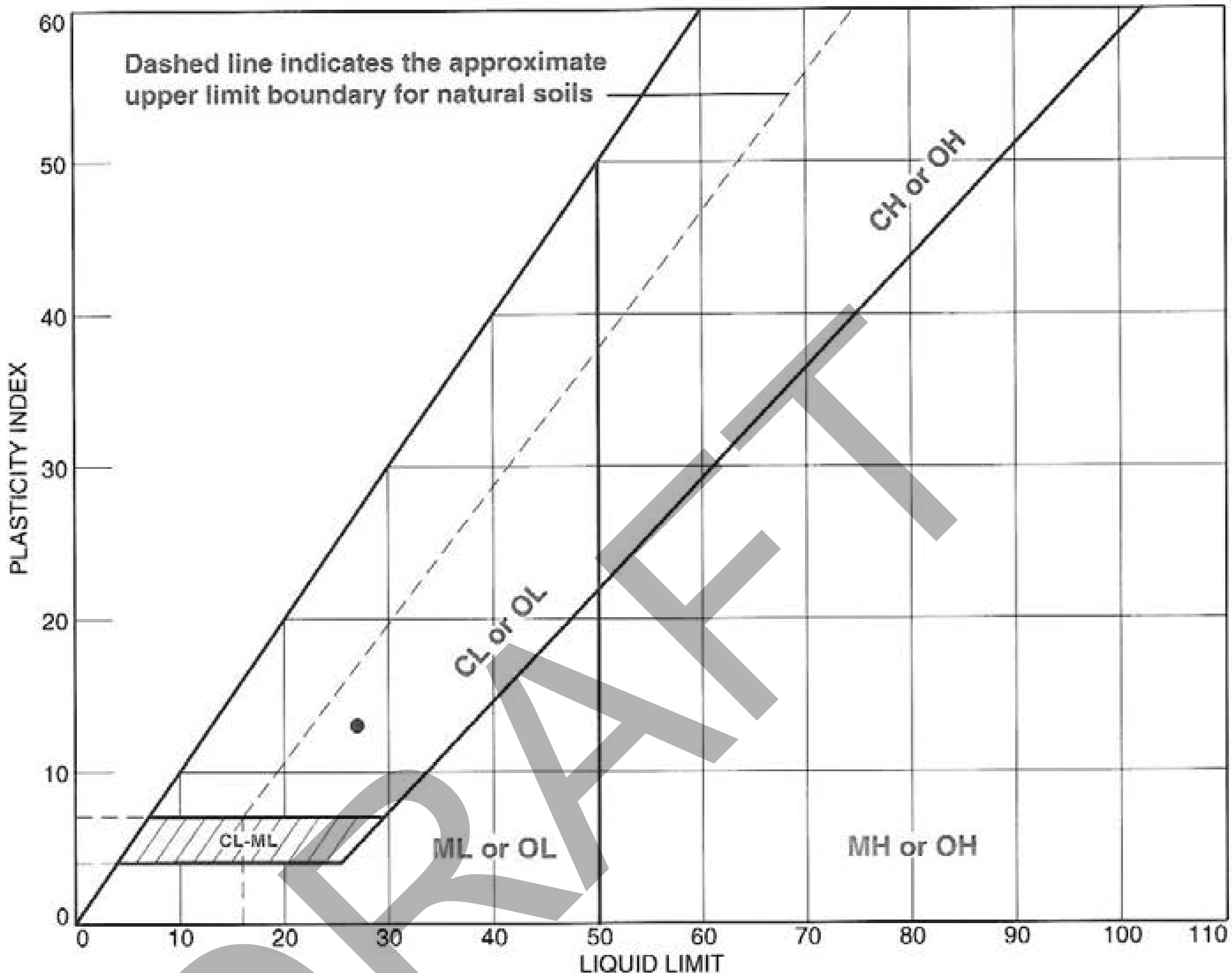



| SOIL DATA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
| ● | Boring SB-10 | SS4 | 8.0-9.5' | 15.4 | 16 | 36 | 20 | SC |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br>Raleigh, North Carolina | **Client:** Progress Energy<br>**Project:** Weatherspoon Dike Stability<br>**Project No.:** 6468100111 **Figure** |

**Tested By:** CS

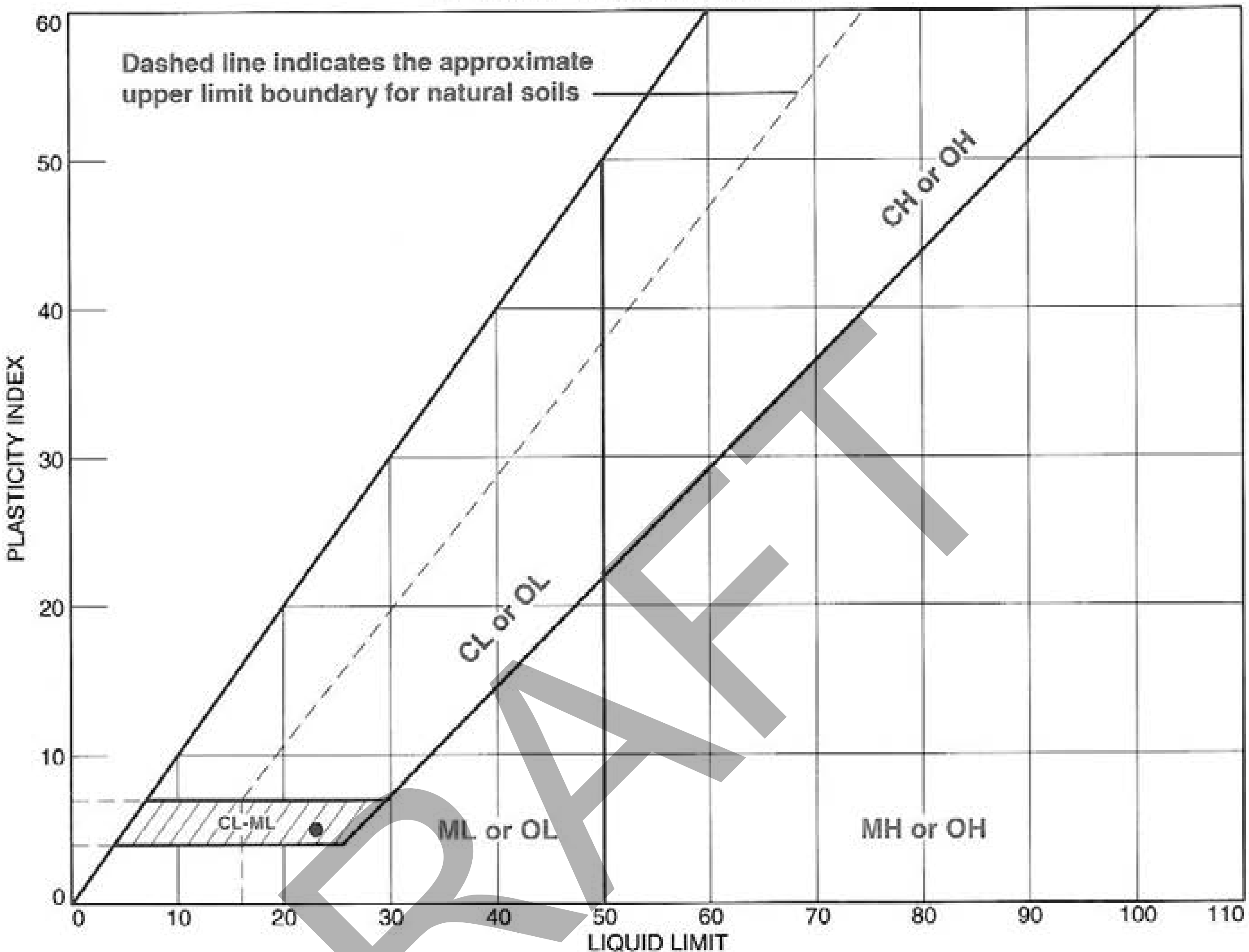
# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D2216-10, D4318-10 Method A




| SOIL DATA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
| ● | Boring SB-11 | SS-7 | 15.5-17.0' | ND | 14 | 27 | 13 | SC |

| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br><br>Raleigh, North Carolina | **Client:** Progress Energy<br>**Project:** Weatherspoon Dike Stability<br><br>**Project No.:** 6468100111 **Figure** |

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D2216-10, D4318-10 Method A




| SOIL DATA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SYMBOL | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | USCS |
| ● | Boring SB-12 | SS-4 | 8.0-9.5' | 19.0 | 18 | 23 | 5 | SC-SM |

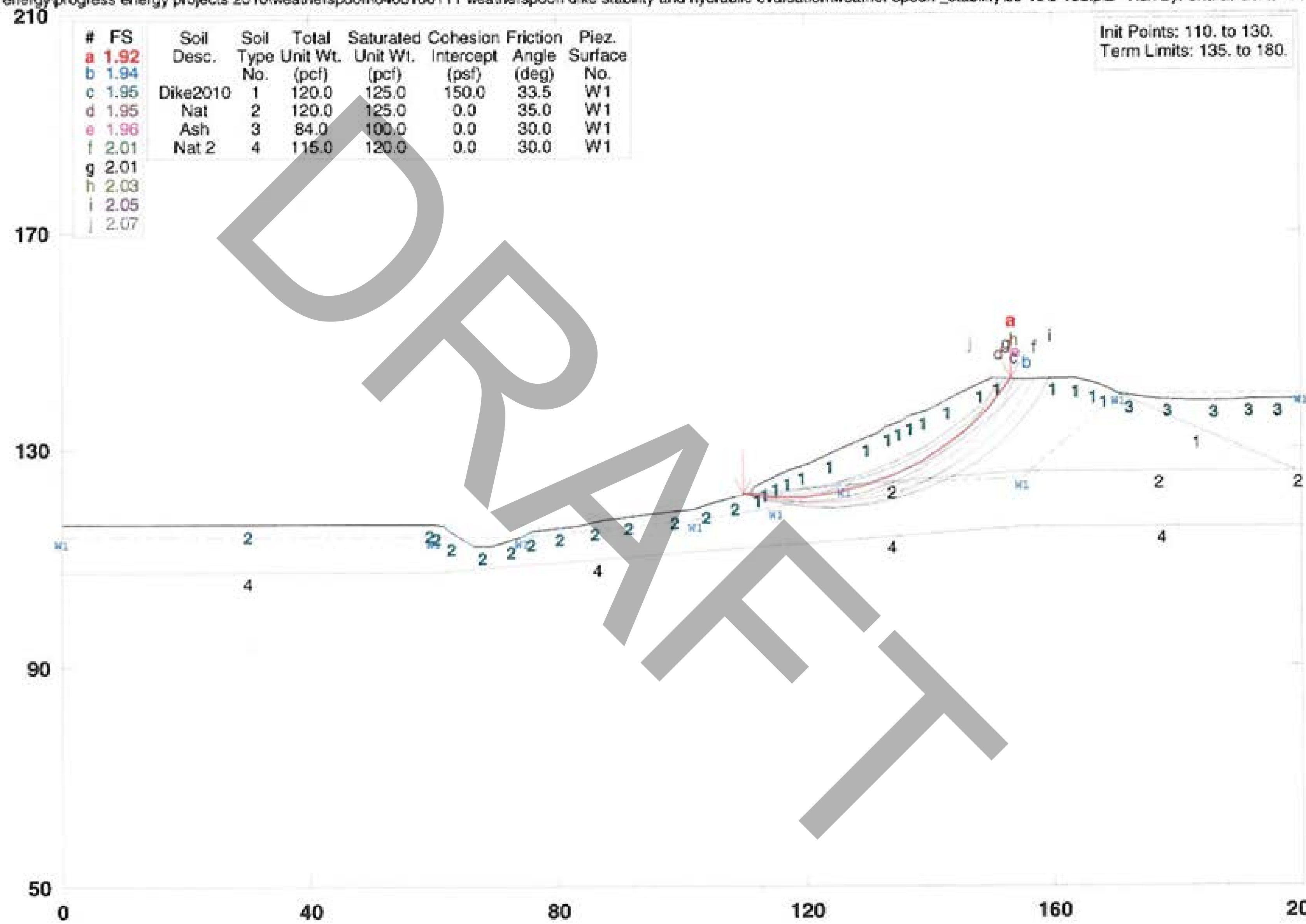
| | |
|---|---|
| MACTEC Engineering and Consulting, Inc.<br>Raleigh, North Carolina | Client: Progress Energy<br>Project: Weatherspoon Dike Stability<br>Project No.: 6468100111 Figure |

Tested By: CS

# Stability Analysis Output Plots

# Progress Energy - Weatherspoon Ash Pond South Dike - Section 10 - within Dike

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-10\s-10d.pl2 Run By: Sharat Gollamudi 12/29/2010




| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

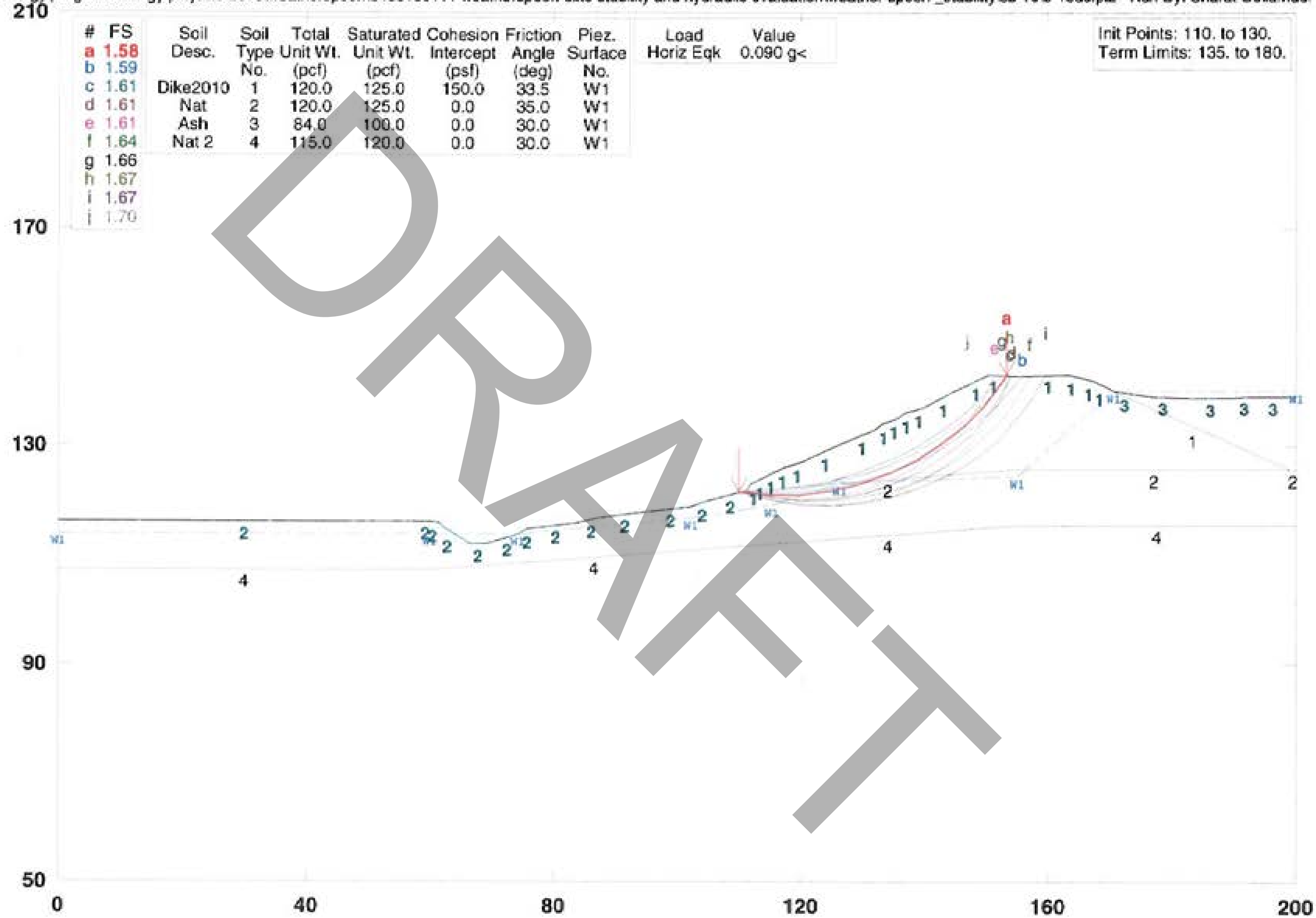
PCSTABL5M/si FSmin=1.92

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Ash Pond South - Sec#10 - within Dike (Seismic)

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-10\s-10ds.pl2 Run By: Sharat Gollamudi 12/29/2010



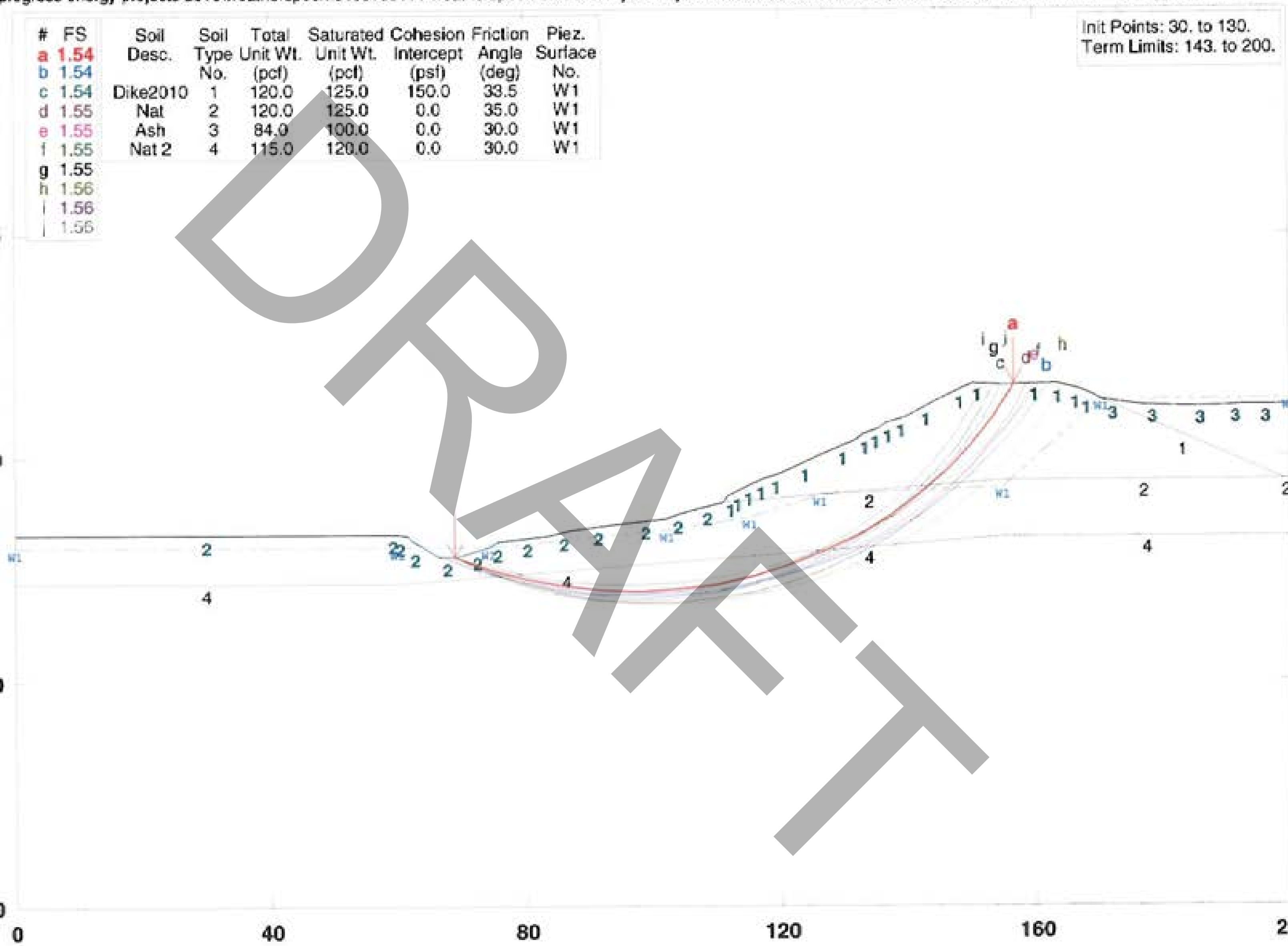

PCSTABL5M/si FSmin=1.58

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Ash Pond South Dike - Section 10 - Deep Failure

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-10\s-10.pl2 Run By: Sharat Gollamudi 12/29/2010




| # | FS |
|---|---|
| a | 1.54 |
| b | 1.54 |
| c | 1.54 |
| d | 1.55 |
| e | 1.55 |
| f | 1.55 |
| g | 1.55 |
| h | 1.56 |
| i | 1.56 |
| j | 1.56 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 120.0 | 125.0 | 0.0 | 35.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

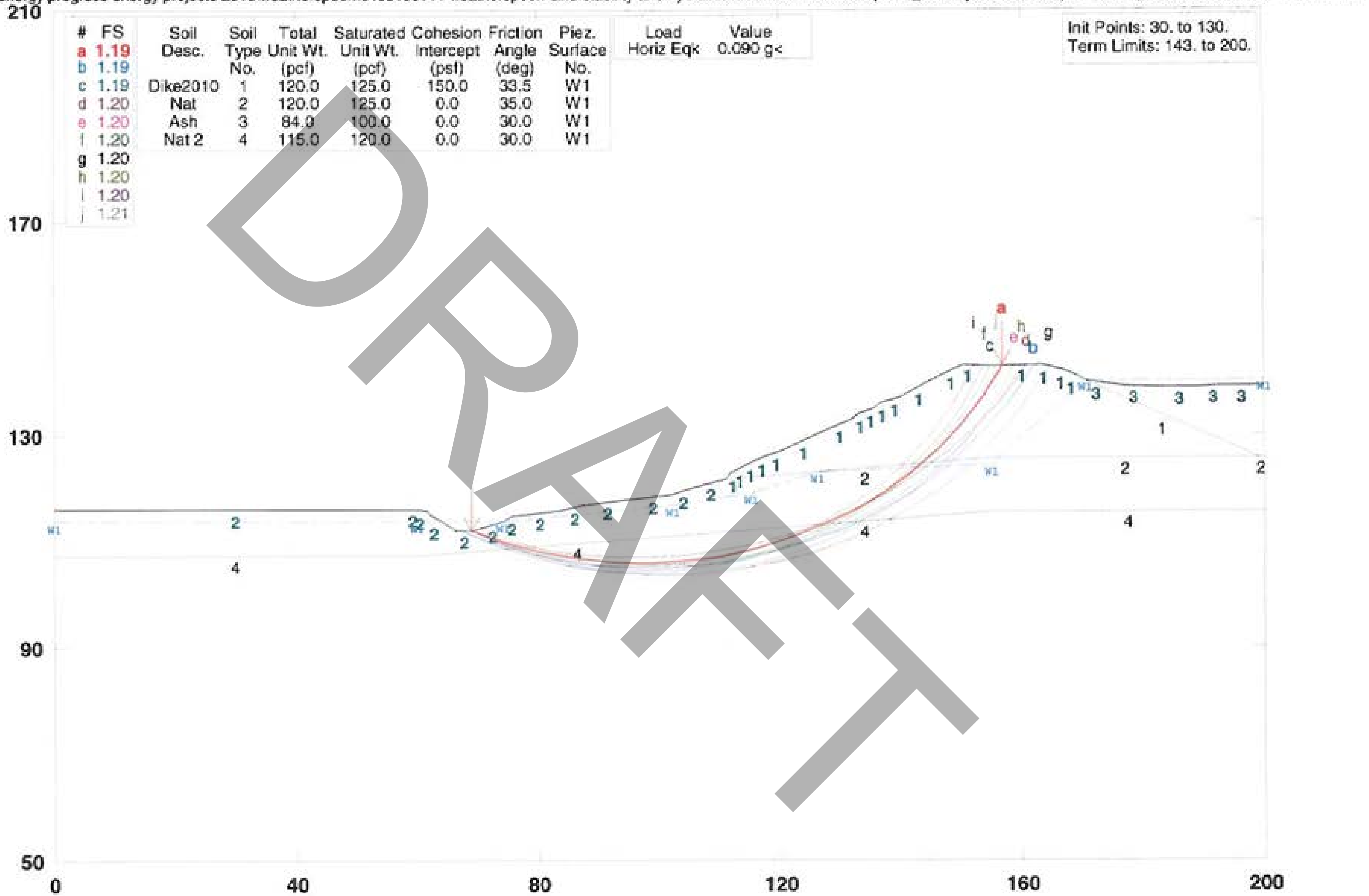
PCSTABL5M/si FSmin=1.54

Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Ash Pond South - Sec#10 - Deep Failure (Seismic)

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-10\s-10s.pl2 Run By: Sharat Gollamudi 12/29/2010 1



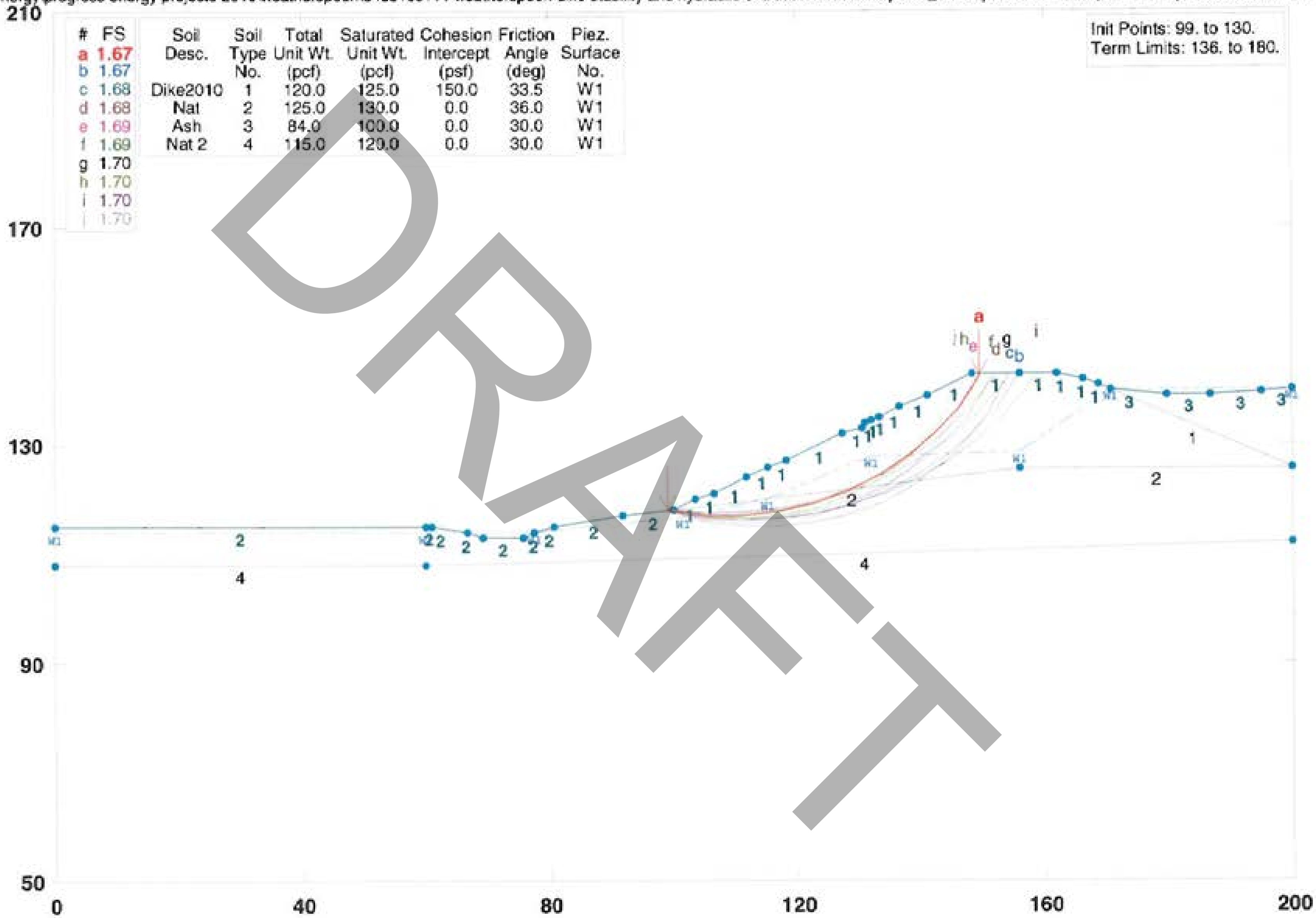

PCSTABL5M/si FSmin=1.19

Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon Ash Pond South-Sec 11 - Dike - H20 from Borings

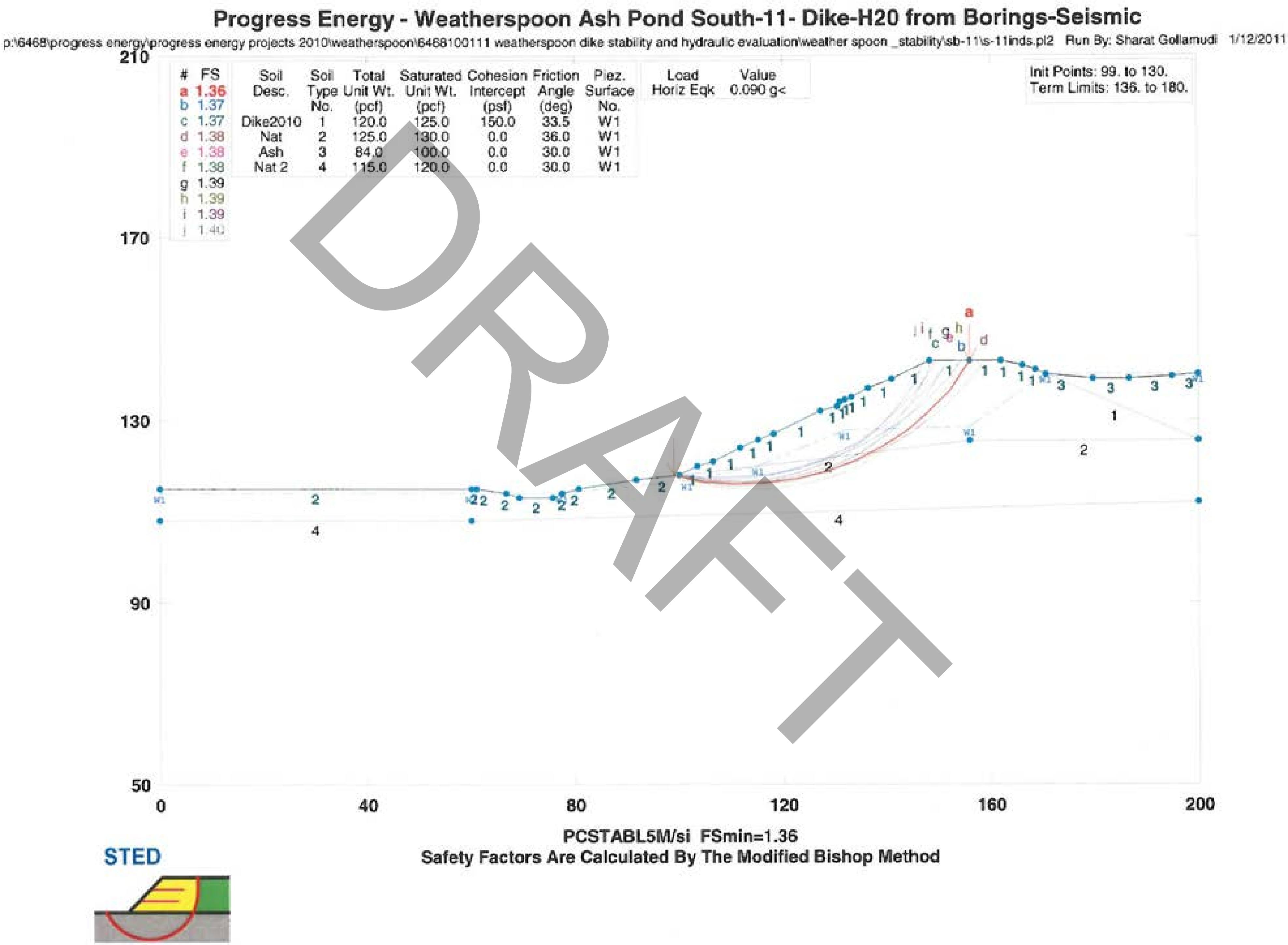
p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-11\s-11intd.pl2 Run By: Sharat Gollamudi 1/12/2011




| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 125.0 | 130.0 | 0.0 | 36.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

PCSTABL5M/si FSmin=1.67
Safety Factors Are Calculated By The Modified Bishop Method

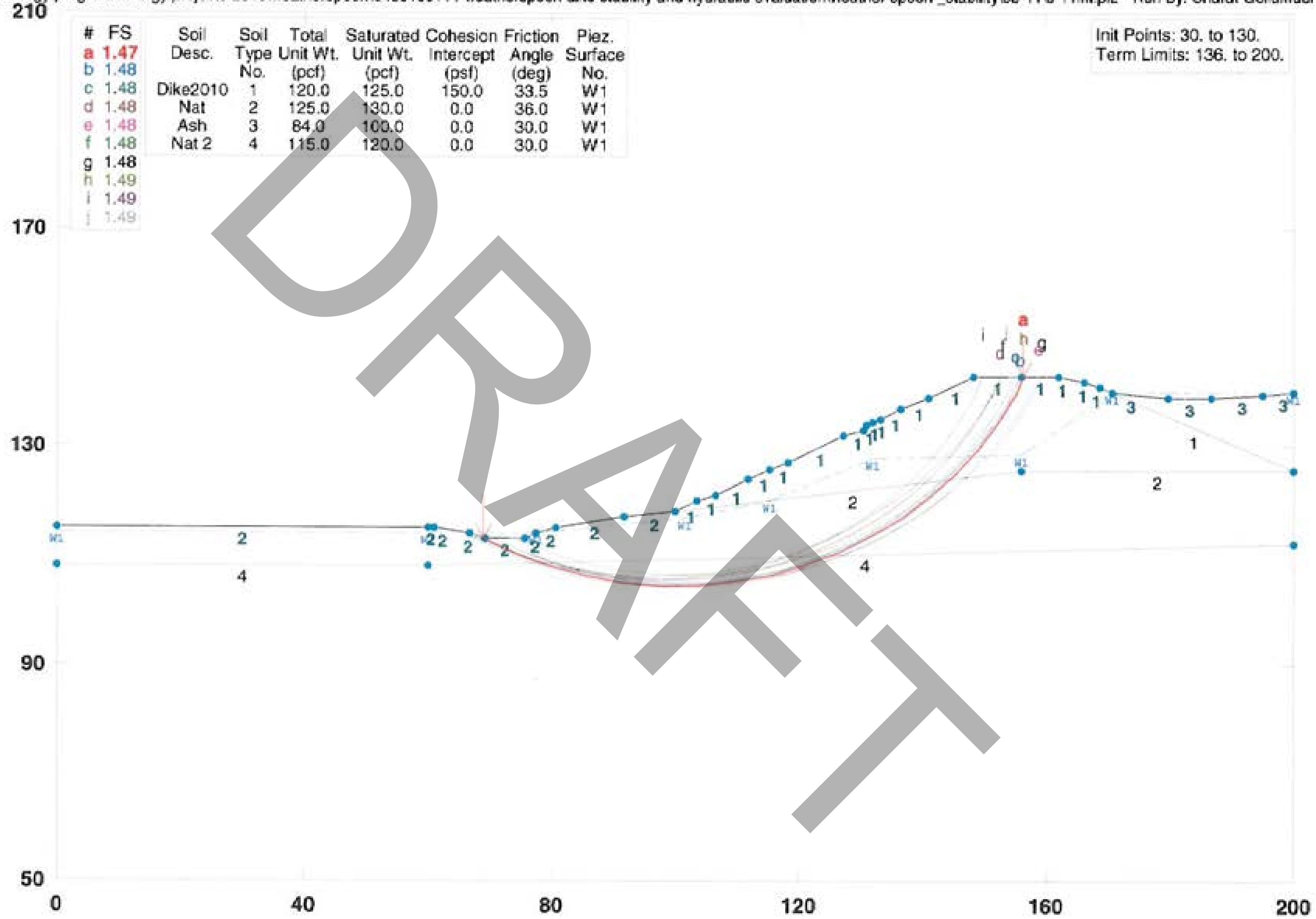
STED



Progress Energy - Weatherspoon Ash Pond South-11- Dike-H20 from Borings-Seismic
p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-11\s-11inds.pl2 Run By: Sharat Gollamudi 1/12/2011
# FS
a 1.36
b 1.37
c 1.37
d 1.38
e 1.38
f 1.38
g 1.39
h 1.39
i 1.39
j 1.40
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 1 120.0 125.0 150.0 33.5 W1
Nat 2 125.0 130.0 0.0 36.0 W1
Ash 3 84.0 100.0 0.0 30.0 W1
Nat 2 4 115.0 120.0 0.0 30.0 W1
Load Horiz Eqk Value 0.090 g<
Init Points: 99. to 130.
Term Limits: 136. to 180.
210
170
130
90
50
0
40
80
120
160
200
PCSTABL5M/si FSmin=1.36
Safety Factors Are Calculated By The Modified Bishop Method
STED

