EXHIBIT 2
Page 1 of 247

DUKE ENERGY.

George T. Hamrick
Senior Vice President,
Coal Combustion Products
400 S. Tryon St.,
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Charlotte, NC 28202

Phone 980-373-8113
Email: George.hamrick@duke-energy.com

October 5, 2016

VIA ELECTRONIC MAIL

Marilyn Thomas PE
Kentucky Department of Environmental Protection
Dam Safety Division
200 Fair Oaks Drive
Frankfort, KY 40601

RE: Submittal of Proposed Ash Basin Dam Modifications
East Bend Station
Boone County, Kentucky
State ID KYDW 1215

Dear Ms. Thomas:

Enclosed, please find correspondence, a description of our plan for the modifications to the basin and dam, as well as engineered drawings related to these activities at the East Bend Station. These drawings have been prepared by Burns and McDonnell with the Permit Package and Stability analysis prepared by AMEC, with Burns and McDonnell acting as Duke Energy's Engineer of Record for this project.

We appreciate the prompt attention that your office has given to this matter and look forward to continuing to work with you to complete the modifications to the East Bend basin embankment.

Duke Energy looks forward to your review and approval of the attached permit package. If you have any questions, comments or need additional information please contact Adam Deller Adam.Deller@duke-energy.com at 513-287-1239 or Jim Thorp Jim.Thorp@duke-energy.com at 317-838-1798.

Respectfully submitted,

George T. Hamrick

George T. Hamrick
Senior Vice President

Attachment: East Bend Ash Basin Dam Construction Permit Modification Report (September 29, 2016)

Duke Energy cc: Adam Deller, Jim Thorp, Tammy Jett, Tim Thiemann, Skip Steele, Jake Keegan, Dale Smith,

AMEC cc: James Studer

DUKE ENERGY COAL COMBUSTION RESIDUALS MANAGEMENT PROGRAM

EAST BEND ASH BASIN DAM CONSTRUCTION PERMIT MODIFICATION REPORT

East Bend Station Boone County, Kentucky
East Bend 1976 Ash Pond Dam (State ID KYDW 1215)

Prepared for

DUKE ENERGY.

Duke Energy Kentucky, Inc.
139 E 4th Street,
Cincinnati, OH 45202

September 28, 2016

Prepared by

amec foster wheeler

Amec Foster Wheeler Environment & Infrastructure, Inc.

amec
foster
wheeler

September 29, 2016

Adam Deller
Midwest CCP Engineering
Duke Energy
139 E 4th Street
Cincinnati, OH 45202

RE: East Bend Ash Basin Dam Construction Permit Modification Report
Coal Combustion Residuals Management Program
East Bend Station
Boone County, Kentucky

Dear Mr. Deller:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) is pleased to provide Duke Energy (Duke) with the attached East Bend Ash Basin Dam Construction Permit Modification Report documenting design modifications to the Ash Basin dike following excavation and removal of coal combustion residual (CCR) materials. The purpose of this Report is to present the permit application with supporting design drawings and engineering calculations to support the repurposing of the Ash Basin as a lined retention basin for future use. The Report and supporting documents were prepared in accordance with the Kentucky Division of Water Dam Safety requirements and current engineering standards of practice.

Please do not hesitate to contact Gil Haines, P.E., BCEE at (770) 421-3434 or gil.haines@amecfw.com with any questions or comments you may have regarding this submittal.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

SB Gulec D

Basak Gulec-Dincer, Ph.D., P.E.
Senior Engineer

Gil M. Haines, P.E., BCEE
Associate Project Manager

SEALS PAGE

STATE OF KENTUCKY
J. L.
STUDER
20495
REGISTERED PROFESSIONAL ENGINEER

James L. Studer, PE (Engineer of Record)
Professional Engineer License No. 20495

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Appendix 1 Dam Construction Permit Application

Attachment A – Topographic Map / Location Map / Design Drawings for Retention Basin

Attachment B – Geologic Conditions

Attachment C – Hydraulic and Hydrologic Analyses

Attachment D – Stability Analyses

Attachment E – Liner Veneer Stability Analyses

1. INTRODUCTION

This dam construction permit application is prepared in order to (i) present the proposed modifications to the East Bend Station (Station) Ash Basin, which will be repurposed as a retention basin following excavation and removal of coal combustion residual (CCR) materials; and (ii) to obtain a dam construction permit for the proposed retention basin. The Station is an active power station with the Ash Basin remaining operational, while converting to a dry CCR handling process. Once the CCR material is excavated, the Ash Basin will be used as a retention basin as part of the site-wide water management strategy. This permit application presents the proposed Ash Basin structure modifications and demonstrates compliance of the proposed modifications with current regulatory requirements as well as current engineering standards of practice. This submittal includes:

- a permit application form,
- permit drawings prepared by Burns & McDonnell,
- geological report, and
- calculation packages.

Stability related calculation packages were prepared by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler). Design drawings and hydrologic and hydraulic calculations package were prepared by Burns & McDonnell.

1.1 Site Description

The East Bend Station is located along the north bank of an eastward bend on the Ohio River in west-central Boone County, Kentucky. A location map for the site is presented in Attachment A of Appendix 1. The Station has an Ash Basin located next to the Ohio River approximately 150 feet from the riverbank on the east side of the main plant and encompasses approximately 53 acres on the 735 acre site. The Ash Basin was constructed in 1978, and the Station with the Ash Basin was in full commercial operation in 1981.

1.2 Surface Impoundment Description

The Ash Basin was designed by Sargent & Lundy Engineers in early 1976 and construction began in 1978. The Station and Ash Basin were commissioned in 1980 and began full commercial operation in 1981. The Ash Basin encompasses a surface area of approximately 53.4 acres. A topographic map and a location map are presented in Figures 1 and 2 of Appendix 1-Attachment A.

The existing Ash Basin includes a divider dike comprised of CCR materials creating an upper level pool and lower level pool of free standing water. The upper level pool free standing water surface elevation is approximately 510 feet while the lower pool free standing water surface elevation is approximately 494 feet as depicted from topographic mapping performed by ESP Associates P.A in 2014. The embankment is 4,200 feet long and 50 feet high, and has a crest width of 12 feet, 2 horizontal to 1 vertical (2H:1V) embankment slopes, and crest elevation of 518 to 520 feet above mean sea level (MSL).

The embankment consists of a compacted, granular fill with a compacted clay core. The embankment is configured in a "U" shape with the main section parallel to the Ohio River and short sections on the east and west ends abutting natural soils on the north side. For more details of the site's subsurface geologic setting, refer to Attachment B.

1.2.1 History and Operation of the Surface Impoundment

Our understanding of site history is as follows:

- In 1974, Sargent & Lundy Engineers prepared a preconstruction geotechnical report, "Preliminary Foundation Investigations", for the Station (Sargent & Lundy Engineers, 1974). Several borings were drilled over the entire site of the proposed Station. Some of these borings were drilled at or near the area of the Ash Basin.
- Construction drawings were prepared by Sargent & Lundy Engineers in 1976.
- Construction of the embankment occurred in 1978 with commercial use in 1981.
- The original construction included a 48-inch-diameter, corrugated riser pipe and a 36-inch-diameter outlet pipe. In 1991, a 40-inch-diameter riser was slip-lined into the 48-inch riser structure. This new riser was connected to a 30-inch-diameter barrel that extends into the outlet pipe.
- In 2014, Amec Foster Wheeler designed and constructed a new spillway to replace the existing principal spillway. A new 42-inch steel casing pipe and a 36-inch high density polyethylene (HDPE) carrier pipe were "jack and bored" through the Ash Basin embankment. The new drainage pipe system was installed to replace the existing spillway structure and outlet pipe; which was grouted in-place and taken out of service. The new 36-inch HDPE pipe was terminated approximately 25 feet above the Ash Basin bottom on the inside side slope of the Ash Basin with a headwall structure. The annular space was pressure grouted to seal around the carrier pipe. Construction of the new spillway was completed in April 2015.
- In 2015, Amec Foster Wheeler completed the Phase 2 Reconstitution of Ash Pond Designs Report. The report included the review of existing data, additional field data and laboratory testing, and an updated analysis of the Ash Basin embankment (Amec Foster Wheeler, 2015).
- In 2016, Amec Foster Wheeler completed the Closure Plan for the closure of the Ash Basin (Amec Foster Wheeler, 2016).

Federal regulations were authorized for CCR surface impoundments and landfills when the U.S. Environmental Protection Agency (USEPA) published the CCR rules in the Federal Register on April 17, 2015. In order to comply with the CCR rules, a Closure Plan was prepared for the Ash Basin by Amec Foster Wheeler in June 2016 (Amec Foster Wheeler, 2016). In this Closure Plan, closure by removal approach was selected for the Ash Basin.

Closure activities include:

- Dewatering of the free water and pore water. The Ash Basin water will be pumped down to prepare for CCR excavation to improve CCR handling and hauling to an on-site landfill.

- CCR materials will be excavated based on the bottom of CCR Grading Plan, available geologic information, including borings logs and geologic cross sections, and visual confirmation.
- Excavated CCR materials will be transferred and placed into an onsite Special Waste Landfill.
- Ash Basin will be repurposed as a retention basin.

In order to use the existing Ash Basin as a retention basin, existing grades will be modified as proposed in this permit application and an intermediate dike constructed.

1.2.2 Sources of Discharges into the Surface Impoundment

CCR materials are discharged into the western reaches of the Ash Basin via sluice pipelines. The sluicing system includes multiple pipelines and a series of pumps and manifold systems. The sluiced material includes bottom ash and other CCR material generated at the Station.

Other influent streams from the Station during normal operating conditions include landfill leachate, sanitary wastewater, cooling tower and boiler blow down, boiler coal pile runoff, stormwater runoff, fire protection water and other minor water sources. General information on process flows is presented as part of the hydrologic and hydraulic calculations by Burns and McDonnell (Appendix 1-Attachment C, Table 2).

2. PROPOSED RETENTION BASIN

2.1 Design Considerations

The existing Ash Basin will be repurposed as a retention basin to provide site water storage and treatment necessary for the larger site-wide water management strategy. Following the permitting and approval by Kentucky Department for Environmental Protection (KDEP), the former Ash Basin will be regraded to the proposed design grades and an intermediate dike constructed. The new retention basin will consist of West and East Basins separated by the intermediate dike. The proposed retention basin will be lined with a composite liner system including a geosynthetic clay liner (GCL) and an HDPE double-sided textured geomembrane. The design drawings for the proposed retention basin prepared by Burns and McDonnell are presented in Appendix 1 Attachment A.

2.2 Area of Modifications

The areas of modification are presented in the following sections.

2.2.1 Grading Modifications

Following the excavation of CCR materials:

- The dam crest will be lowered approximately 14 ft (from the existing crest elevation of 518 feet MSL to 520 feet MSL). This will result in a new crest elevation at 505 feet MSL. The proposed grading contours by Burns and McDonnell are shown in Appendix 1 Attachment A.

- Existing 2H:1V slopes of the embankments will be reduced to 3H:1V.
- An intermediate dike will be installed to create two interconnected basin units (East and West Basins). This intermediate dike will be oriented north to south with a 30-ft crest width and approximately 3H:1V side slopes. It will separate the basin into the West Retention Basin (referred to as Retention Basin 1 in the stability analysis calculations) and East Retention Basin (referred to as Retention Basin 2 in the stability analysis calculations). The intermediate dike will be constructed using the excavated dike materials generated from the lowering of the main dike crest.

2.2.2 Proposed Liner System

Because the existing Ash Basin does not include a low permeable liner system, the following liner system will be constructed (from bottom to top) following CCP removal and subgrade preparation:

- Compacted subgrade;
- Geosynthetic Clay Liner (GCL);
- 60-mil double-sided textured HDPE geomembrane;
- 16 oz. non-woven geotextile;
- Granular cover material (12-in. thick); and
- Riprap (15-in. thick).

Liner system will be constructed to line the East and West Basin and on maximum 3H:1V side slopes. See Appendix 1 Attachment A for proposed liner system vertical and horizontal extents by Burns and McDonnell.

Due to the minimal slopes of the proposed basin floor, the side slopes were considered the critical areas of interest in terms of veneer stability. As such, calculations were limited to the side slopes of the embankments.

2.3 Engineering Evaluations and Analyses

The engineering evaluation and analyses performed as part of this permit application include hydrology and hydraulic analysis, retention basin stability analysis, and liner veneer stability analysis. Findings of these analyses are summarized below.

2.3.1 Hydrologic and Hydraulic Analysis

The objective of the hydrologic and hydraulic calculations are to support design through storm routing of flows for the retention basin using the Hydrologic Modeling System (HEC-HMS) v4.0 developed by US Army Corps of Engineers. Hydrologic and hydraulic calculation package is presented in Attachment C.

According to the hydrologic and hydraulic calculation package by Burns and McDonnell the East Bend retention basin is described as a Class (B) moderate hazard structure. As defined by the KDEP Division of Water Engineering Memorandum No. 5, Class (B) moderate hazard structure is a structure whose failure could cause major damage to a property or project, but loss of life is very unlikely. According to Engineering Memorandum No.5, Class (B) structures are generally located in predominantly rural agricultural areas where failure may damage isolated homes, main highways or major railroads, or cause interruption of uses or service of relatively important public utilities. However, it should also be noted that there are no such structures on the banks of the Ohio River. Using the design rainfall depth equation for a Class B structure provided in Engineering Memorandum No.5, a 6-hr design storm depth of 13.7 inches was calculated using the 100-year, 6-hr rainfall. This 6-hr design storm was distributed using the dimensionless design storm distribution from Natural Resources Conservation Service (NRCS) Technical Release 60 (TR-60) (Natural Resources Conservation Service, 2005).

Burns and McDonnell analyzed the proposed retention basin as East and West Basins separated by the intermediate dike. A 20-ft long broad-crested spillway with crest elevation of 497.6 feet MSL discharges from the West Basin to the East Basin. There is also an emergency spillway on the intermediate dike at invert elevation 503 feet MSL as shown in the Design Drawings in Appendix 1 Attachment A. The primary spillway that discharges to the Ohio River is at the East Basin at elevation 494 feet MSL. The emergency spillway that discharges to the Ohio River is on the East Basin berm and at elevation 503 feet MSL. The top of dam for the proposed retention basin (West and East Basins) is at elevation 505 feet MSL.

The drainage areas presented in Figure 1 of Attachment C were measured using recent topographic maps and prepared by Burns and McDonnell. Weighted SCS Curve Numbers and lag times were calculated following NRCS TR-55 (Natural Resources Conservation Service, 1986). An elevation table was developed using the proposed future grades of the East and West Basins. HEC-HMS was used for the hydrologic and hydraulic analysis. Process flows, as compiled in Table 2 of Attachment C, were included in the HEC-HMS model.

The peak IDF flow for the combined (East and West Basin) inflow and discharge are calculated to be 724.1 cfs and 54.4 cfs, respectively. Normal pool elevations for the East and West Basins are 495.6 feet MSL and 498.0 feet MSL, respectively. The overall peak pool elevation is 500.9 feet MSL which allows 4.1 feet of freeboard.

2.3.2 Slope Stability Analysis

The objective of this calculation is to evaluate the static and pseudo-static stability of the retention basin with the proposed modifications. Slope stability calculation package is presented in Appendix 1 Attachment D.

Two critical cross sections were analyzed and include both a critical section through the eastern slope of the dike and a critical section through the proposed divider dike. The critical section locations were selected based upon the dike geometries and underlying material properties that resulted in lower factors of safety. The selected geotechnical and shear strength properties were obtained from the previous Phase 2 Reconstitution of Ash Pond Designs Report (Amec Foster Wheeler, 2015).

The stability factors of safety for the critical cross sections were analyzed using limit equilibrium procedures and Morgenstern-Price's method-of-slices, as implemented in the computer program SLOPE/W (August 2015 Release) by GEO-SLOPE International. Critical failure surfaces were modeled as wedge (translational) failures, deep circular failures, and shallow circular failures. For each analysis case, the lowest factor of safety of the critical failure surfaces governs as required by the limit equilibrium method. In addition, four loading conditions were analyzed:

- long-term steady seepage,
- rapid drawdown,
- earthquake loading, and
- end of construction conditions.

The phreatic surface conditions at the site were modeled based upon available groundwater information that was developed in the Conceptual Site Model (CSM) report (M.S. Belgin & Associates, 2015). For the rapid drawdown condition, the Ohio River was modeled according to the 100-yr flood elevation of 481 feet MSL.

The proposed design modifications to the existing Ash Basin were shown to result in acceptable factors of safety at the critical cross sections. The proposed dike geometries were shown to have acceptable stability factors of safety under the loading conditions analyzed. These results were based on the available design information, regulatory requirements, material properties, groundwater levels, and seismic data at the time of this report.

2.3.3 Liner Veneer Stability Analysis

The objective of this calculation is to evaluate the static and seismic (pseudo-static method) retention basin proposed liner system veneer stability. Veneer stability during construction is also evaluated. The composite liner system (refer to as the liner system) will be constructed on 3H:1V slopes at the retention basin. Since the specific materials to be used in liner system construction are not known, minimum interface friction angles that satisfy the minimum factors of safety are back-calculated. Veneer stability was evaluated using Matasovic (1991). Liner veneer stability calculation package is presented in Appendix 1 – Attachment E.

The minimum required interface friction angle is 28.8 degrees for the static condition. The minimum required interface friction angle for the seismic conditions (based on an acceptable deformation of 1 foot) is 27.2 degrees. Therefore, the controlling minimum interface friction angle for the East Bend retention basin is reported as 28.8 degrees. Prior to liner system construction, interface friction testing should be performed on the liner system materials to demonstrate that a minimum interface friction angle of 28.8 degrees is achieved.

Veneer stability under construction load is also evaluated assuming that the construction equipment will be operating on the liner system side slopes. Veneer stability during construction was evaluated for two conditions: for 2.25-foot thick protective cover (top of riprap), and 1-foot thick protective cover (top of granular cover material). The factor of safety against sliding under the dozer track was calculated using Thiel and Narejo (2005). The factor of safety was calculated for a minimum interface friction angle of 28.8 degrees.

Calculated factors of safety for construction loading are 1.2 and 1.0 for 2.25-ft thick protective cover and 1-ft thick protective cover, respectively. Calculated factors of safety are acceptable since the Thiel and Narejo method adds extra 30 percent loading to the driving force calculation to account for inertial force. There is no tension in the geosynthetic components of the liner system due to construction loading with the assumed construction equipment.

3. CONSTRUCTION SEQUENCE

The repurposing and new retention basin construction will be completed in two phases. The sequencing and phasing plans are described in further detail below.

Phase 1 – West Basin Repurposing (13.6 acres)

Phase 1 will consist of removing CCR material from the west side of the existing Ash Basin. During the CCR removal a sheet pile wall will be constructed to separate the west and east basins with a top elevation of 500 feet MSL. A peninsula will be constructed on the south side of the pond so that the sheet pile wall will not penetrate the core of the existing dike. Once the sheet pile wall is in place, existing water in the west side will be pumped into the east side and remaining CCR material will be removed from the west side of the pond. An intermediate dike will then be constructed in the cleaned portion of the new west basin to permanently separate the two new basins. The west side dike will also be lowered in this phase from the existing elevation of 520 feet MSL to a new top of dike elevation of 505 feet MSL. Material from this excavation will then be used to modify the existing side slopes inside the new basin from the current 2H:1V slope to a more gradual 3H:1V slope. An outfall structure with an emergency spillway will be constructed in this intermediate dike to allow the West Basin to flow into the East Basin and not overtop the new dike. Once all CCR material has been removed, the pond bottom will also be regraded to aid in the installation of the new basin lining system. The new basin liner will consist of a GCL liner below a 60-mil textured HDPE liner. The HDPE liner will be protected with a geotextile fabric and a 12-inch granular layer. The side slopes of the new basin will have an additional layer of riprap to protect the slopes from erosion. Any storm water that will accumulate in the West Basin will be pumped over the temporary divider dike into the existing east side of the Ash Basin, where the current outfall is located.

Phase 2 – East Basin Repurposing (22.9 acres)

Phase 2 will repurpose the east side of the basin similar to the west side, with one minor difference. Since the intermediate dike will already be installed there is no need to install sheet pile wall for this phase. The east side will be dewatered and pumped into the West Basin. The West Basin water levels will be kept much lower in order to prevent flows from entering the newly installed concrete weir structure connecting the two basins. The CCR will be removed, pond bottom regraded, dike lowered to 505 feet MSL and side slopes adjusted to 3H:1V slopes similar to the West Basin. The outfall from the basin is located on the east side, so as the East Basin is being repurposed a pumping system will be installed in the West Basin to pump water from the West Basin to the existing outfall. The existing emergency overflow will be modified to accommodate the lower dike elevation.

4. REFERENCED DOCUMENTS

Amec Foster Wheeler, "Phase 2 Reconstitution of Ash Pond Designs, Final Report Submittal, East Bend Station," July 6, 2015.

Amec Foster Wheeler, "Duke Energy Ash Basin Closure Plan, East Bend Station, Rev A" June 30, 2016.

GEO-SLOPE International Ltd., "Stability Modeling with SLOPE/W", August 2015 Release.

Kentucky Department for Environmental Protection, Division of Water, "Engineering Memorandum No. 5, June 1999.

Matasovic, N., "Selection of Method for Seismic Slope Stability Analysis", Proceedings: Second International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, March 11-15, 1991, St. Louis, MO, Paper No. 7.20.

M.S. Belgin & Associates, "Conceptual Site Model (CSM), East Bend Station, Draft," March 29, 2016.

Natural Resources Conservation Service, "Urban Hydrology for Small Watersheds", TR-55, USDA, Conservation Engineering Division, June 1986.

Natural Resources Conservation Service, "Earth Dams and Reservoirs", TR-60, USDA, Conservation Engineering Division, July 2005.

Sargent & Lundy Engineers, "Preliminary Foundation Investigations", September 20, 1974.

Thiel, R. and Narejo, D., "Lamination Strength Requirements for Geonet Drainage Geocomposites", Proceedings of the Geo-Frontiers 2005, Austin, Texas, January 24-26, 2005.

US Army Corps of Engineers, "Hydrologic Modeling System HEC-HMS", Version 4.0, Hydrologic Engineering Center, 2013.

APPENDICES

Appendix 1 Dam Construction Permit Application

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

Date: 9/28/2016

The following is a general description of the design, including the various factors involved, the general plans, sections and specifications. Included in the drawings are vicinity maps and curves showing the hydraulic capacities. Items not pertinent to this project are deleted.

LOCATION AND PURPOSE:

1. County Boone
2. Stream Off-Stream, Ohio River
3. Latitude 38degrees 54minutes 07seconds Longitude -84degrees 50minutes 28seconds
4. Purpose Modifying, lining, and repurposing excavated ash basin to provide stormwater retention and sediment control.
5. Topographic Map (*7 ½ Quadrangle*) Name (*Attach Copy*)
Rising Sun KY-IN (Attachment A, Figure 1)

SUMMARY OF DESIGN:

1. Drainage Area 261.2 Acres 0.4081 Sq.Miles
2. Storage Capacity Sediment: 459; Normal Pool: 844 Maximum Water Surface: 1122 Acre Feet
3. Maximum Height Of Dam 44 Feet
4. Spillway Capacity Principal Spillway: 84.20 Emergency Spillway 89.27 @ Maximum Water Surface C.F.S.
5. Top Of Dam Elevation 505.0' to 515' Feet, MSL
6. Normal Water Surface 498.0 West Basin; 495.6 East Basin Feet, MSL
7. Maximum Water Surface 500.93' Feet, MSL
8. Minimum Water Surface 494.00' (East Basin Principal Spillway Invert) Feet, MSL
9. Freeboard Above Maximum Water 4.1 Feet
10. Power Capacity N/A Feet
11. General Plans and Sections See Attachment A(*Attach 1 Copy*) Burns and McDonnell

DESIGN DATA:

1. Geological Report, Author and Data See Attachment B(*Attach Copy*) Amec Foster Wheeler
2. Log Of Test Pits and Drill Holes See Attachment B (*Attach Copy*) Amec Foster Wheeler
3. Hydraulic Data, Capacities and requirements and by whom established See Attachment C by Burns and McDonnell
   a. Storage (Irrigation, Flood Etc.) Attachment C, Table 3
   b. Spillway Attachment C; Principal Spillway Figure 4, Emergency Spillway Figure 6

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

c. Outlet N/A

d. Diversion N/A

e. Area-Storage Capacity Curves For Various Elevations Of Water Surface Attachment C; Figure 4

4. Hydrologic Data

a. Hydrographs	Attachment C; Inflow: Figure 3 Outflow: Figure 7
b. Maximum Recorded Runoff	No historic flood level because basin did not cross a stream.
c. Maximum Anticipated	Runoff at IDF: 54.4 cfs
d. Discharges (*100 Yr., Etc.*)	IDF: 54.4 cfs
e. Design Values & Method	Attachment C Section 1.0
5. Right Of Way Information	Entire dam on Duke Energy Property

RESERVOIR:

1. General Dimensions: Existing basin is rectangle 3,400' x 650' divided into two rectangular basins: East 1,850' x 650' and West 1,300' x 650'.

2. Existing Structures: Inlet structures throughout; East Basin primary and emergency spillways.

3. Proposed Structures: Reduce height of existing dike to elevation 505 feet MSL. Construct intermediate dike dividing existing basin into East and West basins. Construct concrete weir spillway and emergency spillway on proposed intermediate dike connecting West Basin to East Basin.

4. Nature Of Land Flooded and Clearing Required:
Repurposing of existing basin placed in the Ohio River Floodplain. No additional land encroachment nor clearing required.

5. House Elevations and Distance From Structure OR Proposed Site
No additional impact.

6. Relocations Required (*Railroad, Highway, Telephone, Power, Pipeline, Etc.*)
No additional impact.

7. Geology

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

a. General Formations Wisconsin glacial outwash (Qwo) and alluvium (Qal) soils of the Wisconsin and younger glaciation periods (Attachment B; Section 2)

b. Factors Relating To Reservoir Losses No losses; modified basins will be lined.

c. Contributing Springs No contribution to reservoir; diverted below liner.

d. Deleterious Mineral and Salt Deposits N/A

DAM SITE:

1. Geological Features, Formations:
   Existing basin located within the Ohio River Riparian Zone on the East Bend Lowland (Attachment B; Section 2).
2. Nature Of Stream Bed and Abutments:
   Existing basin did not cross a stream, but was located within the transition zone of the Ohio River riparian zone abuting the upland zone paralell to river flow on the northern bank.
3. Interpretation of Test Pits and Drill Holes:
   Attachment B; Section 2.2
4. Percolation Tests, Ground Water:
   No percolation tests performed. Groundwater level consistent with river level.

DAM:

1. Features Governing Design:
   Topography, location of plant, Ohio River, and modification of existing basin
2. Water Surface Elevation, Storage Capacities, Freeboard, Etc.:
   See Summary of Design
3. Grouting Requirements:
   Modified structure will be lined eliminating dike seepage source.

SPILLWAY:

1. Requirements:
   Pass design storm without overtopping dam. The modeled design storm is 13.7" in 6 hours.
2. a. Factors Governing Design and Location:
   Storage Capacity
   b. Maximum Spillway Velocity 12 ft/s
3. Type: Primary Spillway: concrete headwall w/ 36" diameter HDPE Pipe
   Emergency Spillway: 25-ft wide by 2' deep concrete channel with 10H:1V sideslopes

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

a. Controlled Or Uncontrolled Uncontrolled

b. Lining Principal: HDPE Pipe; Emergency: Concrete

c. Dimension See #3 above

d. Elevation Primary Spillway: 494.0' ; Emergency Spillway: 503.0'

4. Gates, Gate Structure

a. Dimensions N/A

b. Operation N/A

5. Stilling Basin

a. General Description N/A

b. Dimensions N/A

6. Approaches N/A

We Certify That The Above Statements Are True And Correct.

George T. Hamrick Oct 4, 2016
Owner **Date**

29 Sept 16
Engineer **Date**

J. L.
STUDER
20495

20495
PE Number

Seal

Commonwealth Of Kentucky
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DIVISION OF WATER
14 Reilly Rd
Frankfort, Ky 40601

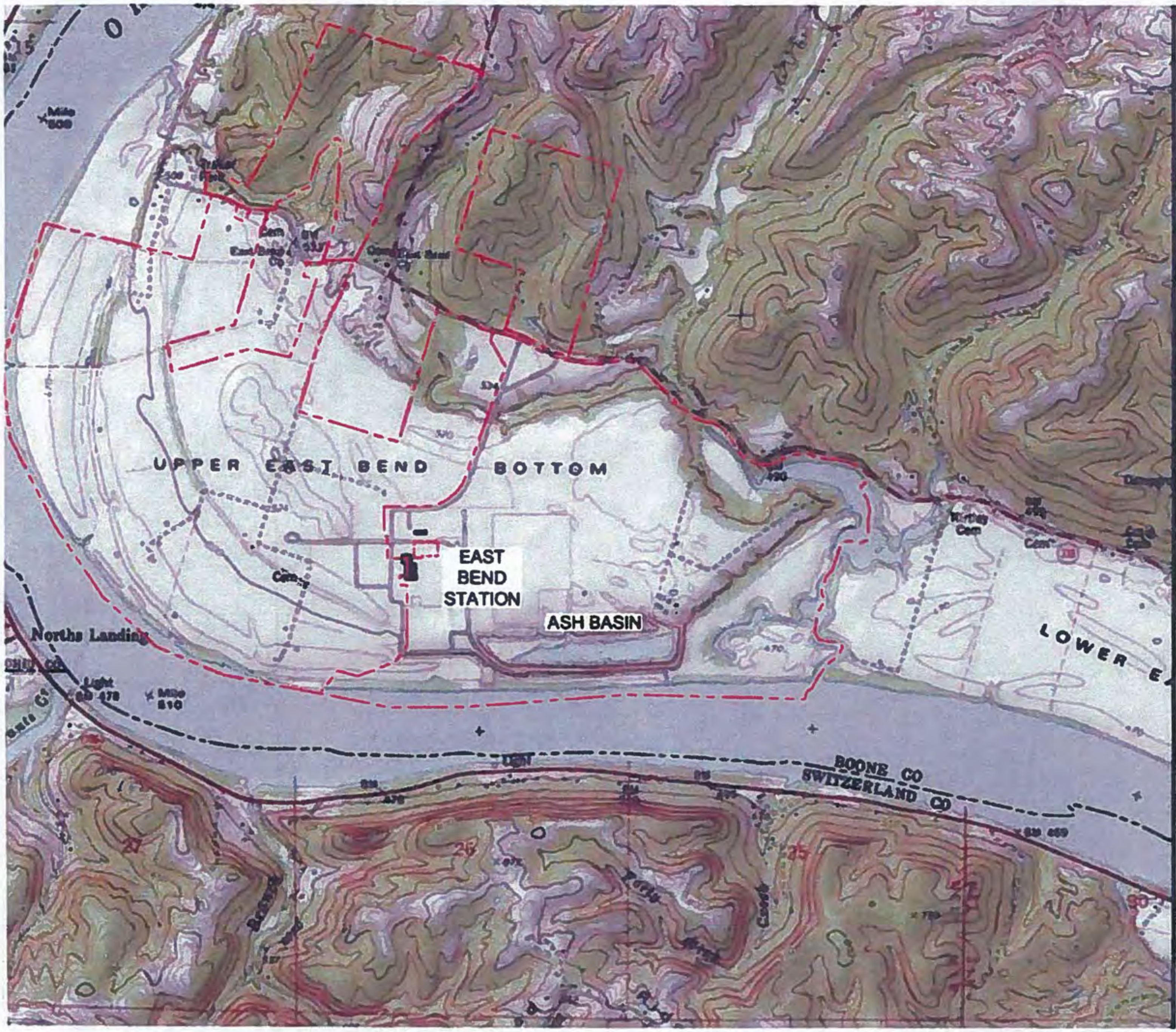
DAM CONSTRUCTION PERMIT APPLICATION DATA SHEET

Attachment A

Topographic Map

Location Map

Design Drawings



LEGEND

APPR

amec foster wheeler

TITLE

EAST BEN
BO

FOR

DUKE
ENER

LEGEND

● OUTFALL ★ EAST BEND STATION □ APPROXIMATE CCR FACILITY BOUNDARY

NOTE: THIS FIGURE IS FOR REFERENCE ONLY.

EAST BEND ASH BASIN CLOSURE PLAN
SITE LOCATION AND FACILITIES MAP

EAST BEND STATION
BOONE COUNTY, KENTUCKY

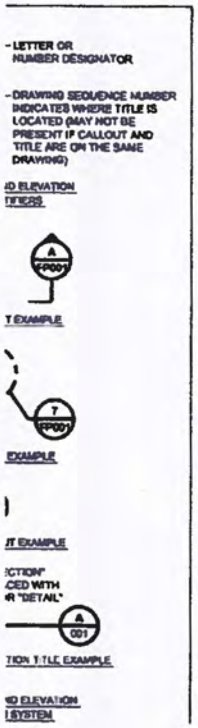
PROJECT NO: 7810-15-0345

FIGURE NO:

amec foster wheeler

DUKE ENERGY.

F:\AMEC_Projects\2014\7810-14-0183_OM\7810-14-0183_01_04_East_Bend_OM\Fig-1_Site_Map.mxd, User: maddison.sutton; Date: 6/22/2016 12.08.32 PM, Checked by: AJ Date: 6/22/2016



ENERGY®

East Bend Station Unit 2
Boone County, Kentucky

2016

88669

Contract Drawings

GENERAL DRAWINGS

DWG. NO.	TITLE
EBS00-CVL-0000	COVER-INDEX
EBS00-CVL-0001	LEGEND, ABBREVIATIONS, VICINITY MAP & GENERAL NOTES

CIVIL DRAWINGS

DWG. NO.	TITLE
EBS00-CVL-0002	EXISTING CONDITIONS
EBS00-CVL-0003	EROSION CONTROL PLAN
EBS00-CVL-0100	SITE PLAN - TEMPORARY (1)
EBS00-CVL-0101	OVERALL GRADING PLAN - TEMPORARY (1)
EBS00-CVL-0105	GRADING SECTIONS - SHEET 1 - TEMPORARY (1)
EBS00-CVL-0106	GRADING SECTIONS - SHEET 2 - TEMPORARY (1)
EBS00-CVL-0200	SITE PLAN - TEMPORARY (2)
EBS00-CVL-0201	OVERALL GRADING PLAN - TEMPORARY (2)
EBS00-CVL-0205	GRADING SECTIONS - SHEET 1 - TEMPORARY (2)
EBS00-CVL-0206	GRADING SECTIONS - SHEET 2 - TEMPORARY (2)
EBS00-CVL-0300	SITE PLAN - FUTURE
EBS00-CVL-0301	OVERALL GRADING PLAN - FUTURE
EBS00-CVL-0305	GRADING SECTIONS - SHEET 1 - FUTURE
EBS00-CVL-0306	GRADING SECTIONS - SHEET 2 - FUTURE
EBS00-CVL-0400	EROSION CONTROL DETAILS
EBS00-CVL-0401	LINER DETAILS
EBS00-CVL-0402	CIVIL DETAILS - SHEET 1

PRELIMINA

⊙ BM

UNLESS AN ELEVATION

TO CONTRACTS.

BLDG	BUILDING	P	[illegible]
BM	BENCHMARK	PC	POINT OF CURVE
BOT	BOTTOM	PCC	PORTLAND CEMENT CONCRETE
CB	CATCH BASIN	PI	POINT OF INTERSECTION
C TO C	CENTER TO CENTER	PL	PROPERTY LINE
CL	CENTERLINE	PT	POINT OF TANGENT
CLMS	CONTROLLED LOW STRENGTH MATERIAL	P.R.C.	POINT OF REVERSE CURVE
CHDPE	CORRUGATED HIGH DENSITY POLYETHYLENE	PSI	POUNDS PER SQUARE INCH
CJ	CONSTRUCTION JOINT	P.V.C.	POINT OF VERTICAL CURVE
CMAP	CORRUGATED METAL ARCH PIPE	P.V.I.	POINT OF VERTICAL INTERSECTION
CMP	CORRUGATED METAL PIPE	P.V.R.C.	POINT OF VERTICAL REVERSE CURVE
CONC	CONCRETE	P.V.T.	POINT OF VERTICAL TANGENT
CPT	CORRUGATED POLYETHYLENE TUBING	R	RADIUS
CVL	CIVIL	REB	REBAR
DBL	DOUBLE	RCC	ROLLER COMPACTED CONCRETE
DET	DETAIL	RD	ROAD
DI	DROP INLET	RPT	RADIUS POINT
DIA	DIAMETER	RCP	REINFORCED CONCRETE PIPE
DWG	DRAWING	RR	RAILROAD
ECB	EXISTING CATCH BASIN	RT	RIGHT
EDB	ELECTRICAL DUCT BANK	ROW	RIGHT-OF-WAY
E	EAST	S	SOUTH
EF	EACH FACE	SLP	SLOPE
EJ	EXPANSION JOINT	S.S.	STAINLESS STEEL
EL	ELEVATION	SHLDR	SHOULDER
EMH	ELECTRICAL MANHOLE	STD	STANDARD
EQN	EQUATION	ST	STORM SEWER
EXIST	EXISTING	STA	STATION
EW	EACH WAY	SWG	SWING
FBD	FLAT BOTTOM DITCH	SY	SQUARE YARD
FFE	FINISHED FLOOR ELEVATION	T&B	TOP AND BOTTOM
FL	FLOWLINE	TEMP	TEMPORARY
FT	FEET, FOOT	TOA	TOP OF ASPHALT
GA	GAGE	TOC	TOP OF CONCRETE
GALV	GALVANIZED	TO GRATING	TOP OF GRATING
GCL	GEOSYNTHETIC CLAY LINER	TOM	TOP OF MANHOLE
H	HORIZONTAL	TOP	TOP OF PIPE
HDPE	HIGH DENSITY POLYETHYLENE	TOR	TOP OF RAIL
HORIZ	HORIZONTAL	TOSB	TOP OF SUBBALLAST
HPT	HIGH POINT	TOSG	TOP OF SUBGRADE
HWY	HIGHWAY	T.P.I.	THREADS PER INCH
ID	INSIDE DIAMETER	TYP	TYPICAL
IF	INSIDE FACE	UON	UNLESS OTHERWISE NOTED
INTSCT	INTERSECTION	V	VERTICAL
INV	INVERT	VC	VERTICAL CURVE
KYTC	KENTUCKY TRANSPORTATION CABINET	VERT	VERTICAL
L	LONG	W	WEST
LB	POUND	W/	WITH
LF	LINEAR FEET	W/O	WITH OUT
LT	LEFT	WT	WEIGHT
MAX	MAXIMUM	WWF	WELDED WIRE FABRIC
MH	MANHOLE		
MIL	MILLI-INCH		
MIN	MINIMUM		
MISC	MISCELLANEOUS		

NOTES:

1. ALL ABBREVIATIONS ARE BURNS & McDONNELL STANDARDS WITHOUT RESPECT TO CONTRACTS.
2. ABBREVIATIONS ARE APPLICABLE TO ALL DWGS.

VICINITY MAP
NOT TO SCALE

MARKS ARE PROVIDED
. THE
TO THE START OF WORK
, WILL

METHODS OF
SHALL FURNISH ALL
COMPLETELY PERFORM
. CONTRACTOR SHALL
CONTRACTOR SHALL BE
F MATERIALS.

ES TO ENSURE SAFETY OF
T TO THE SITE.
SULTING FROM
THE SITE BY THE ENGINEER
RESPONSIBILITY.

MATERIALS THROUGH
ALS IN A SECURE LOCATION

R SURROUNDINGS OF THE
VENT THEFT, VANDALISM

THAT ARE NOT THE

CONSTRUCTION PERMITS
NOTICE CERTIFICATE OF
IS PERFORMING THE WORK

HA STANDARDS

CAL, STATE, AND FEDERAL

11. UNKNOWN SITUATIONS OR CONDITIONS NOT COVERED IN THE CONTRACT DOCUMENTS MAY ARISE DURING CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE OWNER IF SUCH A CONDITION IS IDENTIFIED WITHIN 24 HOURS
12. ALL DIMENSIONS, ELEVATIONS, AND CONDITIONS SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR AND ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER FOR CLARIFICATION BEFORE PROCEEDING WITH THE AFFECTED PART OF WORK.
13. THE CONTRACTOR SHALL VISIT THE SITE AND FAMILIARIZE THEMSELVES WITH THE EXISTING CONDITIONS BEFORE SUBMITTING THEIR BID.
14. IF CERTAIN FEATURES ARE NOT FULLY SHOWN OR CALLED FOR ON THE CONTRACT DRAWINGS OR SPECIFICATIONS, THEIR CONSTRUCTION SHALL BE OF THE SAME CHARACTER AS FOR SIMILAR CONDITIONS THAT ARE SHOWN OR CALLED FOR, SUBJECT TO THE APPROVAL OF THE ENGINEER AND THE OWNER
15. ALL WORK SHALL BE DONE TO THE LINES, SLOPES, THICKNESS, AND GRADES INDICATED IN THE CONTRACT DRAWINGS. MAXIMUM SLOPE SHALL BE [illegible] UNLESS INDICATED OTHERWISE. ALL ESTABLISHED MONUMENTS, BENCHMARKS, REFERENCE POINTS, STAKES, AND OTHER CONTROL POINTS SHALL BE CAREFULLY PRESERVED BY THE CONTRACTOR. CONTRACTOR SHALL NOTIFY OWNER IN WRITING OF BENCHMARKS, REFERENCE LINES, OR OTHER CONTROL POINTS WHICH MAY HAVE BEEN DISTURBED OR WHICH APPEAR TO BE OFF LINE OR GRADE.
16. ONCE THE WORK HAS BEEN STARTED, THE CONTRACTOR SHALL COMPLETE THE WORK WITHOUT ANY INTERRUPTIONS.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING POTABLE WATER AND TEMPORARY SANITARY FACILITIES FOR CONTRACTOR'S PERSONNEL. CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR INSTALLING AND REMOVING ANY REQUIRED TEMPORARY UTILITY CONNECTIONS.
18. GRADES AND ELEVATIONS SHOWN ARE FINISHED SURFACING
19. INSTALL EROSION CONTROL MEASURES PER THE SWPPP AND AS NECESSARY TO PERFORM WORK IN ACCORDANCE WITH ALL APPLICABLE LAND DISTURBANCE ORDINANCES AND REGULATIONS.

GENERAL DEMOLITION NOTES:

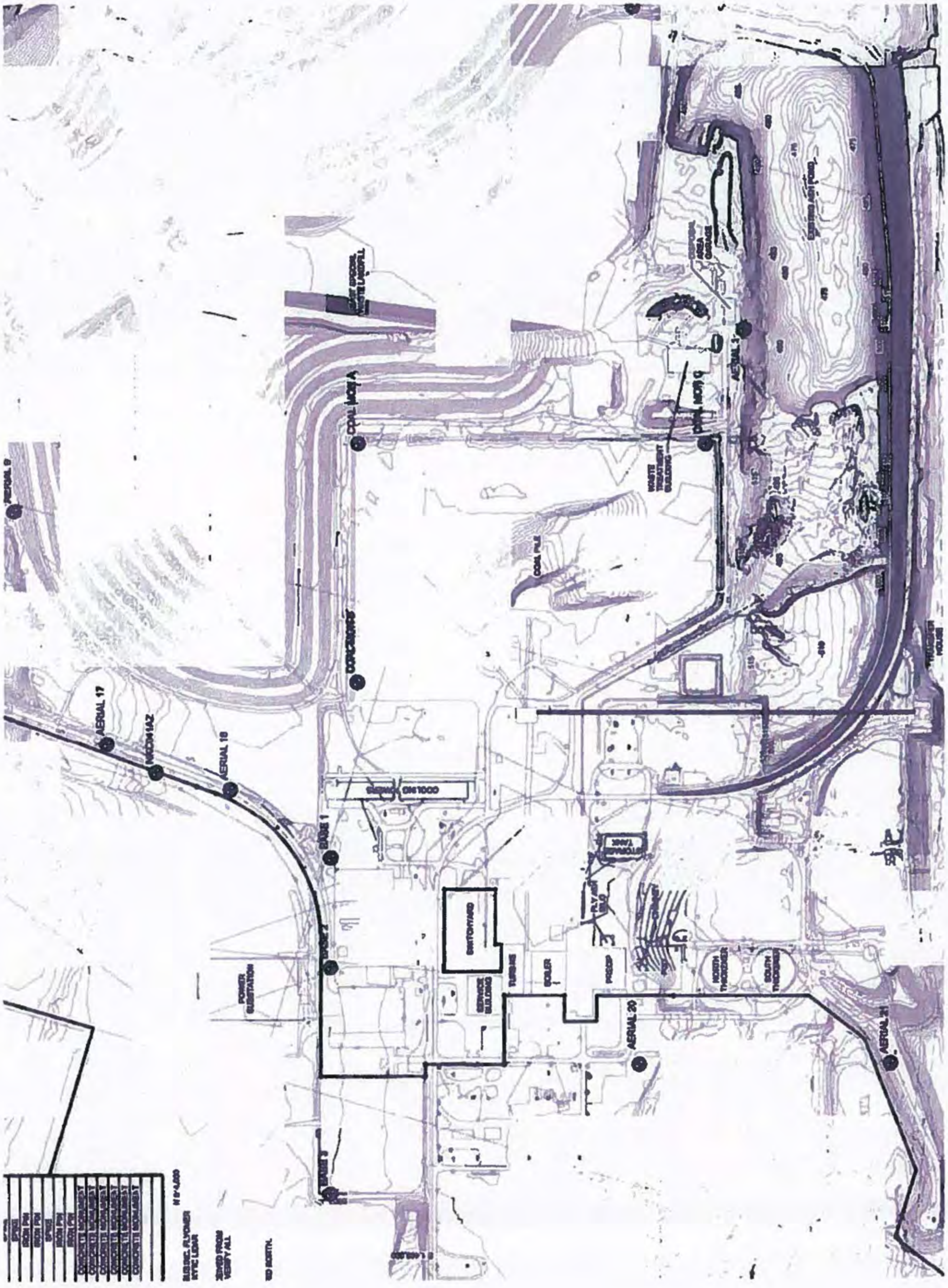
1. ALL DEMOLITION WASTE, DEBRIS, AND UNSATISFACTORY MATERIALS SHALL BE DISPOSED OF OFF THE SITE. ITEMS WITHIN THE PROJECT LIMITS, EVEN IF NOT IDENTIFIED, SHALL BE REMOVED AND PROPERLY DISPOSED OFFSITE.
2. DEBRIS REMOVAL MAY CONTAIN ANY OF THE FOLLOWING MATERIALS: AGGREGATE, CONCRETE, ASPHALT, MASONRY, FOUNDATIONS, REBAR, FENCE MATERIAL, PIPING, LIGHT POLES, SILT FENCE, AND MISCELLANEOUS STRUCTURES. LARGE PIECES OF MATERIAL MAY NEED TO BE CRUSHED AND/OR BROKEN UP FURTHER IN ORDER TO BE HAULED AWAY TO THE WASTE DISPOSAL SITE.
3. ANY DAMAGE TO PAVEMENT AREAS DESIGNATED TO REMAIN SHALL BE REPAIRED OR REMOVED AND REPLACED AT NO ADDITIONAL COST TO OWNER.
4. CONTRACTOR SHALL PRESERVE EXISTING TREES AND VEGETATION WHENEVER PRACTICABLE.

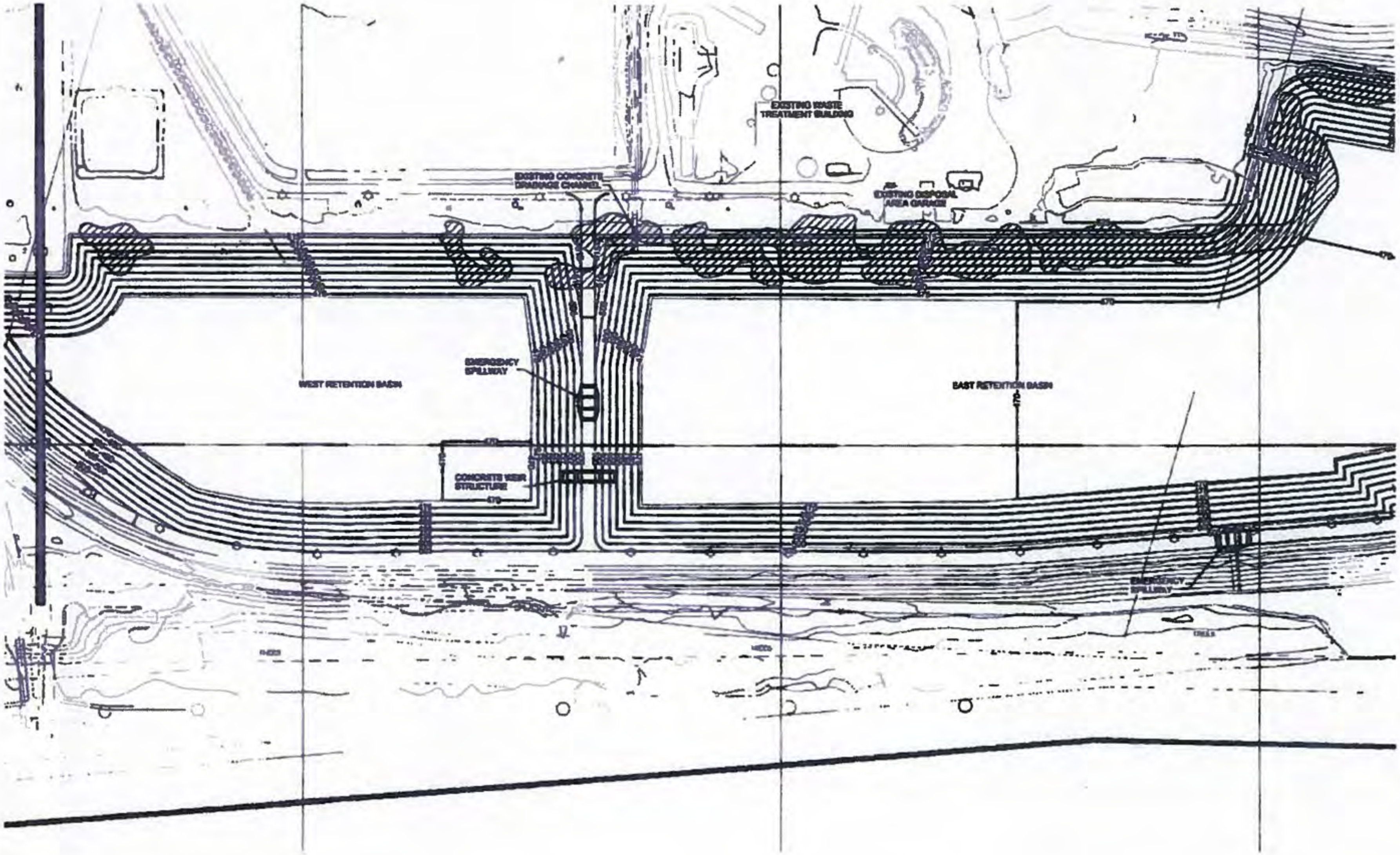
UTILITY DEMOLITION NOTES:

1. CONTRACTOR SHALL COORDINATE WITH THE OWNER PRIOR TO REMOVAL OF EXISTING UTILITIES IN SERVICE. RELOCATED UTILITIES SHALL BE CONSTRUCTED BEFORE REMOVAL OF EXISTING UTILITIES TO ENSURE UNINTERRUPTED SERVICE TO THE FACILITIES SERVED BY THE UTILITY. ALL RELOCATIONS SHALL BE COORDINATED WITH THE OWNER.
2. UTILITY CAPPING METHODS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS FOR SPECIFIC PIPE MATERIAL IN SERVICE. ALL CAPPING SHALL BE INSPECTED AND APPROVED BY THE OWNER.
3. ALL STRUCTURES, VALVES, ETC. TO REMAIN SHALL BE PROTECTED AND ADJUSTED TO FINISH GRADE.
4. IN AREAS OF UTILITY REMOVAL OF ABANDONED LINES, THE PORTION OF EXISTING ABANDONED LINES TO REMAIN SHALL BE CAPPED OR PLUGGED AT REMOVAL INTERFACE.
5. ALL UTILITIES EQUAL TO OR GREATER THAN 6.00 INCHES IN DIAMETER AND INDICATED TO BE ABANDONED IN PLACE SHALL BE FILLED WITH A LOW STRENGTH FLOWABLE FILL. END SECTIONS SHALL BE PLUGGED TO CONTAIN FLOWABLE FILL. FLOWABLE FILL SHALL BE A

EXCAVATION AND BACKFILL NOTES:

1. THE SITE SHOULD BE STRIPPED OF ALL UNSUITABLE MATERIAL, SUCH AS, BUT NOT LIM
PAVEMENT, DEBRIS, GRAVEL, CONCRETE AND ANY FILL OR STOCKPILES IDENTIFIED FR
ON-SITE CONSTRUCTION ACTIVITIES.
2. ALL EXCESS CUT MATERIAL SHALL BE DISPOSED OF ON-SITE IN A MANNER AND AT A LO
THE OWNER.
3. EXCAVATIONS SHALL BE SLOPED OR SHORED IN ACCORDANCE WITH FEDERAL, STATE A
REGULATIONS, INCLUDING OSHA (29 CFR PART 1926) EXCAVATION TRENCH SAFETY STA
CONTRACTOR SHALL DESIGN, FURNISH, INSTALL, AND LATER REMOVE ALL TEMPORARY
AS REQUIRED TO MAINTAIN EXCAVATIONS AND BANKS IN A SAFE AND STABLE CONDITIO
OTHERWISE.
4. THE CONTRACTOR SHALL PROVIDE TEMPORARY SHORING AS REQUIRED TO ENSURE ST
SURROUNDING STRUCTURES AS REQUIRED.
5. THE EFFECTS OF PROPOSED CUT EXCAVATIONS ON THE LOAD BEARING MATERIALS SU
ADJACENT STRUCTURE FOUNDATIONS SHALL BE INVESTIGATED BY A QUALIFIED ENGINE
FOR LIMITING EXCAVATION DEPTH AND DISTANCE FROM THE EXISTING FOUNDATIONS S
VERIFY EXCAVATION STABILITY. SHEETING AND SHORING, OR OTHER MEANS OF BRACI
SHALL BE UTILIZED IF NECESSARY.
6. THE BEARING SURFACES THAT ARE DEGRADED BY EXPOSURE TO THE ELEMENTS OR C
ACTIVITIES, SHALL BE RE-EXCAVATED TO, OR RECONSTRUCTED OF SUITABLE BEARING
7. MINIMUM OF 6 INCHES OF COMPACTED STRUCTURAL FILL AGGREGATE MATERIAL SHALL
THE BASE OF ALL FOUNDATIONS. THE AGGREGATE MATERIAL SHALL BE AASHTO NO. 57
THE AGGREGATE WILL BE PROMPTLY COVERED AND NOT EXPOSED TO WEATHER. THE
MATERIAL CAN BE TYPE 5 CRUSHER RUN COMPACTED PER THE GEOTECHNICAL REPOR
8. ROAD EMBANKMENT PLACEMENT CRITERIA MATERIAL SHALL BE PLACED IN LIFTS NOT E
LOOSE. FILL SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF STANDARD PRO
D698, WITH THE MOISTURE CONTENT DEVIATING FROM THE OPTIMUM DRY DENSITY BY
APPLICABLE (FOR COHESIONLESS MATERIAL), THE BACKFILL SHALL BE COMPACTED TO
RELATIVE DENSITY AS PER ASTM D-4253 AND D-4254.


AERIAL 9
AERIAL 17
AERIAL 18
AERIAL 1
AERIAL 20
AERIAL 21
COAL NORTH A
COAL NORTH C
COOLING TOWERS
SWITCHYARD
SERVICE BUILDING
TURBINE
BOILER
PRECIP
NORTH THICKENER
SOUTH THICKENER
POWER SUBSTATION
WASTE TREATMENT BUILDING
COAL PILE
STORAGE TANK
FLY ASH SILO
EXISTING ASH POND
SPECIAL WASTE LANDFILL
THICKENER HOUSE



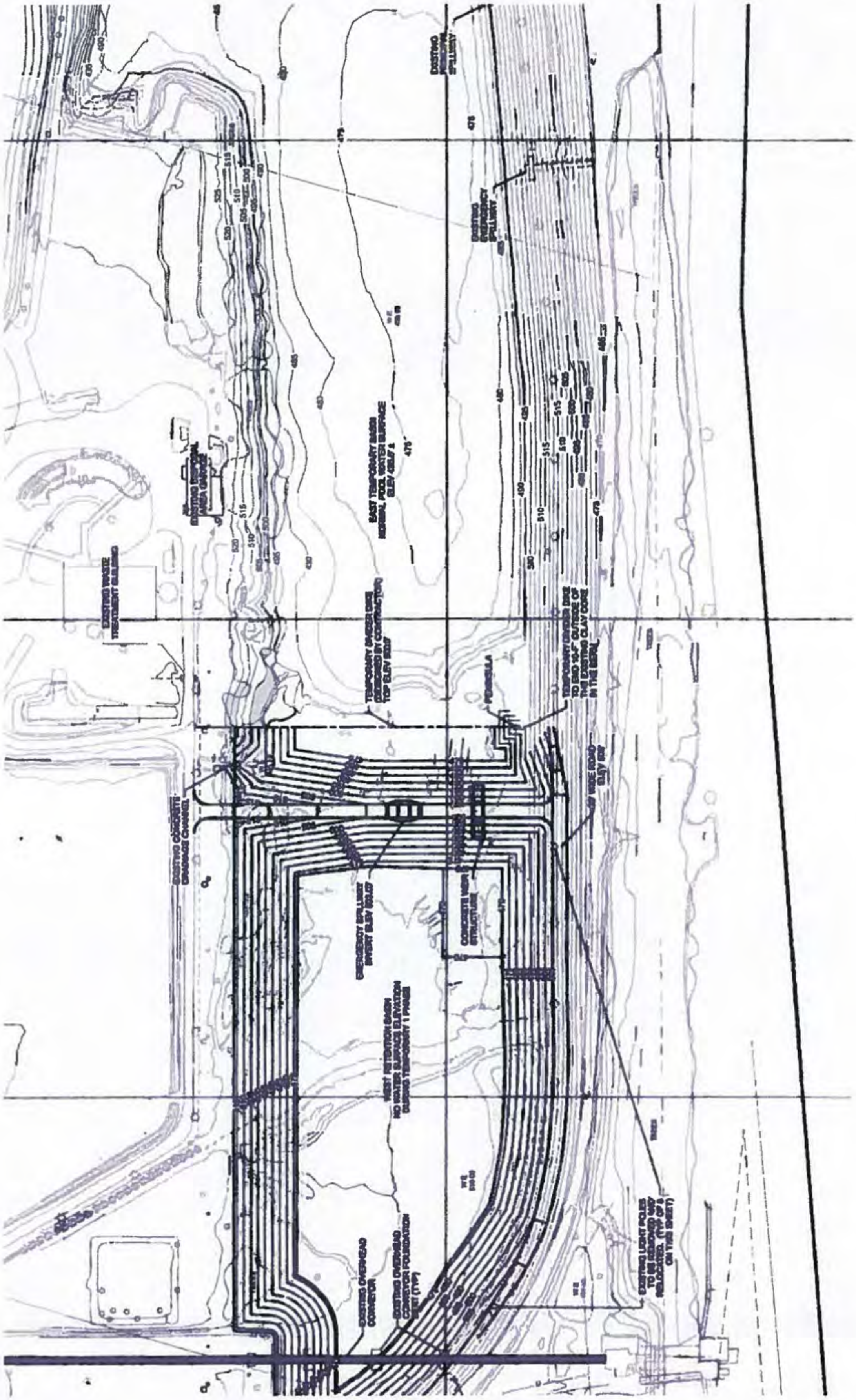
QUIRED FOR THIS PROJECT. PREVENTION OF POLLUTION RESULTING FROM
/ CONTROLLING SOIL EROSION, WATERWAY SEDIMENTATION, AND AIRBORNE
NSIBLE FOR ENSURING THAT EROSION AND SEDIMENTATION ARE CONTROLLED

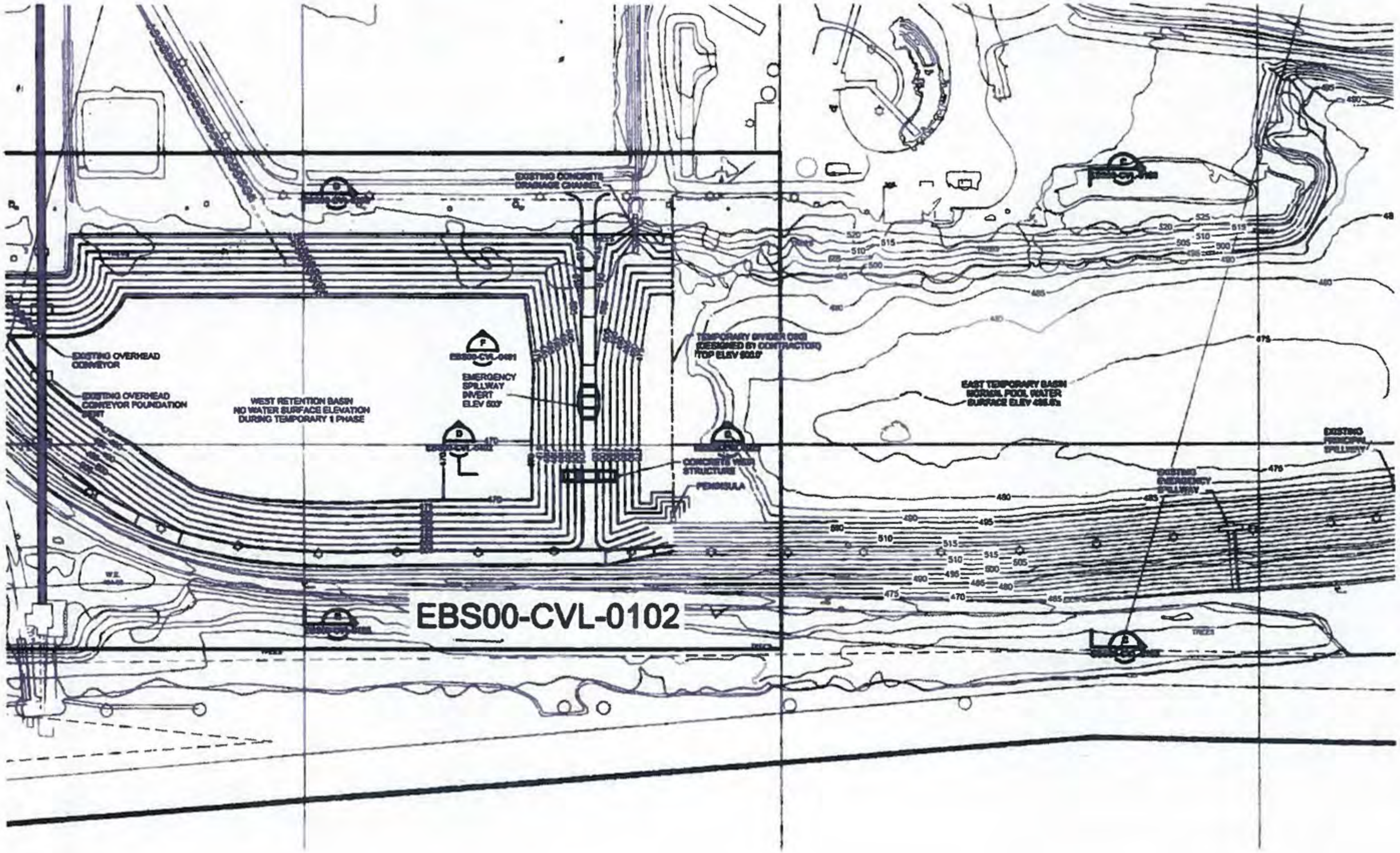
LL BE IMPLEMENTED AND MAINTAINED THROUGHOUT THE DURATION OF
TRUCTION IN AN AREA, ALL TEMPORARY EROSION AND SEDIMENT CONTROL
TION ALL TEMPORARY SOIL EROSION AND SEDIMENT CONTROL MEASURES

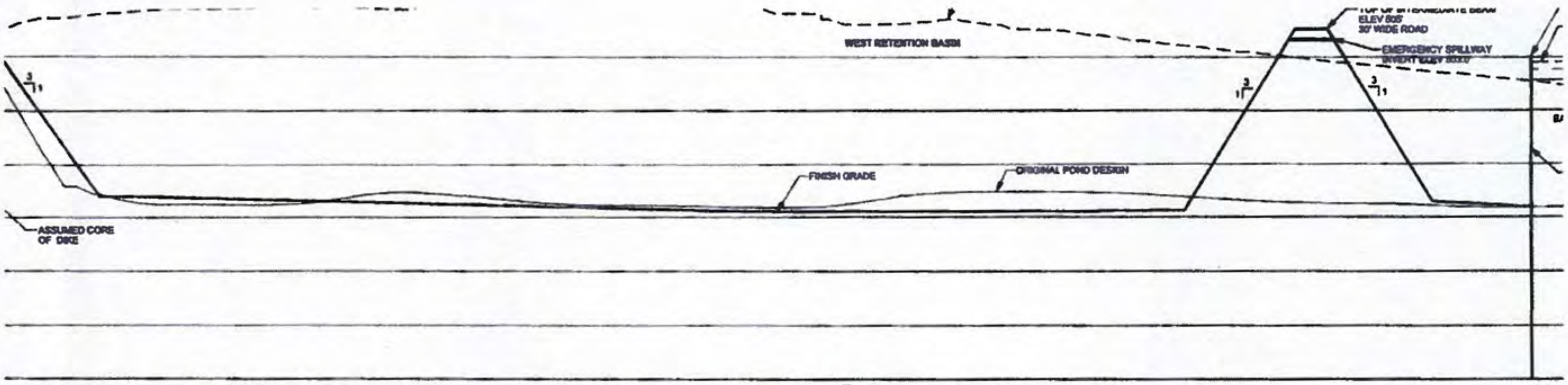
CTOR'S RESPONSIBILITY, WHO SHALL UTILIZE APPROPRIATE BEST MANAGEMENT
T FENCE, FIBER LOGS OR OTHER MEANS TO CONTROL EROSION AS NEEDED. THE
D SWPPP PLANS AS NEEDED.

