

Meeting Notice & Agenda

MARION CITY COUNCIL

Tuesday, October 11, 2022 – 5 p.m.

Marion City Hall, 217 South Main Street, Marion, KY

Special Meeting

Call to Order

Business Agenda

1. Update on Marion Sanitary Sewer Projects
2. Update on Leaf Collection Program
3. Update on Staff Openings
4. Consideration of Going Out for Bids on 2022/23 Street Improvements
5. Consideration of Appointments to Marion Recreation, Tourist, and Convention Commission
6. Update on Water Supply Issues
7. Adjourn

Press Release

DRA Media Contact:

Shawna Blair

202-515-1354

sblair@dra.gov

October 06, 20

Delta Regional Authority Announces \$3 Million Investment into Four Western Kentucky Infrastructure Projects

DRA's investment will improve water, draining, and transportation infrastructure projects to help build safer, more resilient communities throughout Western Kentucky.

CLARKSDALE, MS – Delta Regional Authority (DRA) today announced that \$3 million will be invested into four Kentucky infrastructure projects through DRA's Community Infrastructure Fund (CIF). The investment will be matched by \$18.6 and will attract an additional \$1.9 million in capital investments. The CIF program addresses unmet basic public infrastructure, transportation infrastructure, and flood control needs to help build safer, more resilient communities in the Delta region. These projects are expected to create or retain 39 jobs, train 20 individuals and affect over 3,300 families.

"As I travel throughout Western Kentucky and listen to community leaders, it is clear that infrastructure upgrades are among the state's greatest needs," said **DRA Federal Co-Chairman Dr. Corey Wiggins**. "Accessible roads, reliable water and sewer services, and secure flood protection are essential in order to maintain existing businesses, attract new industries, and keep a community healthy and thriving."

Kentucky: FY 2022 CIF Investment Snapshot

- **Number of Projects:** 4
- **DRA Investment:** \$3,007,255
- **Total Project Investment:** \$21,681,467
- **Additional Capital Investment:** \$1,900,000
- **Jobs Created:** 12
- **Jobs Retained:** 27
- **Individuals Trained:** 20
- **Families Affected:** 3,314

The following projects were funded by CIF:

1. **JSA – Barkley Regional Airport Sewer Extension | Paducah, KY:** The Paducah McCracken Joint Sewer Agency will use DRA funds to connect the new Barkley Regional Airport terminal and 20 homes to public sewer infrastructure. This investment is projected to retain 25 jobs, train 20 individuals and affect 20 families.
 - **DRA Investment: \$1,771,285**
 - **Total Investment: \$2,021,285**
2. **Casey Jones Distillery Expansion Utility Project | Hopkinsville, KY:** The Christian County Fiscal Court will use DRA funds to assist with the upgrade of water and electric utilities to provide enough capacity to accommodate an expansion project being undertaken by Casey Jones Distillery. This investment is projected to create 12 jobs.
 - **DRA Investment: \$58,785**
 - **Total Investment: \$58,785**
 - **Additional Capital Investment: \$1,900,000**
3. **Marion Wastewater Treatment Plant | Marion, KY:** The City of Marion will use DRA funds to construct a new 1.5 MGD wastewater treatment plant. This investment is projected to retain 2 jobs and affect 1,335 families.
 - **DRA Investment: \$1,013,860**
 - **Total Investment: \$19,410,224**
4. **Water Treatment Plant Sludge Diversion Project | Morganfield, KY:** The City of Morganfield will use DRA funds to install a new pipeline, three manholes, and four sluice gates. This investment is projected to affect 1,959 families.
 - **DRA Investment: \$163,325**
 - **Total Investment: \$191,173**

###

About the Delta Regional Authority

The Delta Regional Authority (DRA) is a federal-state partnership created by Congress in 2000 to promote and encourage the economic development of the lower Mississippi River Delta region and Alabama Black Belt. DRA invests in projects supporting transportation infrastructure, basic public infrastructure, workforce training, and business development. DRA's mission is to help create jobs, build communities, and improve the lives of those who reside in the 252 counties and parishes of the eight-state region.

TWEET

SHARE

EMPLOYMENT OPPORTUNITY: CITY OF MARION POLICE DEPARTMENT is seeking to fill the position of Police Officer as soon as possible. Under the general direction of the Chief of Police, the Officer will be responsible for patrolling and other such duties common to our department's operations. Minimum requirements include basic training and certification as recognized by the Department of Criminal Justice Training (DOCJT); some experience in law enforcement is desirable, but not mandatory. A copy of the full job description for the Police Officer's position is available from the City Administrator. Salary for a DOCJT Certified Officer is set at \$45,444.33 for the 2022-2023 fiscal year. The City also pays 100% of the officer's health insurance premiums, and 25% of any covered family member. We offer 10 paid vacation days and 12 paid holidays per year. Anyone interested in the position should submit a City of Marion Job Application to the City Administrator's office. The position is open until filled. The City of Marion is an Equal Opportunity Employer and a Certified Drug-Free Workplace.

Employment Opportunity

City Administrator

The City of Marion, KY is seeking an experienced, qualified applicant to fill the full-time position of City Administrator.

Marion has a population of about 3,100, an annual budget of approximately 4M+ and has 25+ f/t employees. The City Administrator is responsible for the efficient oversight, management, and day-to-day operation of the affairs of the City in accordance with Local, State, and Federal laws. Demonstrated abilities include, but are not limited to, the exercise of mature judgment and the ability to resolve municipal issues related to continual quality public service and interdepartmental relations; strong financial management; project management; town-planning and land use skills, as well as significant knowledge of municipal law. The candidate of choice will be a proven team builder, will possess excellent leadership skills, be collaborative in nature, effectively communicate, possess the ability to cultivate relationships and advance the initiatives currently underway. The City Administrator is appointed by, and accountable to, the Mayor of Marion.

Requirements: The successful candidate must possess a minimum of a Bachelor's Degree in a related field with a specialization in business or public administration, plus at least five (3) years of administrative / managerial experience in a public jurisdiction or private organization. Salary range for this position is \$65,000 - \$75,000 annually depending on experience and qualifications.

A City Application is available on the City's website (www.marionky.gov).

Deadline for submission of applications is close of business, December 2, 2022 or until a suitable candidate is found. Interviews will be on-going throughout the recruitment process.

The City of Marion is an Equal Employment Opportunity Employer

Employment Opportunity Planning & Zoning Coordinator

The City of Marion has full-time permanent positions available in the Planning and Zoning Department. Minimum qualifications include graduation from high school or equivalent; the ideal candidate will have some experience related to public service or enforcement. A combination of experience and education will be considered for compliance with these standards.

ESSENTIAL DUTIES:

- Conduct enforcement and permitting task as necessary to assure property compliance with City Code.
- Coordinate regular meetings/trainings of boards and committees associated with the performance of primary task
- Manages records/files related to permitting, code enforcement, and abatement within city limits.
- Acts as point of contact for the general public; answers general questions
- Other such duties common to City operations

The successful applicants will work under the general direction of the City Administrator. All resumes must be accompanied by a City of Marion job application. A Job description for the positions is available from the City Administrator by request. Salary for positions is set at \$13.41/hour, but advances to \$13.91/hour after successful completion of a six-month probationary period. Upon completion of a probationary period, employee benefits include; 100% of the employee's health insurance premiums; 25% of any covered family members; and vacation/holiday pay. Interested candidates will need to submit their application to the City Administrator, positions open until filled. The City of Marion is an Equal Opportunity Employer and a Certified Drug-Free Workplace.

ADVERTISEMENT FOR BIDS

Sealed Bids for “**2022/23 Marion City Street Resurfacing**” for the City of Marion, will be received by the City of Marion, 217 South Main Street, Marion, Kentucky 42064 until 2:00 p.m. (local time) on November 3, 2022, and then publicly opened and read aloud.

The scope of work includes the resurfacing of various city streets in Marion, Kentucky. The city streets needing resurfacing will be selected at a later time.

The Bid Form and Specification may be examined at the following:

City of Marion
217 South Main Street
Marion, Kentucky 42064
(270) 965-2266

Copies of the BID Package may be obtained by contacting City of Marion listed above. Partial sets of documents will not be provided.

The OWNER reserves the right to waive any informality, reject any or all bids, or partially reject any or all line items included in the bid.

No BIDDER may withdraw Bid within sixty (60) consecutive calendar days after the actual date of the opening thereof.

“EQUAL EMPLOYMENT OPPORTUNITY”

Honorable Jared Byford, Mayor
City of Marion

2021 Street Paving
City of Marion, KY

| Street | Description (Begin/End) | Entire Width or Trench Repair? | Length (feet) | Approx. Width (feet) | Pavement Thickness (inches) | Approx. Tons | (\$/Ton) | Price to Repave w/o Milling (\$) |
|----------------------|---|--------------------------------------|------------------|-------------------------|-----------------------------------|-----------------|----------|--|
| Hart Street | Country Club Drive to Dead End | Entire Width | 440 | 18 | 1.5 | 73 | | \$0.00 |
| Rudd Street | Country Club Drive to Head Start | Entire Width | 500 | 18 | 1.5 | 83 | | \$0.00 |
| Chapel Hill Road | Country Club Drive to Tyler Manufacturing | Entire Width | 1400 | 20 | 1.5 | 257 | | \$0.00 |
| West Carlisle Street | South Weldon Street to South Yandell | Entire Width | 760 | 20 | 1.5 | 139 | | \$0.00 |
| North Weldon Street | West Popular Street to Travis Street | Entire Width | 720 | 18 | 1.5 | 119 | | \$0.00 |
| | | | | | TOTAL | 670 | | \$0.00 |

Enon to Marion WL and PS Narrative:

This narrative provides additional insight into the decisions made and assumptions taken to provide the accompanying exhibit and preliminary opinion of probable project cost (OPPC) for the proposed Enon to Marion WL and PS project.

Purpose: Provide the City of Marion with approximately 400,000 gallons per day potable water supply.

Source of Supply: Caldwell County Water District (Caldwell County) or direct connection with Princeton Water Works (Princeton). Other sources have been investigated by Bell and others. No permanent solution has been selected at this point.

Location of Connection: Enon Community near the intersection of Piney Creek Road and KY-902. The proposed alignment will terminate at the City of Marion (Marion) Water Treatment Plant.

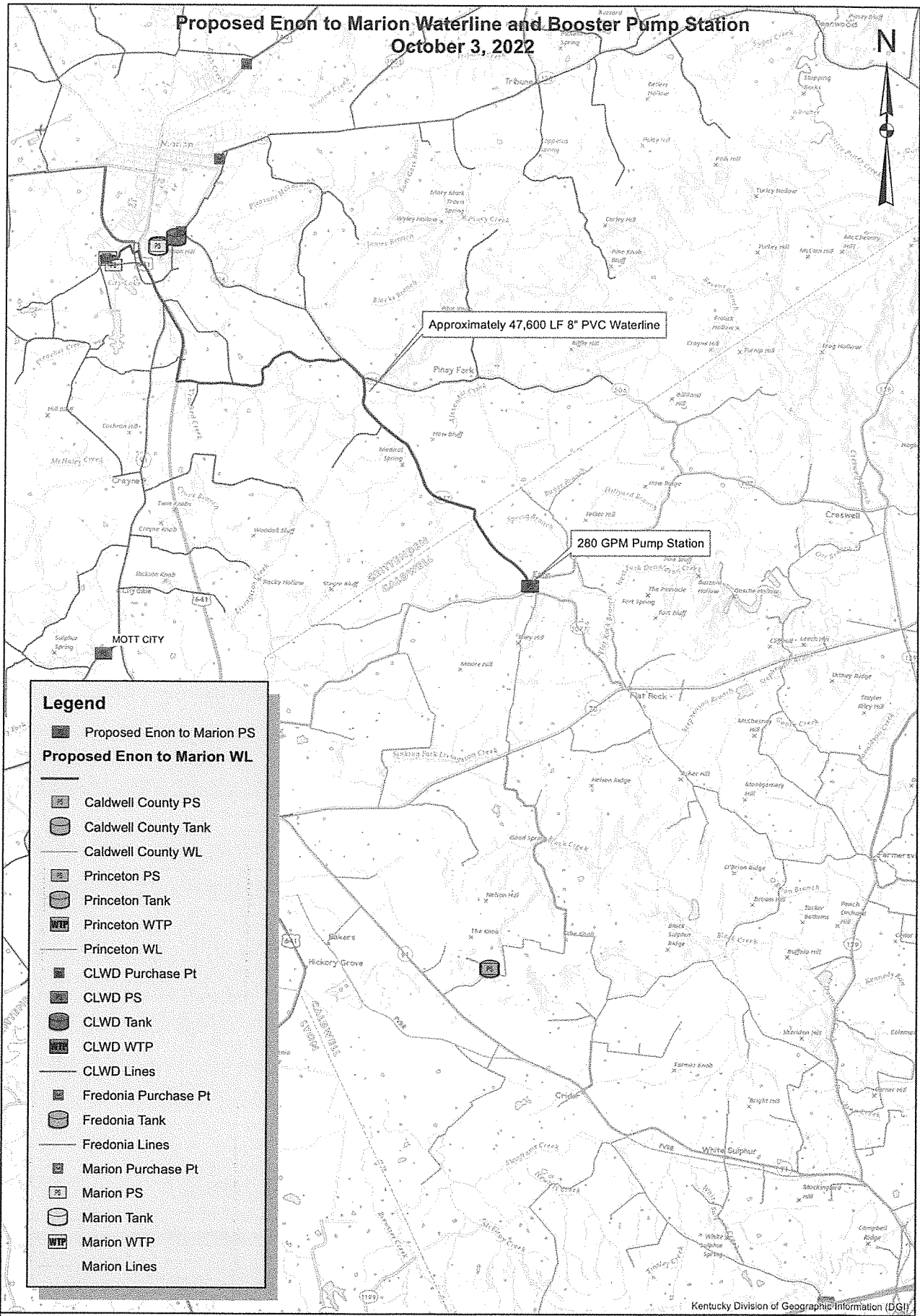
Design Assumptions:

1. Caldwell County (or Princeton) can provide approximately 280 gallons per minute to the connection location at a pressure that is adequate for all existing customers in the Caldwell (or Princeton) water distribution system(s). This includes having any necessary system upgrades completed (Princeton and/or Caldwell County) to provide this flowrate prior to the project coming online.
2. The proposed water line will be 8-inch diameter to reduce friction loss to a manageable amount over the length of the proposed connection.
3. No customer connections will be made along the proposed 8-inch diameter transmission main.
4. Proposed alignment follows roadway right-of-way where possible, this should reduce the number of easements required.
5. The Marion water treatment plant can receive the constant flow of approximately 280 gallons per minute without disruption i.e., there is adequate clearwell storage to allow for constant pumping.

Engineer's Preliminary Opinion of Probable Project Costs: \$5,374,000

Proposed Enon to Marion Waterline and Booster Pump Station

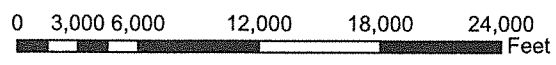
October 3, 2022



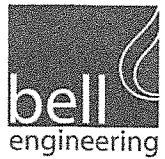
Legend

- Proposed Enon to Marion PS
- Proposed Enon to Marion WL**
- Caldwell County PS
- Caldwell County Tank
- Caldwell County WL
- Princeton PS
- Princeton Tank
- Princeton WTP
- Princeton WL
- CLWD Purchase Pt
- CLWD PS
- CLWD Tank
- CLWD WTP
- CLWD Lines
- Fredonia Purchase Pt
- Fredonia Tank
- Fredonia Lines
- Marion Purchase Pt
- Marion PS
- Marion Tank
- Marion WTP
- Marion Lines

Kentucky Division of Geographic Information (DGI)



1 inch = 6,000 feet



**Crittenden-Livingston County Water District
Water System Improvements
September 2022 Estimate of Probable Cost**

Estimated Construction Cost:

| | |
|--|----------------------|
| Additional 2.0 MGD treatment capacity | \$ 12,000,000 |
| Additional clearwell | \$ 2,000,000 |
| Raw water intake improvements | \$ 1,500,000 |
| Sitework and plant piping | \$ 800,000 |
| Additional Cumberland River crossing (southern Livingston County) | \$ 850,000 |
| 12-inch ductile iron or C900 pipe; 15,000 l.f. @ \$180.00/l.f. (Highway 723) | \$ 2,700,000 |
| 12-inch HDPE water line; 48,000 l.f. @ \$200.00/l.f. (Salem to Marion WTP) | \$ 9,600,000 |
| Pavement and property bores/restoration | \$ 150,000 |
| Upgrade Moore Hill Pump Station | \$ 250,000 |
| Main line and service reconnections along US 60 | \$ 300,000 |
| Connections/metering at Marion Water Treatment Plant | \$ 100,000 |
| Onsite electrical, new generator and Jackson Purchase Energy service upgrade | <u>\$ 1,000,000</u> |
| Estimate of Probable Construction Cost | \$ 31,250,000 |

Estimated Project Budget:

| | |
|--|----------------------|
| Construction | \$ 31,250,000 |
| Design (Per R/D Chart) | \$ 2,000,000 |
| Construction observation (Per R/D Chart) | \$ 660,000 |
| Easements | \$ 200,000 |
| Legal and administrative | \$ 500,000 |
| Permitting, surveying and geotechnical | \$ 100,000 |
| Contingency | <u>\$ 2,290,000</u> |
| Estimate of Probable Project Budget | \$ 37,000,000 |

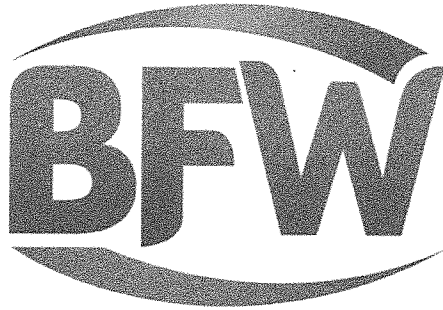


CRITTENDEN-LIVINGSTON COUNTY WATER DISTRICT
 WATER SYSTEM IMPROVEMENTS
 MARION, KY
 FOR
CITY OF MARION, KENTUCKY
 LOCATION MAP

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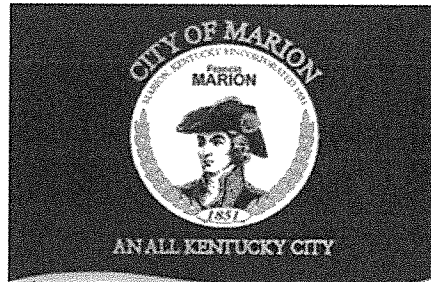
HUSSEY GAY BELL
Established 1958
 4117 HILLSBORO PIKE, SUITE 206, NASHVILLE, TN 37215 / 615.460.7515

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BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

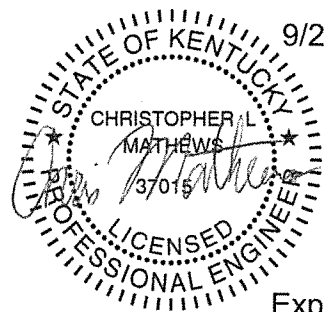
GEOTECHNICAL STABILITY ANALYSIS REPORT



Lake George Dam Marion, Kentucky

Submittal Date:

September 23, 2022



9/23/2022

Exp. 6/30/2024



BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.
500 SOUTH 17th STREET | PADUCAH, KY 42003

September 23, 2022

Mr. Charles Adam Ledford
City Administrator
City of Marion
217 South Main Street
Marion, Kentucky 42064

RE: ***Geotechnical Stability Analysis Report
Lake George Dam
Marion, Kentucky
BFW No: 22231***

Dear Mr. Ledford:

Bacon Farmer Workman Engineering & Testing, Inc. (BFW), is pleased to present the attached Geotechnical Stability Analysis Report for the referenced project. The foundation investigation was conducted in accordance with applicable ASTM standard and the *Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams* published by the Kentucky Division of Water (KDOW). It should be noted that this report only pertains to the geotechnical stability of the dam. Recommendations for repairs to the dam are provided under separate cover.

The attached report includes a review of pertinent project information, descriptions of site and subsurface conditions encountered, and the results of our stability analysis.

Sincerely,

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

A handwritten signature in black ink, appearing to read "Chris Mathews".

Christopher L. Mathews, P.E.
Geotechnical Engineer/Project Manager

A handwritten signature in black ink, appearing to read "Chris Farmer".

Christopher N. Farmer, P.E.
Principal Engineer

Attachment: Geotechnical Stability Analysis Report

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Appendix C – Subsurface Boring Logs

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Appendix E – Seepage and Slope Stability Analysis

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1. PROJECT INFORMATION

The purpose of this geotechnical study was to explore the subsurface conditions present at the site, to determine pertinent engineering properties of the materials encountered and evaluate the stability of the existing Lake George Dam in Marion, Kentucky. The site location is shown on Figure 1.1.

Initial concerns related to Lake George located in Marion, Kentucky were identified on or about April 27, 2022. A clean water leak was detected at the dam and communicated to the City of Marion Water Staff. The City of Marion began assessing the leak and immediately notified the Kentucky Division of Water (KDOW) and they began reviewing the leak.

On April 29, 2022, a small hole had developed mid-way up the dam, immediately above the area where the leak had occurred. It was determined that the size of the sinkhole on the side of the dam had grown exponentially, and plans were made to organize a controlled breach. The dam was breached at what was identified by KDOW to be the safest point on the dam. In an effort to prevent dam failure, a controlled breach was dug to the west of the hole. The water was diverted around the back side of the dam adjacent to Lake George Drive and directed to Crooked Creek. After about 5 to 7 days of draining, the controlled breach reduced the water level to below the breach. By early June, Lake George was drained to a level which was less than one (1) foot, which allowed for safe evaluation of the City's system and any damage to it.