# Progress Energy - Weatherspoon Ash Pond South-Sec 11 - Deep - H20 from borings

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-11\s-11int.pl2 Run By: Sharat Gollamudi 1/12/2011

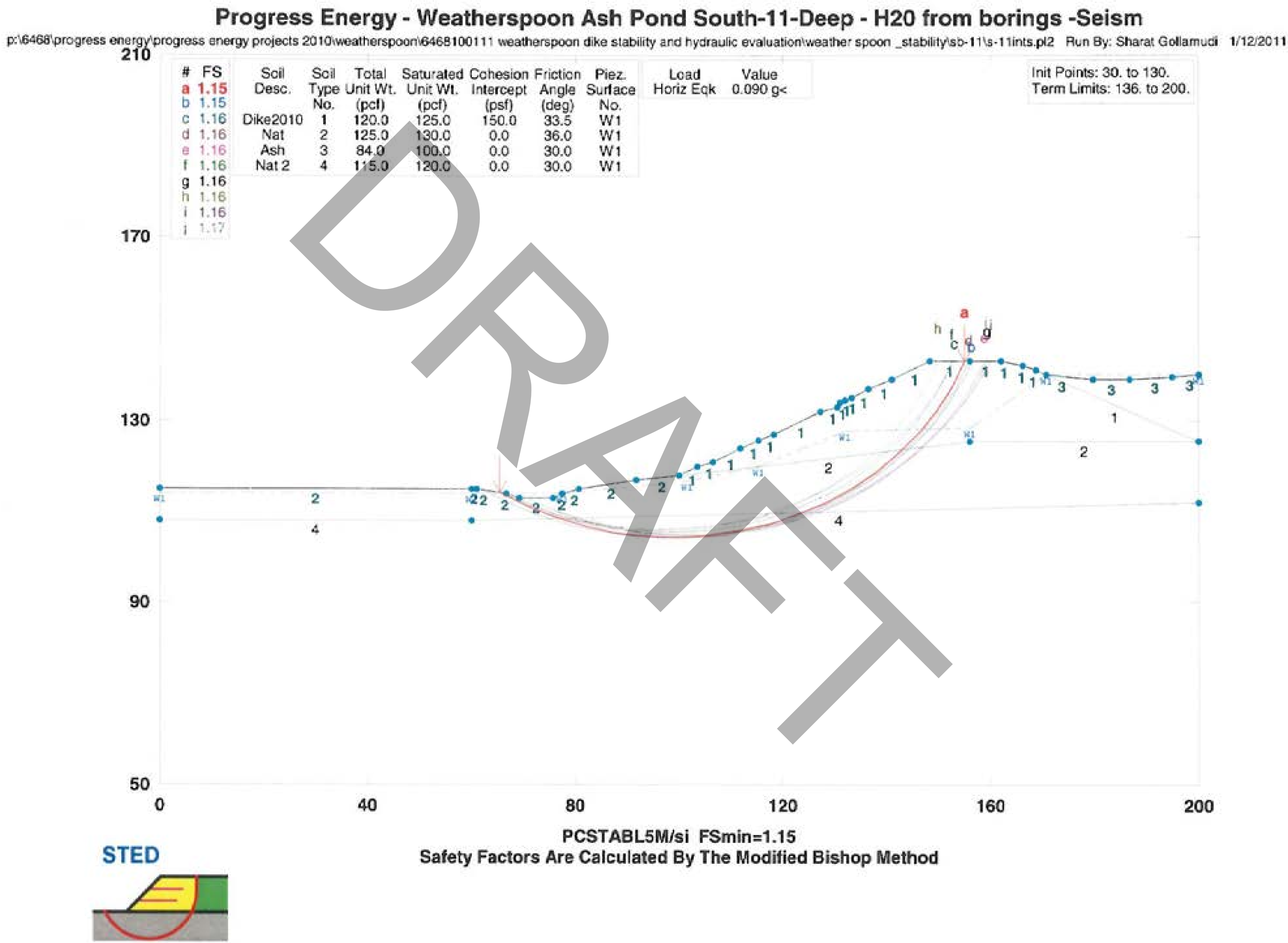



| # | FS |
|---|---|
| a | 1.47 |
| b | 1.48 |
| c | 1.48 |
| d | 1.48 |
| e | 1.48 |
| f | 1.48 |
| g | 1.48 |
| h | 1.49 |
| i | 1.49 |
| j | 1.49 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 125.0 | 130.0 | 0.0 | 36.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 30.0 | W1 |

PCSTABL5M/si FSmin=1.47
Safety Factors Are Calculated By The Modified Bishop Method

STED


Progress Energy - Weatherspoon Ash Pond South-11-Deep - H20 from borings -Seism
p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-11\s-11ints.pl2 Run By: Sharat Gollamudi 1/12/2011
# FS
a 1.15
b 1.15
c 1.16
d 1.16
e 1.16
f 1.16
g 1.16
h 1.16
i 1.16
j 1.17
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 1 120.0 125.0 150.0 33.5 W1
Nat 2 125.0 130.0 0.0 36.0 W1
Ash 3 84.0 100.0 0.0 30.0 W1
Nat 2 4 115.0 120.0 0.0 30.0 W1
Load Value
Horiz Eqk 0.090 g<
Init Points: 30. to 130.
Term Limits: 136. to 200.
210
170
130
90
50
0
40
80
120
160
200
PCSTABL5M/si FSmin=1.15
Safety Factors Are Calculated By The Modified Bishop Method
STED

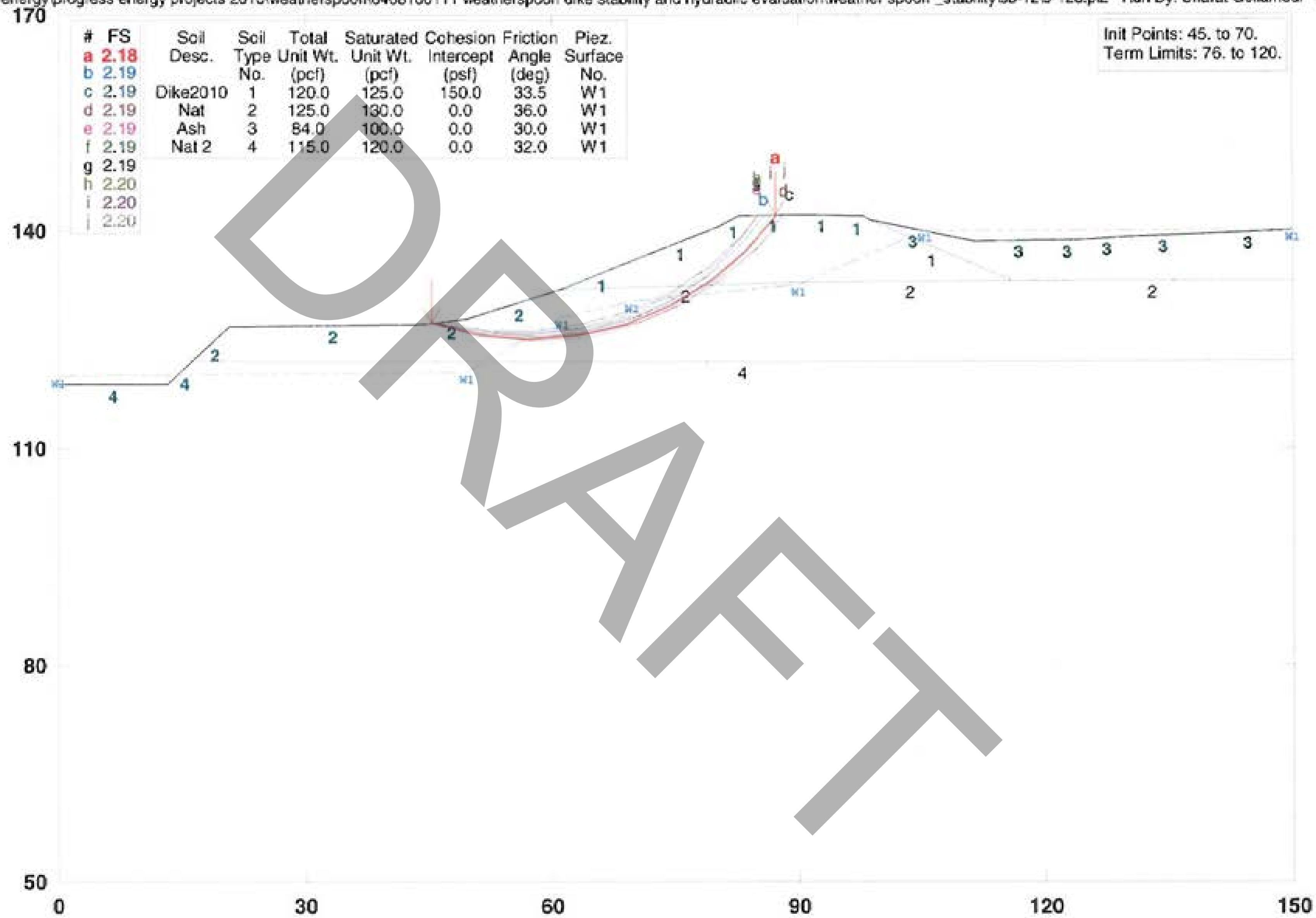
## Progress Energy - Weatherspoon Ash Pond South Dike - Section 12 - within slope

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-12\s-12d.pl2 Run By: Sharat Gollamudi 12/30/2010 1

| # | FS |
|---|---|
| a | 2.18 |
| b | 2.19 |
| c | 2.19 |
| d | 2.19 |
| e | 2.19 |
| f | 2.19 |
| g | 2.19 |
| h | 2.20 |
| i | 2.20 |
| j | 2.20 |

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 125.0 | 130.0 | 0.0 | 36.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |

Init Points: 45. to 70.
Term Limits: 76. to 120.

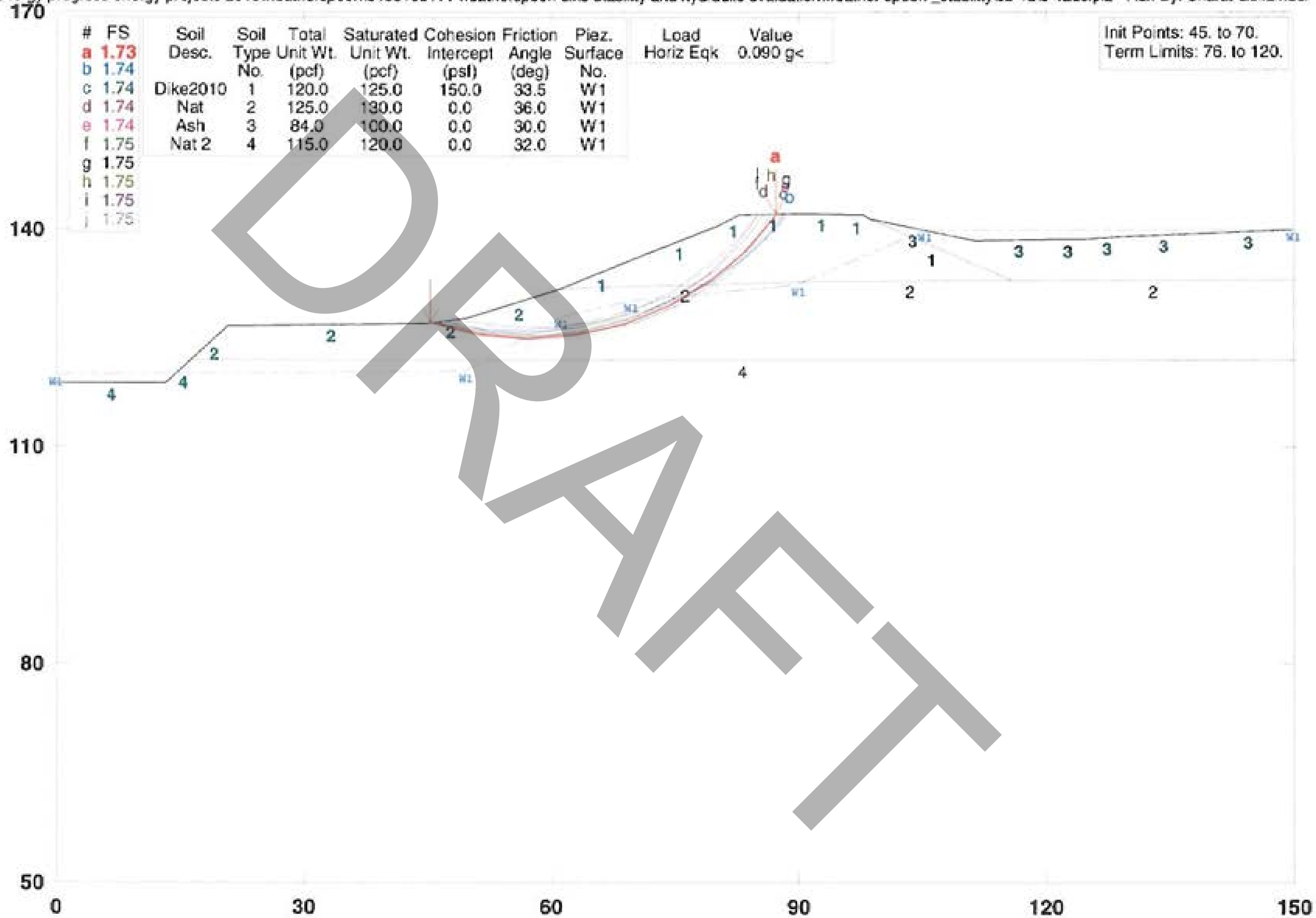


PCSTABL5M/si FSmin=2.18
Safety Factors Are Calculated By The Modified Bishop Method



## Progress Energy - Weatherspoon Ash Pond South - Sec#12 - within slope (Seismic)

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-12\s-12ds.pl2 Run By: Sharat Gollamudi 12/30/2010



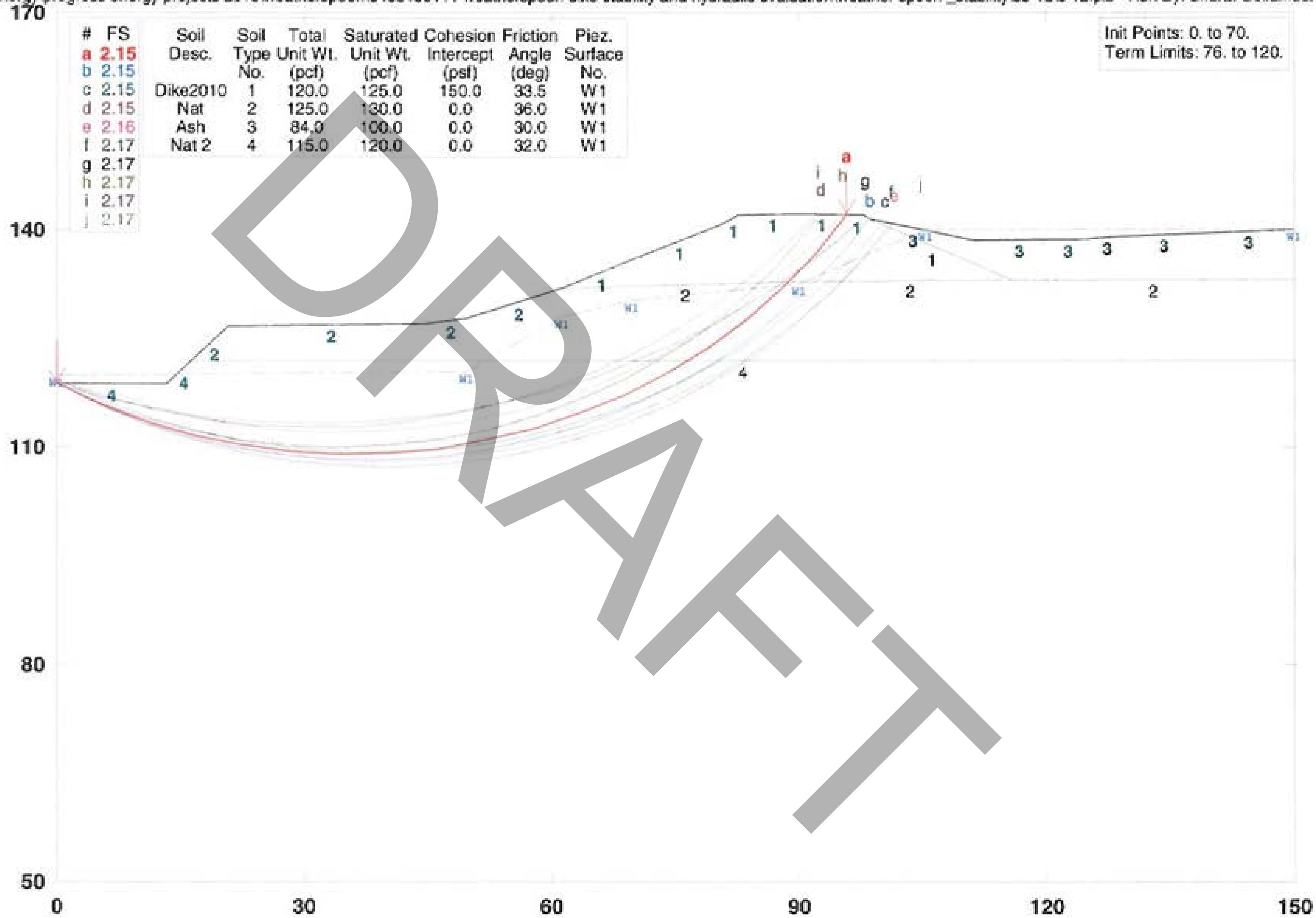

| Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No. |
|---|---|---|---|---|---|---|
| Dike2010 | 1 | 120.0 | 125.0 | 150.0 | 33.5 | W1 |
| Nat | 2 | 125.0 | 130.0 | 0.0 | 36.0 | W1 |
| Ash | 3 | 84.0 | 100.0 | 0.0 | 30.0 | W1 |
| Nat 2 | 4 | 115.0 | 120.0 | 0.0 | 32.0 | W1 |

PCSTABL5M/si FSmin=1.73
Safety Factors Are Calculated By The Modified Bishop Method

STED

# Progress Energy - Weatherspoon Ash Pond South Dike - Section 12 - Deep Failure

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-12\s-12.pl2 Run By: Sharat Gollamudi 12/30/2010

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Safety Factors Are Calculated By The Modified Bishop Method

STED

## Progress Energy - Weatherspoon Ash Pond South - Sec#12 - Deep Failure (Seismic)

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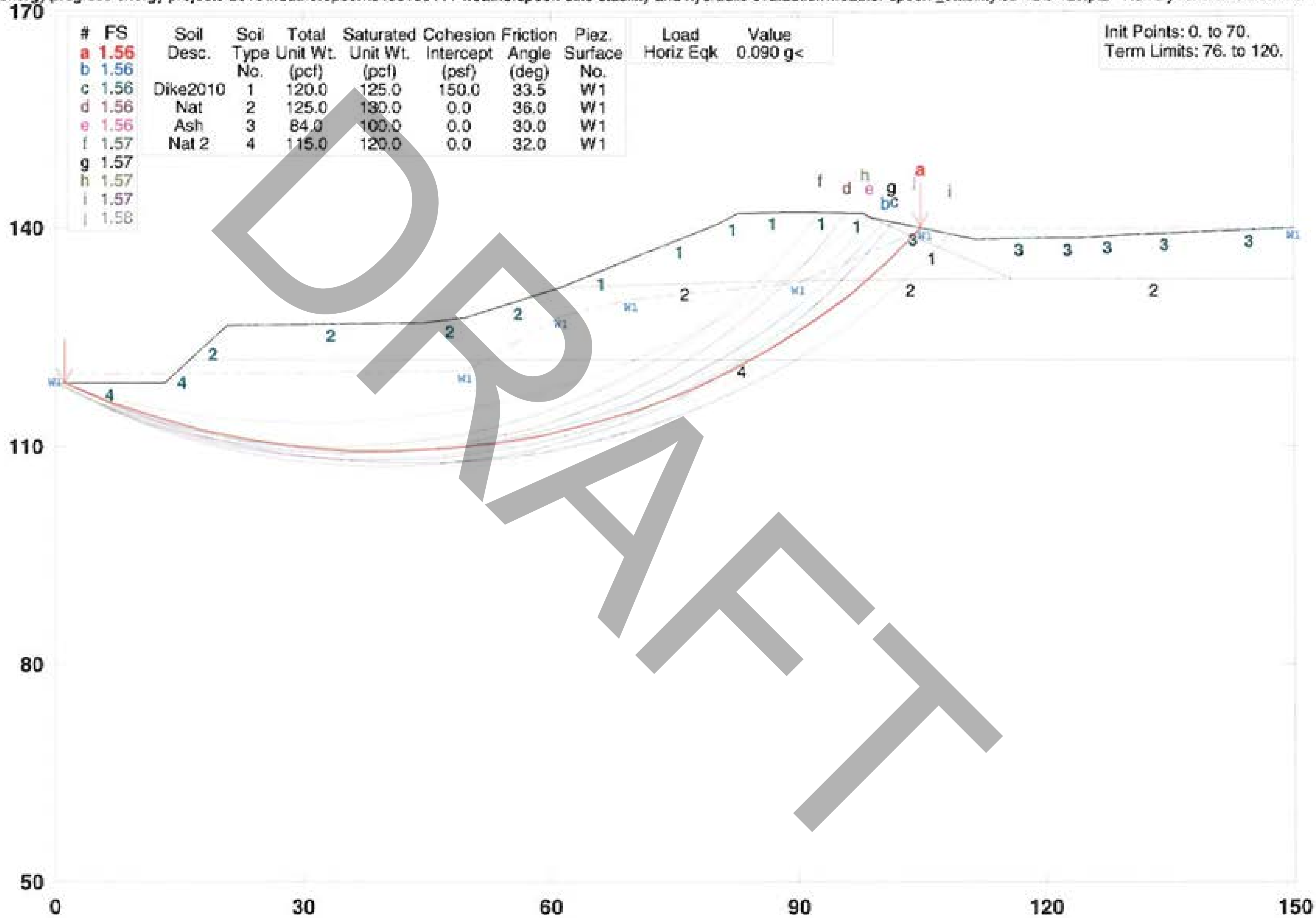


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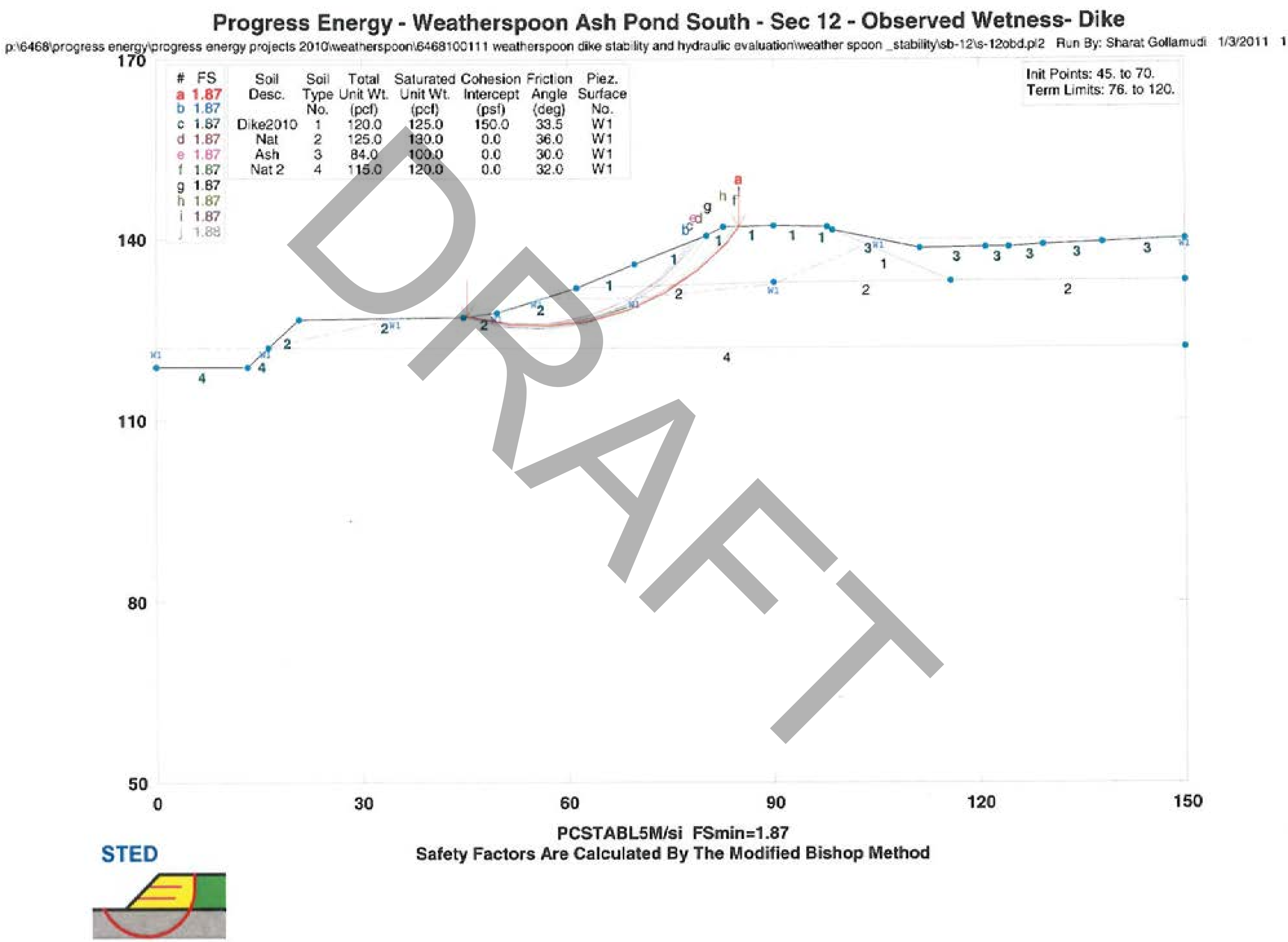
Safety Factors Are Calculated By The Modified Bishop Method



STED



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b 1.87
c 1.87
d 1.87
e 1.87
f 1.87
g 1.87
h 1.87
i 1.87
j 1.88
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 1 120.0 125.0 150.0 33.5 W1
Nat 2 125.0 130.0 0.0 36.0 W1
Ash 3 84.0 100.0 0.0 30.0 W1
Nat 2 4 115.0 120.0 0.0 32.0 W1
Init Points: 45. to 70.
Term Limits: 76. to 120.
170
140
110
80
50
0
30
60
90
120
150
DRAFT
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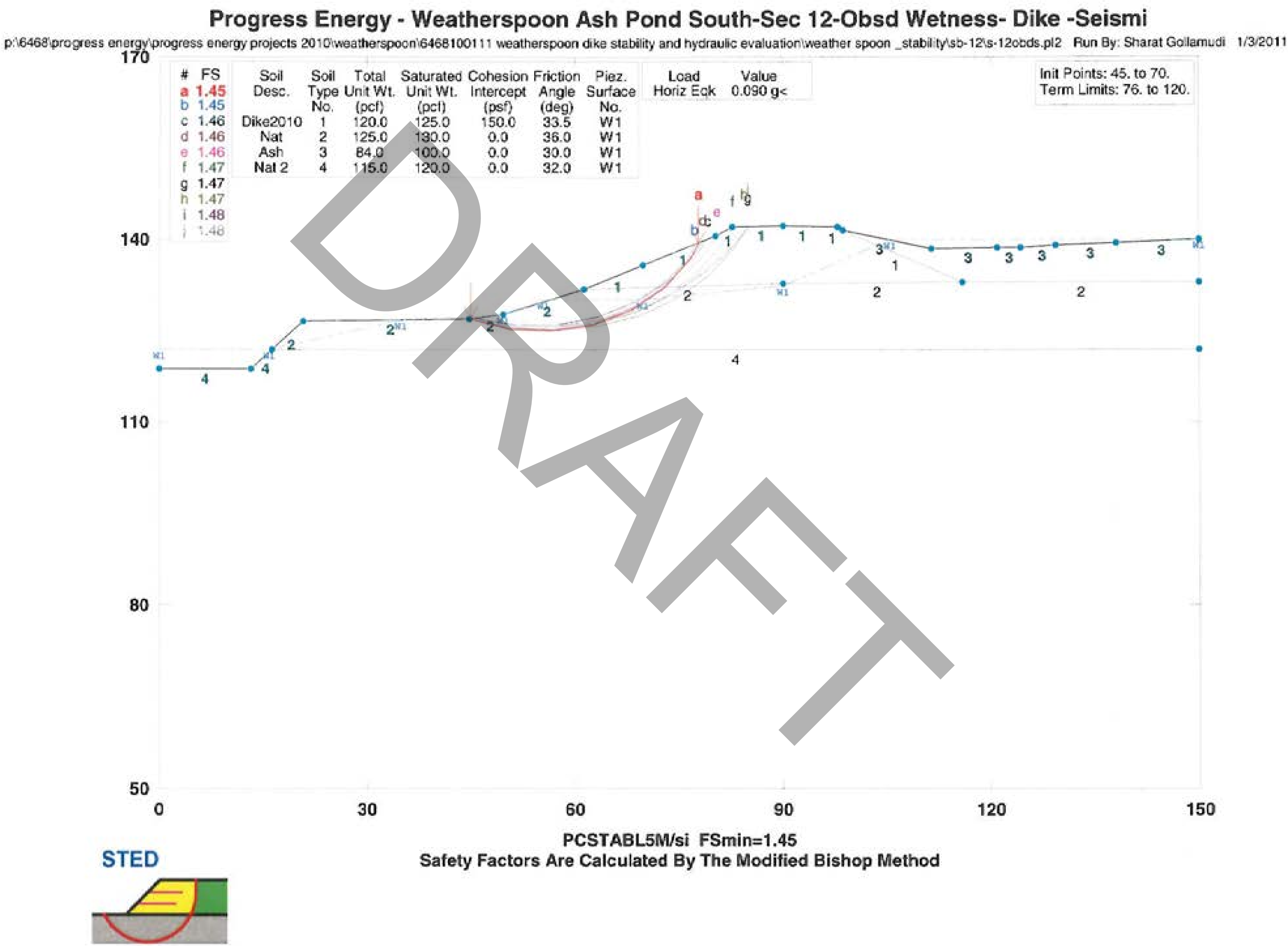
Safety Factors Are Calculated By The Modified Bishop Method
STED