R TO BEGINNING WORK. THE DEVICES SHALL BE PLACED DOWN-SLOPE OF
UP. THE IDEAL LOCATION IS ON THE SAME CONTOUR. SILT FENCE SHALL BE
CHES ONE-THIRD OF SILT FENCE HEIGHT. AFTER SIGNIFICANT RUNOFF EVENTS,
L STRUCTURES FOR SILT BUILD-UP THAT INTERFERES WITH THE PERFORMANCE
REPLACE THOSE STRUCTURES, AS NECESSARY.

EXHIBIT 2

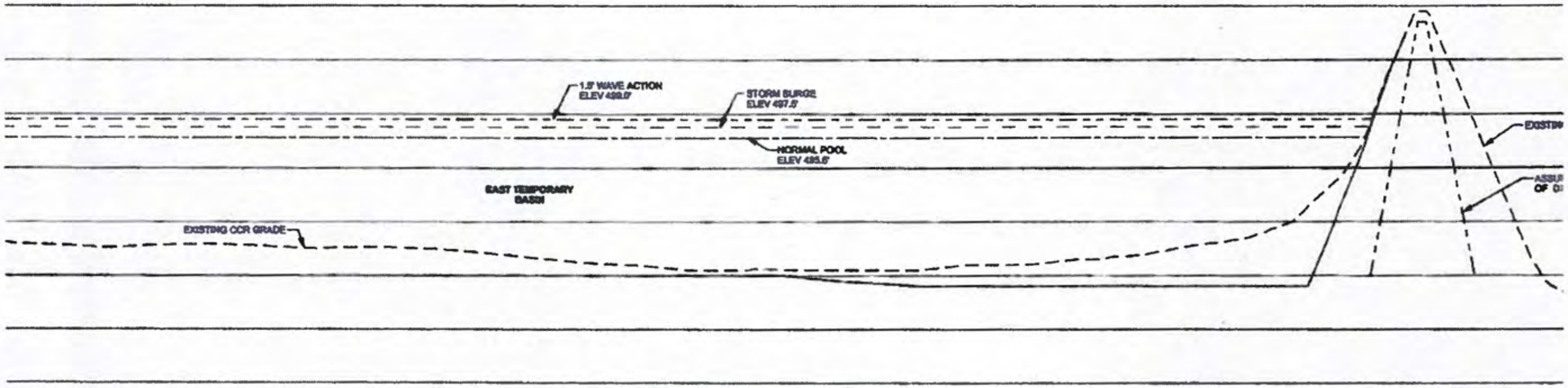

EXISTING EMERGENCY SPILLWAY
EXISTING WASTE TREATMENT BUILDING
EAST TEMPORARY BASIN NORMAL POOL WATER SURFACE
PENINSULA
CONCRETE WEIR STRUCTURE
EXISTING CONCRETE DRAINAGE CHANNEL
EMERGENCY SPILLWAY
WEST RETENTION BASIN
EXISTING OVERHEAD CONVEYOR
EXISTING LIGHT POLES TO BE REMOVED AND RELOCATED
475
480
485
490
495
500
505
510
515
520
525


EBS00-CVL-0102
EXISTING CONCRETE DRAINAGE CHANNEL
EXISTING OVERHEAD CONVEYOR
EXISTING OVERHEAD CONVEYOR FOUNDATION
WEST RETENTION BASIN NO WATER SURFACE ELEVATION DURING TEMPORARY 1 PHASE
EBS00-CVL-0401
EMERGENCY SPILLWAY INVERT ELEV 503'
EBS00-CVL-0402
TEMPORARY DIVIDER DIKE (DESIGNED BY CONTRACTOR) TOP ELEV 500.0'
CONCRETE WEIR STRUCTURE
PENINSULA
EAST TEMPORARY BASIN NORMAL POOL WATER SURFACE ELEV 488.0'±
EXISTING PRINCIPAL SPILLWAY
EXISTING EMERGENCY SPILLWAY
TREES
W.E.
470
475
480
485
490
495
500
505
510
515
520
525



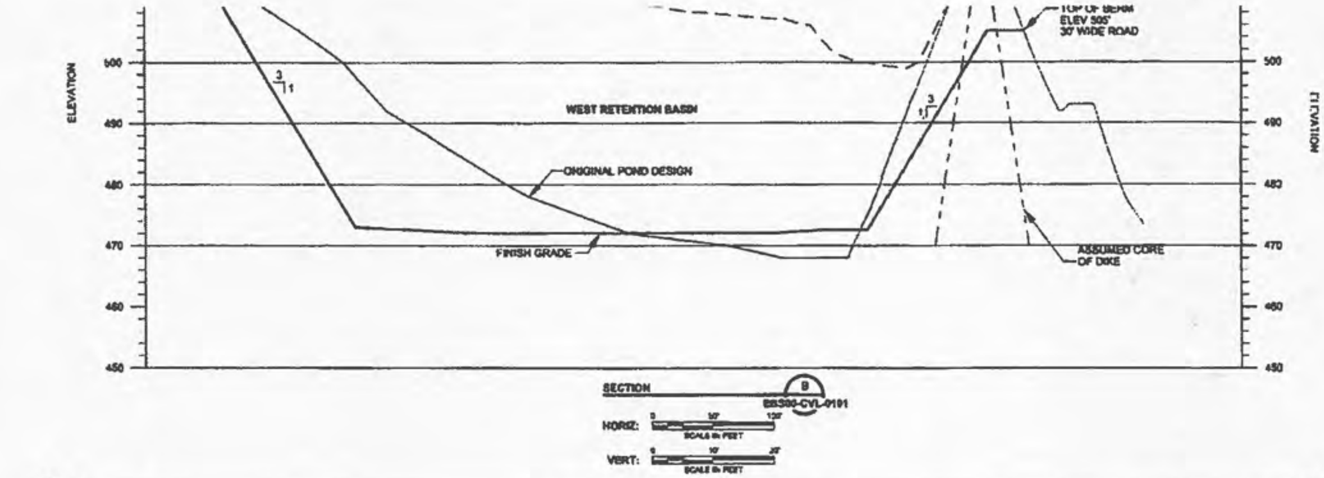
SECTION A
EBS00-CVL-0101

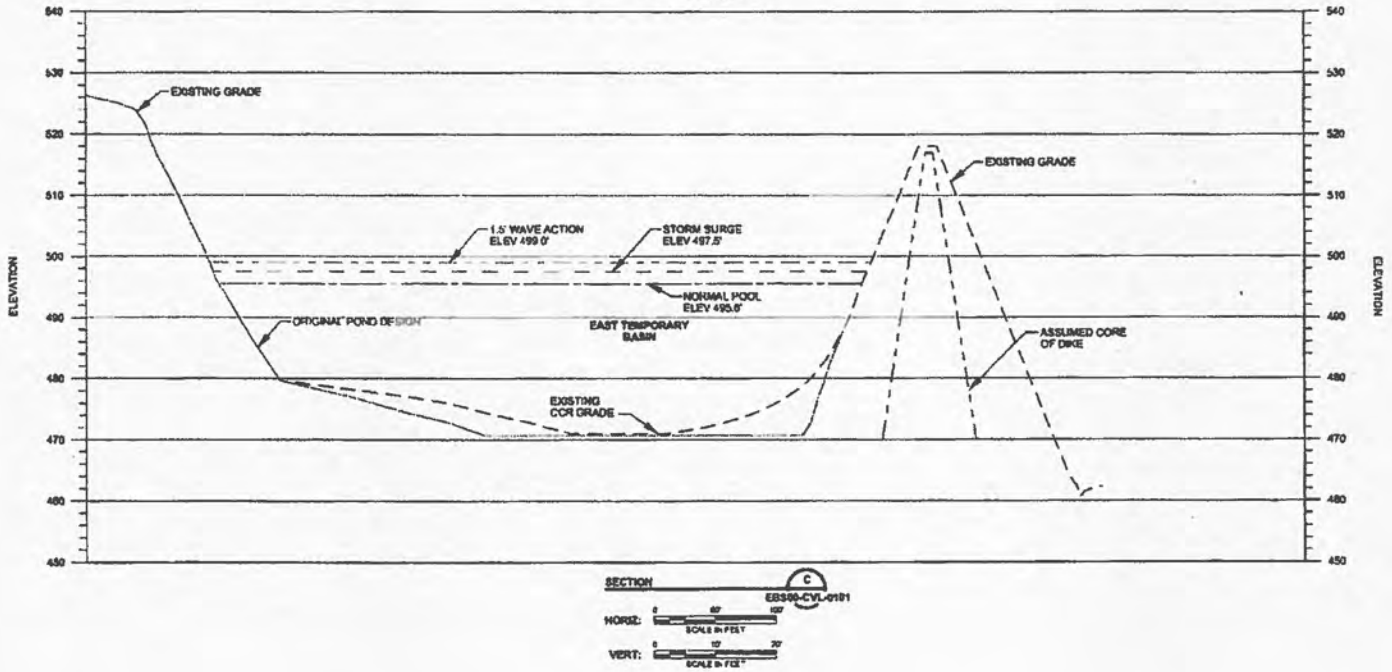
HORIZ: 0 50' 100' SCALE IN FEET
VERT: 0 10' 20' SCALE IN FEET

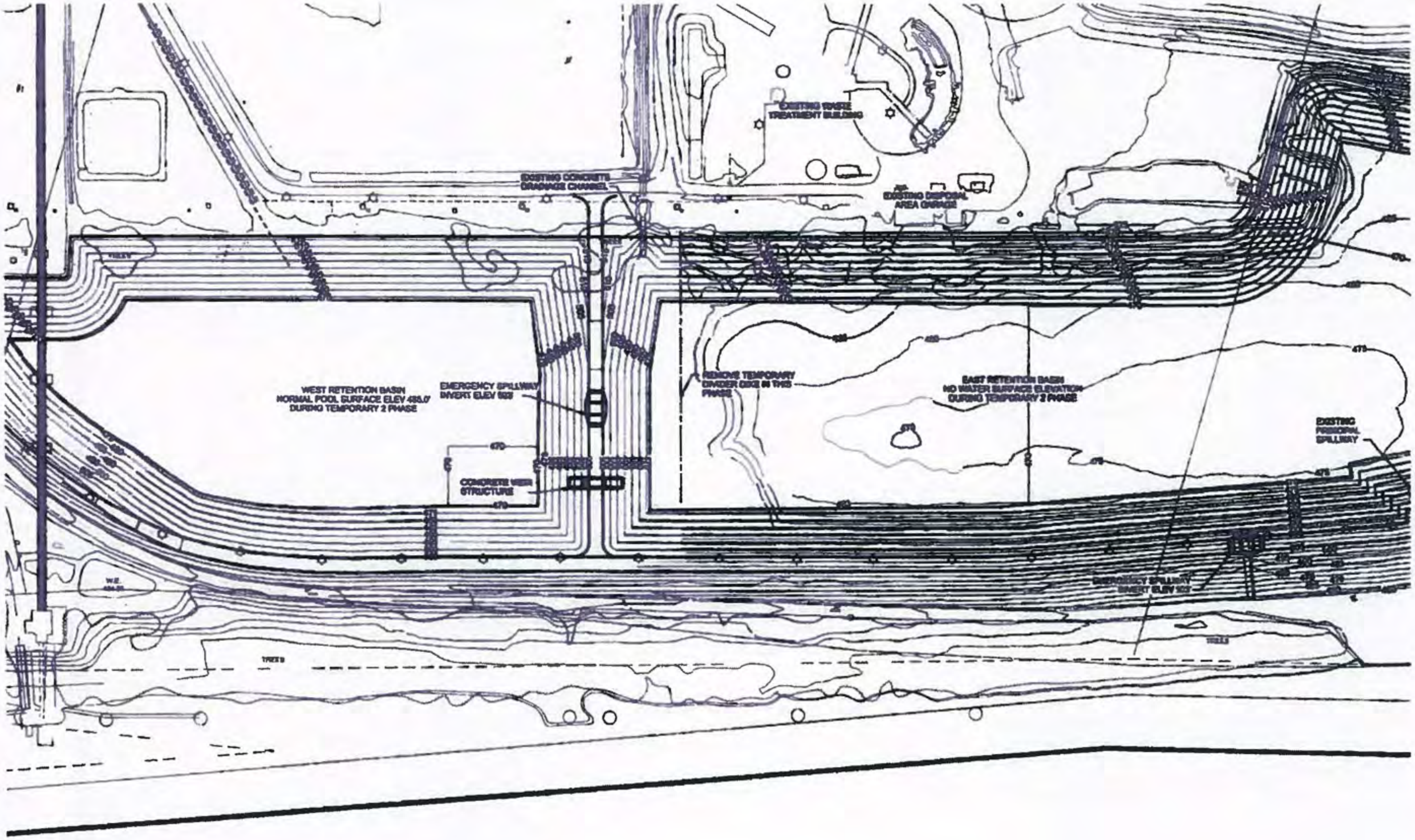


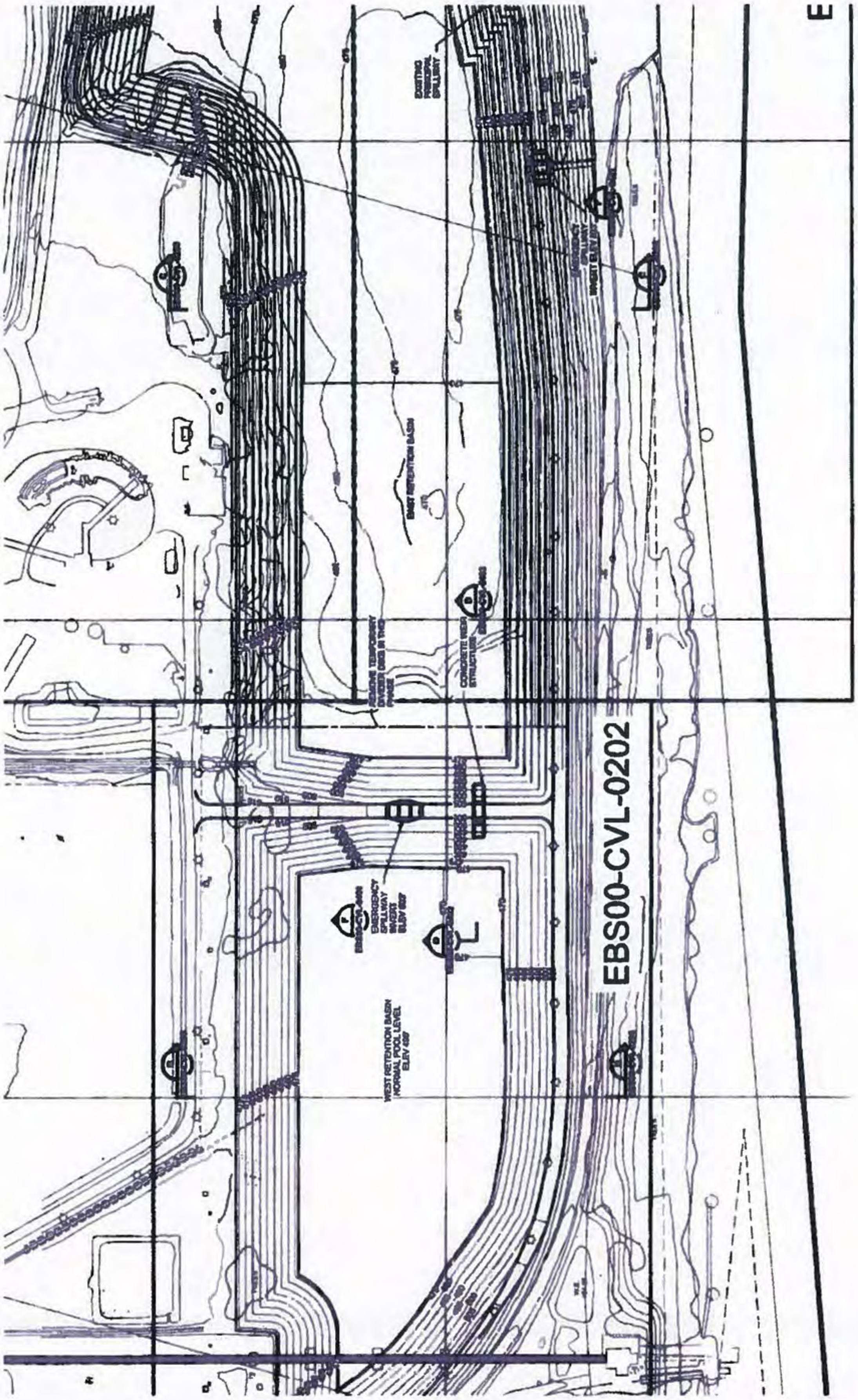
SECTION A
EBS00-CVL-0101

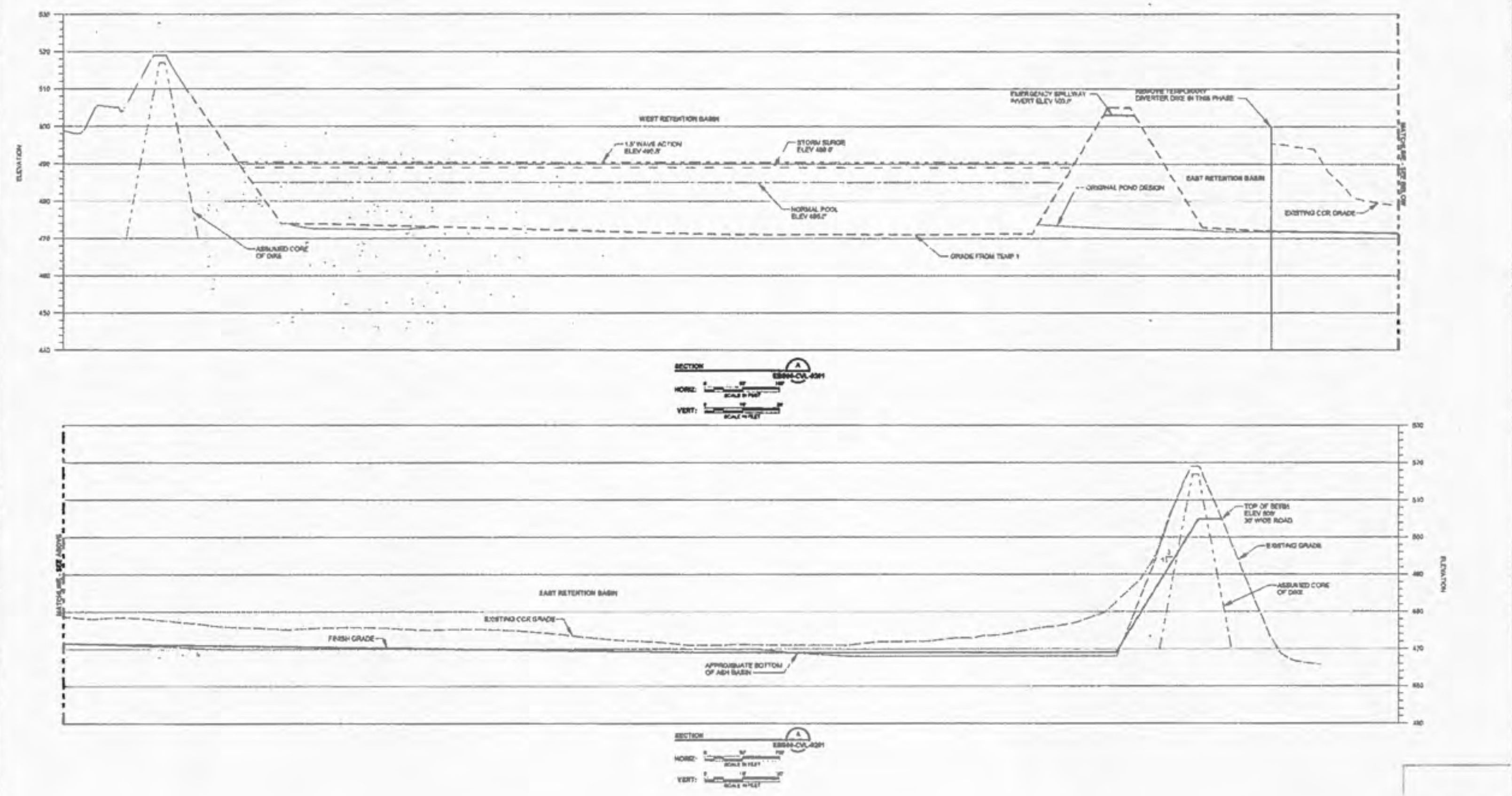
HORIZ: 0 50' 100' SCALE IN FEET
VERT: 0 10' 20' SCALE IN FEET


ELEVATION
500
490
480
470
460
450
TOP OF BERM
ELEV 505'
30' WIDE ROAD
3
1
WEST RETENTION BASIN
ORIGINAL POND DESIGN
FINISH GRADE
ASSUMED CORE
OF DIKE
SECTION
B
EBS00-CVL-0101
HORIZ:
0
50'
100'
SCALE IN FEET
VERT:
0
10'
20'
SCALE IN FEET


ELEVATION
540
530
520
510
500
490
480
470
460
450
EXISTING GRADE
1.5' WAVE ACTION
ELEV 499.0'
STORM SURGE
ELEV 497.5'
NORMAL POOL
ELEV 495.6'
ORIGINAL POND DESIGN
EAST TEMPORARY
BASIN
EXISTING
CCR GRADE
ASSUMED CORE
OF DIKE
SECTION
C
EBS00-CVL-0101
HORIZ:
0
50'
100'
SCALE IN FEET
VERT:
0
10'
20'
SCALE IN FEET


EXISTING WASTE TREATMENT BUILDING
EXISTING CONCRETE DRAINAGE CHANNEL
EXISTING DISPOSAL AREA GARAGE
WEST RETENTION BASIN
NORMAL POOL SURFACE ELEV 485.0'
DURING TEMPORARY 2 PHASE
EMERGENCY SPILLWAY
INVERT ELEV 503
470
470
CONCRETE WEIR STRUCTURE
REMOVE TEMPORARY DIVIDER DIKE IN THIS PHASE
EAST RETENTION BASIN
NO WATER SURFACE ELEVATION
DURING TEMPORARY 2 PHASE
475
475
475
EXISTING PRINCIPAL SPILLWAY
EMERGENCY SPILLWAY
INVERT ELEV


E
EXISTING PRINCIPAL SPILLWAY
EAST RETENTION BASIN
REMOVE TEMPORARY DIVERSION DIKE IN THIS PHASE
CONCRETE WEIR STRUCTURE
EMERGENCY SPILLWAY INVERT
WEST RETENTION BASIN NORMAL POOL LEVEL
EBS00-CVL-0202



PRELIMINARY - NOT FOR CONSTRUCTION

BURNS MEDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

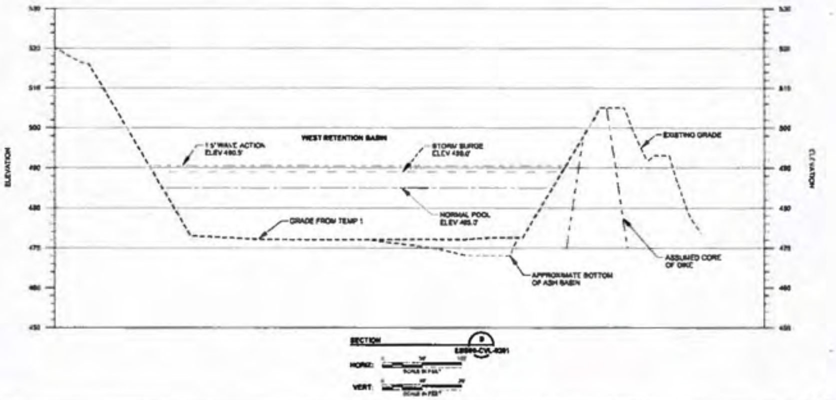
WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 1 (TEMP 2)
EAST BEND STATION UNIT 2

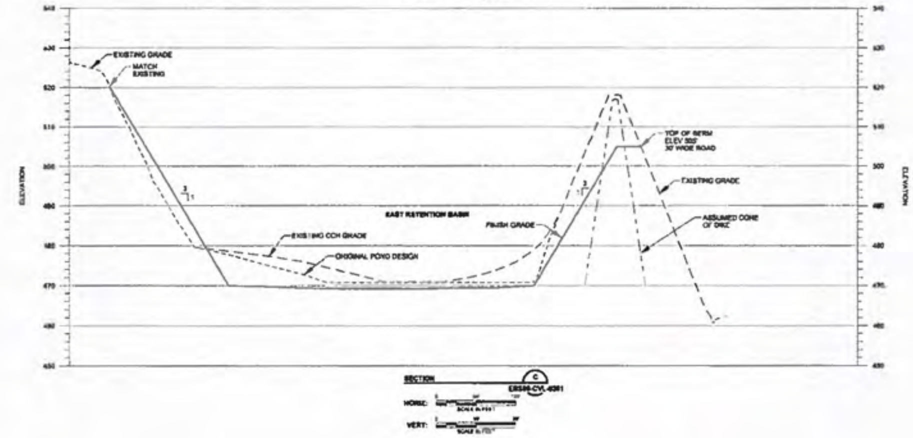
DUKE ENERGY.

EB600-CVL-0205 F

no.	date	by	chd	description
E	[illegible]	[illegible]	RHO	ISSUED FOR OWNER REVIEW
D	[illegible]	[illegible]	RHO	ISSUED FOR REVIEW
C	[illegible]	[illegible]	RHO	ISSUED FOR REVIEW
B	[illegible]	[illegible]	RHO	ISSUED FOR 60% REVIEW
A	[illegible]	[illegible]	RHO	ISSUED FOR 30% REVIEW

no.	date	by	chd	description
F	[illegible]	[illegible]	RHO	ISSUED FOR PERMITTING





no.	date	by	chd	description
E	[illegible]	[illegible]	RNO	ISSUED FOR OWNER REVIEW
D	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
C	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
B	[illegible]	[illegible]	RNO	ISSUED FOR 60% REVIEW
A	[illegible]	[illegible]	RNO	ISSUED FOR 30% REVIEW

no.	date	by	chd	description
F	[illegible]	[illegible]	RNO	ISSUED FOR PERMITTING

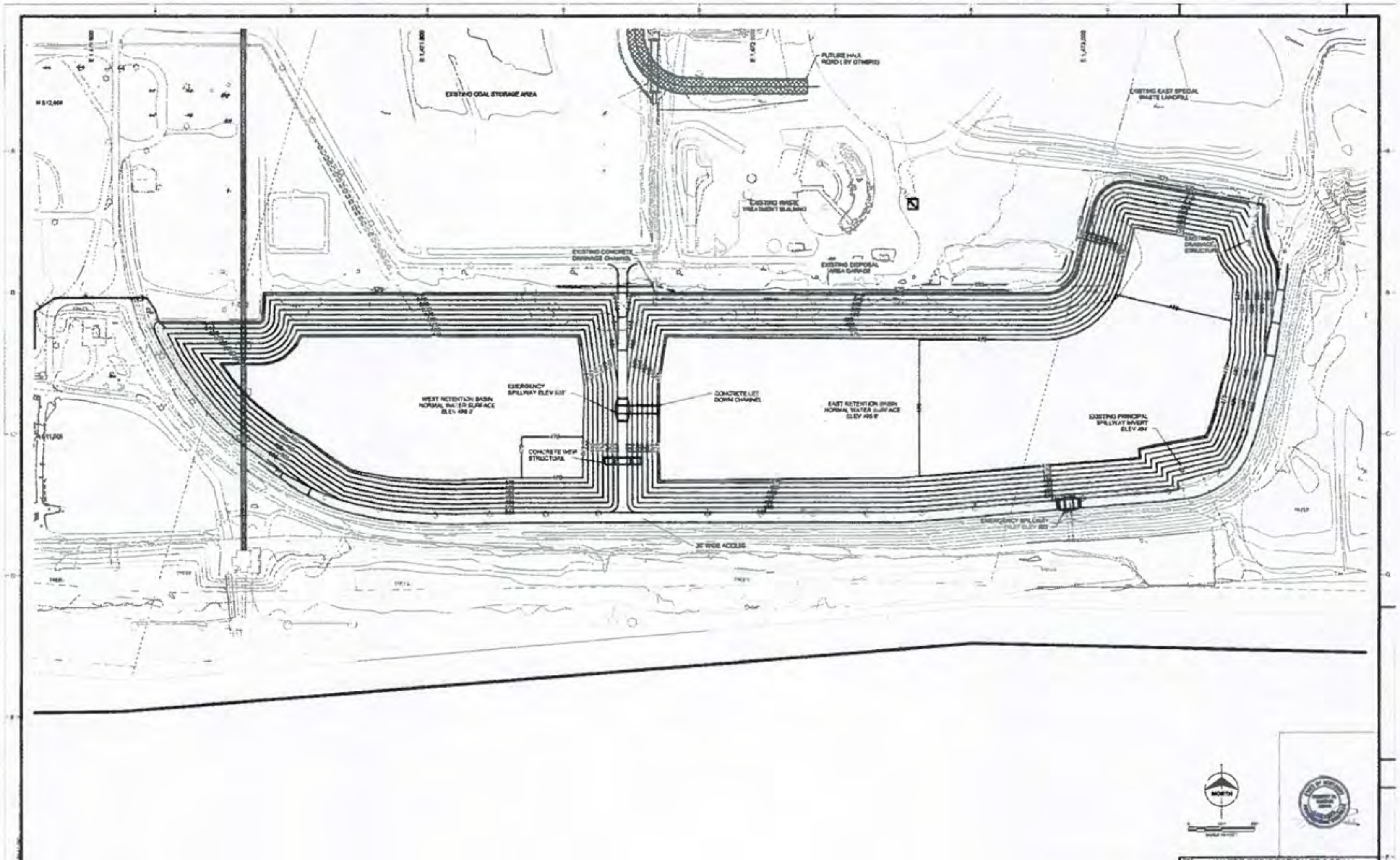
PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 2 (TEMP 2)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0206
F



no.	date	by	chd	description
E	[illegible]	[illegible]	RNO	ISSUED FOR PERMITTING
D	[illegible]	[illegible]	RNO	ISSUED FOR OWNER REVIEW
C	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
B	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
A	[illegible]	[illegible]	RNO	ISSUED FOR 60% REVIEW

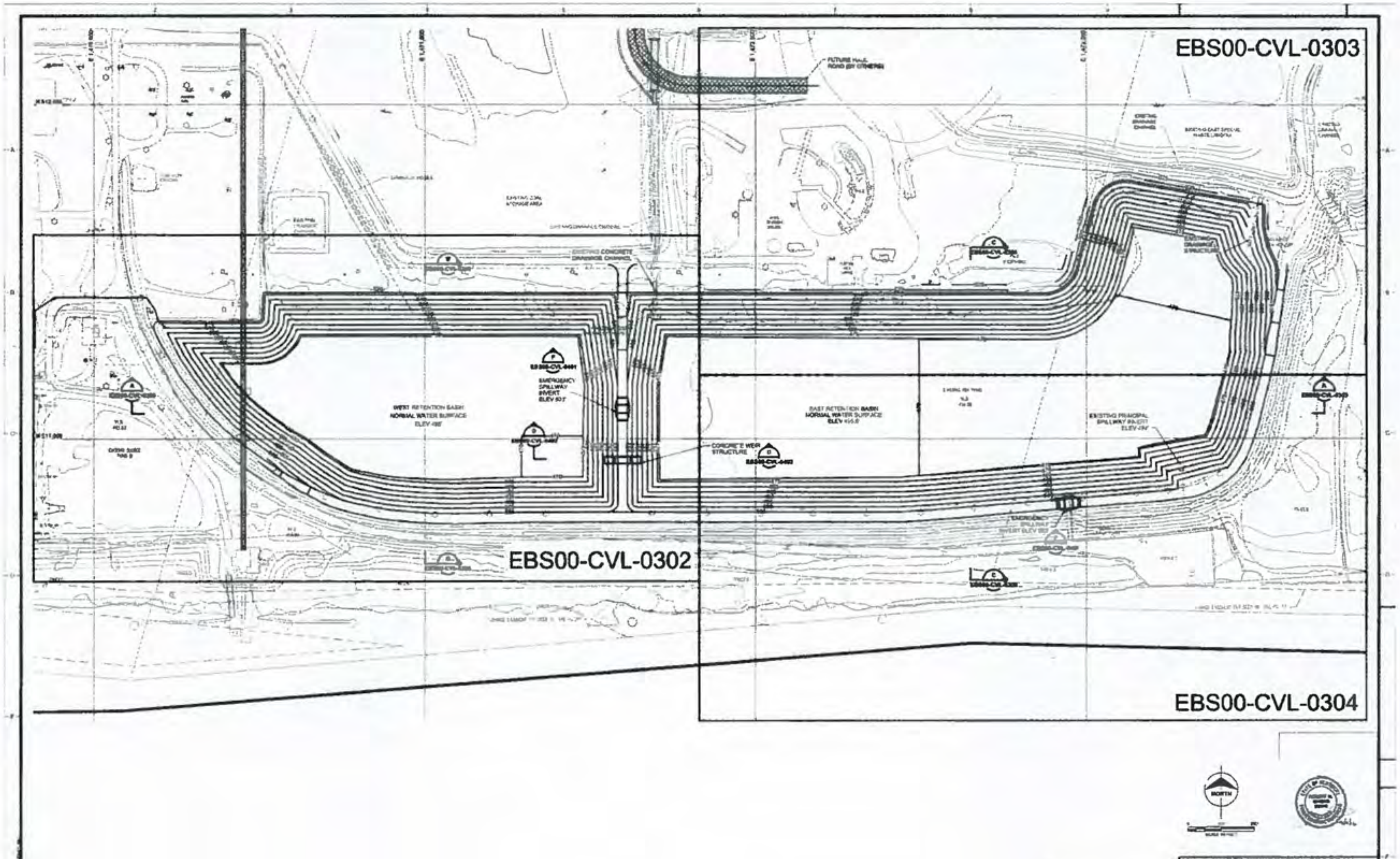
PRELIMINARY - NOT FOR CONSTRUCTION

BURNS & McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
PRM LICENSE NO. 40

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
SITE PLAN (FUTURE)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0300
E



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FIRM LICENSE NO. 48

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
OVERALL GRADING PLAN (FUTURE)

EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0301

F

no.	date	by	chk	description
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A	[illegible]	[illegible]	RNO	ISSUED FOR 30% REVIEW

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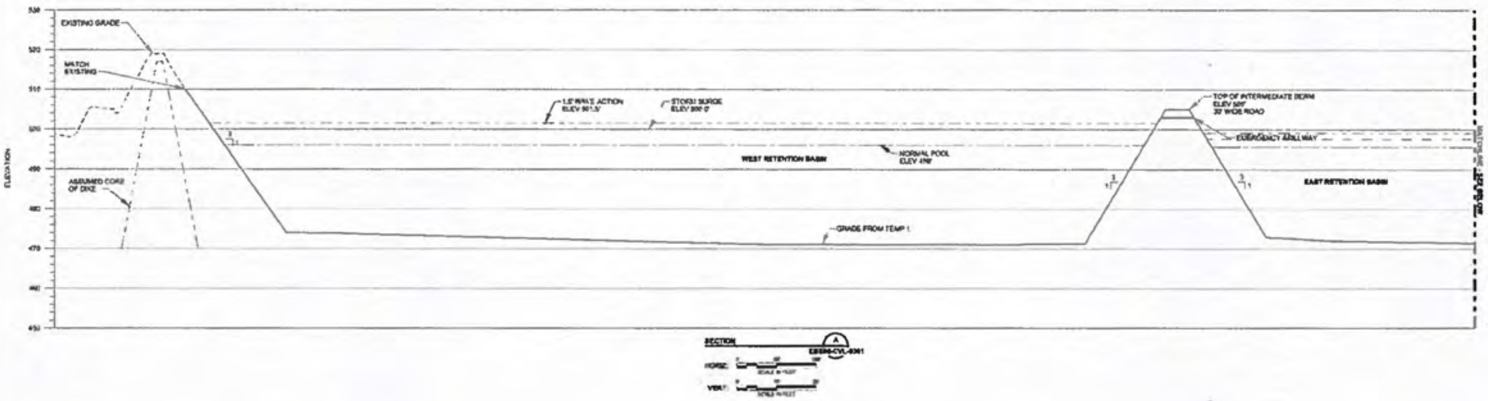

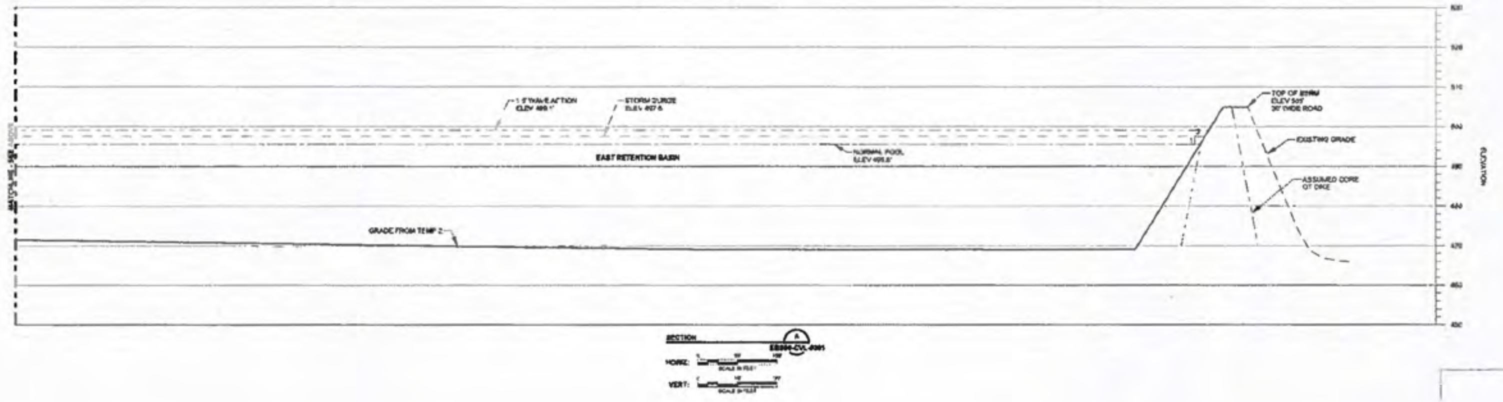

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no.	date	by	chd	description
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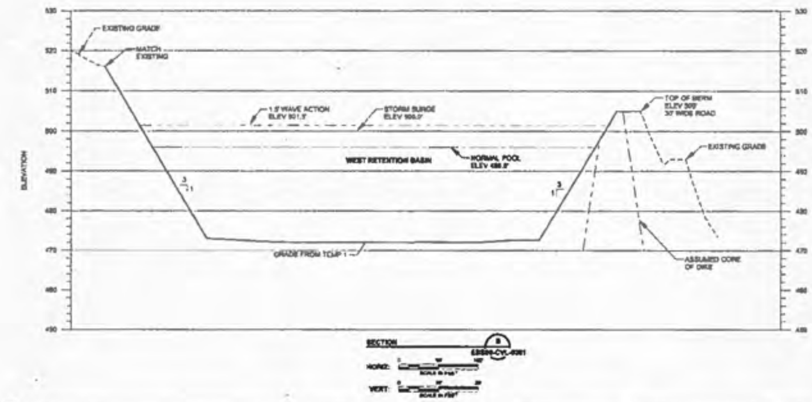
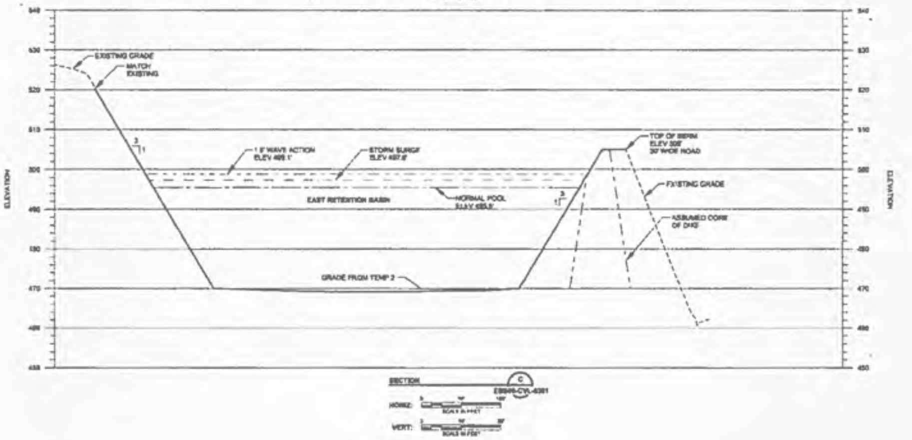
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 1 (FUTURE)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS80-CVL-0305
F





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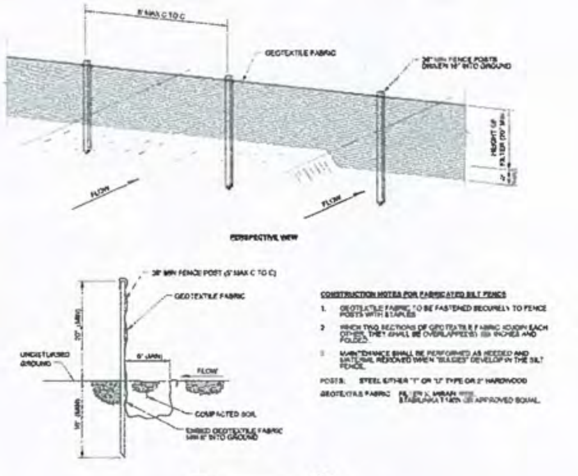
KANSAS CITY, MO 64114
816-333-9400
PWM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 2 (FUTURE)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0306
F



CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

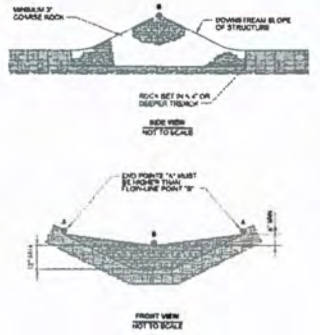
1. GEOTEXTILE FABRIC TO BE FASTENED SECURELY TO FENCE POSTS WITH STAPLES.
2. WHEN TWO SECTIONS OF GEOTEXTILE FABRIC ADJOIN EACH OTHER, THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
3. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: STEEL EITHER "T" OR "U" TYPE OR 2" HARDWOOD

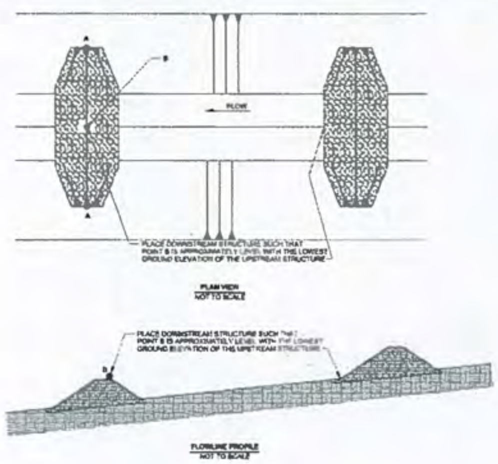
GEOTEXTILE FABRIC: FILTER X, MIRAFI 100X, STABILENKA T140N OR APPROVED EQUAL.

DETAIL ① EBS00-CVL-0003

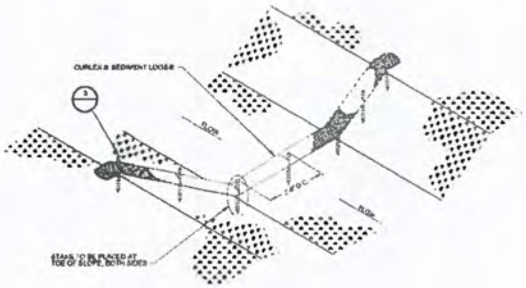
SILT FENCE, TRENCH INSTALLATION DETAIL
NOT TO SCALE



DIA OF ROCK (IN)	SUGGESTED ROCK DIAMETER AND FLOW DEPTHS					
	DOWNSTREAM FACE OF STRUCTURE					
	35%	30%	25%	20%	15%	10%
	MAXIMUM FLOW DEPTH ON ROCK (IN)					
3	6	7	8	10	13	20
6	12	14	16	20	26	40

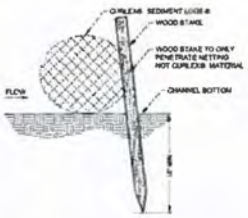


ROCK CHECK DAM IN DITCH
NOT TO SCALE



DETAIL ② EBS00-CVL-0003

CURLEX® SEDIMENT LOGS®
NOT TO SCALE



NOTES:

1. 1 1/8" X 1 1/8" X 30" WOODEN STAKES ARE RECOMMENDED FOR 6", 9", AND 12" SEDIMENT LOGS.
2. ANGLE STAKES UPSTREAM.
3. EXTEND SEDIMENT LOG UP THE SIDE SLOPES TO THE EXPECTED HIGH WATER LEVEL OR 2 FEET (VERTICAL), WHICHEVER IS GREATER.

DETAIL ③

STAKE DETAILS (NO TRENCH)
NOT TO SCALE

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D	[illegible]	[illegible]	RNO	ISSUED FOR OWNER REVIEW
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B	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
A	[illegible]	[illegible]	RNO	ISSUED FOR 60% REVIEW

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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
EROSION CONTROL DETAILS
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0400
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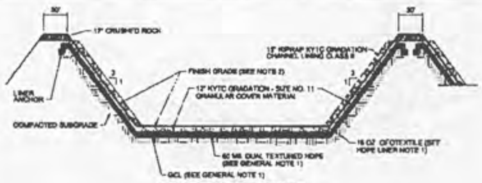
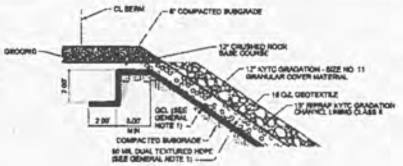
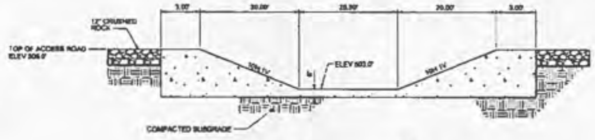


TYPICAL RETENTION BASIN LINER SECTION
NOT TO SCALE

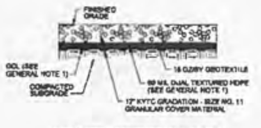


LINER ANCHOR DETAIL
NOT TO SCALE

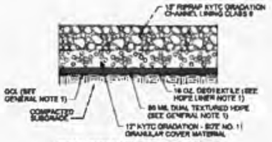


SECTION (F) EBS00-CVL-0101, 0201, 0301
TYPICAL EMERGENCY SPILLWAY
NOT TO SCALE

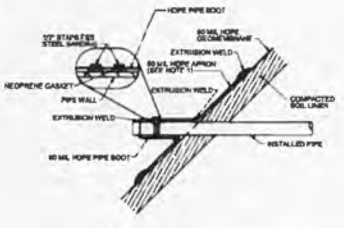
CONCRETE PUSH WALL FOR HOLDING BASIN
NOT TO SCALE



TYPICAL RETENTION BASIN BOTTOM SURFACING
NOT TO SCALE



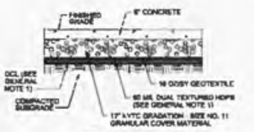
TYPICAL RETENTION BASIN SLOPE SURFACING
NOT TO SCALE



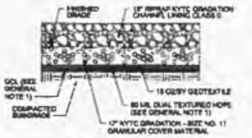
NOTES:

1. APRON MUST EXTEND A MINIMUM OF 18" BEYOND OUTSIDE DIAMETER OF PIPE
2. GEOCOMPOSITE AND PROTECTIVE SOIL COVER OVERLYING GEOMEMBRANE NOT SHOWN FOR SAKE OF CLARITY.

PIPE PENETRATION DETAIL
NOT TO SCALE



TYPICAL HOLDING BASIN BOTTOM SURFACING
NOT TO SCALE

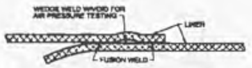


TYPICAL HOLDING BASIN SLOPE SURFACING
NOT TO SCALE

NOTE:

- GRIND LINER PRIOR TO WELDING

TYPICAL EXTRUSION WELD
NOT TO SCALE



TYPICAL DOUBLE FUSION WELD
NOT TO SCALE

TYPICAL GCL SLOPE TO BOTTOM LAPPING
NOT TO SCALE

HDPE LINER NOTES:

1. THE CONTRACTOR SHALL USE CAUTION WHEN INSTALLING LINER SECTION COMPONENTS. INSTALL PER MANUFACTURERS RECOMMENDATIONS.
2. IN LIEU OF INSTALLING A LINEAR ANCHOR TRENCH, THE CONTRACTOR MAY EXTEND THE LINER BEYOND THE TOP OF THE SLOPE AROUND STRUCTURES. THE CONTRACTOR SHALL PROVIDE ENGINEERING CALCULATIONS AND LINER DESIGN INFORMATION AND APPROVAL IN LIEU OF THE ANCHOR TRENCH.
3. IN LIEU OF INSTALLING A LINEAR ANCHOR TRENCHES BETWEEN THE PRIMARY AND SECONDARY BASINS, THE CONTRACTOR MAY EXTEND THE LINER BEYOND THE TOP OF THE SLOPE TO THE ADJACENT BASIN. THE CONTRACTOR SHALL PROVIDE ENGINEERING CALCULATIONS AND LINER DESIGN INFORMATION AND APPROVAL IN LIEU OF THE ANCHOR TRENCHES.
4. THE CONTRACTOR SHALL PROVIDE LINER DESIGN INFORMATION AND APPROVAL FOR THE ACCESS RAMP LOCATIONS. THE LINER SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS WITHOUT WRINKLES, OVERLAPS, AND CREASES.
5. THE CONTRACTOR SHALL PROVIDE LINER DESIGN INFORMATION AND APPROVAL FOR THE PENETRATIONS.

GENERAL NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR PROPER STORAGE OF THE MATERIALS PER MANUFACTURER RECOMMENDATIONS.
2. ALL FINISH GRADE ELEVATIONS ARE TO FINAL SURFACE ELEVATIONS EXCEPT FOR THE AREAS OF RIPRAP. RIPRAPED CHANNEL ... HAVE AN ADDITIONAL 15 INCH OF TRUE THICKNESS ABOVE THE FINISH GRADE.
3. INSTALL ALL MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.

no.	date	by	ckd	description	no.	date	by	ckd	description
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D	08/19/16	MAW	RNO	ISSUED FOR REVIEW					
C	08/09/16	MAW	RNO	ISSUED FOR REVIEW					
B	07/01/16	MAW	RNO	ISSUED FOR 60% REVIEW					
A	05/10/16	MAW	RNO	ISSUED FOR 30% REVIEW	F	09/09/16	MAW	RNO	ISSUED FOR PERMITTING

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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
LINER DETAILS
EAST BEND STATION UNIT 2

DUKE ENERGY.

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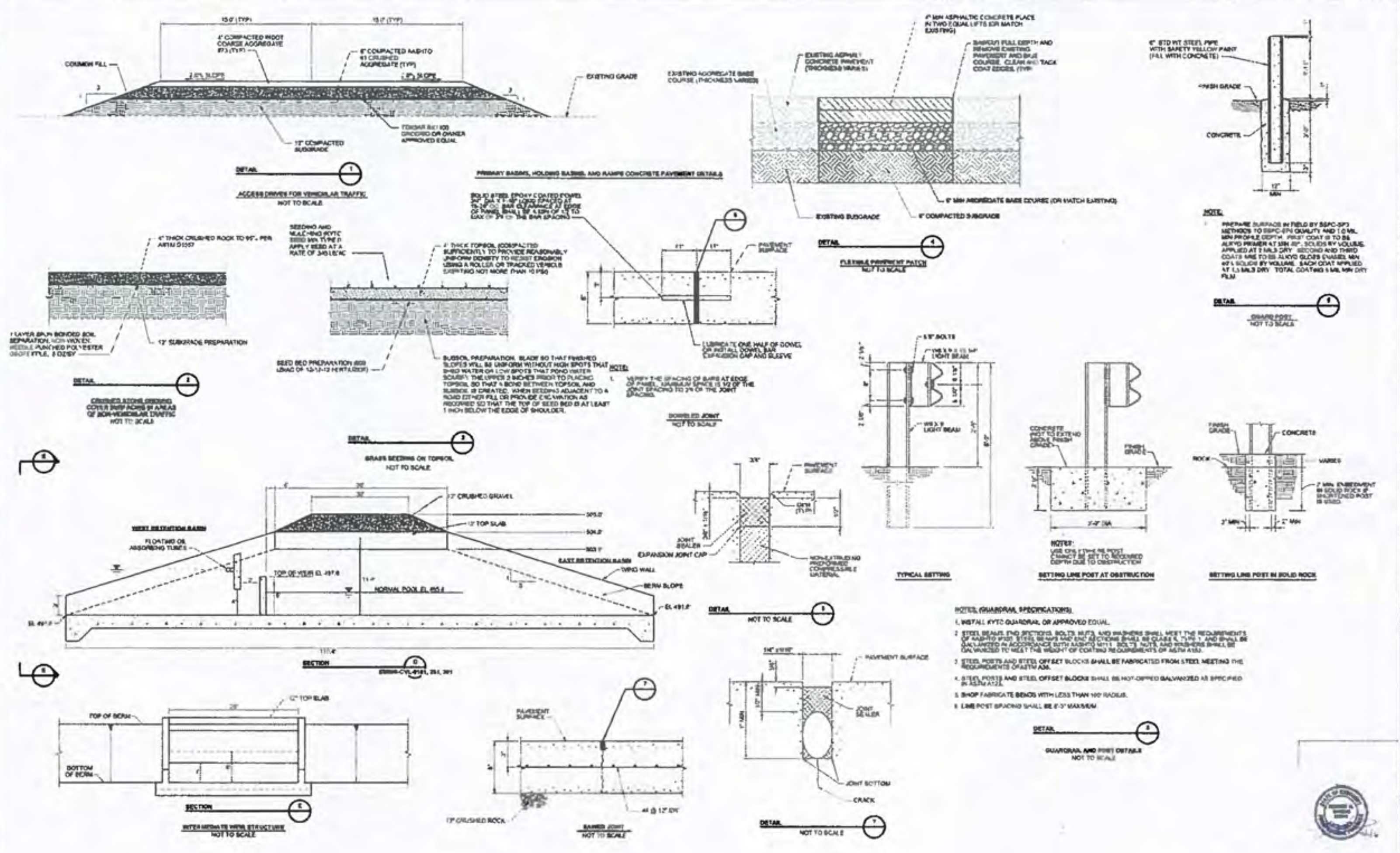

NOTE:

1. PREPARE SURFACE IN FIELD BY SSPC-SP3 METHODS TO SSPC-SP6 QUALITY AND 1.0 MIL MIN PROFILE DEPTH. FIRST COAT IS TO BE ALKYD PRIMER AT MIN 48% SOLIDS BY VOLUME, APPLIED AT 2 MILS DRY. SECOND AND THIRD COATS ARE TO BE ALKYD GLOSS ENAMEL MIN 47% SOLIDS BY VOLUME. EACH COAT APPLIED AT 1.5 MILS DRY. TOTAL COATING 5 MIL MIN DRY FILM.

NOTES: (GUARDRAIL SPECIFICATIONS)

1. INSTALL KYTC GUARDRAIL OR APPROVED EQUAL.
2. STEEL BEAMS, END SECTIONS, BOLTS, NUTS, AND WASHERS SHALL MEET THE REQUIREMENTS OF AASHTO M180. STEEL BEAMS AND END SECTIONS SHALL BE CLASS A, TYPE 1 AND SHALL BE GALVANIZED IN ACCORDANCE WITH AASHTO M111. BOLTS, NUTS, AND WASHERS SHALL BE GALVANIZED TO MEET THE WEIGHT OF COATING REQUIREMENTS OF ASTM A153.
3. STEEL POSTS AND STEEL OFFSET BLOCKS SHALL BE FABRICATED FROM STEEL MEETING THE REQUIREMENTS OF ASTM A36.
4. STEEL POSTS AND STEEL OFFSET BLOCKS SHALL BE HOT-DIPPED GALVANIZED AS SPECIFIED IN ASTM A123.
5. SHOP FABRICATE BENDS WITH LESS THAN 100' RADIUS.
6. LINE POST SPACING SHALL BE 6'-3" MAXIMUM.

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C	[illegible]	[illegible]	RHO	ISSUED FOR REVIEW
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A	[illegible]	[illegible]	RHO	ISSUED FOR 60% REVIEW

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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
CIVIL DETAILS - SHEET 1
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0402
D

Attachment B

Geological Report

DUKE ENERGY COAL COMBUSTION RESIDUALS MANAGEMENT PROGRAM

EAST BEND ASH BASIN DAM CONSTRUCTION PERMIT MODIFICATION REPORT

GEOLOGICAL REPORT

East Bend Station

Boone County, Kentucky
East Bend 1976 Ash Pond Dam (State ID KYDW ID 1215)
Amec Foster Wheeler Project No. 7810-15-0345

Prepared for

DUKE ENERGY

Duke Energy (Duke)
550 South Tryon Street
Charlotte, North Carolina, 28202
September 16, 2016

amec
foster
wheeler

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  2.2 On-Site Materials *3*

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Figure 1 Site Location Map

Appendices

Appendix A Boring Logs – Sargent & Lundy Engineers (1974)
Appendix B Boring Logs – Amec Foster Wheeler Phase 2 Report (2015)
Appendix C Boring Logs – Amec Foster Wheeler Subsurface Investigation (2016)

1 Overview

This report summarizes geological conditions and site subsurface explorations for use in the East Bend Ash Basin Dam Construction Permit Application project for the Duke Energy (Duke) East Bend Station (Station), located near Rabbit Hash in Boone County, Kentucky.

This report covers the Ash Pond Dam (State ID KYDW ID 1215) herein referred to as the Ash Basin or future retention basin. The Station is located along the north bank of an eastward bend on the Ohio River in west-central Boone County. Site location map is presented in Figure 1. The Ash Basin dike was designed in the mid-1970s by Sargent & Lundy Engineers. Construction commenced on the impoundment in 1978 and the Station began commercial operation in 1981.

The Ash Basin dike is a compacted, granular fill embankment with a compacted clay core. The Ash Basin dike is configured in a "U" shape with the main section parallel to the river and short sections on the east and west ends abutting natural soils on the north side. Coal Combustion Residual (CCR) materials has historically been deposited within the Ash Basin by hydraulic sluicing operation. A Closure Plan for the Ash Basin was prepared by Amec Foster Wheeler Environment &Infrastructure, Inc. (Amec Foster Wheeler) in 2016. According to this Closure Plan, the Ash Basin will be closed by removal. The closure approach involves the excavation of CCR materials from the Ash Basin and transferal and placement into the onsite West Special Waste Landfill. According to Duke's plans, following the removal of the CCR materials, the Ash Basin will be repurposed as a retention basin to provide site water storage and treatment as part of a larger site-wide water management strategy.

2 Geologic Setting

The Station is adjacent to the Ohio River. This area is part of the Outer Bluegrass physiographic region of the state, which is characterized by rolling hills and valleys caused by the weathering of relatively thick-bedded limestone that has been pushed up along the crest of the Cincinnati Arch. The bedrock of this region is generally composed of limestones and shales from the Ordovician Period (510 to 440 million years ago), with the overburden soil deposition occurring during the Tertiary (66 to 2.6 million years ago), and Quaternary Periods (2.6 million years ago to present). The soils are primarily the results of glacial deposition and the ensuing erosion and sedimentation of alluvial soils from the Ohio River, during the Pleistocene and Holocene Series.

According to published geologic information, the Ash Basin is constructed on both Wisconsin glacial outwash (Qwo) and alluvium (Qal) soils of the Wisconsin and younger glaciation periods. The Ash Basin dike appears to be built primarily upon the alluvium soils. Qal, deposited by the Ohio River. These soils are characterized as sandy silts and silty sands and contain scattered pebbles and cobbles. They were deposited on an erosional surface cut on glacial outwash and on outwash terraces below the highest Wisconsin terrace level. The north side of the Ash Basin is constructed upon the glacial outwash soils, which consist of glacially deposited gravel, sand, silt, and clay and is commonly overlain by 5 to 20 feet of sand and sandy silt. Gravels in these soils can include limestone, siltstone, quartz, chert, granite, gneiss, schist, coal and fine-grained igneous and metamorphic rocks, with the largest fragments about 4 inches across. The underlying rock formation is reported to be approximately 178 feet from the natural ground surface, as determined by boring B-3 drilled during the original geotechnical investigation in 1974.