During the evaluations, it was determined that the pipe running through the dam had failed, which led to the leak and erosion of the embankment soils. Accordingly, the intent of this evaluation was to determine the stability of the dam at various pool elevations after repairs had been made to the temporary spillway, existing spillway pipe and the dam embankment. BFW's recommendations for those repairs will be provided under separate cover.

The geotechnical exploration and analysis included in this report were performed in general accordance with the *Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams* published by the KDOW.



Figure 1.1. Project Location

2. SUBSURFACE EXPLORATION

2.1 SUBSURFACE EXPLORATORY METHODS

The procedures used by Bacon Farmer Workman Engineering & Testing, Inc. (BFW), Inc. for field sampling and testing were in general accordance with ASTM procedures, and established engineering practice. Nine (9) Piezocone Penetration Test (CPTu) soundings were advanced to refusal on bedrock at depths 6.6 to 31.2 feet. Hand auger borings were advanced immediately adjacent to two of the sounding locations to depths of 9.3 to 15 feet. The exploration locations were surveyed in the field by personnel from BFW. See the Exploration Location Plan in Appendix A for more detail on the exploration locations.

2.1.1 CPTu Soundings

The CPTu soundings were conducted in accordance with ASTM D5778 "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils" using a Vertec S4 CPT rig. The CPTu hydraulically pushes an instrumented cone through the soil while continuous readings are recorded on a portable computer. Load cells within the cone measure the in-situ parameters of the soil: tip resistance, sleeve friction and pore water pressure. These in-situ measurements of tip, side resistance, and porewater pressure are recorded every 2 centimeters (approximately 1-inch). No soil samples are gathered through this subsurface investigation technique; however, these measurements are an evaluation of soil strength, which is used to interpret how they will behave under loading. There are direct correlations between CPT results and the shear strength of soils and per USACE EM 1110-1-1800 *Geotechnical Investigations*, CPT is an acceptable method for establishing the in-situ shear strength of soils, The CPTu Logs in Appendix B of this report graphically illustrate the relative strength of the soils encountered and provide an approximate soil stratigraphy. Stratification lines on the CPTu Logs represent approximate boundaries between soil behavior types based on accepted correlations between the tip, side, and porewater pressure measurements. The CPTu soundings were grouted with cement/bentonite grout upon completion.

2.1.2 Hand Auger Borings

To supplement the data collected from the CPTu soundings, two (2) hand auger borings we advanced adjacent to CPTu soundings. Field vane shear tests were be performed in accordance with ASTM D2573 within the hand auger borings to provide additional strength information of the soils. The hand auger borings were backfilled with bentonite chips at the completion of the subsurface investigation

Our geotechnical engineer performed the vane shear tests and visually classified soil samples obtained in accordance with Unified Soil Classification System (USCS) and ASTM D-2488 guidelines. Records of the conditions encountered, and visual soil classification were prepared and incorporated in Subsurface Boring Logs included in Appendix C.

The Subsurface Boring Logs represent BFW's interpretation of the conditions encountered within the soil test borings. It should be noted that strata changes may vary from those encountered within the soil test borings, transitions may be gradual or abrupt, and conditions may vary significantly at other locations. Representative soil samples obtained from the boring were preserved in plastic bags, sealed, and taken to the laboratory for testing.

2.2 LABORATORY TESTING PROCEDURES

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the soils encountered during the exploration. The following laboratory tests were performed on representative soil samples:

- Moisture content – ASTM D2216
- Atterberg Limits – ASTM D4318
- Grain Size Analysis – ASTM C136
- Grain Size Analysis with Hydrometer – ASTM D422

Based on the laboratory test results, the soils encountered were classified according to the USCS classification system. The results of the laboratory testing program are shown along with the field test results on the Boring Logs in Appendix C and included in Appendix D.

2.3 REGIONAL GEOLOGY

According to the Kentucky Geologic Map Service, the site is underlain by the Cypress Sandstone, Paint Creek Shale, and Bethel Sandstone. The Cypress Sandstone consists of sandstone and shale, interbedded: The sandstone is light- and medium-gray, very fine to fine grained; beds commonly 1/2 to 4 inches thick; some disseminated carbon in upper part of unit. The shale is sandy, gray and black. Outcrops are common.

The Paint Creek Shale consists of shale and limestone: The shale is dark-gray; commonly calcareous in lower part and sandy near top; some pyrite. Limestone, medium-gray, medium-crystalline, commonly sandy; abundant fossil fragments; beds generally 2 to 6 inches thick. Outcrops are rare.

The Bethel Sandstone is light-gray to white; weathers brown, very fine to medium grained, friable, locally crossbedded and ripple-marked; beds commonly 1 to 3 feet thick; thin beds of gray shale common in upper part but rare elsewhere. Lower 3 to 5 feet generally contains abundant calcareous fossil fragments as much as 1/4 inch in diameter and much interstitial calcareous cement.

2.4 SUBSURFACE CONDITIONS

CPTu soundings C-1 through C-3 were advanced near the downstream toe of the dam in the native foundation soils. Based on the results of the CPT soundings, the native soils consist of loose to dense sands and gravels and occasionally small amounts of cohesive sand and silt. The remaining soundings were advanced on the existing dam embankment and the CPTu soundings indicated the embankment soils consisted of predominately soft to medium stiff lean clay soils with occasional silty layers. Hand auger borings were advanced immediately adjacent to soundings C-5 and C-8 and encountered predominately lean clay soils and occasionally silt. Vane shear testing indicated in-situ undrained shear strength of the embankment soils ranging from 0.2 to greater than 4.8 kips per square foot (ksf). Each CPT sounding was advanced to the depth of cone refusal, which we anticipate occurred on bedrock. The depth and elevation of bedrock encountered at each boring is summarized in Table 2.1. No rock coring was performed for the project; however, we anticipate the bedrock consists of either limestone or sandstone.

Table 2.1 – Bedrock Depth and Elevation

| Location | Ground Surface Elevation (msl) | Approximate Depth to Bedrock (ft) | Approximate Bedrock Elevation (msl) |
|----------|--------------------------------|-----------------------------------|-------------------------------------|
| C-1 | 585 | 7.4 | 577.6 |
| C-2 | 577 | 6.6 | 570.4 |
| C-3 | 586 | 7.9 | 578.1 |
| C-4 | 604 | 20.2 | 583.8 |

Table 2.1 – Bedrock Depth and Elevation (Continued)

| Location | Ground Surface Elevation (msl) | Approximate Depth to Bedrock (ft) | Approximate Bedrock Elevation (msl) |
|----------|--------------------------------|-----------------------------------|-------------------------------------|
| C-5 | 604 | 31.2 | 572.8 |
| C-6 | 588 | 10.2 | 577.8 |
| C-7 | 590 | 18.9 | 571.1 |
| C-8 | 585 | 18.4 | 566.6 |
| C-9 | 593 | 22.3 | 570.7 |

2.5 GROUNDWATER

Groundwater was not encountered in the hand auger borings. However, pore pressure response in the CPTu soundings indicated that groundwater may currently be present within the embankment at depth ranging from 14 to 26 feet. It should be noted that the ground water level is dependent upon seasonal and climatic variations and may be present at different depths in the future. Additionally, the phreatic surface within the embankment will be dependent upon the pool elevation of Lake George.

3. GEOTECHNICAL EVALUATIONS

Based on the results of the subsurface exploration, current site conditions observed, laboratory results, and our review of the project plans, the following geotechnical stability analysis of the embankment was performed. The analyses were performed in general accordance with the *Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams* published by the KDOW.

3.1 BASIS FOR RECOMMENDATIONS

The following recommendations are based on data from this exploration and the stated project information. In our evaluations, we have utilized both subsurface data from this exploration and our experience with similar subsurface conditions.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized based on soil test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil-engineering services during the site preparation, excavation, and repair phases of the dam. The geotechnical engineer should observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.2 SEEPAGE ANALYSIS

To develop the phreatic surface used in our slopes stability analyses, a seepage analysis was performed at the critical (tallest) cross section of the dam. The analyses were performed using the finite element (FEM) analysis method and the commercially available software program Slide2 (developed by RocScience, Inc). The ground surface in the seepage model was created based on the topographic survey information collected by BFW. The subsurface profile model is shown on the attached Seepage Analysis Output Plots in Appendix E. Hydraulic conductivities used in the seepage models were developed using results of the laboratory permeability testing, the CPT data according to Lunne 1977 (estimated based on the weighted average of the normalized soil behavior type). Normal pool elevations of El. 591 and 600 were evaluated. Representative soil layers were modeled with the parameters shown on the output plots in Appendix E. The calculated phreatic surfaces for each pool elevation are also shown in Appendix E.

3.3 SLOPE STABILITY ANALYSIS

Slope stability analyses were conducted using limit equilibrium slope stability methods and the commercially available software program Slide2 (developed by Rocscience, Inc.). The analyses considered soil properties from the subsurface exploration data, and the embankment geometry determined from our topographic survey.

Three analyses conditions were evaluated for the existing embankment geometry, as required by KDOW. The conditions analyzed were steady state seepage, rapid draw down and seismic. All analyses use long term strength parameters. The phreatic surface and pore pressures in the embankment determined in the seepage analysis were used in the slope stability analysis. For the seismic evaluation, the peak ground acceleration (PGA) from the design earthquake along with procedures for seismic slope stability outlined in Federal Highway Administration (FHWA) publication *FHWA-HI-99-012 Geotechnical Earthquake Engineering* were utilized. Soil parameters used in the analyses and the results of the analyses are shown on the output plots in Appendix E. A critical factor of safety (FOS) was calculated for each condition and then compared to the KDOW required FOS. The results of the analysis are shown in Table 3.1.

Based on the analysis performed, the dam embankment achieves the KDOW required FOS for both pool elevations analyzed. Additionally, the embankment soils encountered are generally considered suitable for earth dam construction. Isolated zones of siltier soils were encountered; however, due to the isolated nature

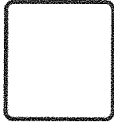
of these soils and the long-term performance of the dam, we do not believe they pose an issue with the stability or performance of the embankment.

Table 3.1 – Slope Stability Analysis Results

| Pool Elevation | Steady-State Seepage | | Rapid Drawdown | | Seismic | |
|----------------|----------------------|----------------|----------------|----------------|--------------|----------------|
| | Required FOS | Calculated FOS | Required FOS | Calculated FOS | Required FOS | Calculated FOS |
| 591 | 1.5 | 2.0 | 1.2 | 1.5 | 1.0 | 1.0 |
| 600 | 1.5 | 2.4 | 1.2 | 1.3 | 1.0 | 1.0 |

It should be noted that our analyses assumes that the damaged pipe will be grouted in place, the erosion damage to the downstream face of the embankment will be repaired and the temporary spillway will be restored to the original design elevation. Additionally, we understand that a new spillway pipe will be installed in the area of the temporary spillway before the embankment elevation is restored in that area. BFW will provide a narrative of the proposed concepts of repair under separate cover. Upon approval of the stability analysis and concept of repair narrative by KDOW, full plans and specifications for repair of the dam and embankment will be prepared. BFW’s civil and geotechnical engineers will work in conjunction to develop these plans.

Appendix A
Exploration Location Map



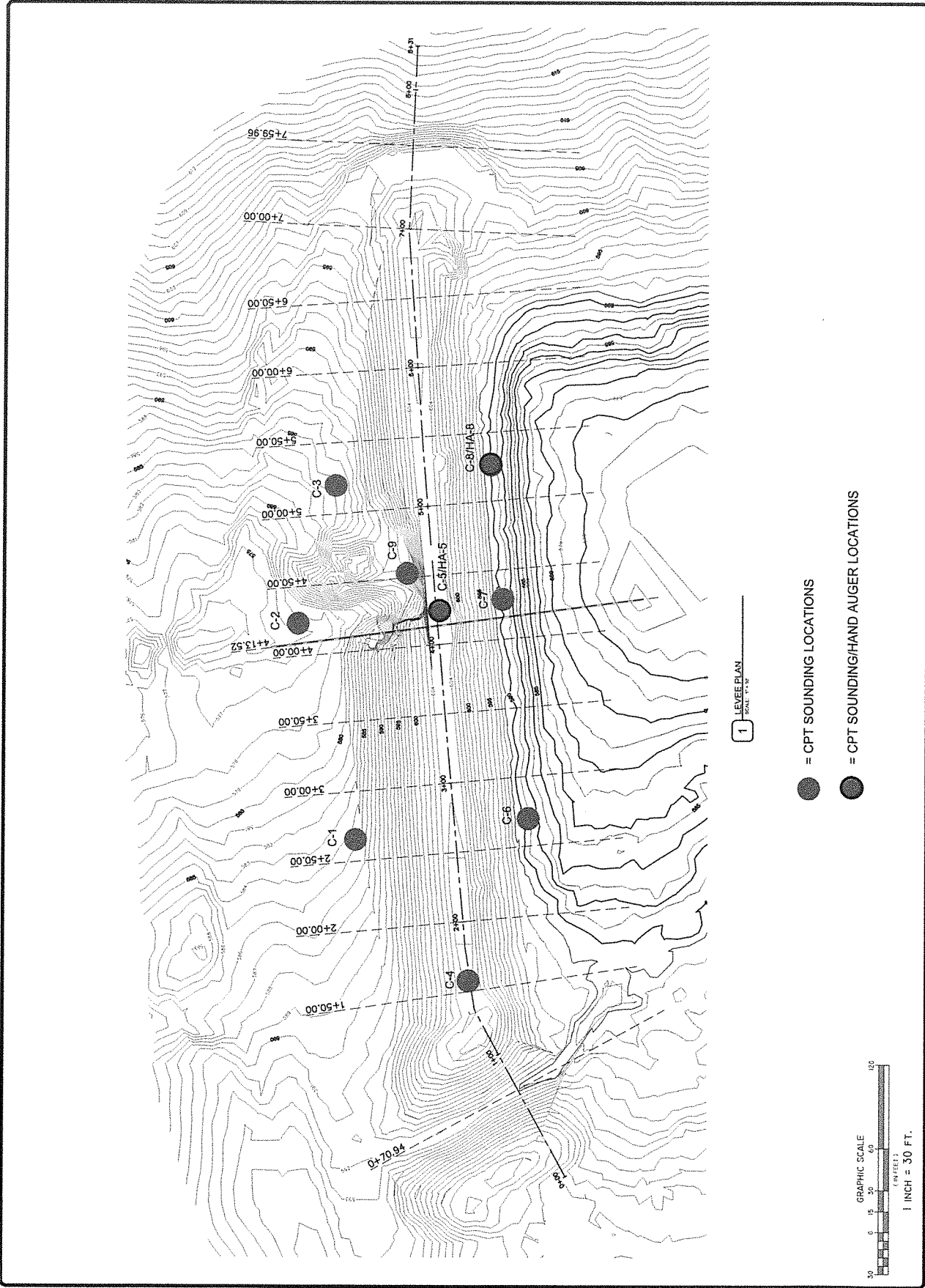
| | |
|------------------|-----------------|
| PROJECT NO. 2223 | DATE 7/2/2022 |
| DESIGNED BY: SAJ | CHECKED BY: LJA |
| REV. DESCRIPTION | BY DATE |
| | |
| | |

BFW
ENGINEERING & TESTING, INC.
BACON | FARMER | WORKMAN

1000 W. MAIN ST. SUITE 100
MADISON, KY 40302
502.261.1111
www.bfw-engineering.com

| |
|------------------------------|
| LEVEE PLAN |
| CITY OF MARRON |
| MARRON, KY |
| CITY OF MARRON - LAKE GEORGE |

SHEET
C1.0



Appendix B

CPTu Logs

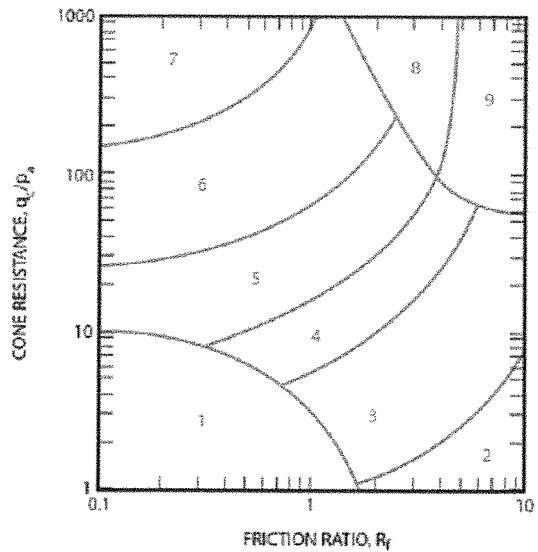


USE AND UNDERSTANDING OF CPT LOGS

The CPTu logs show the corrected Tip Resistance (q_t), Friction (f_s), Porewater Pressure (U_2), SPT N_{60} correlation (N_{60}), and the Soil Behavior interpretation results. The corrected cone tip resistance (q_t) is measured as the maximum force over the projected area of the cone tip. The sleeve friction (f_s) is used as a measure of soil type and can be expressed by friction ratio (R_f) which is used in the soil behavior classification. The u_2 position element is required for the measurement of penetration porewater pressures and the correction of tip resistance. Calculations of q_t , R_f , and the SPT N_{60} calculation are discussed below.

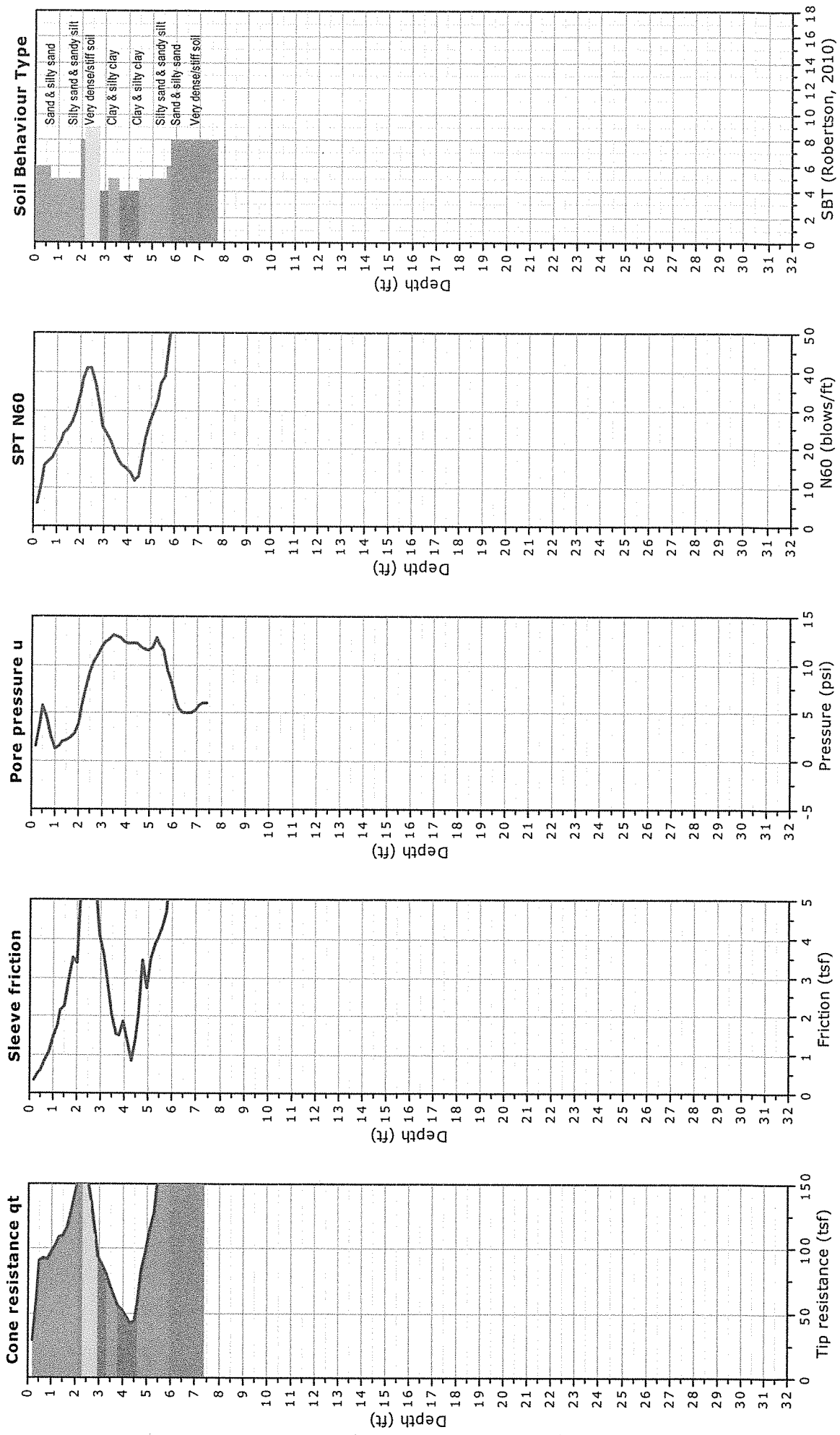
The estimated stratigraphic profiles included in the CPTu logs are based on relationships between q_t , f_s , R_f , and U_2 as shown graphically in the figure below.