Progress Energy - Weatherspoon Ash Pond South-Sec 12-Obsd Wetness- Dike -Seismi
p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-12\s-12obds.pl2 Run By: Sharat Gollamudi 1/3/2011
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b 1.45
c 1.46
d 1.46
e 1.46
f 1.47
g 1.47
h 1.47
i 1.48
j 1.48
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 1 120.0 125.0 150.0 33.5 W1
Nat 2 125.0 130.0 0.0 36.0 W1
Ash 3 84.0 100.0 0.0 30.0 W1
Nat 2 4 115.0 120.0 0.0 32.0 W1
Load Value
Horiz Eqk 0.090 g<
Init Points: 45. to 70.
Term Limits: 76. to 120.
170
140
110
80
50
0
30
60
90
120
150
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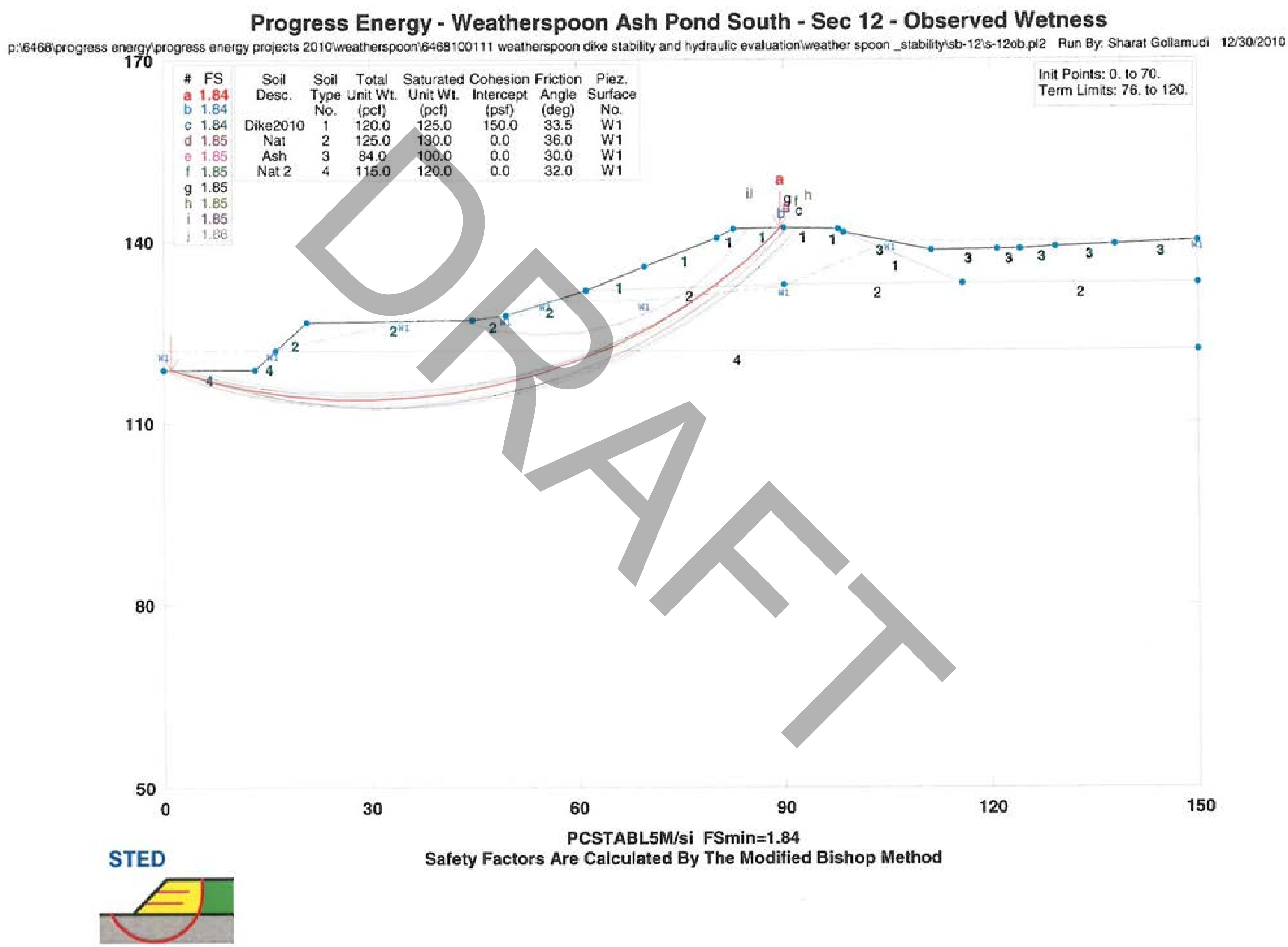
Safety Factors Are Calculated By The Modified Bishop Method
STED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# FS
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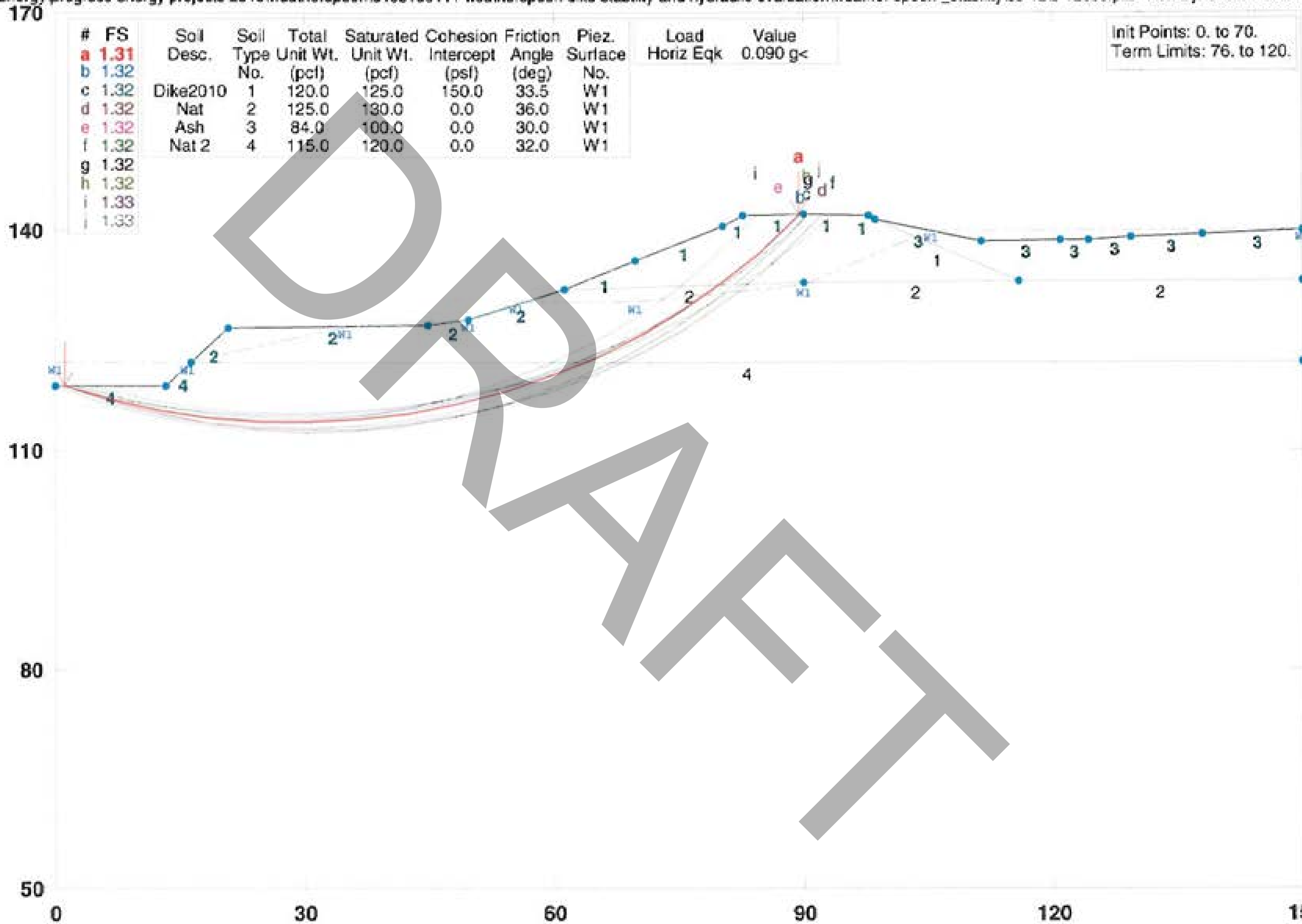
b 1.84
c 1.84
d 1.85
e 1.85
f 1.85
g 1.85
h 1.85
i 1.85
j 1.86
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Piez. Surface No.
Dike2010 1 120.0 125.0 150.0 33.5 W1
Nat 2 125.0 130.0 0.0 36.0 W1
Ash 3 84.0 100.0 0.0 30.0 W1
Nat 2 4 115.0 120.0 0.0 32.0 W1
Init Points: 0. to 70.
Term Limits: 76. to 120.
170
140
110
80
50
0
30
60
90
120
150
PCSTABL5M/si FSmin=1.84
Safety Factors Are Calculated By The Modified Bishop Method
STED
DRAFT

## Progress Energy - Weatherspoon Ash Pond South - Sec 12 - Observed Wetness-Seism

p:\6468\progress energy\progress energy projects 2010\weatherspoon\6468100111 weatherspoon dike stability and hydraulic evaluation\weather spoon _stability\sb-12\s-12obs.pl2 Run By: Sharat Gollamudi 1/3/2011

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Safety Factors Are Calculated By The Modified Bishop Method

STED

E 5th St
S Roberts
Old Allenton Rd
Indigo Island
Burnt Island
Andrew Jackson Hwy
Wilmington Hwy
2.42 mi
© 2010 Google
© 2010 Europa Technologies
Imagery Date: Jun 18, 2008
34° 33.033' N 78° 58.173' W elev 119 ft
Place Categories
Bars/Clubs
Coffee Shops
Dining
Lodging
Banks/ATMs
Gas Stations
Grocery Stores
Major Retail
Movie/DVD Rental
Pharmacy
Shopping Malls
Fire
Hospitals
Places of Worship
Schools
Transportation

Document title

# W.H. Weatherspoon Plant Dam and Dike Inspection Procedure

Document number

EVC-WSPC-00029

Applies to: W.H. Weatherspoon Fossil Plant - Carolinas

Keywords: environmental

Legend:
OPS Operations
ENG Engineering
WMT Work Management
TRN Training
ENV Environmental
FIN Financial
ICT Combustion Turbine
ADM Administrative

| Organizational Applicability | | | | | | | |
|---|---|---|---|---|---|---|---|
| OPS | ENG | WMT | TRN | ENV | FIN | ICT | ADM |
| X | X | | | X | | | X |

## 1.0 PURPOSE

1.1 The purpose of this program is to implement a dam and dike inspection procedure that effectively identifies any signs of potential problems that may require a repair or special attention. This procedure is also intended to comply with the requirements specified in corporate document - Non-Hydroelectric Facility Dam and Dike Inspection Program Manual.

## 2.0 TERMS AND DEFINITIONS

2.1 Breach – An opening or a breakthrough of a dam sometimes caused by rapid erosion of a section of earth or ash embankment by water.

2.2 Dam – An artificial barrier constructed to impound or divert water or liquefied material.

2.3 Dam Emergency Notification – A document that identifies potential emergency conditions at a dam or dike and specifies preplanned actions to be followed to minimize impacts to the environment.

2.4 Dike/levee – Any artificial barrier that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from flooding by flow waters.

2.5 Distress – A condition of severe stress, strain, or deterioration indicating possible or potential failure.

2.6 Embankment – Fill material placed with sloping sides and usually with a length greater than its height. An "embankment" is a part of a dam.

2.7 Freeboard – The vertical dimension between the crest of the dam at its lowest point and the reservoir water surface.

2.8 Riprap – A layer of large stones, broken rock, or precast blocks placed in random fashion on the upstream slope of an embankment dam. The purpose of riprap is to aid in the prevention of degradation of the structural fill portion of the dam.

2.9 Seepage – The slow oozing of a fluid through a permeable material. A small amount of seepage will normally occur in any dam or embankment that retains water. The rate will depend on the relative permeability of the material in and under the structure, the depth of water behind the structure, and the length of the path the water must travel through or under the structure.

2.10 Spillway/weir – A passage to conduct excess water or other liquid safely through, over, or around a dam or other artificial barrier that impounds the liquid.

## 3.0 RESPONSIBILITIES

Dam safety issues at W.H. Weatherspoon Plant fall under the regulatory jurisdiction of the North Carolina Utilities Commission (NCUC). This procedure specifies how the Weatherspoon Plant completes and documents dam and dike inspections. In the event of an ash pond release, all employees **shall** reference Weatherspoon Fossil Plant Dam Emergency Notification Procedure: EMG-WSPC-00003.

3.1 Plant Manager

The plant manager is the person responsible for implementing the dam and dike inspection procedure. Implementation includes ensuring that inspections are completed on the specified frequency and that appropriate funding is available to correct any identified problems or deficiencies.

3.2 Plant Environmental Coordinator

The plant environmental coordinator has the primary responsibility of updating the dam and dike inspection procedure. The procedure shall be updated every two years or in the event that inspection procedures and/or practices need to be added and/or modified.

The plant environmental coordinator will assist in ensuring that the dam and dike inspections are completed by the specified frequency. The plant environmental coordinator will review the inspection reports and file in the appropriate file point location of **13580-C**.

The plant environmental coordinator will assist in ensuring that inspection recommendations and deficiencies are addressed in a timely manner. The plant environmental coordinator will contact the Dam and Dike Program Manager – Field Engineering of conditions found during inspection (including construction on or in close proximity to dams) and if inspection results indicate any significant problem(s).

The plant environmental coordinator will assist in scheduling annual inspection training. The inspection training will be conducted by a third party contractor after the third party contractor conducts the annual dam and dike inspection.

3.3 Plant Chemistry Technicians

The plant chemistry technicians are responsible for conducting the dam and dike inspections. The plant chemistry technicians shall receive annual inspection training.

The plant chemistry technicians will use and fill out Attachment 1 while conducting the dam and dike inspections. The plant chemistry technicians will give the completed inspection forms to the plant environmental coordinator for review and filing. If the inspection indicates issues and or problems with the dam and/or dikes, the plant chemistry technician will generate a work order to address the problem when appropriate.

## 4.0 PRECAUTIONS AND LIMITATIONS

Detailed inspections have the potential for injury to plant personnel. Care must be used due to the high traffic volume on the constricted plant roads. All plant procedures must be followed when crossing the train track rails. Foot travel over uneven terrain is another common hazard.

## 5.0 PREREQUISITES

Annual dam and dike inspection training provided by a third party contractor. (Weatherspoon Dam Inspection Training Materials)

## 6.0 MATERIAL AND SPECIAL EQUIPMENT

Plant truck or other form of motorized transportation.

## 7.0 BACKGROUND/HISTORY

**7.1** The ash pond was formed by an earth embankment in a more or less rectangular shape. The ash pond was last expanded in 1979 and now covers approximately 54.5 acres.

**7.2** In 2005 an interior geo-tube berm was installed to increase the storage capacity. This geo-tube berm is not considered to be a dike. The original pond's exterior dike is still the primary ash impoundment.

**7.3** In 2007 another interior triangular shaped lift was completed in the ash pond. The plant began sluicing ash to this containment in June of 2007. There is a gated valve that can control flow to either the upper geo-tube or the lower lifted area of the ash pond. The flow can be diverted for fill control purposes as well as for repair work to take place.

## 8.0 PROCEDURE

**8.1** The overall structural integrity of the ash pond shall be inspected on a **monthly** basis and if possible the inspection shall take place during periods of dry weather.

**8.2** Complete Attachment 1 while conducting the inspection.

**8.3** Return completed inspection form to the plant environmental coordinator.

8.3.1 Discuss any noted issues or areas of concern.

8.3.2 Initiate work request as needed to address issues or concerns.

8.3.3 Route to plant manager for review.

8.3.4 File completed form in **13580-C.**

## 9.0 RETURN TO NORMAL

None

## 10.0 DOCUMENTATION

Attachment 1: Weatherspoon Plant Dam and Dike Inspection Form

## 11.0 REFERENCES

Weatherspoon Fossil Plant Dam Emergency Notification Procedure: EMG-WSPC-00003

Weatherspoon Data Sheet for Dam Emergency Notifications FRM-WSPC-00024

Non-Hydroelectric Facility Dam and Dike Inspection Program Manual

Weatherspoon Dam Inspection Training Materials

AUTHORIZED COPY

Attachment No. 1
File Point: 13580-C

**Weatherspoon Plant**
**Monthly Inspection Form**

Date inspected (Month/Day/Year): ____________ Inspected by: ____________________

Conditions/Weather around time of Inspection (If possible, perform inspection during dry weather):
____________________________________________________________

Was previous monthly report reviewed? ________________________________

**Ash Pond:**

| Parameter to be Inspected | Condition | | Location of Problem | Corrective Action Taken (i.e., work order submitted) | Comments - Any early warning signs? |
|---|---|---|---|---|---|
| | No Issues | Issues Exist | | | |
| Vegetation growth, including trees | | | | | |
| Overall condition of pond (overflow likely) | | | | | |
| Erosion control of exterior slopes | | | | | |
| Erosion control of interior banks/slopes (wave-induced beaching erosion or from animal burrows) | | | | | |
| Seepage control of embankment/slopes | | | | | |
| Interior geo-tube berm spillway (blocked or plugged) | | | | | |
| Drainage pipe from interior lifted berm to flood control area (blocked or plugged) | | | | | |
| Ash pond outflow to cooling pond (water exiting appears) | | | | | |

Additional Comments:____________________________________________________________
____________________________________________________________

**Environmental Coordinator:**__________________ **Plant Manager**____________________

PROGRESS ENERGY CAROLINAS

W. H. WEATHERSPOON STEAM ELECTRIC PLANT

ASH POND DAM – ROBES-009

LUMBERTON, ROBESON COUNTY, NORTH CAROLINA

# FIVE-YEAR INDEPENDENT CONSULTANT INSPECTION

# FINAL REPORT



DECEMBER 20, 2010

BY MACTEC ENGINEERING AND CONSULTING, INC.

RALEIGH, NORTH CAROLINA

MACTEC

**PROGRESS ENERGY CAROLINAS**

**W. H. WEATHERSPOON STEAM ELECTRIC PLANT**

**ASH POND DAM – ROBES-009**

**LUMBERTON, ROBESON COUNTY, NORTH CAROLINA**



**FIVE-YEAR INDEPENDENT CONSULTANT INSPECTION**

**FINAL REPORT**

**DECEMBER 20, 2010**

**BY MACTEC ENGINEERING AND CONSULTING, INC.**

**RALEIGH, NORTH CAROLINA**

**W. H. WEATHERSPOON STEAM ELECTRIC PLANT**

**ASH POND DAM – ROBES-009**

**LUMBERTON, ROBESON COUNTY, NORTH CAROLINA**

**MACTEC PROJECT NO. 6468-10-0025(01)**

**FIVE-YEAR INDEPENDENT CONSULTANT INSPECTION**

**DECEMBER 20, 2010**

**BY MACTEC ENGINEERING AND CONSULTING, INC.**

**RALEIGH, NORTH CAROLINA**

**REPORT PREPARED BY**

NORTH CAROLINA PROFESSIONAL SEAL 6428 ENGINEER J. ALLAN TICE

12-22-10


**J. Allan Tice, P.E.**
**Senior Principal Engineer**
**Registered, North Carolina 6428**

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## 1.0 SUMMARY

### 1.1 General

MACTEC Engineering and Consulting, Inc. (MACTEC) has prepared this report to present the results of an independent consultant inspection of the ash pond dikes at Progress Energy Carolinas' W.H. Weatherspoon Steam Electric Plant in Lumberton, North Carolina. The independent consultant inspection is performed at five-year intervals. Past five-year independent consultant inspections were performed under an agreement between Progress Energy and the North Carolina Utilities Commission (NCUC). Effective January 1, 2010, regulatory oversight for dams owned by utility companies was transferred from the NCUC to the North Carolina Department of Environment and Natural Resources, Division of Land Quality, Land Quality Section, Dam Safety Program (NCDENR Dam Safety). The dam is entered in the Dam Safety inventory as the "1979 Weatherspoon Ash Pond" and has an inventory number of ROBES-009.

Prior inspections were generally performed in accordance with U.S. Army Corps of Engineers (USACOE) guidelines(1)*[1] for a Phase I Inspection. These guidelines were part of the agreement between Progress Energy and the NCUC governing dam safety inspections. The current inspection generally followed the USACOE guidelines and guidelines published by NCDENR Dam Safety(2) . North Carolina Dam Safety Regulations published in the North Carolina Administrative Code, Title 15A, Subchapter 2K(3) were reviewed prior to the inspection.

The last independent consultant inspection was made in 2005 by MACTEC Engineering and Consulting, Inc. (MACTEC). The results of that inspection were presented in a report to Progress Energy dated December 6, 2005(4). Subsequent to the last five-year inspection, brief site visits for observation were made by MACTEC at various times as described later in this report.

A detailed review of the historical information about the site geology, engineering data, design and construction of the dikes and operations is contained in a historical volume submitted in 1995(5). The historical information is summarized in this report.

Prior inspections focused on the active portion of the ash pond, referred to variously as the South Pond or the 1979 Pond. We understand that NCDENR Dam Safety considers the entire

* Number in parentheses refers to references listed in Reference List Section 5.0

perimeter dike system as the ash pond dam without distinction between diked sections that retain old sedimented ash and dikes that retain current slurry ash. The present inspection was expanded from prior areas of focus to review the perimeter dike system around the entire ash storage area. For purposes of description and discussion, segments of the dikes constructed prior to 1979 are called the Northern Ash Area and those constructed in 1979 are called the Southern Ash Area.

The dikes in the Northern Ash Area have a history of successful performance. No design or construction information has been located. The dikes are in fair condition with some local areas having steep slopes or old scarps that appear inactive. Significant tree growth present on the exterior slopes requires evaluation, although the inspection did not identify structural problems associated with the tree growth. A separate engineering study for the stability of the dikes has been conducted that recommends possible remedial actions for locally steep areas.

Overall, the dikes in the Southern Ash Area and appurtenant structures are judged to be have been designed, constructed and maintained in satisfactory manner. The structures have performed well and, based on our observations, they do not exhibit significant safety concerns. Seepage present at locations on the south dike has increased slightly since the 2005 inspection and should be closely observed. An engineering evaluation of the seepage conditions has been conducted under a separate study that recommends possible remedial measures to reduce the seepage effects..

## 1.2 Purpose and Scope

The purpose of this dam safe inspection and report is to identify, within the limitations of surface field inspection and office review of available data, records and operating history, any actual or potential deficiencies related to the maintenance, operation, or surveillance of the dams, dikes and other water control structures of the plant in order to protect the public's safety and property. The objective is to recommend immediate action for public protection where necessary, further studies and analysis where required, and acceptance of the present condition of the dikes if justified by the engineering data and inspections.

This investigation has been conducted in general conformity with the guidelines for inspection described in the previously cited USACOE and NCDENR Dam Safety guidelines. It encompassed a review of the 2005 safety inspection report a review of the available documents for description of the geologic and engineering data relative to site conditions as well as the design, construction, and operational features of the entire perimeter dike and appurtenant structures. The internal maintenance and inspection records since 2005 and plans for future maintenance activities were also reviewed in consultation with maintenance and operations personnel at the Weatherspoon Plant.

A site visit was made on April 9, 2010 for the purpose of inspecting features relating to the safety and integrity of the ash pond dikes and appurtenant structures. These features included evidence of leakage, erosion, seepage, slope instability, settlement, and conditions of protective vegetation. Photographs were obtained to document the general condition of the dike and significant features observed during the field inspection.

1.3 Conclusions

Based on a review of pertinent data in the manner described above, the following conclusions were reached:

<u>Northern Ash Area</u>

1. Design and construction information is limited to some construction photographs and a 1973 topographic dike plan.
2. The dikes have performed well; no dike failures are known to have occurred. Locally steep areas exist on the exterior slope, and some indicate past slumping. No areas indicate recent activity.
3. No evidence of seepage emerging from the dikes or immediately adjacent toe areas was seen.
4. No ash slurry has been discharged into the areas adjacent to the dikes for over 20 years, and the sedimented ash present has a dry surface capable of supporting light traffic.
5. Vegetation on the exterior slopes has not been maintained due to the inactive conditions, and small and large trees have grown up on the slope. No indications of structural distress to the dike from the tree growth were seen.

<u>Southern Ash Area</u>

1. No evidence of excessive, erosion, instability or settlement of the dikes was observed. In general, the ash pond dikes appear to be in good condition and well maintained. The

discharge structures appear to be in generally in good condition.

2. Seepage is present at localized spots on the lower portion of the south dike, the base of the east dike and at the southeast corner of the pond dike. The seepage on the south dike appears to have increased slightly in recent years. Possible remedial measures should be considered, consistent with the potential future use plans for the ash pond.

3. The toe drain installed along the south dike continues to function. Outlets from the drain into the drainage ditch are partially blocked with soil and need to be cleaned. The outlet ditch from the toe drain is being well maintained .

4. Local erosion along the interior slopes of the south dike and the dike separating the pond from the settlement basin has generally been covered by ash and has thick growth of reeds limiting risk of further erosion.

5. No emergency actions are necessary related to dike stability or seepage.

## 1.4 Recommendations

Based on the field inspection and review of available data, the following recommendations are made:

<u>Northern Ash Area</u>

1. Locally steep areas resulting from past slumping activity or erosion should be considered for remedial work. The separate engineering study described in this report provides specific recommendations. Implementation of recommendations should be considered in conjunction with Progress Energy's plans for future use and life of the ash pond.
2. A plan for management of tree growth on the exterior slopes should be developed that is consistent with Progress Energy's plans for future use and life of the ash area.

<u>Southern Ash Area</u>

1. Local seepage on the south dike slope and at the toe of the east dike and the southeast corner of the pond should be observed during the normal monthly inspections for change

in volume of flow or appearance of soil fines in the seepage. Changes should be brought to the attention of Progress Energy's engineering support personnel.

2. Remedial measures for seepage effects on the south dike should be considered as discussed in the separate engineering study report.
3. The eroded spots on the interior of the south dike and the separator dike should be watched for signs of enlargement. If the areas enlarge, placement of geotextile and rip rap should be done.
4. The outlets of the toe drain pipes at the collector ditch should be cleared of sediment that reduces free flow of water out of the pipes.

## 2.0 ASH POND DESCRIPTION

The ash pond area is located east of the generating plant, which is located on the east bank of the Lumber River about one mile southeast of Lumberton, North Carolina. The latitude and longitude of the pond are: N34$^0$35'25", W78$^0$58'06". Exhibit 1 shows the plant location. Exhibit 2 shows the location of the ash pond relative to the plant and the area descriptions. The ash ponds were created by constructing total perimeter dikes above the original ground.

The first diked area for receiving sluiced ash was created in a wooded area about 1600 feet north of the generating units. As the plant expanded and ash volume increased, additional diked areas to receive sluiced ash were constructed to the south of the original pond. Exhibit 3 shows the sequence of these ash pond constructions based on review of plant records. The last dikes were constructed in 1979. For purposes of this report, the ash pond has been divided into a Northern Ash Area and a Southern Ash Area as indicated on Exhibit 2, roughly corresponding to the division between the last dike construction in 1979 and the original dikes.



### 2.1 Northern Ash Area

A review of available drawings and photographs on file at the Weatherspoon Plant did not disclose specific design or construction records for the first ash pond areas (designated as Areas A and B on Exhibit 3). A photograph from 1955 (Exhibit 4) shows the 1955 original ash pond dike near completion.

A plant construction photograph from 1948 shows the ash pond area prior to construction, and indicates the ash pond north area was wooded (Exhibit 5). The rail line entry to the plant is along the north and west edges of the original ash pond area. An excavation was required for the rail line. A construction photograph from 1949 (Exhibit 6) shows that the excavated material was cast up to become a material source for some of the original dikes.

While there are no plans, topographic mapping conducted in 1973 by Olsen Associates, by Smith and Smith in 1990 and by McKim and Creed in 2010 (Exhibit 7) all indicate crest elevations in the range of 143 feet to 146 feet. Current survey elevations are referenced to the North American Vertical Datum, 1988; older surveys are likely referenced to the 1929 USGS datum. There is an approximate 1 to 1.5 foot difference between the two datums in the Lumberton area, with the 1988 datum being lower than the 1929 datum. Thus, a direct comparison of elevations shown on older drawings to those on current drawings is misleading.

Additional dike construction in the Northern Ash Area occurred between the 1950's and 1979 as shown on Exhibit 3. A file review at the Weatherspoon Plant found only the above referenced Site Plan prepared in 1973 by Olsen Associates. Topographic contours of the exterior slopes of dikes that were present in the southern portion of the Northern Ash Area indicate slopes that ranged from approximately 2(H) : 1(V) to 3(H) : 1(V).

2.2 Southern Ash Area

The last ash pond perimeter dike construction was done in 1979 by extending dikes south of the previous ash ponds as shown on Exhibit 8 (CP&L Drawing No. RCD-1280). Design was done by Progress Energy (then known as CP&L) personnel and construction was done under CP&L supervision.

Exhibit 9 (CP&L Drawing No. RCD- 1281) contains cross sections of the dikes. The crest of the dikes is at Elevation 145 feet, the crest width is 12 feet, the inside slope is 2(H): 1 (V), and the outside slope is 2.5(H): 1(V). A berm, 16 feet wide, was provided on the outside slope of the south dike at Elevation 123 feet. The maximum height of the dikes is about 28 feet. The maximum operating pond level is Elevation 143.0 feet.

Over time, as ash began to fill the 1979 pond, several episodes of dry stacking and construction of interior containment areas occurred in both the Northern Ash Area and the north portion of the Southern Ash Area. The dikes for such areas are not considered by Dam Safety as jurisdictional, and are not addressed in this report.

Ash is currently discharged into an interior containment area. Water from this area is directed to the south end of the 1979 Ash Pond area where the permanent pond discharge structures are present. The permanent pond discharge structures consist of a vertical 24-inch diameter concrete pipe connected to a 24-inch diameter concrete outlet pipe that releases water into a settling basin. The same type of discharge structure is present in the settling basin, and outflow is directed into a channel that leads to the cooling lake.

Based on the height of the dikes and the available storage capacity, the dam is classified as "small" in accordance with North Carolina Dam Safety Regulations[3] The area downstream of the ash pond dikes is undeveloped agricultural land, woods and the Cooling Pond. The rail spur leading to the plant is present north of the Northern Ash Area. A drainage swale and small creek exist between the rail spur and the dikes. Failure of the ash pond dikes would not endanger lives or cause severe damage to the downstream facilities. Ash released from the pond in the event of a failure could ultimately reach the Lumber River and expose Progress Energy to a Notice of Violation of the plant's NPDES permit. Considering the extent of damage that would result from failure, a hazard classification of "low" using the USCOE categories has been used in all prior inspections. NCDENR Dam Safety has reviewed the potential for ash released to create environmental impacts and has classified the dam as "Intermediate" with respect to hazard.

Further details about the dike design and construction of the 1979 Ash Pond Dikes are contained in the Historical Volume dated 1995[5].

## 3.0 ACTIVITIES SINCE 2005 INSPECTION

Progress Energy personnel actively maintain and inspect the active ash pond dikes. Weekly and monthly inspections are conducted by plant maintenance staff. The following actions related to the performance of the dikes, some in response to the 2005 inspection, were taken since the 2005 field inspection by an independent consultant.

### 3.1 Maintenance Activities

Routine maintenance consists of cutting excess vegetation on the exterior slopes and mowing the crest and upper portions of the slopes. The grass cutting activities have been limited to the interior areas in the Northern Ash Area and all of the Southern Ash Area. Trees growing on the exterior slopes of the Northern Ash Area have not been cut over the years because this area has contained no ash slurry for many years and was considered outside the active ash storage pond.

The head walls for the culvert carrying the ash pond outflow under the cooling pond access road were replaced since the 2005 inspection.

### 3.2 Engineering Inspections

MACTEC personnel conducted brief site visits in 2006 through 2009 for limited field inspections. These limited field inspections, focused on the Southern Ash Area, found generally good conditions. The conditions observed were summarized in brief reports.

.

Progress Energy personnel conduct visual observations of the dikes as part of the weekly Fuel Handling Operations environmental checks under plant procedure 4.3-6. A separate monthly inspection is also conducted specifically targeted to the dike conditions under Progress Energy procedure EVC-WSPC-00029, implemented in October, 2009 (Exhibit 10). Review of the monthly inspection file for 2005 through spring, 2010 indicated the reports are adequate. As a result of the Dam Safety inspection visit, additional attention is being given to the conditions along the north dike in the Northern Ash Area.

On January 27, 2010, representatives of NCDENR Dam Safety conducted their first site visit to inspect the dikes. The results of their inspection were presented in a Notice of Deficiency letter dated April 29, 2010 (Exhibit 11). Two conditions were cited:

- Excessive seepage on the south dike of the Southern Ash Area, and
- Presence of large trees on exterior slopes of the northern and eastern dikes.

Progress Energy implemented activities to respond to the deficiencies, including retaining MACTEC to conduct seepage and stability review work. The results of that work were presented in a MACTEC preliminary report dated September 27, 2010 [(6)] that was provided to NCDENR Dam Safety.

**4.0 FIELD INSPECTION OBSERVATIONS**

4.1 Method of Inspection

The field inspection for the Ash Pond Dike at the W.H. Weatherspoon Plant was conducted April 9, 2010 by Al Tice and Sharat Gollamudi of MACTEC. Mr. Larry Baxley, plant environmental coordinator and Mr. Keith Long from the fuel handling group accompanied MACTEC on the field visit.

A visual inspection was made of the dikes and appurtenant structures on foot or from a slow moving vehicle. Observations were made of the condition of the crest, interior and exterior slopes and structures where foot-accessible. Photographs were taken to document existing conditions. Selected photographs are contained in Appendix A. The location and orientation of each photograph is shown on the Photograph Location Map also contained in the Appendix. In general, comparison of the 2010 photographs of the Southern Ash Area with comparable 2005 photographs showed no significant change in conditions.

Past inspections have focused on the Southern Ash Area (1979 Ash Pond) where water is impounded. The 2010 inspection included observation of the entire perimeter dikes, including spots marked by Dam Safety by red flagging during their January, 27, 2010 site visit. For purposes of this report, the Northern Ash Area and the Southern Ash Area are discussed separately.

4.2 Northern Ash Area

There was no water or slurry ash adjacent to the perimeter dikes of the Northern Ash Area. A small amount of standing water from rainfall was present in a low area at the northeast corner of the Northern Ash Area, near the location of original discharge pipe that is no longer present.

4.2.1 Crest

No areas of concern were noted on the crest of the dike. The crest is relatively level and has a thin, but adequate, grass cover with some gravel (Photographs 1 and 2).

4.2.2 Interior Slopes

The interior slopes are mostly covered by dry sedimented ash that has a good grass cover (Photographs 1, 3 and 4). A few old trees are present along the edge of the dike crest in one area (Photograph 4); these trees present no concerns for dike stability. The sedimented ash extends approximately 80 to 100 feet south to the toe of one of the interior containment dikes. Grading has been conducted to create a drainage swale to guide rainfall east to a low area where it is allowed to infiltrate (Photograph 3). Where interior slopes are exposed around the lower area at the northeast corner, they are covered with grass, reeds and small brush (Photograph 5). No indications of slope stability concerns were observed on these exposed segments of the interior slope.

4.2.3 Exterior Slopes

The exterior slopes from the plant road access ramp on the west side to the start of the north dike are generally covered with small brush and kudzu (Photograph 6). There is one section approximately 125 feet in length where near vertical slopes are present (Photograph 7). The dike height in this area is low (< 10 feet), and there are no indications of active or recent slumping. The area at the toe of the west side dike is topographically low, and some standing water can be seen during periods of rain. There is old sedimented ash adjacent to the dike crest and level with the crest on the interior. Even if a regressive slumping occurred, its effect would be to reduce the travel path width on the dike crest and not cause a breach or release of ash. MACTEC recommends a plan be developed to address the near vertical slope area by either moving the dike crest travel area to the west (out onto the sedimented ash), by using soil anchors to provide stabilization, or by placing a rip rap berm along the toe.

The exterior slope along the northern and eastern dike has moderate to thick growth of brush and trees. Some trees are 8 to 12 inches in diameter. The slope has segments with signs of old slumping or erosion, leaving steep slopes (Photographs 8 and 9). A notable area is at the former discharge pipe (Photograph 10). None of the areas show signs of recent activity. The slope angle outside the irregular areas is typically 2(H) : 1(V).

In some spots, Progress Energy plant personnel have placed timbers along the edge of the exterior slope, at the crest level, to provide lateral restraint against local sloughing of the dike crest edge

(Photograph 11). These areas are also associated with locally steep upper slope conditions that may represent old shallow slumps. These areas did not show signs of recent activity.

MACTEC was authorized by Progress Energy to conduct a separate study for evaluation of the dike stability and to recommend needed actions. The report of that work, issued separately[(5)], recommends providing soil anchors, slope flattening or stability berms at locations having low factors of safety consistent with the future useful life of the dikes. Progress Energy is developing plans for addressing the tree growth consistent with future use expectations for the Northern Ash Area as requested by the Dam Safety Notice of Deficiency (Exhibit 11).

Reconnaissance along the lower portions and toe areas of the Northern Ash Area dikes did not find indications of seepage or wet areas.