2.1 Subsurface Investigations

The available geotechnical investigations and information for the Ash Basin dike are summarized as follows:

- In 1974, a preconstruction geotechnical report, "Preliminary Foundation Investigations", was prepared by Sargent & Lundy Engineers in 1974 for the East Bend Station. Several borings were drilled over the entire site of the proposed Station. Some of these borings were drilled at or near the area of the Ash Basin and presented in Appendix A.
- In March 2015, Amec Foster Wheeler completed the "Phase 2 Reconstitution of Ash Pond Designs Report" (referred to as Phase 2 Report hereafter) which included the review of existing data, gathering of additional field data and laboratory testing, and updated the analysis of the Ash Basin embankment. This report primarily focused on analysis and obtaining supplemental data to evaluate the Ash Basin dike. Amec Foster Wheeler performed series of soil test borings, cone penetration testing (CPT) soundings, and laboratory testing. Boring logs from this subsurface investigation are presented in Appendix B.
- Phase 2 Report recommended additional field site characterization work in support of Ash Basin closure options evaluations. In February 2016, Amec Foster Wheeler commenced subsurface exploration which was completed in March 2016. The additional field investigation for data gathering included borings and CPT sounding along the north side of the Ash Basin and the interior of the Ash Basin at accessible locations. Boring logs from this event are presented in Appendix C.

The stratigraphies encountered at each subsurface investigation are included on the logs of the explorations. On-site materials are discussed in the following section.

2.2 On-Site Materials

2.2.1 Granular Shell - Dike

The Ash Basin embankment contains a granular shell material on the downstream and upstream slopes as identified in previous design documents. According to the previous boring logs and laboratory data presented in Phase 2 Report, this region consists of predominantly sandy soils with varying amounts of silt, clay, and gravel. Unified Soil Classification System (USCS) symbols of SM (silty sand) and SC-SM (silty clayey sand) were identified through laboratory testing. Based on review of the site geology and boring logs, it is likely that this material was sourced from the sandy alluvium deposits at the site.

2.2.2 Clay Core - Dike

A clay core regions is present between the granular shell of the embankment as identified in previous design documents. The clay core was also engineered to extend along the base of the impoundment into the upstream areas of the pond. According to the boring logs and laboratory data presented in Phase 2 Report, this region consists of predominantly clayey soils with varying amounts of sand, silt, and gravel. The USCS classifications of CL (lean clay), SC (clayey sand), and CL-ML (sandy silty clay) were confirmed through laboratory testing. Based on review of the site geology and boring logs, it is likely that this material was sourced from the clayey alluvium deposits at the site.

2.2.3 Clayey Alluvium

The natural materials beneath the granular shell and clay core regions are alluvial in nature and were discovered to be predominantly clayey or sandy. The clayey alluvial soils were typically found to exist in a layer immediately underneath the embankments and were of varying thicknesses. According to the boring logs and laboratory data, this region consists of predominantly clayey soils with varying amounts of sand. A USCS classification of CL (lean clay) was identified through laboratory testing performed for Phase 2 investigation. Borings drilled during the February 2016 investigation did not show a continuous clayey alluvium layer within the Ash Basin area. This region often appears as lenses inside the sandy alluvium.

2.2.4 Sandy Alluvium 1

In addition to the clayey alluvial soils, there are also regions of sandy alluvial soils. The sandy alluvial soils were typically found to exist in layers immediately underneath the clayey alluvium and were of varying thicknesses. In Phase 2 Report, the sandy alluvium soils were divided into "sandy alluvium 1" and "sandy alluvium 2." This division was based on the Standard Penetration test (SPT) values, with all "sandy alluvium 1" soils having SPTs greater than 4, and all "sandy alluvium 2" soils having SPTs between 0 and 4. According to the boring logs and laboratory data, this region consists of predominantly sandy soils with varying amounts of silt, clay, and gravel. A USCS classification of SM (silty sand) was predominant in this layer, although one sample tested as SC (clayey sand) as presented in Phase 2 Report.

February 2016 subsurface exploration supported the findings of Phase 2 Report. Sandy alluvium 1 (sandy soils with silt, clay and gravel with SPT values higher than 5) was predominantly encountered within the Ash Basin area.

2.2.5 Sandy Alluvium 2

The "sandy alluvium 2" layer is defined as having SPT values between 0 and 4. This region often appears as a lens inside the Sandy Alluvium 1. According to the boring logs and laboratory data of Phase 2 report, this region consists of both sandy and fine-grained soils, but all samples were determined to have a significant amount of sand content. USCS classification of ML (sandy silt), CL (sandy lean clay), and SC (clayey sand) were determined through laboratory testing as presented in Phase 2 Report.

Clayey alluvium and sandy alluvium with SPT values lower than 5 were observed as pockets within the sandy alluvium layer during the February 2016 subsurface exploration.

2.2.6 CCR Material

During Phase 2 field exploration, a layer of bottom ash and/or other CCR materials were encountered during drilling operations on the upstream slope of the embankment. This material was not sampled using SPT or Shelby Tubes; however, it was examined and classified from auger cuttings. During the field exploration the bottom ash was estimated by the rig geologist to be sandy and more permeable than the other embankment and alluvial materials.

During the time of retention basin construction, CCR materials will not exist within the Ash Basin area.

2.2.7 Groundwater

A Conceptual Site Model (CSM) was prepared by M.S. Belgin & Associates in March 2016 to summaries groundwater investigations at the Station. Based on this CSM, groundwater levels ranged from 454 ft to 466 ft MSL. Under normal Ohio River water levels, the groundwater surface maps consistently show a river elevation of around 455 ft. MSL with an increase in the phreatic surface to around 458-460 ft. MSL to the north of the existing Ash Basin.

3 References

Amec Foster Wheeler, “Phase 2 Reconstitution of Ash Pond Designs Final Report Submittal, East Bend Station”, March 13, 2015.

M.S. Beljin & Associates. 2016. *Conceptual Site Model (CSM) East Bend Station, Draft Internal Document,* March, 2016.

Sargent & Lundy Engineers, “Preliminary Foundation Investigations”, September 20, 1974.

LEGEND

● OUTFALL ★ EAST BEND STATION ▭ APPROXIMATE CCR FACILITY BOUNDARY

NOTE: THIS FIGURE IS FOR REFERENCE ONLY.

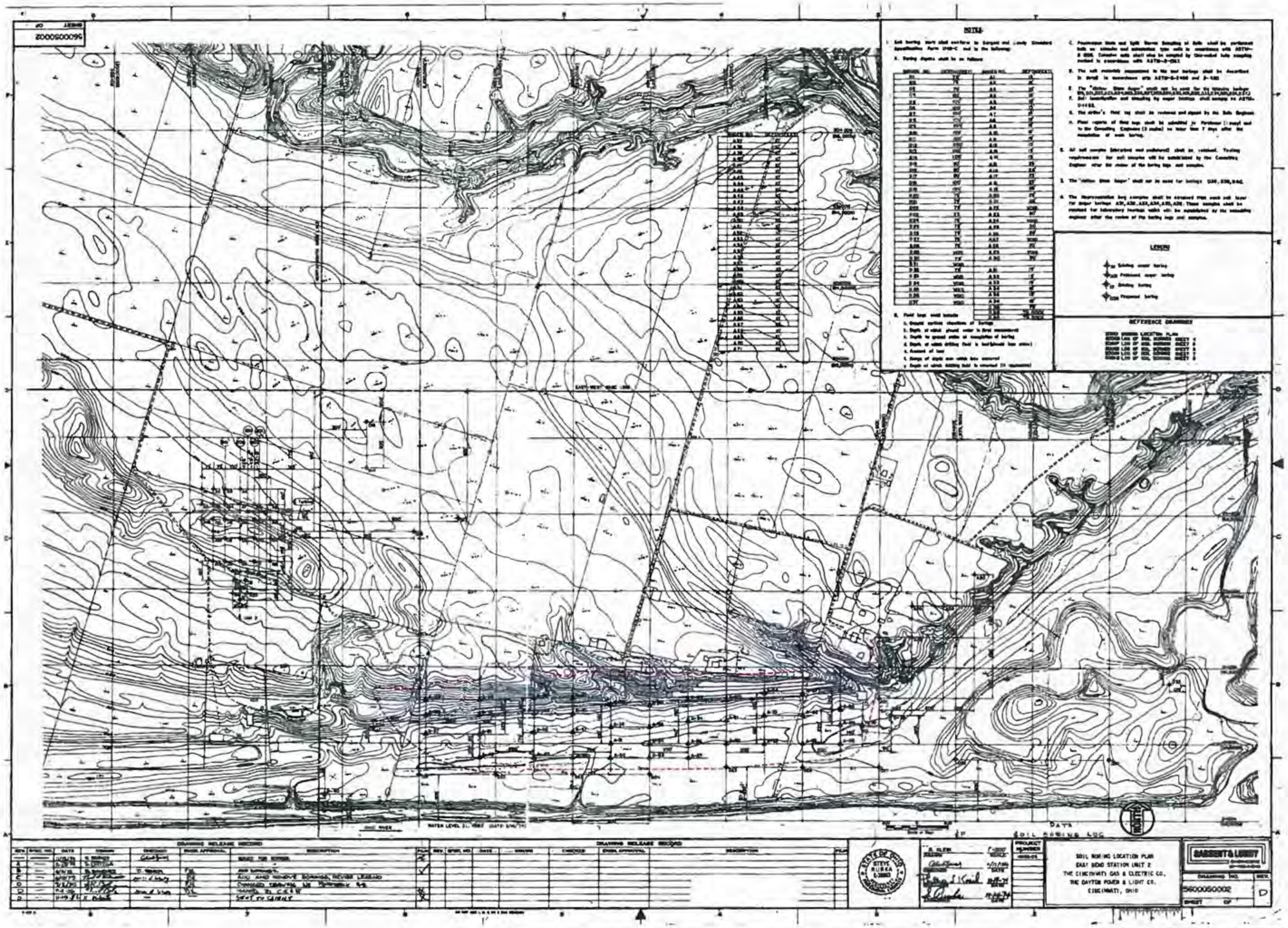
EAST BEND ASH BASIN CLOSURE PLAN
SITE LOCATION AND FACILITIES MAP
EAST BEND STATION
BOONE COUNTY, KENTUCKY

PROJECT NO:	7810-15-0345	FIGURE NO:	1

F:\AMEC_Projects\2014\7810-14-0183_OM\7810-14-0183_01_04_East_Bend_OM\Fig-1_Site_Map.mxd, User: maddison.sutton; Date: 6/22/2016 12:08:32 PM, Checked by: AJ Date: 6/22/2016

APPENDICES

Appendix A
Boring Logs – Sargent & Lundy Engineers (1974)



STATE OF OHIO
STEVE
RUBKA

R. KLEIN
DRAWN

1"=200'
SCALE

DATE

PROJECT NUMBER

SOIL BORING LOCATION PLAN
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY

DRAWING NO. 5600050002
REV. D
SHEET OF

5600000007

BORING A-29

VOID

BORING A-30

[illegible]

BORING A-31

[illegible]

BORING A-32

[illegible]

BORING A-33

[illegible]

BORING A-34

[illegible]

BORING A-35

[illegible]

BORING A-36

[illegible]

BORING D-1

[illegible]

BORING D-2

[illegible]

BORING D-3

[illegible]

BORING D-4

[illegible]

BORING D-5

[illegible]

BORING D-6

[illegible]

BORING D-7

[illegible]

BORING D-8

[illegible]

BORING D-9

[illegible]

BORING D-10

[illegible]

BORING D-11

[illegible]

DRAWING RELEASE RECORD

—	—	[illegible]	[illegible]	[illegible]	[illegible]	ISSUED TO GC&E
—	—	[illegible]	[illegible]	—	—	SENT TO CLIENT

REFERENCE DRAWINGS	
50000	SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG SHE

STEVE RURKA 9231

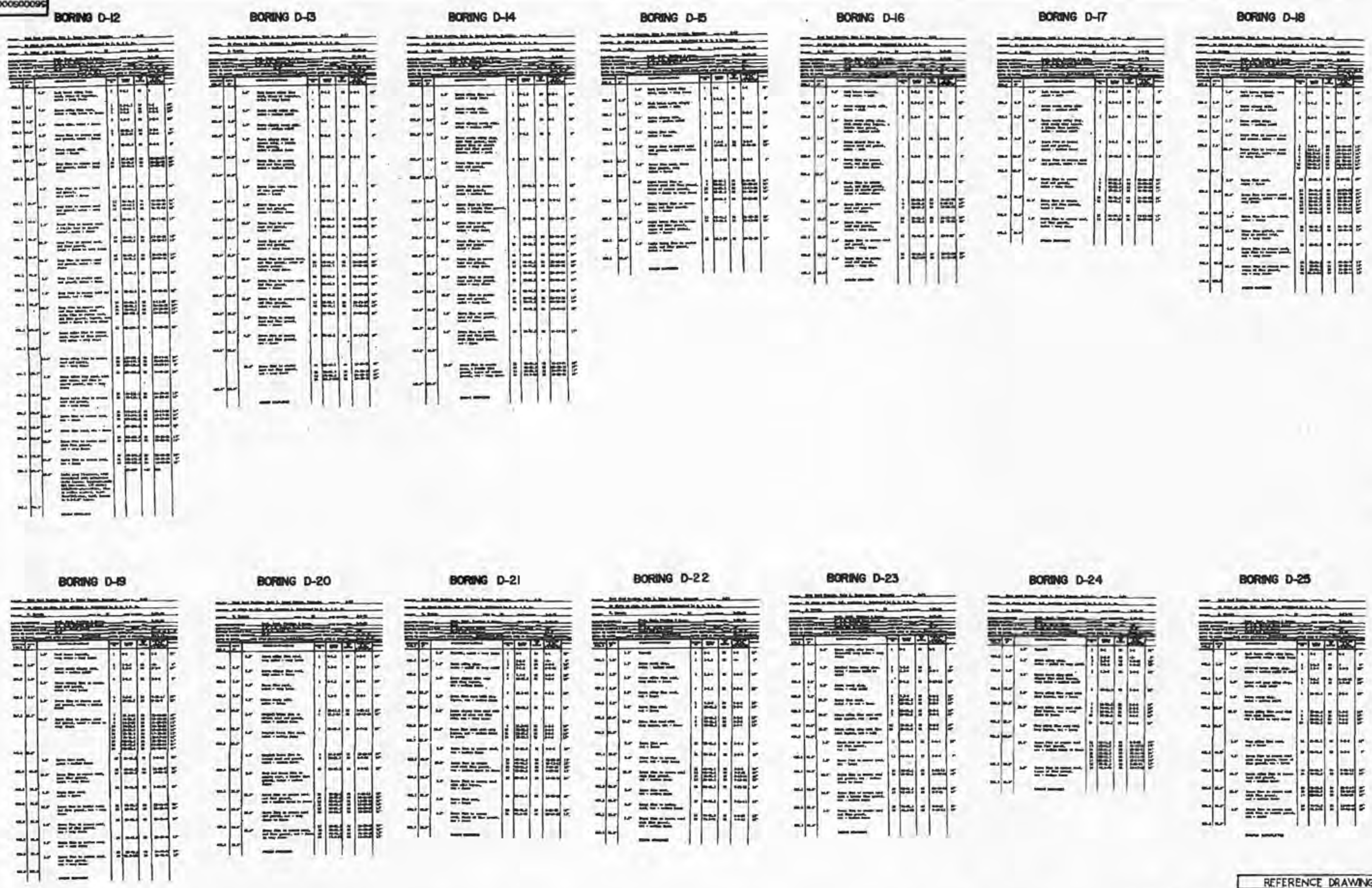
7-8-75

LOG OF SOIL BORINGS
SHEET 7
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. 5600000007

9000S00099



REFERENCE DRAWINGS

S0000 SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG SHP

DRAWING RELEASE RECORD

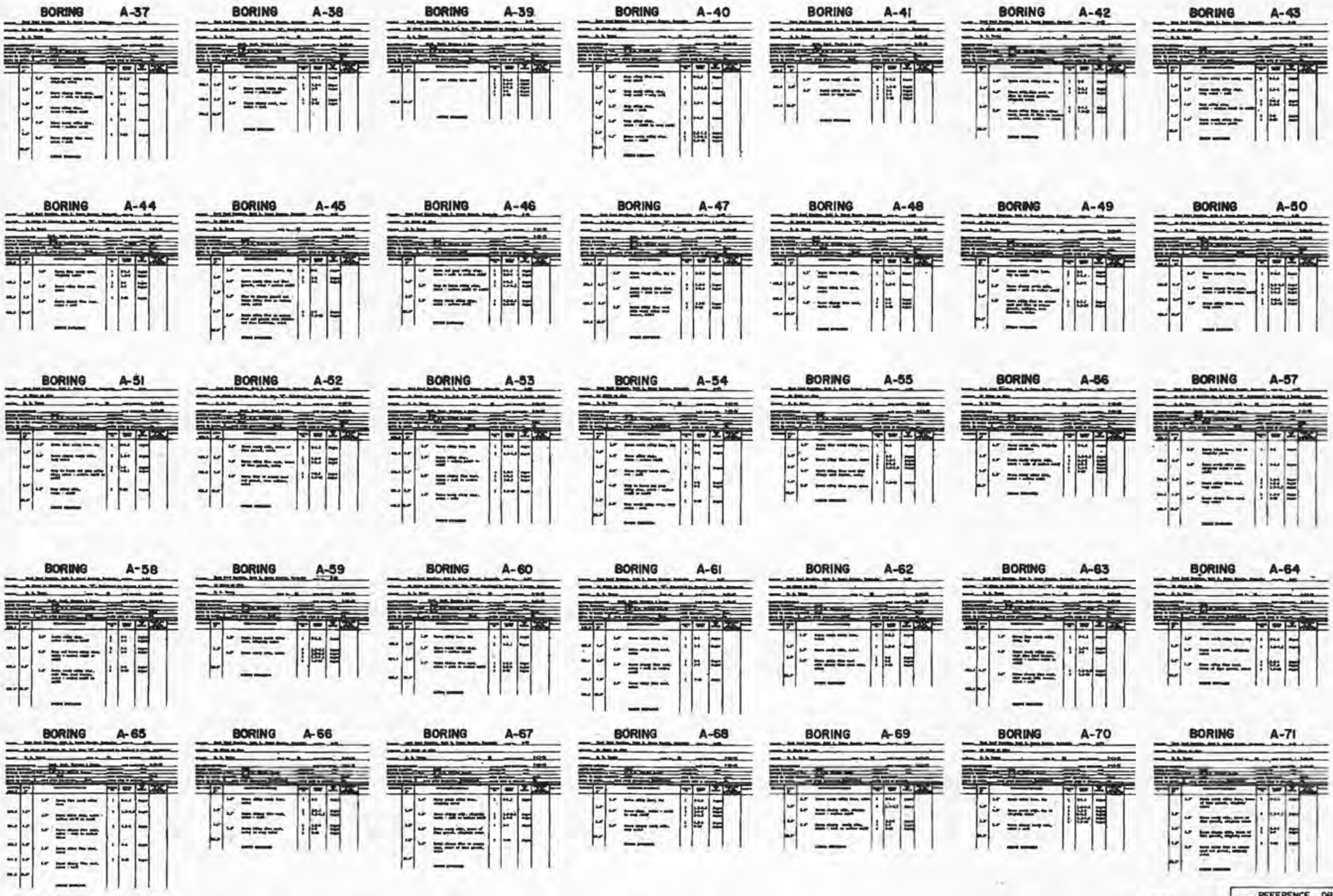
ISSUED TO CG&E
SENT TO CLIENT

STEVE RURKA 9231

LOG OF SOIL BORINGS
SHEET 6
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY

DRAWING NO. 5600S0006



REFERENCE DRAWINGS

S0002 SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG

DRAWING RELEASE RECORD

—	—	12-9-75				ISSUED TO CODE	X
—	—	11-15-76		—	—	SENT TO CLIENT	X

STEVE RURKA
8231

12-29-75
12-29-75
12-29-75

LOG OF SOIL BORINGS
SHEET 8
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. 5600080010

6000S00096

BORING D-26

[illegible]

BORING D-27

[illegible]

BORING D-28

[illegible]

BORING D-29

VOID

BORING D-30

[illegible]

BORING D-31

VOID

BORING D-32

[illegible]

BORING D-33

VOID

BORING D-34

VOID

BORING D-35

VOID

BORING D-36

VOID

BORING D-37

VOID

BORING D-38

[illegible]

BORING D-39

[illegible]

BORING D-40

[illegible]

REFERENCE DRAWINGS

80000 SOIL BORING LOCATION PLAN

DATA
LOG SOIL BORG SH 7

DRAWING RELEASE RECORD

REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION
—	—	[illegible]	[illegible]	[illegible]	[illegible]	ISSUED TO CG&E
—	—	[illegible]	[illegible]	—	—	SENT TO CLIENT

STEVE RURKA
9231

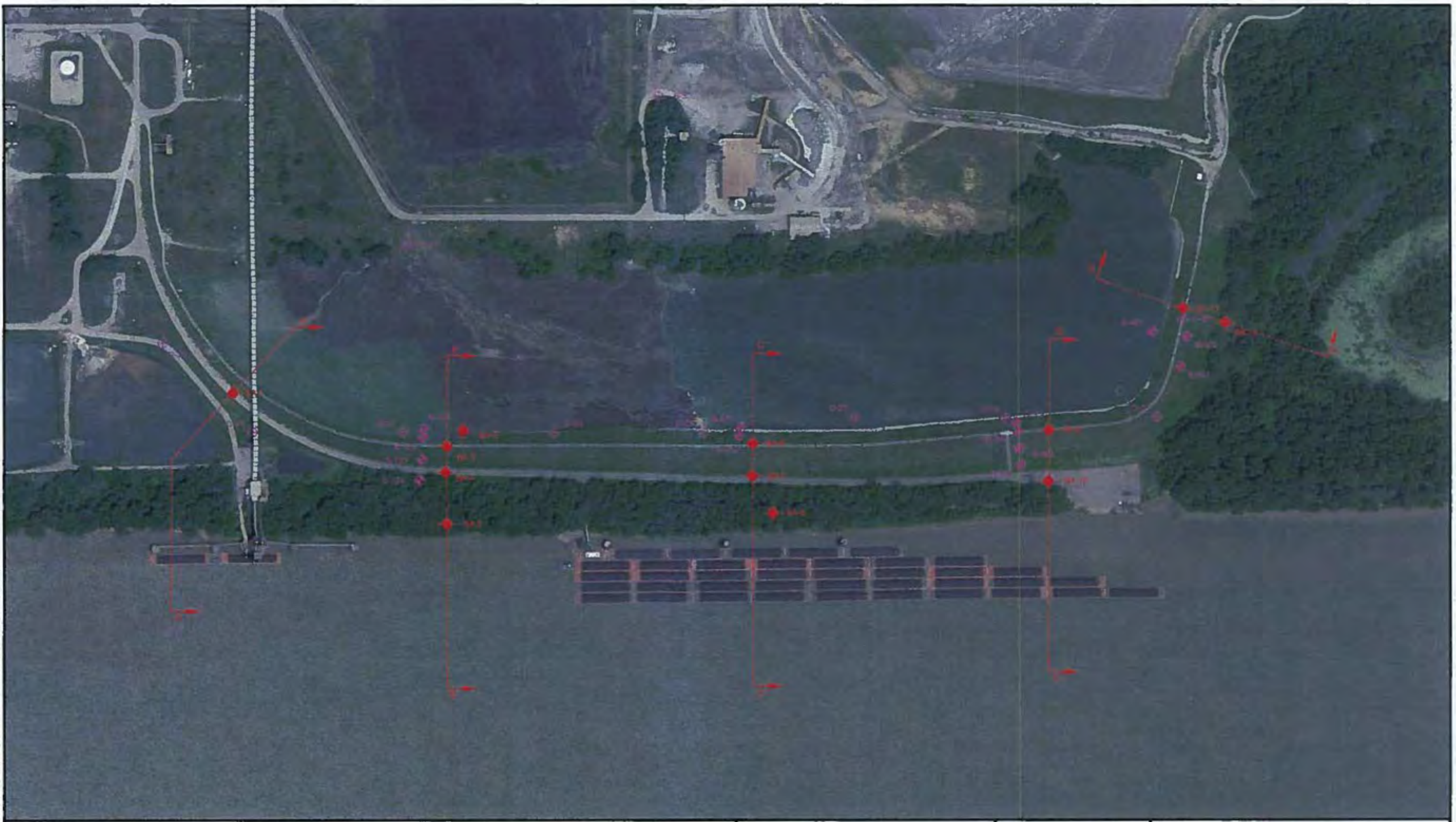
7-6-75

LOG OF SOIL BORINGS
SHEET 7
EAST BEND STATION UNIT 2.
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO.
5600050009

Appendix B
Boring Logs – Amec Foster Wheeler Phase 2 Report (2015)



LEGEND

BA-2 ◆	PROPOSED BORINGS
B-102 ⊕	PREVIOUSLY DRILLED BORINGS BY BBC&M (AS SHOWN IN BBC&M 2011)
D-22 ⊕	PREVIOUSLY DRILLED BORINGS BY SARGENT & LUNDY (AS SHOWN IN BBC&M 2011)

N

0' 150' 300' 450'
1" = 300'

AMEC Environment & Infrastructure
9725 Cogdill Road
Knoxville, Tennessee 37932

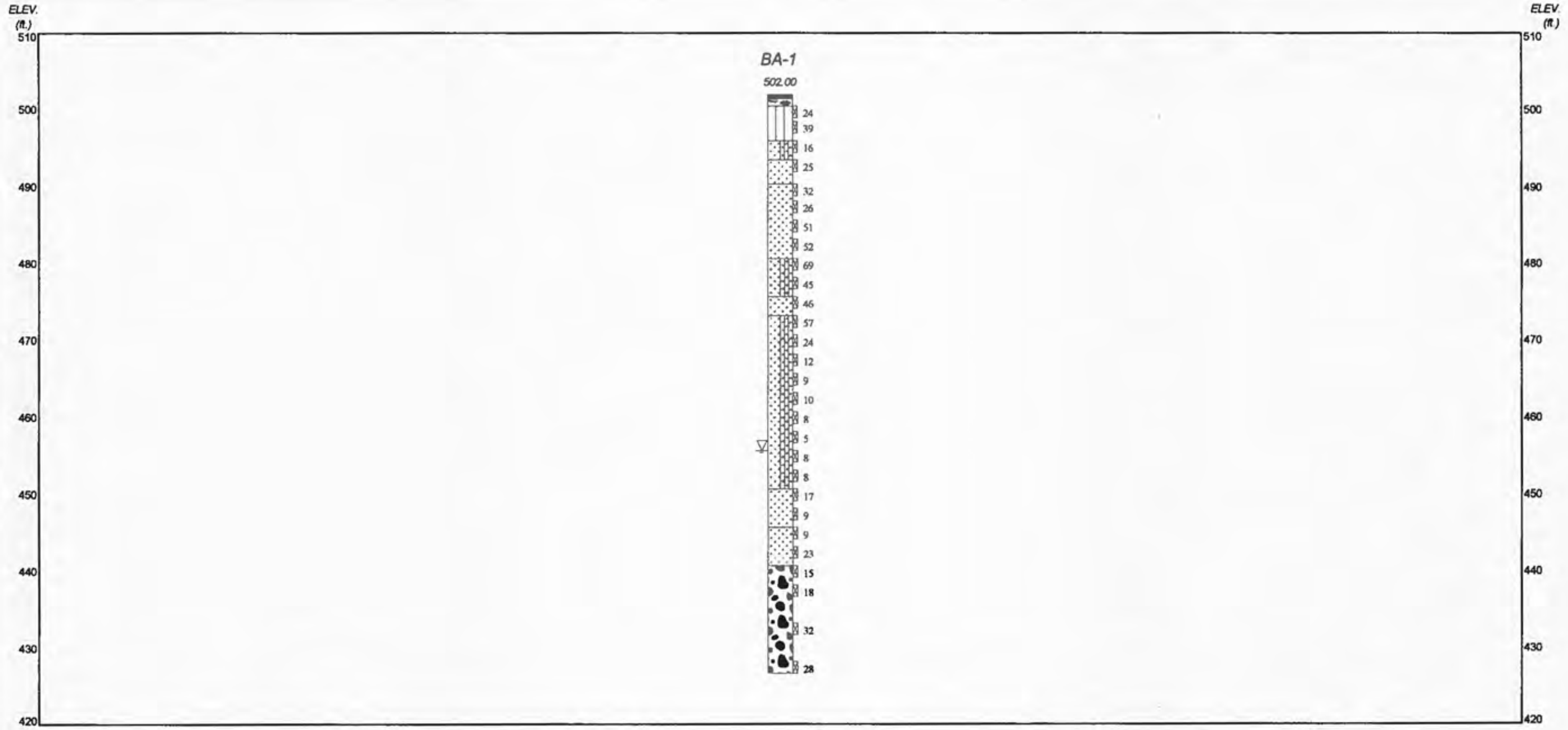
amec

CLIENT: Duke Energy.

TITLE:

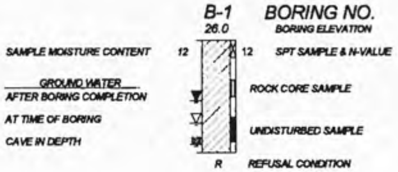
BORING LOCATION PLAN
EAST BEND ASH POND
BOONE COUNTY, KENTUCKY

DR: JRH	REV: CB	PROJ. NO.: 7810140159
CHK: MB	DATE: 12-19-2014	DWG NO. NA
SCALE: AS SHOWN		FIGURE



MATERIAL LAYERING CODES

- Fill
- Low Plasticity Inorganic Clays (CL)
- High Plasticity Inorganic Clays (CH)
- Low Plasticity Inorganic Silts (ML)
- High Plasticity Inorganic Silts (MH)
- Poorly Graded Sand and Gravel
- Topsoil
- Poorly Graded Sand (SP)
- Well Graded Sand (SW)
- Silty Sand (SM)
- Clayey Sand (SC)
- Well Graded Gravel (GW)
- Poorly Graded Sand with Clay (SP-SC)
- Poorly Graded Sand with Silt (SP-SM)
- Silty Clayey Sand (SC-SM)
- Low PLasticity Organic Soils (OL)
- Limestone
- Alluvium



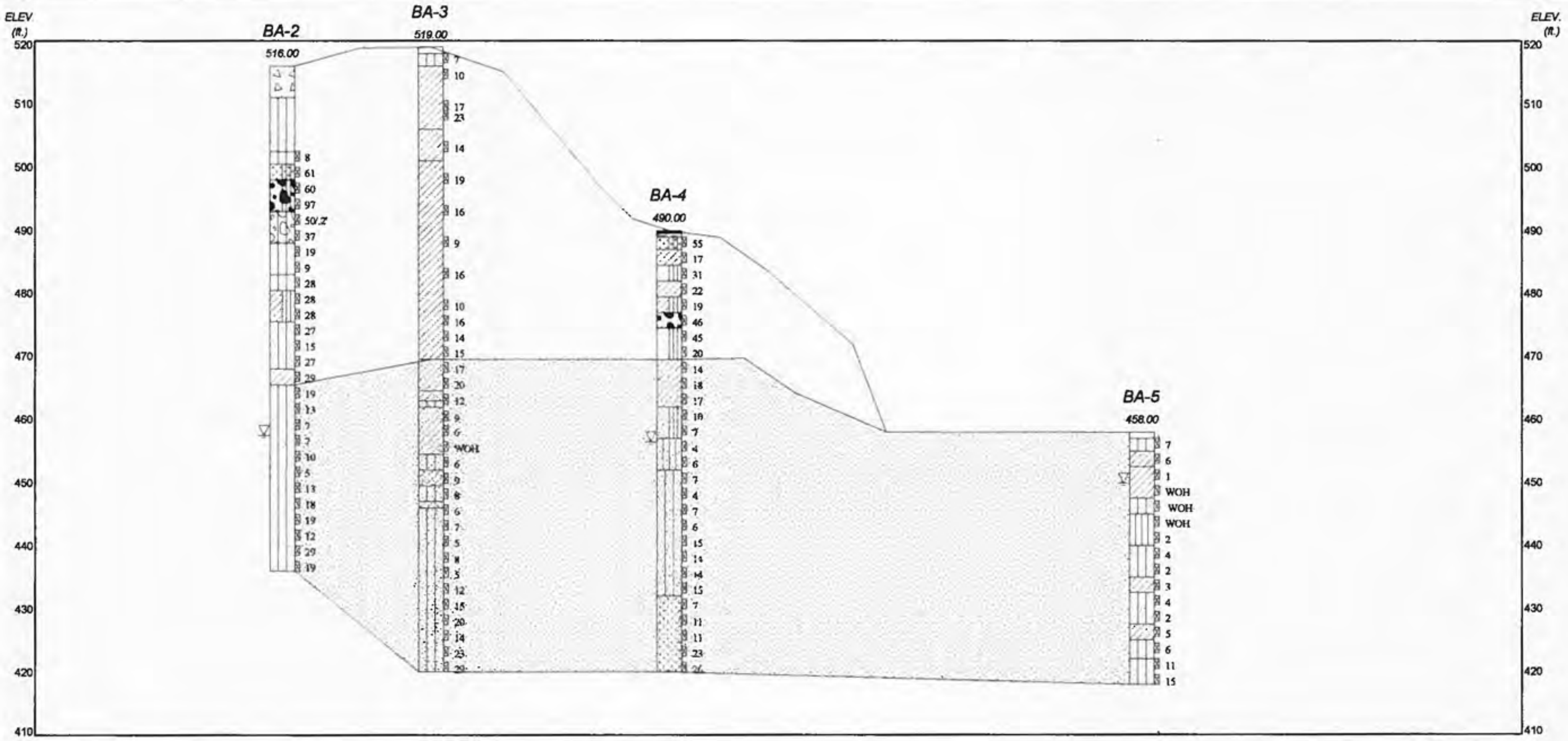
THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE

CROSS-SECTION A - A'

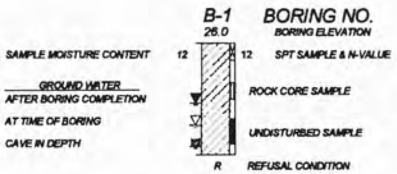
PROJECT DUKE East Bend Phase 2 Reconstitution
PROJECT NO. 7810140159

amec



MATERIAL LAYERING CODES

- Fill
- Low Plasticity Inorganic Clays (CL)
- High Plasticity Inorganic Clays (CH)
- Low Plasticity Inorganic Silts (ML)
- High Plasticity Inorganic Silts (MH)
- Poorly Graded Sand and Gravel
- Topsoil
- Poorly Graded Sand (SP)
- Well Graded Sand (SW)
- Silty Sand (SM)
- Clayey Sand (SC)
- Well Graded Gravel (GW)
- Poorly Graded Sand with Clay (SP-SC)
- Poorly Graded Sand with Silt (SP-SM)
- Silty Clayey Sand (SC-SM)
- Low PLasticity Organic Soils (OL)
- Limestone
- Alluvium



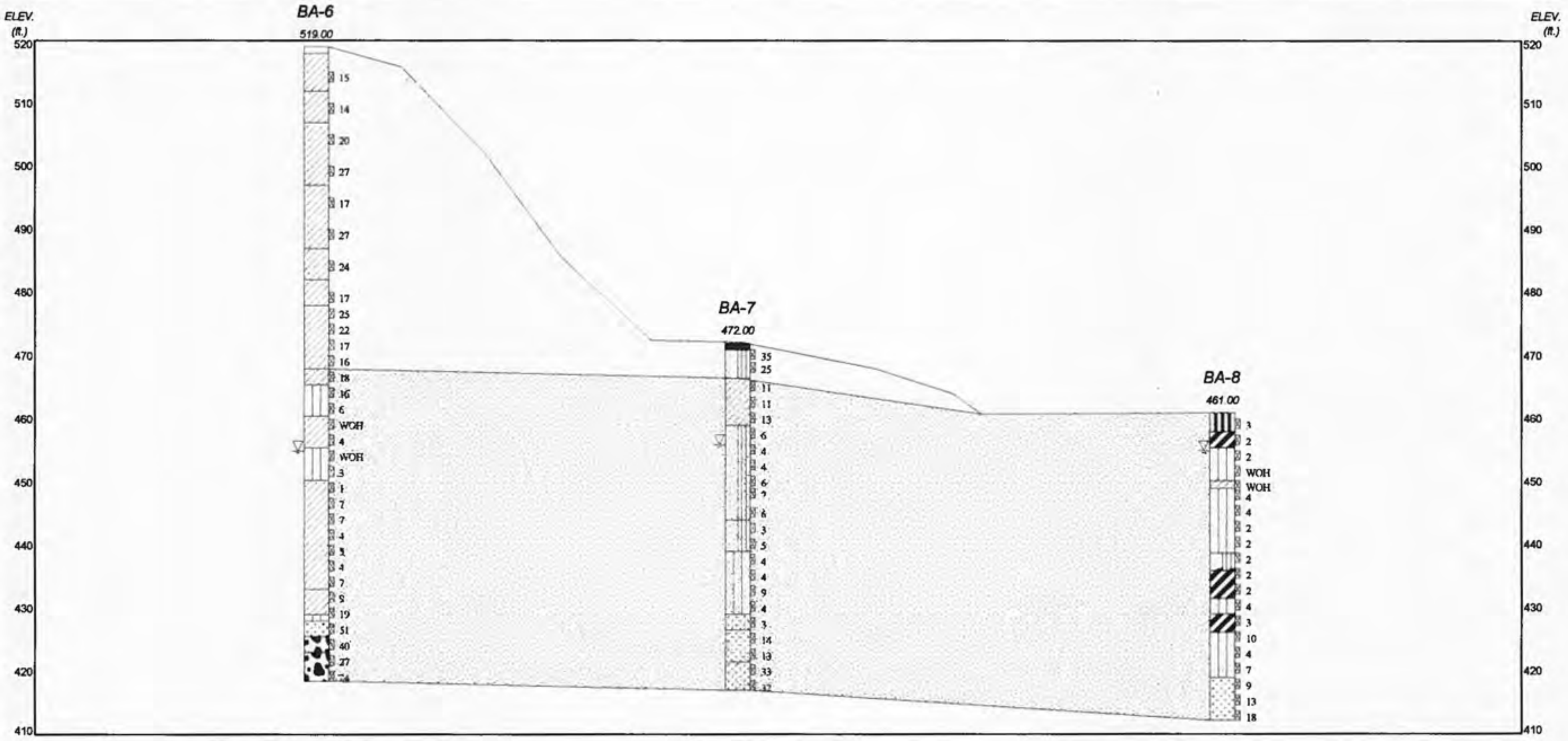
THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE

CROSS-SECTION B - B'

PROJECT DUKE East Bend Phase 2 Reconstitution
PROJECT NO. 7810140159

amec



MATERIAL LAYERING CODES

▨ Fill	☐ Topsoil	▥ Poorly Graded Sand with Clay (SP-SC)
▨ Low Plasticity Inorganic Clays (CL)	☐ Poorly Graded Sand (SP)	▥ Poorly Graded Sand with Silt (SP-SM)
▨ High Plasticity Inorganic Clays (CH)	▨ Well Graded Sand (SW)	▥ Silty Clayey Sand (SC-SM)
▥ Low Plasticity Inorganic Silts (ML)	▥ Silty Sand (SM)	☐ Low PLasticity Organic Soils (OL)
▥ High Plasticity Inorganic Silts (MH)	▨ Clayey Sand (SC)	▦ Limestone
☐ Poorly Graded Sand and Gravel	▨ Well Graded Gravel (GW)	▩ Alluvium

B-1 BORING NO.
26.0 BORING ELEVATION

SAMPLE MOISTURE CONTENT 12 — 12 SPT SAMPLE & N-VALUE

ROCK CORE SAMPLE

GROUND WATER
AFTER BORING COMPLETION ▼
AT TIME OF BORING ▽
CAVE IN DEPTH

UNDISTURBED SAMPLE

R REFUSAL CONDITION

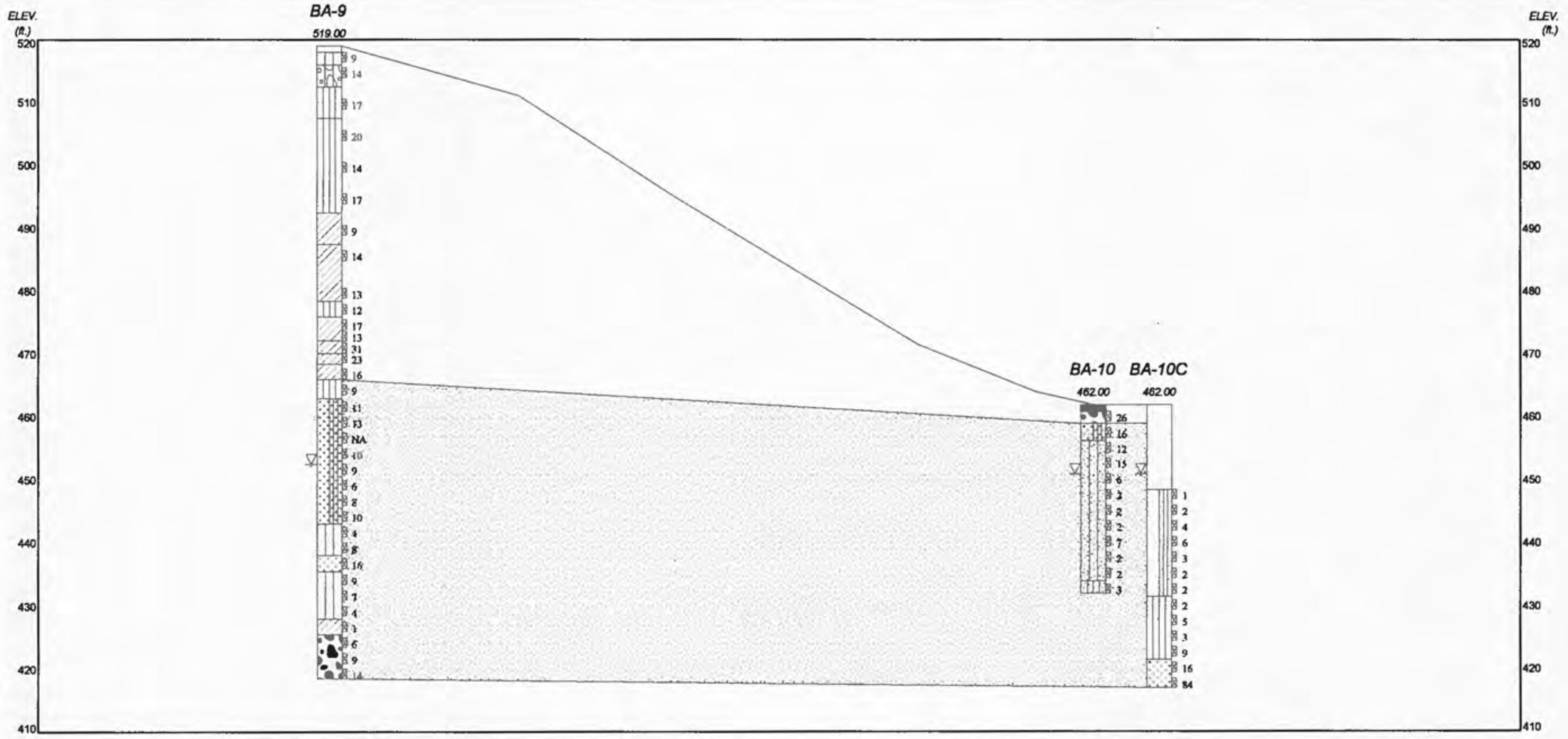
THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE

CROSS-SECTION C - C'

PROJECT DUKE East Bend Phase 2 Reconstitution
PROJECT NO. 7810140159

amec



MATERIAL LAYERING CODES

- Fill
- Low Plasticity Inorganic Clays (CL)
- High Plasticity Inorganic Clays (CH)
- Low Plasticity Inorganic Silts (ML)
- High Plasticity Inorganic Silts (MH)
- Poorly Graded Sand and Gravel
- Topsoil
- Poorly Graded Sand (SP)
- Well Graded Sand (SW)
- Silty Sand (SM)
- Clayey Sand (SC)
- Well Graded Gravel (GW)
- Poorly Graded Sand with Clay (SP-SC)
- Poorly Graded Sand with Silt (SP-SM)
- Silty Clayey Sand (SC-SM)
- Low PLasticity Organic Soils (OL)
- Limestone
- Alluvium

B-1 BORING NO.
26.0 BORING ELEVATION
SAMPLE MOISTURE CONTENT 12
12 SPT SAMPLE & N-VALUE
GROUND WATER
AFTER BORING COMPLETION
AT TIME OF BORING
CAVE IN DEPTH
ROCK CORE SAMPLE
UNDISTURBED SAMPLE
R REFUSAL CONDITION

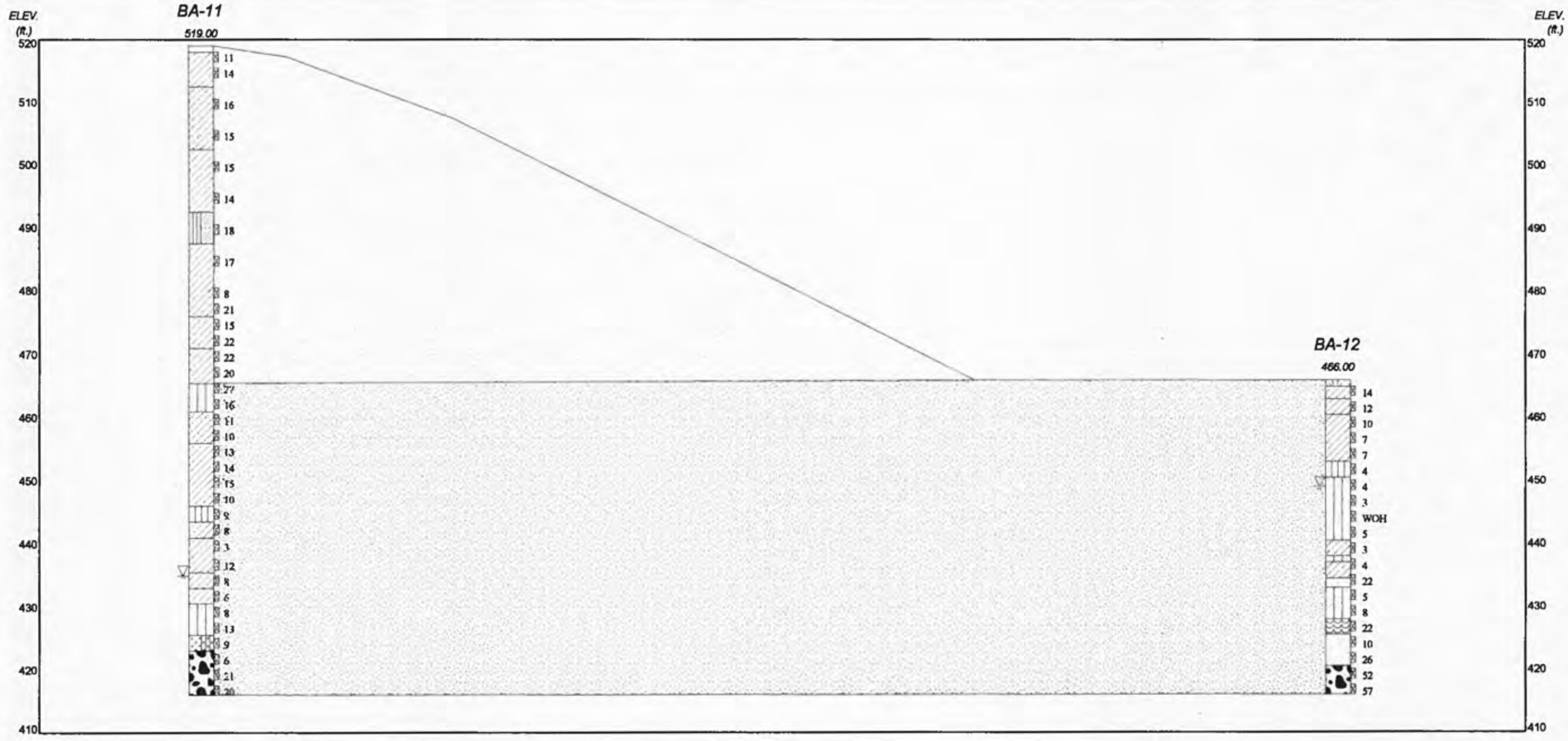
THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

SUBSURFACE PROFILE

CROSS-SECTION D - D'

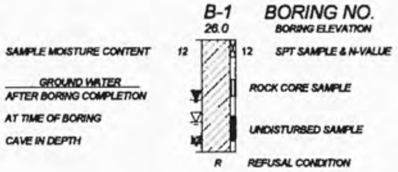
PROJECT DUKE East Bend Phase 2 Reconstitution
PROJECT NO. 7810140159

amec



MATERIAL LAYERING CODES

- Fill
- Low Plasticity Inorganic Clays (CL)
- High Plasticity Inorganic Clays (CH)
- Low Plasticity Inorganic Silts (ML)
- High Plasticity Inorganic Silts (MH)
- Poorly Graded Sand and Gravel
- Topsoil
- Poorly Graded Sand (SP)
- Well Graded Sand (SW)
- Silty Sand (SM)
- Clayey Sand (SC)
- Well Graded Gravel (GW)
- Poorly Graded Sand with Clay (SP-SC)
- Poorly Graded Sand with Silt (SP-SM)
- Silty Clayey Sand (SC-SM)
- Low PLasticity Organic Soils (OL)
- Limestone
- Alluvium



THE SOIL PROFILE SHOWN IS BASED ON INTERPOLATION OF CONDITIONS AT WIDELY SPACED BORINGS OR SOUNDINGS AND REASONABLE ENGINEERING JUDGEMENT AND IS NOT WARRANTED.

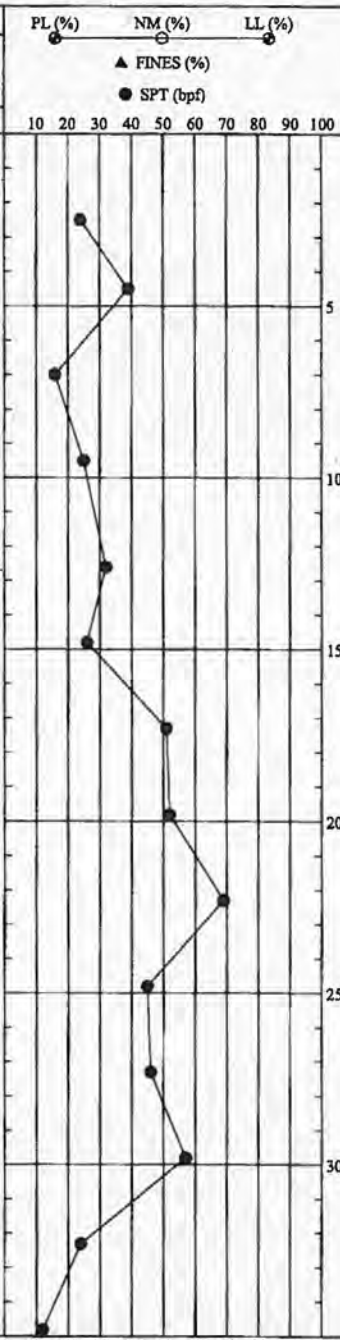
SUBSURFACE PROFILE

CROSS-SECTION E -E'

PROJECT DUKE East Bend Phase 2 Reconstitution
PROJECT NO 7810140159

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Asphalt: gravel subgrade		502.0			
	Gravel subgrade					
	Fill: medium dense, dry to moist, brown with dark grayish brown, Silty SAND with gravel (SM), mostly fine to coarse sand, little non plastic fines, little fine gravel				☒	(18)
				SS-1		12-14-10
	dense, some gravel, few to little non plastic fines (silt)				☒	(18)
				SS-2		15-20-19
5			497.0			
	Fill: medium dense, dry to moist, brown with dark grayish brown mottling, Well graded SAND with silt and gravel (SW-SM), mostly fine to coarse sand, few non plastic fines, little fine gravel				☒	(17)
				SS-3		4-7-9
	Fill: medium dense, moist, brown, Well graded SAND (SW), mostly fine to coarse sand, few fine gravel, trace non plastic fines (silt)				☒	(18)
				SS-4		8-10-15
10			492.0			
	Fill: dense, moist, brown with light brown mottling, Well graded SAND with gravel (SW), mostly fine to coarse sand, some fine gravel, trace non plastic fines (silt)				☒	(13)
				SS-5		21-17-15
	medium dense				☒	(11)
15			487.0	SS-6		12-16-10
	very dense				☒	(13)
				SS-7		19-29-22
					☒	(12)
20			482.0	SS-8		5-25-27
	Fill: very dense, moist, brown with dark brown mottling, Well graded SAND with silt (SW-SM), mostly fine to coarse sand, few to little non plastic fines (silt), trace to few fine gravel				☒	(16)
				SS-9		25-36-33
					☒	(14)
25			477.0	SS-10		20-22-23
	Fill: dense, moist, dark grayish brown, Well graded SAND (SW), mostly fine to coarse sand, trace non plastic fines and gravel				☒	(12)
				SS-11		15-25-21
	Fill: very dense, moist, dark grayish brown wih brown mottling, Well graded SAND with silt (SW-SM), mostly fine to coarse sand, few non plastic fines, trace fine gravel				☒	(13)
30			472.0	SS-12		10-17-40
	medium dense, trace to few non plastic fines, no gravel				☒	(14)
				SS-13		12-11-13
	medium dense, moist, fine to medium sand				☒	(12)
35			467.0	SS-14		3-5-7



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid auger to 9' / Casing advancer 9' to 75.3'
HOLE DIAMETER:	8" Solid stem auger / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 46.3 ft bgs at time of drilling.

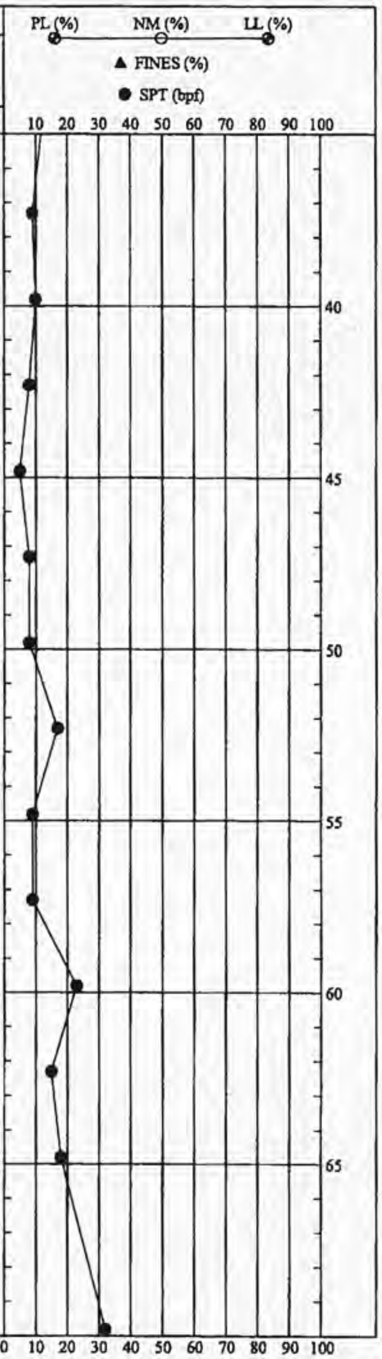
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/28/2014
COORD N: 510963 **COMP. DATE:** 10/28/2014
COORD E: 1470381 **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-1

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35	Fill: very dense, moist, dark grayish brown wih brown mottling, Well graded SAND with silt (SW-SM), mostly fine to coarse sand, few non plastic fines, trace fine gravel	467.0			
			SS-15	☒	(14) 2-4-5
40		462.0	SS-16	☒	(13) 6-6-4
			SS-17	☒	(12) 4-4-4
	trace to few non plastic fines				
45		457.0	SS-18	☒	(13) 2-2-3
	▽ wet		SS-19	☒	(12) 3-3-5
	mostly fine to coarse sand				
50		452.0	SS-20	☒	(10) 3-4-4
	Alluvium: medium dense, wet, brown, Well graded SAND (SW), mostly fine to medium (trace coarse) sand, trace non plastic fines (silt)		SS-21	☒	(11) 4-7-10
	loose				
55		447.0	SS-22	☒	(18) 5-5-4
	Alluvium: loose, wet, brown, Well graded SAND with gravel (SW), mostly fine to coarse sand, little to some fine gravel, trace non plastic fines (SW)		SS-23	☒	(12) 3-4-5
	No Recovery				
60		442.0	SS-24	☒	(0) 12-14-9
	Alluvium: medium dense, wet, dark brown, Well graded GRAVEL with sand (GW), mostly fine gravel, few to little, fine to coarse sand, no fines		SS-25	☒	(1) 2-6-9
	brown, little to some, fine to coarse sand, trace non plastic fines (silt)				
65		437.0	SS-26	☒	(10) 10-11-7
	No Recovery				
70		432.0	SS-27	☒	(0) 15-16-16



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid auger to 9' / Casing advancer 9' to 75.3'
HOLE DIAMETER:	8" Solid stem auger / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 46.3 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

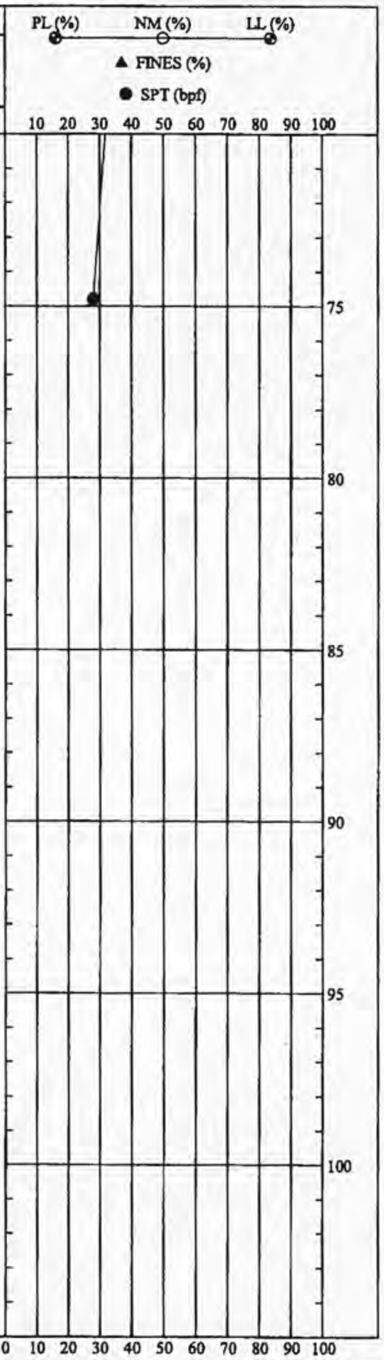
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/28/2014
COORD N: 510963 **COMP. DATE:** 10/28/2014
COORD E: 1470381 **Page 2 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-1

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70	Alluvium: medium dense, wet, dark brown, Well graded GRAVEL with sand (GW), mostly fine gravel, few to little, fine to coarse sand, no fines		432.0		☒	
	medium dense					(1)
75			427.0	SS-28	☒	20-16-12
	Boring terminated at 75.3 feet					
80			422.0			
85			417.0			
90			412.0			
95			407.0			
100			402.0			
105			397.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid auger to 9' / Casing advancer 9' to 75.3'
HOLE DIAMETER:	8" Solid stem auger / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 46.3 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

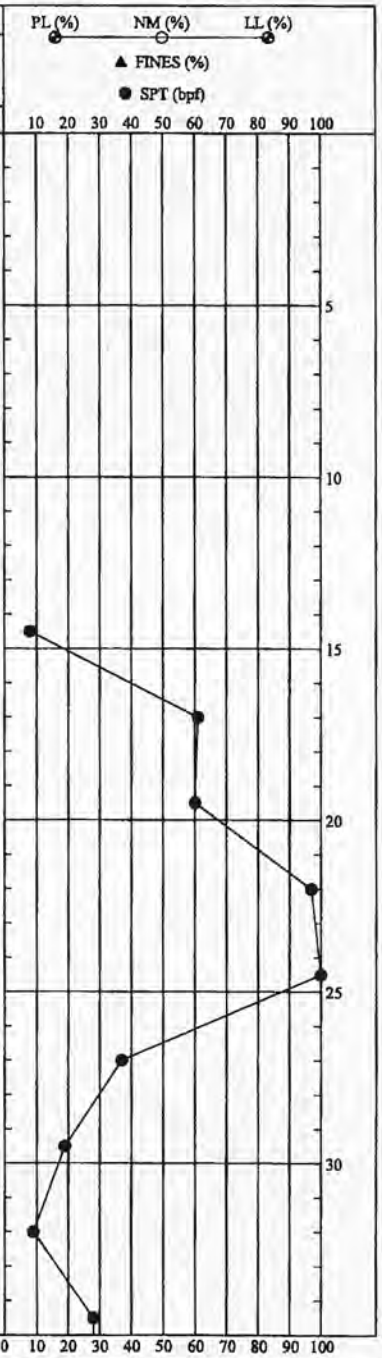
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/28/2014
COORD N: 510963 **COMP. DATE:** 10/28/2014
COORD E: 1470381 **Page 3 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-1

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Bottom Ash	516.0			
5	Fill: Silty SAND (SM)	511.0			
10		506.0			
	Fill: loose, moist, dark yellowish brown, Silty SAND (SM), mostly fine to medium sand, some non plastic fines (silt)		SS-1	☒	(14) 3-3-5
15		501.0			
	Fill: very dense, moist, brown, Well graded SAND with silt and gravel (SW-SM), mostly fine to coarse sand, little fine to coarse gravel, few non plastic fines (silt)		SS-2	☒	(16) 12-21-40
	Fill: very dense, moist, brown, Well graded GRAVEL with silt and sand (GW-GM), mostly fine to coarse gravel, little fine to coarse sand, few non plastic fines (silt)		SS-3	☒	(16) 15-20-40
20		496.0			
	brown with light brown mottling		SS-4	☒	(17) 23-43-54
	Fill: very dense, moist, brown with dark brown mottling, Silty GRAVEL with sand (GM), mostly fine to coarse gravel, little non plastic fines (silt), little fine to coarse sand		SS-5	☒	(17) 17-58-50/.2'
25		491.0			
	with dark gray mottling		SS-6	☒	(17) 16-24-13
	Fill: medium dense, moist, brown with light brown, dark gray mottling, Silty SAND with gravel (SM), mostly fine to medium sand, some non plastic fines (silt), little fine to coarse gravel		SS-7	☒	(16) 6-7-12
30		486.0			
	loose, brown, mostly fine sand, little fine gravel		SS-8	☒	(12) 2-3-6
	Fill: medium dense, moist, brown with dark gray mottling, Silty SAND (SM), mostly fine to coarse sand, some non plastic fines (silt), little fine gravel		SS-9	☒	(16) 9-10-18
35		481.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem auger with mud
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 58.5 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

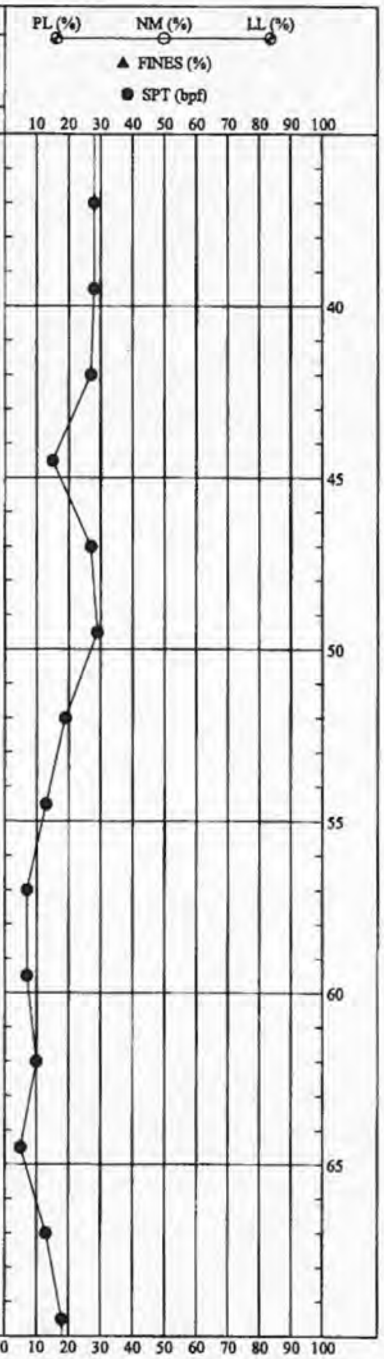
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/7/2014
COORD N: 510838 **COMP. DATE:** 11/7/2014
COORD E: 1471142 **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-2

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		481.0		
	Fill: medium dense, moist, brown with dark gray mottling, Clayey SAND with gravel (SC-SM), mostly fine to coarse sand, some non plastic fines (silt), little fine gravel		SS-10	(17) 10-16-12
	brown with dark gray mottling		SS-11	(17) 9-12-16
40		476.0		
	Fill: stiff to very stiff, moist, brown with dark gray mottling, Sandy lean CLAY (CL), mostly fine to medium sand, some non plastic fines (silt), trace fine gravel		SS-12	(17) 7-12-15
	trace fine coarse gravel		SS-13	(16) 2-5-10
45		471.0		
	trace black oxide nodules		SS-14	(18) 7-12-15
	Fill: very stiff, moist, brown with reddish brown mottling, lean CLAY (CL), mostly non to low plasticity fines (clay), few fine sand		SS-15	(18) 7-12-17
50		466.0		
	Alluvium: medium dense, moist, brown, Silty SAND (SM), mostly fine to medium sand, some non plastic fines (silt), trace black oxide nodules		SS-16	(16) 6-8-11
	stiff		SS-17	(17) 5-6-7
55		461.0		
	loose		SS-18	(18) 2-2-5
	∇		SS-19	(18) 2-3-4
60		456.0		
			SS-20	(18) 2-5-5
			SS-21	(18) 3-3-2
65		451.0		
			SS-22	(13) 5-5-8
			SS-23	(13) 4-8-10
70		446.0		



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem auger with mud
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 58.5 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

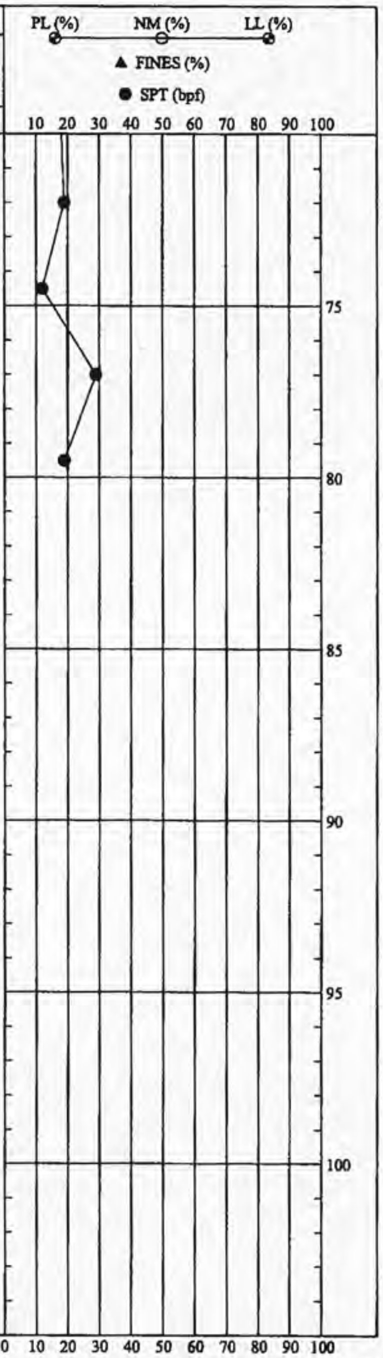
PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159
START DATE: 11/7/2014
COORD N: 510838
COMP. DATE: 11/7/2014
COORD E: 1471142
Page 2 of 3
LOCATION: East Bend Station, KY

BORING NO.: BA-2

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70			446.0			
				SS-24	☒	(14) 9-9-10
				SS-25	☒	(14) 3-5-7
75			441.0			
				SS-26	☒	(16) 6-13-16
				SS-27	☒	(13) 8-9-10
80	Boring terminated at 80.0 feet		436.0			
85			431.0			
90			426.0			
95			421.0			
100			416.0			
105			411.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Hollow stem auger with mud
HOLE DIAMETER: 7"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 58.5 feet bgs at time of drilling.