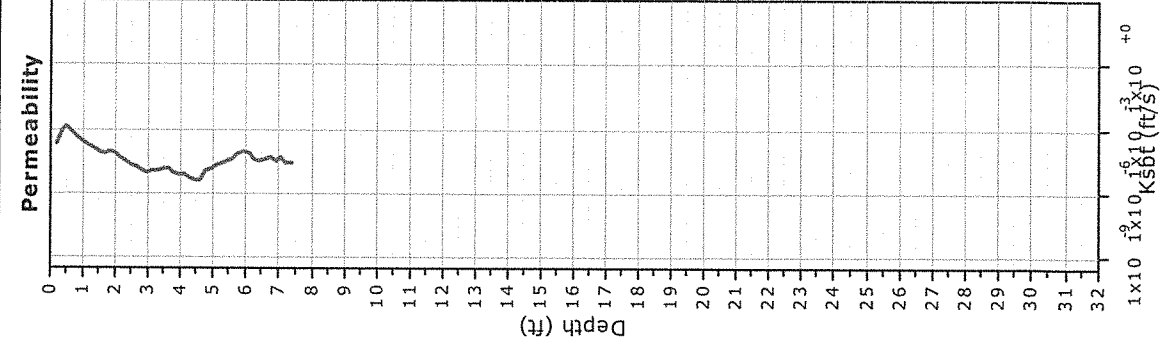
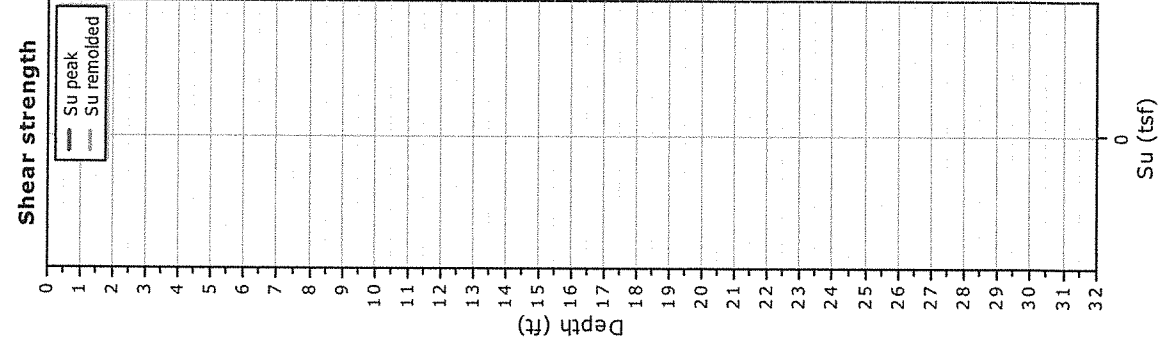
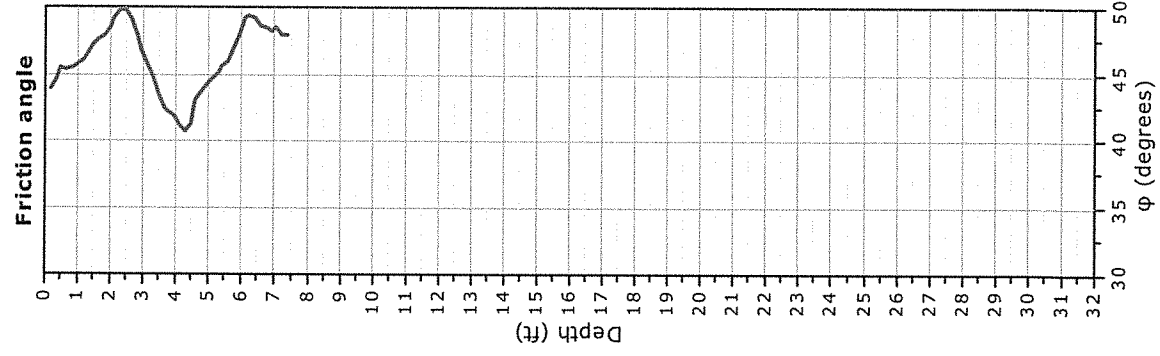
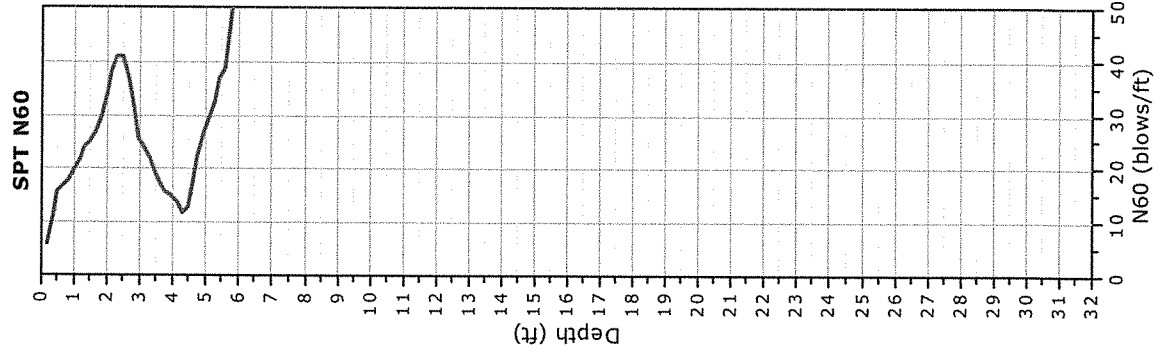
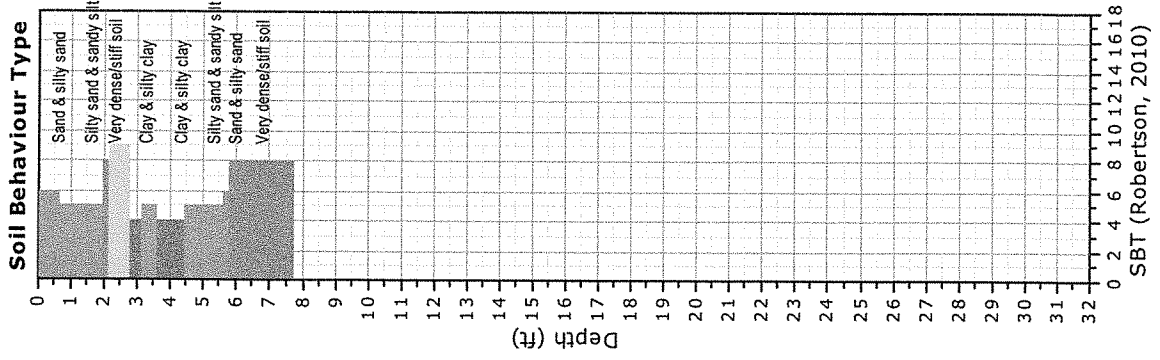
Non-normalized CPT Soil Behavior Type (SBT) chart

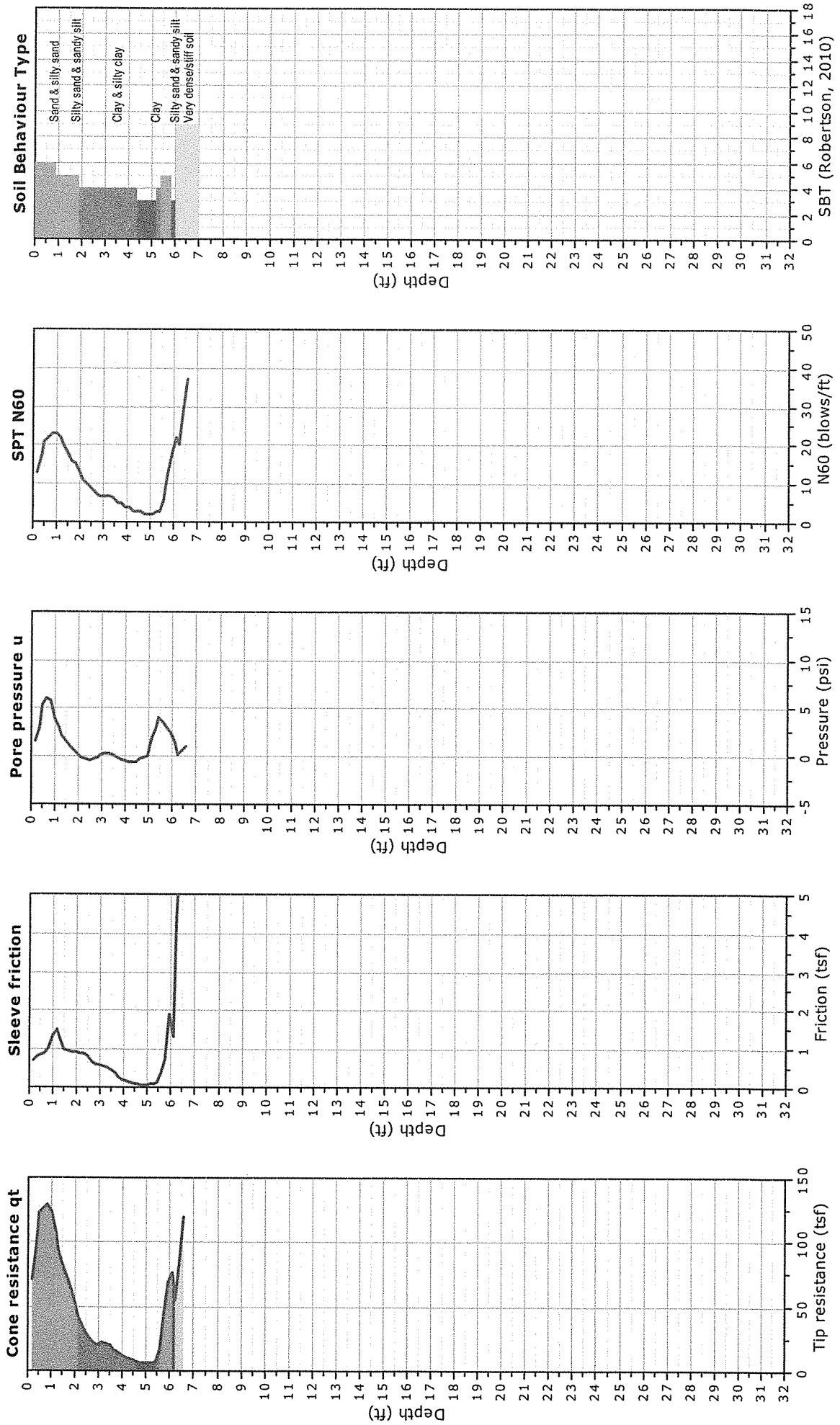


| <i>Z</i> | <i>Soil Behavior Type</i> |
|----------|--|
| 1 | <i>Sensitive, fine grained</i> |
| 2 | <i>Organic soils - clay</i> |
| 3 | <i>Clay - silty clay to clay</i> |
| 4 | <i>Silt mixtures - clayey silt to silty clay</i> |
| 5 | <i>Sand mixtures - silty sand to sandy silt</i> |
| 6 | <i>Sands - clean sand to silty sand</i> |
| 7 | <i>Gravelly sand to dense sand</i> |
| 8 | <i>Very stiff sand to clayey sand*</i> |
| 9 | <i>Very stiff fine grained*</i> |

** Heavily overconsolidated or cemented*

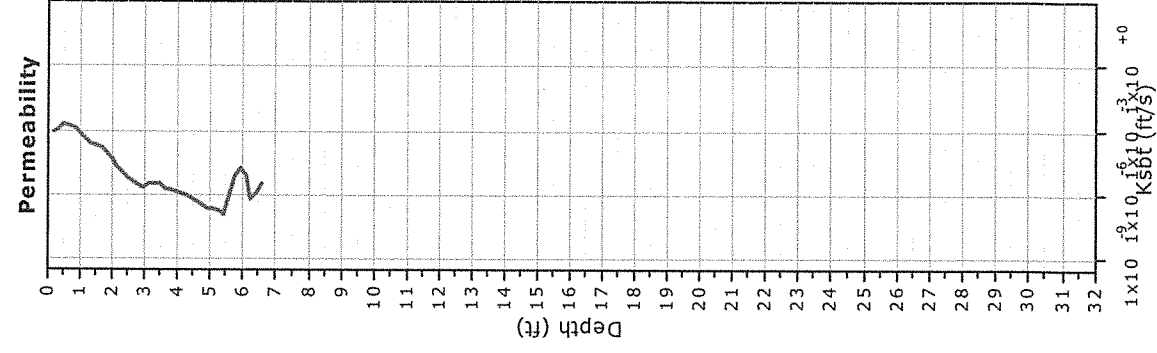
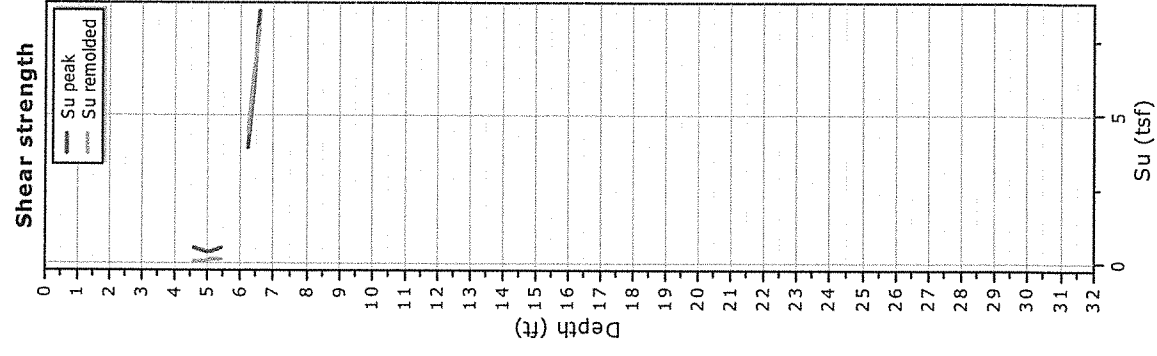
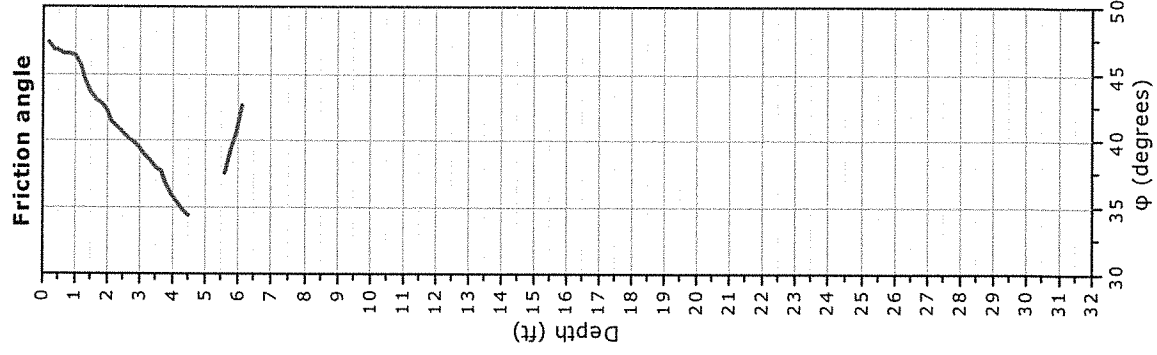
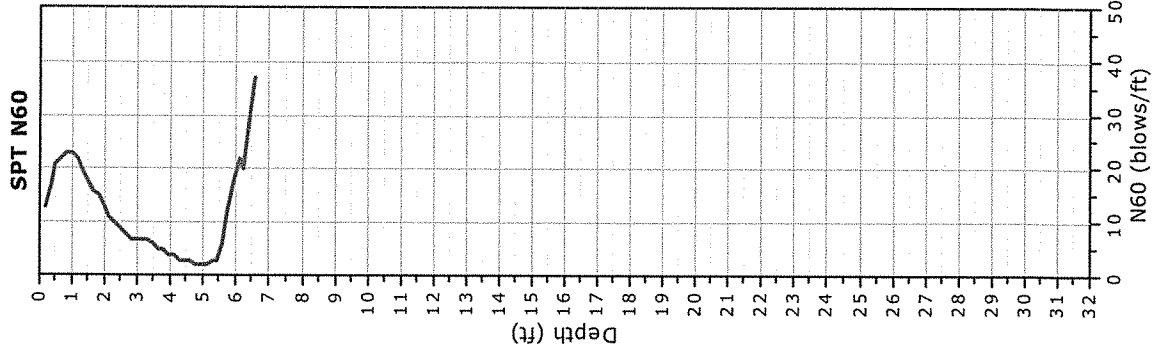
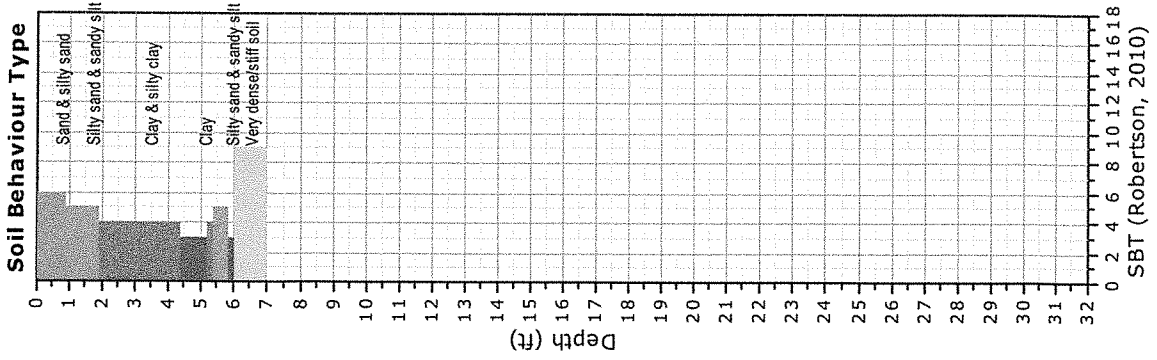