## 4.3 Southern Ash Area

Water resulting from placement of slurried ash is impounded in the southeastern corner of the Southern Ash Area, where the pond discharge structure and the settling basin are present. The ash pond level was estimated at Elevation 141.5; the water surface was at the top of the inlet riser. As can be seen on Exhibit 2, the area of impounded water comprises about 10 percent of the overall area. There are drainage swales along the west and east sides adjacent to the dikes that carry water discharged from interior containment areas to the area at the pond discharge structure.

The embankment crest and side slopes were visually examined. No significant evidence of erosion, settlement or instability was found. Overall, the dikes are in satisfactory condition and are being well maintained. Dike crest width and side slopes are consistent with the design dimensions. Seepage conditions along the east dike toe area are similar to previous observations, but the areas of seepage and the amounts were slightly greater on the south dike.

### 4.3.1 Crest

No areas of concern were noted on the crest of the dike. The crest is relatively level and has a thin, but adequate, grass cover (Photographs 12, 13 and 14). An area of the separating dike between the pond and the settling basin was repaired in 1990 when seepage was observed as the pond level was being raised. The repaired area appears as a slight “hump” in the dike. There were no indications of seepage seen in this area during our inspection.

4.3.2 Interior Slopes

The interior slopes are well vegetated and the vegetation is well maintained (Photographs 13, 15, 16 and 17). Previous inspections have noted beaching erosion along some portions of the south dike. The beaching erosion areas appear inactive and grown over with reeds and grass (Photograph 18). The pond-side slope of the separating dike and the interior slope on the southern portion of the east dike also show some effects of past wave erosion with local sections of near vertical slopes for 1 to 2 feet above the water line. These dike sections appear to be down wind of the prevailing wind direction.

The limited depth of water and the small area of impounded water limit the potential for significant wave erosion. Reed growth is prevalent and serves to protect the slopes against increase in beaching erosion. We recommend closely watching these areas for indications of enlargement of the existing erosion. Placement of geotextile and riprap may be needed if the eroded areas show signs of enlarging.

4.3.3 Exterior Slopes

The exterior slopes are well grassed, and the vegetation is well maintained (Photographs 19, 20 and 21). Occasional small trees are present that have been previously cut, and show signs of regrowth. The plant should continue the normal vegetation cutting.

The east dike exterior slope and area adjacent to the toe have a history of wet areas. The area was as seen before with some soft, wet spots but no active seepage (Photograph 19). The wet areas extend a maximum of five feet up the dike from the toe.

At the southeast corner of the ash pond, wet spots have been noted adjacent to the toe of the slope during past inspections with no seepage flow seen. The area was wet, and some rutting from mowing traffic was observed (Photograph 22). No flowing seepage was seen. The dike slope was moist to wet for about 1 to 2 feet up the slope.

The exterior slope of the south dike has had localized wet spots and slight seepage noted in past inspections. An exploration and evaluation of the worst areas was conducted in 1993 that concluded the overall stability of the dike was satisfactory. Progess Energy installed a toe drain with lateral outlets in the area in 1994 that continues to have slight water exiting the outlets.

Conditions on the south exterior slope were generally similar to those seen in past visits (Photograph 23), but wet areas appeared to be expanded from the last inspection. In past inspections, an area of slightly increased wetness and minor seepage was noted in the lower third of the slope, near the middle row of the old water level casings. This area appeared similar to the previous observations (Photograph 24). Seasonal variation in amount of seepage has been noted by Progress Energy personnel and by MACTEC during past inspections. Progress Energy personnel had placed some sand fill over one wet slope area since the last inspection visit in 2009. This area had sparse grass cover, but no signs of surface erosion (Photograph 25).

Past studies of the wet areas and seepage in the south dike indicated that the seepage may be from rainwater saturating sandier materials near the fill surface and being trapped by clayey materials within the dike, thus flowing downslope and emerging as seepage. The seepage was concluded as not being from the pond itself. As noted during the current field inspection, seepage areas appear to be slightly larger and there is some slight ooze/flow in some spots. A separate evaluation of the stability and seepage of the dikes in the Southern Ash Area was authorized by Progress Energy. The report, issued separately[(6)], concluded the dikes were generally satisfactory with respect to slope stability, and recommended improvements along the south dike at the seepage areas. Progress Energy is developing plans for improvements to be consistent with the useful life of the pond area. Until such improvements are made, the plant personnel conducting monthly inspections should watch the identified seepage areas closely for signs of change or enlargement and notify Progress Energy engineers if such signs are found.

The toe drain was installed in 1994 has solid outlet pipes leading to the drainage ditch adjacent to the south dike toe road. The area around theoutlets of the toe drain have been cleaned and marked for easy location. Only very slight flow was emerging from some of the drains. The flow was orange-stained. The flow was not carrying soil fines, and no accumulation of soil fines at the outlets was observed. We observed that soil had accumulated in some of the drain outlet pipes and was partly restricting flow. MACTEC used a hand auger to partially remove soil blockage and noted a rapid increase in flow that subsided after about 15 minutes to a more typical rate.

Photograph 26 shows the outlet after soil removal. We recommend that all of the outlet pipes be cleaned out.

The ditch that carries the flow from the toe drain outlets and surface runoff was sufficiently clear of potential vegetation that would block flow into the outfall ditch (Photograph 27).

## 4.4 Discharge Structures

The pond water flows through a skimmer discharge structure to a settling pond. Water from the settling pond flows into a skimmer type inlet and discharges through a 24-inch diameter concrete pipe. Both skimmer structures are in good condition (Photographs 28 and 17). The skimmer for the main pond is slightly tilted as a result of a slight mis-alignment during recent removal in anticipation of a hurricane in 2009 and replacement. The mis-alignment does not impact the function of the vertical riser. The outflow pipe from the settling basin is in good condition at the outlet end (Photograph 29) and no signs of water flowing around the exterior of the pipe were seen.

The outflow from the discharge pipe flows in a channel which has rip rap and vegetation, and then through a culvert under the access road to the Cooling Lake (Photograph 30). The timber headwalls for this culvert were replaced by concrete walls since the 2005 inspection.

The ash discharge line is supported on timbers laid on the sedimented ash. The discharge is into an interior containment area.

**5.0 REFERENCES**

1. “Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, Washington, D.C., 1976.

2. “Dam Operation, Maintenance ,and Inspection Manual”, North Carolina Department of Environment and Natural Resources, Division of Land Resources, Land Quality Section, 1985 (revised 2007)

3. “Dam Safety”, North Carolina Administrative Code, Title 15A, Department of Environment and Natural Resources, Subchapter 2K, April 1995.

4. MACTEC Engineering and Consulting, Inc., 2005, “Five-Year Independent Consultant Inspection of Ash Pond Dikes W. H. Weatherspoon Steam Electric Plant”, report to Progress Energy Carolinas, December 5.

5. LAW Engineering, 1995, “Carolina Power & Light Company, Weatherspoon Steam Electric Plant, Ash Pond Dikes, Historical Volume”, report to CP&L, December 4.

6. MACTEC Engineering and Consulting, Inc., 2010, Preliminary Report Seepage and Stability Analysis, Weatherspoon Plant, Report submitted to Progress Energy, September 27.

# EXHIBITS

LIST OF EXHIBITS

1. Weatherspoon Plant Location

2. Aerial Photograph – Ash Area

3. Ash Pond Construction Sequence

4. Construction Photograph 2/28/1955 – Original Ash Pond Dike

5. Construction Photograph 8/5/1948 – Ash Disposal Area Prior to Construction

6. Construction Photograph 7/20/1949 – Railroad Cut Material Stacked in Area of Northern Ash Pond

7. Ash Pond Area Topographic Map, 2010

8. Weatherspoon Steam Electric Plant, Ash Pond Area Plan, Carolina Power & Light Company Drawing RCD-1280.

9. Weatherspoon Steam Electric Plant, Ash Pond, Sections & Details, Carolina Power & Light Company Drawing RCD-1281.

10. W. H. Weatherspoon Plant Dam and Dike Inspection Procedure, EVC-WSPC-00029, October, 2009.

11. Letter from North Carolina Department of Environment and Natural Resources, Division of Land Resources to Mr. Fred Holt, Progress Energy Carolinas, Inc. "Notice of Deficiency", April 29, 2010.

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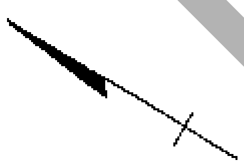
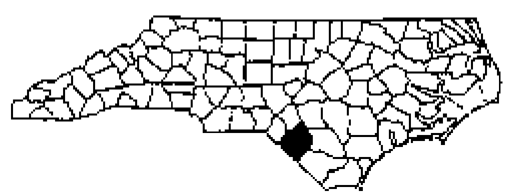






MACTEC

RALEIGH, NORTH CAROLINA

**SITE LOCATION MAP**

W.H. WEATHERSPOON STEAM ELECTRIC PLANT
PROGRESS ENERGY CAROLINAS
LUMBERTON, NC

| | | | |
|---|---|---|---|
| DRAWN: | — | DATE: | August, 2010 |
| DFT CHECK: | — | SCALE: | Not to Scale |
| ENG CHECK: | — | JOB: | 6468-10-0111 |
| APPROVAL: | | DRAWING: | 1 |

REFERENCE: DeLorme Map Export

**EXHIBIT 1**


G:\DEPT\GEOTECH\30720\FORMS\SITEMAP.XLS

**AERIAL PHOTOGRAPH - ASH AREA**

WEATHERSPOON STEAM ELECTRIC PLANT

LUMBERTON, NORTH CAROLINA

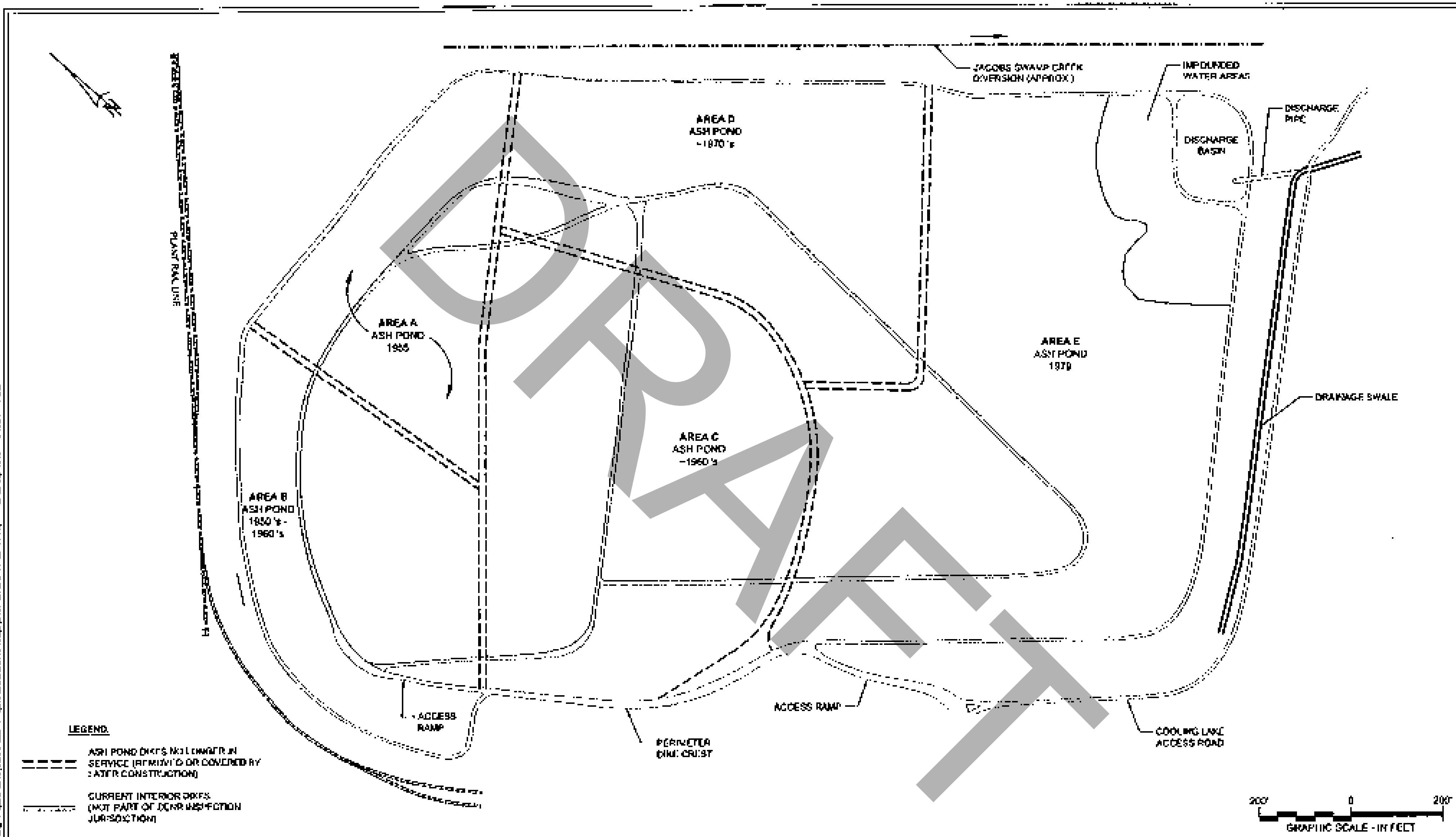
MACTEC

RALEIGH, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | | DATE: | August, 2010 |
| DFT CHECK: | | SCALE: | NTS |
| ENG CHECK: | | JOB: | 6468-10-10111 |
| APPROVAL: | | Dwg. | 3 |

REFERENCE: Aerial photograph from Google; image date June 18, 2008

EXHIBIT 2




MACTEC

MACTEC ENGINEERING AND CONSULTING, INC
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

ASH POND CONSTRUCTION SEQUENCE
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: R.R. | DATE: SEPTEMBER 2010 | DRAWING | |
| ENG CHECK: SG | SCALE: AS SHOWN | 2 | |
| APPROVAL: [signature] | JOB No.: 6468-10-0111 | | |

REFERENCE: SMITH AND SMITH TOPOGRAPHIC MAP, 1990; OLSEN ASSOCIATES "SITE PLAN", 1973; MCKIM AND CREED TOPOGRAPHIC MAP, 2010.

EXHIBIT 3

Construction photograph from 2/28/1955 showing "New ash disposal area..completed retaining dyke tying into old railroad cut spoil banks and new pipeline to disposal area."

**EXHIBIT 4**


**EXHIBIT 5**
**PHOTO DATE 8/5/1948**

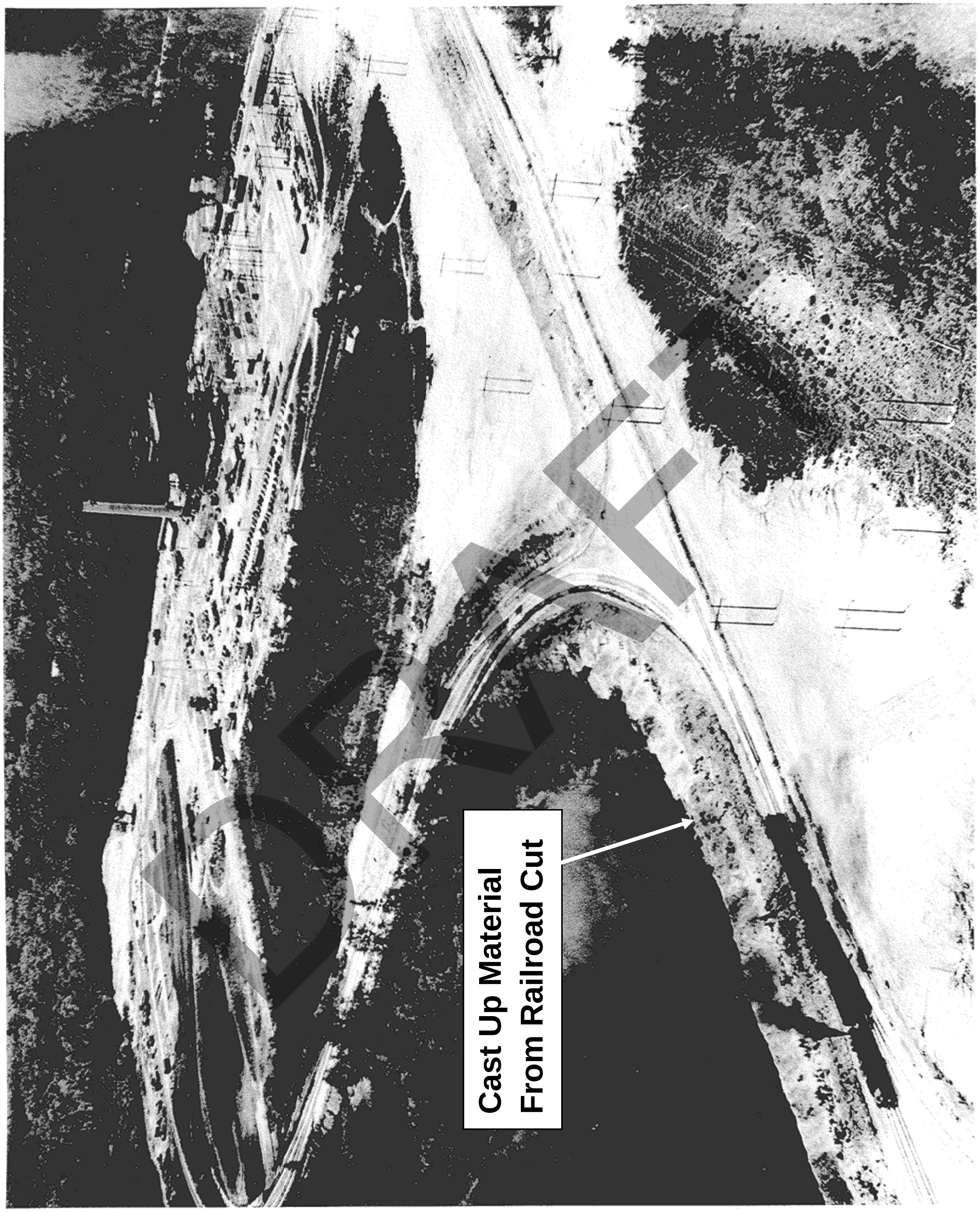



**EXHIBIT 6**
**PHOTO DATE 7/20/1949**

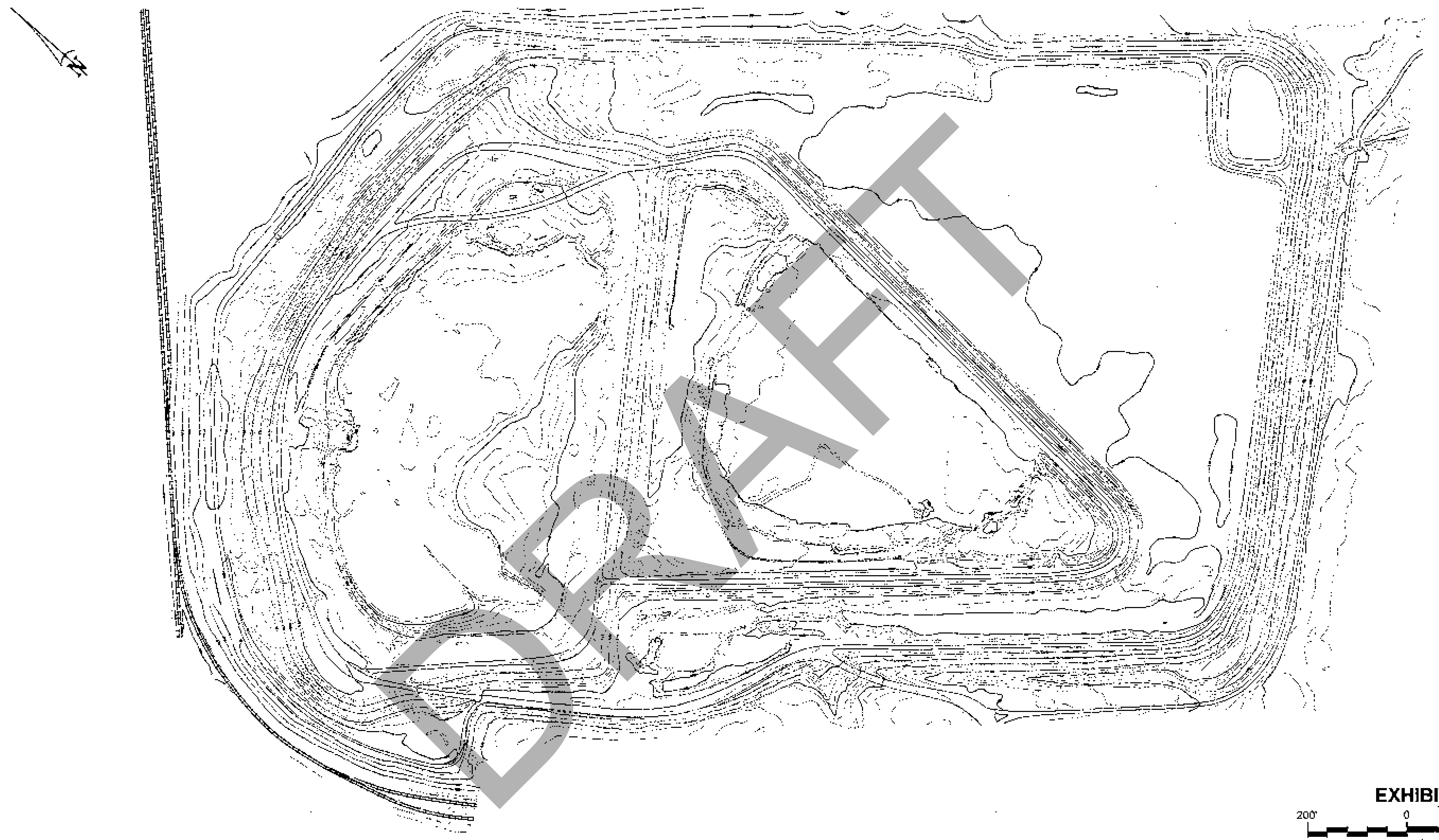


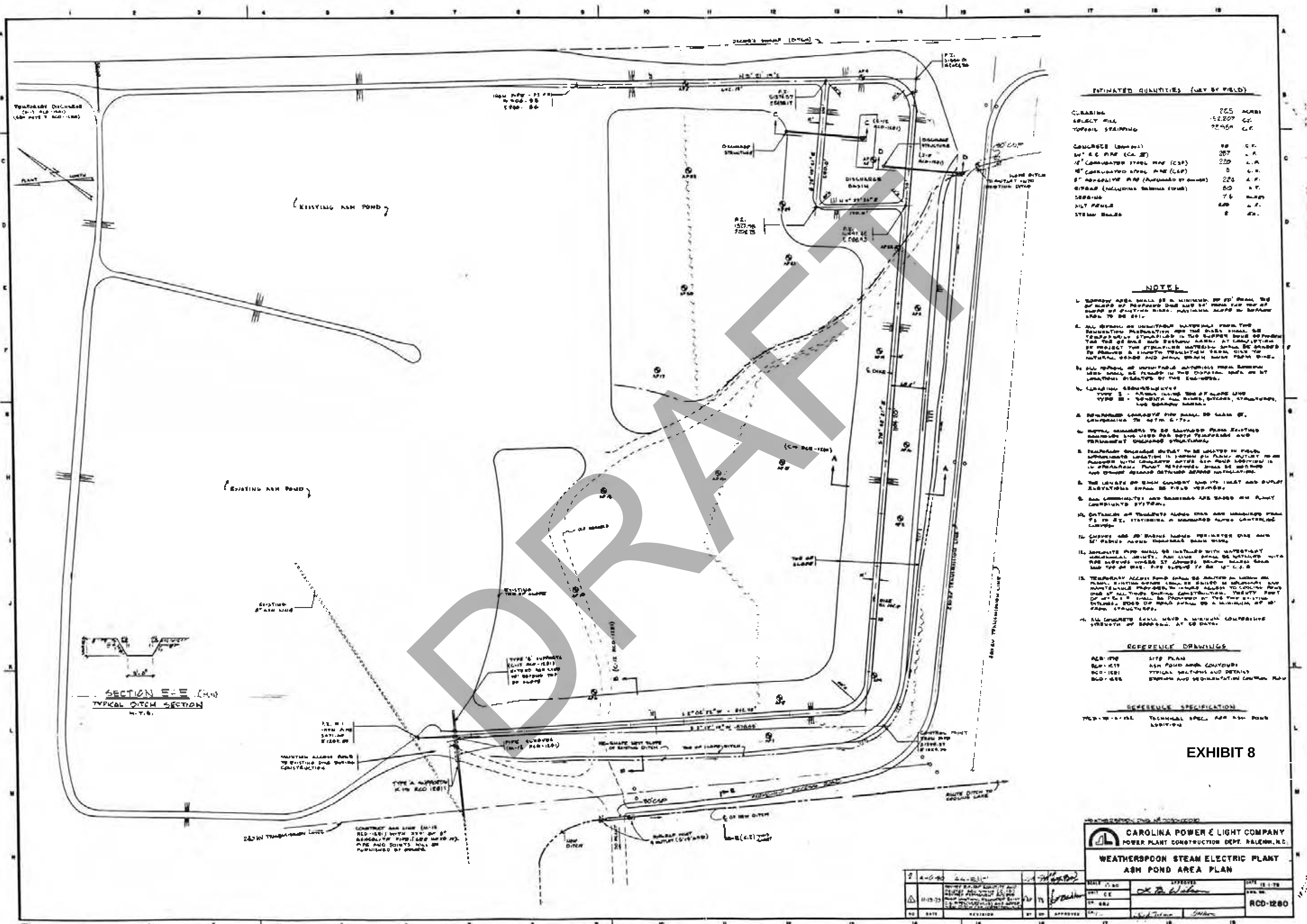

EXHIBIT 7

200' 0 200'

GRAPHIC SCALE - IN FEET

| MACTEC<br>MACTEC ENGINEERING AND CONSULTING, INC.<br>3301 ATLANTIC AVENUE<br>RALEIGH, NORTH CAROLINA | ASH POND TOPOGRAPHY<br>W. H. WEATHERSPOON PLANT<br>LUMBERTON, NORTH CAROLINA | DRAWN: R.R. | DATE: NOVEMBER 2010 | DRAWING |
|---|---|---|---|---|
| | | ENG CHECK: | SCALE: AS SHOWN | |
| | | APPROVAL: | JOB No.: 6468-10-0111 | |

REFERENCE: TOPOGRAPHY PREPARED BY McKIM AND CREED, 2010.


EXISTING ASH POND
EXISTING ASH POND
SECTION E-E
TYPICAL DITCH SECTION
ESTIMATED QUANTITIES
NOTES
REFERENCE DRAWINGS
REFERENCE SPECIFICATION
DRAFT
EXHIBIT 8
CAROLINA POWER & LIGHT COMPANY
POWER PLANT CONSTRUCTION DEPT. RALEIGH, N.C.
WEATHERSPOON STEAM ELECTRIC PLANT
ASH POND AREA PLAN
RCD-1280

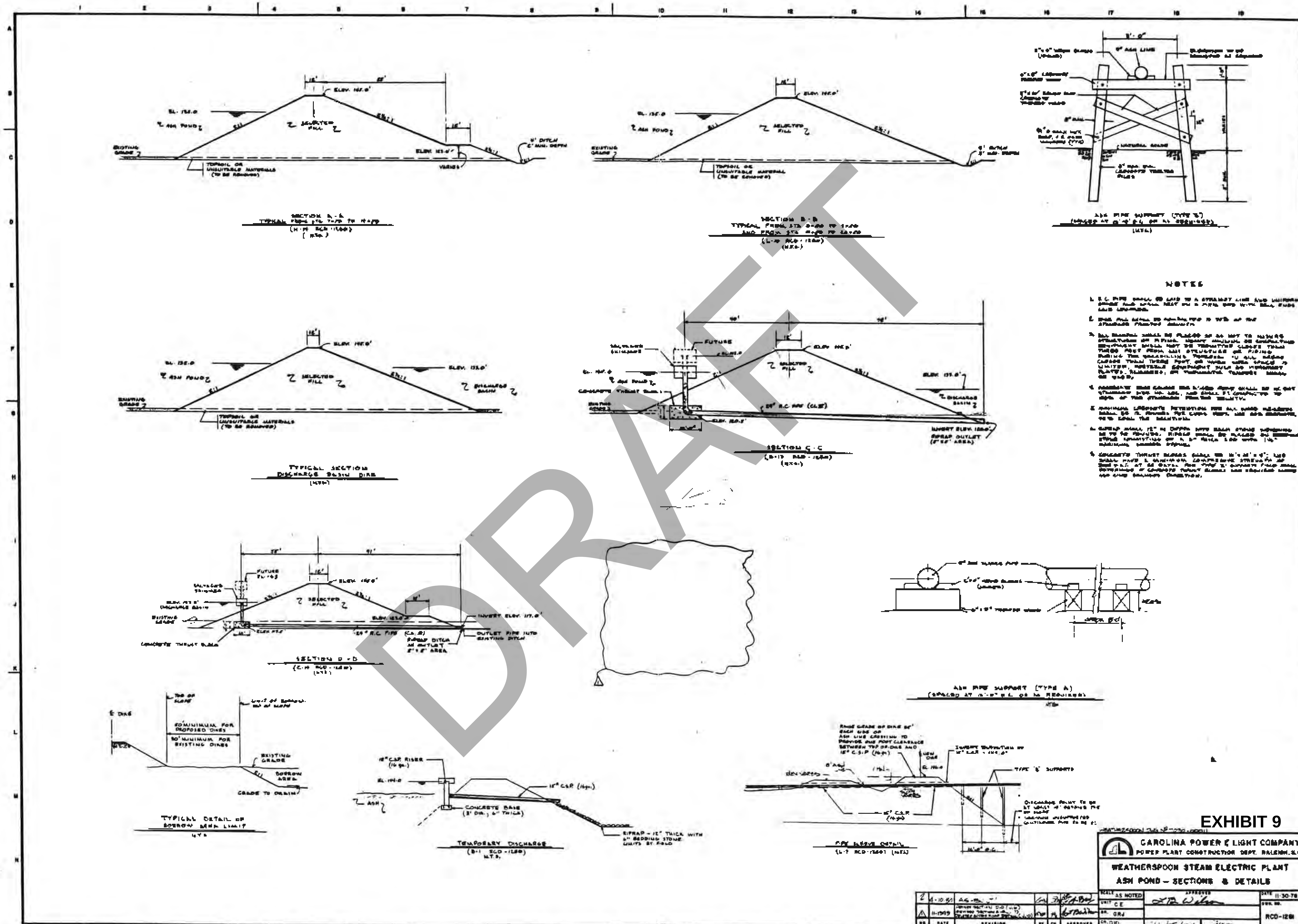

SECTION A-A
SECTION B-B
ASH PIPE SUPPORT (TYPE B)
NOTES
TYPICAL SECTION
DISCHARGE BASIN DIKE
SECTION C-C
SECTION D-D
ASH PIPE SUPPORT (TYPE A)
TYPICAL DETAIL OF BORROW AREA LIMIT
TEMPORARY DISCHARGE
PIPE SLEEVE DETAIL
RCD-1281
CAROLINA POWER & LIGHT COMPANY
POWER PLANT CONSTRUCTION DEPT. RALEIGH, N.C.
WEATHERSPOON STEAM ELECTRIC PLANT
ASH POND – SECTIONS & DETAILS
AS NOTED
RCD-1281



EXHIBIT 9

Document title

# W.H. Weatherspoon Plant Dam and Dike Inspection Procedure

Document number

EVC-WSPC-00029

Applies to: W.H. Weatherspoon Fossil Plant - Carolinas

Keywords: environmental

**Legend**:
OPS Operations
ENG Engineering
WMT Work Management
TRN Training
ENV Environmental
FIN Financial
ICT Combustion Turbine
ADM Administrative

| Organizational Applicability | | | | | | | |
|---|---|---|---|---|---|---|---|
| **OPS** | **ENG** | **WMT** | **TRN** | **ENV** | **FIN** | **ICT** | **ADM** |
| X | X | | | X | | | X |



## 1.0 PURPOSE

1.1 The purpose of this program is to implement a dam and dike inspection procedure that effectively identifies any signs of potential problems that may require a repair or special attention. This procedure is also intended to comply with the requirements specified in corporate document - Non-Hydroelectric Facility Dam and Dike Inspection Program Manual.

## 2.0 TERMS AND DEFINITIONS

2.1 Breach – An opening or a breakthrough of a dam sometimes caused by rapid erosion of a section of earth or ash embankment by water.

2.2 Dam – An artificial barrier constructed to impound or divert water or liquefied material.

2.3 Dam Emergency Notification – A document that identifies potential emergency conditions at a dam or dike and specifies preplanned actions to be followed to minimize impacts to the environment.

2.4 Dike/levee – Any artificial barrier that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from flooding by flow waters.

2.5 Distress – A condition of severe stress, strain, or deterioration indicating possible or potential failure.





**EXHIBIT 10**
**1 of 5**

2.6 Embankment – Fill material placed with sloping sides and usually with a length greater than its height. An "embankment" is a part of a dam.

2.7 Freeboard – The vertical dimension between the crest of the dam at its lowest point and the reservoir water surface.

2.8 Riprap – A layer of large stones, broken rock, or precast blocks placed in random fashion on the upstream slope of an embankment dam. The purpose of riprap is to aid in the prevention of degradation of the structural fill portion of the dam.

2.9 Seepage – The slow oozing of a fluid through a permeable material. A small amount of seepage will normally occur in any dam or embankment that retains water. The rate will depend on the relative permeability of the material in and under the structure, the depth of water behind the structure, and the length of the path the water must travel through or under the structure.

2.10 Spillway/weir – A passage to conduct excess water or other liquid safely through, over, or around a dam or other artificial barrier that impounds the liquid.

## 3.0 RESPONSIBILITIES

Dam safety issues at W.H. Weatherspoon Plant fall under the regulatory jurisdiction of the North Carolina Utilities Commission (NCUC). This procedure specifies how the Weatherspoon Plant completes and documents dam and dike inspections. In the event of an ash pond release, all employees **shall** reference Weatherspoon Fossil Plant Dam Emergency Notification Procedure: EMG-WSPC-00003.

3.1 Plant Manager

The plant manager is the person responsible for implementing the dam and dike inspection procedure. Implementation includes ensuring that inspections are completed on the specified frequency and that appropriate funding is available to correct any identified problems or deficiencies.

3.2 Plant Environmental Coordinator

The plant environmental coordinator has the primary responsibility of updating the dam and dike inspection procedure. The procedure shall be updated every two years or in the event that inspection procedures and/or practices need to be added and/or modified.

The plant environmental coordinator will assist in ensuring that the dam and dike inspections are completed by the specified frequency. The plant environmental coordinator will review the inspection reports and file in the appropriate file point location of **13580-C**.

The plant environmental coordinator will assist in ensuring that inspection recommendations and deficiencies are addressed in a timely manner. The plant environmental coordinator will contact the Dam and Dike Program Manager – Field Engineering of conditions found during inspection (including construction on or in close proximity to dams) and if inspection results indicate any significant problem(s).

The plant environmental coordinator will assist in scheduling annual inspection training. The inspection training will be conducted by a third party contractor after the third party contractor conducts the annual dam and dike inspection.

3.3 Plant Chemistry Technicians

The plant chemistry technicians are responsible for conducting the dam and dike inspections. The plant chemistry technicians shall receive annual inspection training.