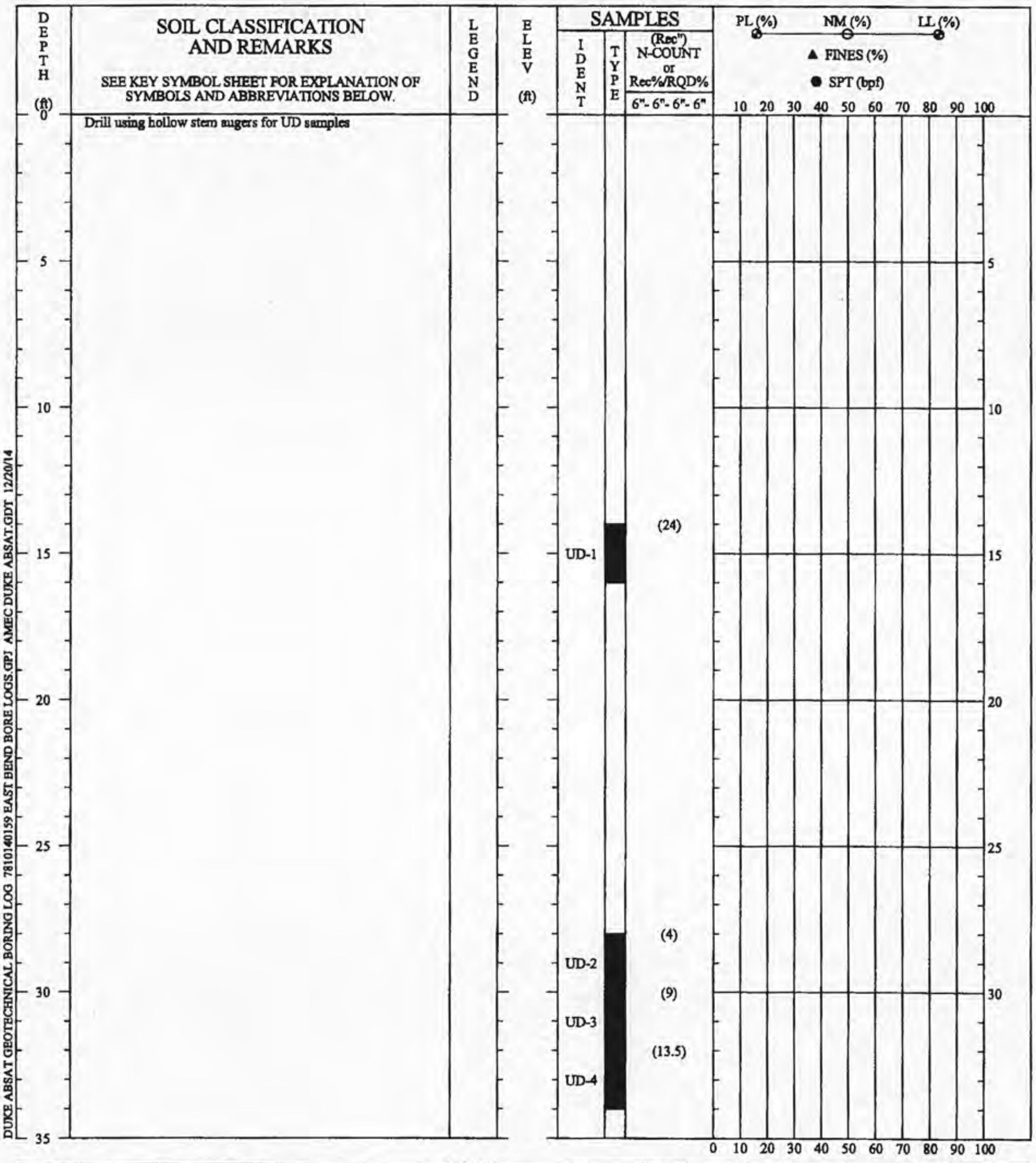
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/7/2014
COORD N: 510838 **COMP. DATE:** 11/7/2014
COORD E: 1471142 **Page 3 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-2

amec



Drill using hollow stem augers for UD samples

IDENT	(Rec") N-COUNT or Rec%/RQD%
UD-1	(24)
UD-2	(4)
UD-3	(9)
UD-4	(13.5)

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	M. Bishop
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow stem augers
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 55 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/10/2014
COORD N: **COMP. DATE:** 11/10/2014
COORD E: **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-2A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
35	Drill using hollow stem augers for UD samples						
				UD-5		(12)	
				UD-6		(7)	
40							
				UD-7		(24)	
45							
50							
				UD-8		(24)	
55	∇						
				UD-9		(24)	
	Boring Terminated at 58.0 feet						
60							
65							
70							

0 10 20 30 40 50 60 70 80 90 100

CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: M. Bishop
EQUIPMENT: Diedrich D-50
DRILL METHOD: Hollow stem augers
HOLE DIAMETER: 7"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 55 feet bgs at time of drilling.

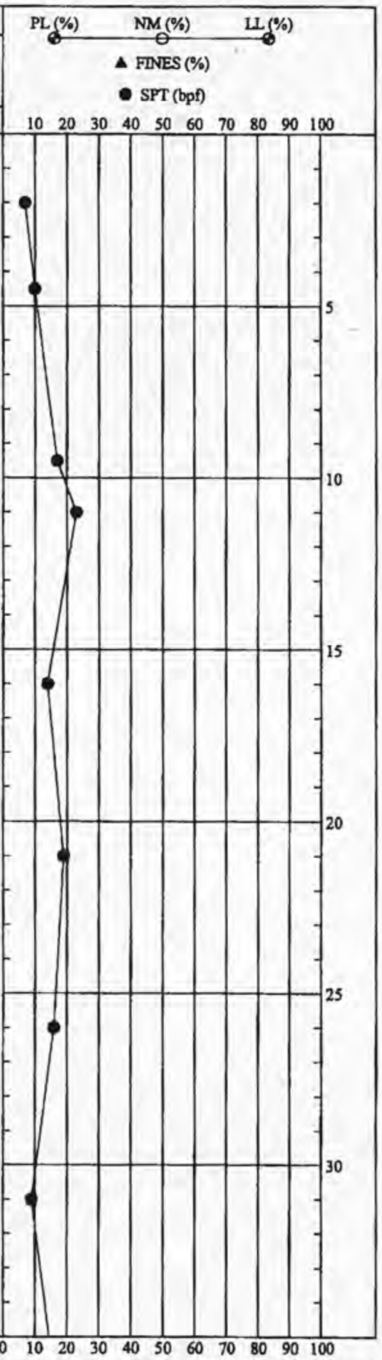
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/10/2014
COORD N: **COMP. DATE:** 11/10/2014
COORD E: **Page 2 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-2A

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Fill: gravel road base	519.0		
	Fill: loose, moist, reddish brown, Silty SAND (SM), fine sand, little silt, trace gravel		SS-1	(1) 5-4-3
	Fill: stiff, wet, reddish brown, Lean CLAY (CL), non plastic clay, trace fine sand and gravel		SS-2	(14) 5-5-5
5		514.0		
			SS-3	(12) 5-8-9
10	No Recovery	509.0	SS-4	(0) 12-12-11
15	Fill: medium dense, moist, dark yellowish brown, Clayey SAND (SC), some clay, trace silt and gravel	504.0	SS-5	(16) 5-7-7
20	Fill: very stiff, wet, brown to gray, Lean CLAY (CL), non plastic clay, few fine sand, trace gravel and silt	499.0	SS-6	(17) 6-8-11
25		494.0	SS-7	(18) 6-9-7
30		489.0	SS-8	(12) 3-4-5
35		484.0		



CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	M. Bishop
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow stem to 10' / Mud rotary from 10' to 99'
HOLE DIAMETER:	7" Hollow Stem Auger/ 4" Mud Rotary
CLOSURE METHOD:	Tremie grouted to ground surface

REMARKS:

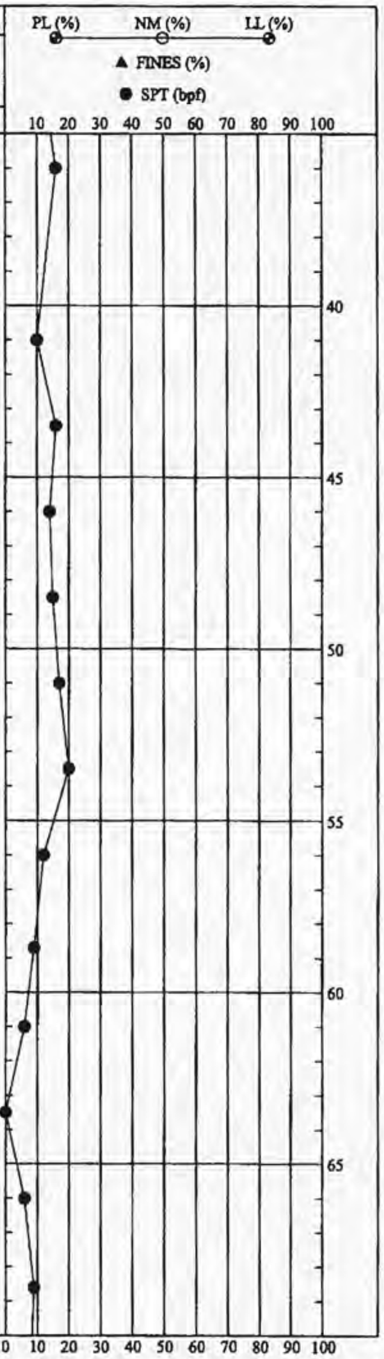
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/4/2014
COORD N: 510786 **COMP. DATE:** 11/6/2014
COORD E: 1471089 **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-3

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		484.0	SS-9	☒	(16) 6-8-8
40		479.0	SS-10	☒	(14) 6-4-6
			SS-11	☒	(14) 4-6-10
45		474.0	SS-12	☒	(17) 7-7-7
			SS-13	☒	(18) 9-8-7
50	Alluvium: very stiff, wet, dark yellowish brown, Lean Clay (CL), non plastic clay, trace fine sand	469.0	SS-14	☒	(18) 5-7-10
			SS-15	☒	(18) 7-9-11
55	Alluvium: stiff, wet, brown, Sandy lean CLAY (CL), non plastic clay with some fine sand, trace silt Alluvium: medium dense, wet, brown, Silty SAND (SM), fine sand, some silt, trace clay	464.0	SS-16	☒	(18) 2-4-8
	Alluvium: loose, wet, brown, Clayey SAND (SC), fine sand, some clay, trace silt		SS-17	☒	(14) 3-4-5
60		459.0	SS-18	☒	(17) 3-2-4
	No Recovery		SS-19	☒	(0) 4-1-WOH
65	Alluvium: loose, wet, brown, Silty SAND (SM), fine sand, little silt	454.0	SS-20	☒	(12) 3-4-2
	Alluvium: loose, wet, brown, Clayey SAND (SC), fine sand, little clay, trace silt		SS-21	☒	(11) 4-5-4
70		449.0			



CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: M. Bishop
EQUIPMENT: Diedrich D-50
DRILL METHOD: Hollow stem to 10' / Mud rotary from 10' to 99'
HOLE DIAMETER: 7" Hollow Stem Auger/ 4" Mud Rotary

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

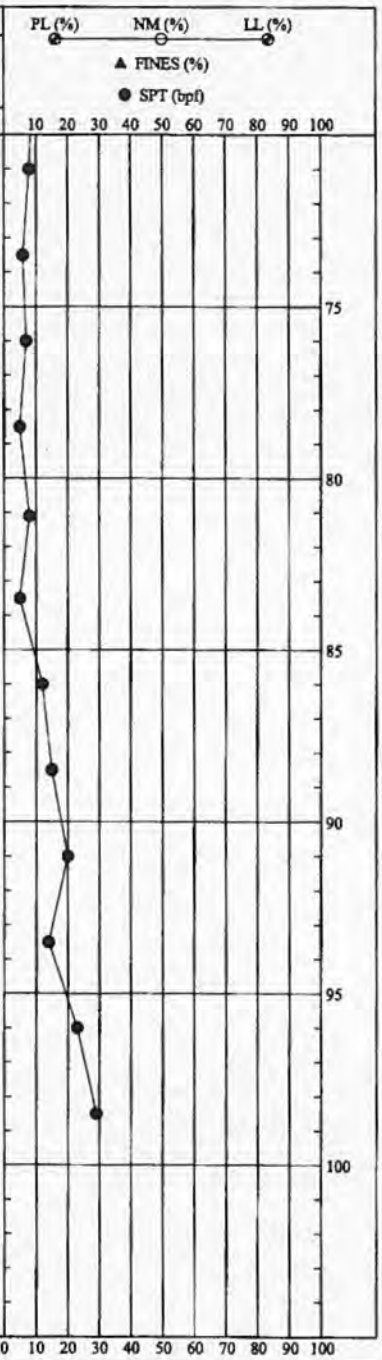
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/4/2014
COORD N: 510786 **COMP. DATE:** 11/6/2014
COORD E: 1471089 **Page** 2 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-3

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70	Alluvium: loose, wet, brown, Silty SAND (SM), fine sand, little silt, few clay		449.0	SS-22	☒	(14) 2-4-4
	Alluvium: medium stiff, wet, brown, Lean CLAY (CL), few fine sand, trace silt	▨		SS-23	☒	(17) 4-3-3
	Alluvium: loose, wet, brown, Silty SAND (SM), fine sand, little silt					
75	streaks of tan and red observed, fine sand		444.0	SS-24	☒	(16) 3-3-4
	trace mica flakes			SS-25	☒	(13) 4-3-2
80			439.0	SS-26	☒	(16) 2-3-5
				SS-27	☒	(14) 2-2-3
85	medium dense		434.0	SS-28	☒	(16) 2-4-8
	trace to few fine rounded gravel			SS-29	☒	(17) 4-7-8
90			429.0	SS-30	☒	(18) 10-11-9
				SS-31	☒	(11) 6-7-7
95			424.0	SS-32	☒	(17) 12-10-13
				SS-33	☒	(14) 7-13-16
	Boring terminated at 99.0 feet					
100			419.0			
105			414.0			



CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: M. Bishop
EQUIPMENT: Diedrich D-50
DRILL METHOD: Hollow stem to 10' / Mud rotary from 10' to 99'
HOLE DIAMETER: 7" Hollow Stem Auger/ 4" Mud Rotary

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS:

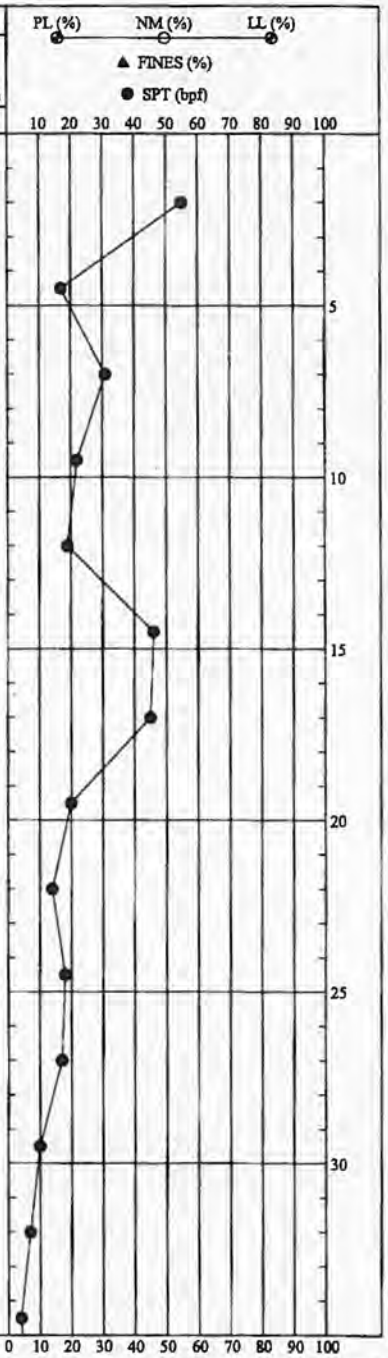
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/4/2014
COORD N: 510786 **COMP. DATE:** 11/6/2014
COORD E: 1471089 **Page 3 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-3

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Asphalt	490.0			
	Gravel Subgrade				
	Embankment Fill: very dense, moist, very dark gray with brown mottling, Well graded SAND with silt and gravel (SW-SM), mostly fine coarse sand, few non plastic fines (silt), little fine gravel.		SS-1	☒	(17) 13-30-25
	Embankment Fill: very stiff, moist, brown with dark yellow mottling, Sandy lean CLAY (CL), mostly fine to medium sand, little non plastic fines (silt)		SS-2	☒	(16) 9-6-11
5		485.0			
	Embankment Fill: dense, moist, light brown with dark gray mottling, Poorly graded SAND with silt (SP-SM), fine to medium sand, few non plastic fines (silt).		SS-3	☒	(16) 5-15-16
	Embankment Fill: medium dense, moist, brown with dark gray mottling, Clayey SAND (SC), mostly fine to coarse sand, few non plastic fines (silt), little fine gravel.		SS-4	☒	(17) 12-13-9
10		480.0			
	Embankment Fill: medium dense, moist, brown with grayish brown mottling, Silty clayey SAND (SC-SM), mostly fine to medium sand, few non plastic fines (silt), few fine gravel		SS-5	☒	(12) 10-9-10
	Embankment Fill: dense, wet, very dark gray with brown mottling, Well graded GRAVEL with sand (GW), fine to coarse gravel, little fine to coarse sand, trace non plastic fines, large gravel in sampler shoe		SS-6	☒	(4) 10-15-31
15		475.0			
	Embankment Fill: medium dense to dense, moist, brown with grayish brown mottling, Poorly graded SAND with silt (SP-SM), mostly fine to medium sand, few non plastic fines (silt)		SS-7	☒	(14) 12-19-26
	trace black oxide nodules, trace fine granite fragments.		SS-8	☒	(11) 8-9-11
20		470.0			
	Alluvium: stiff, moist, dark gray with reddish brown mottling, Lean CLAY (CL), mostly low plasticity fines, trace fine granite fragments, trace black oxide nodules		SS-9	☒	(12) 5-6-8
	very stiff, with dark red mottling		SS-10	☒	(16) 4-7-11
25		465.0			
	very stiff, brown, no rock fragments		SS-11	☒	(14) 5-7-10
	Alluvium: loose, moist, brown, Poorly graded SAND with silt (SP-SM), mostly fine sand, few non plastic fines (silt), trace low plasticity fines (clay).		SS-12	☒	(16) 3-4-6
30		460.0			
			SS-13	☒	(18) 2-3-4
	▽ Alluvium: soft, wet, brown, Sandy SILT (ML), mostly fine sand, little low plasticity fines		SS-14	☒	(5) 3-2-2
35		455.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Solid stem to 8.5' / Mud rotary from 8.5' to 70'
HOLE DIAMETER: 8" Solid stem / 4" Mud rotary

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 33.5 feet bgs at time of drilling.

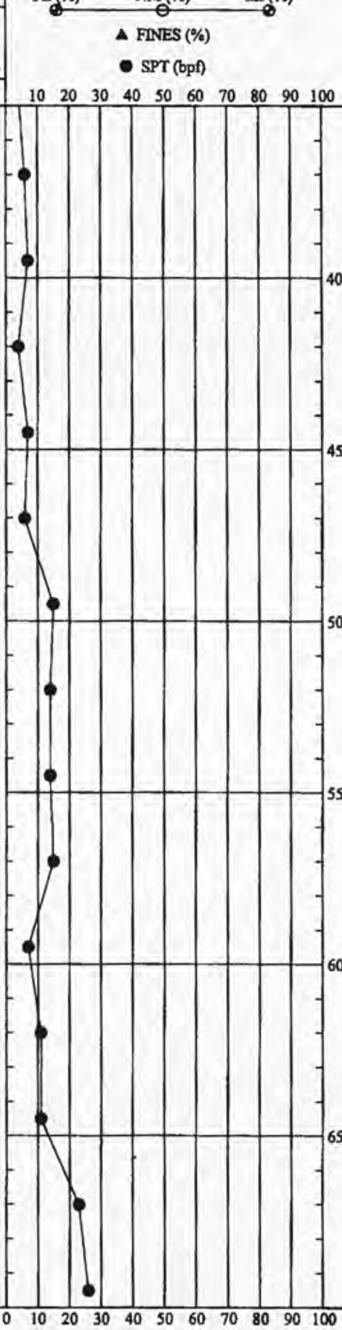
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/21/2014
COORD N: 510700 **COMP. DATE:** 10/21/2014
COORD E: 1471084 **Page 1 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-4

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		455.0			
	No Recovery		SS-15	☒	(0) 2-2-4
	Alluvium: loose, wet, brown, Silty SAND (SM), mostly fine to medium sand, little to some non plastic fines (silt), trace non plastic fines (clay), trace black oxide nodules		SS-16	☒	(16) 1-2-5
40		450.0			
	very loose		SS-17	☒	(14) 2-1-3
	loose		SS-18	☒	(15) 4-2-5
45		445.0			
			SS-19	☒	(13) 2-2-4
	medium dense, no clay fines		SS-20	☒	(12) 2-6-9
50		440.0			
			SS-21	☒	(11) 4-8-6
			SS-22	☒	(12) 4-7-7
55		435.0			
	trace fines (clay), low plasticity		SS-23	☒	(11) 6-5-10
	Alluvium: loose, wet, brown, Well graded SAND (SW), mostly fine to coarse sand, trace non plastic fines (silt), few fine gravel		SS-24	☒	(6) 3-4-3
60		430.0			
	medium dense, dark gray red mottling		SS-25	☒	(9) 4-5-6
	dark brown		SS-26	☒	(11) 5-6-5
65		425.0			
	few little fine gravel		SS-27	☒	(10) 8-12-11
	coarse gravel in spoon		SS-28	☒	(10) 12-12-14
70	Boring terminated at 70.0 feet	420.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Solid stem to 8.5' / Mud rotary from 8.5' to 70'
HOLE DIAMETER: 8" Solid stem / 4" Mud rotary

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 33.5 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/21/2014
COORD N: 510700 **COMP. DATE:** 10/21/2014
COORD E: 1471084 **Page** 2 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-4

DEPTH (ft) | SOIL CLASSIFICATION AND REMARKS | LEGEND | ELEV (ft) | SAMPLES: IDENT, TYPE, (Rec") N-COUNT or Rec%/RQD% 6"-6"-6"-6" | PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100

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

Drill using mud rotary for UD samples

IDENT	(Rec") N-COUNT or Rec%/RQD% 6"-6"-6"-6"
UD-1	(14)
UD-2	(8)
UD-3	(23)
UD-4	(6)
UD-5	(0)
UD-6	(6)
UD-7	(22)
UD-8	(24)
UD-9	(24)
UD-10	(23)
UD-11	(20)

Boring Terminated at 46.0 feet

Depth (ft): 0 5 10 15 20 25 30 35 40 45 50

0 10 20 30 40 50 60 70 80 90 100

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	C. Seifert
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Boring advanced using mud rotary drilling to obtain relatively undisturbed (UD) thin-walled tube samples.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

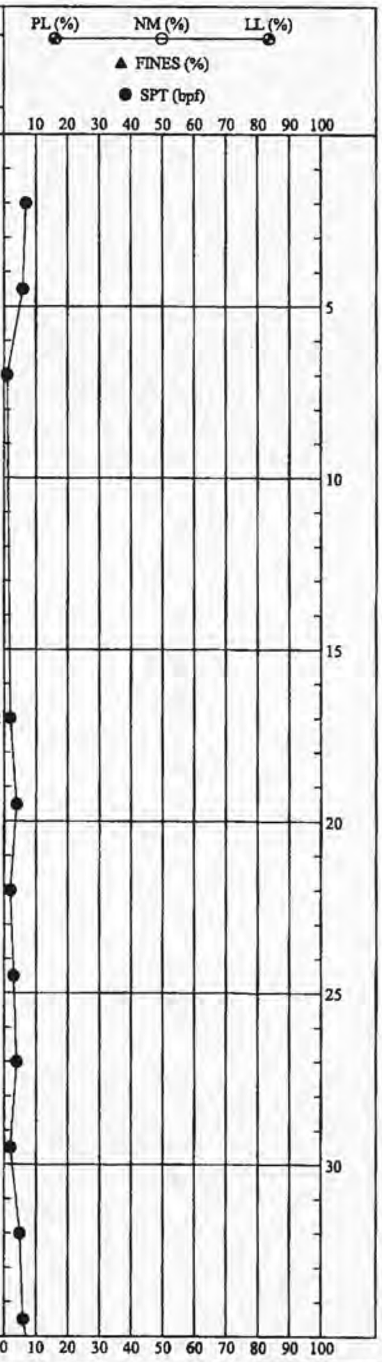
PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/30/2014
COORD N: **COMP. DATE:** 10/30/2014
COORD E: **Page** 1 **of** 1
LOCATION: East Bend Station, KY

BORING NO.: BA-4A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)
0	Fill:	☒	458.0
	Alluvium: loose, moist, dark reddish brown, Silty SAND (SM), fine sand, some silt	░	
	Alluvium: loose, moist, dark reddish brown, clayey SAND (SC), fine sand, some clay, trace silt	▨	
5	Alluvium: very soft, moist to wet, very dark gray, Lean CLAY (CL), clay, few silt, trace fine sand ▽	▨	453.0
10			448.0
	Alluvium: loose, wet, brown, Silty SAND (SM), fine sand, some silt	░	
	Alluvium: very soft, wet, reddish brown, SILT (ML) few clay and fine sand	▥	
15			443.0
	Alluvium: very loose to loose, wet, brown to dark reddish brown, Silty SAND (SM), fine sand, some silt	░	
20			438.0
	Alluvium: very loose, wet, dark reddish brown, Clayey SAND (SC), fine sand, some clay	▨	
25			433.0
	Alluvium: very loose, wet, brown, Silty SAND (SM), fine sand, some silt, trace clay	░	
30			428.0
	Alluvium: loose, wet, dark gray, Clayey SAND (SC), fine sand, some clay, trace silt	▨	
	Alluvium: loose, wet, brown, Silty SAND (SM), fine sand, little silt, trace clay	░	
35			423.0

SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
SS-1	☒	(11) 3-3-4
SS-2	☒	(12) 2-3-3
SS-3	☒	(16) 1-WOH-1
SS-4	☒	(13) WOH
SS-5	☒	(18) 1-1- WOH
SS-6	☒	(18) WOH
SS-7	☒	(12) WOH-WOH-2
SS-8	☒	(16) WOH-2-2
SS-9	☒	(18) WOH-1-1
SS-10	☒	(18) 2-1-2
SS-11	☒	(13) 2-2-2
SS-12	☒	(11) 1-1-1
SS-13	☒	(11) 1-2-3
SS-14	☒	(18) 1-1-5



CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: D. Atkinson
EQUIPMENT: Diedrich D-50
DRILL METHOD: Mud Rotary
HOLE DIAMETER: 4"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at about 8.1 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

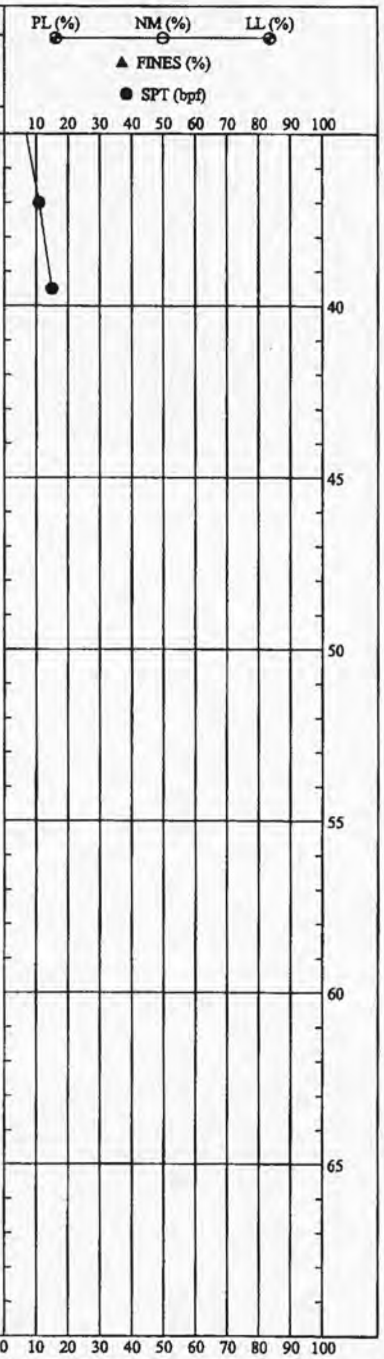
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/3/2014
COORD N: 510530 **COMP. DATE:** 11/3/2014
COORD E: 1471088 **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-5

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		▨	423.0			
	Alluvium: medium dense, wet, brown, Silty SAND (SM), fine sand, little silt	▨		SS-15	☒	(18) 2-3-8
		▨		SS-16	☒	(18) 5-7-8
40	Boring terminated at 40.0 feet		418.0			
45			413.0			
50			408.0			
55			403.0			
60			398.0			
65			393.0			
70			388.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	D. Atkinson
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 8.1 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

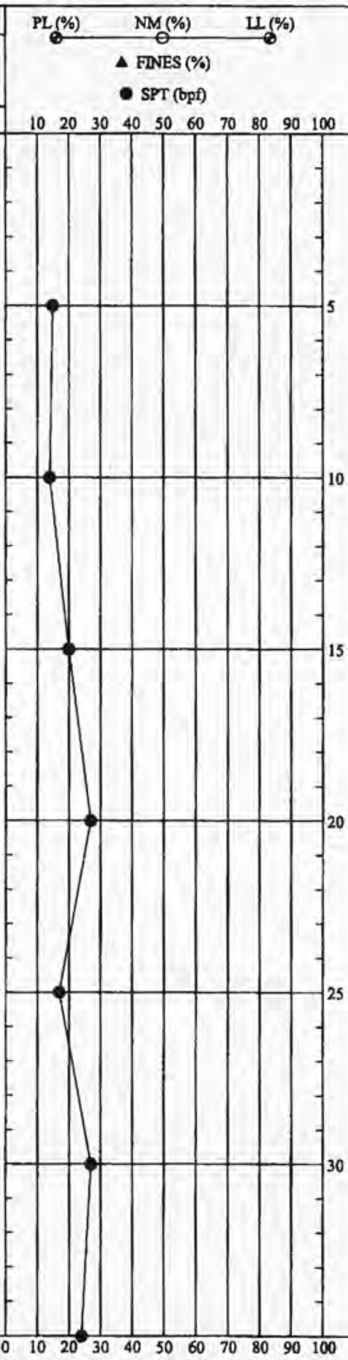
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/3/2014
COORD N: 510530 **COMP. DATE:** 11/3/2014
COORD E: 1471088 **Page 2 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-5

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Fill: gravel road base		519.0			
	Fill: stiff, moist, strong brown with brownish mottling, Lean CLAY (CL), mostly non plastic fines, (silt), little some fine sand, few to little fine gravel, trace root fragments, few non to low plasticity fines (clay)	▨				
		▨			☒	(16)
5		▨	514.0	SS-1	☒	6-7-8
	Fill: stiff, moist, strong brown with brown mottling, Lean Clay with gravel (CL), mostly non plastic fines (silt), few to little, non to low plasticity fines, (clay), little fine gravel, few fine sand	▨				
		▨			☒	(11)
10		▨	509.0	SS-2	☒	2-6-8
	Fill: very stiff, moist, strong brown with brown mottling, Sandy lean CLAY (CL), some fine sand, few fine gravel	▨			☒	(12)
15		▨	504.0	SS-3	☒	6-10-10
	with dark gray mottling, trace fine gravel, trace wood fragments	▨			☒	(12)
20		▨	499.0	SS-4	☒	8-9-18
	Fill: very stiff, moist, strong brown with dark gray mottling, Lean CLAY with sand (CL), mostly non to low plasticity fines (clay), few non plastic fines (silt), trace fine gravel, some sand	▨			☒	(13)
25		▨	494.0	SS-5	☒	4-6-11
	No Recovery	▨			☒	(0)
30		▨	489.0	SS-6	☒	10-13-14
	Fill: very stiff, moist, strong brown with grayish brown mottling, Clayey SAND with gravel (SC), mostly non plastic	▨			☒	(7)
35			484.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 9' / Casing advancer 9' to 100.5"
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Drilled using 3.5" solid stem auger to 9' then 3" casing advancer to 100.5'

REVIEWED BY: M. Bishop

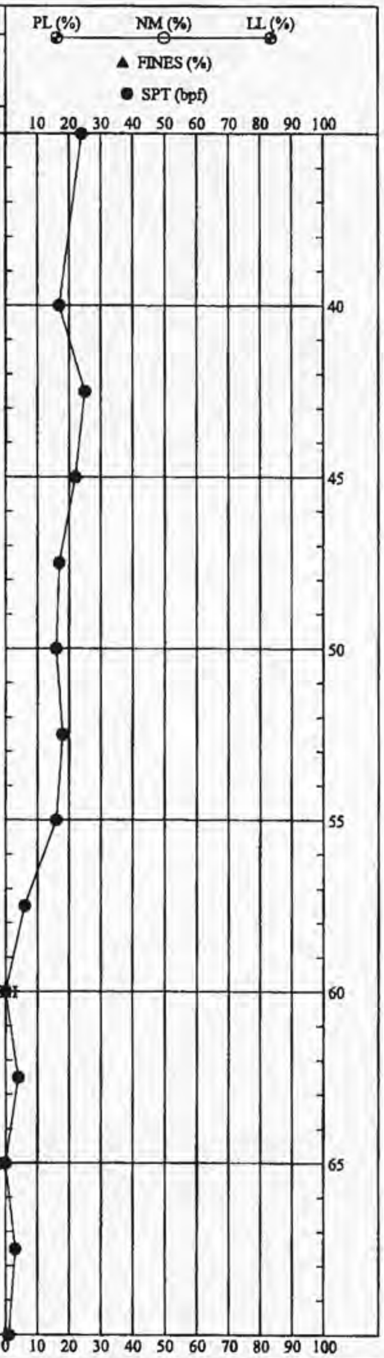
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/5/2014
COORD N: 510794 **COMP. DATE:** 11/6/2014
COORD E: 1472101 Page 1 of 3
LOCATION: East Bend Station, KY

BORING NO.: BA-6

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35	fines (silt), little some fine sand, trace fine gravel and non to low plasticity fines (clay)	484.0	SS-7	23-12-12
	Fill: very stiff, moist, brown with grayish brown mottling, Sandy lean CLAY (CL), mostly fine sand, little to some non plastic fines (silt), trace fine gravel			(13)
40		479.0	SS-8	6-8-9
	Fill: very stiff, moist, brown with dark gray mottling, Lean CLAY with sand (CL), mostly non plastic fines (silt), some fine sand, few non to low plasticity fines (clay), trace fine gravel			(16)
			SS-9	7-12-13
				(11)
45		474.0	SS-10	2-10-12
	trace black oxide nodules			(16)
			SS-11	6-8-9
				(13)
50		469.0	SS-12	4-6-10
	Alluvium: medium dense, moist, brown with dark gray, gray, reddish brown mottling, Clayey SAND (SC), mostly fine sand, some non to low plasticity fines (clay), few non plastice fines (silt), trace coarse gravel			(12)
			SS-13	6-8-10
	Alluvium: medium dense, moist, brown with light brown mottling, Lean CLAY with sand (CL), mostly fine sand, some non plastic fines (silt), trace to few non to low plasticity fines (clay)			(16)
55		464.0	SS-14	5-7-9
	loose, brown			(13)
			SS-15	3-3-3
	Alluvium: very loose, Sandy lean CLAY (CL), trace non to low plasticity fines (clay)			(13)
60		459.0	SS-16	WOH-WOH-WOH
	mostly fine to medium sand			(14)
			SS-17	2-1-3
	∇ Alluvium: very loose, wet, brown, Silty SAND (SM), mostly fine to medium sand, some non plastic fines (silt), trace non to low plasticity fines (clay)			(7)
65		454.0	SS-18	1-WOH-WOH
				(18)
			SS-19	1-1-2
				(14)
70		449.0		



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 9' / Casing advancer 9' to 100.5"
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Drilled using 3.5" solid stem auger to 9' then 3" casing advancer to 100.5'

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

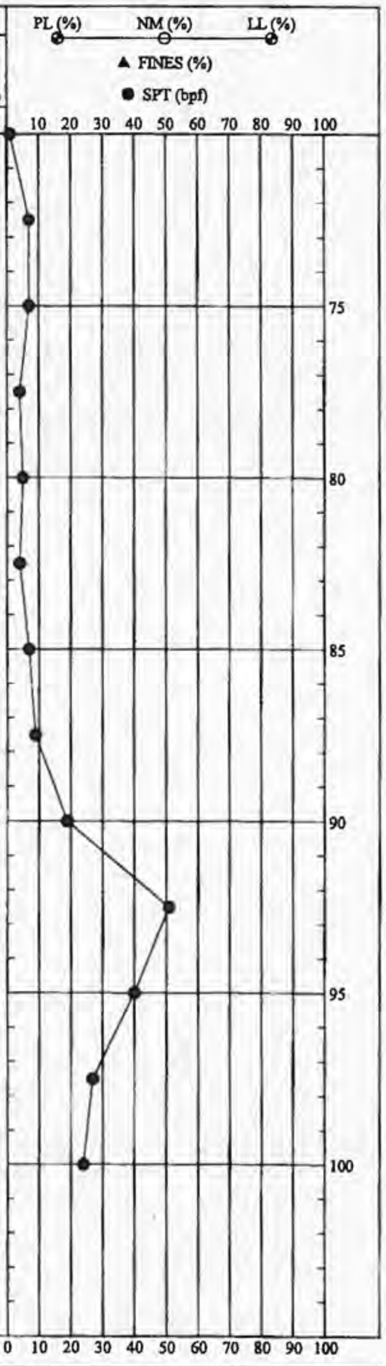
PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/5/2014
COORD N: 510794 **COMP. DATE:** 11/6/2014
COORD E: 1472101 **Page 2 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-6

amec

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70	Alluvium: very soft, wet, brown, Sandy lean CLAY (CL), mostly fine to medium sand, some non plastic fines (silt), trace non to low plasticity fines (clay)	449.0	SS-20	☒	1-WOH-1
			SS-21	☒	(13) 3-3-4
75	medium stiff	444.0	SS-22	☒	(18) 3-3-4
	soft, few non to low plasticity fines (clay)		SS-23	☒	(18) 1-2-2
80	medium stiff, trace few non to low plasticity fines (clay)	439.0	SS-24	☒	(13) WOH-2-3
	soft, dark gray, few non to low plasticity fines (clay)		SS-25	☒	(18) 2-2-2
85	medium stiff, dark gray with brown mottling, trace non to low plasticity fines (clay)	434.0	SS-26	☒	(14) 2-2-5
	Alluviuum, stiff, moist to wet, dark gray, Sandy lean CLAY (CL), mostly low plasticity fines (clay), few non plastic fines (silt), some fine to medium sand		SS-27	☒	(18) 2-4-5
90	very stiff, moist	429.0	SS-28	☒	(10) 5-10-9
	Alluviuum: medium dense, wet, brown with dark gray mottling, Silty SAND (SM), mostly fine to medium sand, some non plastic fines (silt)				
	Alluvium: very dense, wet, brown with trace dark gray mottling, Well graded SAND (SW), mostly fine to medium sand, trace fine to coarse gravel, trace non plastic fines (silt)		SS-29	☒	(11) 8-8-43
95	Alluviuum, dense, wet, brown with very dark gray gravel, Well graded GRAVEL (GW), mostly fine to coarse gravel, few fine to coarse sand, trace non plastic fines (silt)	424.0	SS-30	☒	(6) 21-26-14
	Alluvium: medium dense, wet, brown with reddish brown mottling, Well graded GRAVEL with sand (GW), mostly fine gravel, some fine to coarse sand		SS-31	☒	(6) 15-14-13
100	trace dark gray mottling	419.0	SS-32	☒	(10) 8-12-12
	Boring terminated at 100.5 feet				
105		414.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Solid stem to 9' / Casing advancer 9' to 100.5"
HOLE DIAMETER: 8" Solid stem / 3" Casing advancer

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Drilled using 3.5" solid stem auger to 9' then 3" casing advancer to 100.5'

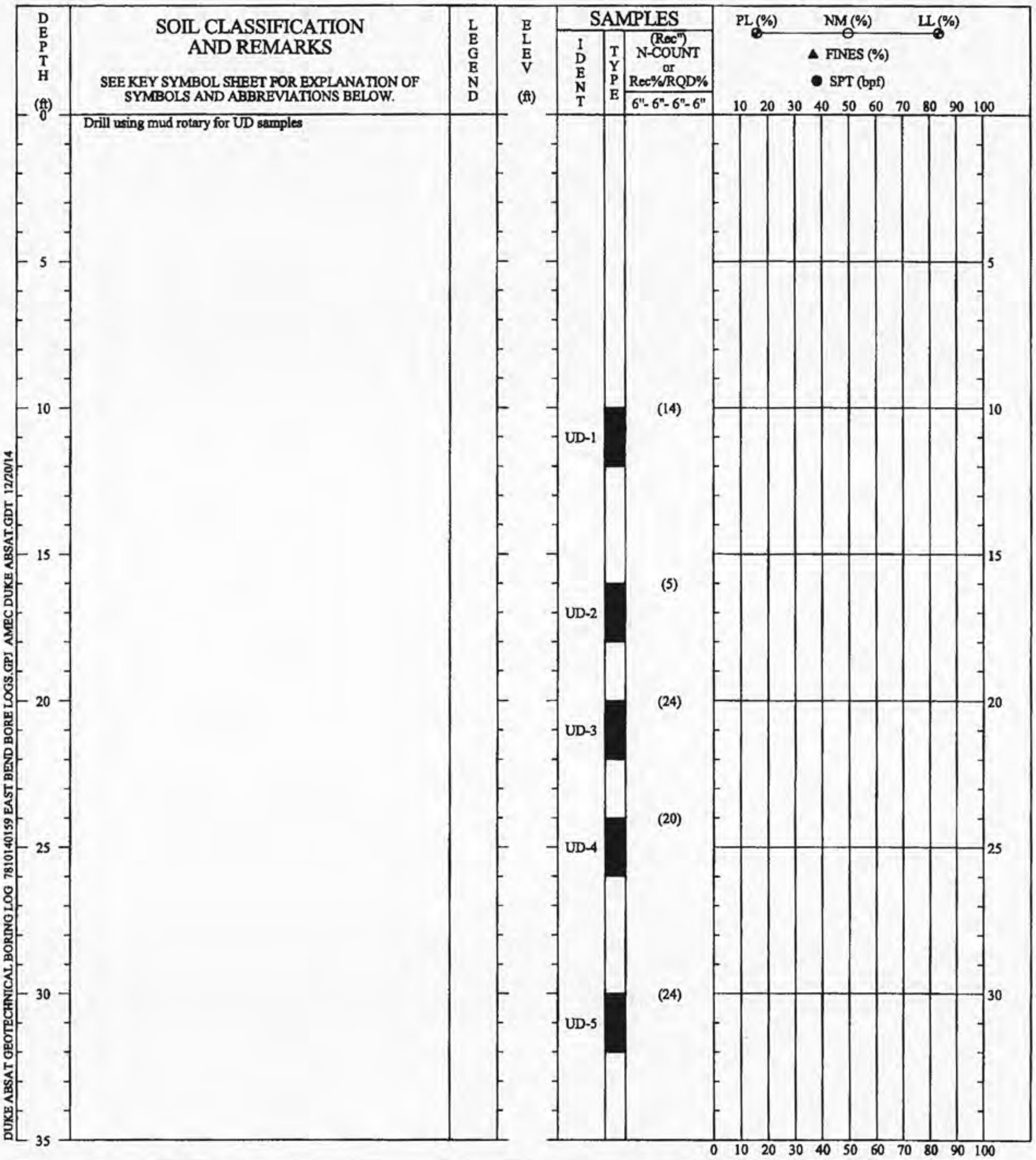
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/5/2014
COORD N: 510794 **COMP. DATE:** 11/6/2014
COORD E: 1472101 **Page** 3 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-6

amec



Drill using mud rotary for UD samples

IDENT	(Rec") N-COUNT or Rec%/RQD%
UD-1	(14)
UD-2	(5)
UD-3	(24)
UD-4	(20)
UD-5	(24)

CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: N. J. Smith
EQUIPMENT: Diedrich D-50
DRILL METHOD: Hollow stem auger
HOLE DIAMETER: 7"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/10/2014
COORD N: **COMP. DATE:** 11/10/2014
COORD E: **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-6A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
35	Drill using mud rotary for UD samples						
				UD-6	■	(24)	
40				UD-7	■	(24)	
				UD-8	■	(16)	
45	Vibrating wire piezometer installed at 45.0 feet						
				UD-9	■	(22)	
50							
55				UD-10	■	(12)	
				UD-11	■	(24)	
60							
65							
70							

0 10 20 30 40 50 60 70 80 90 100

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	N. J. Smith
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow stem auger
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/10/2014
COORD N: **COMP. DATE:** 11/10/2014
COORD E: **Page 2 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-6A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
70							
75	Vibrating wire piezometer installed at 75.0 feet						75
	Boring Terminated at 77.0 feet						
80							80
85							85
90							90
95							95
100							100
105							0 10 20 30 40 50 60 70 80 90 100

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	N. J. Smith
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow stem auger
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

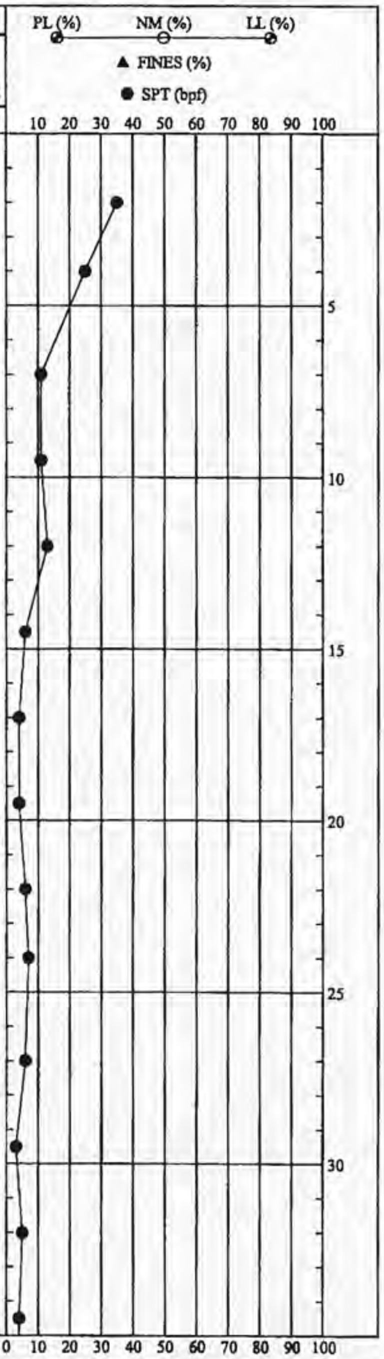
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/10/2014
COORD N: **COMP. DATE:** 11/10/2014
COORD E: **Page** 3 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-6A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Asphalt Pavement		472.0			
	Embankment Fill: dense, moist, brown, Poorly graded SAND with silt (SP-SM), mostly fine sand, few non plastic fines (silt)			SS-1	☒	(17) 8-15-20
	medium dense, reddish brown mottling			SS-2	☒	(18) 13-15-10
5			467.0			
	Alluvium: stiff, moist, brown, lean CLAY (CL), trace fine sand, mostly low plasticity fines Alluvium: stiff, moist, brown, lean CLAY (CL), trace fine sand, mostly low plasticity fines			SS-3	☒	(12) 3-5-6
	light gray mottling			SS-4	☒	(16) 4-5-6
10			462.0			
	trace black oxide nodules			SS-5	☒	(12) 3-5-8
	Alluvium: loose, moist, brown, Silty SAND (SM), mostly fine to medium sand, few non plastic fines (silt), trace black oxide nodules			SS-6	☒	(10) 3-3-3
15			457.0			
	very loose, wet, no black oxide nodules ∇			SS-7	☒	(11) 2-1-3
	trace black oxide nodules			SS-8	☒	(12) 2-2-2
20			452.0			
	loose			SS-9	☒	(5) 2-3-3
				SS-10	☒	(10) 3-3-4
25			447.0			
	trace non plastic fines (clay)			SS-11	☒	(12) 2-3-3
	Alluvium: very loose, wet, brown, Poorly graded SAND with silt (SP-SM), mostly fine to medium sand, few non plastic fines (silt), trace non plastic fines (clay)			SS-12	☒	(17) 2-1-2
30			442.0			
	loose			SS-13	☒	(18) 2-2-3
	Alluvium: very loose, wet, dark gray, Silty SAND (SM), mostly poorly graded fine to medium sand, little non plastic fines (silt), trace non plastic fines (clay)			SS-14	☒	(18) 1-2-2
35			437.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 10' / Mud rotary from 10' to 55'
HOLE DIAMETER:	8" Solid stem / 4" Mud rotary
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 16.0 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

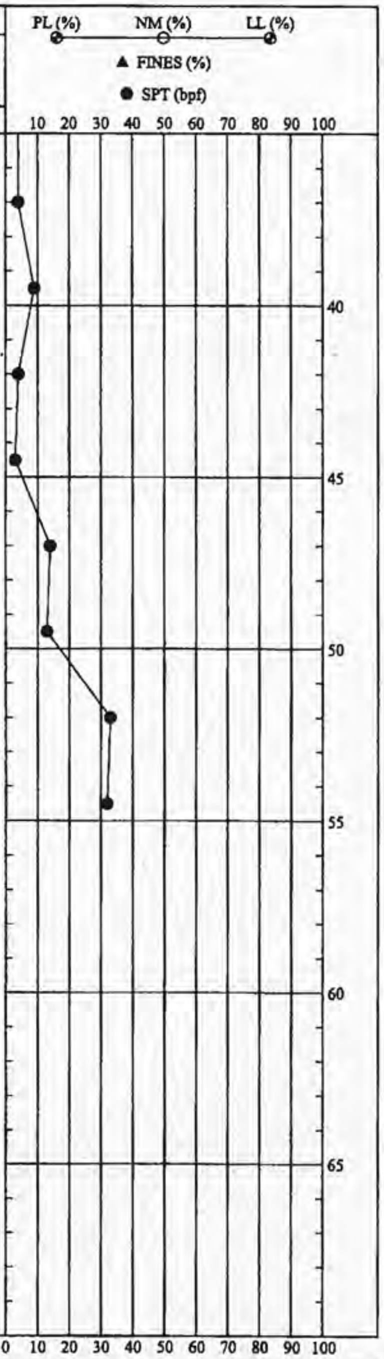
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/20/2014
COORD N: 510688 **COMP. DATE:** 10/20/2014
COORD E: 1472100 **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-7

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	(Rec")	N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35	little to some non plastic fines (silt)	437.0	SS-15	(18)	1-2-2
	loose, little non plastic fines (silt), trace non plastic fines (clay)		SS-16	(18)	2-3-6
40		432.0			
	very loose		SS-17	(14)	WOH-2-2
	Alluvium: soft, wet, dark gray, Sandy SILT (ML), fine to medium sand, mostly non plastic fines (silt), trace few non plastic fines (clay)		SS-18	(11)	2-1-2
45		427.0			
	Alluvium: medium dense, wet, dark gray with little brown mottling, Well graded SAND (SW), mostly fine to coarse sand, trace non plastic fines (silt), trace wood fragments		SS-19	(8)	4-8-6
	brown, trace wood fragments		SS-20	(13)	6-8-5
50		422.0			
	Alluvium: dense, wet, dark gray, Well graded SAND with gravel (SW), mostly fine to coarse sand, little fine gravel (granite, chert), trace non plastic fines (silt), subrounded-subangular gravel		SS-21	(12)	11-17-16
	some fine gravel (granite, chert)		SS-22	(12)	12-14-18
55	Boring terminated at 55.0 feet.	417.0			
60		412.0			
65		407.0			
70		402.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 10' / Mud rotary from 10' to 55'
HOLE DIAMETER:	8" Solid stem / 4" Mud rotary
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 16.0 ft bgs at time of drilling.

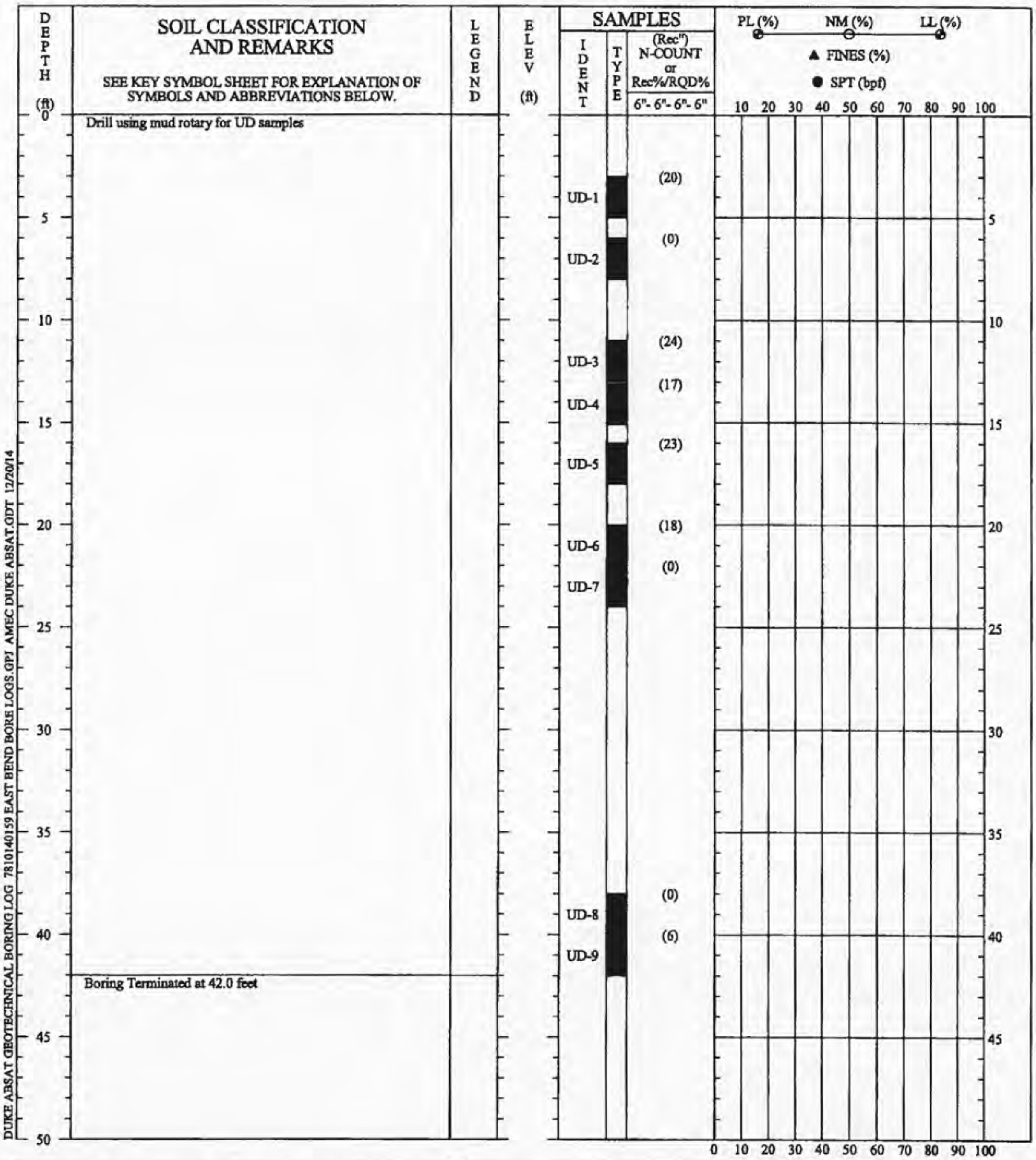
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/20/2014
COORD N: 510688 **COMP. DATE:** 10/20/2014
COORD E: 1472100 **Page 2 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-7

amec



Drill using mud rotary for UD samples

IDENT	(Rec") N-COUNT or Rec%/RQD%
UD-1	(20)
UD-2	(0)
UD-3	(24)
UD-4	(17)
UD-5	(23)
UD-6	(18)
UD-7	(0)
UD-8	(0)
UD-9	(6)

Boring Terminated at 42.0 feet

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	C. Seifert
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Boring advanced using mud rotary drilling to obtain relatively undisturbed (UD) thin-walled tube samples.