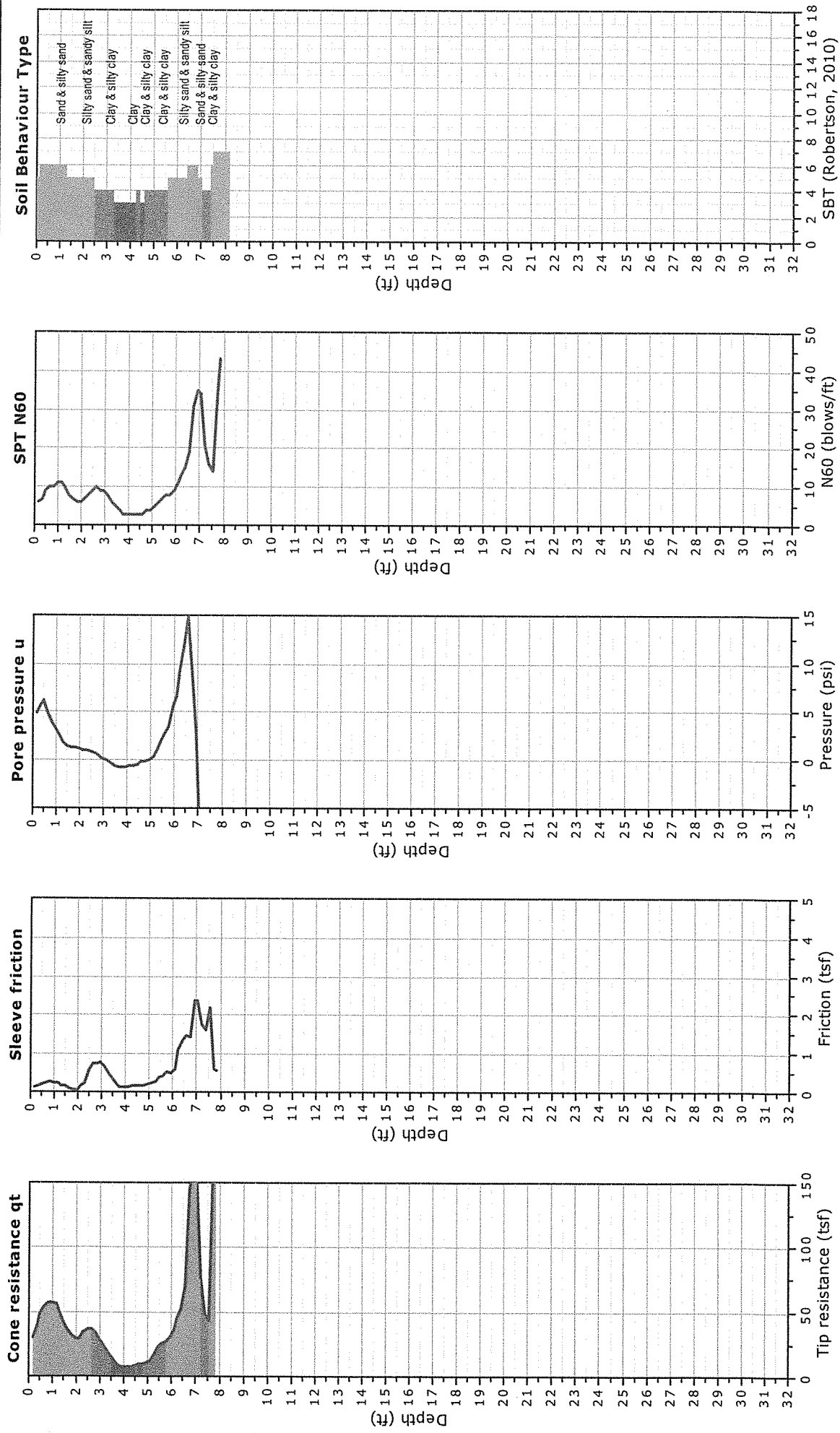


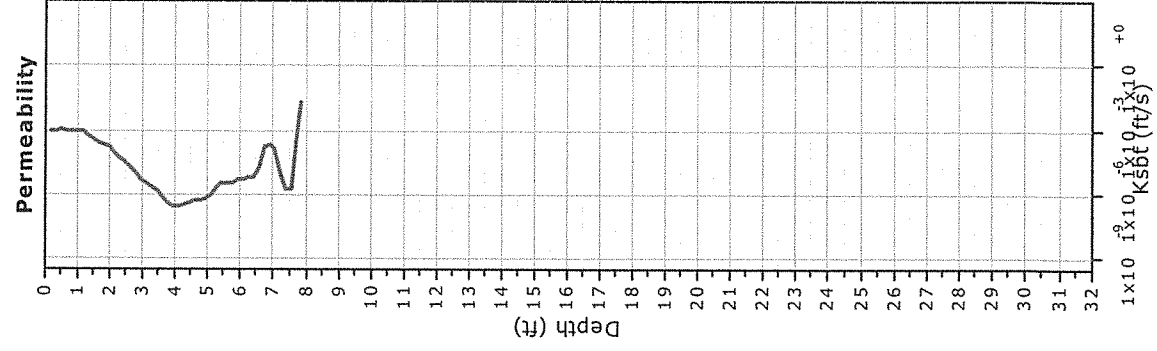
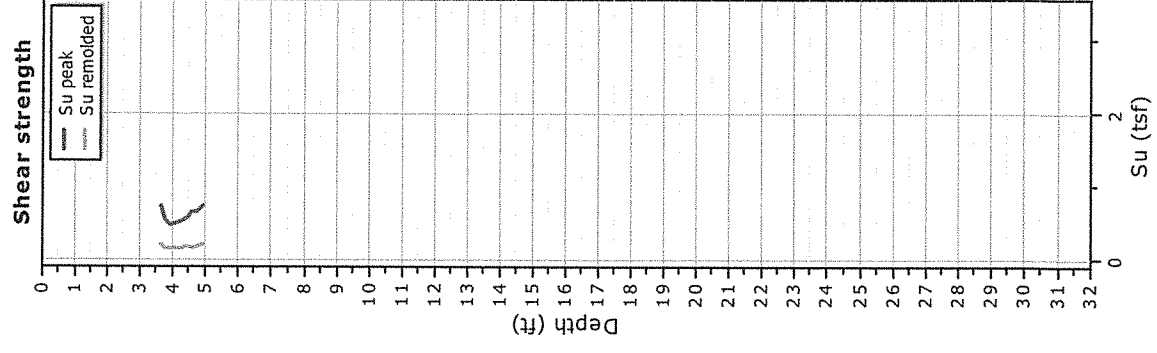
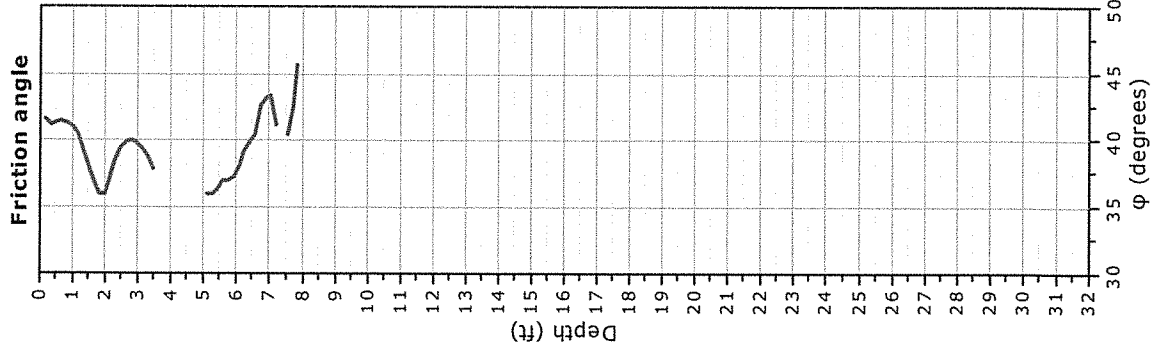
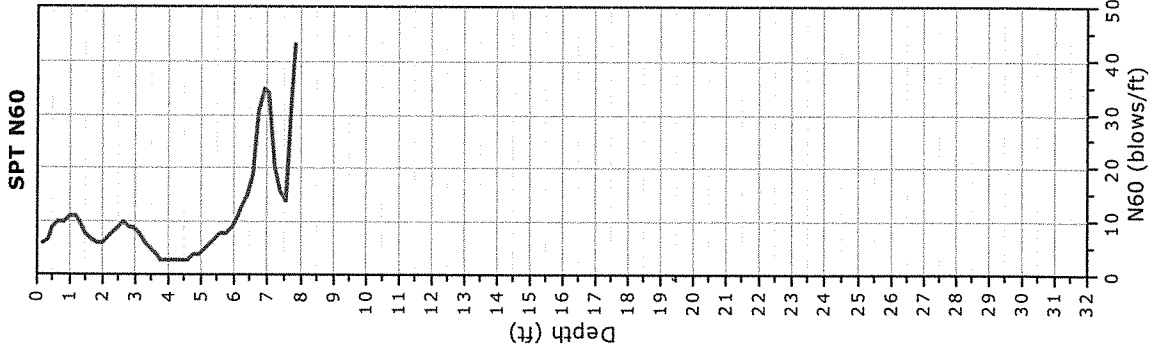
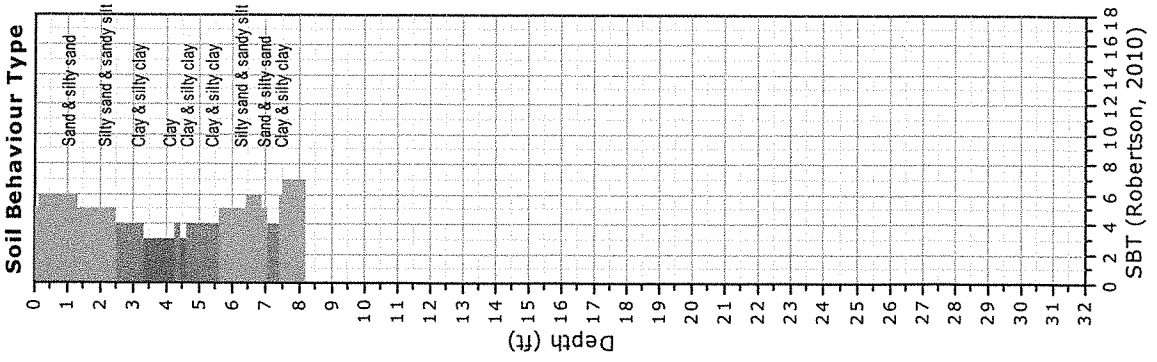


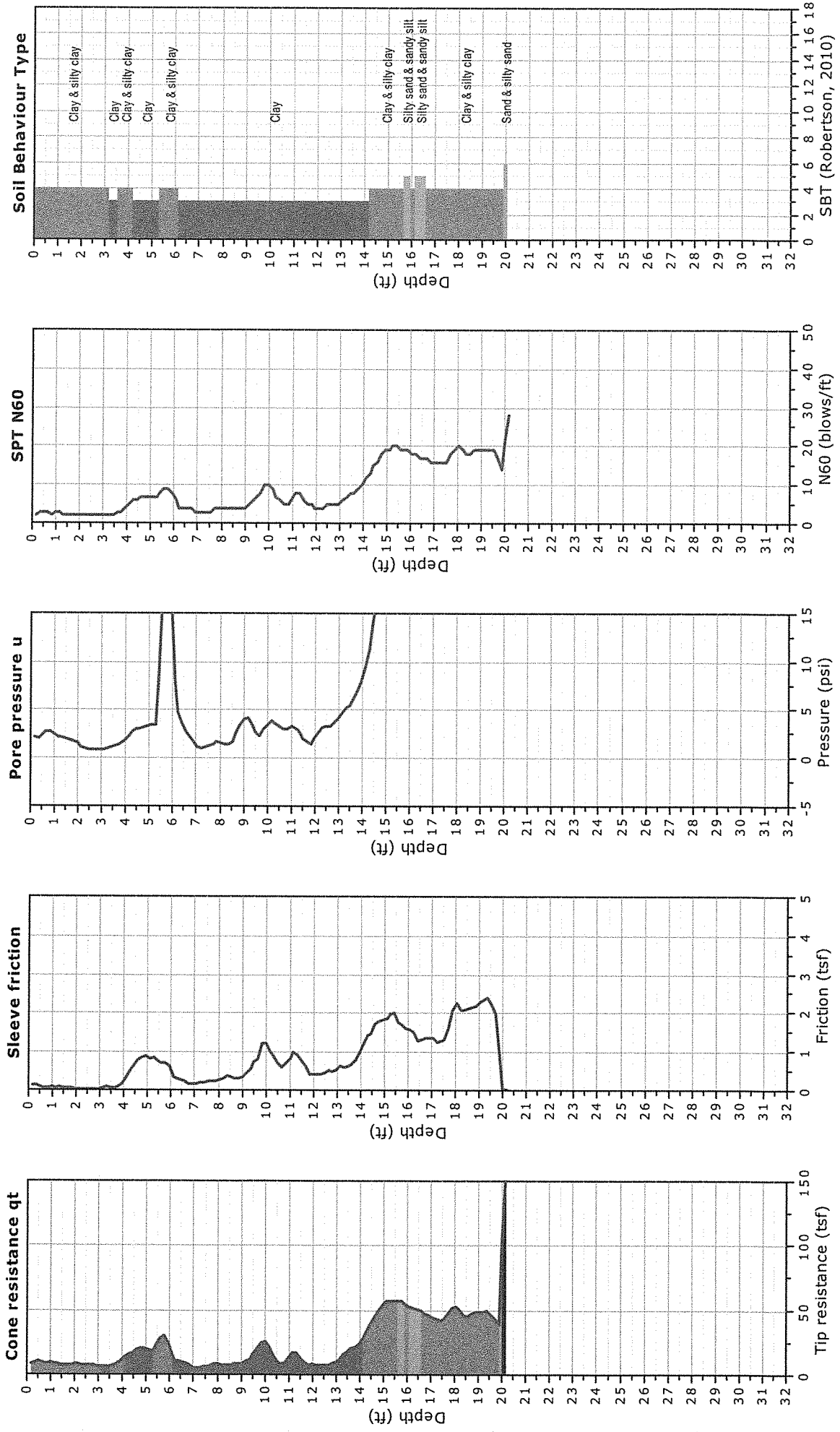
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 Surface Elevation: 577.00 ft

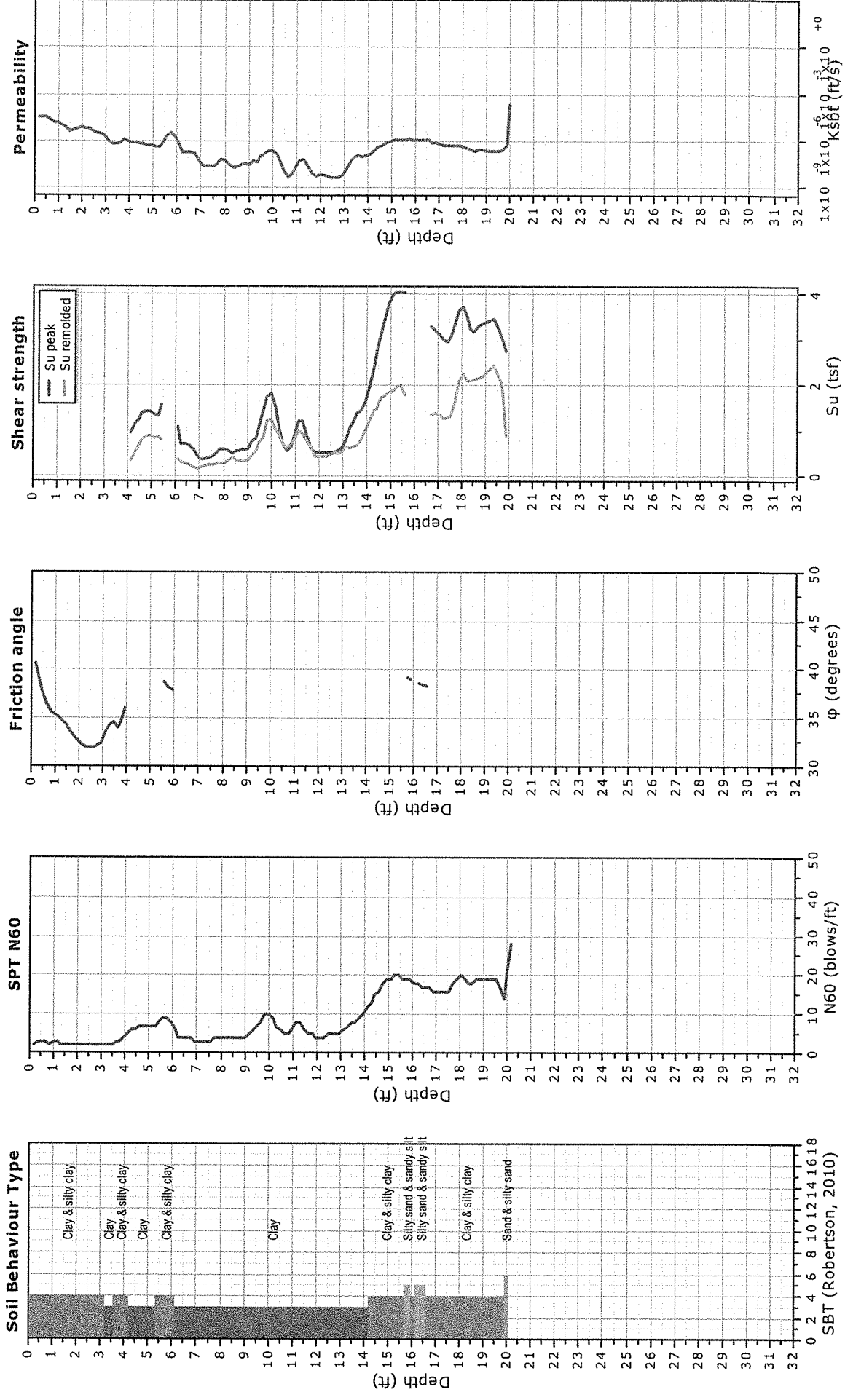
Project: 22231: Lake George Dam Emergency Repairs
Location: Marion, KY





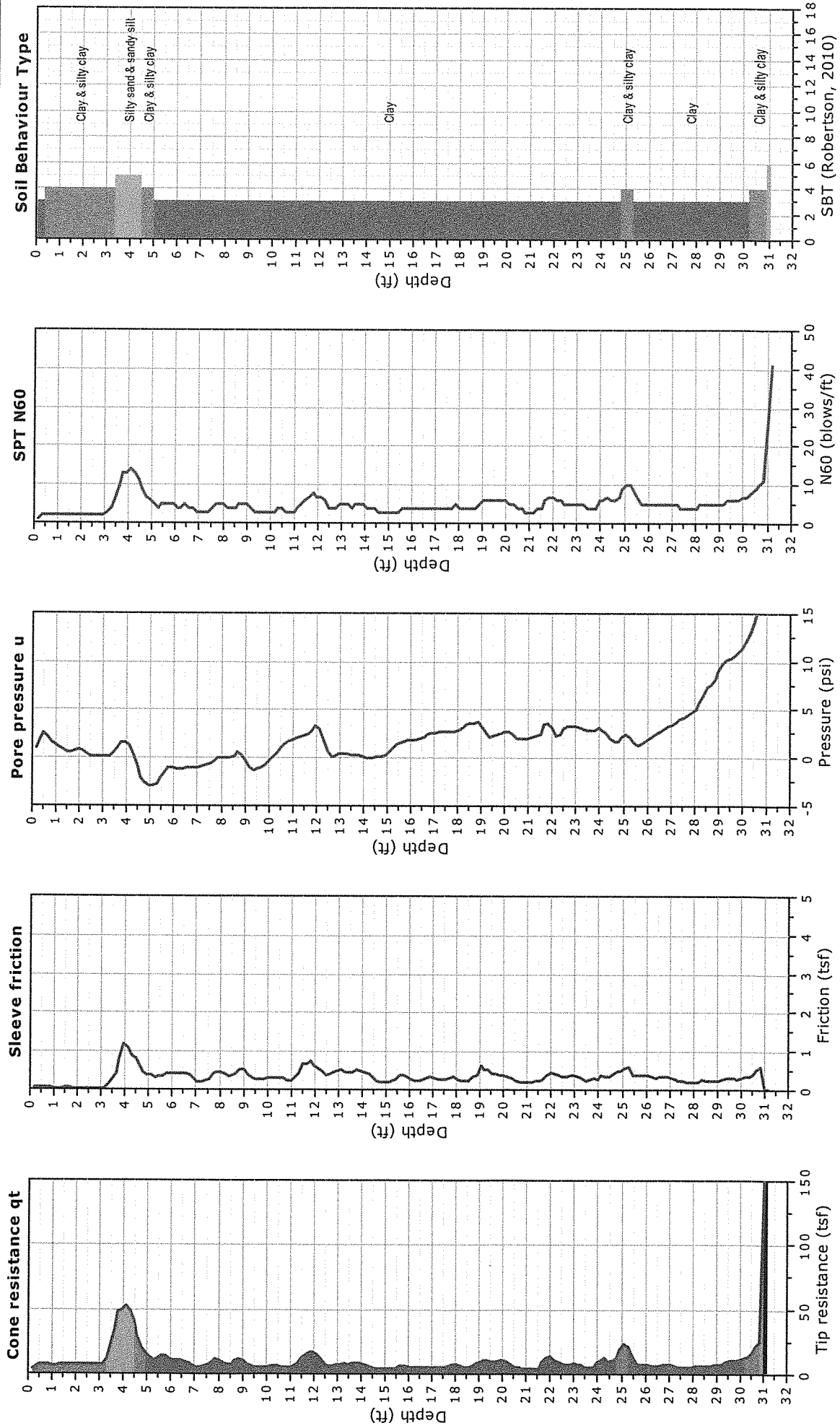


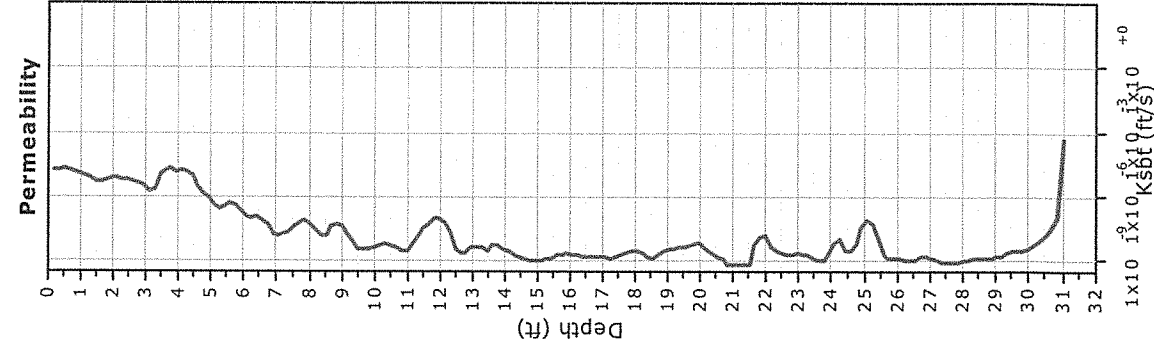
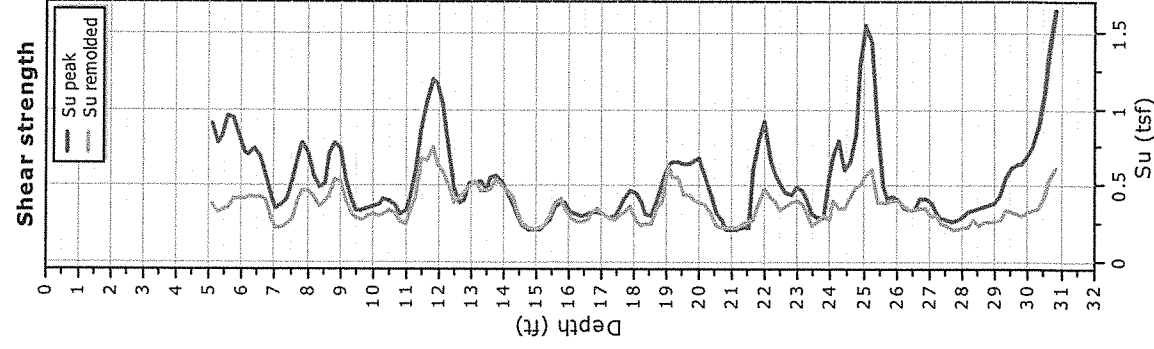
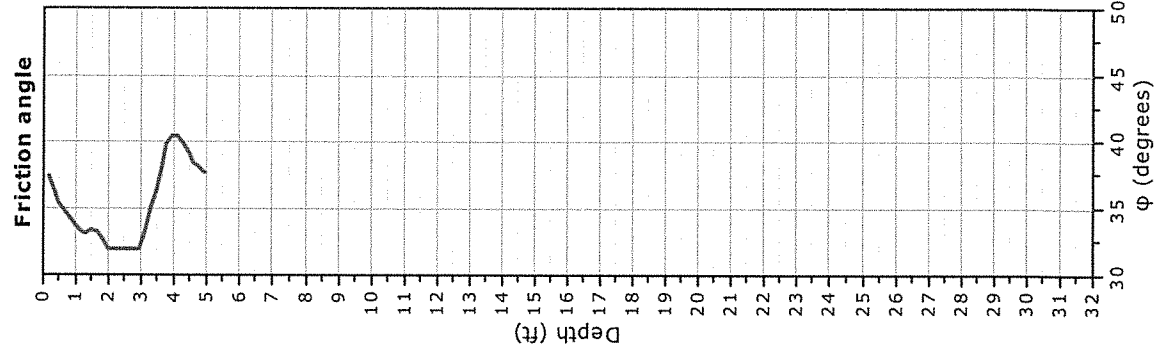
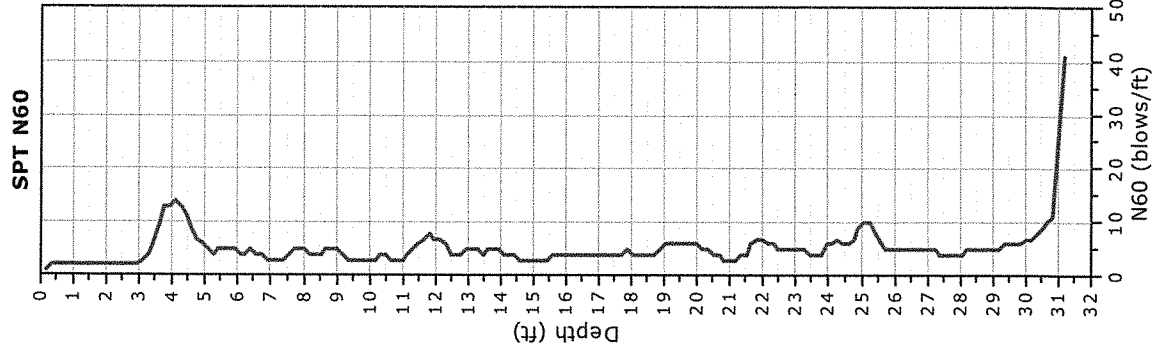
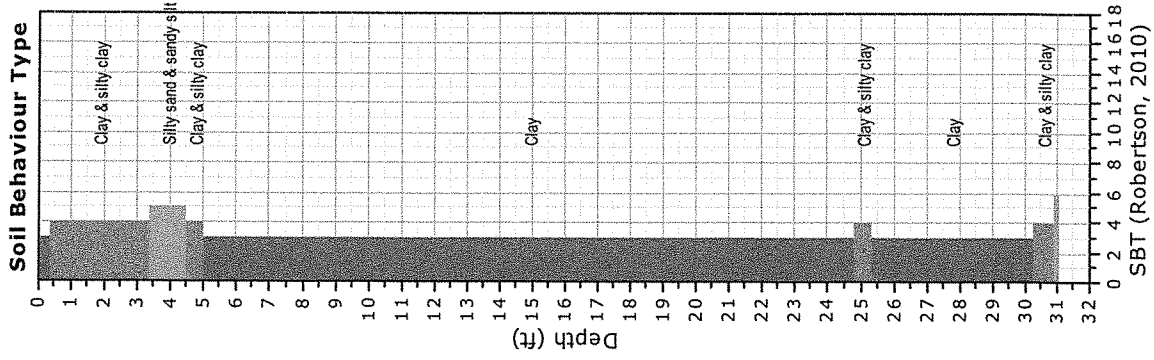