The plant chemistry technicians will use and fill out Attachment 1 while conducting the dam and dike inspections. The plant chemistry technicians will give the completed inspection forms to the plant environmental coordinator for review and filing. If the inspection indicates issues and or problems with the dam and/or dikes, the plant chemistry technician will generate a work order to address the problem when appropriate.

## 4.0 PRECAUTIONS AND LIMITATIONS

Detailed inspections have the potential for injury to plant personnel. Care must be used due to the high traffic volume on the constricted plant roads. All plant procedures must be followed when crossing the train track rails. Foot travel over uneven terrain is another common hazard.

## 5.0 PREREQUISITES

Annual dam and dike inspection training provided by a third party contractor. (Weatherspoon Dam Inspection Training Materials)

## 6.0 MATERIAL AND SPECIAL EQUIPMENT

Plant truck or other form of motorized transportation.

## 7.0 BACKGROUND/HISTORY

**7.1** The ash pond was formed by an earth embankment in a more or less rectangular shape. The ash pond was last expanded in 1979 and now covers approximately 54.5 acres.

**7.2** In 2005 an interior geo-tube berm was installed to increase the storage capacity. This geo-tube berm is not considered to be a dike. The original pond's exterior dike is still the primary ash impoundment.

**7.3** In 2007 another interior triangular shaped lift was completed in the ash pond. The plant began sluicing ash to this containment in June of 2007. There is a gated valve that can control flow to either the upper geo-tube or the lower lifted area of the ash pond. The flow can be diverted for fill control purposes as well as for repair work to take place.

## 8.0 PROCEDURE

**8.1** The overall structural integrity of the ash pond shall be inspected on a **monthly** basis and if possible the inspection shall take place during periods of dry weather.

**8.2** Complete Attachment 1 while conducting the inspection.

**8.3** Return completed inspection form to the plant environmental coordinator.

8.3.1 Discuss any noted issues or areas of concern.

8.3.2 Initiate work request as needed to address issues or concerns.

8.3.3 Route to plant manager for review.

8.3.4 File completed form in **13580-C.**

## 9.0 RETURN TO NORMAL

None

## 10.0 DOCUMENTATION

Attachment 1**:** Weatherspoon Plant Dam and Dike Inspection Form

## 11.0 REFERENCES

Weatherspoon Fossil Plant Dam Emergency Notification Procedure: EMG-WSPC-00003

Weatherspoon Data Sheet for Dam Emergency Notifications FRM-WSPC-00024

Non-Hydroelectric Facility Dam and Dike Inspection Program Manual

Weatherspoon Dam Inspection Training Materials

**Attachment No. 1**
**File Point: 13580-C**

**Weatherspoon Plant**
**Monthly Inspection Form**

Date inspected (Month/Day/Year): ______________ Inspected by: ________________________

Conditions/Weather around time of Inspection (If possible, perform inspection during dry weather):
______________________________________________________________________

Was previous monthly report reviewed? ________________________________________

**Ash Pond:**

| Parameter to be Inspected | Condition | | Location of Problem | Corrective Action Taken (i.e., work order submitted) | Comments - Any early warning signs? |
|---|---|---|---|---|---|
| | No Issues | Issues Exist | | | |
| Vegetation growth, including trees | | | | | |
| Overall condition of pond (overflow likely) | | | | | |
| Erosion control of exterior slopes | | | | | |
| Erosion control of interior banks/slopes (wave-induced beaching erosion or from animal burrows) | | | | | |
| Seepage control of embankment/slopes | | | | | |
| Interior geo-tube berm spillway (blocked or plugged) | | | | | |
| Drainage pipe from interior lifted berm to flood control area (blocked or plugged) | | | | | |
| Ash pond outflow to cooling pond (water exiting appears) | | | | | |

Additional Comments:______________________________________________________________________

**Environmental Coordinator:**____________________ **Plant Manager**________________________

North Carolina
Department of Environment and Natural Resources

Beverly Eaves Perdue, Governor
Dee Freeman, Secretary

James D. Simmons, P.G., P.E.
Director and State Geologist

NCDENR
Division of Land Resources



April 29, 2010



# NOTICE OF DEFICIENCY

**CERTIFIED MAIL**
**RETURN RECEIPT REQUESTED**
RECEIPT#: 7008 1300 0001 1492 9926

Progress Energy of the Carolinas
ATTN: Fred Holt
PO Box 1551 PEB 4
Raleigh, NC 27602

RE: Weatherspoon Ash Pond Dam
ROBES-009-I
Robeson County, N.C.

Dear Mr. Holt:

The Dam Safety Law of 1967" provides for the certification and inspection of dams in the interest of public health, safety, and welfare, in order to reduce the risk of failure of such dams; to prevent injuries to persons, damage to property; and to insure the maintenance of stream flows.

A visual inspection of the subject dam was conducted on January 27, 2010 by staff of the Land Quality Section Fayetteville Regional Office. During this inspection, the following conditions were noted:

1. Severe Seepage was observed along the southern downstream slope of the dam. Excessive seepage can cause failure of the dam due to internal erosion and/or embankment sliding. You should inspect the seepage periodically and notify this office if there is an increase in the amount of seepage, a discoloration of water, or if embankment sliding occurs.

2. Large trees are growing on both the eastern and northern downstream slopes of the dam.

These conditions appear serious and justify further engineering study to determine appropriate remedial actions. During this inspection we also investigated the potential for property damage and loss of life in the event that your dam fails. This investigation determined that the failure of your dam could result in significant property damage downstream. Therefore, we are listing your dam in the "Intermediate Hazard" category.

In order to insure the safety of this dam, you are directed to retain the services of a registered professional engineer or an experienced engineering firm to complete a geotechnical investigation and hydraulic analysis of the dam to determine compliance with North Carolina Administrative Code, Title 15A, Subchapter 2K. A report summarizing the investigation and analysis and resulting recommendations must be submitted to this office for review.

In addition to the above, the following items pertinent to maintenance and operation of the dam are also recommended.

1. Maintain a ground cover sufficient to restrain accelerated erosion on all earthen portions of the structure.

2. Periodically check the operation of all drain valve facilities. This will insure satisfactory operation of the drains should an emergency situation arise.

3. Periodically monitor the subject dam and appurtenant works with respect to elements affecting its safety. This is in light of the legal duties, obligations, and liabilities arising from the ownership and/or operation of the dam.

4. Remove all trees less than eight inches in diameter. Though it is not our policy to allow any trees to grow on a dam, it is recommended that all trees greater than eight inches in diameter be left on the dam and all other trees and bushes be removed. Trees that are larger than eight inches in diameter that are in poor shape of pose a threat to the structural integrity of the dam and need removal require an engineer's supervision and prior approval from this office. Note that all cut growth should be removed from the dam.

As a dam owner, you may incur liability should your dam have a problem or fail, if such an event results in loss of life, property damage, or environmental damage downstream. It is therefore requested that you prepare an Emergency Action Plan (EAP) for this dam. The EAP establishes procedures to be followed in events that could adversely impact the dam such as extreme precipitation, seismic activity, excessive seepage, slides, sinkholes, and other natural hazards, and for warning the public downstream in the event of an emergency at the dam. Guidance for preparing an EAP can be found on the Internet at http://www.dlr.enr.state.nc.us/pages/damsafetyprogram.html or by calling Dam Safety Program staff at (919) 733-4574. Two copies of an EAP for this dam should be and submitted to this office.

Please advise this Office of your intended action in this matter. If positive action is not taken on or before **June 30, 2010**, your case will be referred for appropriate enforcement action. Enforcement could include a civil penalty of up to $500.00 per day of violation, and/or issuance of a Dam Safety Order requiring the repair or removal of this dam, and/or injunctive relief to gain compliance.

Should you have any questions, please contact me at (910) 433-3300.

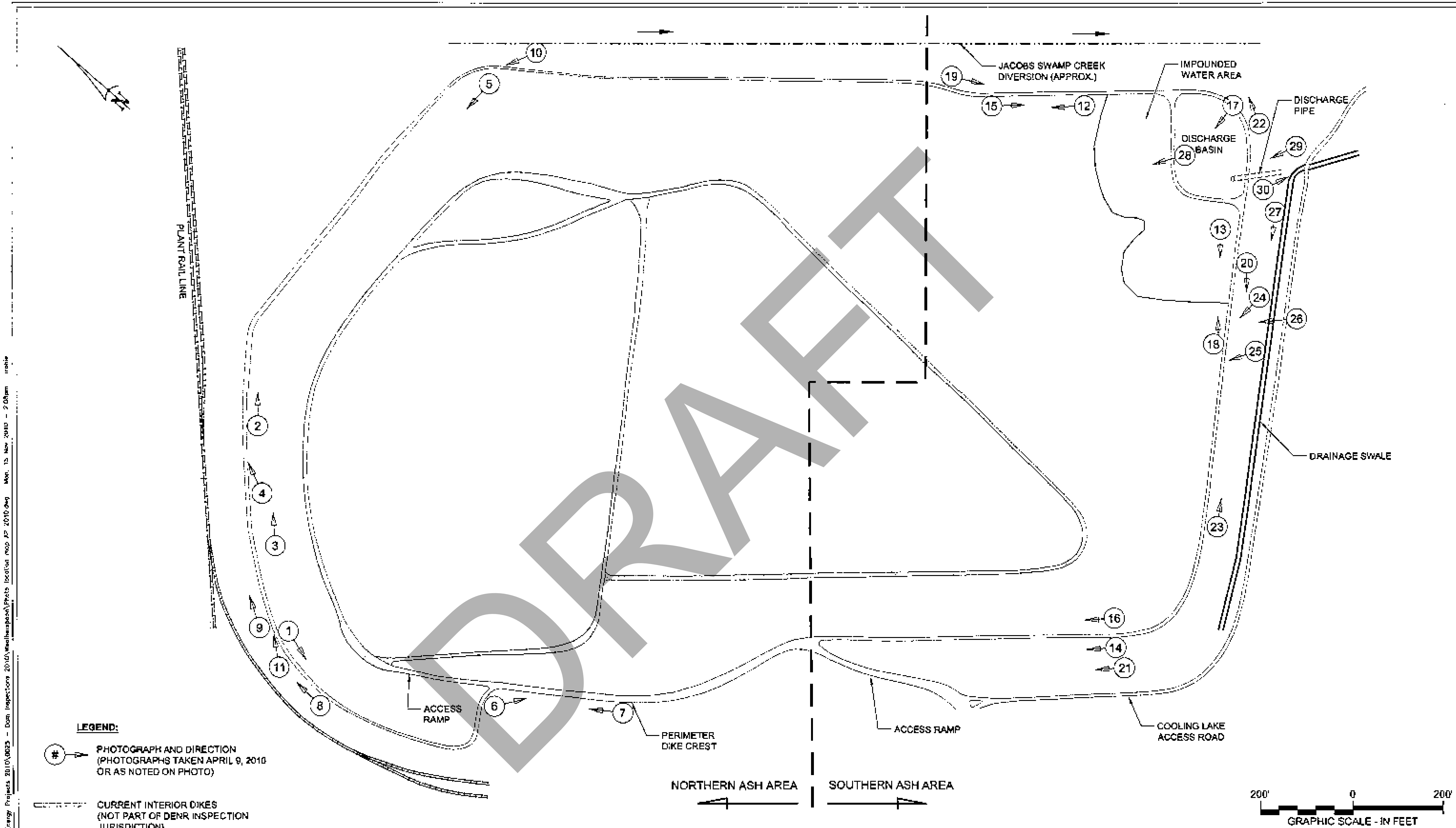
Sincerely,

M. Stephen Cook, C.P.E.S.C.
Regional Engineer
Land Quality Section

MSC\rfl

cc: Steve McEvoy, State Dam Safety Engineer (electronic copy)
Belinda Henson, Water Quality Regional Engineer
Land Quality Section-Fayetteville Regional Office files (2 copies)

# APPENDIX A
# PHOTOGRAPHS




MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA

# ASH POND PHOTOGRAPH LOCATION PLAN
WEATHERSPOON PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | R.R. | DATE: | NOVEMBER 2010 |
| ENG CHECK: | | SCALE: | AS SHOWN |
| APPROVAL: | | JOB No.: | 6468-10-0025 (01) |

DRAWING
P-1

REFERENCE: SMITH AND SMITH TOPOGRAPHIC MAP, 1990; OLSEN ASSOCIATES "SITE PLAN", 1973; McKIM AND CREED TOPOGRAPHIC MAP, 2010.

**Photograph 1:** Crest and interior area – Northern Ash Area, north dike.


**Photograph 2:** Crest and interior area – Northern Ash Area, north dike.

**Photograph 3:** Interior drainage swale – Northern Ash Area, north dike.

**Photograph 4:** Interior area, local tree presence – Northern Ash Area, north dike.

**Photograph 5:** Local standing water near old pond discharge – Northern Ash Area.

**Photograph 6:** Exterior slope – Northern Ash Area, west dike. Note vegetation.

**Photograph 7:** Local steep scarp on exterior slope – Northern Ash Area, west dike.

**Photograph 8:** Tree growth on exterior slope – Northern Ash Area, north dike.

**Photograph 9:** Typical bench and tree growth – Northern Ash Area, west end north dike.

**Photograph 10:** Remnants of old pond discharge pipe – Northern Ash Area, east dike.

**Photograph 11:** Local timber restraint at crest level – Northern Ash Area, north dike.

**Photograph 12:** Crest and interior slope – Southern Ash Area, east dike.

**Photograph 13:** Crest and interior slope – Southern Ash Area, south dike.



**Photograph 14:** Crest of west dike, Southern Ash Area.

**Photograph 15:** Interior slope and ash/water channel – Southern Ash Area, east dike.

**Photograph 16:** Interior slope – Southern Ash Area, west dike.

**Photograph 17:** Interior slopes and skimmer, settling basin – Southern Ash Area.

**Photograph 18:** Old beaching erosion on south dike – Southern Ash Area.

**Photograph 19:** Exterior slope and toe wet area – Southern Ash Area, east dike.

**Photograph 20:** Exterior slope and toe road – Southern Ash Area, south dike.

**Photograph 21:** Exterior slope – Southern Ash Area, west dike.



**Photograph 22:** Local wet areas and slight seepage – Southern Ash Area, southeast corner at settling basin dike.

**Photograph23:** Toe of south dike – Southern Ash Area.



**Photograph 24:** Seepage spot on dike toe – Southern Ash Area, south dike.

**Photograph 25:** Sand fill placed on seepage area – Southern Ash Area, south dike.

**Photograph 26:** Toe drain outlet pipe after cleaning – Southern Ash Area, south dike.

**Photograph 27:** Drainage swale along toe or south dike – Southern Ash Area.

**Photograph 28:** Skimmer structure for Southern Ash Area.

**Photograph 29:** Discharge pipe outlet from Settling Basin – Southern Ash Area.

**Photograph 30:** Outflow channel toward Cooling Lake – Southern Ash Area.

MACTEC

engineering and constructing a better tomorrow

May 5, 2009

Mr. Bill Forster
Progress Energy
7001 Pinecrest Road
Raleigh, North Carolina 27613

**Subject: REPORT OF 2009 LIMITED (ANNUAL) FIELD INSPECTION
ASH POND
WEATHERSPOON PLANT
ROBESON COUNTY, NORTH CAROLINA
MACTEC PROJECT 6468-09-2351 (04)**

Dear Mr. Forster:

On March 10, 2009, Mr. Al Tice and James Schiff of MACTEC Engineering and Consulting, Inc. (MACTEC) visited the Weatherspoon Plant to perform a limited (annual) field inspection of the Ash Pond Dikes. The inspection was coordinated in the field by Mr. Bill Forster representing Progress Energy. Mr. Larry Baxley, plant environmental coordinator and Mr. Matt Suskie, who is monitoring the present work in the ash pond, accompanied Mr. Tice and Mr. Schiff on the inspection. Prior to the inspection, we reviewed the 2008 Limited Field Inspection report to confirm observations from previous inspections. The last 5-year independent consultant inspection was performed in 2005 and the next will be next year (2010).

The field inspection included a discussion of activities since the last inspection, review of available records and a driving/walking reconnaissance tour of the dikes. The weather conditions during the inspection were clear, and slightly windy. No rainfall had fallen within 24 hours prior to the inspection. This letter summarizes the observations made during the inspection and provides our recommendations for any follow-up actions. We have also included a discussion on the design and construction history of the dikes. Exhibits (Appendix B) showing the location and construction documents are attached. A photograph location map is in Appendix B. Photographs of selected conditions are included in Appendix C. Appendix D includes the summary sheet for the updated dam assessment forms. Appendix E contains a summary of the ash pond dike design information.

The active ash ponds are inspected on a 5-year basis in compliance with the agreement between Progress Energy and the North Carolina Utilities Commission. The last 5-year independent consultant inspection was performed by MACTEC in 2006 and the next will be in 2011. In addition to the 5-year inspections, Progress Energy inspects the ash ponds regularly with plant personnel. MACTEC conducts an annual site visit for inspection to check on activities in response to previous report recommendations and check for changes in conditions that would require additional study or remediation activities.

## SUMMARY

This report presents the results of a limited field inspection of the Ash Pond Dikes near the Progress Energy Weatherspoon Plant in Robeson County, North Carolina. The last inspection report of the Ash Pond was completed in 2005, and the next will be in 2010.

Based on the current inspection, there is no significant change in the condition of the Ash Pond dikes from the 2008 limited (annual) inspection. Overall, the ash pond dikes and appurtenant structures are judged to maintain in satisfactory manner. The structures have performed well and based on observations, they do not exhibit significant safety concerns. There had been some cutting of heavy brush growth on the interior and exterior slopes that made our dam inspection easier. Seepage along the south dike (southeast and south west) continues to be observed during routine inspections by plant personnel.

The status for addressing previous recommendations is reported under Field Observations.

## RECORDS

There is no permanent instrumentation in the Ash Pond dikes. Several temporary casings for checking water levels were installed in the exterior slope of the Ash Pond south dike in 1993 as part of a stability study. While these casings are still in place, they are in a deteriorated condition and are not suitable for accurate water level measurements.

It was confirmed during the site visit that plant personnel are continuing to provide adequate routine surveillance (weekly) of the dikes and are maintaining appropriate records for their inspection activities. Lab personnel currently are assigned responsibility for performing routine inspections. Weekly inspections are performed for the Ash Pond dikes by lab personnel. NPDES logs were reviewed to confirm plant inspection activities. The plant is currently utilizing existing piezometers installed at the Ash Pond for groundwater monitoring (started December, 2006).

## ASH POND DESCRIPTION

The Weatherspoon Steam Electric Plant, originally called the Lumberton Steam Electric Station, is located on the east bank of the Lumber River about one mile southeast of Lumberton, North Carolina. Approximated latitude and longitude of the pond are N34°35'25", W78°58'06". Access is by means of old U.S. Highway 74 and the Progress Energy Carolina entrance road there from. Exhibits 1 show the plant location. Exhibit 2 shows the ash pond relative to the plant.

The ash pond covered by this inspection was constructed in 1979 by extending dikes south of the previous ash ponds as shown on Exhibit 3 (CP&L Drawing No. RCD-1280). Design was done by Progress Energy (then known as CP&L) personal and construction was done under CP&L supervision. Subsurface conditions were explored with 25 borings.

Exhibit 4 (CP&L Drawing No. RCD-1281) contains cross sections of the dikes. The crest of the dikes is at Elevation 145 feet, the crest width is 12 feet, the inside slope is 2 (horizontal): 1 (vertical) and the outside slope is 2.5 (horizontal): 1 (vertical). A berm, 10 feet wide, was provided on the outside slope of the south dike at Elevation 123 feet. The maximum height of the dikes is about 28 feet. The maximum operating pond level is Elevation 143.0 feet. The soils used in dike construction were specified to contain 10 percent or greater material passing the No. 200 sieve and to be compacted to at least 95 percent of the standard Proctor maximum dry density. Construction was inspected by representatives of Progress Energy.

Over time, as ash began to fill the pond, a dry-stacking area was developed on the north portion of the pond (the original ash pond) where previously deposited ash had drained and dried to a stable surface. Several episodes of removal of ash from the active pond and transporting it to the stacking area have occurred. Currently, ash is being removed from the area and transported to a cement plant for commercial use in cement production. Exhibit 5 shows the approximate area of the ash stacking and the active pond based on a survey in 2004.

To obtain additional ash storage capacity, Progress Energy has used fiber bags (tradename Geotubes) to build internal containment capability within the northern area of ash stacking. Also, internal dikes constructed of ash were built in the north end of the active ash pond in 2007 to allow additional storage. These features are not included in the inspection of the ash pond dikes.

Based on the height of the ash pond dikes and the ash pond storage capacity, the ash pond dikes are classified as "small" in accordance with the COE guidelines and "small" in accordance with the North Carolina Dam Safety Guidelines. The area downstream of the ash pond is undeveloped agricultural land, woods, and the Cooling Pond. Failure of the ash pond would not endanger lives or cause severe damage to the downstream facilities. Ash released from the pond in the event of a failure could ultimately reach the Lumber River and expose Progress Energy to a Notice of Violation of their plant NPDES permit. Considering the extent of damage that would result from failure, a hazard classification of "low" using the COE categories has been used in all prior inspections. A review of the present conditions below the ash pond did not reveal any new development that would warrant a change of this hazard classification.

Further details about the dike design and construction are contained in the Historical Volume issued in 1995 as part of that 5-year Independent Consultant Inspection.

## FIELD OBSERVATIONS

The entire length of the dike crest for the active ash pond was checked by a driving/walking tour during the current inspection. The water level in the pond at the time of our visit was about four feet below the crest of the dikes. Much of the pond area is filled with sedimented ash which has developed a thick reed growth. As shown on Exhibit 5, there is only a small portion of the pond that contains water. Observations of the crest, slopes and structures are presented below. Photographs are in Appendix C.

<u>Crest:</u> The crest is in good condition with no indications of unusual settlement, rutting or cracks (Photographs 1, 2 and 3). The separating dike between the main ash pond and the secondary settling pond did not show indications of settlement in the area over the pipe connecting the main pond riser to the secondary settling pond riser. This area had been excavated to repair a leaking joint several years ago and then backfilled with compacted soil.

<u>Interior Slopes:</u> The interior slopes are in good condition (Photographs 3, 4 and 5). Primary attention was given to the slopes in the portion of the pond where water is impounded. Past inspections have reported that minor beaching erosion has occurred at the waterline along the east dike, on the pond side of the separator dike, and on the south dike. The worst areas, along the south

dike, have largely been submerged by sedimented ash. Reed growth has aided in minimizing expansion of the erosion, and the areas appear similar to previous recent inspections. Reeds and brush had recently been cut on these slopes. Reed growth in the sedimented ash has not been cut, and it does not need cutting.

Exterior Slopes: The exterior slopes are in good condition, and the vegetation is reasonably well maintained (Photographs 6 through 10). There are no indications of surface erosion. Vegetation on the west dike slope is thicker and is not mowed as often as the other two dikes because there is only sedimented ash against this dike. We recommend that the west dike vegetation be mowed before the next 5-year inspection scheduled for 2010. Grass along the base of the east and south dikes had been cut recently. Due to some soft and wet areas along the base of both slopes, the mowing equipment created several rutted areas that need to be filled in (Photographs 10 and 11). Standing water was observed in several of the rutted areas.

The eastern dike exterior slope and area adjacent to the toe has a history of wet ground conditions possibly associated with seepage, although seepage exiting the dike slope as a flow has not been documented. The wet conditions were noted during the current inspection and did not appear to be wetter than seen in the last inspection (Photograph 10). At the wet areas, the lower 10 feet of the slope is wet to damp, but no seepage flow was seen.

Another area with historical wetness is at the southeast corner of the pond (Photograph 12). This area had some minor rutting from the mowing equipment, but otherwise appeared similar to previous inspections.

The exterior slope of the south dike also has a history of wet ground conditions possibly associated with seepage. In 2003, an area of slightly increased wetness and minor seepage was noted in the lower third of the slope, near the middle row of old water level casings. Similar observations of wet conditions and evidence of seepage were made during the current inspection. These areas were small and appeared to be adequately stabilized by vegetation with no signs of significant surface erosion (Photograph 13).

A toe drain along the south dike was installed in 1994 to reduce wet conditions in the toe road. The toe drain is provided with outlet pipes to discharge flow into the drainage ditch along the adjacent access road. The vegetation around the drain pipes and in the drainage ditch had recently been cut. The outlets are well maintained, with signs that sediment accumulations are being removed. Flow from the drain outlets was slight, ranging from a trickle to about ½ gpm (Photograph 14).

Structures: The skimmer structures on the vertical risers in the ash pond and in the secondary settling basin appeared to be in good condition (Photographs 15 and 16). The discharge pipe from the secondary settling basin was free flowing with no visible underseepage (Photograph 17). The flow from the discharge pipe follows a channel that passes under the access road then through a culvert that ultimately discharges into the Cooling Lake. The discharge channel appears to be free flowing with minor vegetation (Photograph 18). The vegetation is maintained on a regular basis according to Progress Energy plant personnel.

For the Ash Pond dike, the status for addressing previous recommendations dating from the 2005 (5-year) inspection report is as follows:

Ash Pond Dike Recommendations – Current Status

| Ref No. | Recommendations | Recommended Time for Implementation | Current Status |
|---|---|---|---|
| AP-2005-1 | The eroded spots on the interior of the south dike and the separator dike should be watched for signs of enlargement. | Routine inspection and maintenance. | On-going |
| AP-2005-2 | The outlet of the collector ditch for the south dike toe drain should be cleared of sediment and vegetation that reduces free flow of water out of the collector ditch. | Routine maintenance. | Completed |
| AP-2005-3 & 2006-1 | Local seepage on the south dike slope and at the toe of the east dike and the southeast corner of the pond should be observed during the normal monthly inspections for change in volume of flow or appearance of soil fines in the seepage. | Routine (monthly) inspection. | On-going |
| AP-2007-1 | Provide a review of the seepage and stability conditions along the toe of the Ash Pond dikes in conjunction with engineering for the next lift or phase of Ash Pond storage capacity additions | Schedule for design of next lift has not been established. | Progress Energy to confirm schedule. |
| AP-2007-2 | The plant should monitor shallow holes in the exterior slope of the "geotube" containment dikes. May be related to animal burrows. Evaluate this condition during the next annual inspection. | Routine monitoring by plant and engineering evaluation during 2008 annual inspection. | No change observed for the 2008 inspection or the present inspection. |

MACTEC is pleased to continue assisting Progress Energy with inspections of the dams at the Weatherspoon Plant. Please contact us if you have any questions about this report.

Sincerely,

**MACTEC ENGINEERING AND CONSULTING, INC.**

James A. Schiff
Project Professional

J. Allan Tice, P.E.
Senior Principal Engineer
Registered, North Carolina 6468

NORTH CAROLINA PROFESSIONAL SEAL 6428 ENGINEER ALLAN TICE

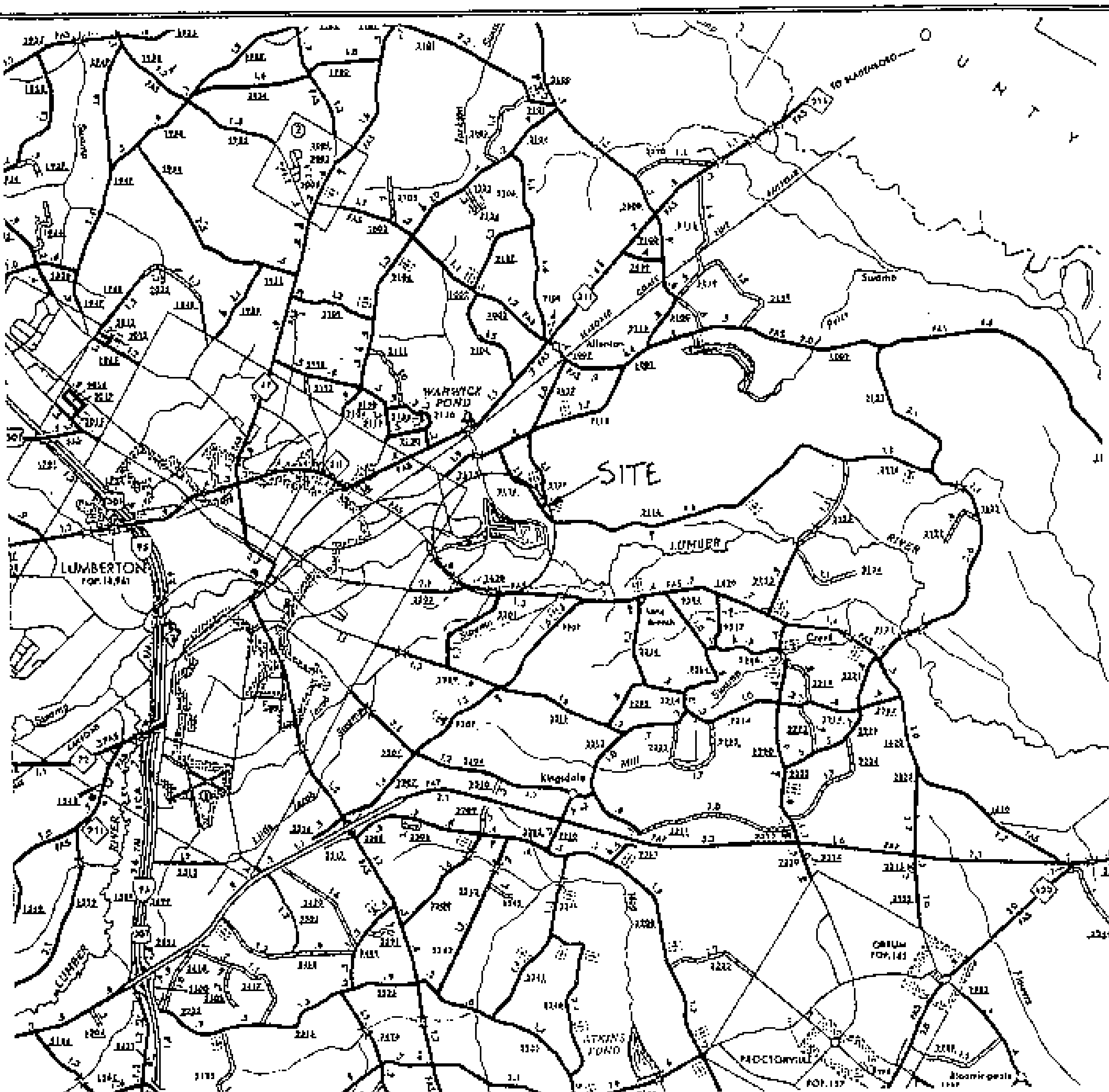
JAS/JAT/jas

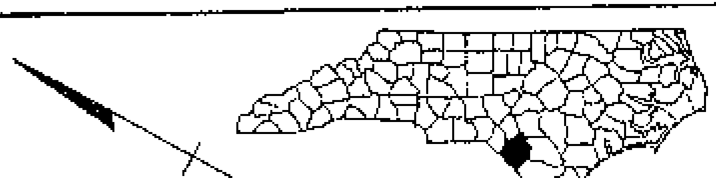
cc: Larry Baxley w/att

Attachments: Appendix A- Exhibits
Appendix B - Photograph Location Plan (Drawing 1)
Appendix C - Photographs
Appendix D - Dam Assessment Forms Summary Sheet
Appendix E – Dam Information Summary Sheets

# APPENDIX A

# EXHIBITS



G:\DEPT\GEOTECH\30720\FORMS\SITEMAP.XLS

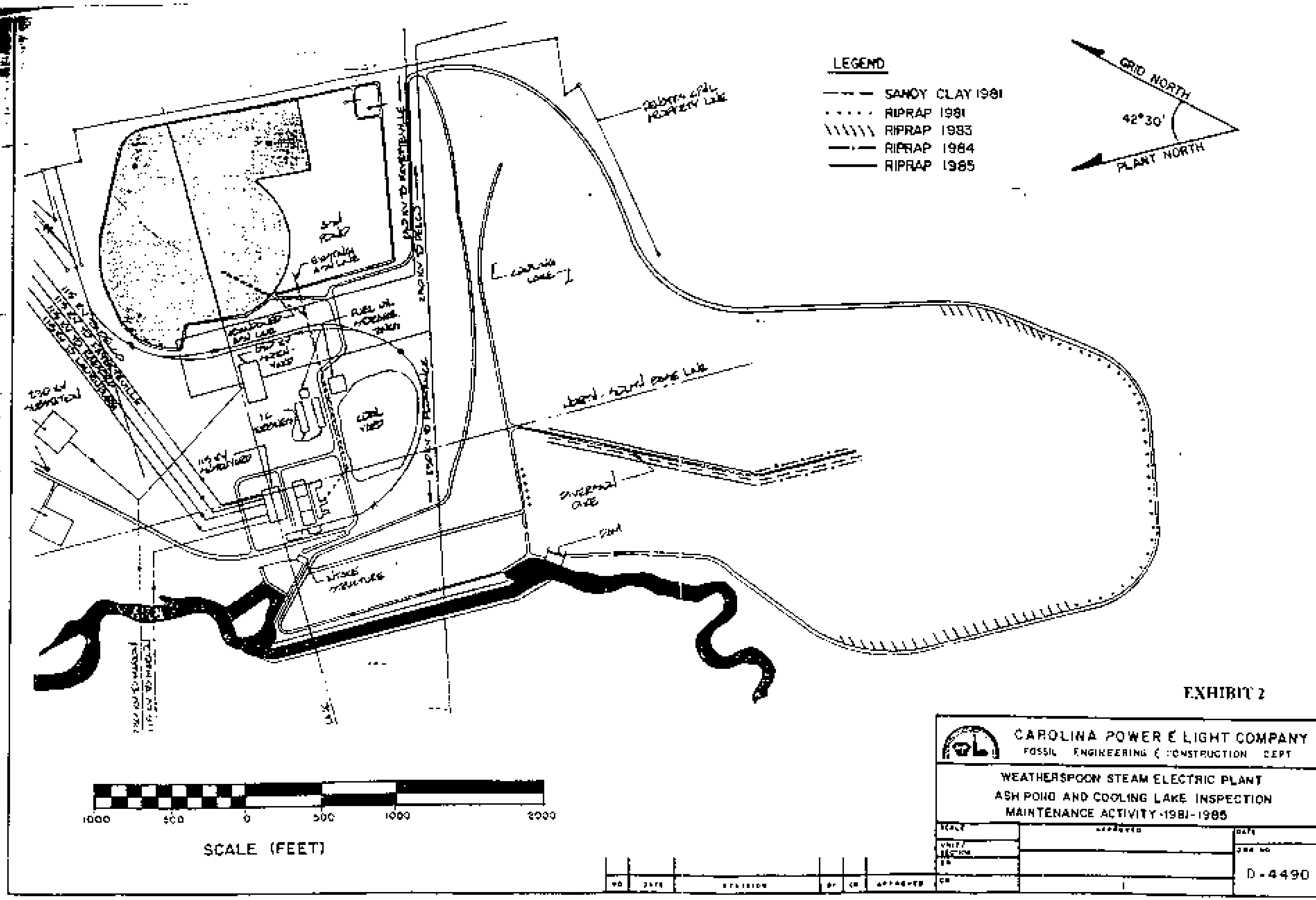
MACTEC

RALEIGH, NORTH CAROLINA

SITE LOCATION MAP
W. H. WEATHERSPOON STEAM ELECTRIC PLANT
LUMBERTON, NORTH CAROLINA

| | | | |
|---|---|---|---|
| DRAWN: | | DATE: | Dec. 05 |
| DFT CHECK: | | SCALE: | 1" ~ 2 mi |
| ENG CHECK: | | JOB: | 6465-05-0993 |
| APPROVAL: | | DWG: | EXHIBIT 1 |