REVIEWED BY: M. Bishop

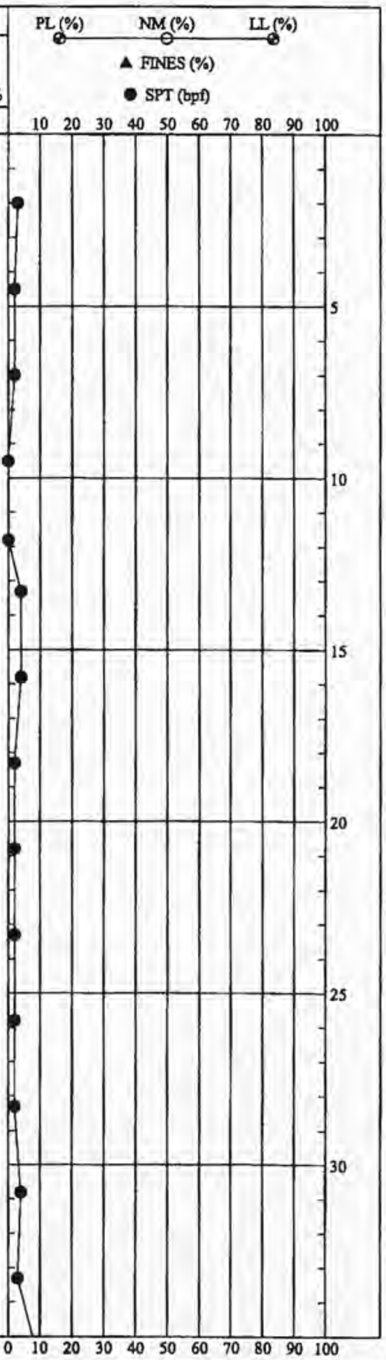
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/28/2014
COORD N: **COMP. DATE:** 10/28/2014
COORD E: **Page** 1 **of** 1
LOCATION: East Bend Station, KY

BORING NO.: BA-7A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0		461.0			
	Alluvium: soft, moist, dark brown, Elastic SILT (MH), little low plasticity fines, trace medium plasticity fines		SS-1	☒	(7) 2-1-2
	Alluvium: very soft, moist, dark brown to very dark gray, Fat CLAY (CH), trace low plasticity fines, mostly high plasticity fines		SS-2	☒	(6) WOH-1-1
5	∇	456.0			
	Alluvium: very loose, wet, brown, Silty SAND (SM), trace low plasticity fines		SS-3	☒	(11) WOH-1-1
			SS-4	☒	WOH (14)
10		451.0			
	Alluvium: very loose, wet, brown, Clayey SAND (SC), some medium plasticity fines		SS-5	☒	WOH (13)
	Alluvium: very loose, wet, brown, Silty SAND (SM), fine sand, little high plasticity fines, clay lens at 13 feet		SS-6	☒	(13) 1-2-2
15	no high plasticity fines, little non plastic fines	446.0	SS-7	☒	(11) WOT-2-2
	clay lenses throughout, less than 0.5 inch diameter		SS-8	☒	(16) 1-1-1
20	clay lens at 20.5 feet	441.0	SS-9	☒	(18) 1-1-1
	Alluviuum: very loose, wet, very dark gray, Poorly graded SAND (SP-SM), fine sand, little medium plasticity fines		SS-10	☒	(18) 1-1-1
25	Alluvium: soft, wet, dark gray, Fat CLAY (CH), mostly high plasticity fines	436.0	SS-11	☒	(18) WOH-1-1
			SS-12	☒	(18) WOH-1-1
30	Alluviuum: very loose, wet, dark gray, Silty SAND (SM), few high plasticity fines, clay lenses throughout	431.0	SS-13	☒	(18) 1-2-2
	Alluviuum: soft, wet, very dark gray, Fat CLAY (CH), mostly high plasticity fines, few fine sand		SS-14	☒	(18) WOH-1-2
35		426.0			(18)



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	C. Seifert
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 6.0 ft bgs at time of drilling.

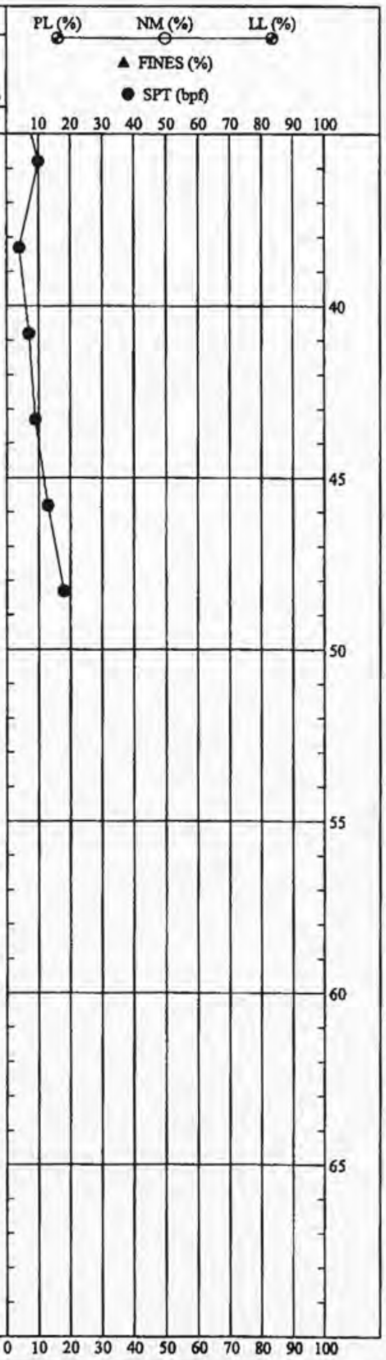
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/31/2014
COORD N: 510564 **COMP. DATE:** 10/31/2014
COORD E: 1472168 **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-8

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		426.0			
	Alluvium: loose, wet, dark gray, Silty SAND (SM), fine sand, little non plastic fines, trace low plasticity fines		SS-15	☒	1-5-5
					(18)
	very dark gray		SS-16	☒	WOT-2-2
					(11)
40		421.0			
	clay lens at 41.0 feet		SS-17	☒	2-3-4
	Alluvium: loose, wet, very dark gray, Well graded SAND (SW),fine to coarse sand, few gravel, few trace non plastic fines				(18)
			SS-18	☒	5-4-5
					(16)
45	medium dense, gravel	416.0			
			SS-19	☒	4-6-7
					(16)
			SS-20	☒	8-8-10
	Boring terminated at 48.8 feet				
50		411.0			
55		406.0			
60		401.0			
65		396.0			
70		391.0			



CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	C. Seifert
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 6.0 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

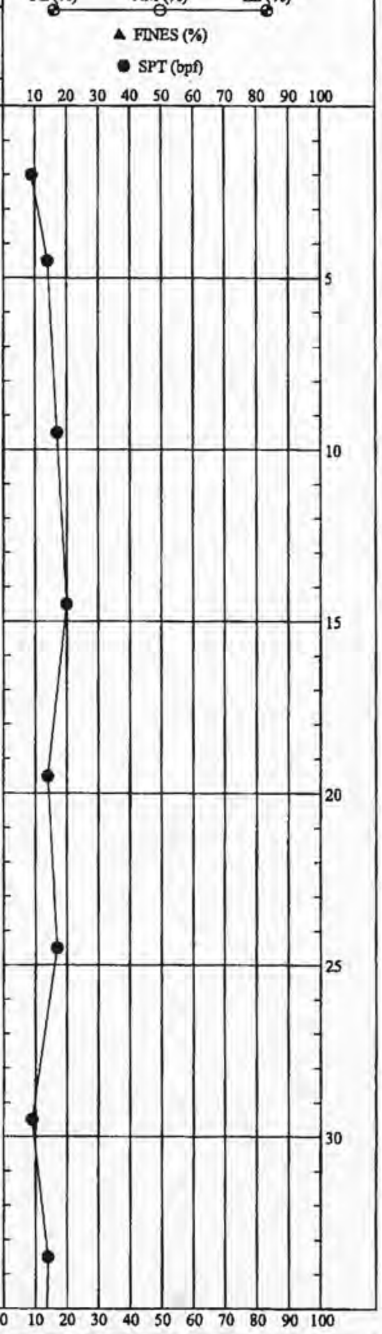
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/31/2014
COORD N: 510564 **COMP. DATE:** 10/31/2014
COORD E: 1472168 **Page** 2 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-8

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Fill	519.0		
	Fill: loose, moist, brown, Silty Sand (SM), mostly fine to medium sand, few fine gravel trace root fragments		SS-1	(14) 3-5-4
	Fill: medium dense, moist, brown with light gray mottling, Silty gravel with sand (GM), little non plastic fines, some fine to medium sand, mostly fine gravel, trace root fragments		SS-2	(14) 6-8-6
5		514.0		
	Fill: very stiff, moist, brown with dark gray mottling, Sandy lean CLAY with gravel (CL), mostly non plastic fines (clay), some fine sand, little fine gravel		SS-3	(18) 3-7-10
10		509.0		
	Fill: very stiff, moist, brown with dark brown , dark gray mottling, Sandy lean CLAY (CL), mostly non plastic fines, some fine sand, few fine gravel, trace root fragments		SS-4	(18) 3-10-10
15		504.0		
	stiff, dark grayish brown with brown mottling, trace fine gravel, trace non plastic fines (clay)		SS-5	(18) 4-6-8
20		499.0		
	very stiff, brown with dark grayish brown mottling, trace few non plastic fines (clay)		SS-6	(18) 5-7-10
25		494.0		
	Fill: stiff, moist, brown with trace gray mottling, Lean CLAY (CL), few fine sand, mostly low plasticity fines (clay), little non plastic fines (silt)		SS-7	(14) 3-3-6
30		489.0		
	Fill: stiff, moist, brown with dark grayish brown mottling, Lean CLAY with sand (CL), mostly non to low plasticity fines (clay), little non plastic fines (silt), little fine sand, trace fine gravel		SS-8	(18) 3-5-9
35		484.0		



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER: 8" Solid stem / 3" Casing advancer

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 66.5 ft bgs at time of drilling.

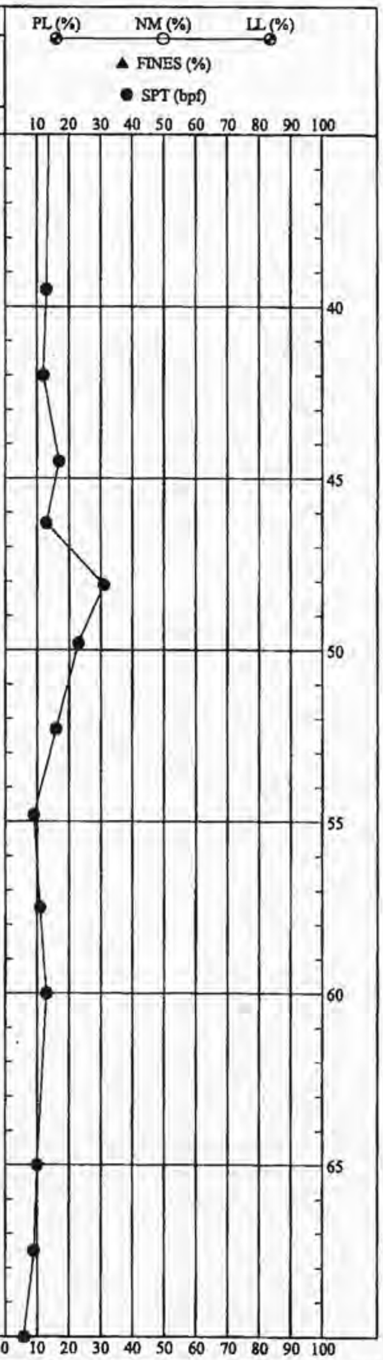
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-9

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		484.0			
	trace grayish brown mottling, few non plastic fines (silt), trace fine gravel		SS-9	☒	(16) 3-6-7
40		479.0			
	Fill: stiff, moist, brown, Sandy lean CLAY (CL), mostly non plastic fines (silt), little to some fine sand, trace non plastic fines (clay), trace black oxide nodules Fill: stiff, moist, brown, Sandy lean CLAY (CL), mostly non plastic fines (silt), little to some fine sand, trace non plastic fines (clay), trace black oxide nodules		SS-10	☒	(18) 3-5-7
	Fill: very stiff, moist, brown with trace gray mottling, Lean Clay (CL), mostly low plasticity fines (clay), little non plastic fines (silt), few fine sand, trace fine gravel		SS-11	☒	(18) 5-8-9
45		474.0			
	stiff, few non plastic fines (silt), trace fine sand and gravel		SS-12	☒	(11) 5-6-7
	Fill: hard, moist, brown with grayish brown mottling, Lean CLAY with sand (CL), mostly low plasticit fines (clay), little fine sand, trace fine gravel, trace roof fragments Fill: hard, moist, brown with grayish brown mottling, Lean CLAY with sand (CL), mostly low plasticit fines (clay), little fine sand, trace fine gravel, trace roof fragments		SS-13	☒	(17) 9-15-16
50	Fill: very stiff, moist, brown with dark grayish brown mottling, Lean CLAY (CL), mostly low plasticity fines (clay), few non plastic fines (silt), trace fine sand and gravel, trace roots	469.0	SS-14	☒	(18) 8-10-13
	Alluvium: very stiff , moist,brown with gray mottling, Lean CLAY (CL), mostly low plasticity fines (clay), few non plsatic fines (silt), trace fine sand		SS-15	☒	(14) 3-7-9
55	Alluvium: stiff, moist, brown, Silt with sand (ML), mostly non plsatic fines (silt), little fine sand, trace low plasticity fines (clay)	464.0	SS-16	☒	(14) 2-4-5
	Alluviuum: medium dense, moist brown, Well graded SAND with silt (SW-SM), mostly fine to medium sand, few non plastic fines (silt)		SS-17	☒	(10) 4-5-6
60		459.0	SS-18	☒	(8) 15-7-6
	driller missed interval		SS-19	☒	(NA) NA-NA-NA
	loose loose				
65		454.0	SS-20	☒	(6) 3-4-6
	▽ wet		SS-21	☒	(6) 4-4-5
	trace non to low plasticity fines (clay)			☒	(10)
70		449.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 66.5 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

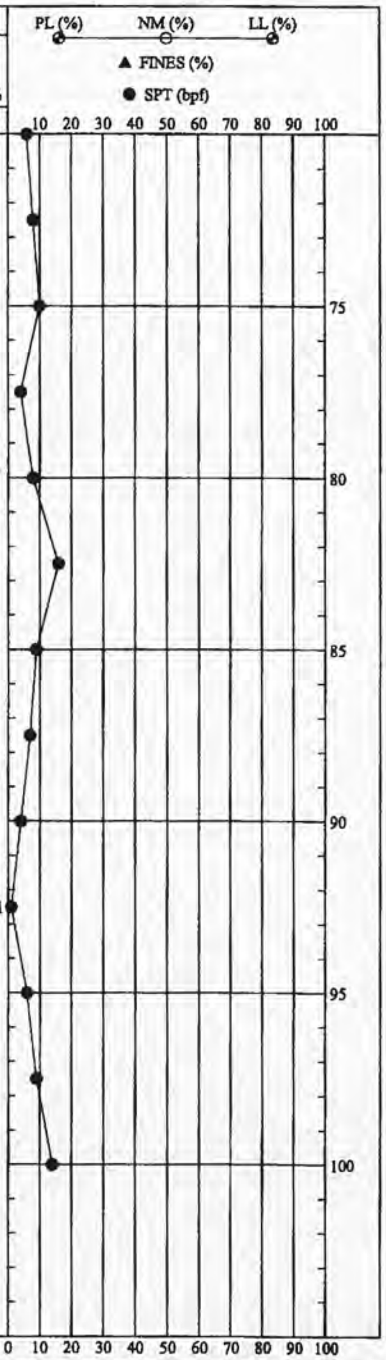
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page 2 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-9

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70		449.0	SS-22	3-3-3
			SS-23	(11) 1-1-7
75	little non plastic fines (silt)	444.0	SS-24	(10) 1-5-5
	Alluvium: very loose wet, brown, Silty SAND (SM), mostly fine to medium sand, little to some non plastic fines (silt), trace non to low plasticity fines (clay)		SS-25	(18) 2-2-2
80	loose	439.0	SS-26	(14) 3-3-5
	Alluvium: medium dense, wet, brown, Well graded SAND (SW), mostly fine to medium sand, trace coarse sand, trace few non plastic fines (silt)		SS-27	(10) 5-7-9
85	Alluvium: loose, wet, dark gray, Silty SAND (SM), mostly fine to medium sand, little to some non plastic fines (silt), trace non to low plasticity fines (clay)	434.0	SS-28	(13) 2-4-5
			SS-29	(14) 2-3-4
90	No Recovery	429.0	SS-30	(0) WOR-2-2
	Alluvium: very soft, moist, dark gray, Lean Clay (CL), few fine sand, mostly low plasticity fines (clay)		SS-31	(5) WOR-WOR-1
95	Alluvium: loose, wet, gray, Well graded SAND (GW), mostly fine to medium sand (trace coarse), trace few to non plastic fines (silt)	424.0	SS-32	(5) 3-3-3
	brown, mostly fine to coarse sand, trace fine gravel, trace non plastic fines (silt)		SS-33	(5) 1-4-5
100	medium dense, trace few fine gravel	419.0	SS-34	(8) 5-8-6
	Boring terminated at 100.5 feet			
105		414.0		



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 66.5 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

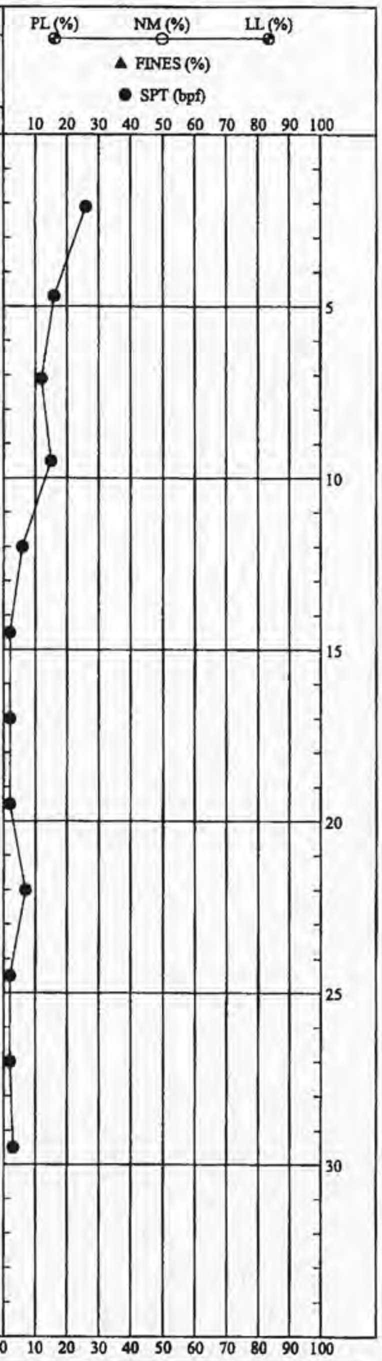
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page 3 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-9

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Asphalt and gravel subgrade	462.0			
	Fill: medium dense, dry, brown with light gray, light brown mottling, Well graded GRAVEL with sand (GW), little fine to coarse sand, trace non plastic fines		SS-1	☒	(16) 9-13-13
5	Alluvium: medium dense, dry, brown with light brown, light gray mottling, Well graded SAND with silt (SW-SM), fine to coarse sand, few non plastic fines, trace fine gravel	457.0	SS-2	☒	(10) 10-9-7
	Alluvium: medium dense, moist, brown, Silty SAND (SM), fine to medium sand, lillte non plastic fines, poorly graded sand		SS-3	☒	(13) 4-8-4
			SS-4	☒	(13) 4-7-8
10		452.0			
	▽ wet, brown		SS-5	☒	(10) 4-4-2
	Started charging augers with water to control heave		SS-6	☒	(14) WOR-1-1
15		447.0			
			SS-7	☒	(16) WOR-1-1
	trace low plasticity fines (clay)		SS-8	☒	(14) WOR-1-1
20		442.0			
	no low plasticity fines (clay) charging augers with water		SS-9	☒	(11) WOR-3-4
	Started charging augers with bentonite mud to control heave		SS-10	☒	(14) 1-1-1
25		437.0			
	dark gray mottling, trace low plasticity fines (clay)		SS-11	☒	(12) WOR-1-1
	Alluvium: soft, moist, dark gray, Silt with SAND (ML), little fine sand, mostly non to low plasticity fines		SS-12	☒	(11) 1-1-2
30	Boring terminated at 30.0 feet Boring offset and redrilled using mud rotary drilling in order to avoid heave of granular soils. (see boring BA-10C)	432.0			
35		427.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Hollow Stem Augers
HOLE DIAMETER: 7"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at about 11.0 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159
START DATE: 10/9/2014
COORD N: 510670
COMP. DATE: 10/9/2014
COORD E: 1473079
Page 1 **of** 1
LOCATION: East Bend Station, KY

BORING NO.: BA-10

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Drill using mud rotary for UD samples					
5						
				UD-1		(20)
10				UD-2		(0)
				UD-3		(12)
15	Piston sampler used			UD-4		(0)
	Piston sampler used			UD-5		(22)
20						
	Piston sampler used			UD-6		(0)
25	Piston sampler used			UD-7		(0)
				UD-8		(0)
	Piston sampler used			UD-9		(0)
30	Piston sampler used			UD-10		(24)
35	Piston sampler used			UD-11		(4)
	Boring Terminated at 36.0 feet					
40						
45						
50						

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

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	M. Bishop
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Boring advanced using mud rotary drilling to obtain relatively undisturbed (UD) thin-walled tube samples.

REVIEWED BY: M. Bishop

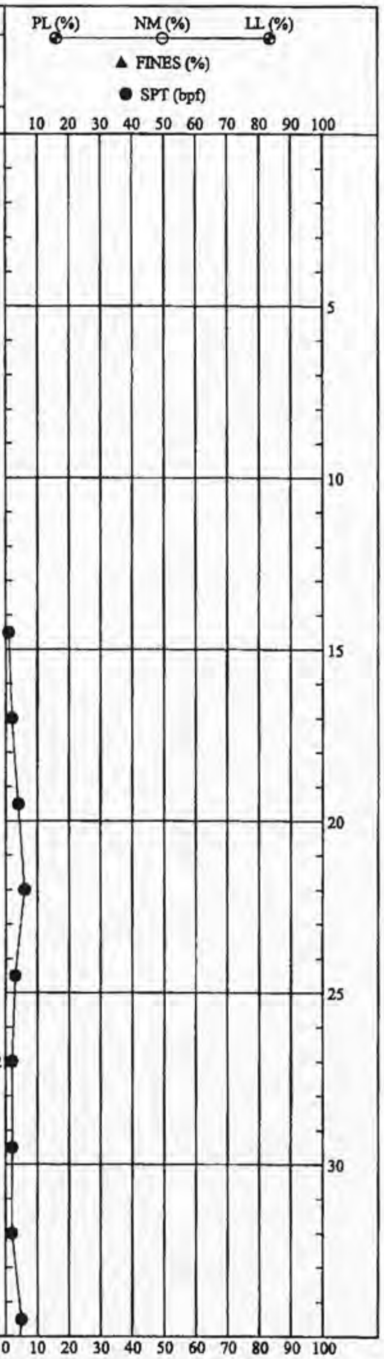
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/27/2014
COORD N: **COMP. DATE:** 10/27/2014
COORD E: Page 1 of 1
LOCATION: East Bend Station, KY

BORING NO.: BA-10A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Mud Rotary drilling	462.0			
5		457.0			
10	∇	452.0			
	Alluvium: very loose to loose, wet, brown, Silty SAND (SM), fine sand, few low plasticity fines (silt)		SS-13	☒	(12) 1-WOH-1
15		447.0			
			SS-14	☒	(12) 2-1-1
	trace dark gray mottling, trace low plasticity fines (clay)		SS-15	☒	(13) 1-1-3
20		442.0			
	no clay, no mottling		SS-16	☒	1-3-3
	very loose		SS-17	☒	(13) 2-2-1
25		437.0			
	dark gray		SS-18	☒	(18) WOR-WOH-2
			SS-19	☒	(18) 1-1-1
30		432.0			
	Alluvium:, very soft, wet, dark gray, Clayey SAND (SC), mostly low plasticity fines (silt), little fine sand, trace low plasticity fines (clay)		SS-20	☒	(12) 1-1-1
	medium stiff, some fine sand		SS-21	☒	(16) 1-1-4
35		427.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Mud Rotary
HOLE DIAMETER: 4"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Boring BA-10 was offset and mud rotary drilling was used to advance boring to target depth.

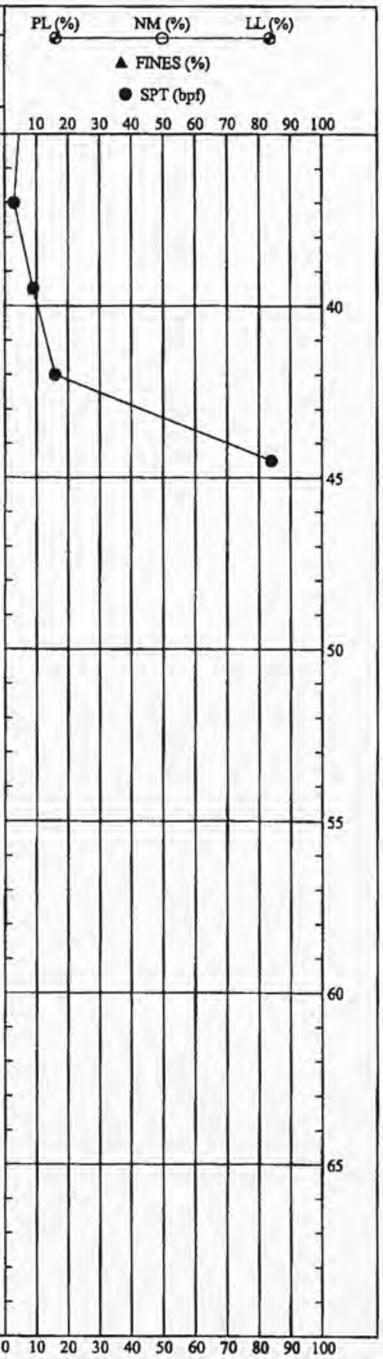
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/10/2014
COORD N: 510670 **COMP. DATE:** 10/13/2014
COORD E: 1473152 **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-10C

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35			427.0			
	soft, little fine sand, mostly low plasticity fines (silt), few low plasticity fines (clay)			SS-22	☒	(18) 1-1-2
	stiff, some fine to medium sand			SS-23	☒	(18) WOH-4-5
40			422.0			
	Alluvium: medium dense, wet, Well graded SAND (SW), fine to medium sand, trace non plastic fines (silt)			SS-24	☒	(12) 6-8-8
	very dense, few fine gravel (granite)			SS-25	☒	(6) 10-48-36
45	Boring terminated at 45.0 feet		417.0			
50			412.0			
55			407.0			
60			402.0			
65			397.0			
70			392.0			



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Mud Rotary
HOLE DIAMETER: 4"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Boring BA-10 was offset and mud rotary drilling was used to advance boring to target depth.

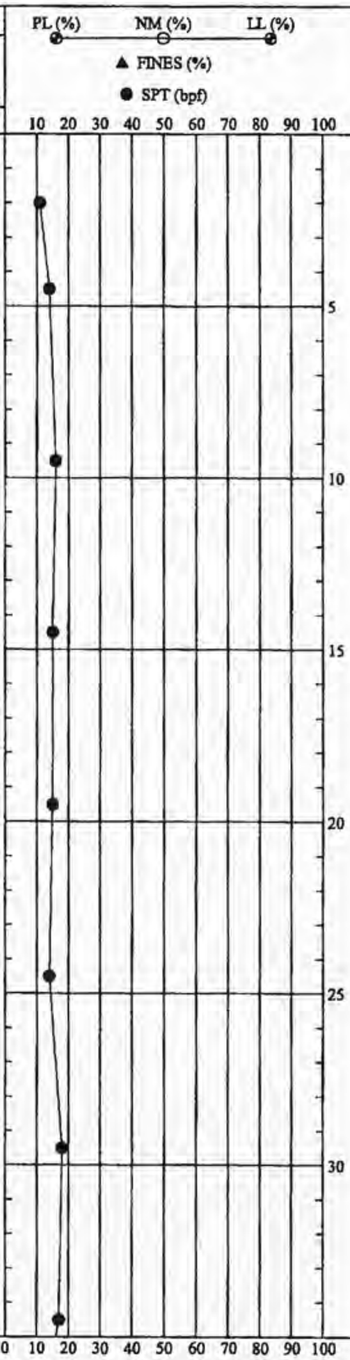
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/10/2014
COORD N: 510670 **COMP. DATE:** 10/13/2014
COORD E: 1473152 **Page 2 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-10C

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Fill: Gravel road base	519.0			
	Fill: stiff, moist, reddish brown with brown mottling, Lean CLAY (CL), little non plastic fines (silt), trace fine sand and gravel		SS-1	☒	(14) 3-5-6
	brown, trace silt, few gravel		SS-2	☒	(12) 6-8-6
5		514.0			
	Fill: medium dense, stiff, with dark brown mottling, Clayey SAND with gravel (SC)		SS-3	☒	(14) 2-7-9
10		509.0			
	No recovery		SS-4	☒	(0) 7-7-8
15		504.0			
	stiff, moist, very dark grayish brown with reddish brown, black organic mottling, Sandy lean CLAY (CL) mostly low to medium plasticity fines, trace few to fine gravel		SS-5	☒	(12) 7-8-7
20		499.0			
	trace fine gravel		SS-6	☒	(12) 8-8-6
25		494.0			
	very stiff, Sandy silty CLAY (CL-ML)		SS-7	☒	(7) 4-6-12
30		489.0			
	brown with reddish brown mottling, Sandy lean CLAY (CL), trace coal fragments		SS-8	☒	(12) 6-7-10
35		484.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Solid stem to 9' / Casing advancer 9' to 103'
HOLE DIAMETER: 8" Solid stem auger / 3" Casing advancer

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at about 84.0 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

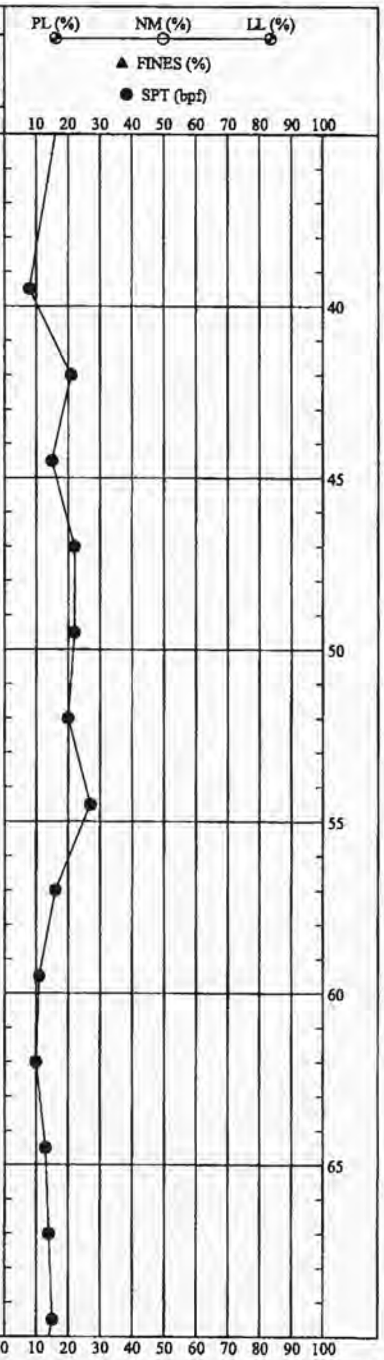
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159
START DATE: 10/22/2014
COORD N: 511244
COMP. DATE: 10/30/2014
COORD E: 1473524
Page 1 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-11

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD%	6"- 6"- 6"- 6"
35		484.0			
	medium stiff, with dark gray, reddish brown, black organic mottling, trace fine gravel		SS-9	(16)	3-3-5
40		479.0			
	very stiff, brown with reddish brown, black organic mottling, trace fine sand and gravel		SS-10	(11)	5-9-12
	Fill: stiff moist, brown with light brown, dark gray mottling, Lean CLAY with sand (CL), mostly low plasticity fines, trace fine sand		SS-11	(11)	6-7-8
45		474.0			
	very stiff, brown with trace dark gray mottling, mostly low to medium plasticity fines, no fine sand		SS-12	(16)	5-10-12
	very stiff, with dark gray mottling, Lean CLAY (CL),mostly low plasticity fines		SS-13	(17)	6-9-13
50		469.0			
	no mottling, trace black oxide nodules		SS-14	(17)	6-8-12
	Alluvium: medium dense, moist, dark gray, Silty SAND (SM), mostly fine to medium sand, little non plastic fines (silt), trace low plasticity fines (clay), few to little fine gravel		SS-15	(12)	6-12-15
55		464.0			
	few low plasticity fines (clay)		SS-16	(16)	11-10-6
	Alluvium: medium dense, moist, gray with reddish brown mottling, Clayey SAND (SC), mostly low to medium plasticity, few red iron water stained nodules, trace black oxide nodules		SS-17	(12)	4-5-6
60		459.0			
	dark brown, mostly low plasticity fines, no staining or oxide nodules		SS-18	(8)	9-5-5
	Alluvium: stiff, moist, gray with reddish brown mottling, Lean Clay (CL), mostly low to medium plasticity fines, few red iron water staining, trace black oxide nodules		SS-19	(11)	3-6-7
65		454.0			
			SS-20	(16)	3-5-9
			SS-21	(13)	4-5-10
70		449.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 9' / Casing advancer 9' to 103'
HOLE DIAMETER:	8" Solid stem auger / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 84.0 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

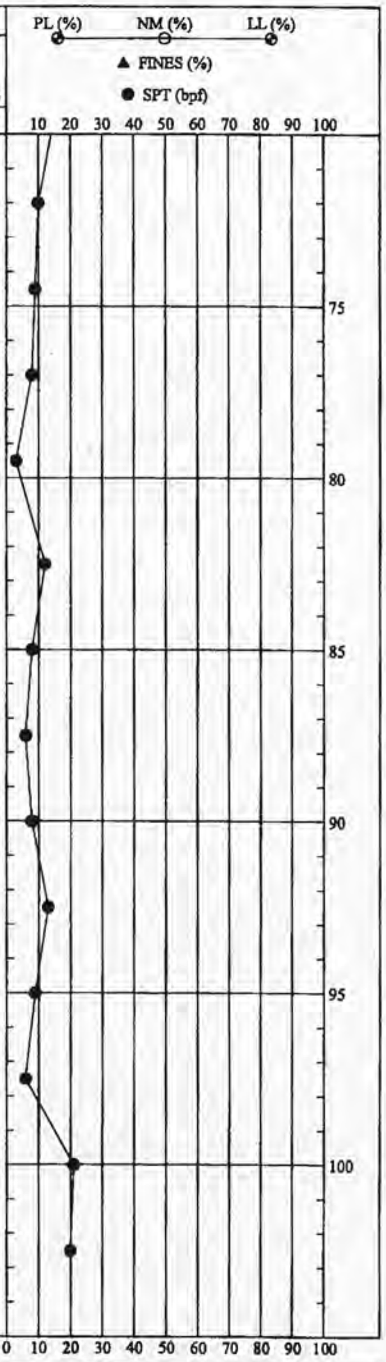
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/22/2014
COORD N: 511244 **COMP. DATE:** 10/30/2014
COORD E: 1473524 **Page 2 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-11

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70		449.0		
	strong brown with gray mottling, trace red iron water staining		SS-22	(14) 2-5-5
75	Alluvium: stiff, moist, brown, Sandy SILT (ML), little fine to coarse sand, mostly non plastic fines (silt), few fine gravel, trace non to low plasticity fines (clay)	444.0	SS-23	(10) 5-5-4
	Alluvium: medium stiff, moist, brown, Lean Clay (CL), trace fine sand, mostly low plastcity fines		SS-24	(5) 1-3-5
80	Alluvium: soft , moist, brown with gray mottling, Sandy lean CLAY (CL), little to some fine to medium sand, mostly low plasticity fines (clay), trace fine gravel	439.0	SS-25	(14) 2-1-2
	No Recovery		SS-26	(0) 3-6-6
85	▽ Alluvium: medium stiff, wet, dark gray with trace dark brown mottling, Sandy lean CLAY (CL), mostly fine to medium sand, little low plasticity fines (clay)	434.0	SS-27	(14) 5-4-4
	Alluvium: medium stiff, moist, dark gray, Sandy Lean CLAY (CL), mostly low plasticity fines, little fine sand		SS-28	(5) 2-3-3
90	Alluviuum: loose, wet, dark gray, Silty SAND (SM), mostly fine to medium sand, little low plasticity fines (clay), trace non plastic fines (silt)	429.0	SS-29	(18) 3-3-5
	medium dense, trace root/wood fragments		SS-30	(4) 4-7-6
95	Alluviuum: loose, wet, dark gray, Well graded SAND with silt (SW-SM), mostly fine to coarse sand, few non plastic fines (silt), few fine gravel, trace low plasticity fines (clay)	424.0	SS-31	(8) 4-4-5
	Alluviuum: loose, wet, dark gray, Well graded gravel with sand (GW), mostly fine to coarse gravel, little fine to coarse sand, trace non plastic fines (silt)		SS-32	(1) 1-3-3
100	medium dense	419.0	SS-33	(6) 7-11-10
	fine to coarse sand, no fines		SS-34	(8) 8-9-11
	Boring terminated at 103.0 feet			
105		414.0		



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Solid stem to 9' / Casing advancer 9' to 103'
HOLE DIAMETER:	8" Solid stem auger / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 84.0 feet bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/22/2014
COORD N: 511244 **COMP. DATE:** 10/30/2014
COORD E: 1473524 **Page** 3 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-11

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Drill using mud rotary for UD samples						
5							
				UD-1	■	(19)	
10							
15				UD-2	■	(7)	
20							
				UD-3	■	(20)	
25							
				UD-4	■	(20)	
30				UD-5	■	(22)	
35							

0 10 20 30 40 50 60 70 80 90 100

CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: D. Atkinson
EQUIPMENT: Diedrich D-50
DRILL METHOD: Mud Rotary
HOLE DIAMETER: 4"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/7/2014
COORD N: **COMP. DATE:** 11/7/2014
COORD E: **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-11A

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
35	Drill using mud rotary for UD samples						
				UD-6	■	(5)	
40							40
				UD-7	■	(23)	
45							45
				UD-8	■	(22)	
50							50
55							55
				UD-9	■	(23)	
60							60
65				UD-10	■	(16)	65
	Boring Terminated at 66.0 feet						
70							0 10 20 30 40 50 60 70 80 90 100

DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR: S & ME/B. Scheiderer
LOGGED BY: D. Atkinson
EQUIPMENT: Diedrich D-50
DRILL METHOD: Mud Rotary
HOLE DIAMETER: 4"

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS:

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

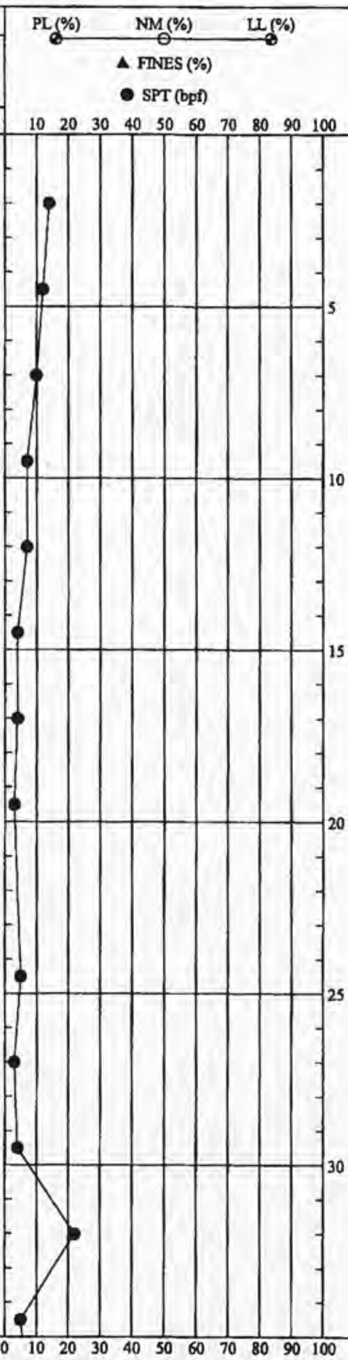
PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 11/7/2014
COORD N: **COMP. DATE:** 11/7/2014
COORD E: **Page** 2 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-11A

amec

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Topsoil	466.0			
	Alluvium: stiff, dry, dark reddish brown, Sandy CLAY (CL)		SS-1	☒	(13) 6-7-7
	Alluvium: stiff, dry, dark reddish brown, Lean CLAY with sand (CL)		SS-2	☒	(13) 5-6-6
5		461.0			
	Alluvium: stiff, moist, brown, Sandy lean CLAY (CL)		SS-3	☒	(15) 4-5-5
	medium stiff, increasing sand content from S-3		SS-4	☒	(18) 2-3-4
10		456.0			
			SS-5	☒	(18) 2-3-4
	Alluvium: soft, moist to wet, brown, Sandy SILT (ML) transition to silty sand (SM)		SS-6	☒	(18) 1-2-2
15		451.0			
	Alluvium: very loose, wet, brown, Silty SAND (SM) ▽		SS-7	☒	(16) 1-2-2
			SS-8	☒	(18) WOH-2-1
20		446.0			
	started charging augers with water.		SS-9	☒	(18) WOH
	loose		SS-10	☒	(18) 1-2-3
25		441.0			
	Alluvium: very loose, wet, brown, Clayey SAND (SC), few quartz sand particles gray and reddish yellow		SS-11	☒	(18) 1-1-2
	Alluvium: very loose, wet, brown, Silty SAND (SM) Alluvium: very loose, wet, gray, Clayey SAND (SC)		SS-12	☒	(18) 1-2-2
30		436.0			
	medium dense, brown				
	Alluvium: medium dense, wet, gray to reddish yellow, Poorly graded SAND (SP), a layer of leaves and a layer of gravels.		SS-13	☒	(18) 8-14-8
	Alluvium: loose, wet, brown, Silty SAND (SM) added drilling mud inside augers		SS-14	☒	(15) 2-2-3
35		431.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	M. Bishop
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow Stem Auger
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 17.0 feet bgs at time of drilling.

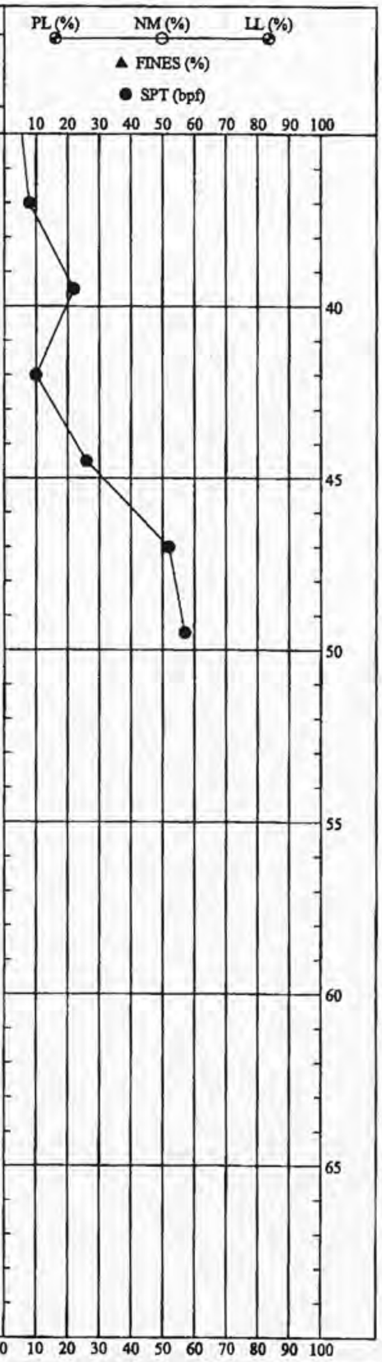
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/9/2014
COORD N: 511197 **COMP. DATE:** 10/9/2014
COORD E: 1473663 **Page** 1 **of** 2
LOCATION: East Bend Station, KY

BORING NO.: BA-12

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35	gray		431.0	SS-15	☒	(13) 5-3-5
	Alluvium: medium dense, wet, gray to very dark gray, organics with Sand, layers of deposited leaves			SS-16	☒	(15) 5-9-13
40	Alluvium: loose, wet, gray, Poorly graded SAND (SP)		426.0	SS-17	☒	(17) 4-4-6
				SS-18	☒	(18) 3-10-16
45	Alluvium: medium dense, wet, gray to white, Well graded gravel with sand (GW)		421.0	SS-19	☒	(18) 19-26-26
	very dense, sand and gravel layers mixed throughout			SS-20	☒	(18) 17-26-31
50	Boring terminated at 50.0 feet		416.0			
55			411.0			
60			406.0			
65			401.0			
70			396.0			



DUKE ABSAT GEOTECHNICAL BORING LOG 7810140159 EAST BEND BORE LOGS.GPJ AMEC DUKE ABSAT.GDT 12/20/14

CONTRACTOR:	S & ME/B. Scheiderer
LOGGED BY:	M. Bishop
EQUIPMENT:	Diedrich D-50
DRILL METHOD:	Hollow Stem Auger
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 17.0 feet bgs at time of drilling.

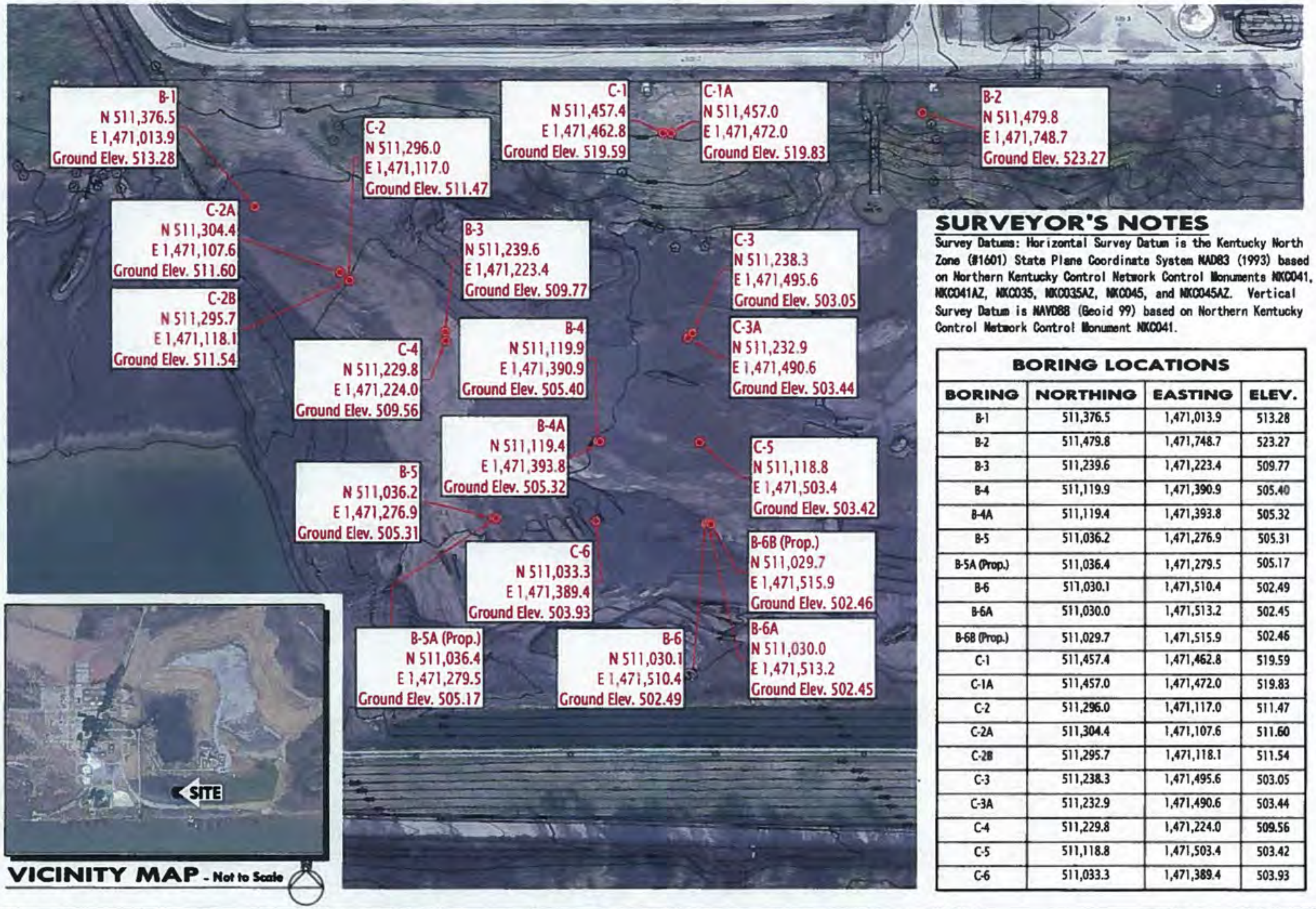
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/9/2014
COORD N: 511197 **COMP. DATE:** 10/9/2014
COORD E: 1473663 **Page 2 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-12

Appendix C
Boring Logs – Amec Foster Wheeler Subsurface Investigation (2016)



VICINITY MAP - Not to Scale

SURVEYOR'S NOTES

Survey Datums: Horizontal Survey Datum is the Kentucky North Zone (#1601) State Plane Coordinate System NAD83 (1993) based on Northern Kentucky Control Network Control Monuments NKC041, NKC041AZ, NKC035, NKC035AZ, NKC045, and NKC045AZ. Vertical Survey Datum is NAVD88 (Geoid 99) based on Northern Kentucky Control Network Control Monument NKC041.

BORING LOCATIONS

BORING	NORTHING	EASTING	ELEV.
B-1	511,376.5	1,471,013.9	513.28
B-2	511,479.8	1,471,748.7	523.27
B-3	511,239.6	1,471,223.4	509.77
B-4	511,119.9	1,471,390.9	505.40
B-4A	511,119.4	1,471,393.8	505.32
B-5	511,036.2	1,471,276.9	505.31
B-5A (Prop.)	511,036.4	1,471,279.5	505.17
B-6	511,030.1	1,471,510.4	502.49
B-6A	511,030.0	1,471,513.2	502.45
B-6B (Prop.)	511,029.7	1,471,515.9	502.46
C-1	511,457.4	1,471,462.8	519.59
C-1A	511,457.0	1,471,472.0	519.83
C-2	511,296.0	1,471,117.0	511.47
C-2A	511,304.4	1,471,107.6	511.60
C-2B	511,295.7	1,471,118.1	511.54
C-3	511,238.3	1,471,495.6	503.05
C-3A	511,232.9	1,471,490.6	503.44
C-4	511,229.8	1,471,224.0	509.56
C-5	511,118.8	1,471,503.4	503.42
C-6	511,033.3	1,471,389.4	503.93

BAUMANN LAND SURVEY, INC.
2300 MONTANA AVE. SUITE 103
CINCINNATI, OHIO 45211
513.860.3999
WWW.BAUMANNLSI.COM

WARNING 811

The location of all utilities and underground structures shown are approximate and are not necessarily all of the existing utilities and structures. It is the contractor's responsibility to determine the exact location and existence of all utilities and underground structures.

~SKETCH~
BORING LOCATIONS
(SURVEYED 03.02.2016)
DUKE ENERGY - EAST BEND GENERATING STATION
BOONE COUNTY, KENTUCKY
PREPARED FOR AMEC-FOSTER WHEELER

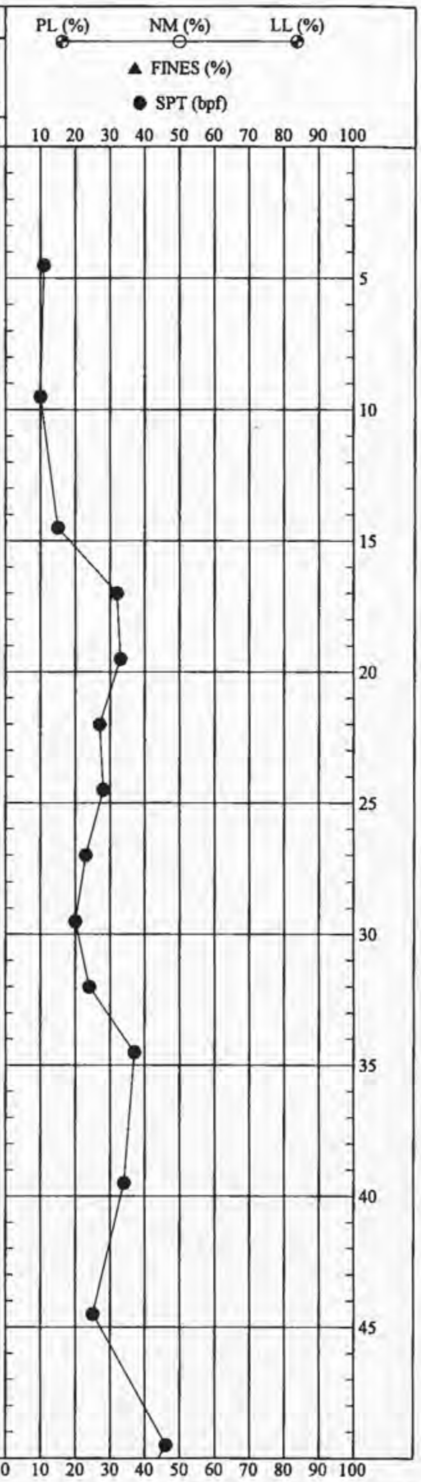
DRAWING: 13571
PROJECT: 22316
DATE: 03.03.2016
REVISION:

0 SCALE 1"=100' 100

North Based on Kentucky North Zone State Plane Coordinate System NAD83 (1993) NAVD88

1
1

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	ASH FILL: Dark Brown-Gray, with Orange-Tan **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Dry	513.3			
5		508.3	SS-1	☒	(1.1) 2-6-5
	ALLUVIAL: Tan and Brown, Gravelly, Coarse to Fine **SAND** (SW), Moist Wet ~8 ft bgs ▽				
10		503.3	SS-2	☒	(0) WOH-6-4
			UD-1	■	(0)
15	Red-Brown and Yellow-Orange-Tan Mottled Coloring ~14.7 to 15 ft bgs	498.3	SS-3	☒	(1.2) 7-6-9
			SS-4	☒	(1.1) 8-12-20
20		493.3	SS-5	☒	(1.1) 2-15-18
			SS-6	☒	(1) 3-13-14
25		488.3	SS-7	☒	(1.2) 2-13-15
			SS-8	☒	(1.1) 2-10-13
30		483.3	SS-9	☒	(0.9) 2-11-9
			SS-10	☒	(1.2) 3-12-12
35		478.3	SS-11	☒	(1.3) 3-14-23
40		473.3	SS-12	☒	(1.3) 4-17-17
45		468.3	SS-13	☒	(1.3) 4-12-13
50		463.3	SS-14	☒	(1.4) 5-23-23



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was Dry to ~40 ft bgs

REVIEWED BY: ____________________

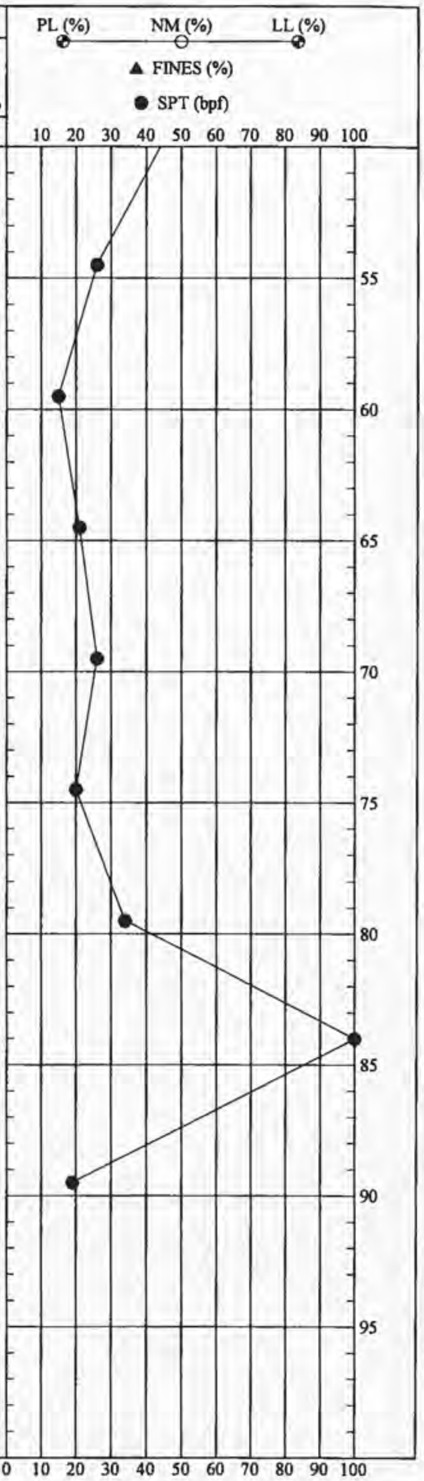
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/22/2016
COORD N: 511377 **COMP. DATE:** 2/22/2016
COORD E: 1471014 **Page** 1 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-1

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan and Brown, Gravelly, Coarse to Fine **SAND** (SW), Moist	463.3		
			SS-15	(1.3) 4-14-12
55		458.3		
	Very Wet ~57 ft bgs and Gravelly, Coarse to Medium **SAND**			
			SS-16	(1.4) 3-6-9
60		453.3		
			SS-17	(1.5) 10-9-12
65	Lense of Fine **SAND** ~64.5 to 64.7 ft bgs	448.3		
			SS-18	(1.5) 9-16-10
70		443.3		
			SS-19	(1.5) 36-12-8
75		438.3		
	Gravelly Coarse to Fine **SAND**			
			SS-20	(1.5) 29-20-14
80		433.3		
			SS-21	(0.5) 50/5.5
85		428.3		
			SS-22	(1.4) 41-9-10
90	**Boring Terminated at 90 ft bgs**	423.3		
95		418.3		
100		413.3		



CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was Dry to ~40 ft bgs

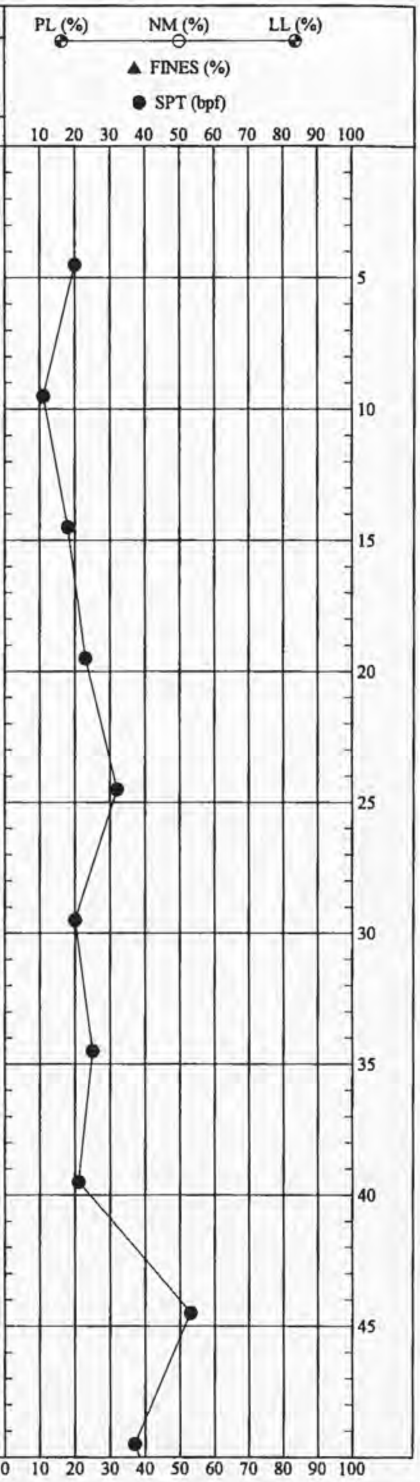
REVIEWED BY: ____________________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/22/2016
COORD N: 511377
COMP. DATE: 2/22/2016
COORD E: 1471014
Page 2 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-1

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Grass/Topsoil ALLUVIAL: Tan-Brown, Medium to Fine **SAND** with Gravel (SW), Moist	523.3			
5		518.3	SS-1		(1.3) 4-10-10
10		513.3	SS-2		(1.1) 2-6-5
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Moist to Dry				
15		508.3	SS-3		(0.9) 1-6-12
20		503.3	SS-4		(1.1) 6-13-10
25		498.3	SS-5		(1.2) 8-17-15
30		493.3	SS-6		(0.9) 3-9-11
35		488.3	SS-7		(1.1) 5-13-12
40		483.3	SS-8 BULK-1		(1.0) 7-10-11
45		478.3	SS-9		(0.3) 8-26-27
50	Slighlty Less Gravel ~47 to 52 ft bgs	473.3	SS-10		(1.2) 4-16-21



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~67 ft bgs; 24-hr Water Level was ~51.6 ft bgs

REVIEWED BY: ____________________

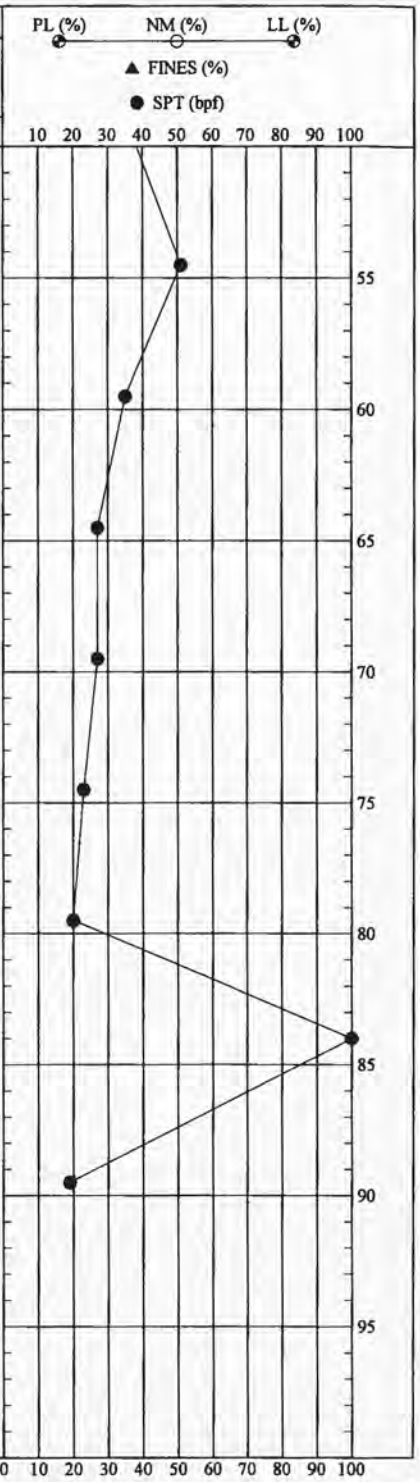
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/25/2016
COORD N: 511480 **COMP. DATE:** 2/25/2016
COORD E: 1471749 **Page** 1 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-2

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Moist to Dry ▼	473.3			
			SS-11	☒	(1.3) 8-22-29
55		468.3			
			SS-12	☒	(1.3) 2-14-21
60		463.3			
	Slightly Less Gravel and Moist ~62 to 67 ft bgs				
			SS-13	☒	(1.4) 3-10-17
65		458.3			
	▽ ALLUVIAL: Tan-Brown, Coarse to Fine Sandy **GRAVEL** (GW), Wet				
			SS-14	☒	(1.5) 6-13-14
70		453.3			
			SS-15	☒	(1.5) 18-12-11
75		448.3			
			SS-16	☒	(1.5) 24-13-7
80		443.3			
			SS-17	☒	(0.5) 50/5.5
85		438.3			
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet				
			SS-18	☒	(0.9) 24-8-11
90	**Boring Terminated at 90 ft bgs**	433.3			
95		428.3			
100		423.3			



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR: S&ME, Inc. (B. Hoskins)
LOGGED BY: C. Murphy
EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~67 ft bgs; 24-hr Water Level was ~51.6 ft bgs