Project: 22231: Lake George Dam Emergency Repairs
Location: Marion, KY

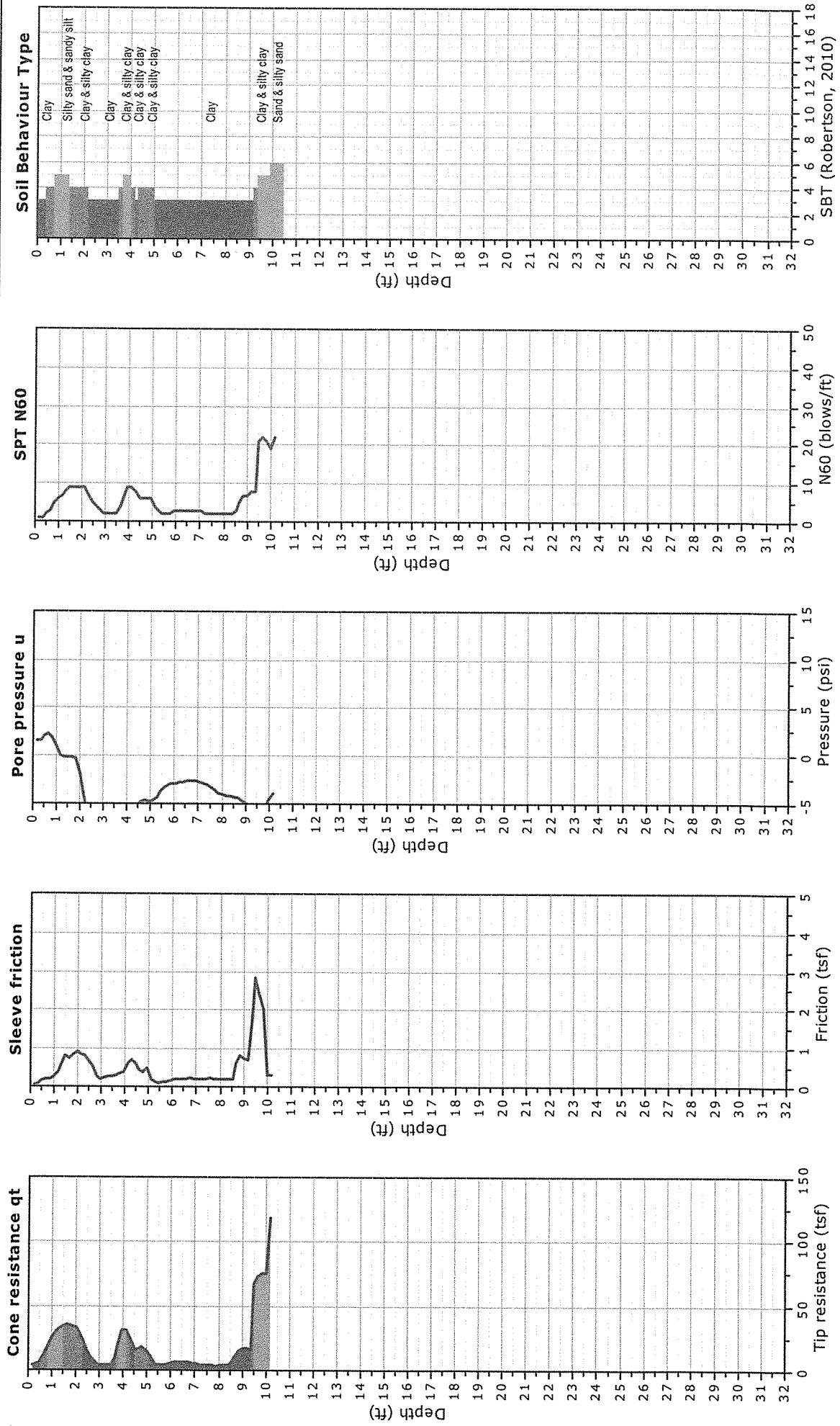
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Surface Elevation: 604.00 ft

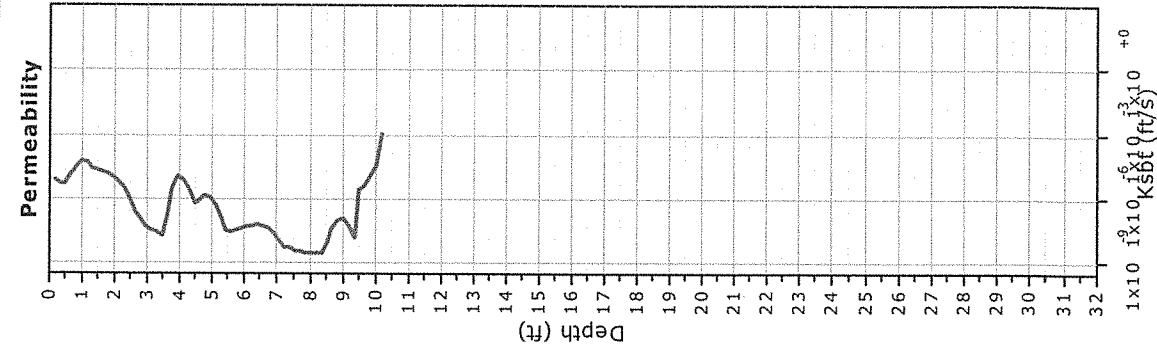
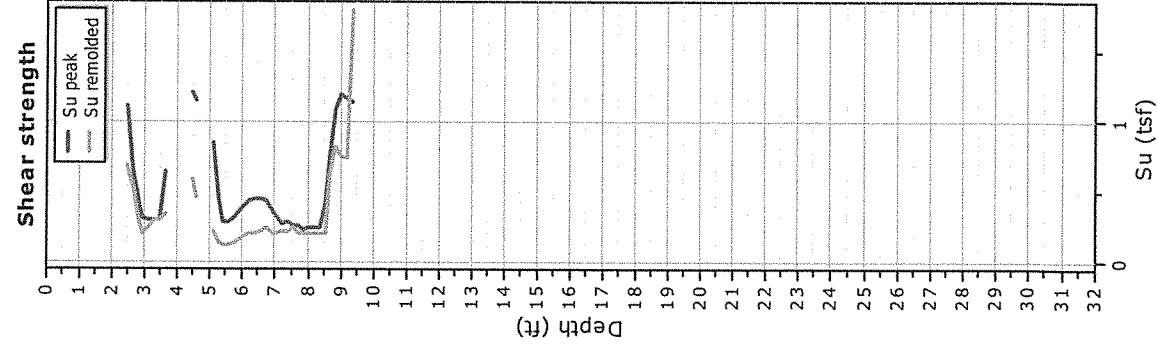
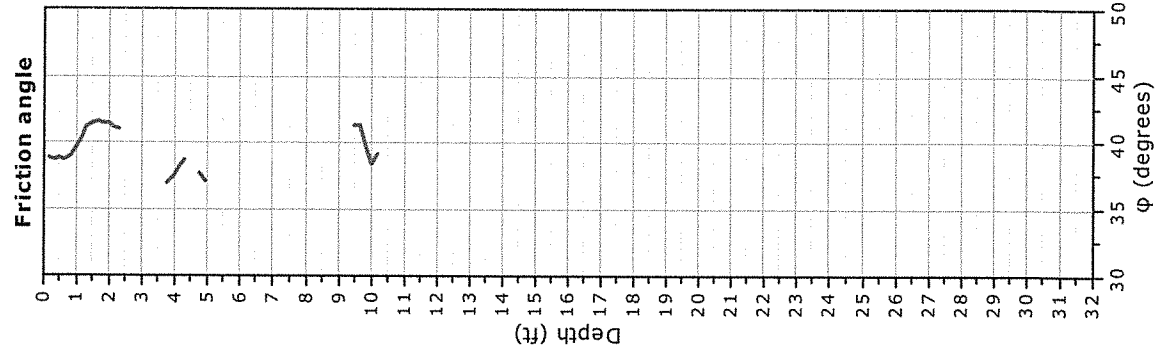
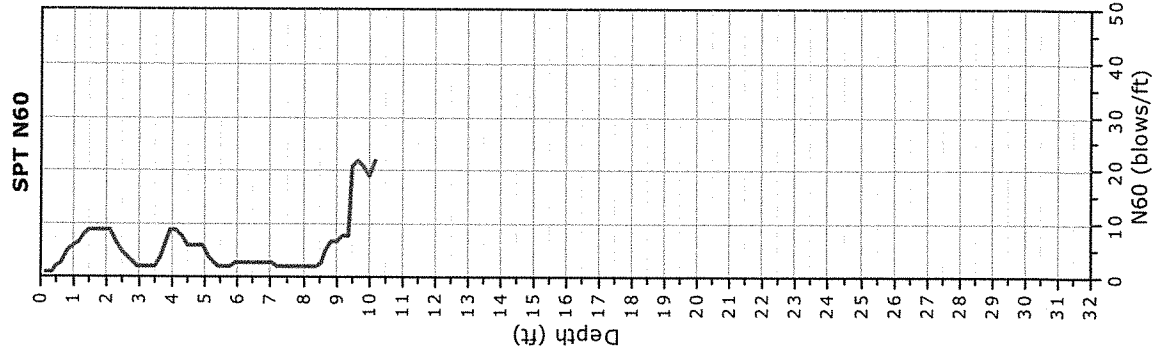
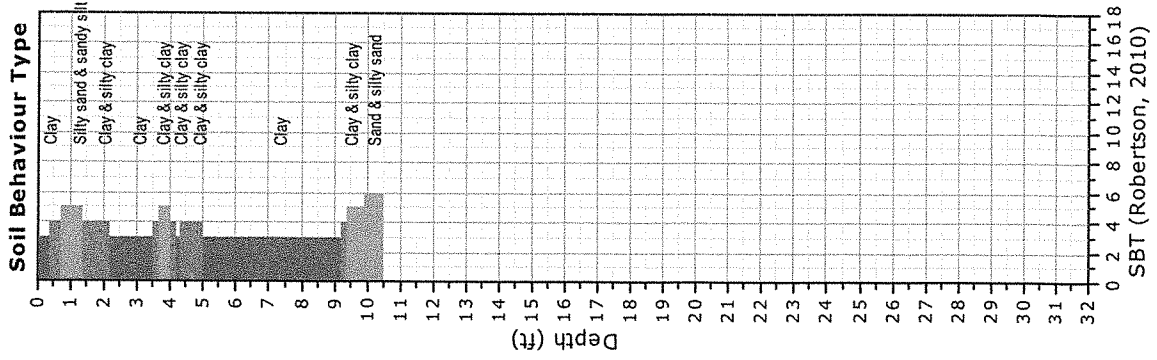