REFERENCE: NCDOT Robeson County Road Map



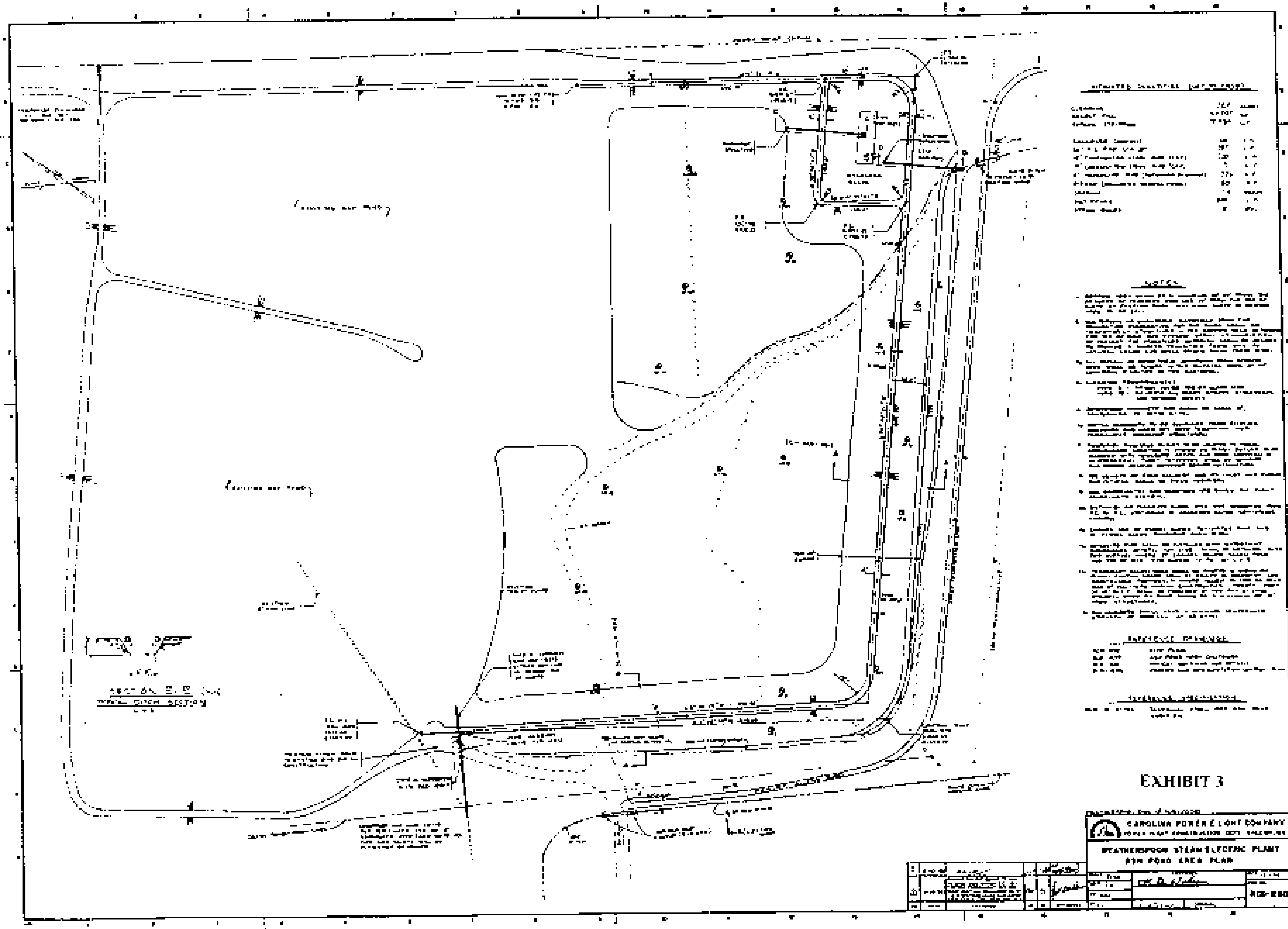
LEGEND
SANDY CLAY 1981
RIPRAP 1981
RIPRAP 1983
RIPRAP 1984
RIPRAP 1985
GRID NORTH
42°30'
PLANT NORTH
SCALE (FEET)
1000
500
0
500
1000
2000
CAROLINA POWER & LIGHT COMPANY
FOSSIL ENGINEERING & CONSTRUCTION DEPT
WEATHERSPOON STEAM ELECTRIC PLANT
ASH POND AND COOLING LAKE INSPECTION
MAINTENANCE ACTIVITY 1981-1985
D-4490


EXHIBIT 2

7030-00010

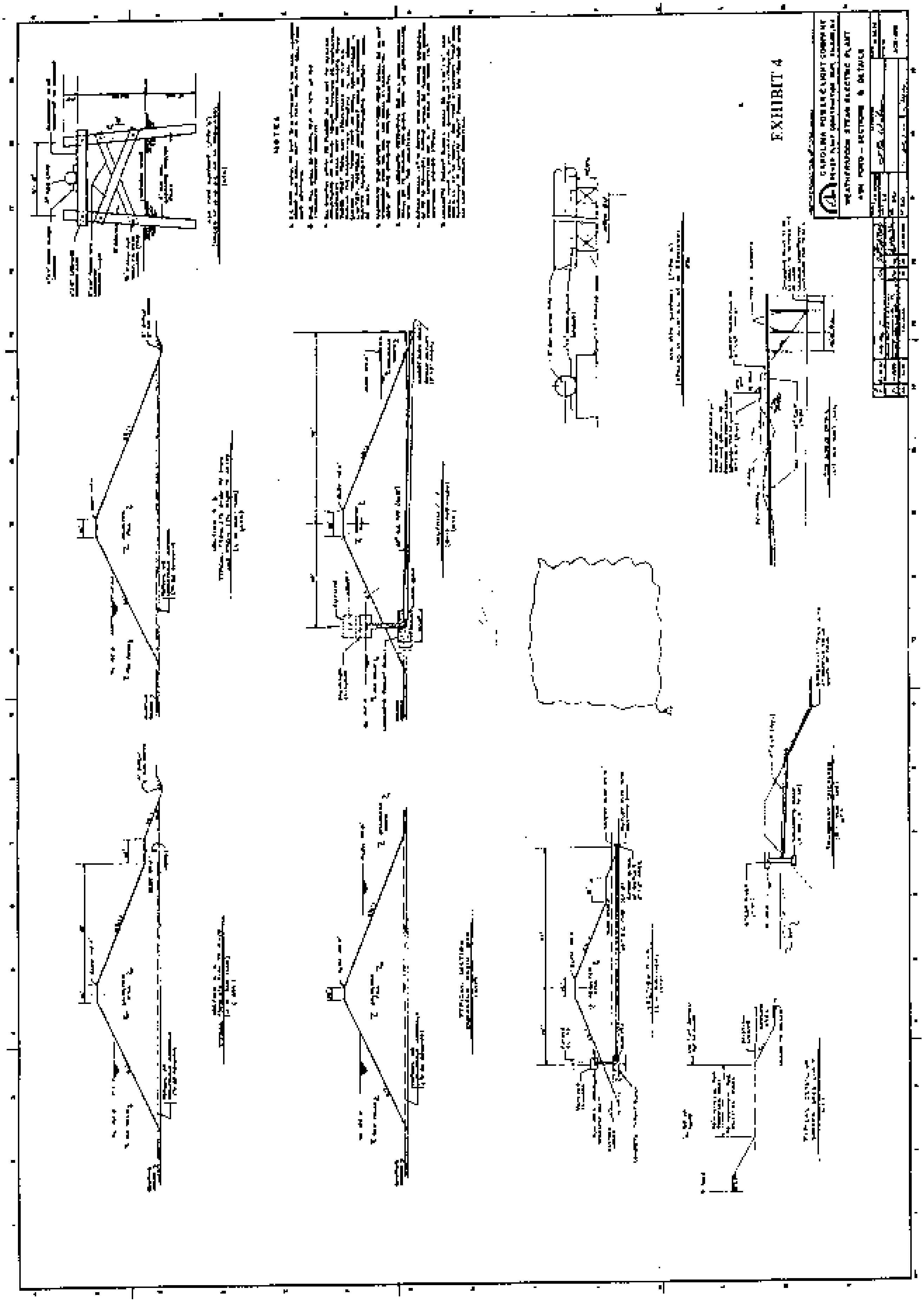
RCD-1280

RCD-1280



ZBD-00011
RCD-1281

RCD 1281



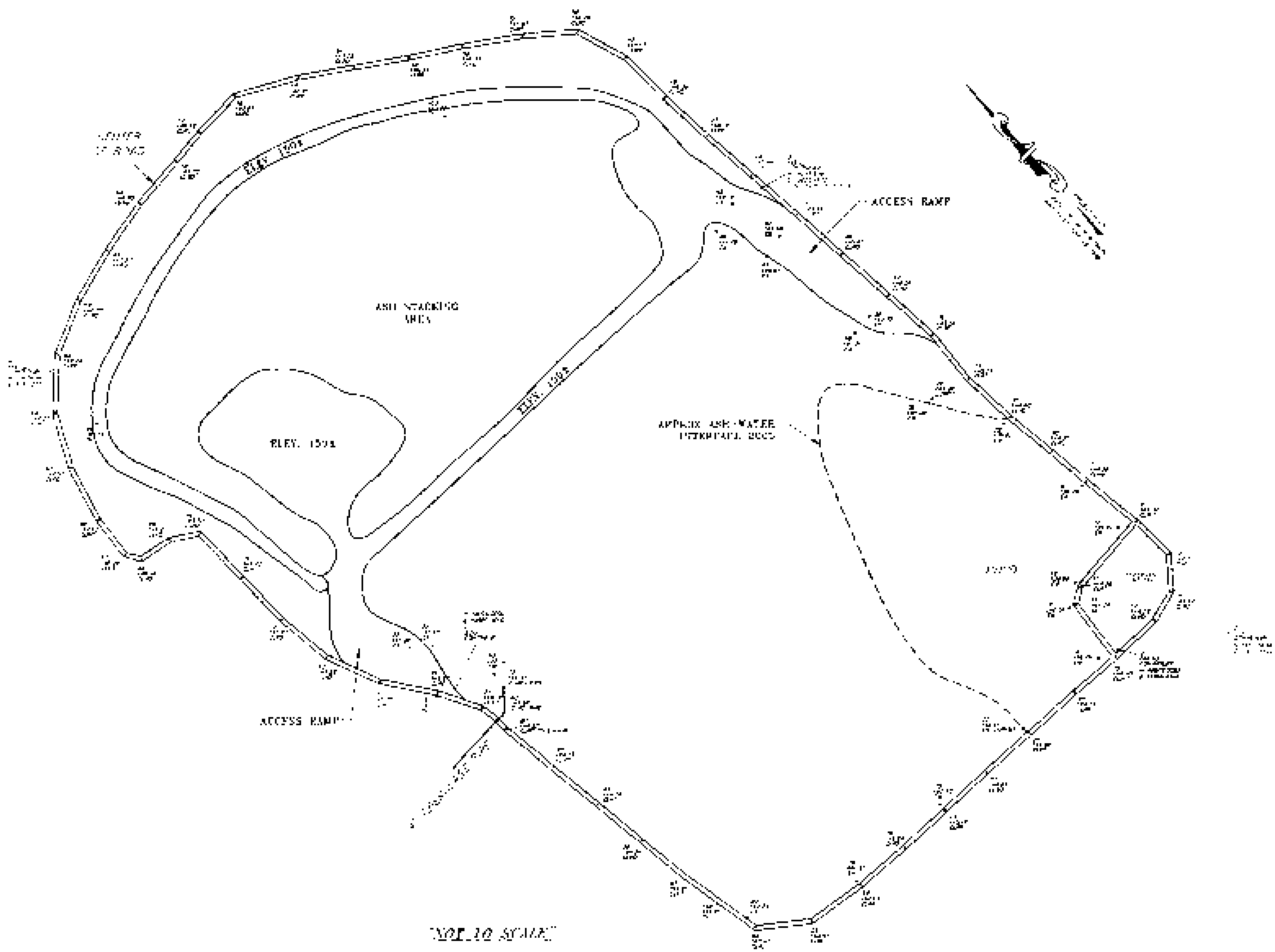
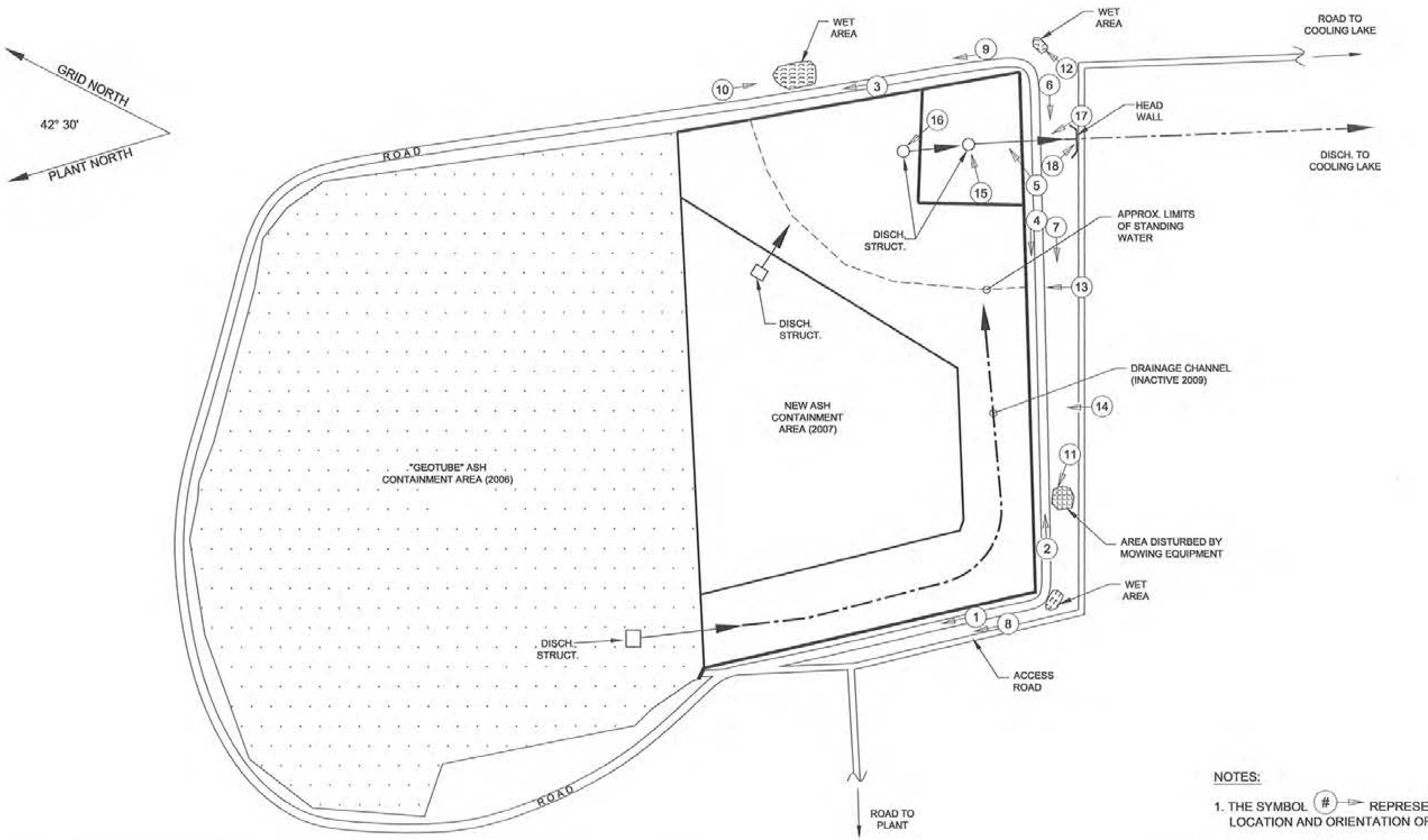



*EXHIBIT 5*

ADAPTED FROM SURVEY BY SMITH AND SMITH DATED
JUNE 29 2001 AND MACTEC FILE DRAWINGS

**APPENDIX B**

PHOTOGRAPH LOCATION PLAN **(Drawing 1)**




NOTES:

1. THE SYMBOL (#) ⊳ REPRESENTS THE APPROX. LOCATION AND ORIENTATION OF THE PHOTOGRAPH.

2. ALL PHOTOGRAPHS TAKEN MARCH 10, 2009.

P:\6468\Progress Energy\CP&L Projects 09\6468092351 Dam Inspections 2009\Drawings\Weatherspoon\Photo location map AP 2009.dwg Tue, 05 May 2009 - 9:37am rrohle

| MACTEC<br>MACTEC ENGINEERING AND CONSULTING, INC.<br>3301 ATLANTIC AVENUE RALEIGH, NORTH CAROLINA | PHOTOGRAPH LOCATION MAP<br>ASH POND INSPECTION<br>WEATHERSPOON STEAM ELECTRIC PLANT | DRAWN: R.R. | DATE: MAY 2009 | DRAWING<br>1 |
|---|---|---|---|---|
| | | DFT CHECK: JAJ | SCALE: N.T.S. | |
| | | APPROVAL: JAJ | JOB: 6468-09-2351.04 | |

REFERENCE: CP&L DRAWING D-4491, UNDATED.

# APPENDIX C

# PHOTOGRAPHS

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


1. Ash Pond – Crest-West Dike looking North


2. Ash Pond – Crest and exterior slope -South Dike looking East

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


3. Ash Pond – Crest and interior slope -East Dike looking North


4. Ash Pond – Interior slope-South Dike looking West

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


5. Ash Pond - Interior slope secondary settling pond dike


6. Ash Pond – Exterior slope, berm and drainage ditch – South Dike


7. Ash Pond – South Dike-Exterior slope looking West


8. Ash Pond – West Dike-Exterior slope looking North

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


9. Ash Pond – East Dike-Exterior Slope looking North from south end


10. Ash Pond – East Dike looking south-Wet area at toe of slope

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


11. Ash Pond – South Dike-West end with ruts from mowing


12. Ash Pond – Southeast corner-wet area (normally seen)


13. Ash Pond – Localized seep on south slope dike


14. Ash Pond – South Dike-outlet from toe drain (typical)

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


15. Ash Pond – Secondary Settlement Pond Skimmer on Riser


16. Ash Pond –Main Pond Skimmer on Riser

**Appendix A – Photographs**
**Ash Pond-2009 Weatherspoon Limited (Annual) Dam Inspection**


17. Ash Pond – Discharge from secondary settling basin


18. Ash Pond – Headwall for drainage pipe leading to cooling pond.

# APPENDIX D

# SUMMARY OF DAM ASSESSMENT FORMS

**FOSSIL GENERATION ASH POND DAM ASSESSMENT FORM**

Last Revised: 04/27/09

PLANT & UNIT: Weatherspoon Ash Pond

ASH POND:

VENDOR: MACTEC Engineering and Consulting, Inc.

OTHER INFORMATION:

Comments: Based on site visit March 10, 2009 and previous dam inspections

Prepared by MACTEC Engineering and Consulting (James Schiff and J. A. Tice)

| CONCRETE STRUCTURES | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| CONCRETE SURFACES | | | | NA |
| STRUCTURAL CRACKING | | | | NA |
| MOVEMENT | | | | NA |
| JUNCTIONS | | | | NA |
| DRAINS | | | | NA |
| WATER PASSAGES | | | | NA |
| SEEPAGE | | | | NA |
| JOINTS | | | | NA |
| FOUNDATION | | | | NA |
| ABUTMENTS | | | | NA |

| EMBANKEMENT STRUCTURES | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| SETTLEMENT | | | ■ (green) | |
| SLOPE STABLITY | | | ■ (green) | |
| SEEPAGE | | ■ (yellow) | | Evaluate south dike seepage |
| DRAINAGE SYSTEM | | | ■ (green) | |
| SLOPE PROTECTION | | | ■ (green) | |

| SPILLWAY STRUCTURES | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| CONTOL GATES | | | | NA |
| UNLINED SPILLWAYS | | | | NA |
| APPROACH CHANNEL | | | | NA |
| OUTLET CHANNEL | | | | NA |
| STILLING BASIN | | | | NA |

| OUTLET WORKS | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| INTAKE STRUCTURE | | | ■ (green) | |
| GATES | | | | NA |
| SLUICES/WATER PASSAGES | | | ■ (green) | |
| STILLING BASIN | | | | NA |
| APPROACH CHANNEL | | | | NA |
| OUTLET CHANNEL | | | ■ (green) | |
| DRAWDOWN FACILITIES | | | | NA |

| SAFETY/PERFORMANCE INSTRUMENTATION | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| HEADWATER/TAILWATER GAGES | | | | NA |
| ALIGNMENT INSTRUMENTATION | | | | NA |
| MOVEMENT INSTRUMENTATION | | | | NA |
| UPLIFT INSTRUMENTATION | | | | NA |
| DRAINAGE INSTRUMENTATION | | | ■ (green) | |
| SEISMIC INSTRUMENTATION | | | | NA |

| RESERVOIR | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| SHORE LINE | | | | NA |
| SEDIMENTATION | | | | NA |
| HAZARD AREAS | | | | NA |
| WATERSHED RUNOFF | | | | NA |

| OPS & MAINT FEATURES | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| RESERVOIR REG. PLAN | | | | NA |
| MAINTENANCE | | | | NA |

| DOWNSTREAM CHANNEL | RED | YEL | GRN | Date Revised: 04/27/09 Initials: JAS |
|---|---|---|---|---|
| DOWNSTREAM CHANNEL | | | | NA |

# APPENDIX E

# DAM INFORMATION SUMMARY

**DAM INFORMATION SUMMARY**
**Weatherspoon Steam Electric Plant**
**Ash Pond**
**Robeson County, North Carolina**

## 1. Location

Located on east bank of Lumber River about one mile southeast of Lumberton

| | |
|---|---|
| Latitude: | N34°58' |
| Longitude: | W78°35' |

## 2. Size and Dimensions

| | |
|---|---|
| Length: | 2,700 feet |
| Maximum Structural Height: | 28 feet |
| Storage capacity: | 240 acre feet |
| Dam Rating: | 2,020 acre feet |
| Size Classification: | Small |
| Hazard Classification: | Low |
| Regulatory Design Storm | 50 yr to 100 yr* |
| US Slope: | 2.0(H):1(V) |
| DS Slope: | 2.5(H):1(V) |
| Crest Width: | 12 feet |
| Crest Elevation: | 145.0 feet |
| Berm (South Dike): | 10 feet wide at el. 123 feet |
| Maximum Pool Elevation: | 143.0 feet |
| Current Operating Level: | 141.5 feet |
| Instrumentation | None |

* Design is based on 100-yr storm of 6.3 inches over 6 hours.

## 3. Geology and Seismicity

Located in Black Creek Formation of Coastal Plain,

Near Zone 1 and 2 boundary seismic zone according to Corps of Engineers with Design Earthquake: $a_h$ = 0.05 to 0.1 g

## 4. Design Information

The present dike is a vertical extension of a previous dike. The extension was designed by CP&L. A subsurface exploration was performed. No stability or seepage analysis was performed for the design. A stability analysis was done by LAW in 1993 with acceptable results (FS = 1.4). No seepage analysis was done. No internal drainage was in the design.

The outlet works consist of a 24-inch reinforced concrete pipe (RCP) vertical riser connected to a 24-inch RCP extending through the dike to a secondary settling basin. A similar riser and pipe combination discharges beyond the secondary settling basin dike into a channel leading to the Cooling Lake. Neither of the pipes has seepage collars.

Hydrologic evaluation has been conducted to show that the design freeboard and outlet works can safely store and pass a 100-yr storm.

**5. Construction History**

**1979:** New dam constructed by C. M. Lindsay under CP&L direction. Testing was conducted.
**1990:** Placed concrete plug above discharge pipe to reduce seepage
**1993:** Installed trench drain along berm parallel to the dike with outlet pipes extended to the adjacent ditch to lower water level on south dike.
**1994:** Exterior slope along south dike experienced surface erosion due to 4-wheel traffic and horses. Repaired by placing woven plastic bags filled with a mixture of cement, blasting sand and Blastox.
**2004:** Riser height increased to 141.5.
**2006 - 2007:** New containment area was placed in service within the 2001-2002 dry stack area. The new containment area was created using geo-tubes and was constructed by Trans-Ash. New containment area within the existing ash pond area completed. Design by MACTEC.

**6. Inspection History**

The dam is inspected on 5-year intervals. Since 2002, yearly site visits have been made for limited visual observations.

| | |
|---|---|
| Ralph Fadum: | 1985 |
| LAW/MACTEC: | 1990, 1995, 1997, 2000, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009 |

**7. Current Issues**

During 2009, a limited field inspection was performed by MACTEC, with current issues and recommendations reported as follows:

- Monitor areas of erosion on interior of south dike
- Continue maintenance to keep the toe drain outlet channel clear of sediment and vegetation on south dike
- Perform engineering evaluation of seepage conditions on south dike slope, at toe of east dike and at southeast corner of the pond in conjunction with design for next lift of interior storage area.

**8. Overall Summary**

The 2009 inspection report indicates that there is no significant change in the condition of the Ash Pond from the 2005 five-year inspection or the 2008 limited field inspection.

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engineering and constructing a better tomorrow

# DAM BREACH ANALYSES AND INUNDATION MAP DEVELOPMENT

**for**

**Ash Pond Dam**

**at**

**Progress Energy Weatherspoon Plant**
**Robeson County, North Carolina**

**Prepared for**
**Progress Energy**

Prepared by

MACTEC Engineering and Consulting, Inc.

Project 6468-10-0187

November 1, 2010



Stephen J. Hanks
Project Engineer

D. Wayne Ingram
Principal Engineer

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**Appendix**

## 1.0 Executive Summary

The Progress Energy Weatherspoon Plant Ash Pond is a storage area for coal combustion byproducts. The Ash Pond Dam is an approximately 28-foot high earthen dam. The impoundment has a normal surface area of approximately 48 acres and a maximum storage capacity of approximately 728 acre-feet. This report summarizes the dam breach and breach inundation analyses completed for the Weatherspoon Ash Pond Dam. The analyses were completed for a wet weather failure and a dry weather failure. The breach flood wave was routed along an on-site discharge canal to the Lumber River. The breach flood wave was routed through the floodplain using Hydrologic Engineering Center – River Analysis System (HEC-RAS) version 4.1 (US Army Corps of Engineers, 2010).

These analyses are intended to be conservative, using worst case assumptions related to failure events, for use in an Emergency Action Plan for the facility. Data for the hydraulic analyses were obtained from readily available information. The HEC-RAS model developed by the Federal Emergency Management Agency (FEMA) for the preparation of the Robeson County Flood Insurance Study was used to analyze the resulting inundation extent of the breach wave.

Available information indicates that the constructed top width of the embankment is 12 feet and the crest elevation is 145.0 feet National Geodetic Vertical Datum of 1929 (NGVD 1929). The design side slopes were estimated to be 2.5 foot horizontal to 1 foot vertical (2.5H:1V) on the exterior and 2H:1V on the interior. The maximum height of the dam is 28 feet from crest low point to the downstream toe at an existing ditch. The hydrologic design criterion for the storage area is the ability to safely pass one half of the probable maximum precipitation (PMP).

The routing of the flood wave was accomplished using HEC-RAS. The breach discharge was routed along a discharge canal to the Lumber River. Most of the flood wave is dispersed along the route of the discharge canal before it arrives in the river as represented in the model.

The breach parameters were developed pursuant to the empirical equations presented by Froehlich (1995) following the evaluation of 63 dam breaches. The breach width estimates were based on a storage volume equal to 60 percent of the total capacity of the impoundment. The bottom width of a trapezoidal-shaped breach was estimated to be approximately 17 feet. The bottom elevation of the breach was assumed to be at 130 feet NGVD. Breach section side slopes of 1H:1V were chosen as they represent the upper limit of the typical range of values. The breach development time was estimated to be 0.6 hour.

A breach scenario into the Weatherspoon Cooling Pond was also considered as part of the inundation study. The maximum storage capacity of the Weatherspoon Ash Pond was evaluated against the available storage capacity of the Cooling Pond. The evaluation considered the inundation impact on the Cooling Pond in the event of a breach of the Ash Pond.

The breach analyses indicate that the breach of the Weatherspoon Ash Pond into the discharge canal is not likely to cause a water level increase of greater than 1 foot by in the Lumber River within the extent of analyses. The majority of flood attenuation occurs along the on-site discharge canal with controlled access. Therefore it is apparent that a breach of the Ash Pond will not pose a significant risk to public safety.

Additionally, a breach of Ash Pond to the Cooling Pond will result in an increase storage volume with the Cooling Pond. However, at the current operating conditions, the Cooling Pond has sufficient capacity to store the breach from the Ash Pond.

## 2.0 Introduction

This report summarizes dam breach analyses completed for the Ash Pond at the Progress Energy Weatherspoon Plant to determine the extent of the inundation resulting from a dam breach. Analyses were completed using HEC-RAS, version 4.1 (US Army Corps of Engineers, 2010). Basic pertinent information regarding the impoundment and dam is summarized in Table 1.

**Table 1.** Weatherspoon Ash Pond Structure Information

| | |
|---|---|
| Impoundment Name | Weatherspoon Ash Pond |
| State Dam ID No | Not assigned |
| Current Size Classification | Small |
| Current Hazard Classification | Intermediate |
| Location | Latitude: 34.590° Longitude: -78.967° |
| County | Robeson |
| Receiving Stream(s) | Lumber River |
| Impoundment Area | 48 acres |
| Maximum Dam Height | 28 feet (117 ft to 145 ft) |
| Normal Water Elevation | 143 feet NGVD |
| Maximum Depth | 15 feet |
| Maximum Hydraulic Storage Volume | 728 acre-feet (as designed) (1,284,000 cubic yards) |
| Material(s) Stored | Coal combustion product |
| Storage status | Unknown |
| Principal Spillway | Riser/Barrel |
| Emergency Spillway | N/A |
| Dam Minimum Section | Top width: 12 feet, Interior Slope: 2H:1V, Exterior Slope: 2.5H:1V |
| Embankment Materials | Earthen |

## 3.0 Description of Facilities and Potentially Impacted Area

### 3.1 General

The Ash Pond Dam is used for storage of coal combustion byproducts produced at the Weatherspoon Plant. The reservoir has a designed storage capacity of 728 acre-feet (AF) below the embankment crest elevation of 145 feet NGVD. Information describing the characteristics of the impoundment, spillway facilities and maximum dam section are provided in Table 1.

The breach flood wave was routed through an approximately 7500-ft long canal to the Lumber River channel. There are no existing bridges or other structures along the drainage course that might be damaged by the breach. The analyses included an assessment of the sensitivity of the model predictions to various breach parameters and flowable impoundment storage volumes.

Other potential Ash Pond dam breach locations were considered. However, it was determined that other potential locations would drain through the Weatherspoon Plant area and into the Weatherspoon cooling reservoir which would accommodate the breach without significant rise in water level. Consequently, the single breach location leading to the Lumber through the canal was analyzed. The canal is located on the Weatherspoon Plant facility.

Based on available information there appears to be few, if any, inhabited structures along the floodplain of the Lumber River in the vicinity of the Weatherspoon Plant. The nearest bridges to the Weatherspoon Ash Pond are South Roberts Avenue (Route 72) upstream and Matthews Bluff Road (County Road 2123) downstream. Neither bridge will be adversely impacted as a result of a dam breach because the flood wave is attenuated along the drainage canal. By the time the flood wave reaches the Lumber River, impacts are minimal and contained within the river banks.

3.2 Impoundment and Embankment Characteristics

The impoundment and embankment characteristics were based on information in a 2005 report prepared by MACTEC. The elevation – volume curve for the Ash Pond is presented in Figure 1.

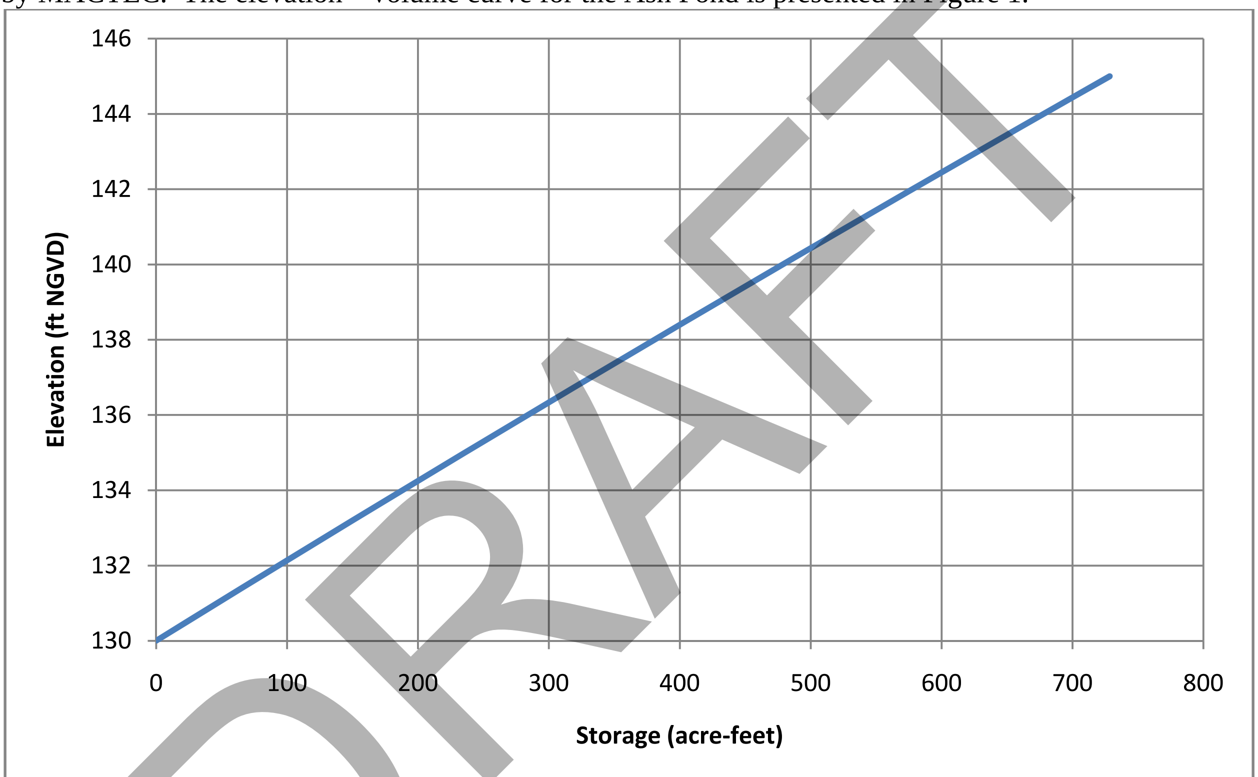


**Figure 1.** Weatherspoon Ash Pond Elevation – Storage Volume Curve

The design top width of the embankment is 12 feet. The design side slopes are 2H:1V on the interior and 2.5H:1V the exterior. The dam crest is approximately 28 feet above surrounding grade. Excess water in the reservoir is discharged into a ditch leading to the Lumber River through a riser and barrel spillway with an overflow elevation of 143.0 ft NGVD. The hydrologic design criterion for the storage area is the ability to safely pass one half of the PMP. There is no drainage area to the Ash Pond except with the Ash Pond dike.