REVIEWED BY: ______________

GEOTECHNICAL BORING RECORD

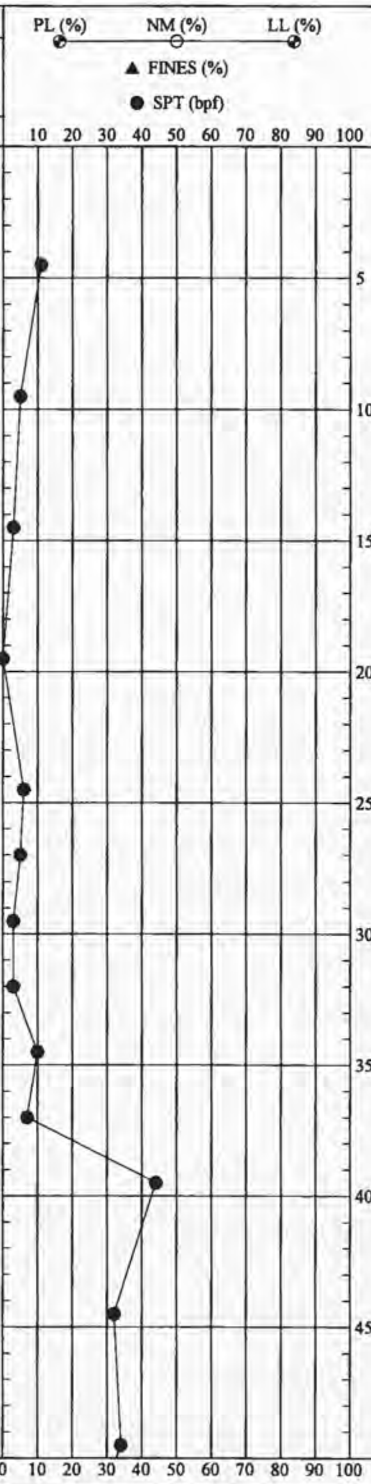
PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
COORD N: 511480
COORD E: 1471749
LOCATION: Union, Kentucky

START DATE: 2/25/2016
COMP. DATE: 2/25/2016
Page 2 of 2

BORING NO.: B-2

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	ASH FILL: Dark Brown-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Dry	509.8		
			SS-1	(1.1) WOR-5-6
5		504.8		
	▼ Wet and Yellow-Orange-Tan "Rust" Color with the Dark-Brown-Gray ~8 ft bgs			
			SS-2	(0.9) WOR-2-3
10		499.8		
			SS-3	(1.3) 1-2-1
15		494.8	BULK-1	
	FILL: Tan, Fine to Very Fine **SAND** (SM), Wet			
			SS-4	(1.5) 2-WOH-WOH
20	FILL: Tan and Black Laminated, Slightly Clayey, **SILT** (ML) with Minor Fine to Very Fine Sand Lenses, Wet	489.8		
	FILL: Light Tan-Gray, Silty, Fine to Very Fine **SAND** (SM)			
			UD-1	(1.3)
			SS-5	(1.2) 4-3-3
25		484.8		
	ASH FILL: Dark Brown-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet			
			SS-6	(1.2) WOR-2-3
	ALLUVIAL: Very Dark Gray, Slightly Clayey, Silty, Fine to Very Fine **SAND** (ML) with Trace Organics, Wet		SS-7	(1.3) 1-1-2
30		479.8		
	ALLUVIAL: Red-Tan, Silty, Clayey, Fine **SAND** (SC), Wet			
	ALLUVIAL: Red-Tan, Silty, Fine to Very Fine **SAND** (SM), Wet		SS-8	(1.0) 1-1-2
	ALLUVIAL: Red-Tan, White, Slightly Clayey, Gravelly, Fine **SAND** (GC), Wet			
			SS-9	(0.5) WOR-4-6
35		474.8		
			SS-10	(0.9) WOR-3-4
	ALLUVIAL: Tan-Brown, Fine **SAND** (SM), Wet			
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet Some Clayey Lenses and Sand Becomes More Coarse with Depth ~38 to 55 ft bgs			
			SS-11	(0.9) 7-21-23
40		469.8		
			SS-12	(0.9) 10-13-19
45		464.8		
			SS-13	(1.2) 8-15-19
50		459.8		



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~8 ft bgs

REVIEWED BY: ____________________

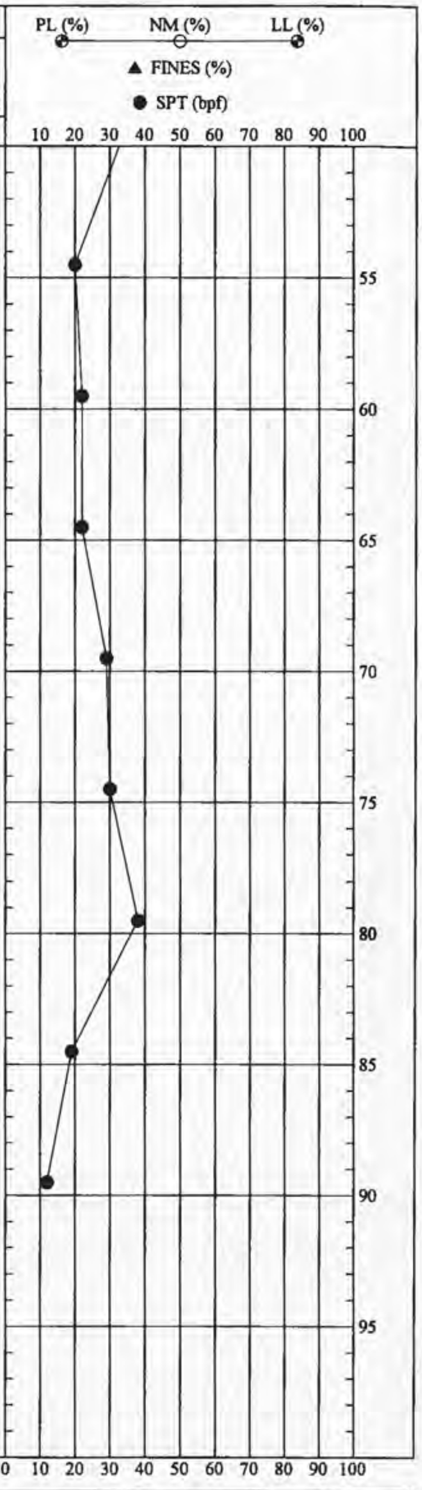
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/18/2016
COORD N: 511240 **COMP. DATE:** 2/19/2016
COORD E: 1471223 **Page 1 of 2**
LOCATION: Union, Kentucky

BORING NO.: B-3

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet	459.8			
55		454.8	SS-14	☒	(1.1) 8-9-11
60		449.8	SS-15	☒	(1.5) 5-10-12
	ALLUVIAL: Tan-Brown, Coarse to Fine, Sandy **GRAVEL** (GW), Wet				
65		444.8	SS-16	☒	(1.2) 6-9-13
70		439.8	SS-17	☒	(1.4) 6-13-16
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet				
75		434.8	SS-18	☒	(1.5) 8-14-16
80		429.8	SS-19	☒	(1.5) 17-20-18
85		424.8	SS-20	☒	(1.4) 21-15-4
90		419.8	SS-21	☒	(0.8) 28-8-4
	Boring Terminated at 90 ft bgs				
95		414.8			
100		409.8			



CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~8 ft bgs

REVIEWED BY: ______________________

GEOTECHNICAL BORING RECORD

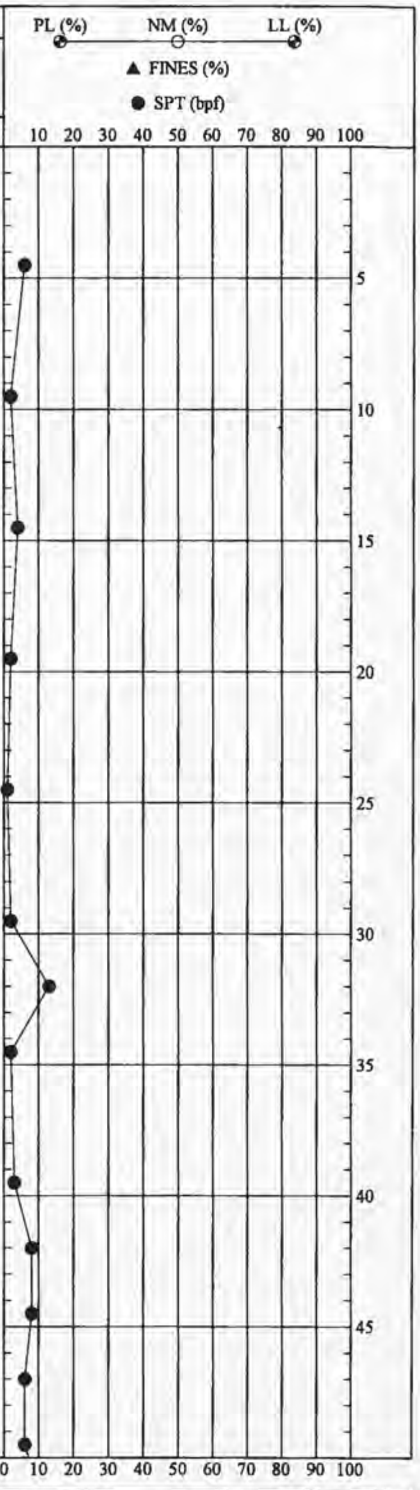
PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/18/2016
COORD N: 511240 **COMP. DATE:** 2/19/2016
COORD E: 1471223 **Page 2 of 2**
LOCATION: Union, Kentucky

BORING NO.: B-3

amec foster wheeler

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"-6"-6"-6"
0	ASH FILL: Dark Gray-Brown and Yellow-Orange-Tan "Rust" Colored **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Dry	505.4			
	▼		SS-1	☒	(1.2) 1-3-3
5		500.4			
	▽ Wet ~8 ft bgs		SS-2	☒	(1.1) 1-1-1
10		495.4	UD-1	■	(1.85)
	ASH FILL: Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND**, Wet Yellow-Orange-Tan "Rust" Colored Lense ~14.2 ft bgs Bottom Ash Lense ~14.2 to 14.4 ft bgs		SS-3	☒	(1.5) WOH-2-2
15		490.4			
	Lense Classifying as **SILT** (MH) ~18.5 to 19 ft bgs		SS-4	☒	(1.5) WOH-1-1
20	ASH FILL: Dark Tan-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet	485.4			
			SS-5	☒	(1.5) 1-WOH-1
25	ASH FILL: Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND**, Wet	480.4	BULK-1		
			UD-2	■	(1.8)
	ASH FILL: Dark Tan-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet		SS-6	☒	(1.5) 2-1-1
30		475.4			
			SS-7	☒	(1.5) 1-1-12
	ALLUVIAL: Red-Tan, Tan, Slightly Clayey, Silty, Fine **SAND** (SM), Moist		SS-8	☒	(0.6) 1-WOH-2
35	ALLUVIAL: Yellow-Red-Tan and Tan Mottled, Silty **CLAY** (CL), Wet	470.4	UD-3	■	(2.0)
	ALLUVIAL: Yellow-Red-Tan and Tan Mottled, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet				
	ALLUVIAL: Red-Brown, Silty **CLAY** (CH), Wet		SS-9	☒	(1.5) 2-1-2
40	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet	465.4			
			SS-10	☒	(1.5) 2-4-4
	ALLUVIAL: Red-Brown, Slightly Clayey, Silty, Fine **SAND** (SM) with Mica, Wet				
	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet		SS-11	☒	(1.2) 2-3-5
45	ALLUVIAL: Red-Brown, Slightly Clayey, Silty, Fine **SAND** (SM) with Mica, Wet	460.4			
			SS-12	☒	(1.3) 1-1-5
	ALLUVIAL: Red-Brown, Silty **CLAY** (CH), Wet				
	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC),		SS-13	☒	(1.5) 1-3-3
50		455.4			



CONTRACTOR: S&ME, Inc. (B. Hoskins)
LOGGED BY: C. Murphy
EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~8 ft bgs; 24-hr Water Level was 13.7 ft bgs; On 2/25/16 Water Level Was ~4 ft bgs

REVIEWED BY: ____________________

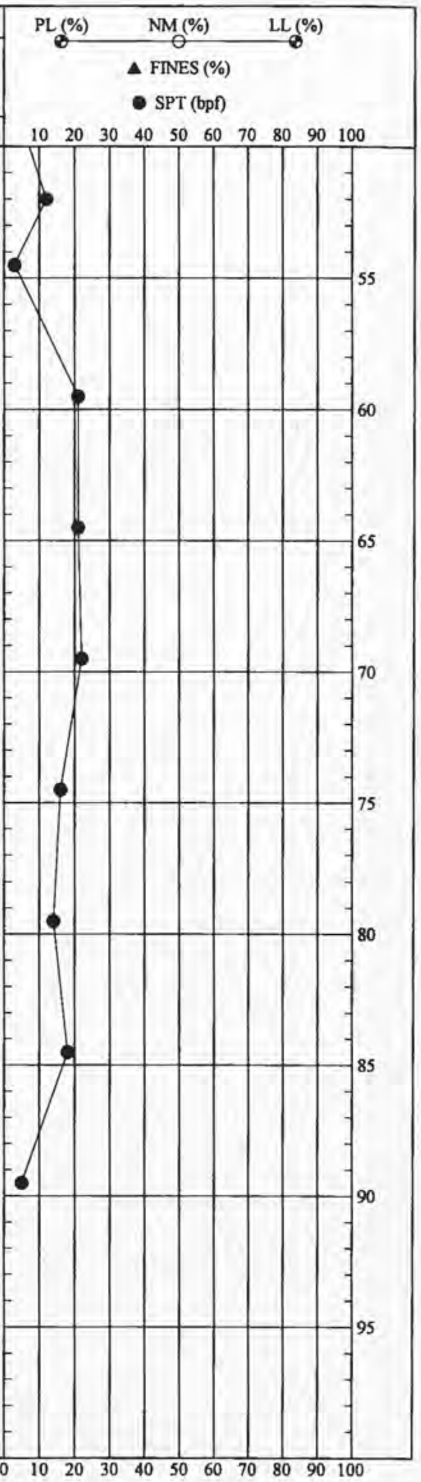
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/23/2016
COORD N: 511120
COMP. DATE: 2/23/2016
COORD E: 1471391
Page 1 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-4

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	Wet ALLUVIAL: Red-Brown, Silty, Fine **SAND** (SM) with Mica, Wet, Some Clayey Lenses and Nodules	455.4			
			SS-14	☒	(1.5) 3-5-7
	Mottled with Tan and Trace Small Gravel ~53 ft bgs				
	ALLUVIAL: Red-Brown, Silty, Fine **SAND** With Gravelly Lenses (SM-SW) with Mica, Wet, Some Clayey Lenses and Nodules		SS-15	☒	(1.0) WOH-1-2
55		450.4			
			SS-16	☒	(0.9) 3-12-9
60		445.4			
	ALLUVIAL: Red-Tan to Tan, Gravelly, Coarse to Fine **SAND** (SW), Wet				
			SS-17	☒	(0.9) 7-11-10
65		440.4			
			SS-18	☒	(0.8) 12-9-13
70		435.4			
			SS-19	☒	(1.1) 8-9-7
75		430.4			
			SS-20	☒	(0.5) 9-5-9
80		425.4			
			SS-21	☒	(1.5) 9-10-8
85		420.4			
			SS-22	☒	(1.5) 14-3-2
90	**Boring Terminated at 90 ft bgs**	415.4			
95		410.4			
100		405.4			



CONTRACTOR: S&ME, Inc. (B. Hoskins)
LOGGED BY: C. Murphy
EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~8 ft bgs; 24-hr Water Level was 13.7 ft bgs; On 2/25/16 Water Level Was ~4 ft bgs

REVIEWED BY: ____________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/23/2016
COORD N: 511120
COMP. DATE: 2/23/2016
COORD E: 1471391
Page 2 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-4

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	ASH FILL: Dark-Gray-Brown and Yellow-Orange-Tan "Rust" Colored **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Dry	505.3			
5	▼	500.3			
	Wet ~8 ft bgs				
10		495.3			
15	ASH FILL: Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND**, Wet Yellow-Orange-Tan "Rust" Colored Lense ~14.2 ft bgs Bottom Ash Lense ~14.2 to 14.4 ft bgs	490.3			
	Lense Classifying as **SILT** (MH) ~18.5 to 19 ft bgs				
20	ASH FILL: Dark, Tan-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet	485.3			
25	ASH FILL: Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND**, Wet	480.3			
30	ASH FILL: Dark, Tan-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet	475.3			
	ALLUVIAL: Red-Tan, Tan, Slightly Clayey, Silty, Fine **SAND** (SM), Moist				
35	ALLUVIAL: Yellow-Red-Tan and Tan Mottled, Silty **CLAY** (CL), Wet	470.3			
	ALLUVIAL: Yellow-Red-Tan and Tan Mottled, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet				
	ALLUVIAL: Red-Brown, Silty **CLAY** (CH), Wet				
40	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet	465.3			
	ALLUVIAL: Red-Brown, Slightly Clayey, Silty, Fine **SAND** (SM) with Mica, Wet				
	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC) with Mica, Wet				
45	ALLUVIAL: Red-Brown, Slightly Clayey, Silty, Fine **SAND** (SM) with Mica, Wet	460.3			
			UD-1		(1.55)
	ALLUVIAL: Red-Brown, Silty **CLAY** (CH), Wet		UD-2		(2.0)
50	ALLUVIAL: Red-Brown, Clayey, Silty, Fine **SAND** (SC),	455.3			

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

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	24-hr Water Level was ~5 ft bgs, Lithologic Descriptions From B-4

REVIEWED BY: ______________________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/26/2016
COORD N: 511119 **COMP. DATE:** 2/29/2016
COORD E: 1471394 **Page 1 of 2**
LOCATION: Union, Kentucky

BORING NO.: B-4A

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
50	Wet ALLUVIAL: Red-Brown, Silty, Fine **SAND** (SM) with Mica, Wet, Some Clayey Lenses and Nodules **Lithologic Descriptions from B-4** **Boring Terminated at 50 ft bgs**		455.3				
55			450.3				55
60			445.3				60
65			440.3				65
70			435.3				70
75			430.3				75
80			425.3				80
85			420.3				85
90			415.3				90
95			410.3				95
100			405.3				0 10 20 30 40 50 60 70 80 90 100

DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	24-hr Water Level was ~5 ft bgs, Lithologic Descriptions From B-4

REVIEWED BY: ____________________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/26/2016
COORD N: 511119
COMP. DATE: 2/29/2016
COORD E: 1471394
Page 2 of 2
LOCATION: Union, Kentucky

BORING NO.: B-4A

amec foster wheeler

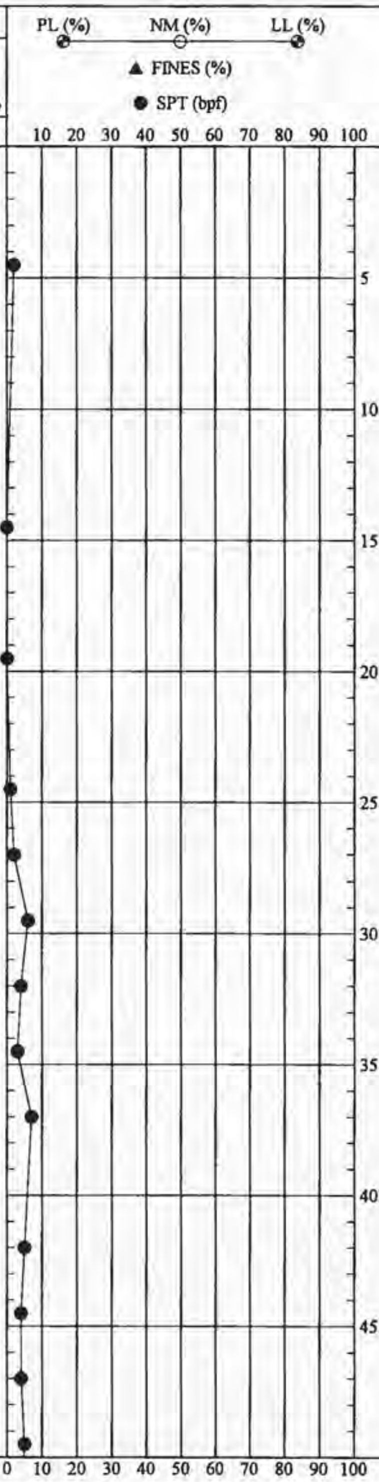
SOIL CLASSIFICATION AND REMARKS

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	ASH FILL: Brown and Black **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Moist	505.3
~4	▽ Wet ~4 ft bgs	
5		500.3
~6	More Coarse Sand ~6 ft bgs	
10		495.3
15		490.3
~19	ASH FILL: Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND** (SM-ML), Wet Lense of Dark Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Moist ~19.5-20.5 ft bgs	
20		485.3
~24	ASH FILL: Dark Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Sand and Gravel-Sized Coal and Slag Fragments, Wet	
25		480.3
~26	ASH FILL: Gray and Tan-Gray **FLY ASH**, Which Classifies as Silty, Fine to Very Fine **SAND** (SM-ML), Wet	
30		475.3
~33.5	Thin Black Veins of Clay (CL/CH) ~33.5 to 34.8 ft bgs	
35	ALLUVIAL/ASH FILL MIX: Tan, Silty, Fine to Very Fine **SAND** Mixed with **FLY ASH** (SM), With Silty, Clayey, Fine to Very Fine **SAND** (SC) Mixed with **FLY ASH** ~35.5 ft bgs, Wet	470.3
~37.5	ALLUVIAL: Tan, Red-Tan, Fine to Very Fine, Sandy, Silty **CLAY** (CL-CH), Wet	
~39	ALLUVIAL: Tan, Red-Tan, Silty, Fine to Very Fine **SAND** (SM) with Some Zones Slightly Clayey and Micaceous, Wet	
40		465.3
~44	More Clayey (SC) ~44 to 44.3 ft bgs	
45		460.3
~46	▼	
~46.5	More Clayey (SC) ~46.5 to 46.7 ft bgs	
~48	Becomes More Coarse (Silty, Medium to Fine **SAND**) ~48 ft bgs	
50		455.3

SAMPLES

IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
SS-1	(1.1) 1-1-1
BULK-1	
UD-1	(1.8)
SS-2	(1.0) 2-1
SS-3	(1.2) 1-1-WOH
SS-4	(1.5) 1-1-WOH
UD-2	(1.75)
SS-5	(1.0) 1-WOH-1
SS-6	(1.0) WOR-1-1
SS-7	(1.5) 1-2-4
SS-8	(1.5) 2-2-2
SS-9	(1.5) WOH-1-2
SS-10	(1.5) WOH-2-5
UD-3	(2.0)
SS-11	(1.1) WOH-2-3
SS-12	(1.4) WOH-2-2
SS-13	(1.4) 1-1-3
SS-14	(1.4) 2-2-3



CONTRACTOR: S&ME, Inc. (B. Hoskins)
LOGGED BY: C. Murphy
EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~4 ft bgs; On 3/3/16 and 3/4/16 Water Level was ~46 ft bgs

REVIEWED BY: ____________________

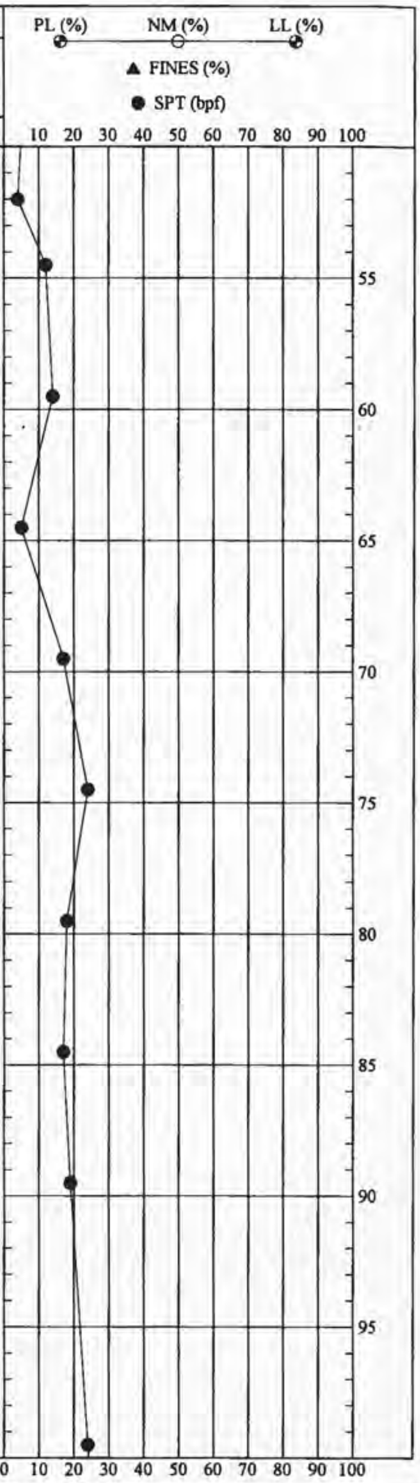
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 3/1/2016
COORD N: 511036
COMP. DATE: 3/4/2016
COORD E: 1471277
Page 1 **of** 4
LOCATION: Union, Kentucky

BORING NO.: B-5

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan, Red-Tan, Silty, Fine to Very Fine **SAND** (SM) with Some Zones Slightly Clayey and Micaceous, Wet	455.3			
	ALLUVIAL: Tan, Red-Tan, Micaceous, Silty, Clayey, Medium to Fine **SAND** (SC), Wet		SS-15	☒	(1.1) 1-1-3
			SS-16	☒	(0.4) 3-5-7
55		450.3			
	ALLUVIAL: Tan, Red-Tan, Micaceous, Silty, Medium to Fine **SAND** (SM), Wet				
60		445.3	SS-17	☒	(1.0) 1-6-8
	ALLUVIAL: Red-Tan to Tan, Gravelly, Coarse to Fine **SAND** (SW), Wet				
	Gravelly Lense ~64 ft bgs				
65		440.3	SS-18	☒	(1.2) 3-2-3
	Gravelly Lense ~67 ft bgs				
70		435.3	SS-19	☒	(0.9) 5-9-8
75		430.3	SS-20	☒	(1.1) 7-11-13
80		425.3	SS-21	☒	(0.6) 13-9-9
85		420.3	SS-22	☒	(0.3) 8-10-7
	Gravelly Lense ~87 ft bgs				
90		415.3	SS-23	☒	(0.6) 7-11-8
95		410.3			
100		405.3	SS-24	☒	(0) 9-12-12



CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~4 ft bgs; On 3/3/16 and 3/4/16 Water Level was ~46 ft bgs

REVIEWED BY: ____________________

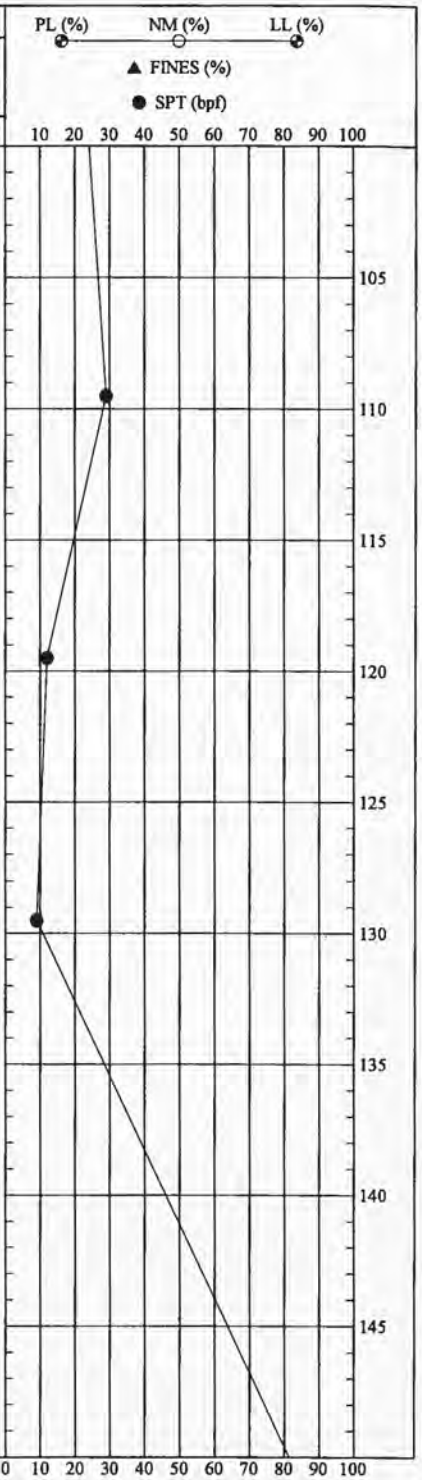
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 3/1/2016
COORD N: 511036 **COMP. DATE:** 3/4/2016
COORD E: 1471277 **Page 2 of 4**
LOCATION: Union, Kentucky

BORING NO.: B-5

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
100	ALLUVIAL: Red-Tan to Tan, Gravelly, Coarse to Fine **SAND** (SW), Wet	405.3			
105		400.3			
110		395.3	SS-25	☒	(1.1) 29-13-16
115		390.3			
120			SS-26	☒	(1.3) 16-7-5
	ALLUVIAL: Tan, Medium to Coarse, Sandy **GRAVEL** (GW), Wet	385.3			
125		380.3			
130		375.3	SS-27	☒	(1.2) 8-5-4
135		370.3			
140		365.3			
145		360.3			
	Larger or More Abundant Gravel ~146 to 150 ft bgs				
150		355.3			



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~4 ft bgs; On 3/3/16 and 3/4/16 Water Level was ~46 ft bgs

REVIEWED BY: ____________________

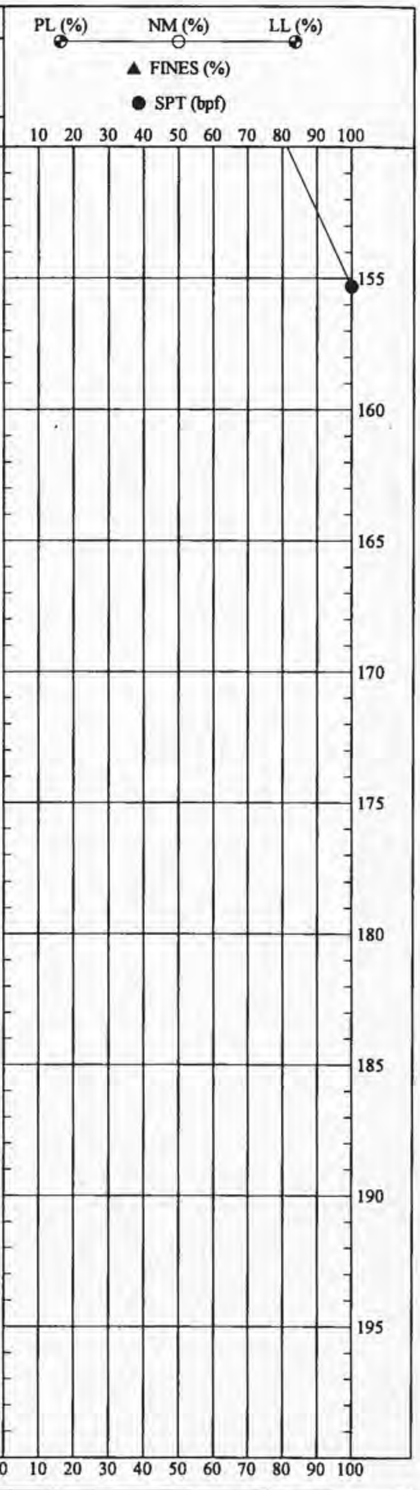
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 3/1/2016
COORD N: 511036
COMP. DATE: 3/4/2016
COORD E: 1471277
Page 3 **of** 4
LOCATION: Union, Kentucky

BORING NO.: B-5

amec foster wheeler

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
150	ALLUVIAL: Tan, Medium to Coarse, Sandy **GRAVEL** (GW), Wet	355.3			
	PARTIALLY WEATHERED ROCK: Tan, Fine-Grained, **SANDSTONE** Rock Fragments				
155	**Auger Refusal at 155.3 ft bgs**	350.3	SS-28	⋈	(0.2) 50/4
160		345.3			
165		340.3			
170		335.3			
175		330.3			
180		325.3			
185		320.3			
190		315.3			
195		310.3			
200		305.3			



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR: S&ME, Inc. (B. Hoskins)
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EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~4 ft bgs; On 3/3/16 and 3/4/16 Water Level was ~46 ft bgs

REVIEWED BY: ________________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 3/1/2016
COORD N: 511036
COMP. DATE: 3/4/2016
COORD E: 1471277
Page 4 **of** 4
LOCATION: Union, Kentucky

BORING NO.: B-5

amec foster wheeler

SOIL CLASSIFICATION AND REMARKS

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

DEPTH (ft)	ELEV (ft)
0	502.5
5	497.5
10	492.5
15	487.5
20	482.5
25	477.5
30	472.5
35	467.5
40	462.5
45	457.5
50	452.5

ASH FILL: Dark Gray-Brown **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Moist

▼

▽

Wet ~8 ft bgs

Color Change to Dark Gray (No Brown) ~18 ft bgs

ALLUVIAL: Black, Clayey **SILT** (ML) with Organic Debris, Wet

ALLUVIAL: Tan, Silty, Fine to Very Fine **SAND** (SM) with Organic Debris, Wet

ALLUVIAL: Gray, Clayey, Fine **SAND** (SC), Wet

ALLUVIAL: Gray, Silty **CLAY** (CL), Wet

ALLUVIAL: Tan-Gray, Fine Sandy, Clayey **SILT** (ML), Wet

ALLUVIAL: Yellow-Red-Tan, Silty **CLAY** (CH), Wet

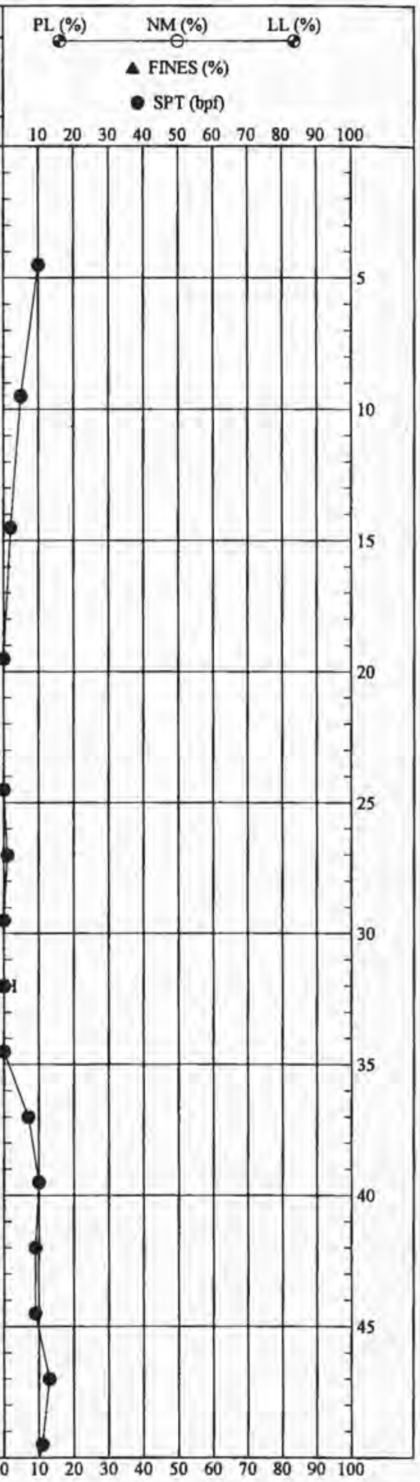
ALLUVIAL: Tan-Gray, Silty, Clayey, Fine **SAND** (SC), Wet; Light Gray, High Plasticity, Clay (CH) Lense ~41.7 ft bgs

ALLUVIAL: Tan to Red-Tan, Silty, Fine to Very Fine **SAND** (SM), Moist to Wet

Orange-Tan, Silty, Fine Sandy **CLAY** Lense (SC) ~48.5 to 48.8 ft bgs

SAMPLES

IDENT	(Rec")	N-COUNT or Rec%/RQD% 6"-6"-6"-6"
SS-1 BULK-1	(1.0)	3-5-5
SS-2	(1.2)	2-2-3
SS-3	(1.5)	2-1-1
UD-1	(1.85)	
SS-4	(0.3)	1-1-WOH
SS-5	(1.5)	1-1-WOH
SS-6	(0.5)	WOH-WOH-1
SS-7	(1.5)	1-WOH-WOH
SS-8	(1.5)	WOH-WOH-WOH
SS-9	(0.2)	1-WOH-WOH
SS-10	(1.5)	WOR-3-4
SS-11	(1.5)	WOH-3-7
SS-12	(1.5)	2-4-5
SS-13	(0.9)	3-3-6
SS-14	(0.9)	3-6-7
SS-15	(1.5)	2-7-4



CONTRACTOR: S&ME, Inc. (B. Hoskins)
LOGGED BY: C. Murphy
EQUIPMENT: CME-550X
DRILL METHOD: 3.25" HSA
HOLE DIAMETER: ~6.5"

CLOSURE METHOD: Tremie Grout

REMARKS: Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~3 ft bgs

REVIEWED BY: ____________

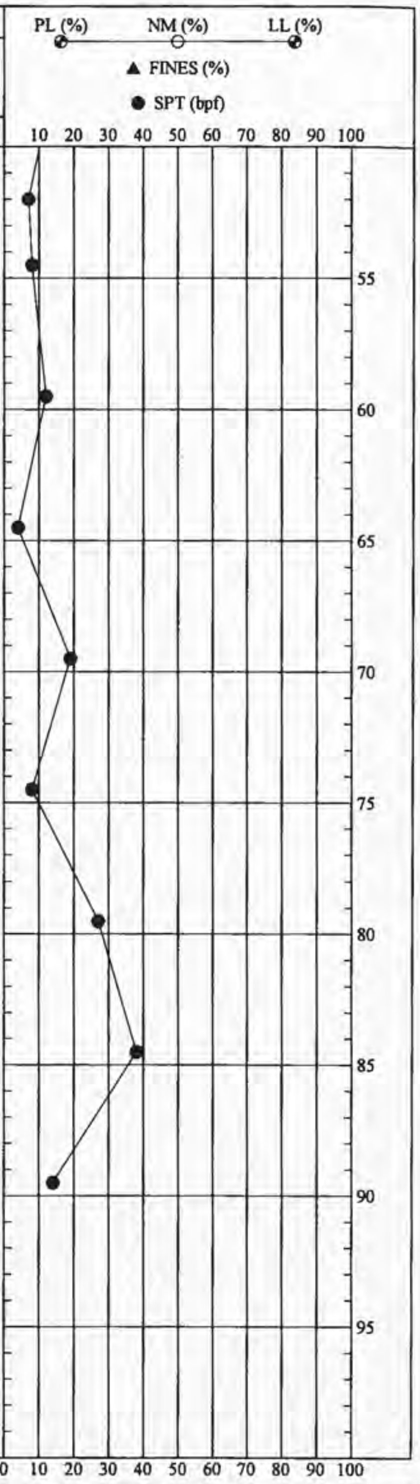
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345 **START DATE:** 2/17/2016
COORD N: 511030 **COMP. DATE:** 2/18/2016
COORD E: 1471510 **Page** 1 **of** 2
LOCATION: Union, Kentucky

BORING NO.: B-6

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan to Red-Tan, Silty, Fine to Very Fine **SAND** (SM), Moist to Wet	452.5			
			SS-16	☒	(1.3) 3-3-4
			SS-17	☒	(1.0) 3-3-5
55		447.5			
	Red-Brown and Gray Mottled, Clayey, Fine to Very Fine **SAND** (SC) with Minor Light Gray, High Plasticity Clay (CH) Veins ~58.5 to 58.9 ft bgs		SS-18	☒	(1.0) 3-5-7
60		442.5			
	ALLUVIAL: Tan-Brown, Slightly Clayey, Gravelly, Coarse to Fine **SAND** (SW), Wet		SS-19	☒	(1.3) 4-2-2
65		437.5			
	ALLUVIAL: Tan, Silty, Fine to Very Fine **SAND** (SM), Wet		SS-20	☒	(1.5) 4-10-9
70		432.5			
	Mottled with Gray, Clayey **SILT** ~74 to 74.5 ft bgs		SS-21	☒	(1.4) 3-6-2
75		427.5			
	ALLUVIAL: Tan-Brown, Coarse to Fine **SAND** with Gravel (SW), Wet Black, Clayey **SILT** Nodule ~79 ft bgs		SS-22	☒	(1.5) 9-14-13
80		422.5			
			SS-23	☒	(1.5) 12-17-21
85		417.5			
	Dark Gray, Fine, Sandy **CLAY** Nodule ~89 ft bgs		SS-24	☒	(1.5) 12-7-7
90	**Boring Terminated at 90 ft bgs**	412.5			
95		407.5			
100		402.5			



CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~3 ft bgs

REVIEWED BY: ____________________

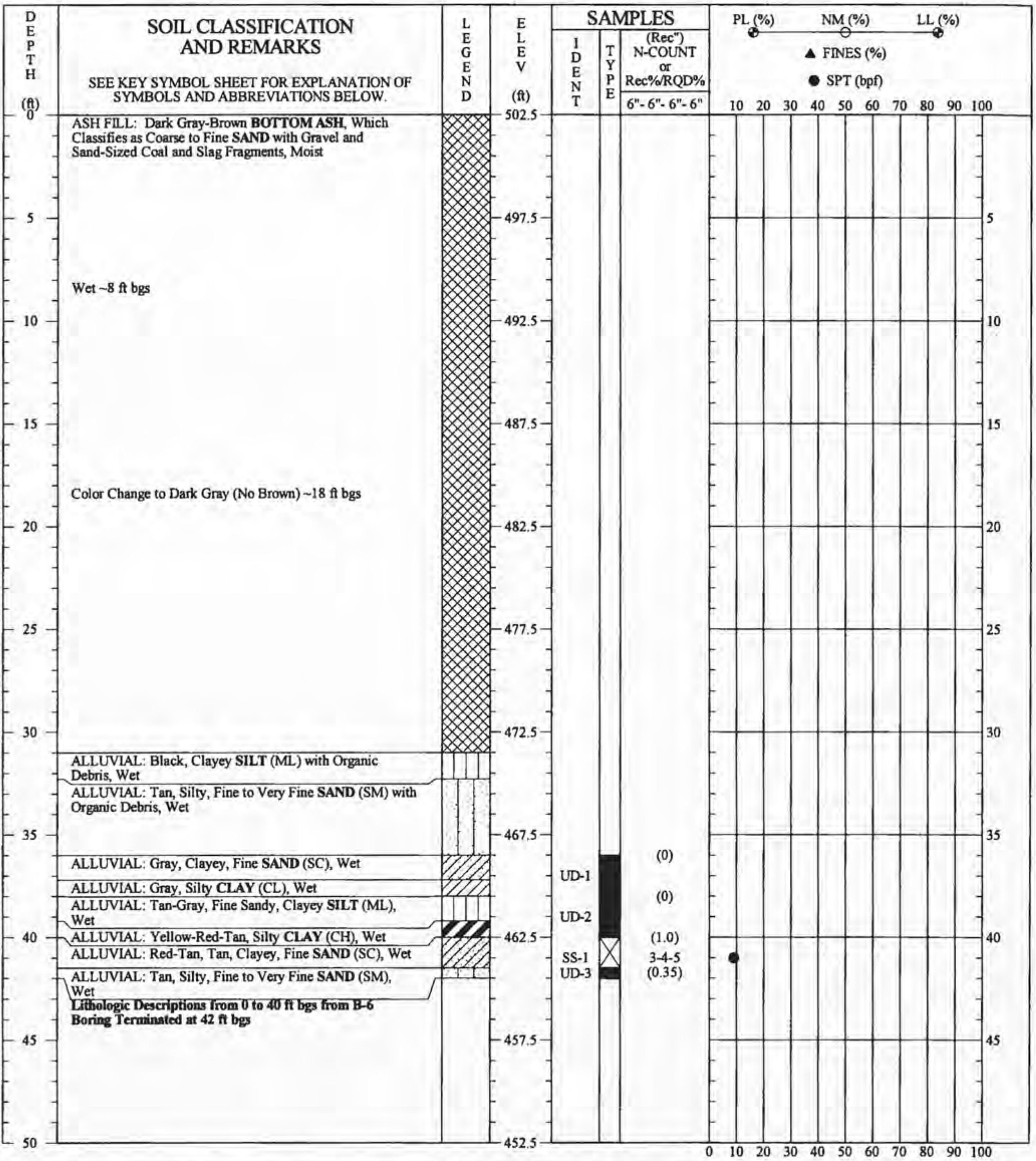
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/17/2016
COORD N: 511030
COMP. DATE: 2/18/2016
COORD E: 1471510
LOCATION: Union, Kentucky

Page 2 of 2

BORING NO.: B-6

amec foster wheeler



ASH FILL: Dark Gray-Brown **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Moist

Wet ~8 ft bgs

Color Change to Dark Gray (No Brown) ~18 ft bgs

ALLUVIAL: Black, Clayey **SILT** (ML) with Organic Debris, Wet

ALLUVIAL: Tan, Silty, Fine to Very Fine **SAND** (SM) with Organic Debris, Wet

ALLUVIAL: Gray, Clayey, Fine **SAND** (SC), Wet

ALLUVIAL: Gray, Silty **CLAY** (CL), Wet

ALLUVIAL: Tan-Gray, Fine Sandy, Clayey **SILT** (ML), Wet

ALLUVIAL: Yellow-Red-Tan, Silty **CLAY** (CH), Wet

ALLUVIAL: Red-Tan, Tan, Clayey, Fine **SAND** (SC), Wet

ALLUVIAL: Tan, Silty, Fine to Very Fine **SAND** (SM), Wet

Lithologic Descriptions from 0 to 40 ft bgs from B-6
Boring Terminated at 42 ft bgs

IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
	(0)
UD-1	
	(0)
UD-2	
	(1.0)
SS-1	3-4-5
UD-3	(0.35)

DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Lithologic Descriptions from B-6 for 0 to 40 ft bgs and Classified from B-6A UD Sample Ends from 40 to 42 ft bgs

REVIEWED BY: ____________________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
COORD N: 511030
COORD E: 1471513
LOCATION: Union, Kentucky
START DATE: 2/25/2016
COMP. DATE: 2/26/2016
Page 1 **of** 1

BORING NO.: B-6A

amec foster wheeler

Attachment C

Hydrologic and Hydraulic Analyses

BURNS & McDONNELL

Hydrologic and Hydraulic Calculations

DUKE ENERGY®

Duke Energy

Water Redirection Program – East Bend Station Unit 2
Project No. 88669

9/27/2016

Hydrologic and Hydraulic Calculations

prepared for

Duke Energy
Water Redirection Program – East Bend Station Unit 2
Boone County, Kentucky

Project No. 88669

9/27/2016

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

INDEX AND CERTIFICATION

Duke Energy
Hydrologic and Hydraulic Calculations
Project No. 88669

Report Index

Chapter Number	Chapter Title	Number of Pages
1.0	Hydrologic and Hydraulic Calculations	12

Certification

I hereby certify, as a Professional Engineer in the state of Kentucky, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Duke Energy or others without specific verification or adaptation by the Engineer.

Robert N. Owens, P.E., KY #26616

Date: 9/27/2016

ROBERT N. OWENS 26616

9/27/16

1.0 HYDROLOGIC AND HYDRAULIC CALCULATIONS

Design storm routing for East Bend Station (EBS) was performed using HEC-HMS v4.0, developed by US Army Corps of Engineers.

1.1 Design Storm

The Kentucky Division of Water Engineering Memorandum No. 5. defines a Class (B) moderate hazard structure as one whose failure could cause major damage to a property or project, but loss of life is very unlikely. This definition adequately describes the existing structure, and so it will be classified as a Class "B" moderate hazard structure. B&McD has evaluated the future conditions of the East and West Basin at EBS using an inflow design flood (IDF) in accordance with the Kentucky Division of Water Engineering Memorandums No. 2 and No. 5. Below is the equation from Memorandum No. 5 to calculate the design rainfall depth for a Class (B) moderate hazard structure.

$$P_B = P_{100} + 0.40(PMP - P_{100})$$

Where P_B denotes a 6-hr design storm rainfall, P_{100} is a 100yr-6hr rainfall, and PMP represents a 6-hr Probable Maximum Precipitation. Precipitation data was found using NOAA Precipitation Frequency Data Server and NOAA Hydrometeorological Report No. 51. The 6-hr design storm rainfall was distributed using the Dimensionless Design Storm Distribution from NRCS, Technical Release 60 (TR-60).

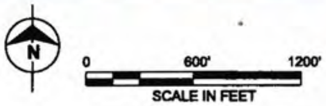
1.2 HEC-HMS Hydrologic Input

The drainage areas to the East and West Basins were measured using recent topographic data and are shown in Figure 1. The total drainage area to the basins is approximately 260 acres. Weighted SCS curve numbers and lag times for the drainage areas were calculated following Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds. Table 1 on page 3 summarizes the drainage area inputs for the HEC-HMS model.

Process flows from East Bend Station are included in the HEC-HMS model. Table 2 on page 4 summarizes the process flows.

Figure 2 on page 4 provides a screenshot of the HEC-HMS model, which shows the routing of the drainage areas and process flows.

RUNOFF AREA DESCRIPTION	SIZE OF DRAINAGE AREA
WEST BASIN DIRECT RUNOFF	18.80 ACRES
EAST BASIN DIRECT RUNOFF	15.41 ACRES
EXISTING LANDFILL EAST SIDE RUNOFF	37.25 ACRES
EXISTING LANDFILL WEST SIDE RUNOFF	93.75 ACRES
COAL PILE RUNOFF	38.29 ACRES
P15 & P16 RUNOFF	34.13 ACRES
FGD STACKOUT RUNOFF	19.25 ACRES
EXISTING LANDFILL NORTHEAST SIDE RUNOFF (NPDES OUTFALL 017)	28.41 ACRES
COAL CONVEYOR STORM WATER SEDIMENT POND RUNOFF	2.27 ACRES
SCR SUMP RUNOFF	4.03 ACRES
SECONDARY SETTLING BASIN BERM RUNOFF (NPDES OUTFALL 013)	8.45 ACRES
MAIN PLANT AREA YARD RUNOFF (NPDES OUTFALL 014)	34.23 ACRES
WEST SIDE YARD RUNOFF (NPDES OUTFALL 015)	40.06 ACRES
SERVICE WATER INTAKE RUNOFF (NPDES OUTFALL 016)	0.9 ACRES
WEST BASIN DIRECT RAINFALL	13.82 ACRES
EAST BASIN DIRECT RAINFALL	25.50 ACRES
COAL CONVEYOR STORM WATER SEDIMENT POND DIRECT RAINFALL	0.24 ACRES



BURNS McDONNELL

date JULY 26, 2016
designed A. MUCKENTHALER

DUKE ENERGY
EAST BEND STATION
HYDROLOGIC AND
HYDRAULIC CALCULATIONS
DRAINAGE AREAS

project 88669
contract

FIGURE 1

\\bmcd\dfs\Clients\ENR\DukeEnr\WtrRedirProg\88669_EastBend\Design\Civil\Dwgs\Working\88669_HEC-HMS DA - Future - 11x17.dgn

Table 1: HEC-HMS Input

Drainage Area	*Area (mi^2)*	*Loss Method*	*Transform Method*	*Weighted Curve Number*	*Lag Time (min)*
*West Basin Direct Runoff**	0.0294	SCS Curve Number	SCS Unit Hydrograph	64	20.54
*East Basin Direct Runoff**	0.0241	SCS Curve Number	SCS Unit Hydrograph	64	9.88
*Existing East Landfill Runoff**	0.0582	SCS Curve Number	SCS Unit Hydrograph	62	30.66
*Existing West Landfill Runoff**	0.1465	SCS Curve Number	SCS Unit Hydrograph	64	65.01
*Coal Pile Runoff**	0.0567	SCS Curve Number	SCS Unit Hydrograph	62	30.49
*Cells P15 & P16 Runoff**	0.0533	SCS Curve Number	SCS Unit Hydrograph	61	17.62
*WSP Pad Runoff**	0.0301	SCS Curve Number	SCS Unit Hydrograph	64	27.86
*Coal Conveyor Stormwater Sediment Pond Runoff**	0.0035	SCS Curve Number	SCS Unit Hydrograph	67	5.14
*SCR Sump Drains**	0.0063	SCS Curve Number	SCS Unit Hydrograph	91	10.00
Existing NE Landfill Runoff	0.0444	SCS Curve Number	SCS Unit Hydrograph	62	16.23
Secondary Settling Basin Berm Runoff	0.0132	SCS Curve Number	SCS Unit Hydrograph	72	21.34
Main Plant Area Yard Runoff	0.0535	SCS Curve Number	SCS Unit Hydrograph	66	14.50
(NPDES Outfall 015)	0.0626	SCS Curve Number	SCS Unit Hydrograph	70	22.92
Service Water Intake Runoff	0.0014	SCS Curve Number	SCS Unit Hydrograph	72	7.40

***Drains to Retention Basins**

Table 2: Process Flows

Baseflows	*Flow (gpm)*	*Flow (cfs)*	*Destination*
CT Overboard	1269.00	2.8275	E
Exist Landfill Cells 1-14 Leachate	108.00	0.2406	E
New Landfill Truck Wash	50.00	0.1114	E
Exist Landfill Cells 15 & 16 Leachate	14.00	0.0312	East Basin
WSP Area Clean Sump Discharge	273.00	0.6083	East Basin
Well Water Filter Backwash	15.94	0.0355	G
Sanitary Use Discharge (Outfall 007)	31.00	0.0691	G
Demineralizer Sump Discharge	227.00	0.5058	G
Boiler Sump Discharge	1918.00	4.2736	G
SCR Sump Discharge	396.00	0.8824	G
DBA System Quench Water	400.00	0.8913	G
Totals			
Baseflow to E	1427.00	3.1796	
Baseflow to East Basin	287.00	0.6395	
Baseflow to G	2987.94	6.6576	

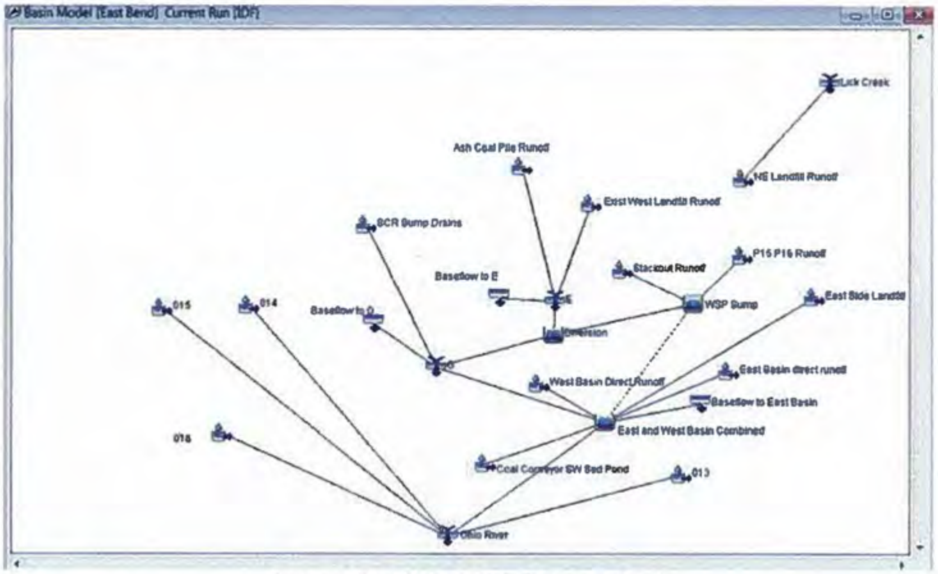


Figure 2: HEC-HMS Screenshot

1.3 Meteorological Input Data

The design rainfall depth for the IDF was calculated using the equation given earlier, which returned a design rainfall of 13.7-inches. This rainfall was then distributed over a 6-hour time period using the dimensionless design storm distribution from Figure 2-4 in TR-60. Figure 3 below shows the 6-hour design storm hydrograph.

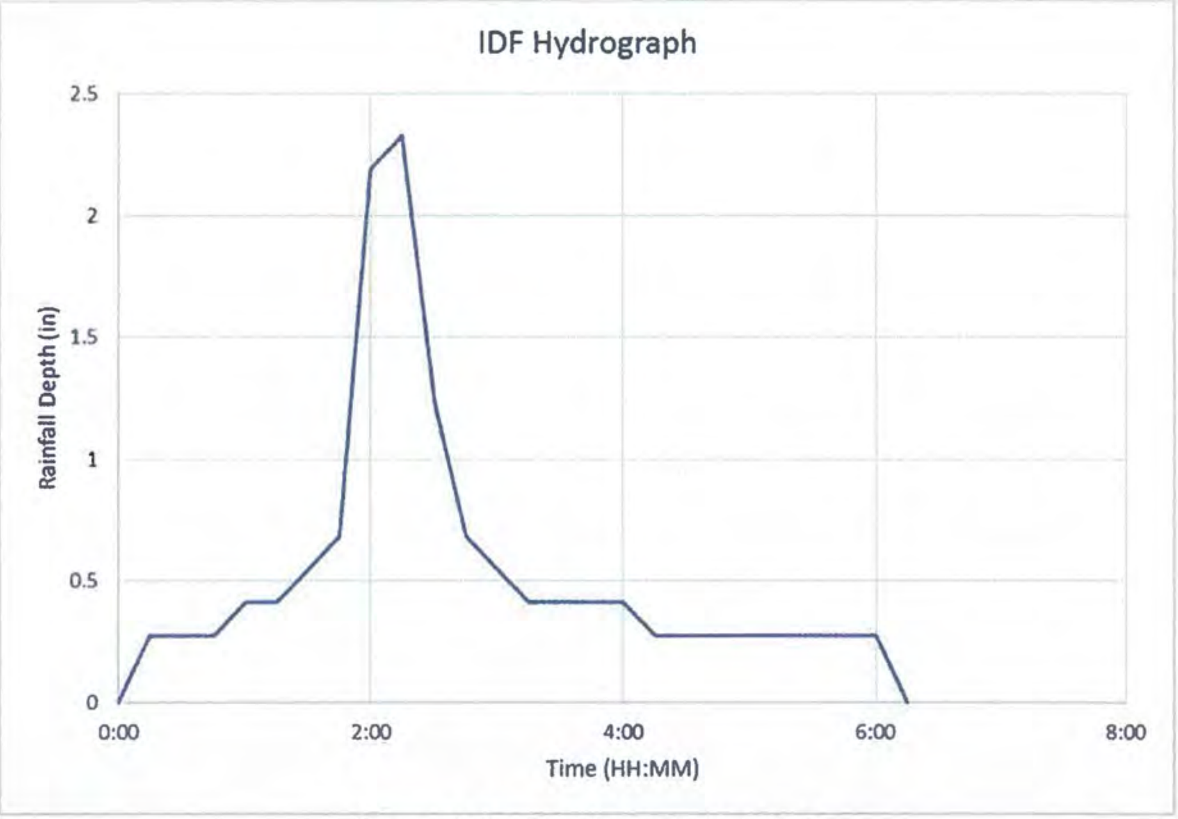


Figure 3: Design Storm Hydrograph

1.4 Elevation-Area-Storage for West and East Basins

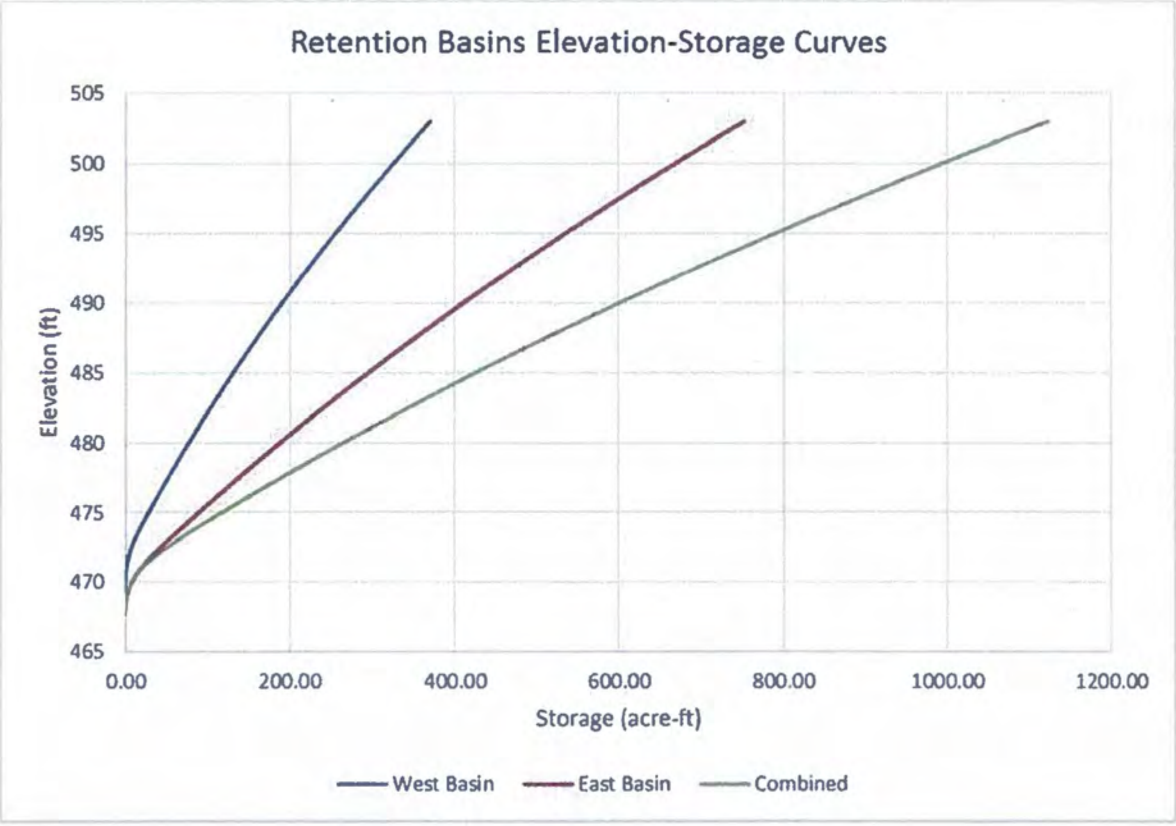
An elevation-area table was developed using the proposed future grades of the West and East Basins. Table 3 below shows the elevation-area data that was used in the HEC-HMS model. The table also shows the estimated cumulative storage of the basins, which have a total maximum capacity of 1,120 ac-ft.

Difficulties arise when the model analyzes a rain event large enough that the East Basin backs up into the West Basin, such as the IDF. This occurs at elevation 497.6'. In such an event the East and West Basins are combined and modeled as a single basin in order to more accurately calculate the peak elevation in the basins.