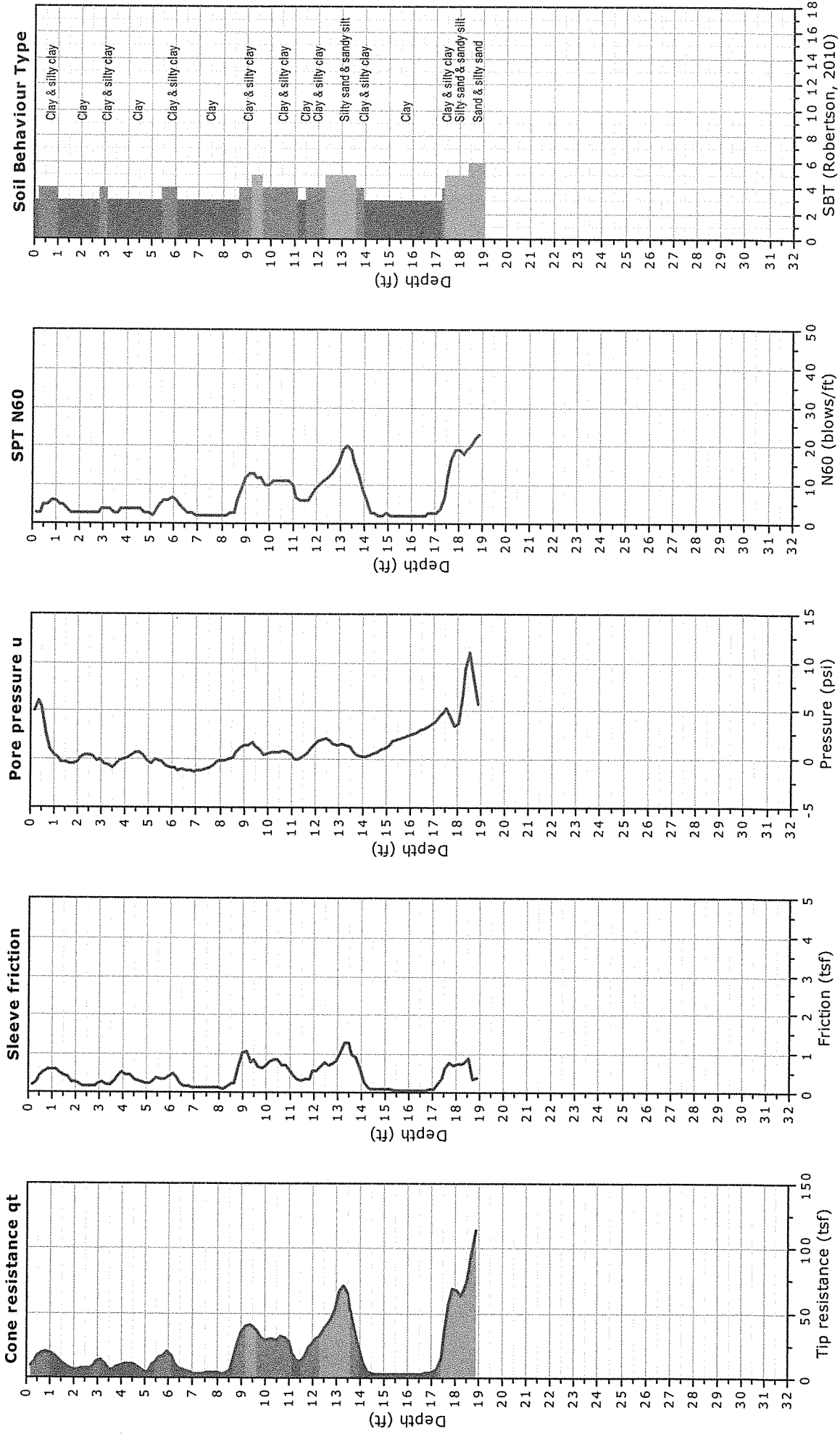


Project: 22231: Lake George Dam Emergency Repairs
Location: Marion, KY

CPT: C-6
 Total depth: 10.17 ft, Date: 7/29/2022
 Surface Elevation: 588.00 ft



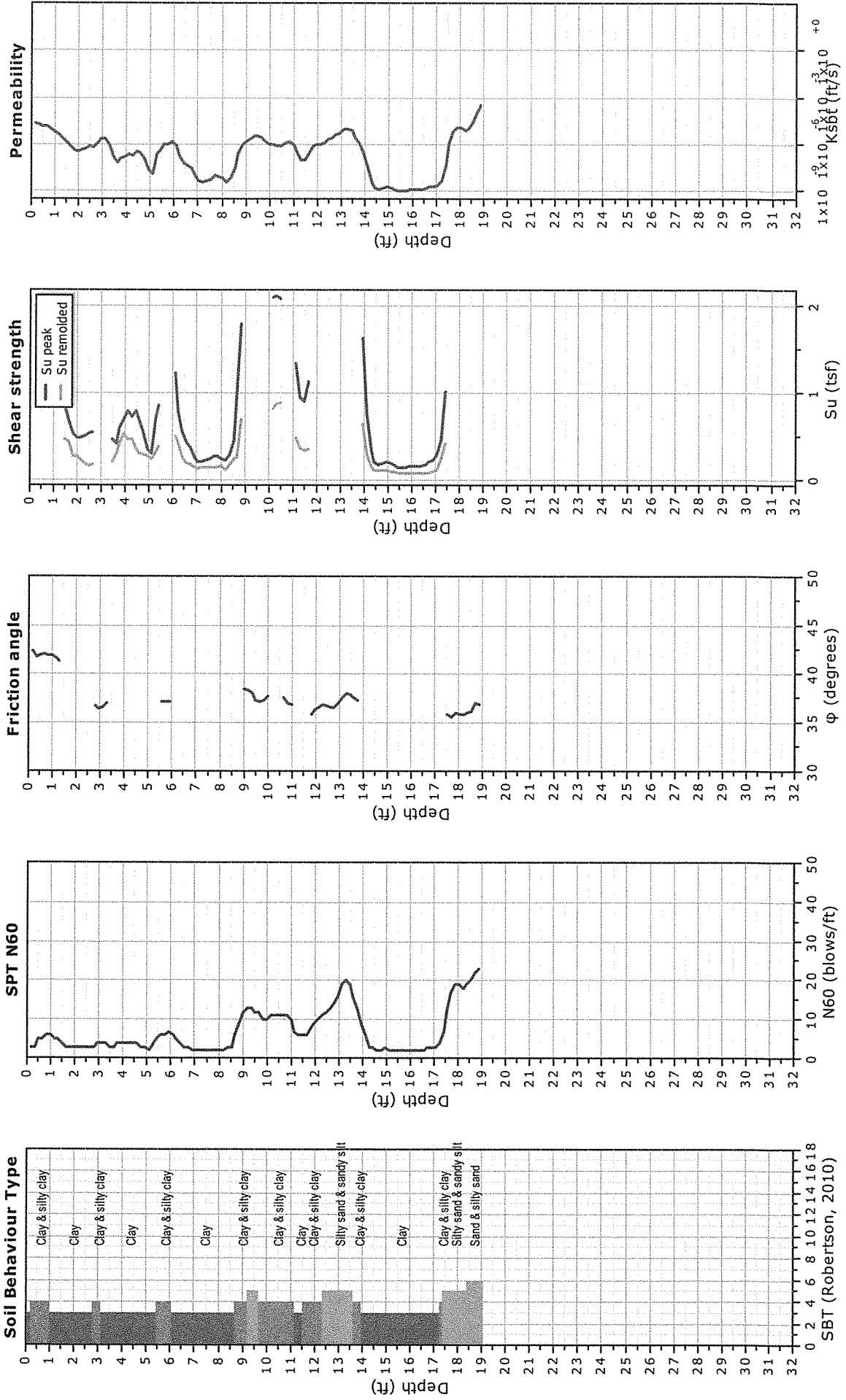


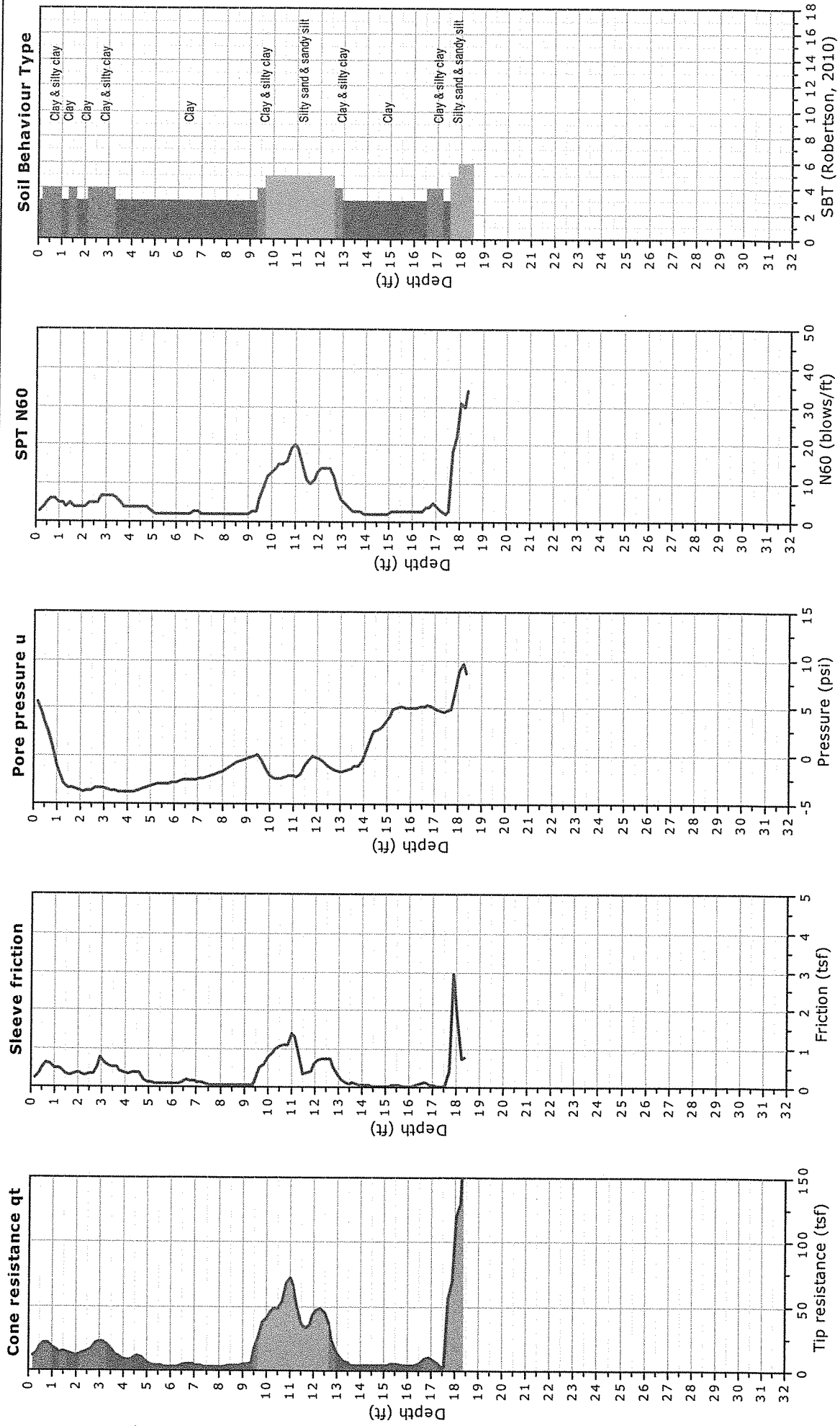


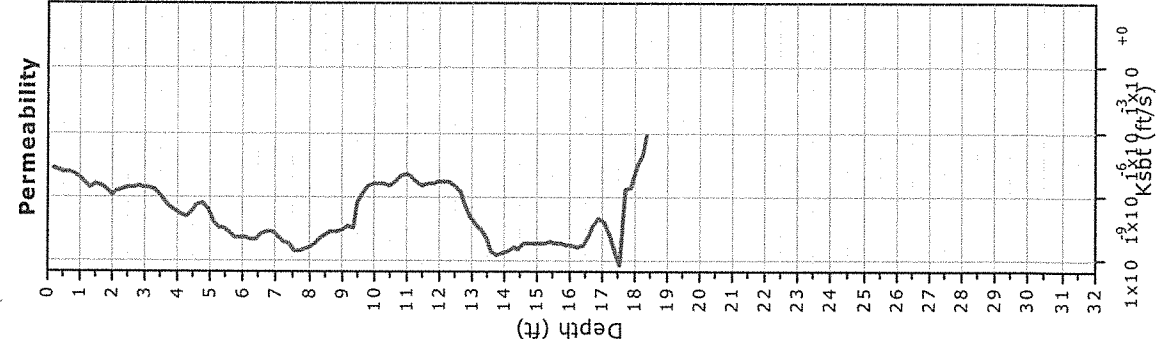
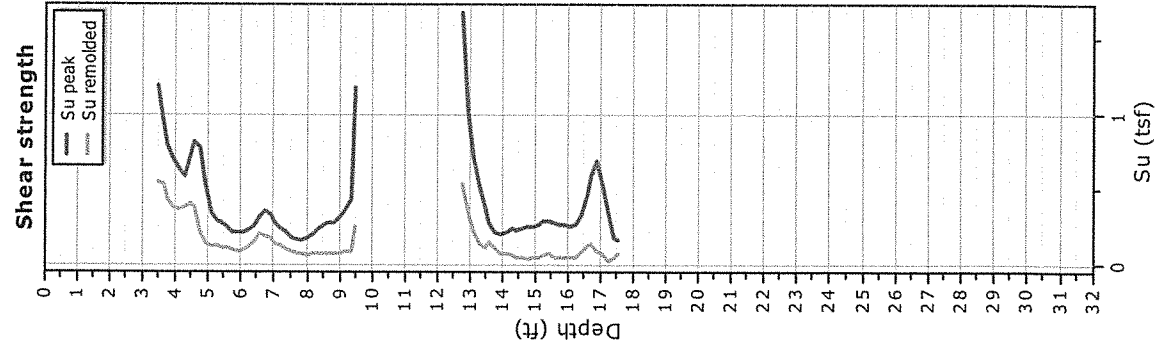
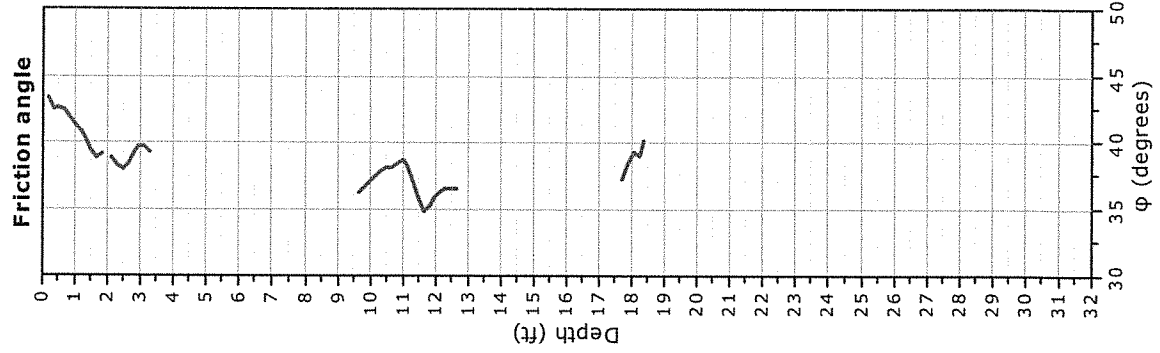
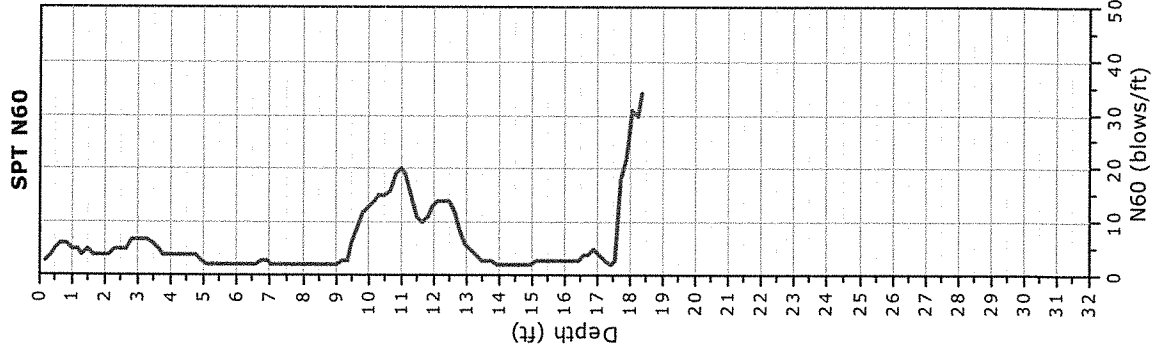
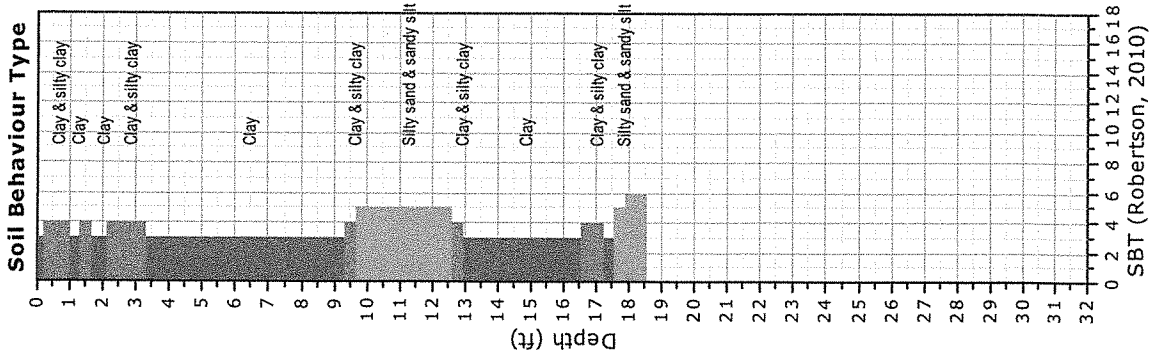
Project: 22231: Lake George Dam Emergency Repairs
Location: Marion, KY

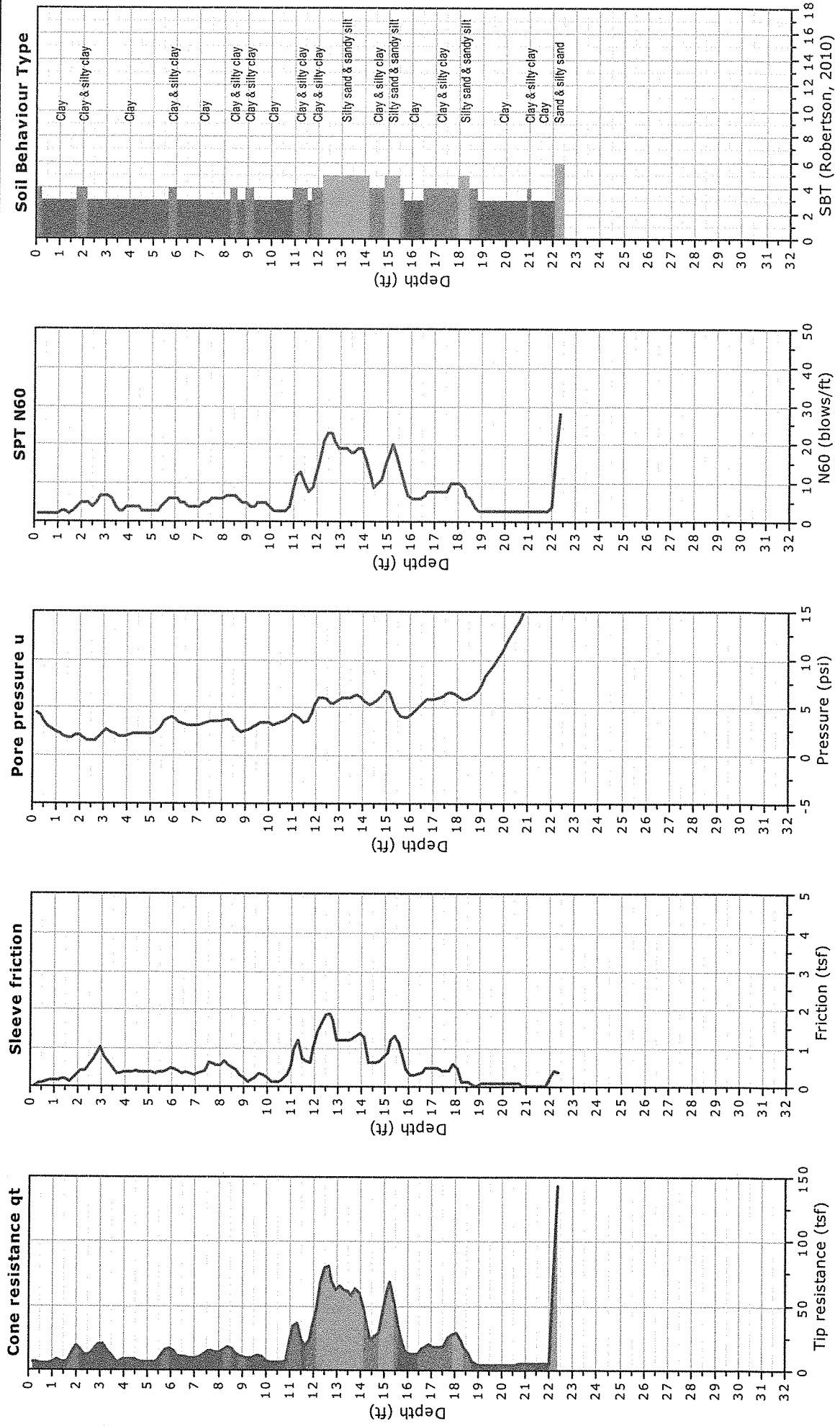
CPT: C-7

Total depth: 18.86 ft, Date: 7/29/2022
 Surface Elevation: 590.00 ft



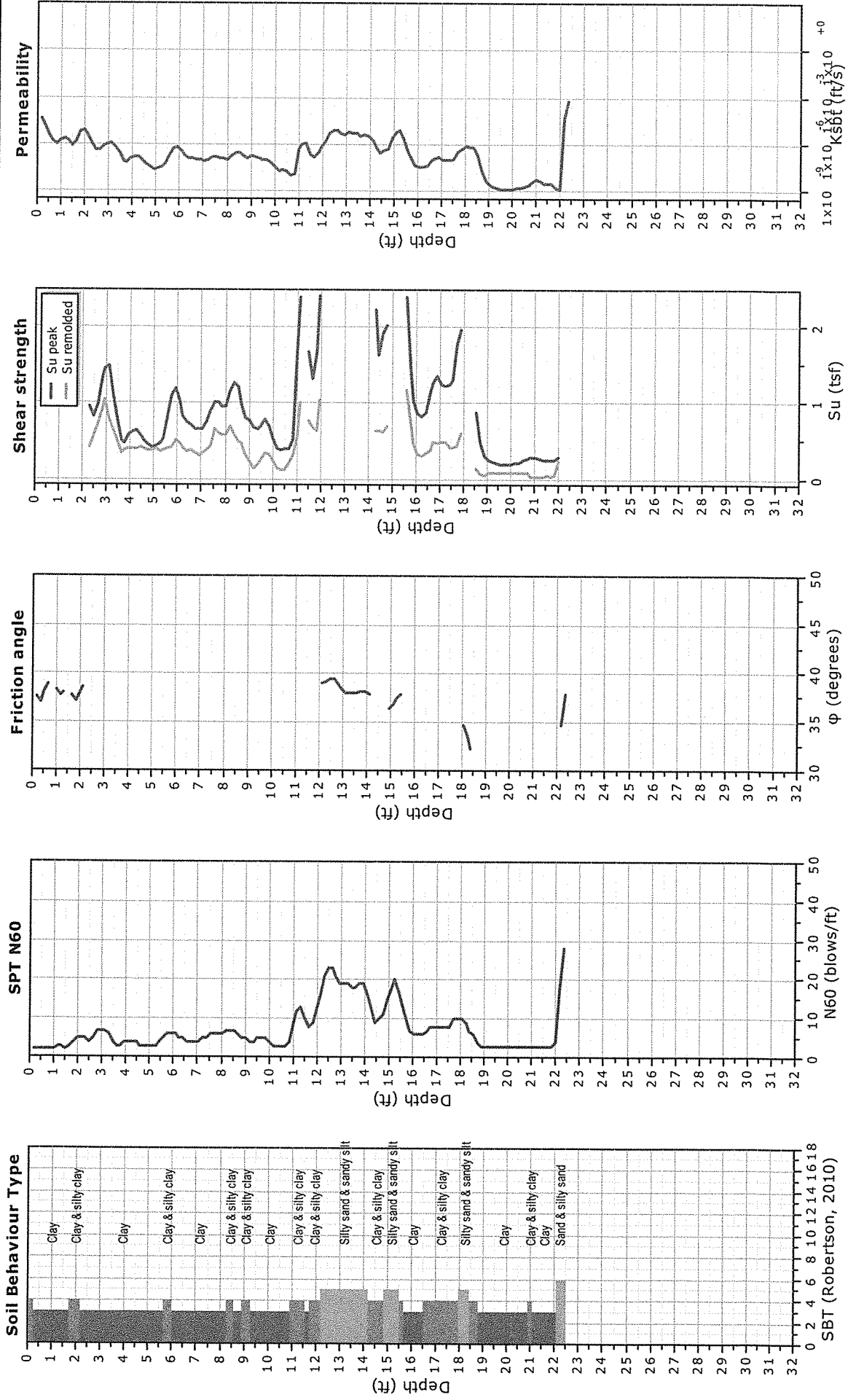






Project: 22231: Lake George Dam Emergency Repairs
Location: Marion, KY

CPT: C-9
 Total depth: 22.31 ft, Date: 7/29/2022
 Surface Elevation: 593.00 ft



Appendix C
Subsurface Boring Logs



Bacon Farmer Workman Engineering & Testing Inc.
 500 S 17th St
 Paducah, KY 42003
 Telephone: 2704431995
 Fax: 2704431904

CLIENT City of Marion, KY PROJECT NAME Lake George Dam Emergency Repairs
 PROJECT NUMBER 22231 PROJECT LOCATION Marion, KY
 DATE STARTED 8/11/22 COMPLETED 8/11/22 GROUND ELEVATION 604 ft HOLE SIZE 2.25 inches
 DRILLING CONTRACTOR BFW DRILLED BY BFW GROUND WATER LEVELS:
 DRILLING METHOD Hand Auger AT TIME OF DRILLING --
 LOGGED BY CLM CHECKED BY CLM AT END OF DRILLING --
 NORTHING 3642220 EASTING 4240588 AFTER DRILLING --

GEOTECH BH COLUMNS - GINT STD US LAB 2021.GDT - 9/8/22 23:52 - C:\USERS\CMATHEWS\ONE DRIVE - BACON FARMER WORKMAN\DOCUMENTS\SPW - WORKING\14\22231 LAKE GEORGE DAM.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | VANE SHEAR (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|---|--------------------|------------------|-----------------------|------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | LEAN CLAY (CL): Orangish brown, very soft, dry (existing fill) | | | | | | | | | | |
| 2.5 | | | S-1 | 100 | | >2.4 | | 18 | | | | |
| 5.0 | | Becomes light brown, soft, moist | S-2 | 100 | | >2.4 | | 17 | 40 | 20 | 20 | |
| 7.5 | | Becomes light brown and gray | S-3 | 100 | | 0.5 | | 22 | | | | |
| | | | S-4 | 100 | | 0.6 | | 27 | 40 | 22 | 18 | |
| | | SILT (ML): Orangish brown, soft, moist (existing fill) | S-5 | 100 | | 0.4 | | 26 | 31 | 25 | 6 | |
| 10.0 | | LEAN CLAY (CL): Orangish brown and gray. very soft, wet (existing fill) | S-6 | 100 | | | | 26 | 46 | 24 | 22 | |
| 12.5 | | | S-7 | 100 | | 0.2 | | 27 | 44 | 24 | 20 | |
| | | | S-8 | 100 | | 1.0 | | 28 | 48 | 25 | 23 | |
| | | | S-9 | 100 | | | | 23 | 46 | 24 | 22 | |
| 15.0 | | Becomes brown and gray | S-10 | 100 | | | | 27 | | | | |

Bottom of borehole at 15.0 feet.