## 4.0 Scope of Investigation

This report summarizes the results of analyses completed to determine the extent of the inundation resulting from a breach of the Ash Pond dam. The analyses extended as far downstream from the impoundment structure in question as significant impacts of a reasonable worst case scenario were determined to propagate. The extent of significant impacts was a site-specific determination, considering factors such as:

- sensitivity of impacted features to high water level (human safety, property damage, emergency services demands, transportation systems, etc.), and
- maximum water level relative to naturally occurring high water levels and fluctuations from precipitation events.

Assessment of the risk of a dam breach occurrence was not part of this work; nor was detailed investigation of the most probable breach location or breach characteristics such as rate of growth, dimensions, and other information that would require more detailed geotechnical information including site-specific materials investigations, testing and analyses. The detailed considerations and analyses required to develop a quantitative descriptive model of the fluidization of the coal combustion products (CCP) stored in this impoundment, the transport and settlement at downstream locations was also not included in the scope of this investigation. Rather, it was assumed that the volume of fluid discharged as a result of a breach behaves as water, a Newtonian fluid in hydraulics terminology. This is a conservative assumption because entrainment of solids in the fluids discharged would cause increased energy losses in the fluid, resulting in slower velocities, quicker flood wave dissipation due to loss of volume due to solids settling and other fluid mechanics considerations.

Recognizing that conservative assumptions regarding breach formation characteristics, conditions at time of breach, along with an assumption that the entire impoundment volume is water would create an unrealistically conservative prediction, the analyses did include an assumption regarding the fraction of the total impoundment volume that would become fluidized and discharged. Also recognizing that this is an assumption, a sensitivity assessment was completed to characterize resultant critical predictions of water levels and timing as a function of the assumed storage volume fluidized.

Data for hydraulic model development came from readily available sources including the FEMA Flood Insurance Study model, LIDAR data from the NC Floodplain Mapping Program, and USGS gage data.

## 5.0 Summary of Methods and Approach

### 5.1 Hydraulic Analysis

The hydraulic analyses completed for this study were based predominantly on application of the hydraulic model Hydraulic Engineering Center – River Analysis System (HEC-RAS), version 4.1 (USACE HEC, January 2010). HEC-RAS is a general application, one-dimensional model that can perform unsteady flow routing through an open channel system that may also include culverts, bridges, levees, tributaries, storage areas and traversing dams. Unsteady flow analyses deals with flow conditions that vary temporally and spatially.

For this study, the general approach was to define the impoundment as a HEC-RAS storage area and analyze a dam breach using the lateral structure option to model the embankment to be breached. A lateral structure in HEC-RAS is a structure located parallel to the flow direction of the river with flow over the structure being analyzed as a weir; for which a breach scenario can be prescribed. The hydraulic model of the Lumber River developed by FEMA for the Flood Insurance Study of Robeson County was used to analyze the effects to the Lumber River resulting from the breach of the Ash Pond Dam. A reach and storage area representing the canal and ash pond were added to the FIS model.

## 5.2 Boundary Conditions

The inundation resulting from a breach of the embankment was analyzed for two separate weather conditions. For both weather conditions, the boundaries of the Lumber River hydraulic model were described using a constant flow rate at the headwater of the model and a specified stage at the tailwater of the model. The flow and tailwater stage of the Lumber River for a dry weather scenario was determined from the maximum monthly mean discharge for USGS streamflow gauge 02134500 – Lumber River at Boardman (Robeson County). The boundary conditions for the wet weather condition were input as the flow rate and tailwater stage of the Lumber River for a 100-year frequency flood as specified in the Flood Insurance Study for Robeson County.

The initial pool elevation for the dry weather scenario was set to the normal pool elevation of 143 feet NGVD. The initial pool elevation for the wet weather scenario was set to the crest elevation of 145 feet NGVD.

## 5.3 Embankment Breach

The breach parameters were developed pursuant to the empirical equations presented by Froehlich (1995) following the evaluation of 63 dam breaches. The breach width estimates were based on a storage volume equal to 60 percent of the total capacity of the impoundment. It was assumed that 60 percent of the total water and solids volume of the Ash Pond would flow out of the pond. The trapezoidal-shaped breach bottom width was estimated to be 17 feet for the wet weather failure scenario. The breach bottom width was estimated to be 16 feet for the dry weather failure scenario. The bottom elevation of the breach was assumed to be the elevation of the reservoir bottom, which is approximately 130 feet NGVD 1929. Side slopes of 1H:1V were chosen as they represent the upper limit of the typical range of values. The breach development time was estimated at 0.6 hour.

## 5.4 Flood Wave Routing

The routing of the flood wave from the breach location to the Lumber River was accomplished by extracting topographical information from LIDAR elevation data available from the North Carolina Flood Mapping Program (NCFMP). The GIS dataset was converted into a continuous Triangulated Irregular Network (TIN) for the area along the flow paths of the flood wave. The flow path centerline was digitized from the flow lines for the drainage canal inferred from the TIN. The cross section lines were then drawn orthogonal to the inferred direction of flow. The topology of the flow path centerlines and geometry of the cross section lines were extracted from the TIN using HEC-GeoRAS version 4.1.1 (USACE HEC, September 2005). HEC-GeoRAS is an extension of ArcGIS developed by the USACE to perform spatial analysis of TINs, and extract geometric information from the TIN for direct import into a HEC-RAS geometry model. Following the import of the HEC-GeoRAS output file, a storage area element and in-line structure element were incorporated into the model to simulate the impoundment and embankment, respectively. Additionally, the Manning roughness values for the cross sections located along the flow paths were set to 0.12.

Routing of the flood wave through the Lumber River was accomplished with the HEC-RAS model developed by FEMA for the Flood Insurance Study for Robeson County.

## 6.0 Model Stability

Hydraulic models of unsteady flows inherently experience problems with stability of the model calculations. HEC-RAS provides a limited number a means to control instability through input parameter selection and model operation control parameters. The breach model was run for a range of inputs related not only to the breach size and rate of development, but other model inputs as well. Doing so provides for development of a more robust model with regard to stability, as well as providing an assessment of sensitivity of the model to the varied inputs.

To increase the stability of the routing model, a pilot channel was added along the entire breach flow path. Pilot channels are one of the available options to prevent the model from going unstable at low flows (USACE HEC, March 2008). The pilot channels were given a width of 4 feet and a Manning roughness value of 0.2. The high Manning value was chosen to restrict flow through the pilot channel during routing of the flood wave.

## 7.0 Sensitivity Assessment

There are several parameters that can be identified as potentially important to determining the prediction of results of a dam breach. Not all, but most, of these are typically inputs to available dam breach models. These parameters have a significant amount of uncertainty in what a representative value might be. In addition to these normal uncertainties, modeling of discharges from impoundments that contain material such as ash or gypsum that may be fluidized by a breach presents additional uncertainties.

It is unlikely that all the contents of the 15-ft deep, 48-acre impoundment would become fluidized in the event of even an extremely large and rapid embankment breach. To assess the impacts of the assumption regarding the fraction of total volume (solids and pore space water) that would be mobilized, various fractions of the total storage volume were assumed to be discharged. The results of four simulations with various fractions of the total storage volume are presented below. Additionally, model sensitivity to breach bottom width, breach development time, and breach side slopes were evaluated. The results of the sensitivity analysis are presented in Tables 2 and 3.

**Table 2.** Results of Sensitivity Analysis for a Dry Weather Breach

| Modification | Peak Discharge Rate (cubic feet per second) | Peak Tailwater Stage (feet NAVD 1988) |
|---|---|---|
| None | 2,505 | 121.8 |
| Increased Breach Bottom Width by 50% | 3,106 | 123.4 |
| Reduced Manning's n Coefficient by 50% | 2,547 | 122.0 |
| Increased Manning's n Coefficient by 50% | 2,547 | 122.0 |
| Reduced Breach Development Time to 0.25 hr | 2,732 | 122.2 |
| Increased Breach Development Time to 0.75 hr | 2,123 | 121.1 |

**Table 3.** Peak Breach Discharge versus Discharge Volume for a Dry Weather Breach

| Percent of Total Volume | Peak Discharge Rate (cubic feet per second) | Discharge Volume (acre-feet) |
|---|---|---|
| 100% | 2,825 | 711 |
| 80% | 2,761 | 585 |
| 60% | 2,505 | 455 |
| 40% | 2,173 | 323 |

## 8.0 Summary of Selected Final Analyses

### 8.1 Assumptions and Selected Inputs

The sensitivity assessment indicates that minor changes in the maximum inundation will result from the modification of the selected parameters, with the most significant alteration in the breach hydrograph resulting from the increase in breach bottom width. Increasing the breach bottom width by 50 percent results in a peak discharge rate increase of 601 cfs (24.0 percent). The selected HEC-RAS model inputs for the final breach analyses are presented in Table 4.

**Table 4.** HEC-RAS Model Inputs

| Input | Value |
|---|---|
| Breach Development Time (minutes) | 42 |
| Breach Bottom Width (feet) | 17 feet * |
| Breach Side Slopes (H:1V) | 1 |
| Breach Bottom Elevation (feet NGVD 1929) | 130 feet |
| Breach Progression Rate | Linear |
| Computation time increment (seconds) | 60 |

* Breach bottom width was estimated to be 16 feet for the dry weather condition.

### 8.2 Flood Wave Travel Time and Route of Travel

It is important for emergency responders to have an estimate of how much time is available in the event of a dam failure to take action at various downstream locations. The available time is not necessarily dependent on the time of arrival of the maximum water level, but the critical time is often dependent rather on a condition that is typically less clear – when impacts become critical. Perhaps the most apparent example of this is when access to an area becomes inundated, affecting the safety of movement of the public and emergency service workers. A default initial impact of 1 foot of inundation was chosen since this is a value were egress by automobile becomes difficult.

The flood wave travel time was determined for two initial conditions. The first initial condition is representative of typical dry weather conditions where the pool elevation is at 143 feet NGVD 1929. The second initial condition is representative of wet weather conditions where the pool elevation is at 145 feet NGVD 1929 and failure of the embankment occurs as a result of overtopping from high inflow. Flood wave travel time for dry weather and wet weather conditions are presented in Tables 4a and 4b.

**Table 4a.** Flood Wave Travel Time (Dry Weather Conditions)

| Location | Distance Downstream (miles) | Peak Inundation Depth (feet) | Time from Start of Breach (minutes) | |
|---|---|---|---|---|
| | | | At Initial Impacts | At Peak Elevation |
| Near Unnamed Tributary to Lumber River | 0.2 | 6.8 | 40 | 145 |
| Midway along Discharge Canal | 0.6 | 5.7 | 60 | 145 |
| Near State Road 2116 | 1.1 | 2.1 | 115 | 205 |

**Table 4b.** Flood Wave Travel Time (Wet Weather Conditions)

| Location | Distance Downstream (miles) | Peak Inundation Depth (feet) | Time from Start of Breach (minutes) | |
|---|---|---|---|---|
| | | | At Initial Impacts | At Peak Elevation |
| Near Unnamed Tributary to Lumber River | 0.2 | 5.6 | 35 | 105 |
| Midway along Discharge Canal | 0.6 | 3.6 | 45 | 105 |
| Near State Road 2116 | 1.1 | 0.6 | 125 | 125 |



Due to conveyance capacity and storage volume of Lumber River relative to the breach flood wave after passing through the drainage canal, minimal inundation is observed for both breach scenarios. As a result, the ash pond breach produced no water level increase in the Lumber River of more than 1.0 foot compared to the no breach condition. Discharge and stage hydrographs in the discharge canal are presented for the dry weather condition and the wet weather condition in Figures 2 and 3, respectively. In the dry weather condition, the initial breach flood wave of ten feet attenuates to one foot by the time it reaches the Lumber River. In the wet weather condition, the initial breach flood wave of 11 feet attenuates to two feet by the time it reaches the Lumber River.

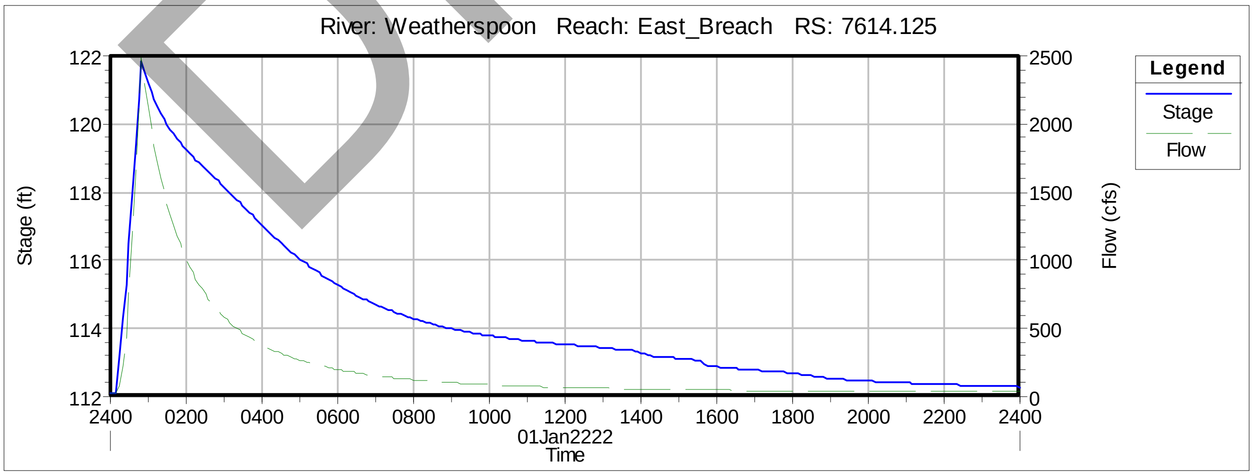


**Figure 2.** Discharge and Stage Hydrographs at embankment, Dry Weather Breach

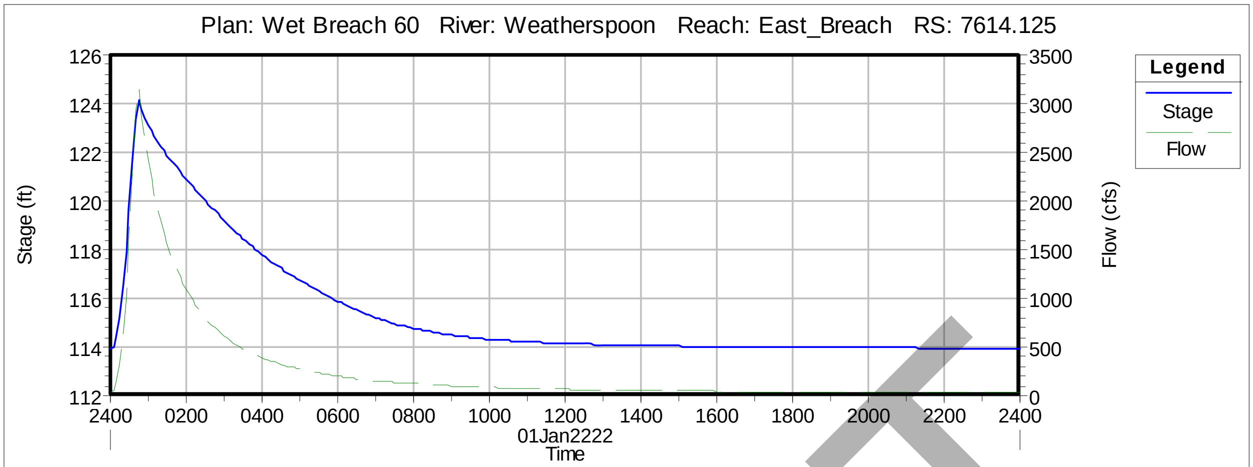


**Figure 3.** Discharge and Stage Hydrographs at embankment, Wet Weather Breach

Stream profiles depicting the effects to the Lumber River from the embankment breach for the dry and wet weather scenarios are provided in Figures 4 and 5. The baseline stream profile is shown as well.

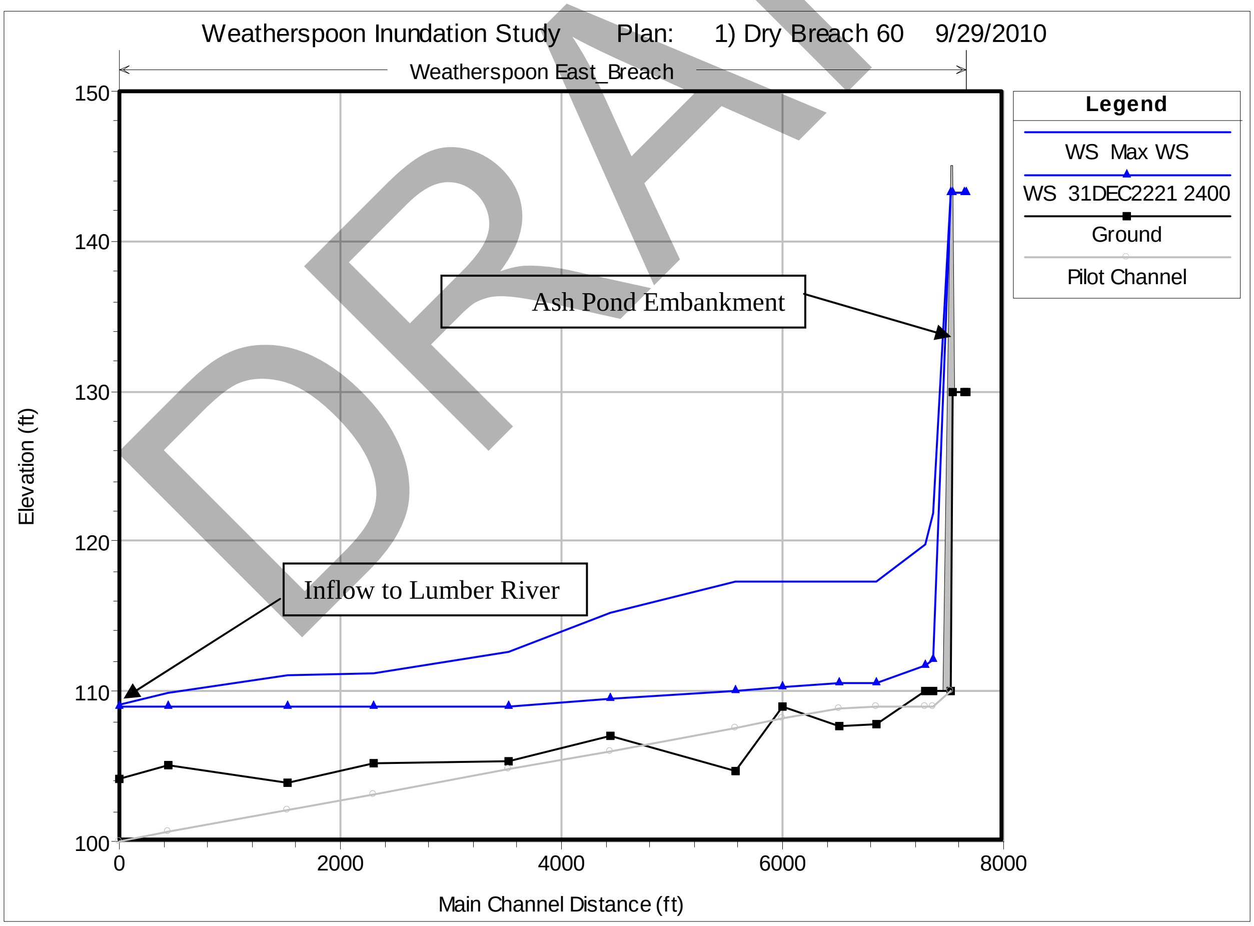


**Figure 4.** Breach Profile along Discharge Canal, Dry Weather Breach

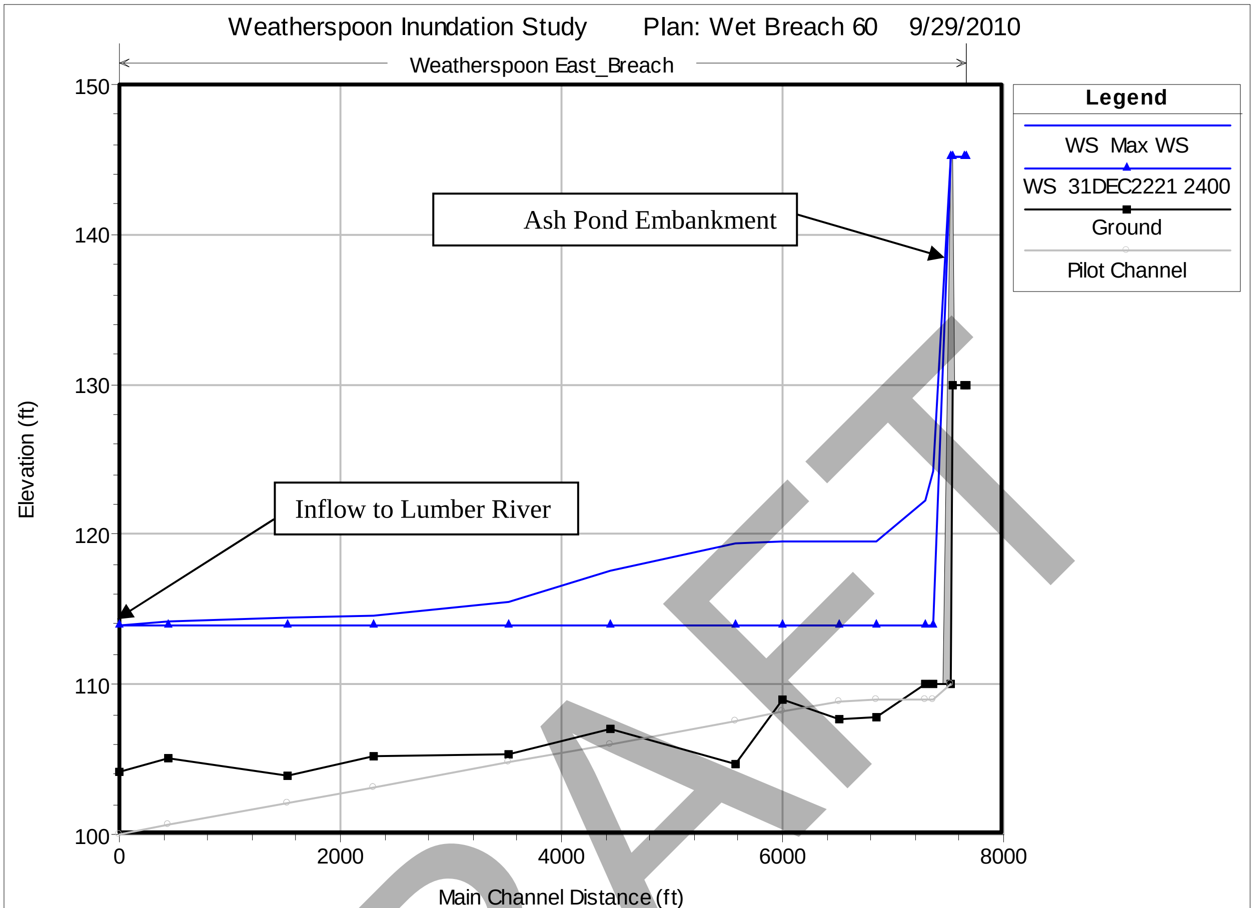


**Figure 5.** Breach Profile along Discharge Canal, Wet Weather Breach

8.3 Breach Analysis of the Ash Pond to the Cooling Pond

Based on the dike crest elevation of 113 feet and design parameters, the Weatherspoon Cooling Pond has a design maximum storage capacity of 930 acre-feet. The Weatherspoon Cooling Pond has a design water level elevation of 110 feet. The calculated excess storage of the Weatherspoon Cooling Pond, at the design water elevation, is 343 acre-feet.

Based on design parameters, the Weatherspoon Ash Pond has a maximum available storage capacity of 240 acre-feet. Therefore, in the event of an Ash Pond breach, the Cooling Pond is capable of storing the full contents of the Ash Pond with 103 acre-feet of remaining storage capacity. Storage calculations are provided in Table 5.

**Table 5.** Breach Analysis – Ash Pond to the Cooling Pond

**Weatherspoon Cooling Pond**

| | | | |
|---|---|---|---|
| Crest Elevation: | | 113 | feet |
| Bottom Elevation: | | 103 | feet |
| Design Water Elevation: | | 110 | feet |
| Water Elevation: | | 112 | feet |
| Design Storage @ 110 feet | 587 | | acre-feet |
| Maximum Storage @ 112 feet: | 810 | | acre-feet |
| Maximum Storage @ 113 feet: | 930 | | acre-feet |

Based on design documents for cooling pond

**Weatherspoon Ash Pond**

| | | |
|---|---|---|
| Crest Elevation: | 145 | feet |
| Bottom Elevation: | 117 | feet |
| Maximum Storage: | 240 | acre-feet |

**Breach Analysis**

| | | | | Weatherspoon Pond | |
|---|---|---|---|---|---|
| | Maximum Capacity (ac-ft) | | Available Storage (ac-ft) | | Excess Storage (ac-ft) |
| **Weatherspoon Ash Pond** | 240 | | 343 | | 103 |
| **Combined** | **240** | **<** | **343** | | **103** |

8.4 Summary of Breach Analysis

The breach analyses indicate that the breach of the Weatherspoon Ash Pond into the discharge canal is not likely to cause a water level increase of greater than 1 foot in the Lumber River. The majority of flood attenuation occurs along the drainage canal. A breach of Ash Pond to the Cooling Pond will result in an increase storage volume with the Cooling Pond. However, at the current operating conditions, the Cooling Pond has sufficient capacity to store the breach. Based on these model results, it appears that a breach of the Ash Pond will not pose a significant risk to public safety.

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Wahl, Tony L., 1998. Predication of Embankment Dam Breach Parameters – A Literature Review and Needs Assessment, U.S. Bureau of Reclamation Dam Safety Report DSO-980004, July 1998.

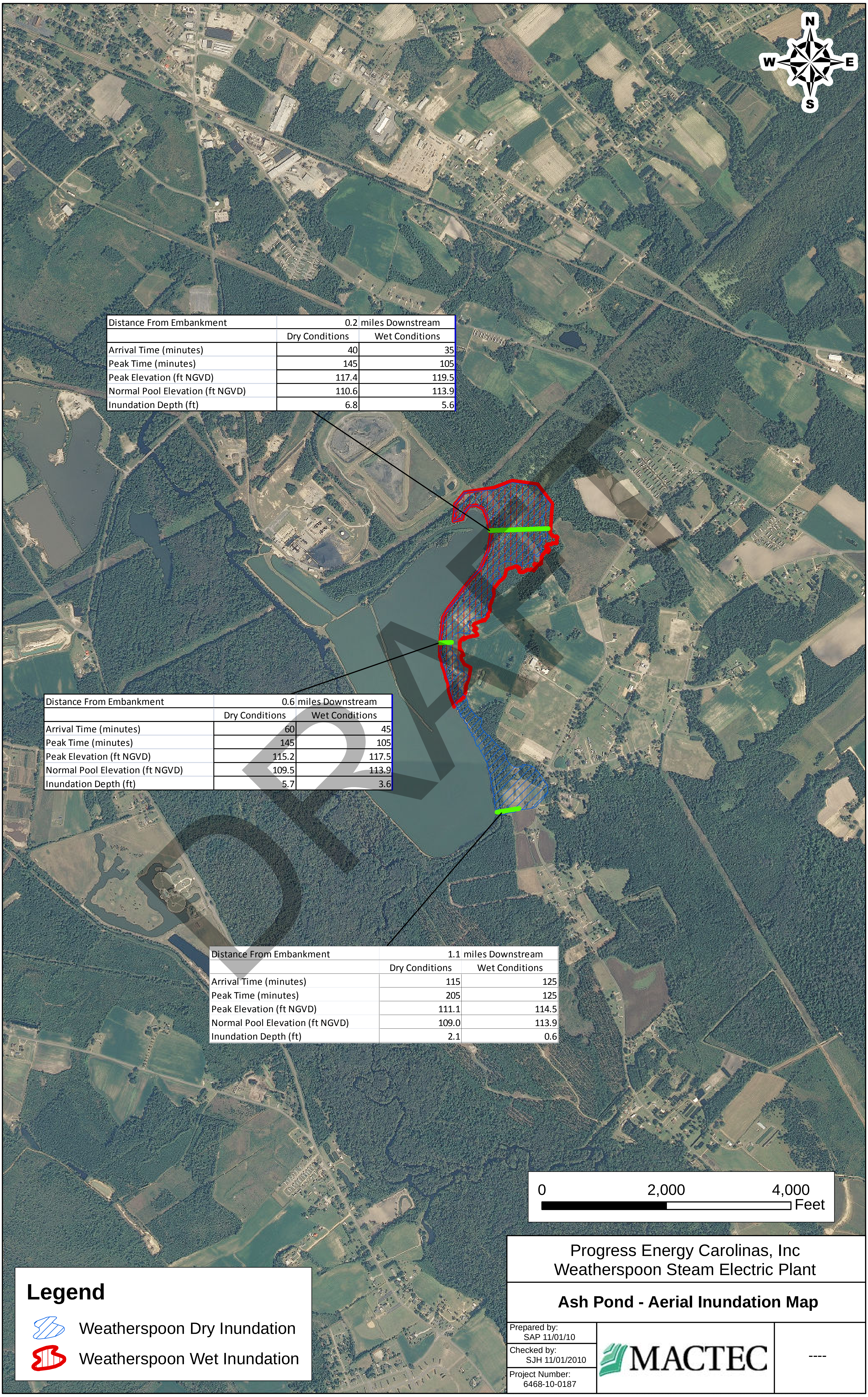
## 10.0 Abbreviations

| | |
|---|---|
| AF | acre-feet |
| cfs | cubic feet per second |
| FEMA | Federal Emergency Management Agency |
| ft | feet |
| GIS | geographic information system |
| HEC-RAS | Hydrologic Engineering Center – River Analysis System |
| HW | headwater (HEC-RAS) |
| NGVD | National Geodetic Vertical Datum of 1929 |
| NOAA | National Oceanic and Atmospheric Agency |
| PMP | Probable Maximum Precipitation |
| RS | River Station (HEC-RAS) |
| SCS | Soil Conservation Service |
| TW | tailwater (HEC-RAS) |
| USGS | United States Geological Survey |
| WS | water surface (HEC-RAS) |

# APPENDIX

Weatherspoon Ash Pond – Aerial Inundation Map

Weatherspoon Ash Pond – Topographical Inundation Map




| Distance From Embankment | 0.2 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 40 | 35 |
| Peak Time (minutes) | 145 | 105 |
| Peak Elevation (ft NGVD) | 117.4 | 119.5 |
| Normal Pool Elevation (ft NGVD) | 110.6 | 113.9 |
| Inundation Depth (ft) | 6.8 | 5.6 |

| Distance From Embankment | 0.6 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 60 | 45 |
| Peak Time (minutes) | 145 | 105 |
| Peak Elevation (ft NGVD) | 115.2 | 117.5 |
| Normal Pool Elevation (ft NGVD) | 109.5 | 113.9 |
| Inundation Depth (ft) | 5.7 | 3.6 |

| Distance From Embankment | 1.1 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 115 | 125 |
| Peak Time (minutes) | 205 | 125 |
| Peak Elevation (ft NGVD) | 111.1 | 114.5 |
| Normal Pool Elevation (ft NGVD) | 109.0 | 113.9 |
| Inundation Depth (ft) | 2.1 | 0.6 |

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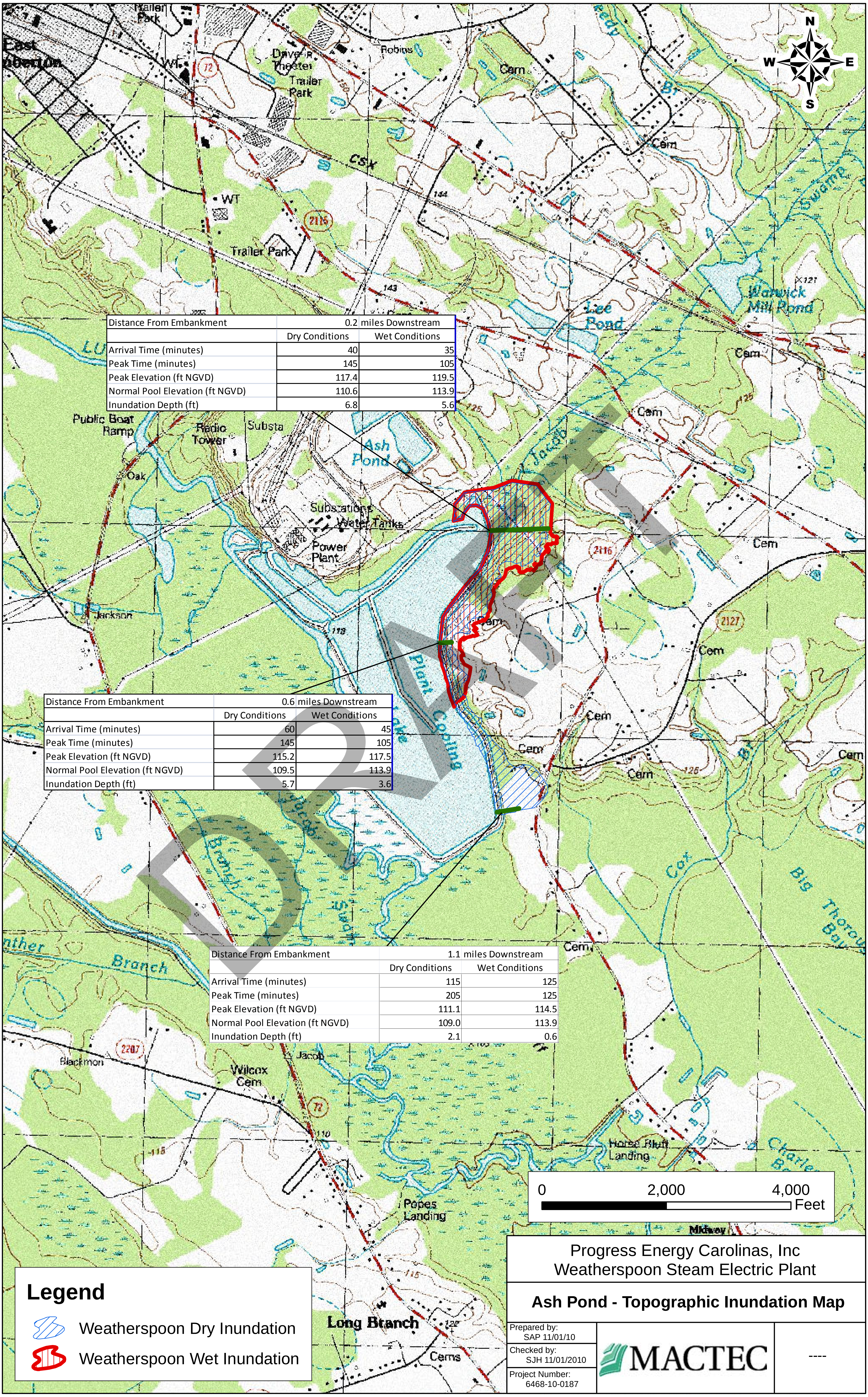


| Distance From Embankment | 0.2 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 40 | 35 |
| Peak Time (minutes) | 145 | 105 |
| Peak Elevation (ft NGVD) | 117.4 | 119.5 |
| Normal Pool Elevation (ft NGVD) | 110.6 | 113.9 |
| Inundation Depth (ft) | 6.8 | 5.6 |

| Distance From Embankment | 0.6 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 60 | 45 |
| Peak Time (minutes) | 145 | 105 |
| Peak Elevation (ft NGVD) | 115.2 | 117.5 |
| Normal Pool Elevation (ft NGVD) | 109.5 | 113.9 |
| Inundation Depth (ft) | 5.7 | 3.6 |

| Distance From Embankment | 1.1 miles Downstream | |
|---|---|---|
| | Dry Conditions | Wet Conditions |
| Arrival Time (minutes) | 115 | 125 |
| Peak Time (minutes) | 205 | 125 |
| Peak Elevation (ft NGVD) | 111.1 | 114.5 |
| Normal Pool Elevation (ft NGVD) | 109.0 | 113.9 |
| Inundation Depth (ft) | 2.1 | 0.6 |