Table 3: Elevation-Area Table for West and East Basins

Elevation	West Basin			East Basin			Total		
	Square Feet	Acres	Cumulative Storage (ac-ft)	Square Feet	Acres	Cumulative Storage (ac-ft)	Square Feet	Acres	Cumulative Storage (ac-ft)
468		0.00	0.00	19,822	0.46	0.00	19,822	0.46	0.00
469		0.00	0.00	135,579	3.11	1.78	135,579	3.11	1.78
470	22,870	0.53	0.00	372,772	8.56	7.62	395,642	9.08	7.62
471	88,337	2.03	1.28	575,925	13.22	18.51	664,262	15.25	19.78
472	195,038	4.48	4.53	751,409	17.25	33.74	946,447	21.73	38.27
473	334,898	7.69	10.61	798,875	18.34	51.54	1,133,773	26.03	62.15
474	395,680	9.08	19.00	812,772	18.66	70.04	1,208,452	27.74	89.04
475	404,069	9.28	28.18	826,738	18.98	88.86	1,230,807	28.26	117.03
476	412,539	9.47	37.55	840,771	19.30	108.00	1,253,310	28.77	145.55
477	421,089	9.67	47.12	854,874	19.63	127.46	1,275,963	29.29	174.58
478	429,719	9.86	56.89	869,073	19.95	147.25	1,298,792	29.82	204.13
479	438,428	10.06	66.85	883,285	20.28	167.36	1,321,713	30.34	234.21
480	447,218	10.27	77.02	897,593	20.61	187.80	1,344,811	30.87	264.82
481	456,086	10.47	87.39	911,970	20.94	208.58	1,368,056	31.41	295.96
482	465,034	10.68	97.96	926,414	21.27	229.68	1,391,448	31.94	327.64
483	474,062	10.88	108.74	940,928	21.60	251.11	1,414,990	32.48	359.85
484	483,169	11.09	119.72	955,509	21.94	272.88	1,438,678	33.03	392.60
485	492,356	11.30	130.92	970,157	22.27	294.98	1,462,513	33.57	425.91
486	501,622	11.52	142.33	984,870	22.61	317.42	1,486,492	34.13	459.76
487	510,968	11.73	153.95	999,648	22.95	340.20	1,510,616	34.68	494.16
488	520,393	11.95	165.79	1,014,489	23.29	363.32	1,534,882	35.24	529.12
489	529,898	12.16	177.85	1,029,397	23.63	386.78	1,559,295	35.80	564.63
490	539,480	12.38	190.12	1,044,371	23.98	410.59	1,583,851	36.36	600.71
491	549,140	12.61	202.62	1,059,409	24.32	434.73	1,608,549	36.93	637.35
492	558,879	12.83	215.34	1,074,512	24.67	459.23	1,633,391	37.50	674.57
493	568,695	13.06	228.28	1,089,680	25.02	484.07	1,658,375	38.07	712.35
494	578,597	13.28	241.45	1,104,911	25.37	509.26	1,683,508	38.65	750.71
495	588,569	13.51	254.85	1,120,268	25.72	534.80	1,708,837	39.23	789.65
496	598,617	13.74	268.47	1,135,822	26.07	560.70	1,734,439	39.82	829.17
497	608,740	13.97	282.33	1,151,427	26.43	586.95	1,760,167	40.41	869.28
498	618,936	14.21	296.42	1,167,167	26.79	613.57	1,786,103	41.00	909.99
499	629,207	14.44	310.75	1,183,009	27.16	640.54	1,812,216	41.60	951.29
500	639,552	14.68	325.31	1,198,791	27.52	667.88	1,838,343	42.20	993.20
501	649,969	14.92	340.12	1,214,603	27.88	695.58	1,864,572	42.80	1035.70
502	660,462	15.16	355.16	1,230,555	28.25	723.65	1,891,017	43.41	1078.81
503	671,030	15.40	370.44	1,246,553	28.62	752.08	1,917,583	44.02	1122.52
504	681,672	15.65		1,263,741	29.01		1,945,413	44.66	
505	692,388	15.90		1,280,205	29.39		1,972,593	45.28	

Figure 4: Retention Basins Elevation-Storage Curves



1.5 West Basin and East Basin Discharges

The proposed structure that discharges from the West Basin to the East Basin was modeled as a broad-crested spillway in HEC-HMS. The spillway's crest elevation is 497.6' and its length is 20'. The spillway coefficient was conservatively set at 2.0 $ft^{0.5}/s$. This spillway is only in effect as long as the storm doesn't raise the east basin to 497.6'. As stated earlier, when the East Basin rises to this level the West and East Basins are modeled as a single basin. Duke is proposing to lower the existing dam height from elevation 515.0' to elevation 505.0'.

AMEC designed the existing spillway structure for the East Basin and they have provided B&McD with their spillway discharge rating table and curve. B&McD used this curve to model the discharge from the East Basin in HEC-HMS. The spillway discharge curve is shown in Figure 4 and Table 4. The maximum possible flow rate and velocity through the spillway are 84.20 cfs and approximately 12 ft/s, respectively. This occurs at elevation 505' (new dam elevation).

Figure 5: AMEC Spillway Rating Curve

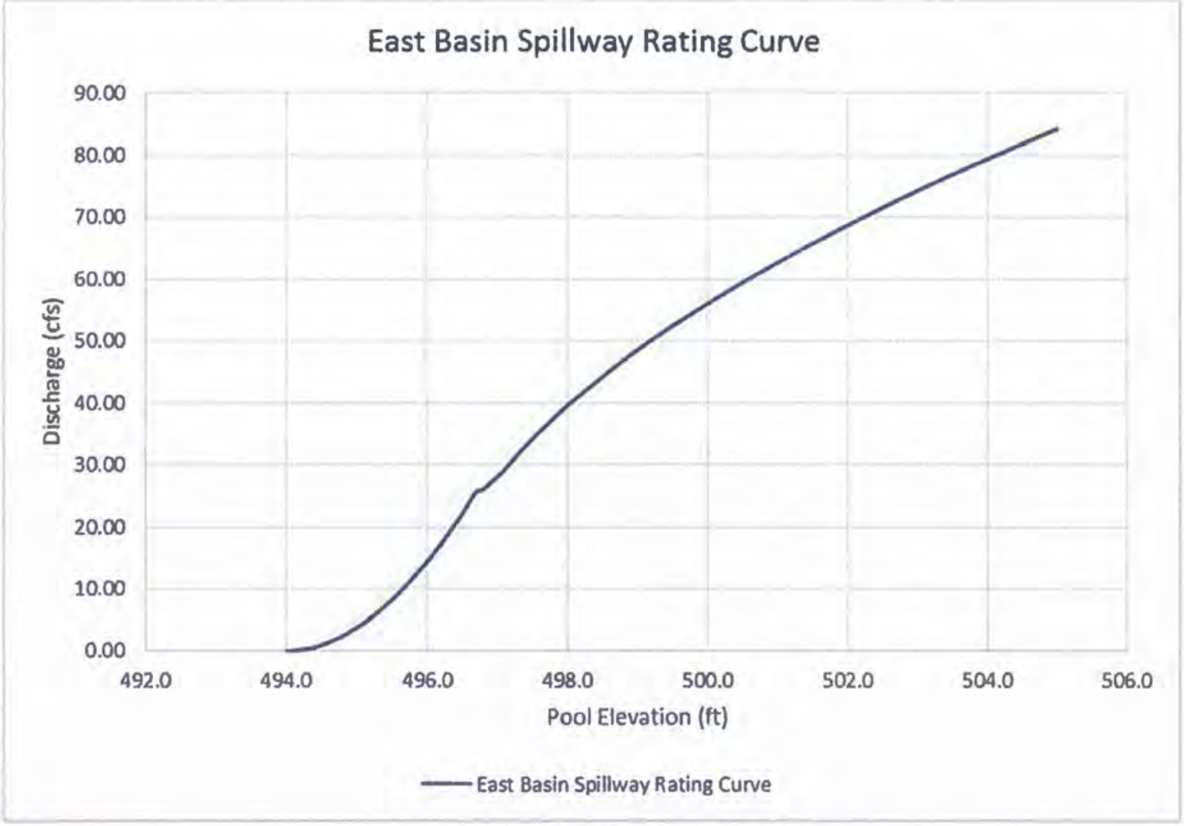


Table 4: AMEC Spillway Discharge Rating Curve

Head (ft)	Pool Elevation (ft)	Spillway Discharge (cfs)	Head (ft)	Pool Elevation (ft)	Spillway Discharge (cfs)
0.0	494.0	0.00	2.4	496.4	20.40
0.1	494.1	0.04	2.5	496.5	22.00
0.2	494.2	0.20	2.6	496.6	23.80
0.3	494.3	0.40	2.7	496.7	25.60
0.4	494.4	0.60	2.8	496.8	26.00
0.5	494.5	1.00	2.9	496.9	27.00
0.6	494.6	1.40	3.0	497.0	28.00
0.7	494.7	1.90	3.1	497.1	29.10
0.8	494.8	2.40	3.2	497.2	30.40
0.9	494.9	3.10	3.3	497.3	31.70
1.0	495.0	3.80	3.4	497.4	32.90
1.1	495.1	4.50	3.5	497.5	34.10
1.2	495.2	5.30	3.6	497.6	35.20
1.3	495.3	6.20	3.7	497.7	36.30
1.4	495.4	7.20	3.8	497.8	37.40
1.5	495.5	8.20	3.9	497.9	38.40
1.6	495.6	9.30	4.0	498.0	39.50
1.7	495.7	10.50	5.0	499.0	48.50
1.8	495.8	11.70	6.0	500.0	56.00
1.9	495.9	13.00	7.0	501.0	62.70
2.0	496.0	14.30	8.0	502.0	68.70
2.1	496.1	15.70	9.0	503.0	74.30
2.2	496.2	17.20	10.0	504.0	79.40
2.3	496.3	18.80	11.0	505.0	84.20

Figure 6: Emergency Spillway Rating Curve

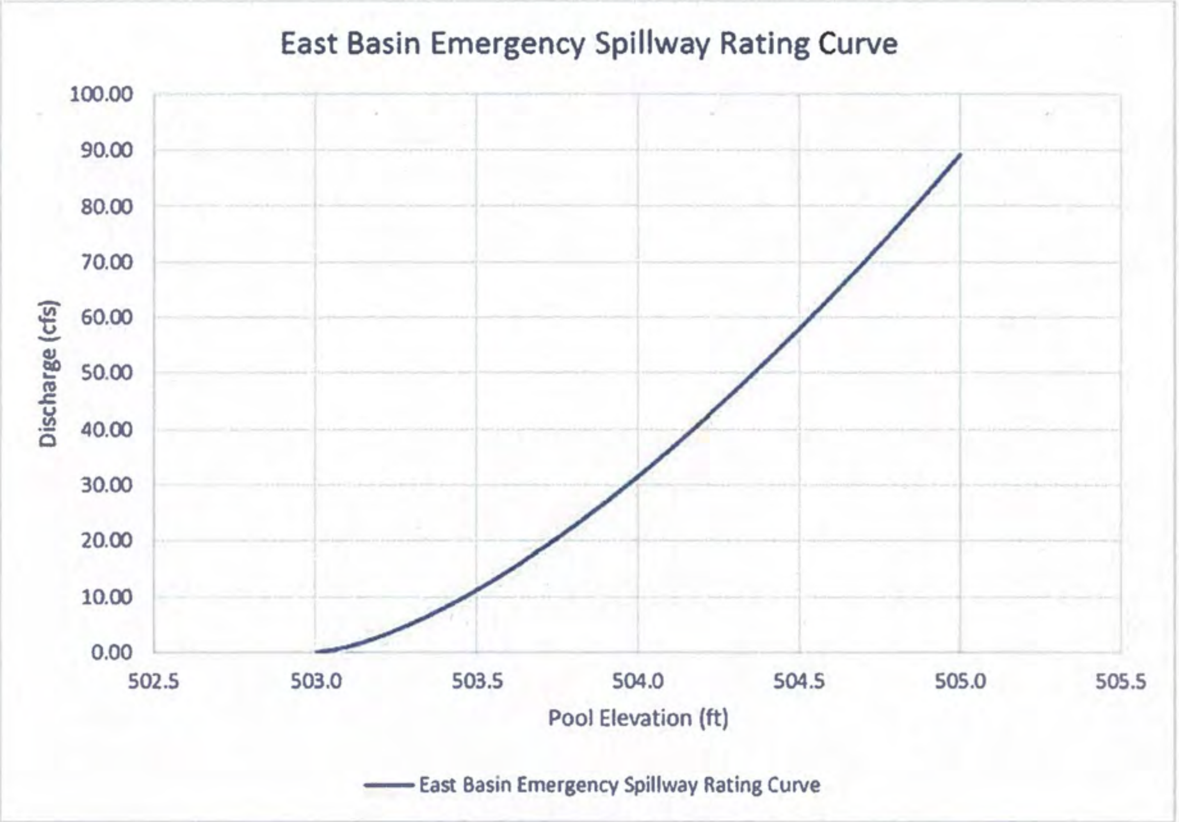


Table 5: Emergency Spillway Discharge Rating Curve

Head (ft)	Pool Elevation (ft)	Emergency Spillway Discharge
0.0	503.0	0.00
0.1	503.1	1.00
0.2	503.2	2.82
0.3	503.3	5.19
0.4	503.4	7.98
0.5	503.5	11.16
0.6	503.6	14.67
0.7	503.7	18.48
0.8	503.8	22.58
0.9	503.9	26.95
1.0	504.0	31.56
1.1	504.1	36.41
1.2	504.2	41.49
1.3	504.3	46.78
1.4	504.4	52.28
1.5	504.5	57.98
1.6	504.6	63.87
1.7	504.7	69.95
1.8	504.8	76.22
1.9	504.9	82.65
2.0	505.0	89.27

1.6 HEC-HMS Results

The following tables and figures summarize the results for the IDF event from the HEC-HMS modeling.

Table 6: Drainage Area Runoff Results

Drainage Area	Volume (ac-ft)		Peak Flow (cfs)	
	Storm Event			
	IDF	100-Yr, 6-hr	IDF	100-Yr, 6-hr
West Basin Direct Runoff	13.6	2.0	99.5	11.5
East Basin Direct Runoff	11.2	1.6	98.5	11.6
Existing East Landfill Runoff	26	3.5	161.6	16.9
Existing West Landfill Runoff	67.9	9.9	287.1	34.7
Coal Pile Runoff	25.3	3.6	157.8	17.4
Cells P15 & P16 Runoff	23.3	3.1	177.1	17.5
WSP Pad Runoff	13.9	2.0	91.0	10.5
Coal Conveyor Stormwater Sediment Pond Runoff	1.7	0.3	16.2	2.4
SCR Sump Drains	4.2	1.2	35.8	10.4
Existing NE Landfill Runoff	19.8	2.7	154.9	16.1
Secondary Settling Basin Berm Runoff	8.3	1.4	60.6	9.0
Main Plant Area Yard Runoff	25.7	4.0	209.8	26.5
(NPDES Outfall 015)	32.1	5.6	229.8	34.3
Service Water Intake Runoff	0.7	0.1	6.8	1.2

Table 7: East and West Basin Combined Storage Results

Storm Event	Normal Pool Elevation (ft)	Peak Pool Elevation (ft)	Proposed Top of Dam Elevation (ft)	Freeboard (ft)	Peak Inflow (cfs)	Peak Discharge (cfs)
IDF	495.6	500.93	505.0	4.1	724.1	54.4

The normal pool elevation is above the invert of the spillway because of the process flows that will be constantly going to the basin. It is at elevation 495.6' that the flows entering the basin equal the flows leaving the basin.

The model reports the peak pool elevation as 499.6'. However, since the model doesn't take into account rainfall directly on the water surface, it is conservative to add the design storm depth to the peak pool elevation. This gives the peak pool elevation to be 500.93'.

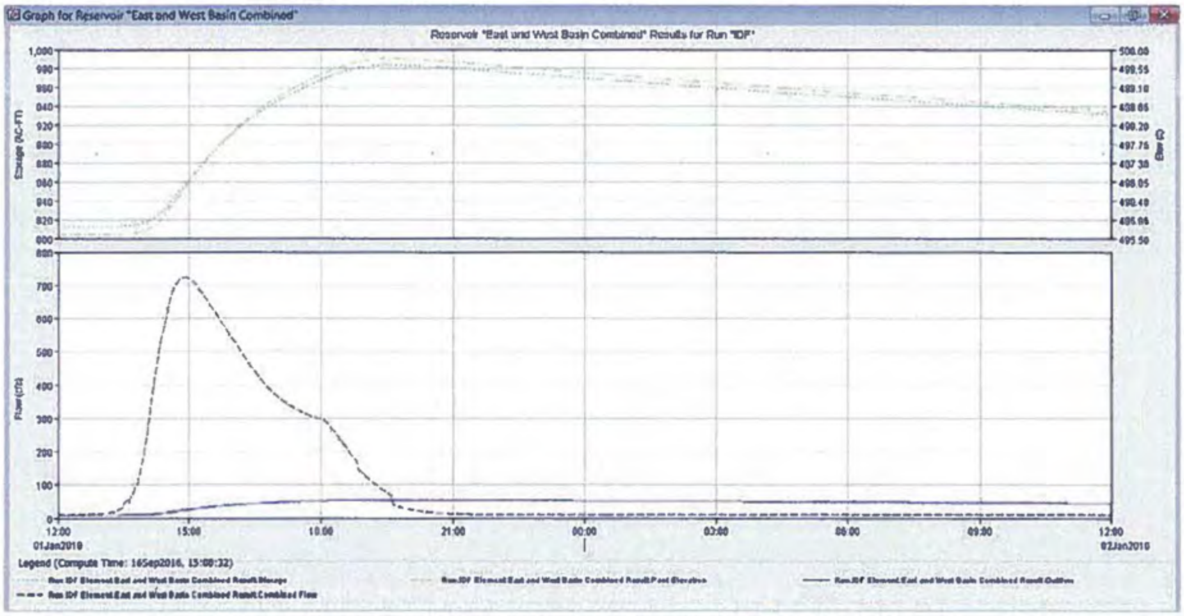


Figure 7: East and West Basin Combined Graphical Results

Attachment D

Stability Analyses

DUKE ENERGY COAL COMBUSTION RESIDUALS MANAGEMENT PROGRAM

EAST BEND STATION – 1976 ASH POND DAM (STATE ID KYDW ID 1215)

PROPOSED RETENTION BASIN STABILITY ANALYSIS FINAL REPORT

Prepared for

Duke Energy
550 South Tryon Street
Charlotte, North Carolina 28202

September 23, 2016

Prepared by

Amec Foster Wheeler Environment & Infrastructure, Inc.
Project No. 7810150345

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EXECUTIVE SUMMARY

Duke plans to modify the existing Ash Pond Dike at the East Bend Station and repurpose as a wastewater storage facility. A divider dike will be installed to separate the basin into Retention Basin 1 to the west, and Retention Basin 2 to the east. A slope stability analysis was performed to calculate safety factors for the proposed design changes. The analysis was performed according to regulatory guidelines.

Two critical cross sections were identified and analyzed; through the eastern slope of the dike and through the proposed divider dike. The critical section locations were selected based upon the dike geometries and underlying material properties resulting in the lowest factors of safety. The selected geotechnical and shear strength properties were obtained from the previous Phase 2 Reconstitution of Design Report (Amec Foster Wheeler, 2015). Five regions were identified and engineering properties assigned.

The critical cross sections were analyzed using limit-equilibrium procedures (Morgenstern-Price's method) with the computer program SLOPE/W to determine the safety factors for critical failure surfaces. Critical failure surfaces were modeled as translational, deep circular, and shallow circular failures.

Four (4) loading conditions were analyzed, including long-term steady seepage, rapid drawdown, earthquake loading, and end of construction conditions. The long-term steady seepage condition considered the dikes under normal operating conditions. Rapid drawdown conditions represent a sudden lowering of the phreatic surface from flood level to steady seepage level. The earthquake loading condition was modeled using pseudo-static analysis with a horizontal seismic coefficient of 0.15g. End of construction conditions represent factors of safety under steady seepage conditions during various phases of construction.

The site phreatic surface conditions were based on available groundwater information developed in the Conceptual Site Model (CSM) report (M.S. Belgin & Associates, 2015). The Ohio River 100-yr flood elevation of 481 ft. Mean Sea Level (MSL) was used to define rapid drawdown conditions.

Proposed Ash Pond design modifications result in acceptable factors of safety. Dike geometries were shown to have acceptable safety factors for all loading conditions analyzed. These results were based on the available design information, regulatory requirements, material properties, groundwater levels, and seismic data at the time of this report.

1. INTRODUCTION

This document presents the Proposed Retention Basin Stability Analysis performed for the 1976 Ash Pond Dam (State ID KYDW ID 1215). The Ash Pond Dam is located at the Duke Energy (Duke) East Bend Station located near Rabbit Hash, Kentucky. Our analysis indicates the proposed modifications are compliant with current regulatory requirements and engineering standards of practice.

1.1 Site Location and Background

The East Bend Generating Station is located along the north bank of an eastward bend on the Ohio River in west-central Boone County, Kentucky. The Ash Pond is located adjacent to the Ohio River on the east side of the main plant (**Figure 1**). It was designed in the mid-1970s by Sargent & Lundy Engineers. Their design provided a crest elevation of 520 ft. MSL with a compacted granular fill embankment and a compacted clay core. The Ash Pond dike is configured in a "U" shape with the main section parallel to the river and short sections on the east and west ends abutting natural soils on the north side. **Figure 2** and **Figure 3** show the historical design of the Ash Pond Dam in plan and section views, respectively.

Coal Combustion Residual (CCR) has historically been deposited within the Ash Pond by hydraulic sluicing operations. From review of the available information, the physical characteristics of the Ash Pond is presented in **Table 1-1**.

Table 1-1: Ash Pond Properties

Property	Value
Surface Area (approximate)	53.4 acres
Dam Height	50 ft
Crest Width	12 ft
Crest Elevation	519 ft MSL
Impoundment Length	4,200 ft
Upstream Slope	2H:1V
Downstream Slope	2H:1V

In 2015, Amec Foster Wheeler conducted a stability analysis of the Ash Pond embankment as part of the Phase 2 Reconstitution of Design report (Amec Foster Wheeler, 2015). The stability analysis resulted in acceptable factors of safety for all loading conditions and cross sections analyzed.

1.2 Proposed Modifications

Duke plans to modify the existing Ash Pond dike and repurpose as a wastewater storage facility. Initially, ash will be excavated from the pond. The dam crest will be lowered from its current elevation of 519 ft. MSL to elevation 505 ft. MSL (approximately 14 ft). The materials excavated from the crest lowering will be used to provide the 3H:1V slopes upstream of the crest, and a divider dike will be installed within the basin as shown in **Figure 4**. The divider dike will be oriented north to south with a 30 ft. crest width and approximately 3H:1V side slopes. It will separate the basin into the new Retention Basin 1 to the west, and Retention Basin 2 to the east.

During grading operations, Duke will place a liner system on the retention basins' bottom and side slopes. The liner system will consist of the following components from bottom to top:

- Compacted subgrade;
- Geosynthetic Clay Liner (GCL);
- 60-mil double-sided textured HDPE geomembrane;
- 16 oz. geotextile;
- Granular cover material (12-in. thick); and
- Riprap (15-in. thick).

2. REGULATORY REVIEW AND REQUIREMENTS

The geotechnical analysis was performed according to the Kentucky Division of Water's "Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams" (Division of Water, 1980). These guidelines address 401 KAR 4:030 requirements.

Section 10 requires:

> *... all structures, other than low hazard structures, have a complete subsurface investigation and soils analysis submitted as an integral part of the drawings. The purpose of the investigation and analysis is to determine the stability of the structure and to assure than any repair or reconstruction results in the establishment of appropriate minimum factors of safety against slope failure (Division of Water, 1980).*

The guidelines recommend loading conditions to analyze and provide acceptable factors of safety. In addition, the guidelines reference the calculation of the factors of safety based upon both circular and translational failure surfaces. For existing dams, the loading conditions and recommended factors of safety are as shown in **Table 2-1**. The guideline states:

> *... any construction, reconstruction, or modification to dams must result in the establishment of the minimum acceptable factor of safety for the appropriate loading condition (Division of Water, 1980).*

Table 2-1: Loading Conditions and Recommended Factors of Safety

Loading Condition	Factor of Safety
Long-Term Steady Seepage	1.5
Rapid Drawdown	1.2
Earthquake Loading	1.0
End of Construction (including construction phases)	1.3*

*Note: End of Construction recommended factor of safety value was not included in 401 KAR 4:030. Therefore, the value of 1.3 was used based upon the Army Corps of Engineer's slope stability document, EM 1110-2-1982 (USACE, 2003).

3. DESIGN INPUTS

3.1 Critical Sections

The critical cross sections identified and analyzed are shown on **Figure 4** and include 1) a critical section through the eastern slope of the embankment (Section D-D') and 2) a critical section through the proposed divider dike (Section F-F'). The critical section locations were selected based upon the dike geometries and underlying material properties resulting in the lowest factors of safety. The cross section ground surface elevations were generated based on a topographic survey performed by Baumann Land Survey, Inc. (Baumann, 2014) and the proposed grading contours used in Burns & McDonnell's Issued for Permitting drawings (Burns & McDonnell, 2016).

The underlying material regions for Cross Section D-D' were identified previously in the Phase 2 Reconstitution of Design Report (Amec Foster Wheeler, 2015). This previous report identified the underlying material regions using available boring information, CPT soundings, and laboratory data. For this analysis, no changes were made to the underlying material regions because no additional subsurface information was gathered at Cross Section D-D'.

The underlying material regions for Cross Section F-F' were not previously defined in the Phase 2 Reconstitution of Design Report. Therefore, the underlying material properties were identified using available boring and CPT information in the vicinity. There is currently no available boring information directly below the proposed divider dike; therefore, underlying material regions in this area were estimated using available boring logs in the vicinity. It was also assumed the divider dike would be constructed using materials excavated from the main dike and would therefore primarily consist of granular shell material as identified in the following section. The borings and CPT soundings used for development of the cross sections are shown on **Figure 4** and included in **Appendix A**.

3.2 Material Properties

The selected geotechnical and shear strength properties were obtained from the previous Phase 2 Reconstitution of Design Report (Amec Foster Wheeler, 2015). Five regions were identified and engineering properties assigned. A brief summary of the materials and their engineering properties is presented as follows and in **Table 3-1**.

- Granular Shell: This region consists of predominately sandy soils with varying amounts of silt, clay, and gravel. Based upon review of the site geology and boring logs, it is likely this material was sourced from the sandy alluvium deposits at or near the site.
- Clay Core: Underneath the granular shell, the existing dike contains a clay core consisting of predominately clayey soils with varying amounts of sand, silt, and gravel. Based upon review of the site geology and boring logs, it is likely this material was sourced from the clayey alluvium deposits at the site.

- Clayey Alluvium: The natural materials beneath the granular shell and clay core regions are alluvial in nature and were discovered to be predominately clayey or sandy. The clayey alluvial soils were typically found in a layer immediately underneath the existing dike. This region consists of predominately clayey soils with varying amounts of sand.
- Sandy Alluvium 1: In addition to the clayey alluvial soils, there are regions of sandy alluvial soils. The sandy alluvial soils were typically found in layers immediately underneath the clayey alluvium or embankment fill materials. In addition, the sandy alluvium soils were divided into "sandy alluvium 1" and "sandy alluvium 2." This division was based upon the SPT $(N_1)_{60}$ values, with "sandy alluvium 1" soils having $(N_1)_{60}$ greater than 4. This region consists of predominately sandy soils with varying amounts of silt, clay, and gravel.
- Sandy Alluvium 2: The "sandy alluvium 2" layer is defined as having $(N_1)_{60}$ values between 0 and 4. This region consists of both sandy and fine-grained soils, but all samples were determined to be predominately sand.

Table 3-1: Unit Weight and Shear Strength Values Used in the Analysis (Amec Foster Wheeler, 2015)

Region	Unit Weight, (pcf)	Shear Strength			
		Effective		Total	
		c' (psf)	φ' (Degree)	c (psf)	Φ (Degree)
Granular Shell	133	0	36	0	36
Clay Core	134	500	32	1000	20
Clayey Alluvium	127	300	28	700	10
Sandy Alluvium 1	123	0	35	500	20
Sandy Alluvium 2	121	0	34	0	22

4. ANALYSIS METHODOLOGY AND INPUTS

The critical cross sections were analyzed using limit-equilibrium procedures (Morgenstern-Price's method) with the computer program SLOPE/W to determine the safety factors for critical failure surfaces. Critical failure surfaces were modeled as translational, deep circular, and shallow circular failures.

The stability analyses were performed on the two (2) critical cross sections, as shown on **Figure 4**, and consider both upstream and downstream failure surfaces for four (4) separate loading conditions. A total of 22 safety factors were generated based upon the analysis inputs.

4.1 Loading Conditions

4.1.1 Long-Term Steady Seepage

This analysis considers the dikes under normal operating conditions. This condition uses soil strength values and phreatic surface to reach equilibrium within and underneath the impoundment, resulting in steady-state seepage and/or hydrostatic conditions.

- Soil Strength: Drained effective shear strength parameters were used for all materials
- Dead Loads: Weight of soil, weight of impounded water in retention basins (impounded water was applied as a normally distributed force)
- Pore Water Pressure: Pore water pressures were established from available groundwater information developed in the Conceptual Site Model (CSM) report (M.S. Belgin & Associates, 2015)
- Applicable Sections: Section D-D' (upstream and downstream), Section F-F' (upstream and downstream)
- Normal Pool Elevations: Retention Basin 1 at 498.0 ft., Retention Basin 2 at 495.6 ft.

4.1.2 Rapid Drawdown

This analysis considers conditions in which the dike has been saturated by elevated river conditions and then subjected to a sudden lowering of the external water source. This analysis was performed according to the three-stage method as presented in the SLOPE/W engineering methodology manual (Geo-Slope, 2013). The phreatic surface was modeled to show the effects of both the flood state and normal pool state of the Ohio River. According to FEMA flood records, the normal pool elevation of the Ohio River was determined as approximately 455 ft. MSL, and the 100-yr flood elevation was determined as 481 ft. MSL as shown in **Figures 5 and 6** for the area. This loading condition assumes the river sustains a 100-yr flood for a period of time, followed by a sudden lowering of the river level. This analysis was performed for two scenarios: 1) Retention basins at normal pool elevation, and 2) Retention basins empty.

- Soil Strength: Drained effective and undrained total shear strength parameters were used depending on the location of the phreatic surfaces and according to the three-stage method (Geo-Slope, 2013)
- Dead Loads: Weight of soil, weight of impounded water in retention basins (impounded water was applied as a normally distributed force)
- Pore Water Pressure: Pore water pressures were established from available groundwater information developed in the CSM report (M.S. Belgin & Associates, 2015) and from available river flood data
- Applicable Sections: Section D-D' (upstream and downstream), Section F-F' (upstream and downstream)
- Scenarios: Rapid drawdown with Retention Basins at normal pool, rapid drawdown with Retention Basins empty

Rapid drawdown conditions were also considered for changes in water levels within the retention basins. However, it was assumed the impermeable liner system would not allow the changing water levels to influence the phreatic surface. Also, higher water levels inside the basins would result in higher resisting forces from the impounded water. Since the water exerts a normal force along the embankment slopes, factors of safety are increased due to the higher water levels. Therefore, rapid drawdown conditions due to changing water levels within the basins did not result in critical loading conditions.

4.1.3 Earthquake Loading

A pseudo-static analysis was performed for a design earthquake recurrence interval of 2,475 years (2 percent probability of exceedance in 50 years) (Amec Foster Wheeler, 2015). A liquefaction assessment conducted for the Phase 2 Reconstitution of Design report indicated the embankment materials were not subject to liquefaction. As described below, a horizontal seismic coefficient k_h was estimated from the Makdisi and Seed (1978) curve.

- Soil Strength: Drained effective shear strength parameters were used for sandy materials, and total shear strength parameters were used for fine-grained materials
- Dead Loads: Weight of soil, weight of impounded water in retention basins (impounded water was applied as a normally distributed force)
- Pore Water Pressure: Pore water pressures were established from available groundwater information developed in the CSM report (M.S. Belgin & Associates, 2015)
- Horizontal seismic coefficient was also applied to reflect the pseudo-static condition. The "Average" curve on **Figure 7** (Makdisi and Seed, 1978) was used to select the appropriate k_h value for each cross section.
- Applicable Sections: Section D-D' (upstream and downstream), Section F-F' (upstream and downstream)

Using the **Figure 7**, the horizontal seismic coefficient (k_h) was calculated. The maximum crest acceleration (u_{max}) was previously calculated in the Phase 2 Reconstitution of Design Report (Amec Foster Wheeler, 2015) as 0.31g. For each cross section, the failure surfaces were shown to pass through the bottom third of the embankment, which conservatively yields a y/h value of approximately 0.66. This value was used to obtain a k_h/u_{max} value of 0.48, and a resulting k_h value of 0.1488. Therefore, a k_h value of 0.15 was used in the analyses to represent a conservative pseudo-static analysis with critical failure surfaces passing through the lower third of the embankment height.

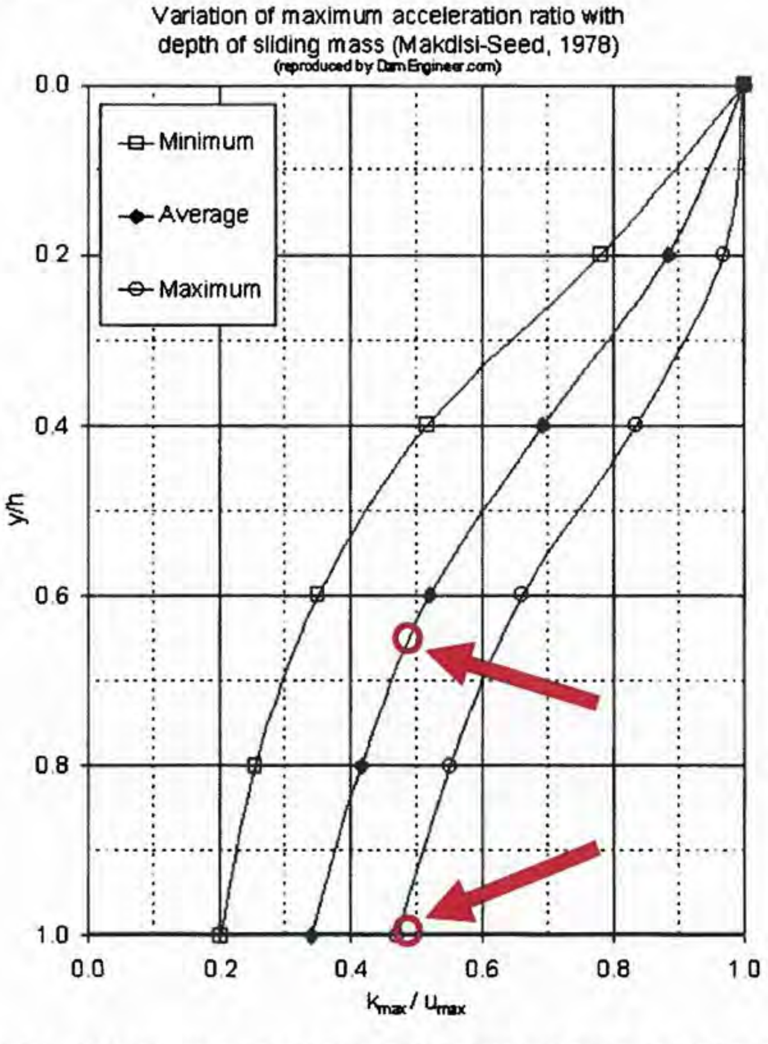


Figure 7: Variation of Maximum Acceleration Ratio with Depth of Sliding Mass (Makdisi and Seed, 1978)

4.1.4 End of Construction (Including Construction Phases)

This analysis considers the divider dike under various phases of construction. Phase 1 represents the period of time when construction of Retention Basin 1 is in progress, and Phase 2 represents the period of time when construction of Retention Basin 2 is in progress.

- Soil Strength: Drained effective shear strength parameters were used for all materials; no additional loading is present at Section D-D' at this stage, and the constructed materials in Section F-F' were primarily coarse-grained and assumed to be free-draining
- Dead Loads: Weight of soil only
- Pore Water Pressure: Pore water pressures were established from available groundwater information developed in the CSM report (M.S. Belgin & Associates, 2015)
- Applicable Sections: Section D-D' (upstream only), Section F-F' (upstream and downstream)
- Scenarios: Phase 1 (Retention Basin 1 empty, Retention Basin 2 full with sheet pile wall separation from Retention Basin 1), Phase 2 (Retention Basin 1 water elevation at 485.0 ft., Retention Basin 2 empty)

4.2 Water Levels and Seepage Conditions

Retention Basin water levels were modeled as identified in the Dam Construction Permit Application dated September 23, 2016 for the East Bend Station 1976 Ash Pond Dam (State ID KYDW 1215). **Table 4-1** includes a summary of the Retention Basin water levels and river levels as described in Section 4.1 and included in the permit application.

Table 4-1: Water Levels Used in the Analysis

Loading Condition	Section D-D'		Section F-F'	
	Upstream	Downstream	Upstream	Downstream
Normal Operating	495.6'	455.0	498.0	495.6
Phase 1 Construction	N/A	N/A	Empty	Empty
Phase 2 Construction	Empty	455.0	485.0	Empty

*N/A – Not Applicable, current conditions still exist during this phase

The site phreatic surface conditions were based on available groundwater information developed in the CSM report (M.S. Belgin & Associates, 2015). The CSM report includes groundwater surface maps generated using several piezometers located around the project site. The groundwater levels at the riverside toe of the embankment are strongly influenced by the Ohio River water levels. The groundwater surface maps at the toe of the embankment consistently reflect the river elevation of around 455 ft. MSL under normal pool levels of the Ohio River. The phreatic surface rises to around 458-460 ft. MSL north of the existing Ash Pond. For Section D-D', the phreatic surface was input as on **Figure 8**, which shows an increase in the phreatic surface from the river level to the northern end of the model. For Section F-F' the phreatic surface was input at elevation 460 ft. MSL as shown on **Figure 9**, as this section is parallel to the river along the northern edge of the pond.

For the rapid drawdown condition, the Ohio River was modeled according at the 100-yr flood elevation of 481 ft. MSL. Due to the influence of the river flood elevation and the sandy alluvial foundation soils, the phreatic surface within the dike materials was modeled at a similar elevation of 480 ft. MSL to represent the flood groundwater condition, as shown on **Figures 8 and 9**. This was chosen as a conservative estimate to represent the estimated high permeability of the sandy soils and influence from the river.

In addition, the wastewater contained within the retention basins was not allowed to influence the dikes' phreatic surface levels, i.e. the liner system eliminates recharge into dike materials. Therefore, it was assumed the steady-state phreatic surface would exist at the lower elevations within the foundation materials, as described previously.

The existing piezometer network needs to be continuously monitored during construction to confirm the ground water levels used in this analysis. Also, the piezometers removed during the dike lowering should be replaced and additional piezometers installed to confirm the liner integrity and the ground water levels used in this analysis.

5. ANALYSIS RESULTS

The analyses were performed using SLOPE/W, and the results for each critical failure surface are presented in **Appendix B**. The output files include the material regions, piezometric conditions, slip surface definition criteria, and dead loads applied to the models. The resulting factors of safety are also shown on the plots.

A compilation of slope stability analysis results and critical failure surfaces are shown on **Figures 8 and 9** for cross sections D-D' and F-F', respectively. The factor of safety results for each loading condition and section face are also included in **Tables 5-1 and 5-2**. As shown, each analysis results in a factor of safety value greater than the required factor of safety as outlined in Section 2 of this report.

Table 5-1: Summary of Stability Analysis for Section D-D'

Loading Condition	Section Face	Factor of Safety	Required Factor of Safety
Long-Term Steady Seepage	Downstream	1.64	1.5
Long-Term Steady Seepage	Upstream	4.64	1.5
Rapid Drawdown (full basin)	Downstream	1.36	1.2
Rapid Drawdown (full basin)	Upstream	2.34	1.2
Rapid Drawdown (empty basin)	Downstream	1.36	1.2
Rapid Drawdown (empty basin)	Upstream	2.21	1.2
Earthquake Loading	Downstream	1.10	1.0
Earthquake Loading	Upstream	2.15	1.0
Phase 2 Construction	Downstream	1.64	1.3
Phase 2 Construction	Upstream	2.33	1.3

Table 5-2: Summary of Stability Analysis for Section F-F'

Loading Condition	Section Face	Factor of Safety	Required Factor of Safety
Long-Term Steady Seepage	Downstream	2.43	1.5
Long-Term Steady Seepage	Upstream	3.12	1.5
Rapid Drawdown (full basin)	Downstream	2.82	1.2
Rapid Drawdown (full basin)	Upstream	3.04	1.2
Rapid Drawdown (empty basin)	Downstream	1.84	1.2
Rapid Drawdown (empty basin)	Upstream	1.90	1.2
Earthquake Loading	Downstream	1.63	1.0
Earthquake Loading	Upstream	1.78	1.0
Phase 1 Construction	Downstream	2.30	1.3
Phase 1 Construction	Upstream	2.28	1.3
Phase 2 Construction	Downstream	2.30	1.3
Phase 2 Construction	Upstream	2.38	1.3

6. ALTERNATE CONFIGURATION ASSESSMENT

Proposed Ash Pond design modifications result in acceptable factors of safety. Dike geometries were shown to have acceptable safety factors for all loading conditions analyzed. These results were based on the available design information, regulatory requirements, material properties, groundwater levels, and seismic data at the time of this report. If any design inputs are noted to change in the future, we recommend an additional analysis using the new parameters. In addition, we recommend monitoring of existing piezometers and/or installation of additional piezometers to confirm the groundwater levels used in the analysis.

Call Matt Bishop at (865) 671-6774 if you have any questions or comments.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

Matt Bishop
Matt Bishop
Staff Professional

Luke C Williams
Luke C. Williams, PE
Senior Engineer

STATE OF KENTUCKY
LUKE C. WILLIAMS
14,642
REGISTERED PROFESSIONAL ENGINEER
/16

7. REFERENCED DOCUMENTS

Amec Foster Wheeler (2015), "Phase 2 Reconstitution of Ash Pond Designs, Final Report Submittal, East Bend Station," July 6, 2015.

Baumann Land Survey, Inc. (Baumann, 2014), "Existing Topography Survey," Topographic Drawings, December 17, 2014.

Burns & McDonnell (2016), "Water Redirection Program, Retention Basin," Issued for Permitting Drawings, September 9, 2016.

Commonwealth of Kentucky, Department for Natural Resources and Environmental Protection, Bureau of Environmental Protection, Division of Water (Division of Water, 1980), "Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams," June 1, 1980.

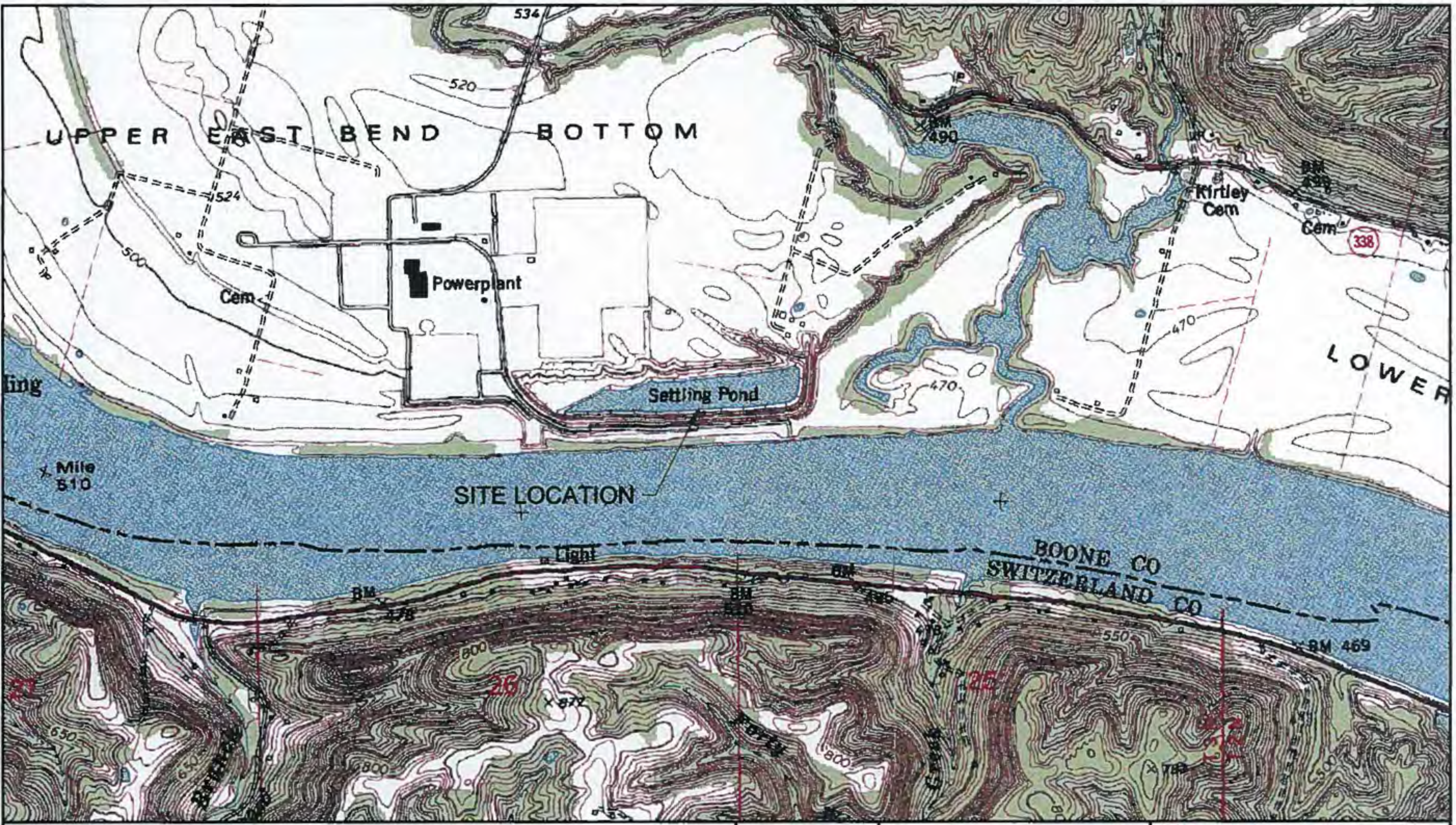
GEO-SLOPE International, Ltd. (Geo-Slope, 2013), "Stability Modeling with SLOPE/W, An Engineering Methodology," September 2013.

Makdisi F, and Seed H (1978), "Simplified Procedure for Estimating Dam and Embankment Earthquake Induced Deformations," Journal of Geotechnical Engineering, 104(7): 849–867, 1978.

M.S. Belgin & Associates (2016), "Conceptual Site Model (CSM), East Bend Station, Draft," March 29, 2016.

US Army Corps of Engineers (USACE, 2003), "Engineering and Design, Slope Stability, EM 1110-2-1902," October 31, 2003.

FIGURES



N
0 200' 500' 1000' 2000'
1"=1000'

Amec Foster Wheeler
Environment & Infrastructure
2030 Falling Waters Road, Suite 300
Knoxville, TN 37922

amec foster wheeler

CLIENT:
DUKE ENERGY

TITLE:
SITE LOCATION PLAN
EAST BEND STATION
BOONE COUNTY, KENTUCKY

DR: WRW
REV: LCW
PROJ. NO.: 7810150345
CHK: MDB
DATE: 08/05/2016
DWG NO. NA
SCALE: AS SHOWN
FIGURE 1

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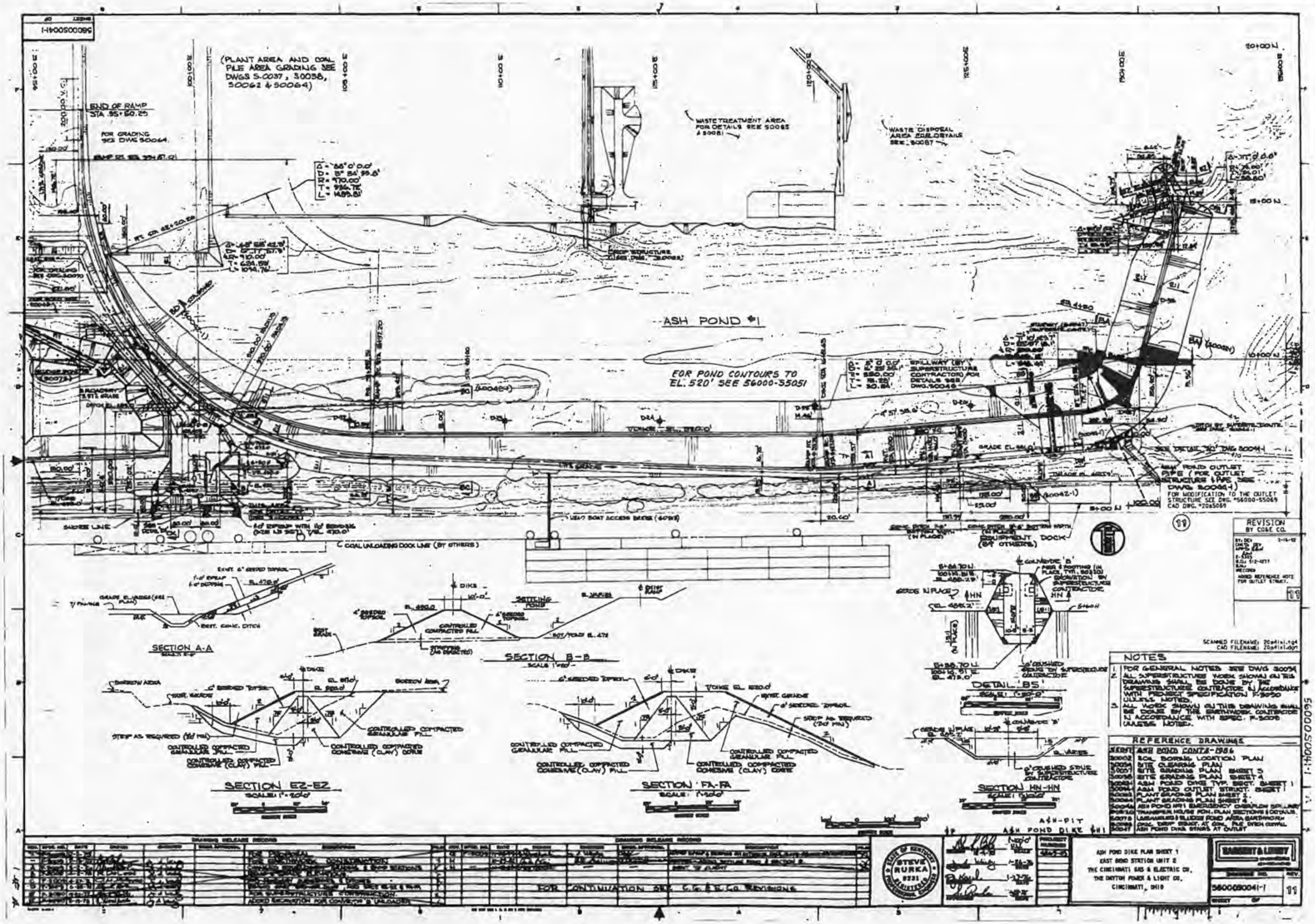

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NOTES

1. FOR GENERAL NOTES SEE DWG 30034
2. ALL SUPERSTRUCTURE WORK SHOWN ON THIS DRAWING SHALL BE DONE BY THE SUPERSTRUCTURE CONTRACTOR IN ACCORDANCE WITH PROJECT SPECIFICATION F-3050 UNLESS NOTED.
3. ALL WORK SHOWN ON THIS DRAWING SHALL BE DONE BY THE EARTHWORK CONTRACTOR IN ACCORDANCE WITH SPEC. F-3006 UNLESS NOTED.

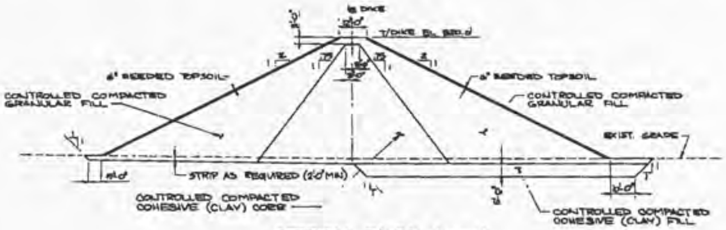
REFERENCE DRAWINGS

[illegible]	ASH POND CONTR-1986
30002	SOIL BORING LOCATION PLAN
30034	SITE CLEARING PLAN
S0037	SITE GRADING PLAN SHEET 3
30038	SITE GRADING PLAN SHEET 4
[illegible]	ASH POND DIKE TYP. SECT. SHEET 1
[illegible]	ASH POND OUTLET STRUCT. SHEET 1
[illegible]	PLANT GRADING PLAN SHEET 3
[illegible]	PLANT GRADING PLAN SHEET 4
[illegible]	ASH POND NO 1 EMERGENCY OVERFLOW SPILLWAY
[illegible]	TRANSFER HOUSE FDN. PLAN SECTIONS & DETAILS
[illegible]	UNSHARED & SLUDGE POND AREA EARTHWORK
[illegible]	[illegible] DROP STRUCT. AT COAL PILE DITCH OUTFALL
[illegible]	ASH POND DIKE STAIRS AT OUTLET

ASH POND DIKE PLAN SHEET 1
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

DRAWING NO. 560005004I-1 REV. 11

56000S0042-1



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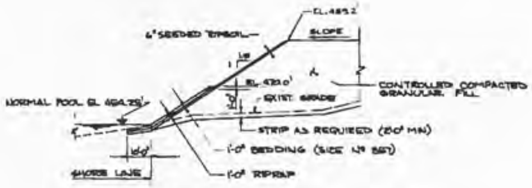

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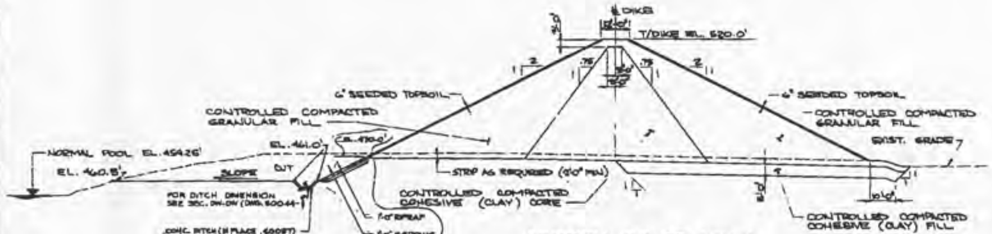

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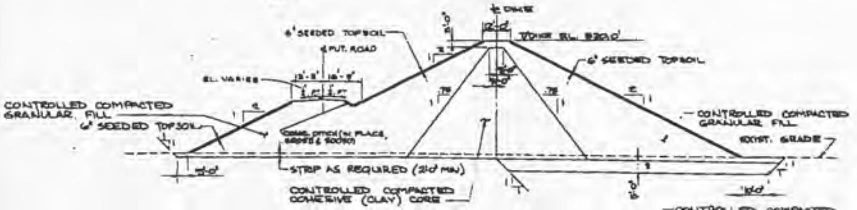

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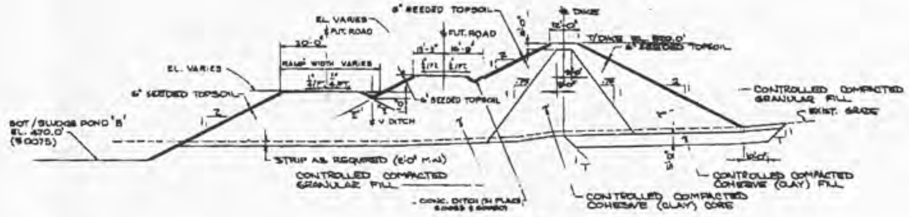

SECTION BD-BD (S0041-1)
STA 35+20

NOTES

1. FOR GENERAL NOTES SEE DWG. S0034

REFERENCE DRAWINGS

S0034	SITE CLEARING PLAN
S0041-1	ASH POND DIKE PLAN SHEET 1
S0075	LIME HANDLING & SLUDGE POND AREA EARTHWORK

ASH-PIT
ASH POND DIKE SH1

GRAPHIC SCALE

DRAWING RELEASE RECORD

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A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	CHANGED [illegible] AREA GRADING ELEVATIONS	X
B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ADD [illegible] DITCHES	X
C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	ADDED [illegible]	X
C	—	[illegible]	[illegible]	—	—	SENT TO CLIENT	X

STATE OF KENTUCKY
STEVE RURKA
9231
REGISTERED PROFESSIONAL ENGINEER

DRAWN 12-9-76
CHECKED 1-26-76 DATE
1-27-76 DATE
ENGINEER DATE

SCALE
PROJECT NUMBER

ASH POND DIKE TYPICAL SECTIONS SHEET 1
EAST BEND STATION UNIT 2
THE CINCINNATI GAS & ELECTRIC CO.
THE DAYTON POWER & LIGHT CO.
CINCINNATI, OHIO

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. 56000S0042-1
REV. C
SHEET OF

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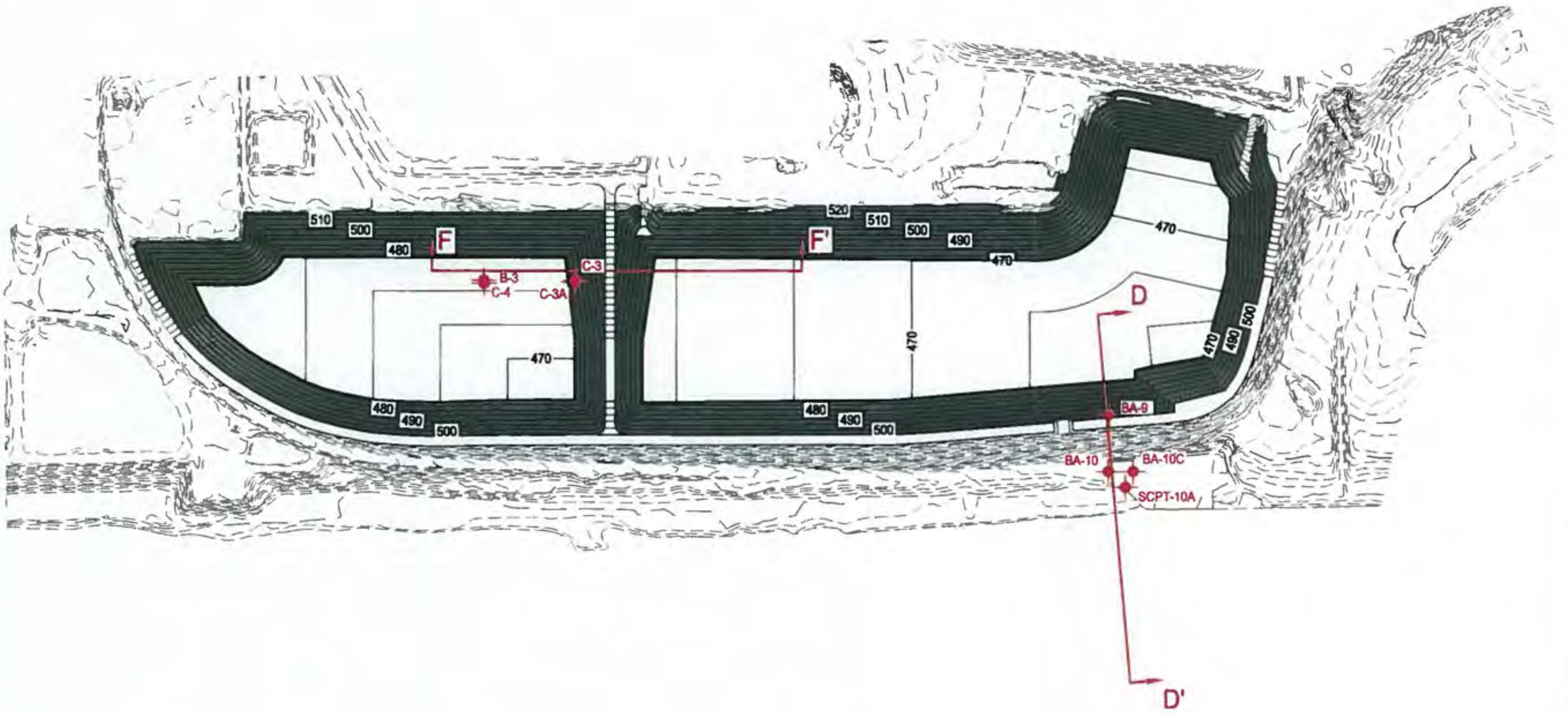

LEGEND

✦	HISTORICAL BORINGS AND CPT SOUNDINGS USED IN ANALYSIS
— — —	E_ISTING MAJOR CONTOURS
- - - - -	E_ISTING MINOR CONTOURS
———	PROPOSED MAJOR CONTOUR
———	PROPOSED MINOR CONTOUR

N

0 60' 150' 300' 600'

1"=300'

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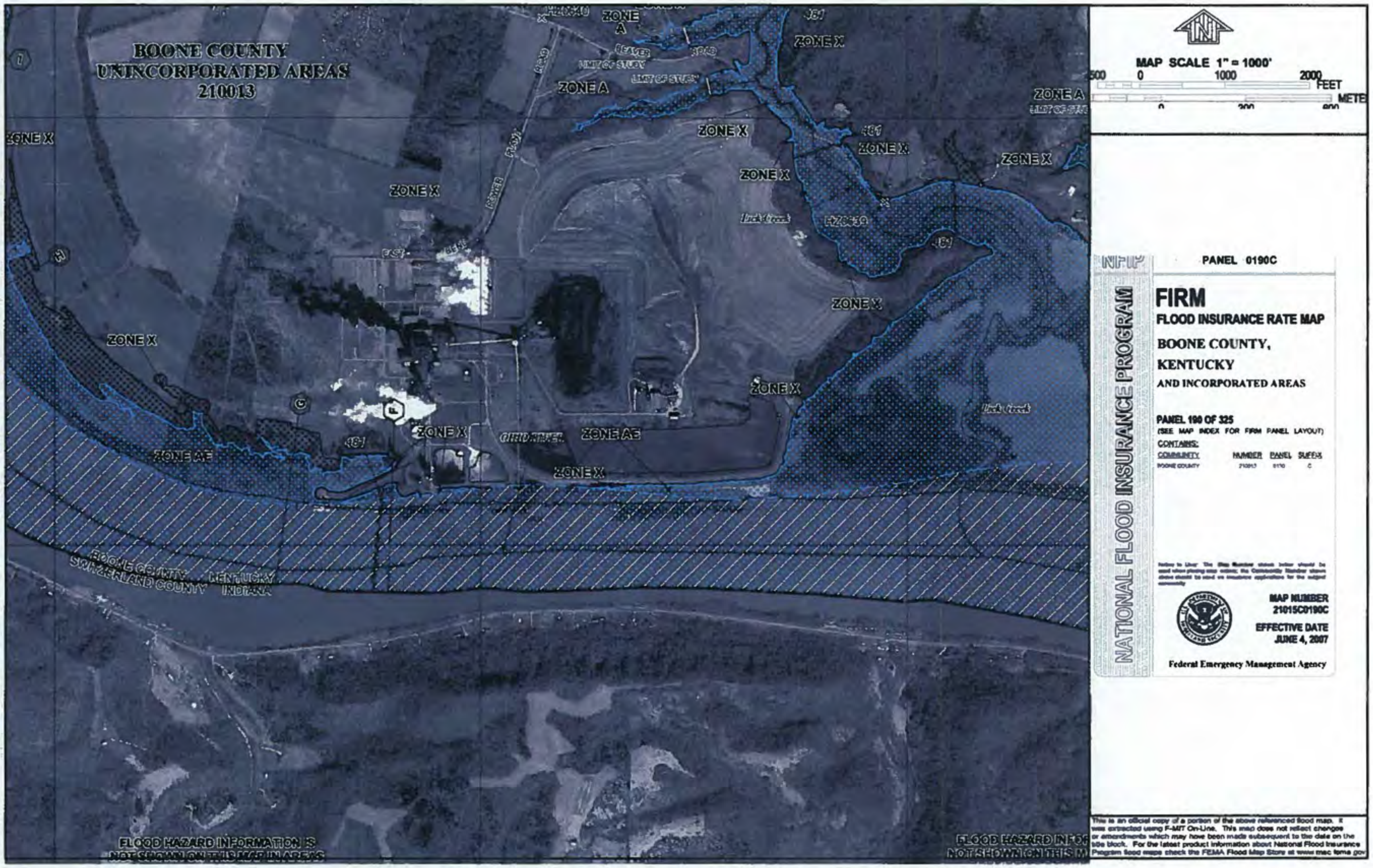
amec foster wheeler