Bacon Farmer Workman Engineering & Testing Inc.
 500 S 17th St
 Paducah, KY 42003
 Telephone: 2704431995
 Fax: 2704431904

BORING NUMBER HA-8

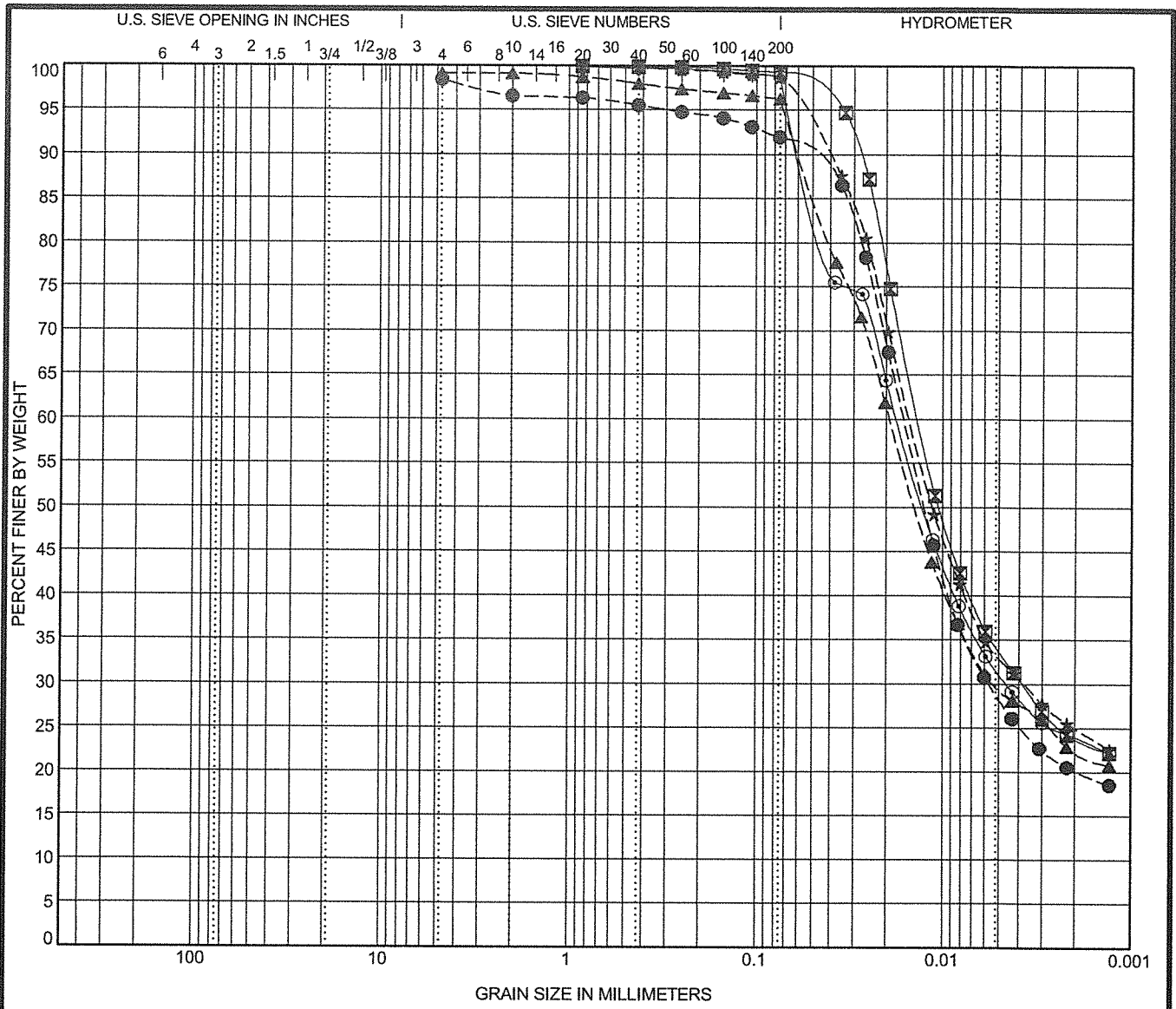
CLIENT City of Marion, KY PROJECT NAME Lake George Dam Emergency Repairs
 PROJECT NUMBER 22231 PROJECT LOCATION Marion, KY
 DATE STARTED 8/11/22 COMPLETED 8/11/22 GROUND ELEVATION 590 ft HOLE SIZE 2.25 inches
 DRILLING CONTRACTOR BFW DRILLED BY BFW GROUND WATER LEVELS:
 DRILLING METHOD Hand Auger AT TIME OF DRILLING --
 LOGGED BY CLM CHECKED BY CLM AT END OF DRILLING --
 NORthing 3642182 EASTING 4240684 AFTER DRILLING --

GEOTECH.BH COLUMNS - GINT STD US LAB 2021.GDT - 9/8/22 23:52 - C:\USERS\CMATHEWS\ONEEDRIVE - BACON FARMER WORKMAN\DOCUMENTS\SPW_WORKING\106914\22231 LAKE GEORGE DAM.GPJ

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | VANE SHEAR (tsf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS | | | FINES CONTENT (%) |
|------------|-------------|---|--------------------|------------------|-----------------------|------------------|--------------------|----------------------|------------------|---------------|------------------|-------------------|
| | | | | | | | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | |
| 0.0 | | LEAN CLAY (CL): Orangish brown and gray, soft, moist (existing fill) | | | | | | | | | | |
| 2.5 | | Becomes brown and gray | S-1 | 100 | | 0.9 | | 22 | | | | |
| 5.0 | | | S-2 | 100 | | 0.9 | | 20 | 41 | 21 | 20 | |
| | | | S-3 | 100 | | 0.2 | | 29 | | | | |
| 7.5 | | | S-4 | 100 | | 0.3 | | 28 | 42 | 21 | 21 | |
| | | SILT CLAY (CL-ML): Brownish gray, soft, moderately dry, with sand (existing fill) | S-5 | 100 | | 1.4 | | 16 | 24 | 18 | 6 | |

Bottom of borehole at 9.3 feet.

Appendix D
Laboratory Test Results



| COBBLES | GRAVEL | | SAND | | | SILT | CLAY |
|---------|--------|------|--------|--------|------|------|------|
| | coarse | fine | coarse | medium | fine | | |

| Specimen Identification | | | Description | | | LL | PL | PI | Cc | Cu |
|-------------------------|------|---------|---------------|--|--|----|----|----|----|----|
| ● | HA-5 | 3 ft | LEAN CLAY(CL) | | | 40 | 20 | 20 | | |
| ☒ | HA-5 | 6.5 ft | LEAN CLAY(CL) | | | 40 | 22 | 18 | | |
| ▲ | HA-5 | 8.5 ft | SILT(ML) | | | 31 | 25 | 6 | | |
| ★ | HA-5 | 9.5 ft | LEAN CLAY(CL) | | | 46 | 24 | 22 | | |
| ◎ | HA-5 | 10.5 ft | LEAN CLAY(CL) | | | 44 | 24 | 20 | | |

| Specimen Identification | | | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|-------------------------|------|---------|------|-------|-------|-----|---------|-------|-------|-------|
| ● | HA-5 | 3 ft | 4.75 | 0.016 | 0.006 | | 0.0 | 6.5 | 63.8 | 28.2 |
| ☒ | HA-5 | 6.5 ft | 0.85 | 0.013 | 0.004 | | 0.0 | 0.6 | 65.7 | 33.7 |
| ▲ | HA-5 | 8.5 ft | 4.75 | 0.019 | 0.005 | | 0.0 | 2.8 | 66.8 | 29.5 |
| ★ | HA-5 | 9.5 ft | 0.85 | 0.015 | 0.004 | | 0.0 | 1.2 | 65.7 | 33.0 |
| ◎ | HA-5 | 10.5 ft | 0.85 | 0.017 | 0.005 | | 0.0 | 1.0 | 67.8 | 31.0 |

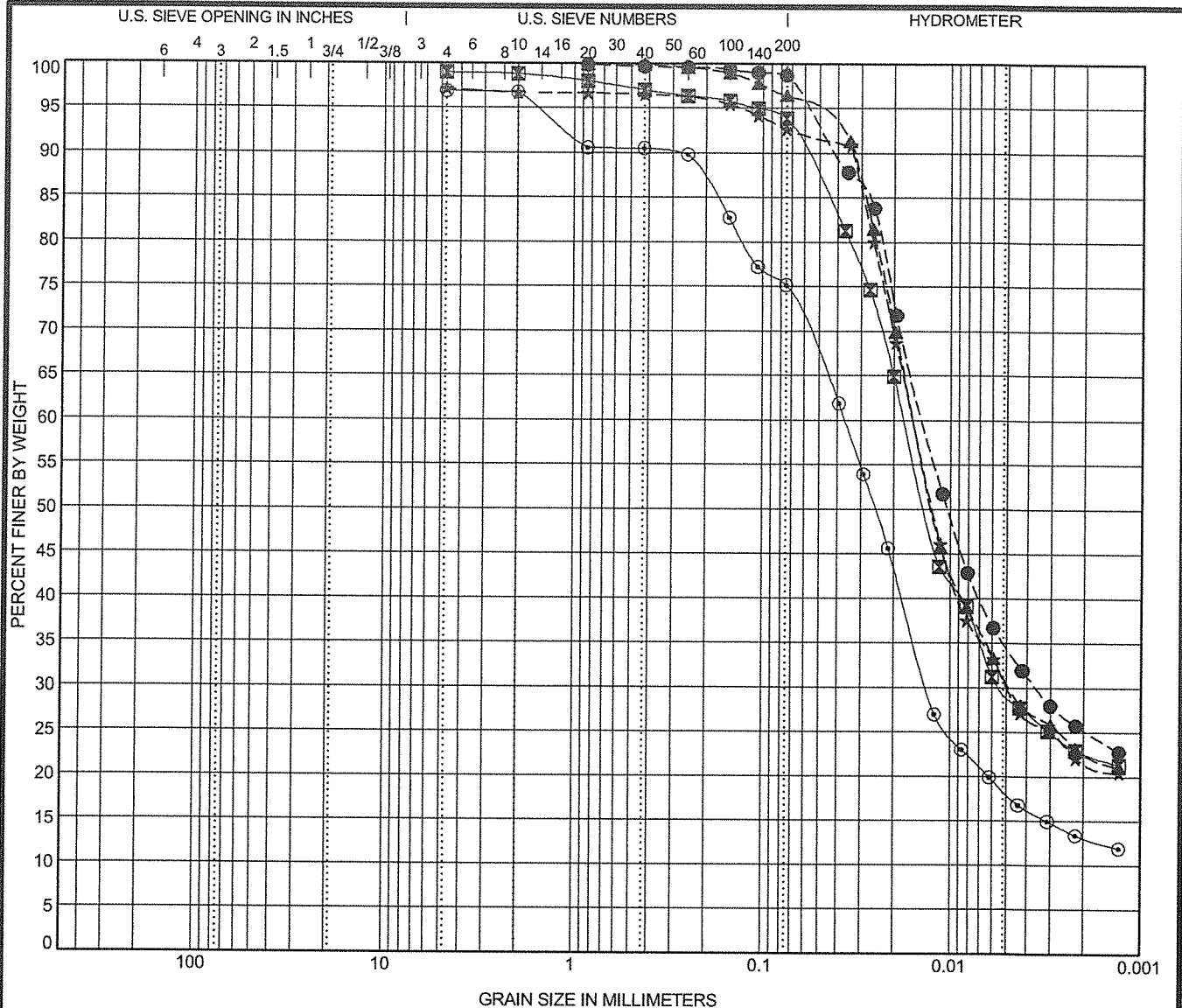


SCI Engineering, Inc.
 130 Point West Blvd.
 St. Charles, Missouri 63301
 Telephone: 636-949-8200

GRAIN SIZE DISTRIBUTION - ASTM

Project Name: Marion KY Dam - Additional Labwork
 Location: Marion, Kentucky
 SCI Project No.: 2022-0925.11

SCI GRAIN SIZE - ASTM 2022-0925.11 MARION KY DAM - ADDITIONAL LABWORK.GPJ SCI ENG.GDT 8/25/22



| COBBLES | GRAVEL | | SAND | | | SILT | CLAY |
|---------|--------|------|--------|--------|------|------|------|
| | coarse | fine | coarse | medium | fine | | |

| Specimen Identification | Description | LL | PL | PI | Cc | Cu | | |
|-------------------------|-----------------------------|-------|-------|-----|---------|-------|-------|-------|
| ● HA-5 12 ft | LEAN CLAY(CL) | 48 | 25 | 23 | | | | |
| ☒ HA-5 13.75 ft | LEAN CLAY(CL) | 46 | 24 | 22 | | | | |
| ▲ HA-8 3 ft | LEAN CLAY(CL) | 41 | 21 | 20 | | | | |
| ★ HA-8 7 ft | LEAN CLAY(CL) | 42 | 21 | 21 | | | | |
| ◎ HA-8 9 ft | SILTY CLAY with SAND(CL-ML) | 24 | 18 | 6 | | | | |
| Specimen Identification | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
| ● HA-5 12 ft | 0.85 | 0.014 | 0.004 | | 0.0 | 1.1 | 64.3 | 34.4 |
| ☒ HA-5 13.75 ft | 4.75 | 0.018 | 0.005 | | 0.0 | 5.0 | 64.6 | 29.3 |
| ▲ HA-8 3 ft | 0.85 | 0.016 | 0.005 | | 0.0 | 3.5 | 65.9 | 30.5 |
| ★ HA-8 7 ft | 4.75 | 0.016 | 0.005 | | 0.0 | 4.5 | 62.6 | 30.0 |
| ◎ HA-8 9 ft | 4.75 | 0.037 | 0.013 | | 0.0 | 21.7 | 57.2 | 18.0 |



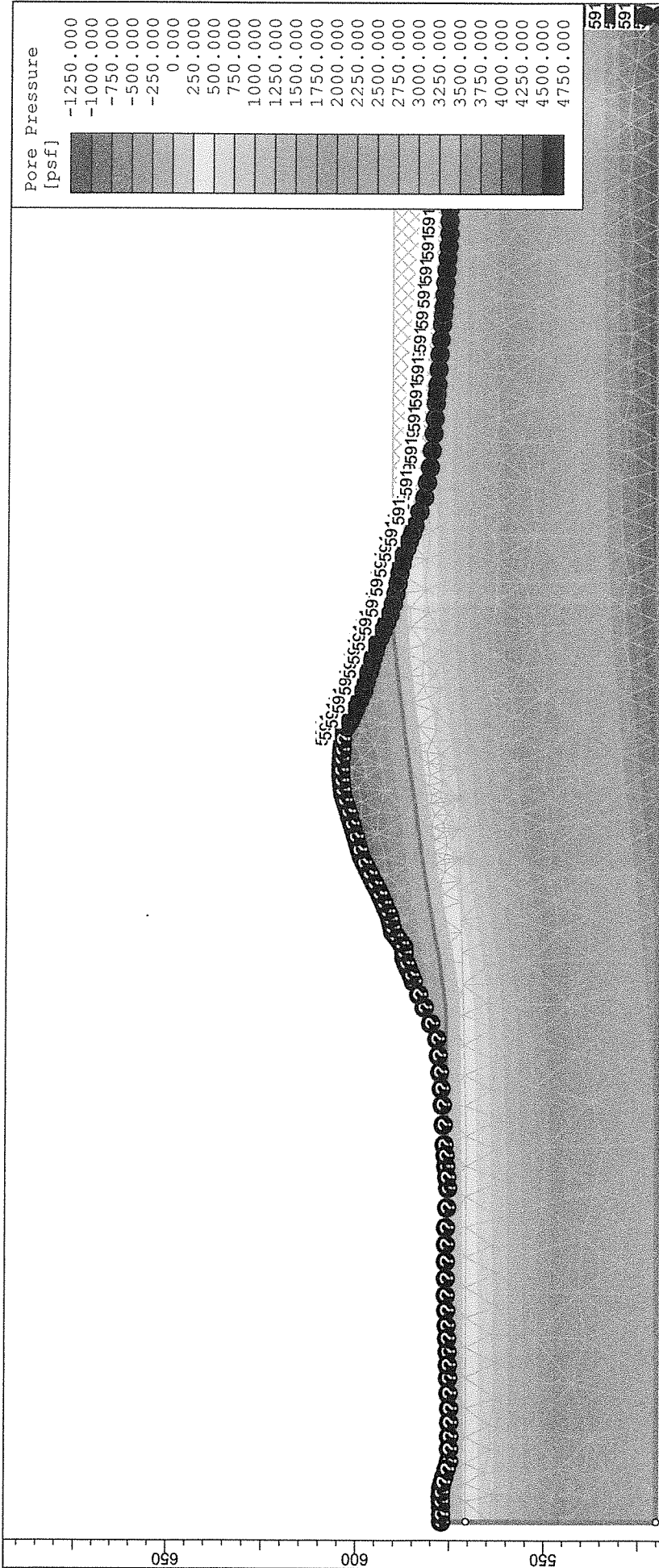
SCI Engineering, Inc.
 130 Point West Blvd.
 St. Charles, Missouri 63301
 Telephone: 636-949-8200

GRAIN SIZE DISTRIBUTION - ASTM

Project Name: Marion KY Dam - Additional Labwork
 Location: Marion, Kentucky
 SCI Project No.: 2022-0925.11

SCI GRAIN SIZE - ASTM 2022-0925.11 MARION KY DAM - ADDITIONAL LABWORK.GPJ SCI.ENG.GDT 8/25/22

Appendix E
Seepage and Slope Stability Analysis



| Material Name | Color | Unit Weight (lbs/ft ³) | Strength Type | Cohesion (psf) | Phi (deg) |
|--|-------|------------------------------------|-------------------|----------------|-----------|
| Embankment Fill (CL) | | 125 | Mohr-Coulomb | 100 | 26 |
| Foundation Soils - Silty Sands and Gravels | | 120 | Mohr-Coulomb | 50 | 30 |
| Bedrock | | 150 | Infinite strength | | |

| Material Name | Color | Model | KS (ft/s) |
|--|-------|--------|-----------|
| Embankment Fill (CL) | | Simple | 1e-07 |
| Foundation Soils - Silty Sands and Gravels | | Simple | 1e-05 |

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

SLIDEINTERPRET 9.019

Project

22231 Lake George Dam Emergency Repairs

Group

Pool EI = 591

Scenario

Long-Term Steady Seepage

Company

BFW Engineering & Testing, Inc.

Drawn By

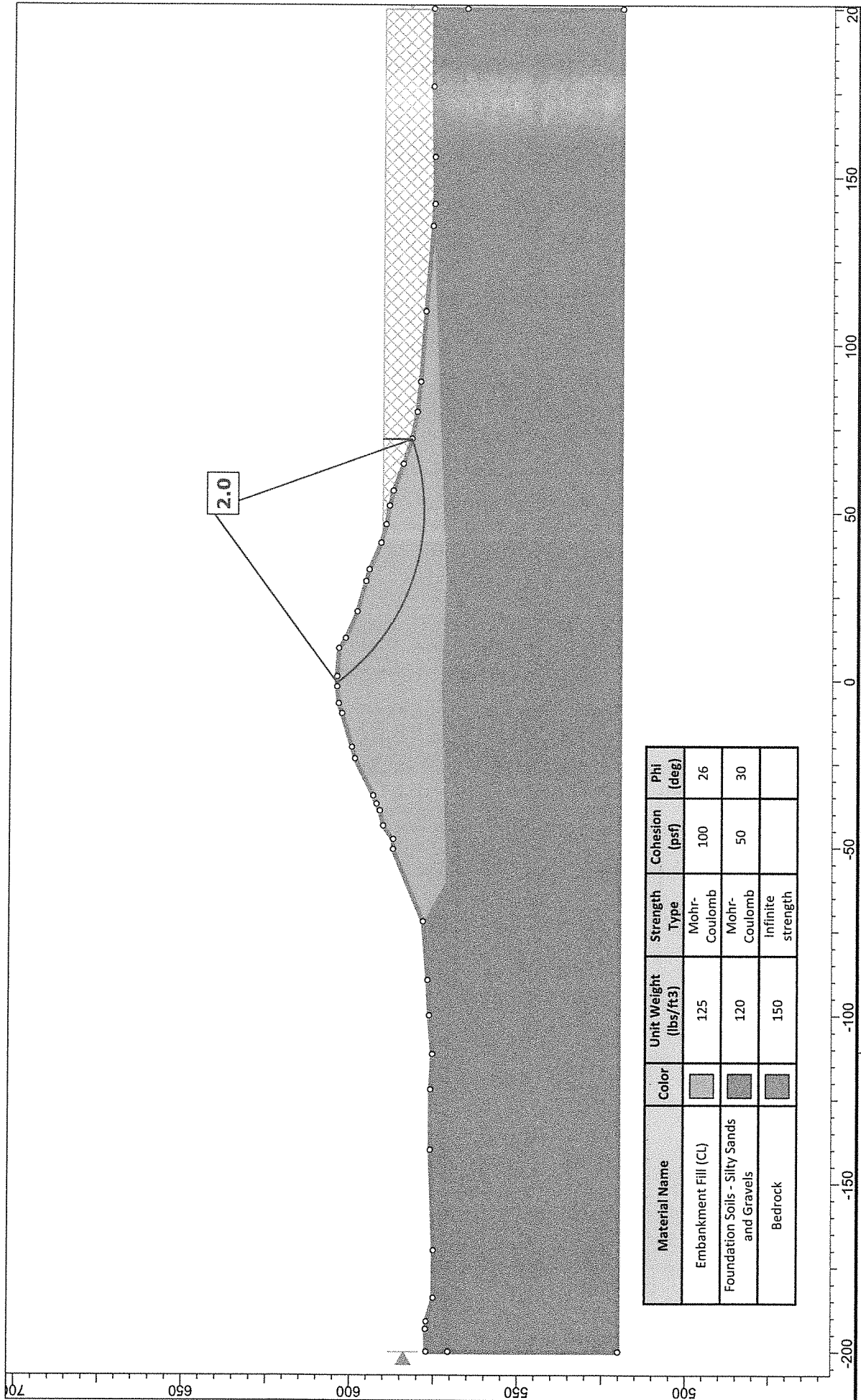
CLM




File Name


STA 4+00.sldm

Date

8/8/2022, 9:39:32 AM



| Material Name | Color | Unit Weight (lbs/ft ³) | Strength Type | Cohesion (psf) | Phi (deg) |
|--|---|------------------------------------|-------------------|----------------|-----------|
| Embankment Fill (CL) |  | 125 | Mohr-Coulomb | 100 | 26 |
| Foundation Soils - Silty Sands and Gravels |  | 120 | Mohr-Coulomb | 50 | 30 |
| Bedrock |  | 150 | Infinite strength | | |



BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Project 22231 Lake George Dam Emergency Repairs