**Legend**

- Weatherspoon Dry Inundation
- Weatherspoon Wet Inundation

Progress Energy Carolinas, Inc
Weatherspoon Steam Electric Plant

**Ash Pond - Topographic Inundation Map**

Prepared by: SAP 11/01/10
Checked by: SJH 11/01/2010
Project Number: 6468-10-0187

MACTEC

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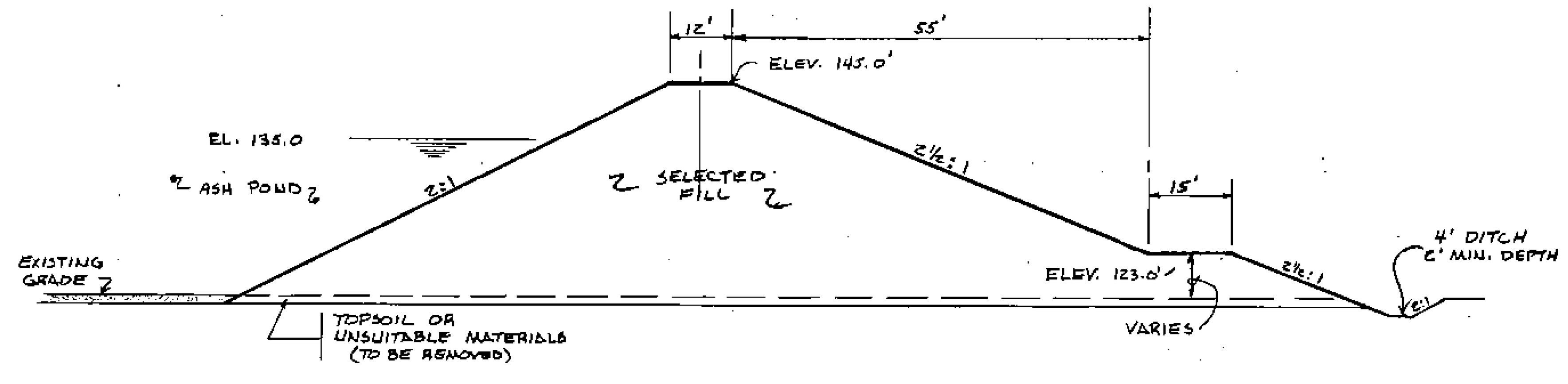
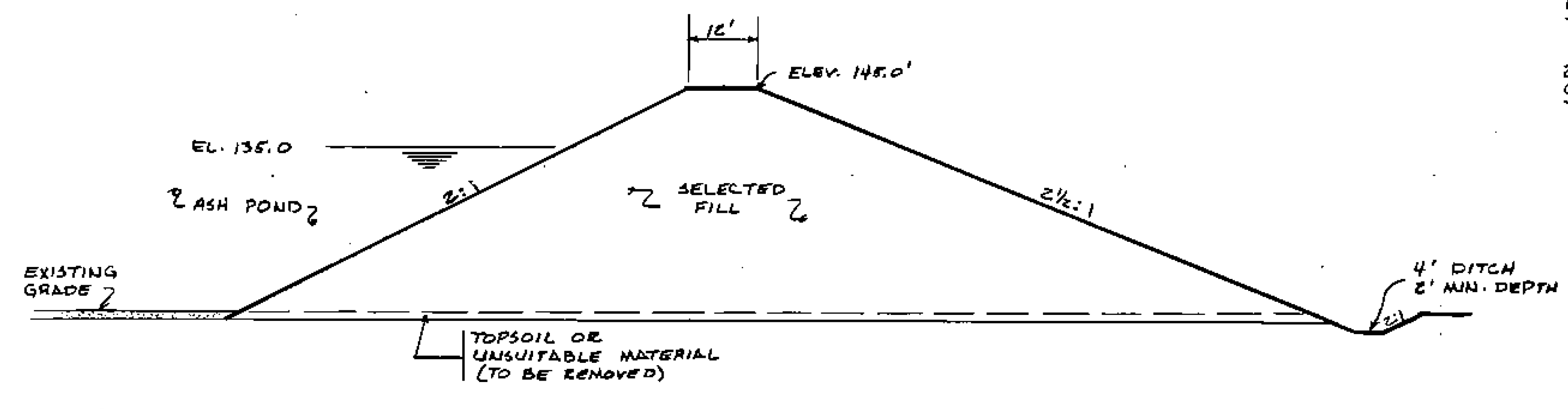
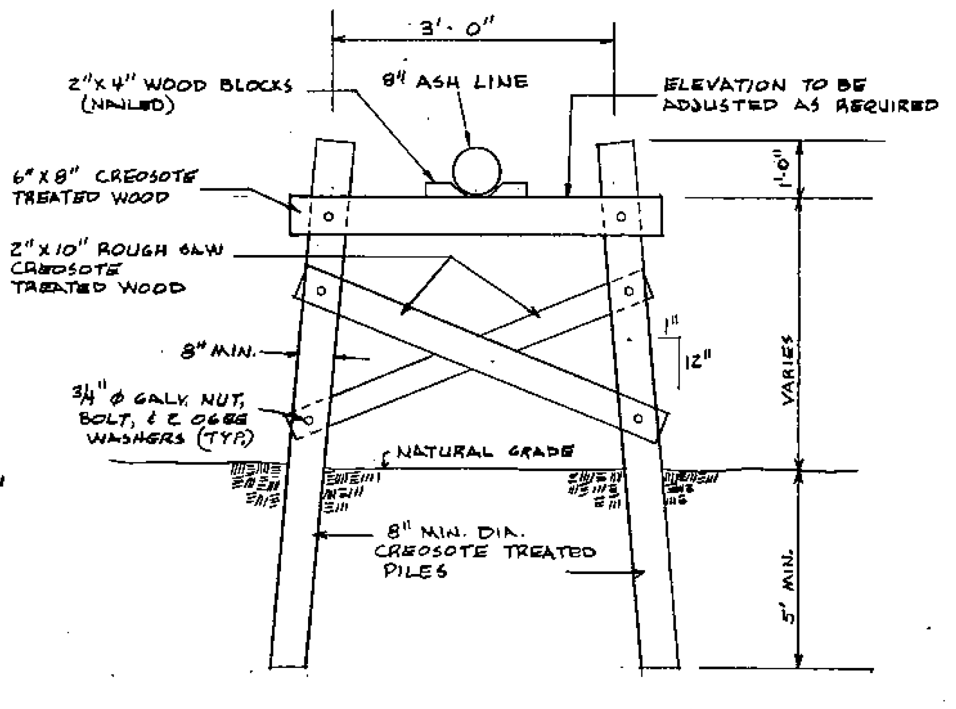



SECTION A-A
TYPICAL FROM STA. 7+50 TO 19+50
(H-14 RCD-1280)
(N.T.S.)



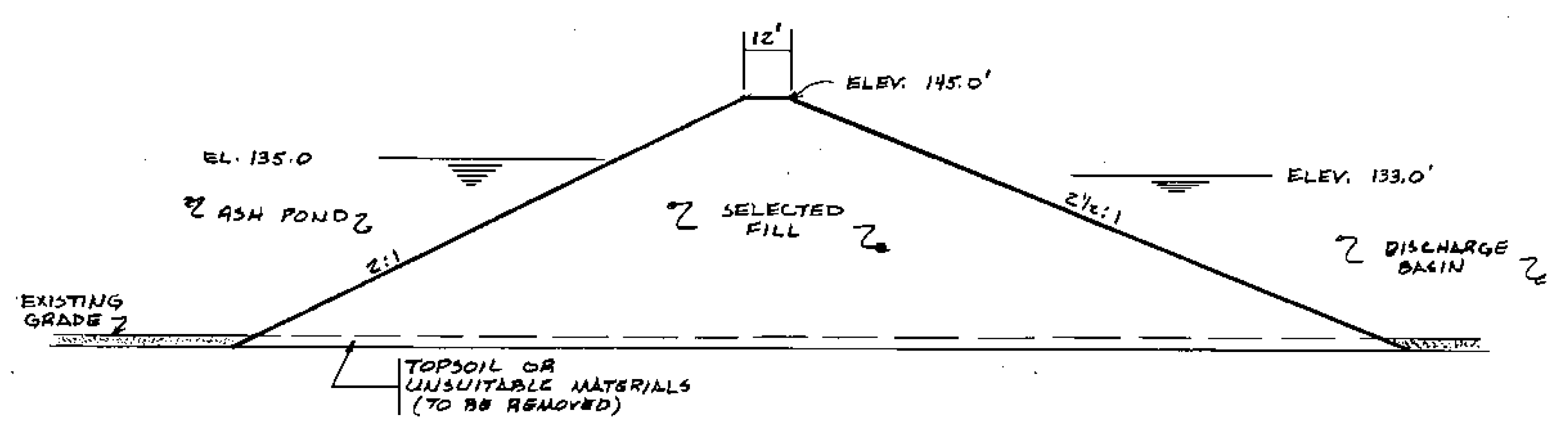

SECTION B-B
TYPICAL FROM STA. 0+00 TO 7+50
AND FROM STA. 19+50 TO 26+50
(L-10 RCD-1280)
(N.T.S.)



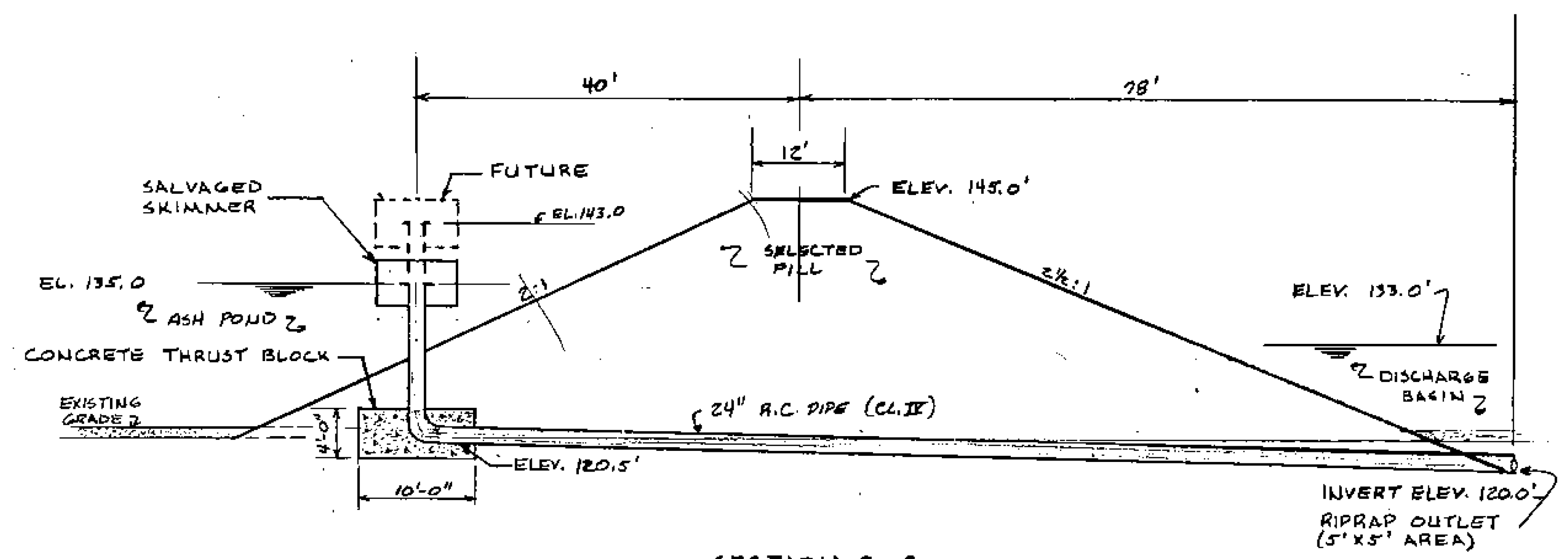

ASH PIPE SUPPORT (TYPE 'B')
(SPACED AT 16'-0" O.C. OR AS REQUIRED)
(N.T.S.)

## NOTES

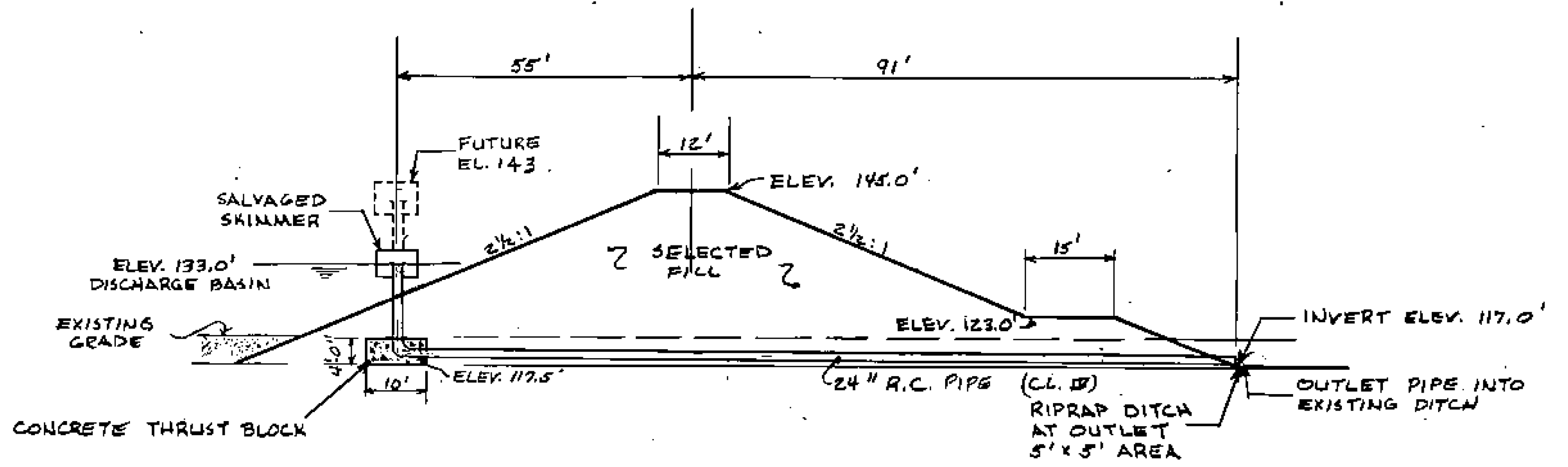
1. R.C. PIPE SHALL BE LAID TO A STRAIGHT LINE AND UNIFORM GRADE AND SHALL REST ON A FIRM BED WITH BELL ENDS LAID UPGRADE.
2. DIKE FILL SHALL BE COMPACTED TO 95% OF THE STANDARD PROCTOR DENSITY.
3. ALL BACKFILL SHALL BE PLACED SO AS NOT TO INJURE STRUCTURES OR PIPING. HEAVY HAULING OR COMPACTING EQUIPMENT SHALL NOT BE PERMITTED CLOSER THAN THREE FEET FROM ANY STRUCTURE OR PIPING DURING THE BACKFILLING PROCESS. IN ALL AREAS CLOSER THAN THREE FEET, OR WHEN WORK SPACE IS LIMITED, PORTABLE EQUIPMENT SUCH AS VIBRATORY PLATES, RAMMERS, OR PNEUMATIC TAMPERS SHALL BE USED.
4. AGGREGATE BASE COURSE FOR ACCESS ROAD SHALL BE NC DOT STANDARD SIZE NO. ABC; AND SHALL BE COMPACTED TO 100% OF THE STANDARD PROCTOR DENSITY.
5. MINIMUM CREOSOTE RETENTION FOR ALL WOOD MEMBERS SHALL BE 12 POUNDS PER CUBIC FOOT. USE 60% CREOSOTE, 40% COAL TAR SOLUTION.
6. RIPRAP SHALL 12" IN DEPTH WITH EACH STONE WEIGHING 60 TO 90 POUNDS. RIPRAP SHALL BE PLACED ON BEDDING STONE CONSISTING OF A 6" THICK BED WITH 1½" MAXIMUM WASHED STONE.
7. CONCRETE THRUST BLOCKS SHALL BE 10'x10'x4'; AND SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 P.S.I. AT 28 DAYS. FOR TYPE 'A' SUPPORTS FIELD SHALL DETERMINE IF CONCRETE THRUST BLOCKS ARE REQUIRED WHERE ASH LINE CHANGES DIRECTION.



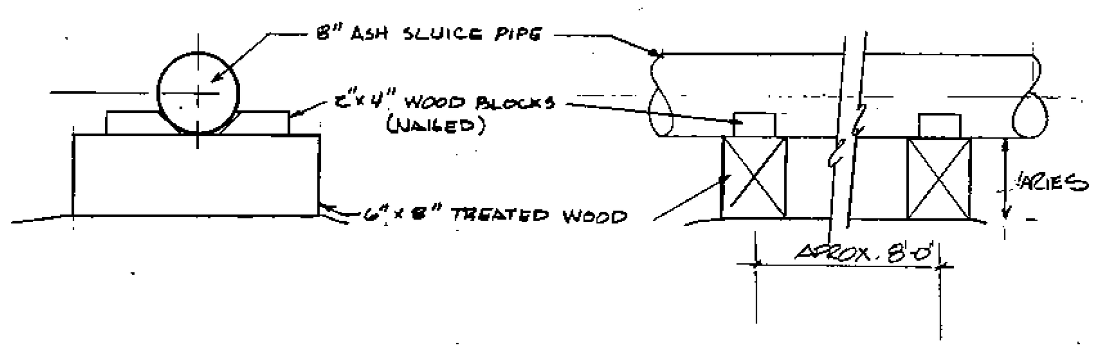

TYPICAL SECTION
DISCHARGE BASIN DIKE
(N.T.S.)



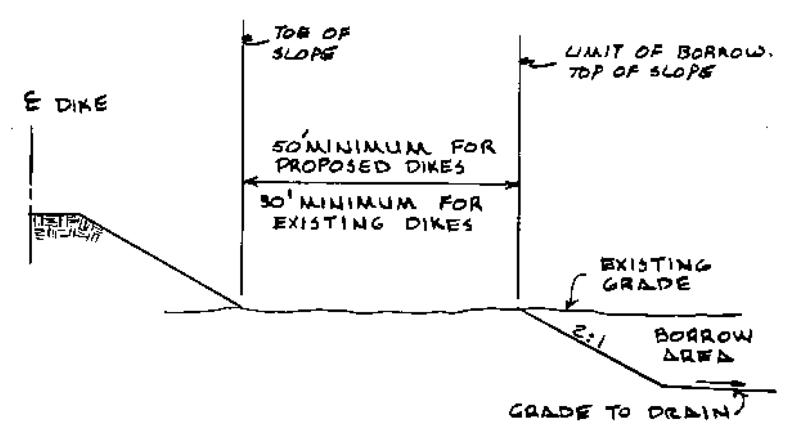

SECTION C-C
(B-13 RCD-1280)
(N.T.S.)



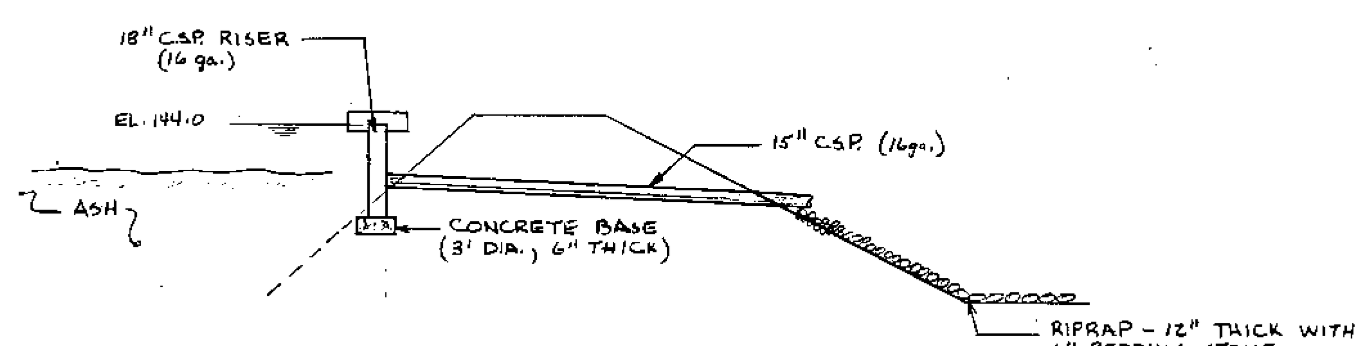

SECTION D-D
(C-14 RCD-1280)
(N.T.S.)



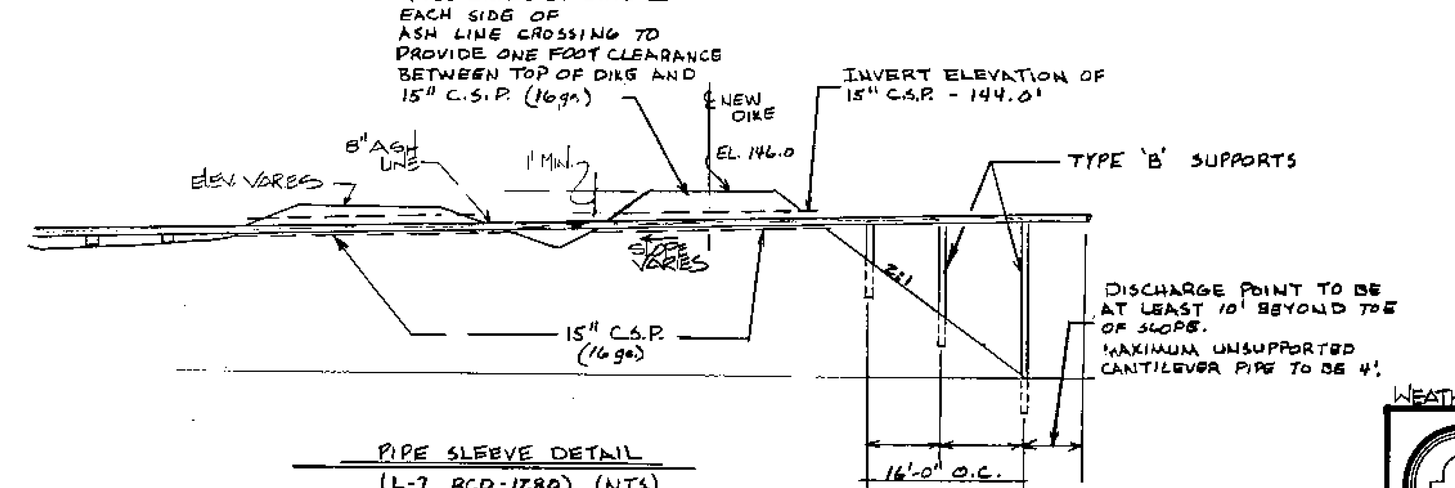

ASH PIPE SUPPORT (TYPE 'A')
(SPACED AT 16'-0" O.C. OR AS REQUIRED)
NTS




TYPICAL DETAIL OF
BORROW AREA LIMIT
N.T.S.




TEMPORARY DISCHARGE
(B-1 RCD-1280)
N.T.S.




PIPE SLEEVE DETAIL
(L-7 RCD-1280) (N.T.S.)

WEATHERSPOON DWG. Nº 7030-00011

CAROLINA POWER & LIGHT COMPANY
POWER PLANT CONSTRUCTION DEPT. RALEIGH, N.C.

**WEATHERSPOON STEAM ELECTRIC PLANT**
**ASH POND – SECTIONS & DETAILS**

| | | |
|---|---|---|
| SCALE AS NOTED | APPROVED | DATE 11-30-78 |
| UNIT CE | | DWG. NO. |
| DR. GRJ | | RCD-1281 |
| CH. DJD | | |

| NO. | DATE | REVISION | BY | CH | APPROVED |
|---|---|---|---|---|---|
| 2 | 4-10-80 | AS-BUILT | | | |
| 1 | 11-1979 | REVISED SECTION D-D (J-6) REVISED SECTION A-A (J-7) DELETED ACCESS ROAD DETAIL (J-10) | | | |

7030-00011

RCD-1281

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:

Date:

Unit Name:

Operator's Name:

Unit I.D.:

Hazard Potential Classification: High Significant Low

Inspector's Name:

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

| | Yes | No | | Yes | No |
|---|---|---|---|---|---|
| 1. Frequency of Company's Dam Inspections? | weekly, monthly Annual, 5-YR | | 18. Sloughing or bulging on slopes? | | ✓ |
| 2. Pool elevation (operator records)? | 139.0 | | 19. Major erosion or slope deterioration? | ✓ | |
| 3. Decant inlet elevation (operator records)? | 139.0 | | 20. Decant Pipes: | | |
| 4. Open channel spillway elevation (operator records)? | | | Is water entering inlet, but not exiting outlet? | | ✓ |
| 5. Lowest dam crest elevation (operator records)? | 142.5 | | Is water exiting outlet, but not entering inlet? | | ✓ |
| 6. If instrumentation is present, are readings recorded (operator records)? | ✓ | | Is water exiting outlet flowing clear? | ✓ | |
| 7. Is the embankment currently under construction? | | ✓ | 21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below): | | |
| 8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)? | N/A | | From underdrain? | ✓ | |
| 9. Trees growing on embankment? (If so, indicate largest diameter below) | ✓ | | At isolated points on embankment slopes? | | ✓ |
| 10. Cracks or scarps on crest? | | ✓ | At natural hillside in the embankment area? | | ✓ |
| 11. Is there significant settlement along the crest? | | ✓ | Over widespread areas? | | ✓ |
| 12. Are decant trashracks clear and in place? | ✓ | | From downstream foundation area? | ✓ | |
| 13. Depressions or sinkholes in tailings surface or whirlpool in the pool area? | | ✓ | "Boils" beneath stream or ponded water? | | ✓ |
| 14. Clogged spillways, groin or diversion ditches? | | ✓ | Around the outside of the decant pipe? | | ✓ |
| 15. Are spillway or ditch linings deteriorated? | | ✓ | 22. Surface movements in valley bottom or on hillside? | | ✓ |
| 16. Are outlets of decant or underdrains blocked? | | ✓ | 23. Water against downstream toe? | ✓ | |
| 17. Cracks or scarps on slopes? | | ✓ | 24. Were Photos taken during the dam inspection? | ✓ | |

**Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.**

Inspection Issue # Comments

U. S. Environmental Protection Agency

# Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # INSPECTOR
Date

Impoundment Name
Impoundment Company
EPA Region
State Agency (Field Office) Addresss

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

New Update

| | Yes | No |
|---|---|---|
| Is impoundment currently under construction? | | |
| Is water or ccw currently being pumped into the impoundment? | | |

**IMPOUNDMENT FUNCTION:**

Nearest Downstream Town : Name
Distance from the impoundment
Impoundment
Location: Longitude Degrees Minutes Seconds
Latitude Degrees Minutes Seconds
State County

Does a state agency regulate this impoundment? YES NO

If So Which State Agency?

**HAZARD POTENTIAL** (In the event the impoundment should fail, the following would occur):

**LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

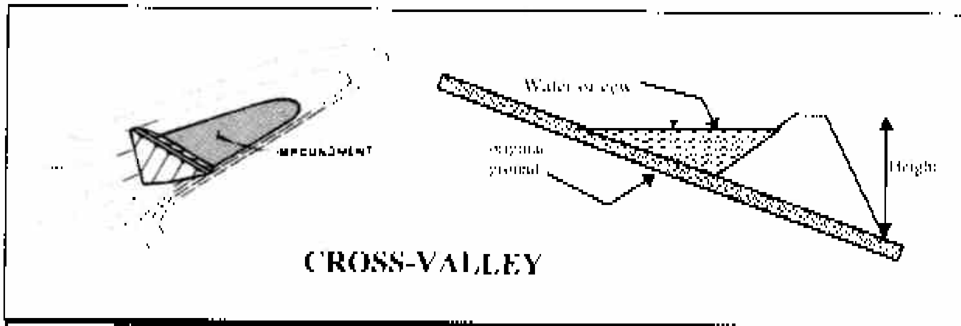
**LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

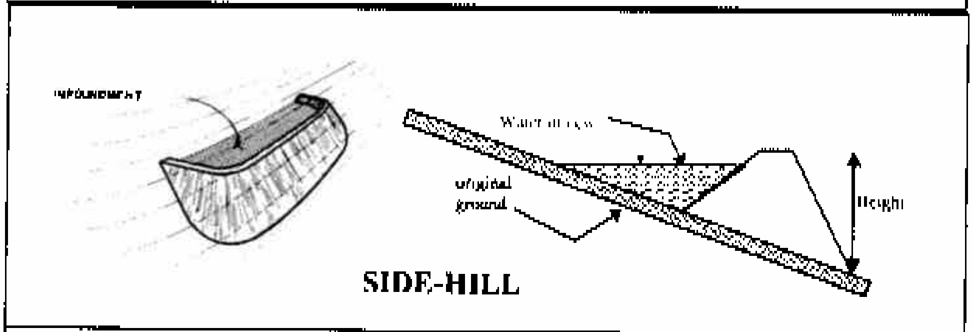
**SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

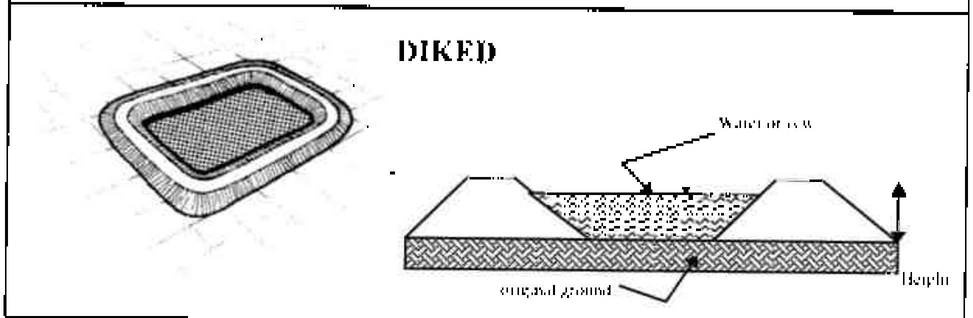
**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

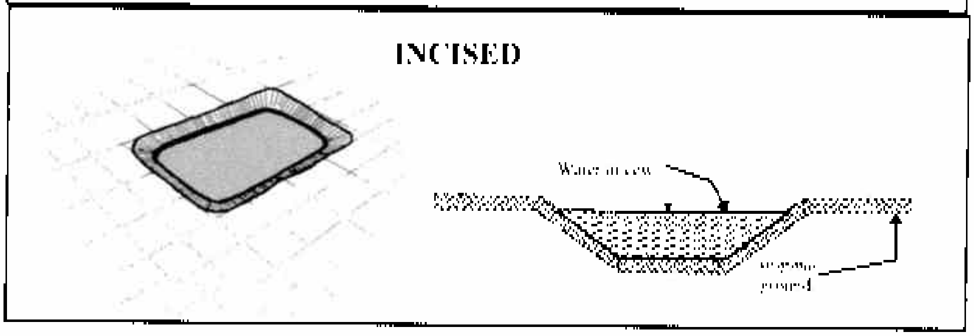
**DESCRIBE REASONING FOR HAZARD RATING CHOSEN:**

## CONFIGURATION:




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

| | | | |
|---|---|---|---|
| Embankment Height | feet | Embankment Material | |
| Pool Area | acres | Liner | |
| Current Freeboard | feet | Liner Permeability | |

**TYPE OF OUTLET** (Mark all that apply)

**Open Channel Spillway**

Trapezoidal

Triangular

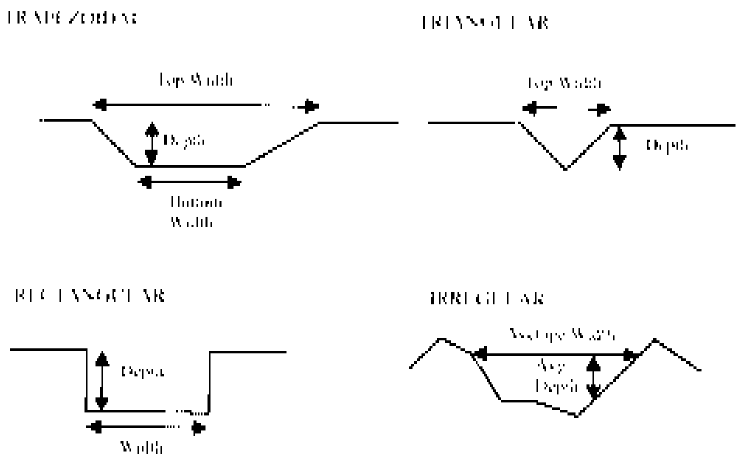
Rectangular

Irregular

depth

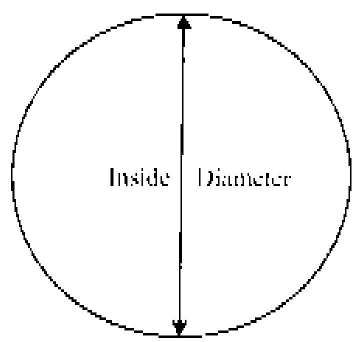
bottom (or average) width

top width



**Outlet**

inside diameter




Material

corrugated metal

welded steel

concrete

plastic (hdpe, pvc, etc.)

other (specify)

Is water flowing through the outlet? YES NO

**No Outlet**

**Other Type of Outlet** (specify)

The Impoundment was Designed By

Has there ever been a failure at this site? YES NO

If So When?

If So Please Describe :

Has there ever been significant seepages at this site? YES NO

If So When?

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES NO

If so, which method (e.g., piezometers, gw pumping,...)?

If so Please Describe :