Group Pool EI = 591

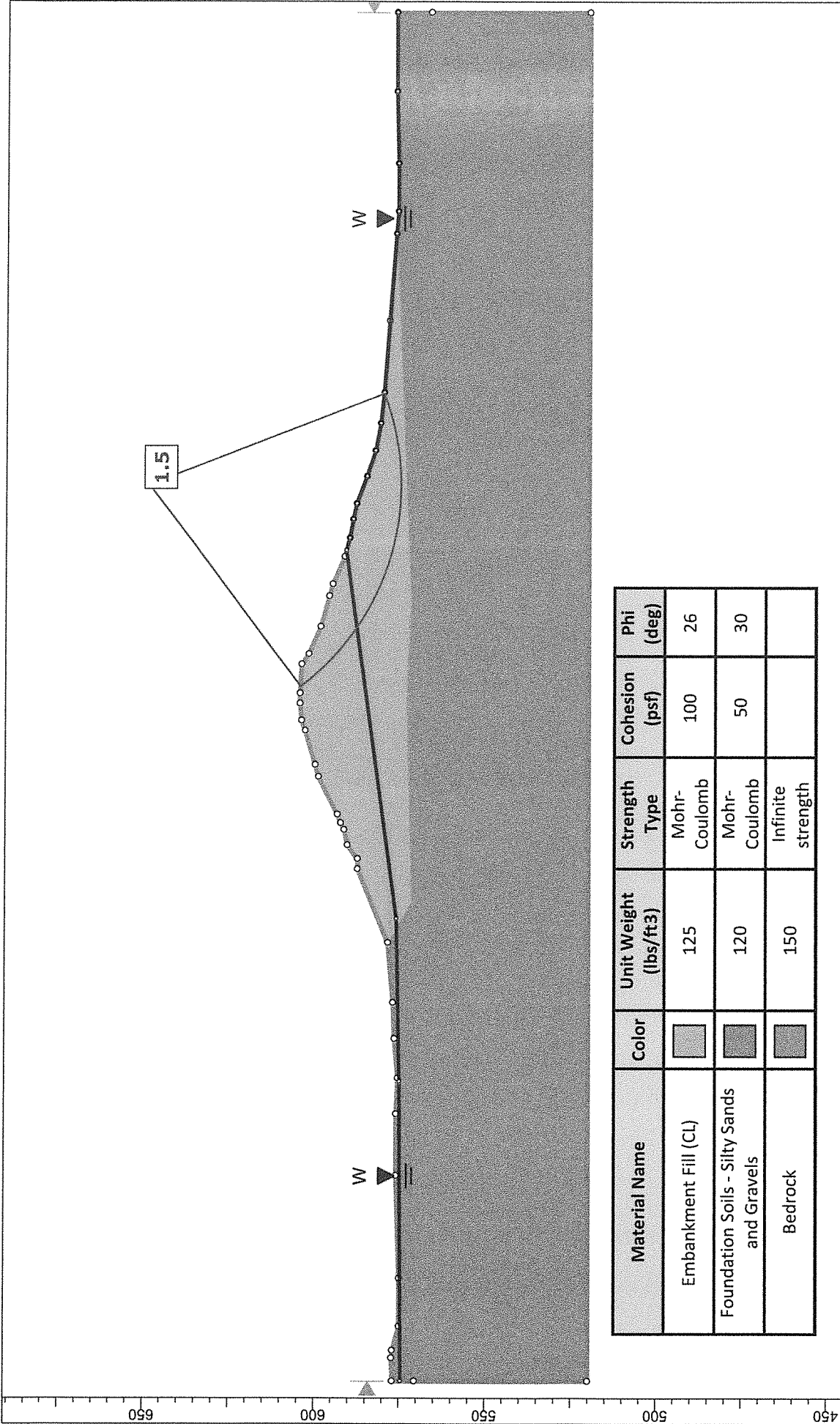
Scenario Long-Term Steady Seepage

Company BFW Engineering & Testing, Inc.

Drawn By CLM

Date 8/8/2022, 9:39:32 AM

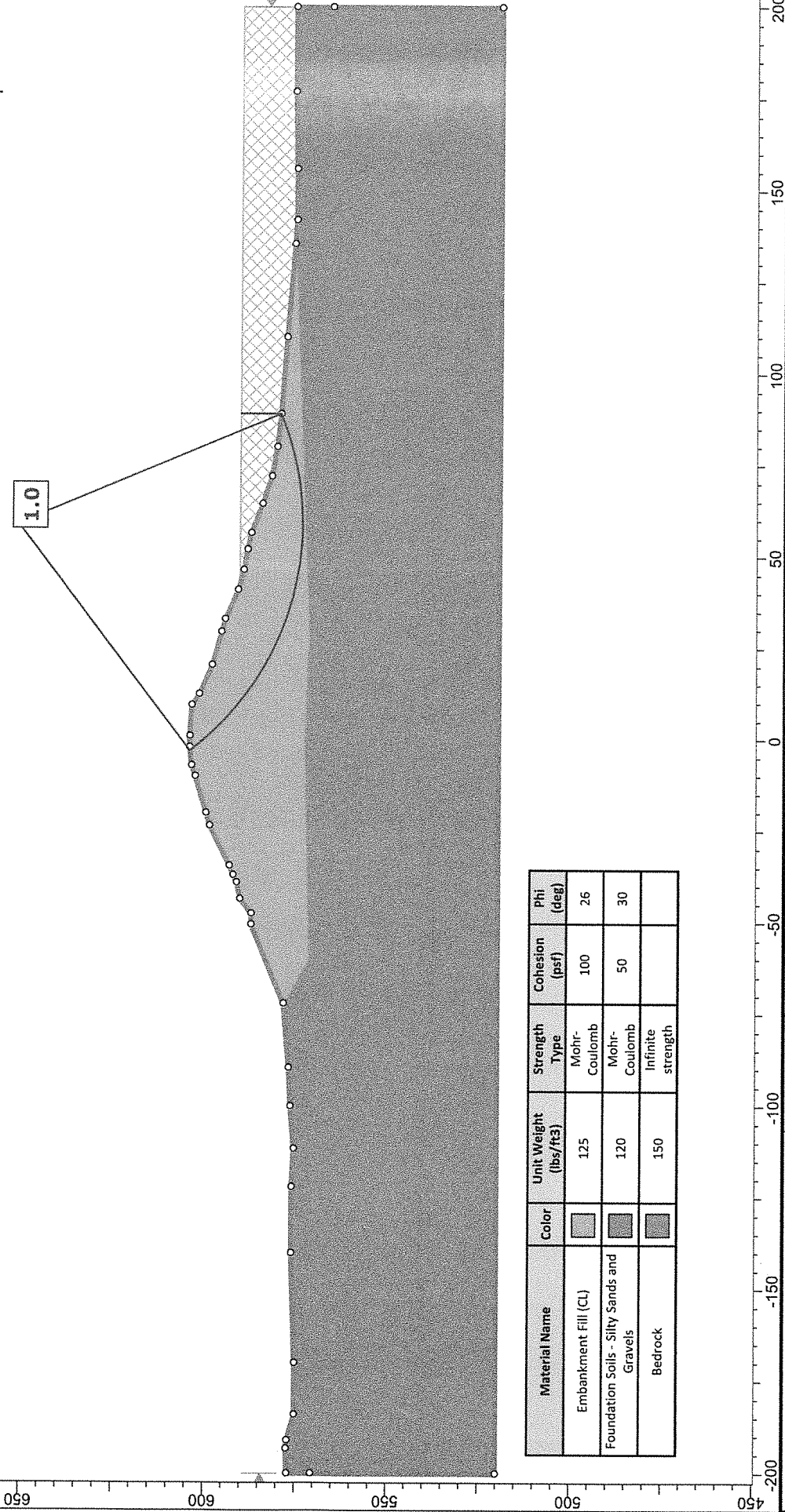
File Name STA 4+00.slm



| | |
|---|---------------------------------|
| 22231 Lake George Dam Emergency Repairs | |
| Project | Scenario |
| BACON FARMER WORKMAN ENGINEERING & TESTING, INC. | Rapid Drawdown |
| Group | Company |
| Pool EI = 591 | BFW Engineering & Testing, Inc. |
| Drawn By | File Name |
| CLM | STA 4+00.slm |
| Date | |
| 8/8/2022, 9:39:32 AM | |



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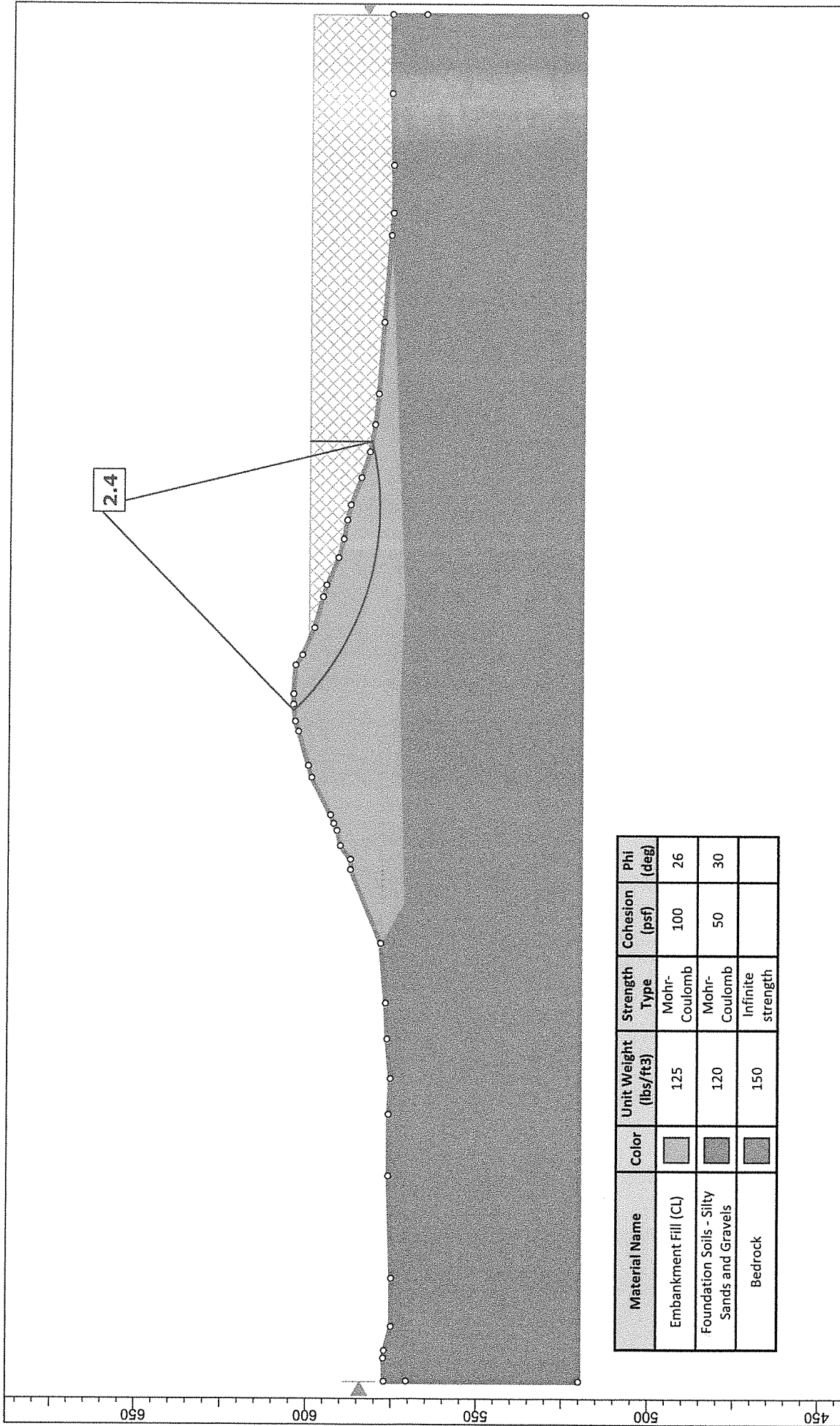
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|--|-------|------------------------------------|-------------------|----------------|-----------|
| Embankment Fill (CL) | | 125 | Mohr-Coulomb | 100 | 26 |
| Foundation Soils - Silty Sands and Gravels | | 120 | Mohr-Coulomb | 50 | 30 |
| Bedrock | | 150 | Infinite strength | | |




BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

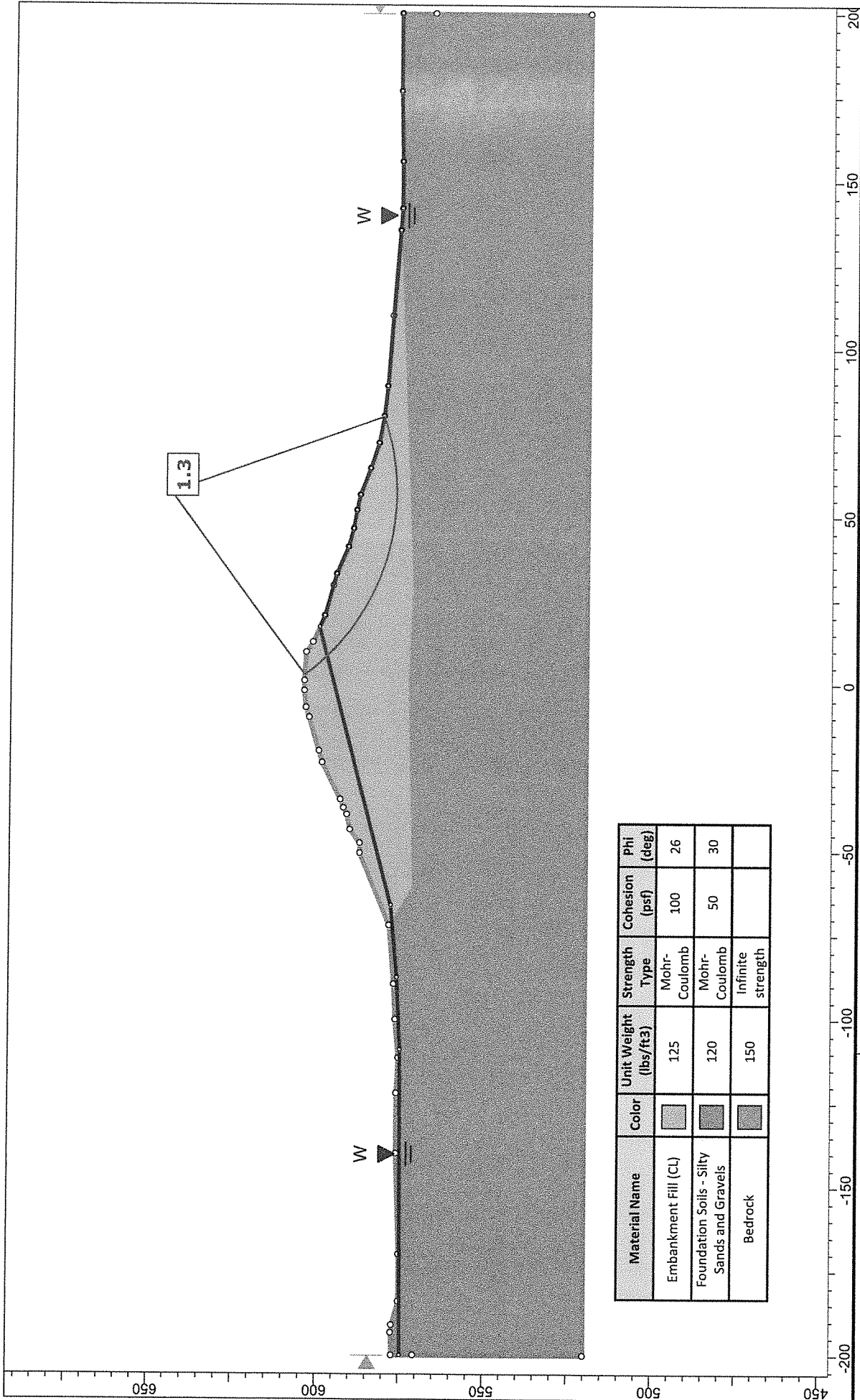
Project: 22231 Lake George Dam Emergency Repairs
Group: Pool EI = 591
Drawn By: CLM
Date: 8/8/2022, 9:39:32 AM


Scenario: Seismic
Company: BFW Engineering & Testing, Inc.
File Name: STA 4+00.slmtd



| Material Name | Color | Unit Weight (lbs/ft ³) | Strength Type | Cohesion (psf) | Phi (deg) |
|--|------------------|------------------------------------|-------------------|----------------|-----------|
| Embankment Fill (CL) | [Light Gray Box] | 125 | Mohr-Coulomb | 100 | 26 |
| Foundation Soils - Silty Sands and Gravels | [Dark Gray Box] | 120 | Mohr-Coulomb | 50 | 30 |
| Bedrock | [Dark Gray Box] | 150 | Infinite strength | | |

| | | | |
|--|--|---|--|
|  BACON FARMER WORKMAN ENGINEERING & TESTING, INC. | | Project | |
| | | 22231 Lake George Dam Emergency Repairs | |
| Group | | Scenario | |
| Pool El = 600 | | Long-Term Steady Seepage | |
| Drawn By | | Company | |
| CLM | | BFW Engineering & Testing, Inc. | |
| Date | | File Name | |
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BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

22231 Lake George Dam Emergency Repairs

Pool EI = 600

CLM

8/8/2022, 9:39:32 AM

Scenario Rapid Drawdown

Company BFW Engineering & Testing, Inc.

File Name STA 4+00.slm

Project

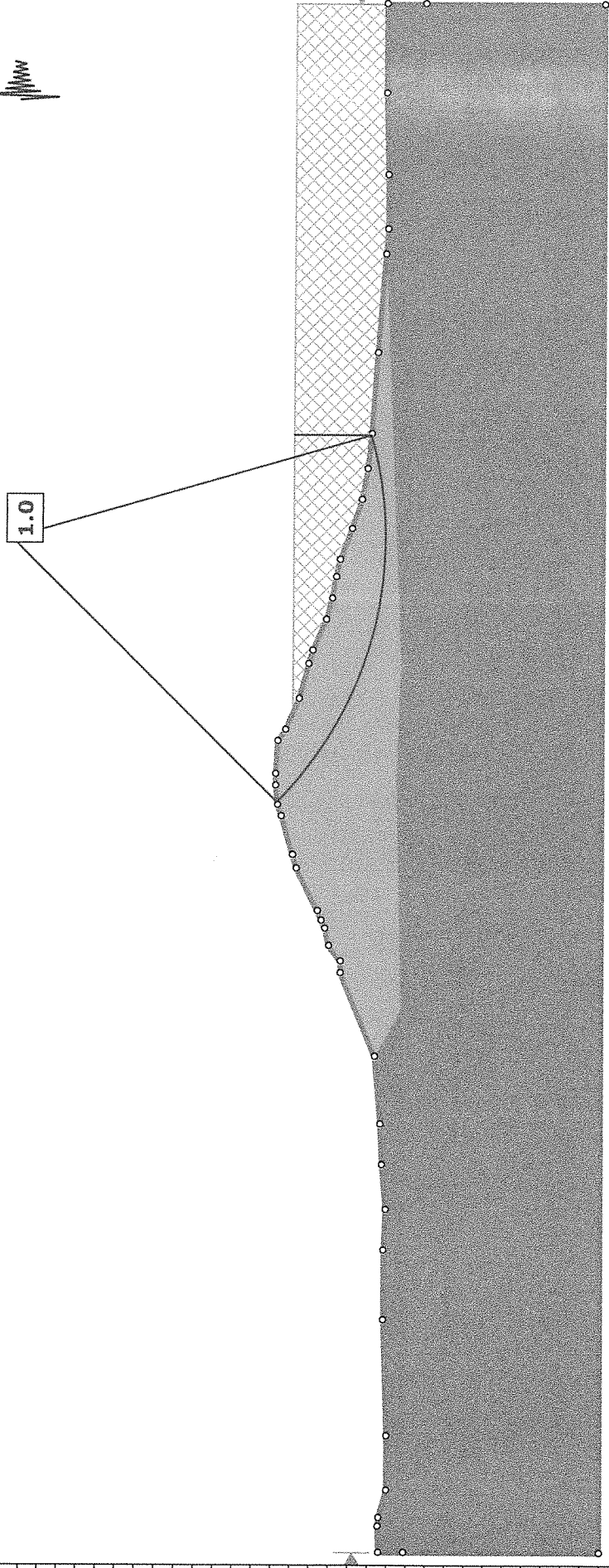
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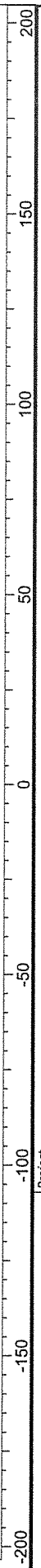
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| Material Name | Color | Unit Weight (lbs/ft ³) | Strength Type | Cohesion (psf) | Phi (deg) |
|--|-------|------------------------------------|-------------------|----------------|-----------|
| Embankment Fill (CL) | | 125 | Mohr-Coulomb | 100 | 26 |
| Foundation Soils - Silty Sands and Gravels | | 120 | Mohr-Coulomb | 50 | 30 |
| Bedrock | | 150 | Infinite strength | | |



22231 Lake George Dam Emergency Repairs

| | | | |
|---|--|--|--|
| | | | |
| BACON FARMER WORKMAN ENGINEERING & TESTING, INC. | | Pool El = 600 | |
| ENGINEERING & TESTING, INC. | | CLM | |
| ENGINEERING & TESTING, INC. | | Seismic | |
| ENGINEERING & TESTING, INC. | | BFW Engineering & Testing, Inc. | |
| ENGINEERING & TESTING, INC. | | STA 4+00.simd | |
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| ENGINEERING & TESTING, INC. | | File Name: STA 4+00.simd | |
| ENGINEERING & TESTING, INC. | | Scenario: Seismic | |
| ENGINEERING & TESTING, INC. | | Company: BFW Engineering & Testing, Inc. | |
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