CLIENT: DUKE ENERGY

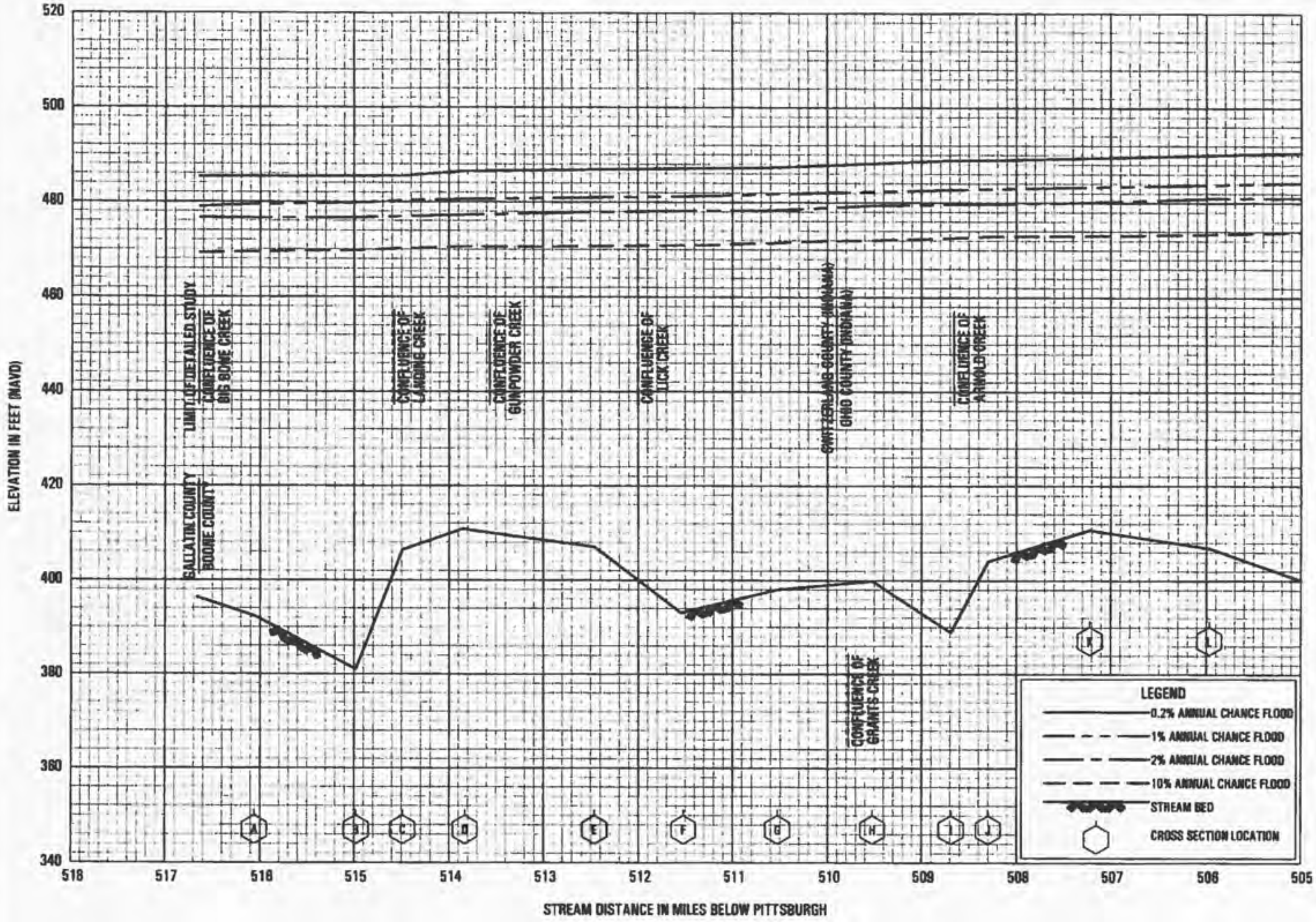
TITLE:

BORINGS AND CROSS SECTION PLAN
EAST BEND STATION
BOONE COUNTY, KENTUCKY

DR: WRW	REV: LCW	PROJ. NO.: 7810150345
CHK: MDB	DATE: 08/05/2016	DWG NO. NA
SCALE:	AS SHOWN	FIGURE 4



This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



FLOOD PROFILES

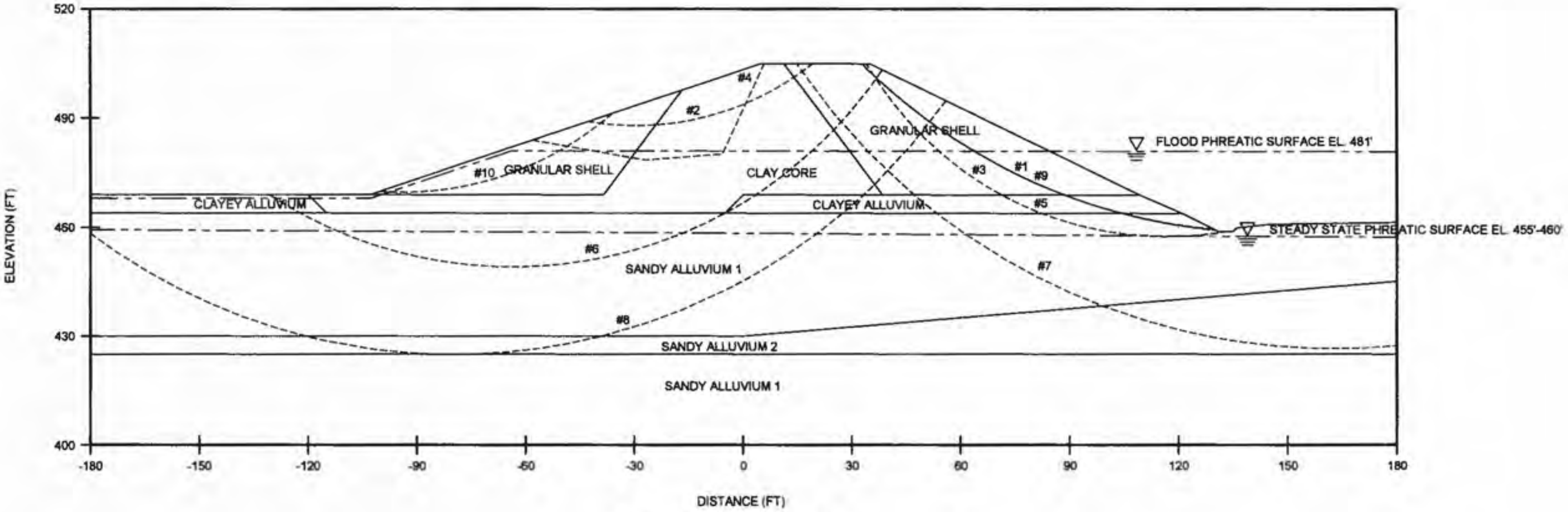
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BOONE COUNTY, KY

AND INCORPORATED AREAS

01P



SECTION D - D'

HORZ SCALE: 1" = 30'
VERT SCALE: 1" = 30'

Parameters for Analyses					
Region	Unit Weight, (pcf)	Shear Strength			
		Effective		Total	
		c' (psf)	ϕ' (Degree)	c (psf)	Φ (Degree)
Granular Shell	133	0	36	0	36
Clay Core	134	500	32	1,000	20
Clayey Alluvium	127	300	28	700	10
Sandy Alluvium 1	123	0	35	500	20
Sandy Alluvium 2	121	0	34	0	22

Summary of Stability Analyses			
Circle	Condition	Section Face	F.S.
1	Long-Term Steady Seepage	Downstream	1.64
2	Long-Term Steady Seepage	Upstream	4.64
3	Rapid Drawdown (full basin)	Downstream	1.36
4	Rapid Drawdown (full basin)	Upstream	2.34
5	Rapid Drawdown (empty basin)	Downstream	1.36
6	Rapid Drawdown (empty basin)	Upstream	2.21
7	Earthquake Loading	Downstream	1.10
8	Earthquake Loading	Upstream	2.15
9	Phase 2 Construction	Downstream	1.64
10	Phase 2 Construction	Upstream	2.33

LEGEND

———	MATERIAL REGION
- - - - -	CRITICAL FAILURE SURFACE
—▽—	PHREATIC SURFACE

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TITLE:
SECTION D - D' ANALYSIS RESULTS
EAST BEND STATION
BOONE COUNTY, KENTUCKY

DR: WRW	REV: LCW	PROJ. NO.: 7810150345
CHK: MDB	DATE: 09/23/2016	DWG NO. NA
SCALE:	AS NOTED	FIGURE 8

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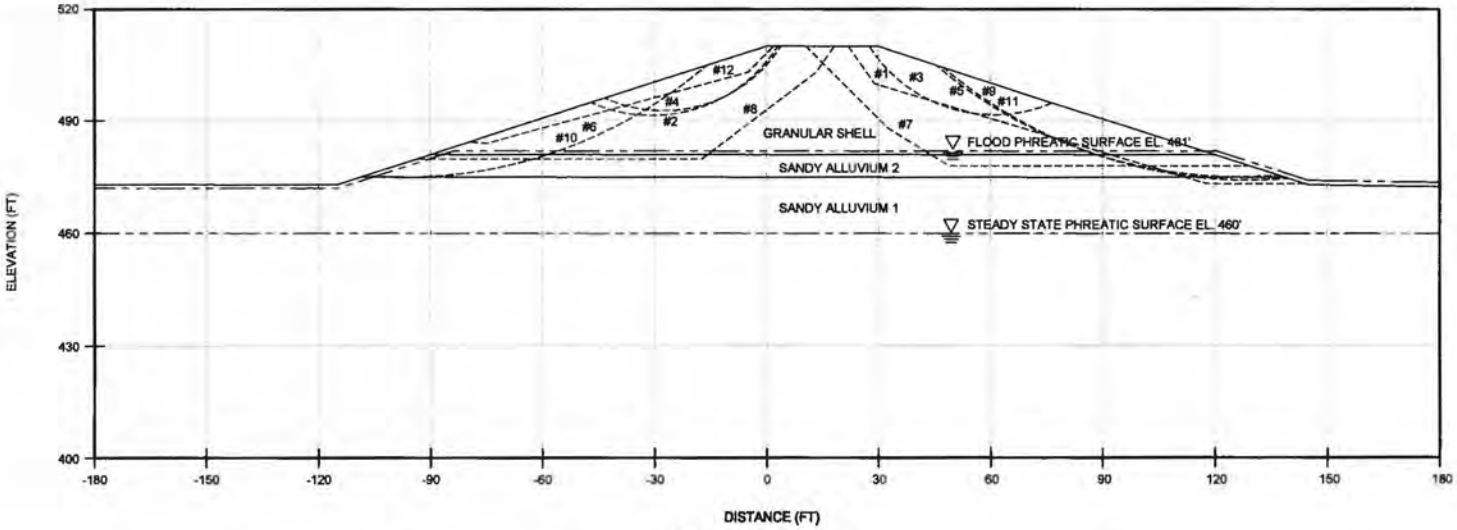

SECTION F - F'

HORZ SCALE: 1" = 30'
VERT SCALE: 1" = 30'

Parameters for Analyses					
Region	Unit Weight, (pcf)	Shear Strength			
		Effective		Total	
		c' (psf)	ϕ' (Degree)	c (psf)	Φ (Degree)
Granular Shell	133	0	36	0	36
Sandy Alluvium 1	123	0	35	500	20
Sandy Alluvium 2	121	0	34	0	22

Summary of Stability Analyses			
Circle	Condition	Section Face	F.S.
1	Long-Term Steady Seepage	Downstream	2.43
2	Long-Term Steady Seepage	Upstream	3.12
3	Rapid Drawdown (full basin)	Downstream	2.82
4	Rapid Drawdown (full basin)	Upstream	3.04
5	Rapid Drawdown (empty basin)	Downstream	1.84
6	Rapid Drawdown (empty basin)	Upstream	1.90
7	Earthquake Loading	Downstream	1.63
8	Earthquake Loading	Upstream	1.78
9	Phase 1 Construction	Downstream	2.30
10	Phase 1 Construction	Upstream	2.28
11	Phase 2 Construction	Downstream	2.30
12	Phase 2 Construction	Upstream	2.38

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LEGEND

———— MATERIAL REGION
- - - - - - CRITICAL FAILURE SURFACE
—▽— PHREATIC SURFACE

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2030 Falling Waters Road, Suite 300
Knoxville, TN 37922

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CLIENT: DUKE ENERGY

TITLE:
SECTION F - F' ANALYSIS RESULTS
EAST BEND STATION
BOONE COUNTY, KENTUCKY

DR: WRW	REV: LCW	PROJ. NO.: 7810150345
CHK: MDB	DATE: 09/23/2016	DWG NO. NA
SCALE: AS NOTED		FIGURE 9

APPENDICES

Appendix A
Referenced Boring Logs and CPT Soundings

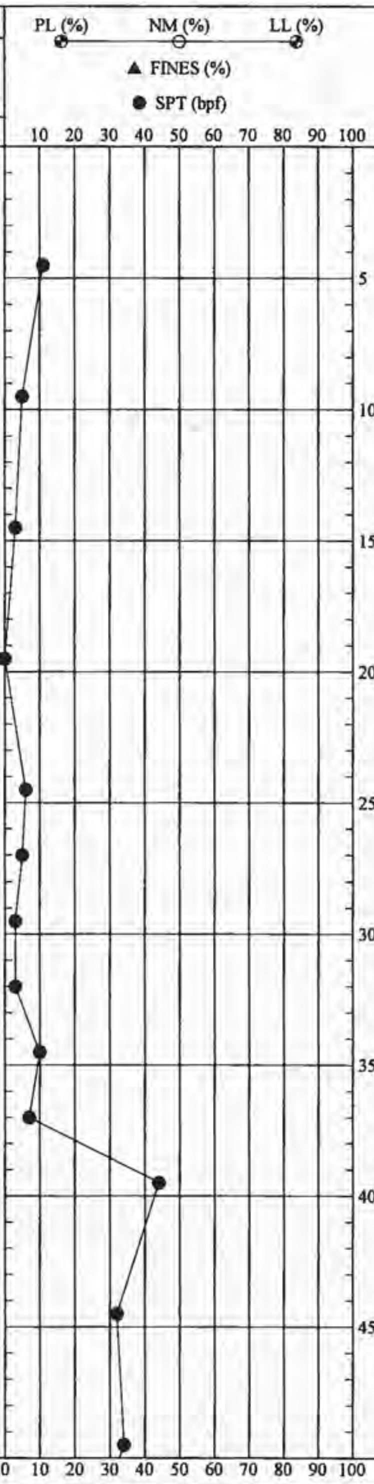
SOIL CLASSIFICATION AND REMARKS

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	ASH FILL: Dark Brown-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Dry	509.8
5		504.8
	▼ Wet and Yellow-Orange-Tan "Rust" Color with the Dark-Brown-Gray ~8 ft bgs	
10		499.8
15		494.8
	FILL: Tan, Fine to Very Fine **SAND** (SM), Wet	
20	FILL: Tan and Black Laminated, Slightly Clayey, **SILT** (ML) with Minor Fine to Very Fine Sand Lenses, Wet	489.8
	FILL: Light Tan-Gray, Silty, Fine to Very Fine **SAND** (SM)	
25		484.8
	ASH FILL: Dark Brown-Gray **BOTTOM ASH**, Which Classifies as Coarse to Fine **SAND** with Gravel and Sand-Sized Coal and Slag Fragments, Wet	
	ALLUVIAL: Very Dark Gray, Slightly Clayey, Silty, Fine to Very Fine **SAND** (ML) with Trace Organics, Wet	
30		479.8
	ALLUVIAL: Red-Tan, Silty, Clayey, Fine **SAND** (SC), Wet	
	ALLUVIAL: Red-Tan, Silty, Fine to Very Fine **SAND** (SM), Wet	
	ALLUVIAL: Red-Tan, White, Slightly Clayey, Gravelly, Fine **SAND** (GC), Wet	
35		474.8
	ALLUVIAL: Tan-Brown, Fine **SAND** (SM), Wet	
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet Some Clayey Lenses and Sand Becomes More Coarse with Depth ~38 to 55 ft bgs	
40		469.8
45		464.8
50		459.8

SAMPLES

IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
SS-1	(1.1) WOR-5-6
SS-2	(0.9) WOR-2-3
SS-3	(1.3) 1-2-1
BULK-1	
SS-4	(1.5) 2-WOH-WOH
UD-1	(1.3)
SS-5	(1.2) 4-3-3
SS-6	(1.2) WOR-2-3
SS-7	(1.3) 1-1-2
SS-8	(1.0) 1-1-2
SS-9	(0.5) WOR-4-6
SS-10	(0.9) WOR-3-4
SS-11	(0.9) 7-21-23
SS-12	(0.9) 10-13-19
SS-13	(1.2) 8-15-19



CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~8 ft bgs

REVIEWED BY: ____________________

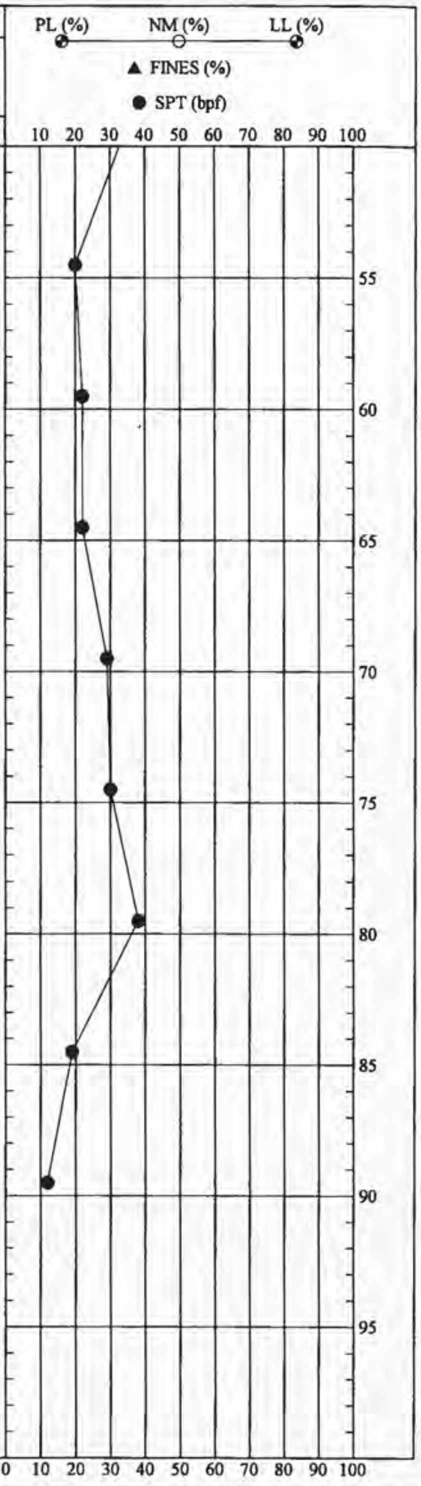
GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
COORD N: 511240
COORD E: 1471223
LOCATION: Union, Kentucky

START DATE: 2/18/2016
COMP. DATE: 2/19/2016
Page 1 **of** 2

BORING NO.: B-3

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
50	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet	459.8		
			SS-14	(1.1) 8-9-11
55		454.8		
			SS-15	(1.5) 5-10-12
60	ALLUVIAL: Tan-Brown, Coarse to Fine, Sandy **GRAVEL** (GW), Wet	449.8		
			SS-16	(1.2) 6-9-13
65		444.8		
			SS-17	(1.4) 6-13-16
70		439.8		
	ALLUVIAL: Tan-Brown, Gravelly, Coarse to Fine **SAND** (SW), Wet			
			SS-18	(1.5) 8-14-16
75		434.8		
			SS-19	(1.5) 17-20-18
80		429.8		
			SS-20	(1.4) 21-15-4
85		424.8		
			SS-21	(0.8) 28-8-4
90	**Boring Terminated at 90 ft bgs**	419.8		
95		414.8		
100		409.8		



DUKE CCP GEOTECHNICAL BORING LOG EASTBEND ASH CLOSURE BORING LOGS.GPJ AMEC DUKE ABSAT.GDT 4/5/16

CONTRACTOR:	S&ME, Inc. (B. Hoskins)
LOGGED BY:	C. Murphy
EQUIPMENT:	CME-550X
DRILL METHOD:	3.25" HSA
HOLE DIAMETER:	~6.5"
CLOSURE METHOD:	Tremie Grout
REMARKS:	Water Level at TOB was ~8 ft bgs; 24-hr Water Level was ~8 ft bgs

REVIEWED BY: ____________

GEOTECHNICAL BORING RECORD

PROJECT NAME: East Bend Ash Closure
PROJECT NO.: 7810.15.0345
START DATE: 2/18/2016
COORD N: 511240
COMP. DATE: 2/19/2016
COORD E: 1471223
Page 2 of 2
LOCATION: Union, Kentucky

BORING NO.: B-3

S&ME

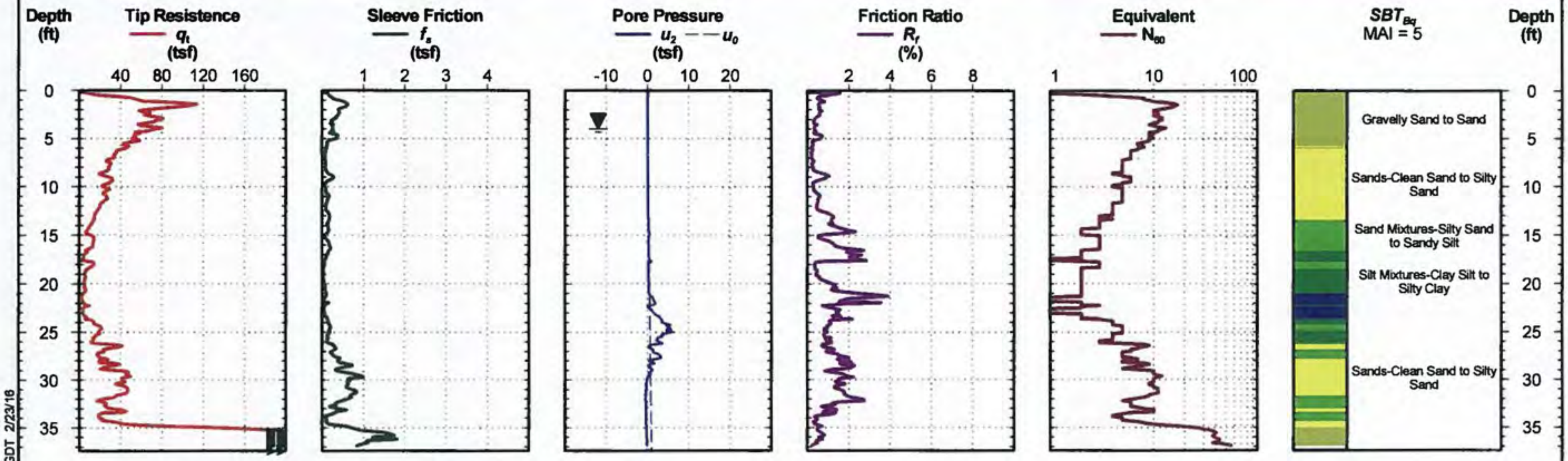
Duke - East Bend CPT Services
Rabbit Hash, Kentucky
S&ME Project No: 1917-16-003

Cone Penetration Test

C-3

Date: Feb. 18, 2016
Estimated Water Depth: 4 ft
Rig/Operator: Gyrotrack/A. Feix

Total Depth: 37.4 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD - SBT BQ 1917-16-003_CPT.GPJ LIBRARY 2011_06_28.GDT 2/23/16

Electronic Filename: *H18F1603C.DAT*

S&ME

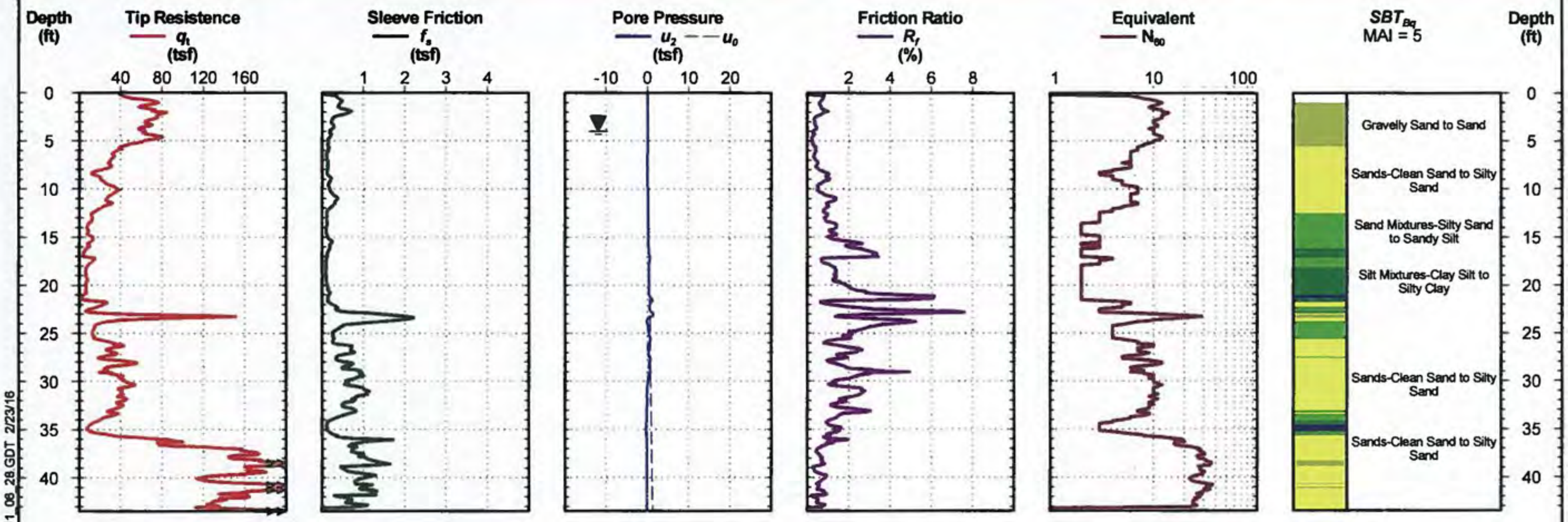
Duke - East Bend CPT Services
Rabbit Hash, Kentucky
S&ME Project No: 1917-16-003

Cone Penetration Test

C-3A

Date: Feb. 18, 2016
Estimated Water Depth: 4 ft
Rig/Operator: Gyrotrack/A. Feix

Total Depth: 43.5 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD - SBT BQ 1917-16-003_CPT.GPJ LIBRARY 2011_06_28.GDT 2/23/16

Page 1 of 1

Electronic Filename: *H18F1604C.DAT*

C-3A

S&ME

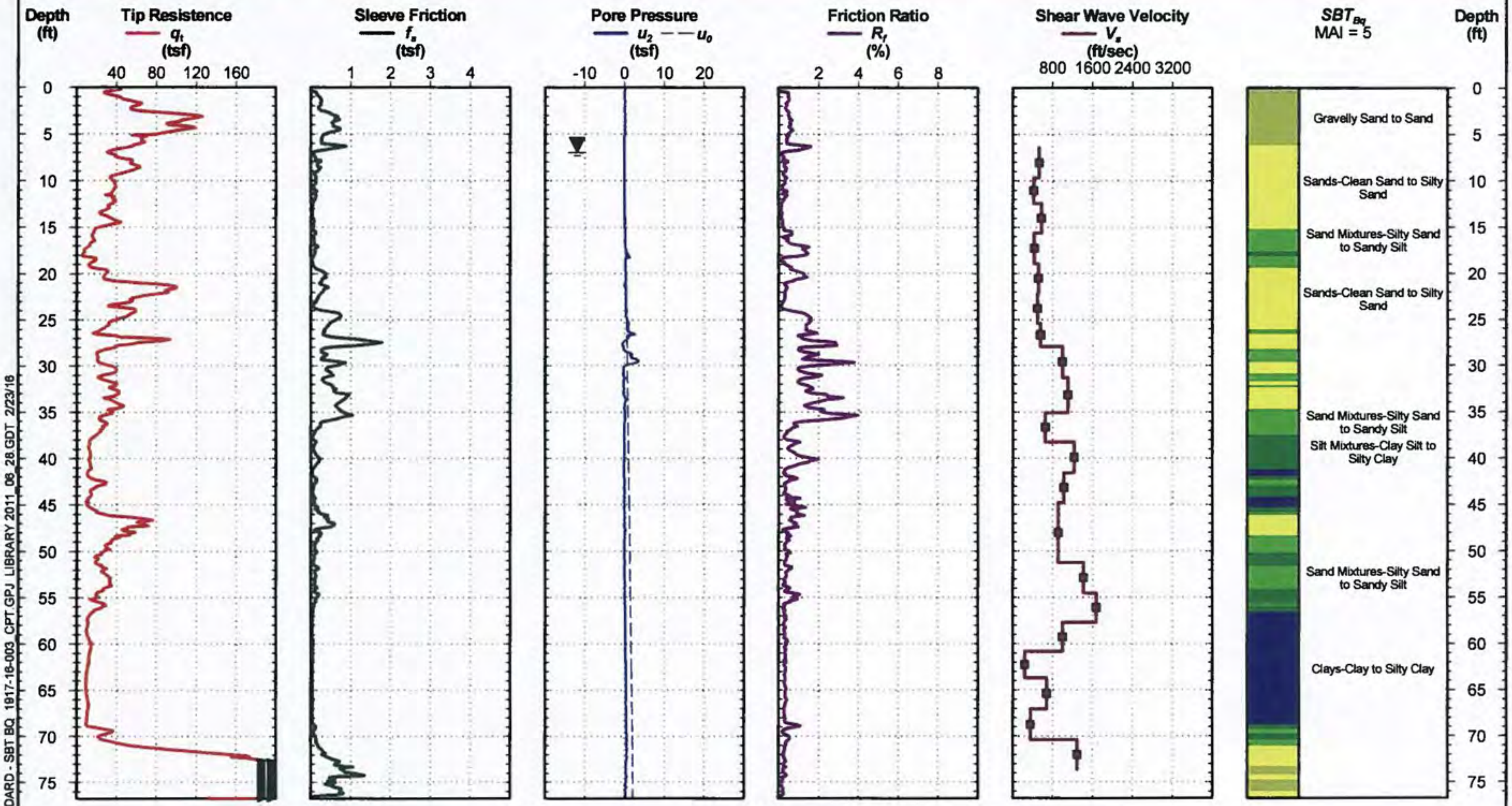
Duke - East Bend CPT Services
Rabbit Hash, Kentucky
S&ME Project No: 1917-16-003

Cone Penetration Test

C-4

Date: Feb. 17, 2016
Estimated Water Depth: 7 ft
Rig/Operator: Gyrotrack/A. Feix

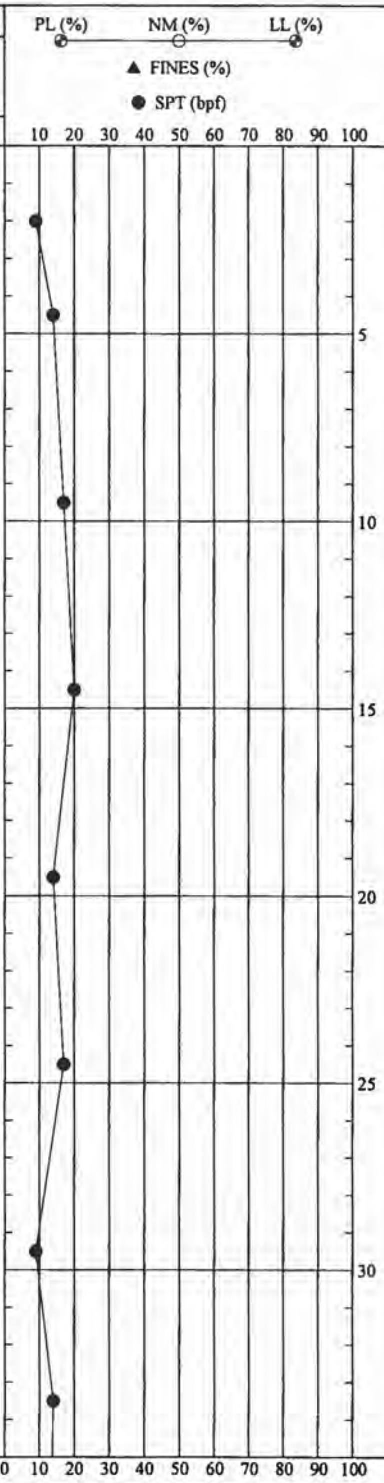
Total Depth: 76.8 ft
Termination Criteria: Maximum Reaction Force
Cone Size: 1.75



CPT REPORT - STANDARD - SBT BQ 1917-16-003 CPT.GPJ LIBRARY 2011_06_28.GDT 2/23/16

Electronic Filename: H17F1601C.DAT

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Fill		519.0			
	Fill: loose, moist, brown, Silty Sand (SM), mostly fine to medium sand, few fine gravel trace root fragments			SS-1		(14) 3-5-4
5	Fill: medium dense, moist, brown with light gray mottling, Silty gravel with sand (GM), little non plastic fines, some fine to medium sand, mostly fine gravel, trace root fragments		514.0	SS-2		(14) 6-8-6
10	Fill: very stiff, moist, brown with dark gray mottling, Sandy lean CLAY with gravel (CL), mostly non plastic fines (clay), some fine sand, little fine gravel		509.0	SS-3		(18) 3-7-10
15	Fill: very stiff, moist, brown with dark brown , dark gray mottling, Sandy lean CLAY (CL), mostly non plastic fines, some fine sand, few fine gravel, trace root fragments		504.0	SS-4		(18) 3-10-10
20	stiff, dark grayish brown with brown mottling, trace fine gravel, trace non plastic fines (clay)		499.0	SS-5		(18) 4-6-8
25	very stiff, brown with dark grayish brown mottling, trace few non plastic fines (clay)		494.0	SS-6		(18) 5-7-10
30	Fill: stiff, moist, brown with trace gray mottling, Lean CLAY (CL), few fine sand, mostly low plasticity fines (clay), little non plastic fines (silt)		489.0	SS-7		(14) 3-3-6
35	Fill: stiff, moist, brown with dark grayish brown mottling, Lean CLAY with sand (CL), mostly non to low plasticity fines (clay), little non plastic fines (silt), little fine sand, trace fine gravel		484.0	SS-8		(18) 3-5-9



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 66.5 ft bgs at time of drilling.

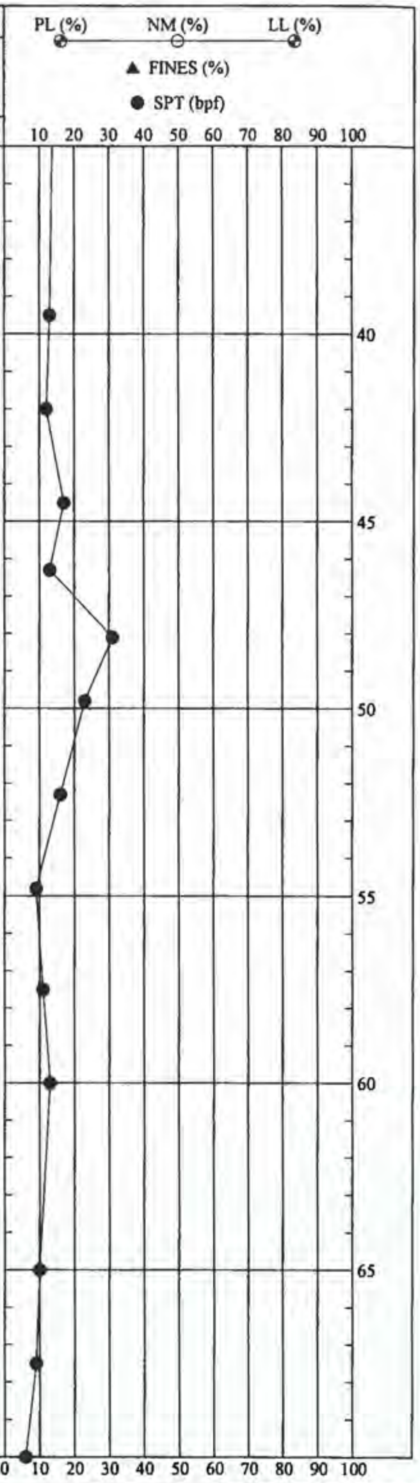
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page 1 of 3**
LOCATION: East Bend Station, KY

BORING NO.: BA-9

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	SAMPLES (Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35		484.0		
	trace grayish brown mottling, few non plastic fines (silt), trace fine gravel		SS-9	(16) 3-6-7
40		479.0		
	Fill: stiff, moist, brown, Sandy lean CLAY (CL), mostly non plastic fines (silt), little to some fine sand, trace non plastic fines (clay), trace black oxide nodules Fill: stiff, moist, brown, Sandy lean CLAY (CL), mostly non plastic fines (silt), little to some fine sand, trace non plastic fines (clay), trace black oxide nodules		SS-10	(18) 3-5-7
	Fill: very stiff, moist, brown with trace gray mottling, Lean Clay (CL), mostly low plasticity fines (clay), little non plastic fines (silt), few fine sand, trace fine gravel		SS-11	(18) 5-8-9
45		474.0		
	stiff, few non plastic fines (silt), trace fine sand and gravel		SS-12	(11) 5-6-7
	Fill: hard, moist, brown with grayish brown mottling, Lean CLAY with sand (CL), mostly low plasticit fines (clay), little fine sand, trace fine gravel, trace roof fragments		SS-13	(17) 9-15-16
	Fill: hard, moist, brown with grayish brown mottling, Lean CLAY with sand (CL), mostly low plasticit fines (clay), little fine sand, trace fine gravel, trace roof fragments		SS-14	(18) 8-10-13
50		469.0		
	Fill: very stiff, moist, brown with dark grayish brown mottling, Lean CLAY (CL), mostly low plasticity fines (clay), few non plastic fines (silt), trace fine sand and gravel, trace roots			
	Alluvium: very stiff , moist,brown with gray mottling, Lean CLAY (CL), mostly low plasticity fines (clay), few non plsatic fines (silt), trace fine sand		SS-15	(14) 3-7-9
	Alluviuum: stiff, moist, brown, Silt with sand (ML), mostly non plsatic fines (silt), little fine sand, trace low plasticity fines (clay)		SS-16	(14) 2-4-5
55		464.0		
	Alluviuum: medium dense, moist brown, Well graded SAND with silt (SW-SM), mostly fine to medium sand, few non plastic fines (silt)		SS-17	(10) 4-5-6
			SS-18	(8) 15-7-6
60		459.0		
	driller missed interval		SS-19	(NA) NA-NA-NA
	loose loose		SS-20	(6) 3-4-6
65		454.0		
	wet ∇		SS-21	(6) 4-4-5
	trace non to low plasticity fines (clay)			(10)
70		449.0		



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER:	8" Solid stem / 3" Casing advancer
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at 66.5 ft bgs at time of drilling.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

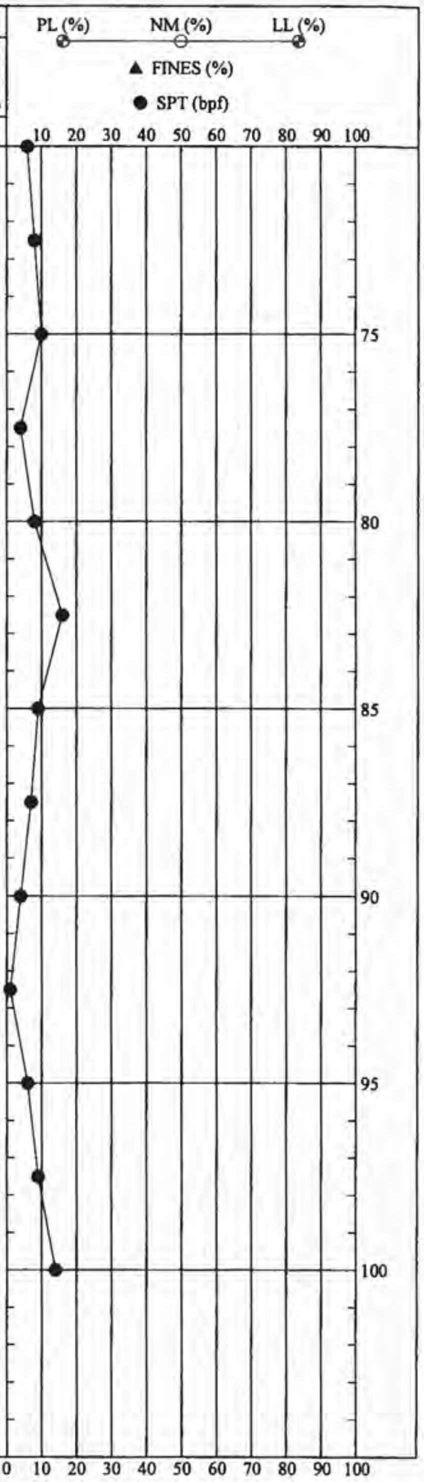
PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page** 2 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-9

amec

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

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
70		449.0	SS-22	3-3-3
			SS-23	(11) 1-1-7
75	little non plastic fines (silt)	444.0	SS-24	(10) 1-5-5
	Alluvium: very loose wet, brown, Silty SAND (SM), mostly fine to medium sand, little to some non plastic fines (silt), trace non to low plasticity fines (clay)		SS-25	(18) 2-2-2
80	loose	439.0	SS-26	(14) 3-3-5
	Alluvium: medium dense, wet, brown, Well graded SAND (SW), mostly fine to medium sand, trace coarse sand, trace few non plastic fines (silt)		SS-27	(10) 5-7-9
85	Alluvium: loose, wet, dark gray, Silty SAND (SM), mostly fine to medium sand, little to some non plastic fines (silt), trace non to low plasticity fines (clay)	434.0	SS-28	(13) 2-4-5
			SS-29	(14) 2-3-4
90	No Recovery	429.0	SS-30	(0) WOR-2-2
	Alluvium: very soft, moist, dark gray, Lean Clay (CL), few fine sand, mostly low plasticity fines (clay)		SS-31	(5) WOR-WOR-1
95	Alluvium: loose, wet, gray, Well graded SAND (GW), mostly fine to medium sand (trace coarse), trace few to non plastic fines (silt)	424.0	SS-32	(5) 3-3-3
	brown, mostly fine to coarse sand, trace fine gravel, trace non plastic fines (silt)		SS-33	(5) 1-4-5
100	medium dense, trace few fine gravel	419.0	SS-34	(8) 5-8-6
	Boring terminated at 100.5 feet			
105		414.0		



CONTRACTOR: S & ME/ P. Tuttle
LOGGED BY: N. J. Smith
EQUIPMENT: CME 550X
DRILL METHOD: Hollow stem to 9' / Casing advancer 9' to 100.5'
HOLE DIAMETER: 8" Solid stem / 3" Casing advancer

CLOSURE METHOD: Tremie grouted to ground surface

REMARKS: Groundwater was encountered at 66.5 ft bgs at time of drilling.

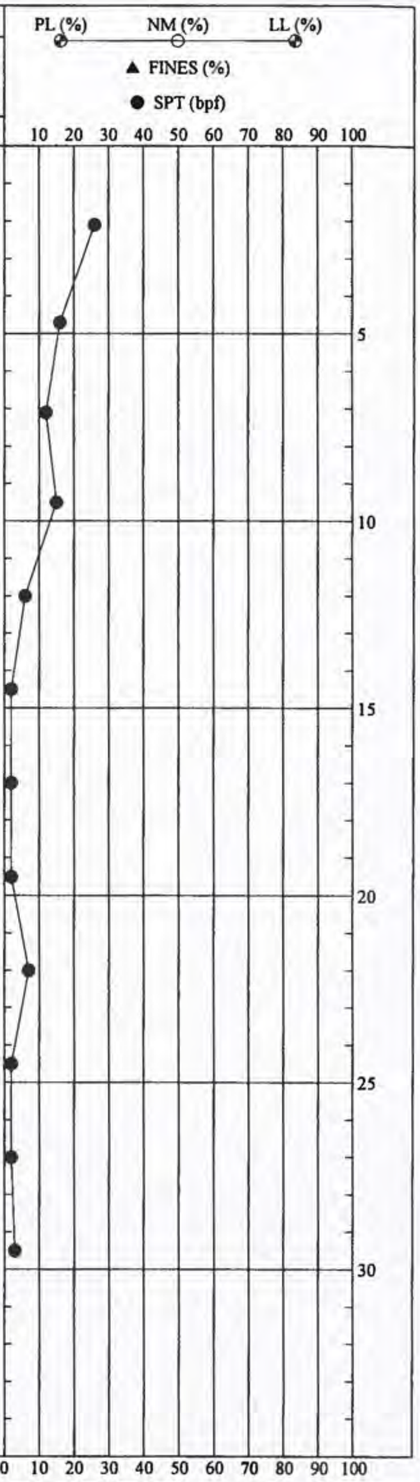
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/24/2014
COORD N: 510840 **COMP. DATE:** 11/4/2014
COORD E: 1473081 **Page** 3 **of** 3
LOCATION: East Bend Station, KY

BORING NO.: BA-9

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Asphalt and gravel subgrade		462.0			
	Fill: medium dense, dry, brown with light gray, light brown mottling, Well graded GRAVEL with sand (GW), little fine to coarse sand, trace non plastic fines			SS-1	☒	(16) 9-13-13
	Alluvium: medium dense, dry, brown with light brown, light gray mottling, Well graded SAND with silt (SW-SM), fine to coarse sand, few non plastic fines, trace fine gravel			SS-2	☒	(10) 10-9-7
5			457.0			
	Alluvium: medium dense, moist, brown, Silty SAND (SM), fine to medium sand, lillte non plastic fines, poorly graded sand			SS-3	☒	(13) 4-8-4
				SS-4	☒	(13) 4-7-8
10			452.0			
	wet, brown	▽		SS-5	☒	(10) 4-4-2
	Started charging augers with water to control heave			SS-6	☒	(14) WOR-1-1
15			447.0			
				SS-7	☒	(16) WOR-1-1
	trace low plasticity fines (clay)			SS-8	☒	(14) WOR-1-1
20			442.0			
	no low plasticity fines (clay) charging augers with water			SS-9	☒	(11) WOR-3-4
	Started charging augers with bentonite mud to control heave			SS-10	☒	(14) 1-1-1
25			437.0			
	dark gray mottling, trace low plasticity fines (clay)			SS-11	☒	(12) WOR-1-1
	Alluvium: soft, moist, dark gray, Silt with SAND (ML), little fine sand, mostly non to low plasticity fines			SS-12	☒	(11) 1-1-2
30	Boring terminated at 30.0 feet		432.0			
	Boring offset and redrilled using mud rotary drilling in order to avoid heave of granular soils. (see boring BA-10C)					
35			427.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Hollow Stem Augers
HOLE DIAMETER:	7"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Groundwater was encountered at about 11.0 feet bgs at time of drilling.

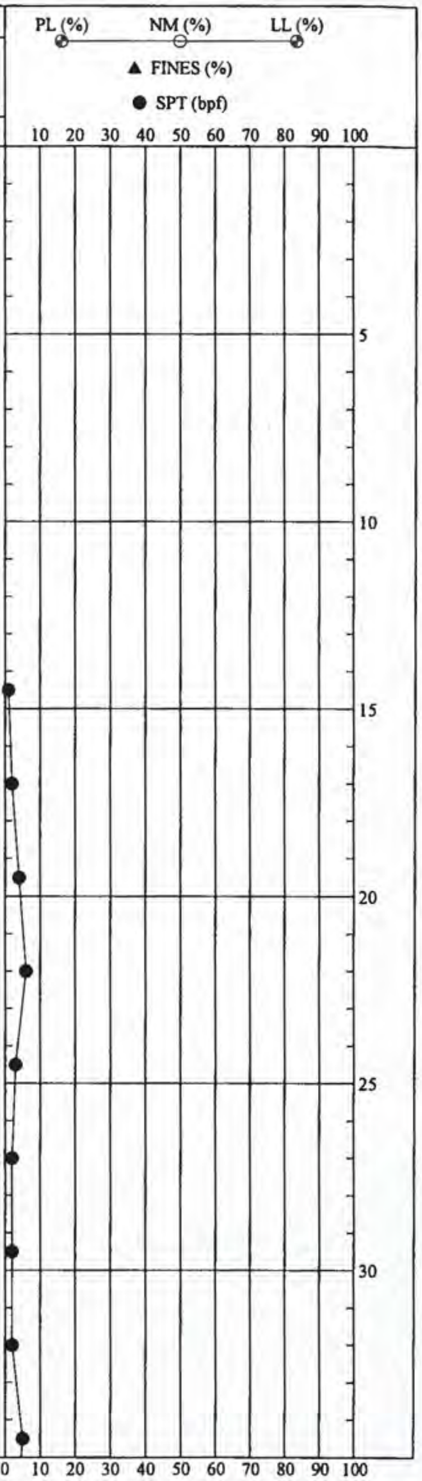
REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/9/2014
COORD N: 510670 **COMP. DATE:** 10/9/2014
COORD E: 1473079 **Page** 1 **of** 1
LOCATION: East Bend Station, KY

BORING NO.: BA-10

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
0	Mud Rotary drilling		462.0			
5			457.0			
10			452.0			
		▽				
	Alluvium: very loose to loose, wet, brown, Silty SAND (SM), fine sand, few low plasticity fines (silt)			SS-13	☒	(12) 1-WOH-1
15			447.0			
				SS-14	☒	(12) 2-1-1
	trace dark gray mottling, trace low plasticity fines (clay)			SS-15	☒	(13) 1-1-3
20			442.0			
	no clay, no mottling			SS-16	☒	1-3-3
	very loose			SS-17	☒	(13) 2-2-1
25			437.0			
	dark gray			SS-18	☒	(18) WOR-WOH-2
				SS-19	☒	(18) 1-1-1
30			432.0			
	Alluvium:, very soft, wet, dark gray, Clayey SAND (SC), mostly low plasticity fines (silt), little fine sand, trace low plasticity fines (clay)			SS-20	☒	(12) 1-1-1
	medium stiff, some fine sand			SS-21	☒	(16) 1-1-4
35			427.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Boring BA-10 was offset and mud rotary drilling was used to advance boring to target depth.

REVIEWED BY: M. Bishop

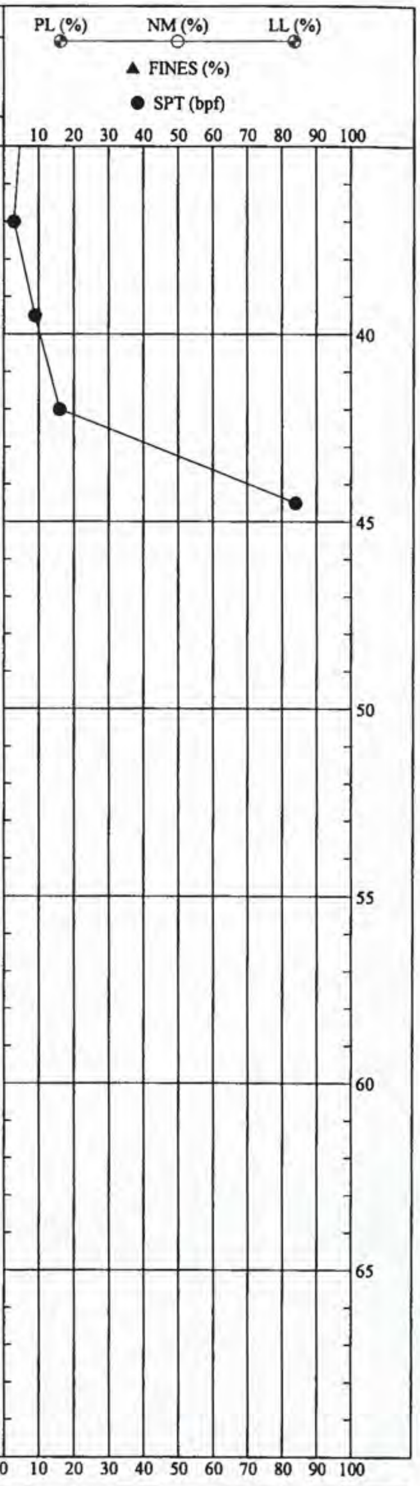
GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/10/2014
COORD N: 510670 **COMP. DATE:** 10/13/2014
COORD E: 1473152 **Page 1 of 2**
LOCATION: East Bend Station, KY

BORING NO.: BA-10C

amec

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	(Rec") N-COUNT or Rec%/RQD% 6"- 6"- 6"- 6"
35			427.0			
	soft, little fine sand, mostly low plasticity fines (silt), few low plasticity fines (clay)			SS-22	☒	(18) 1-1-2
	stiff, some fine to medium sand			SS-23	☒	(18) WOH-4-5
40			422.0			
	Alluvium: medium dense, wet, Well graded SAND (SW), fine to medium sand, trace non plastic fines (silt)			SS-24	☒	(12) 6-8-8
	very dense, few fine gravel (granite)			SS-25	☒	(6) 10-48-36
45	Boring terminated at 45.0 feet		417.0			
50			412.0			
55			407.0			
60			402.0			
65			397.0			
70			392.0			



CONTRACTOR:	S & ME/ P. Tuttle
LOGGED BY:	N. J. Smith
EQUIPMENT:	CME 550X
DRILL METHOD:	Mud Rotary
HOLE DIAMETER:	4"
CLOSURE METHOD:	Tremie grouted to ground surface
REMARKS:	Boring BA-10 was offset and mud rotary drilling was used to advance boring to target depth.

REVIEWED BY: M. Bishop

GEOTECHNICAL BORING RECORD

PROJECT NAME: DUKE East Bend Phase 2 Reconstitution
PROJECT NO.: 7810140159 **START DATE:** 10/10/2014
COORD N: 510670 **COMP. DATE:** 10/13/2014
COORD E: 1473152 **Page 2 of 2**
LOCATION: East Bend Station, KY

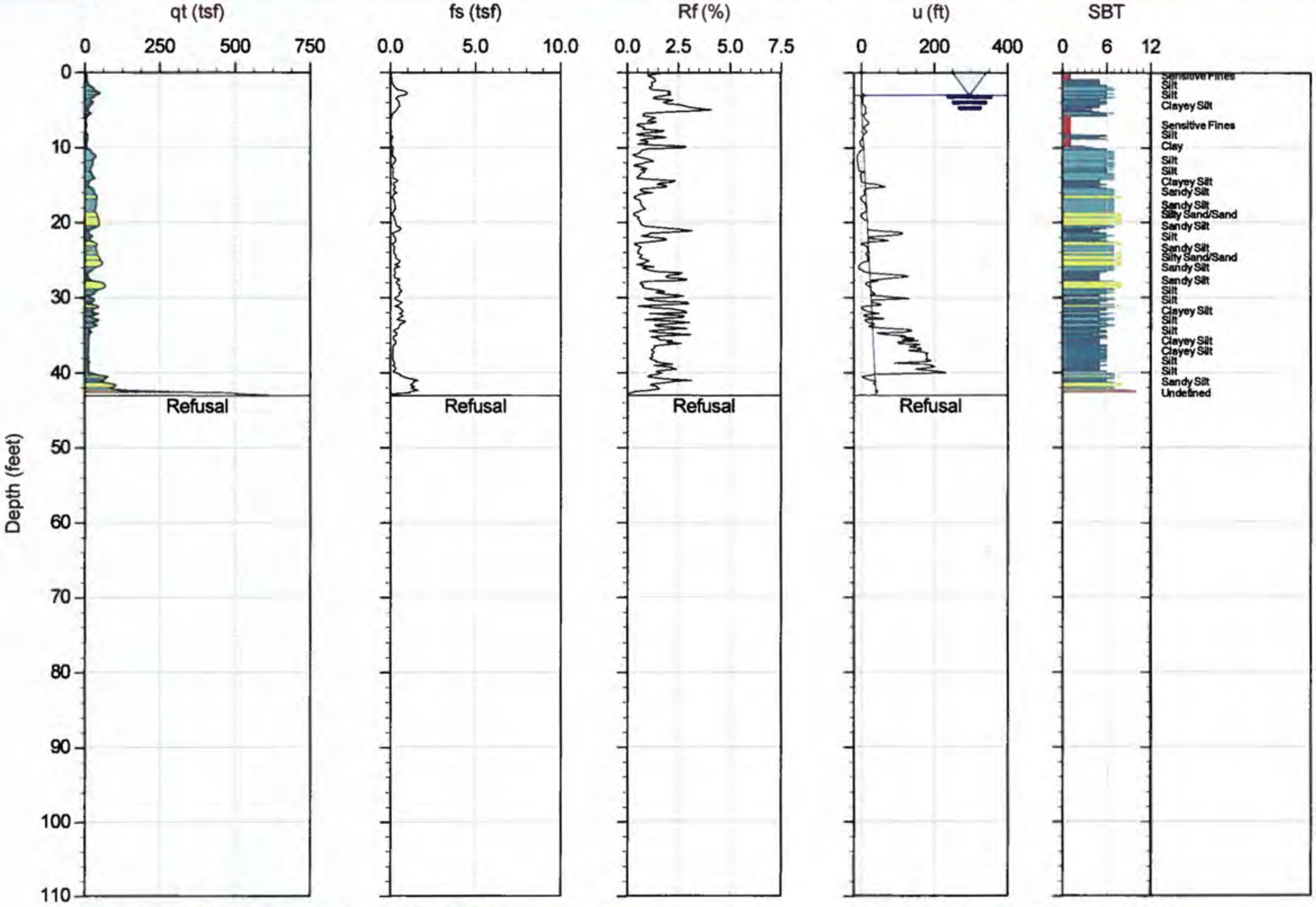
BORING NO.: BA-10C

amec

CONETEC AMEC

Job No: 14-54101
Date: 11:10:14 14:14
Site: East Bend Station Phase 2

Sounding: SCPT-10a
Cone: 167:T1500F15U500



Max Depth: 13.100 m / 42.98 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 14-54101_SP10A.COR
Unit Wt: SBT Chart Soil Zones

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 38.90068 E: -84.83780
Page No: 1 of 1

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

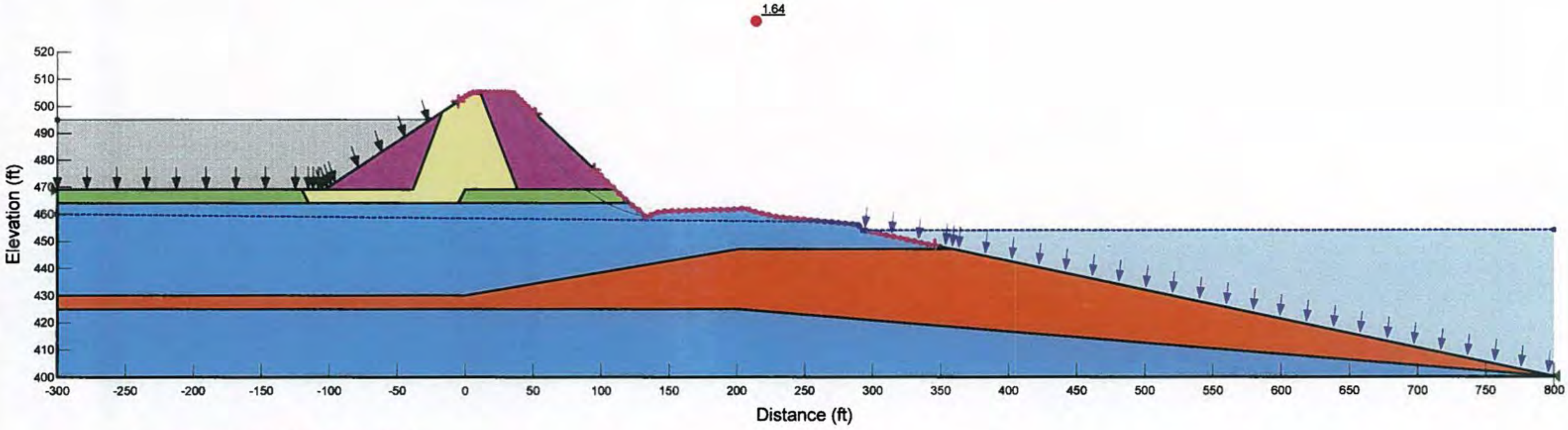
Appendix B
Slope Stability Results

Section D-D': Normal Operating Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



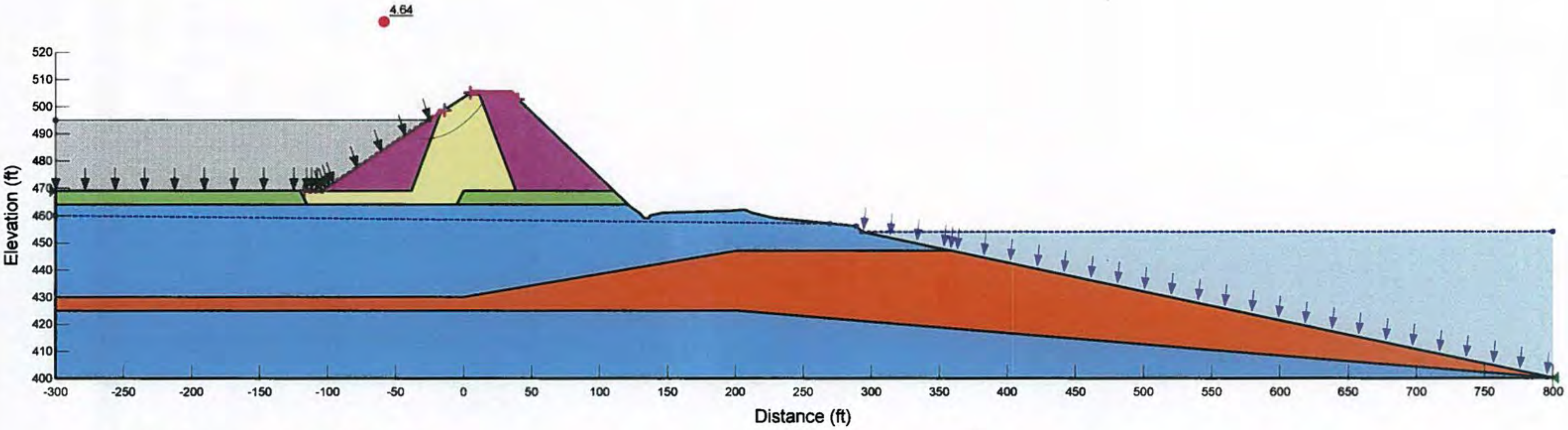
Scale Exaggerated 1H unit per 2V unit

Section D-D': Normal Operating Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/4/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, and (c) pseudo-static conditions.

Each analysis case shows the results for the critical failure surface geometry.



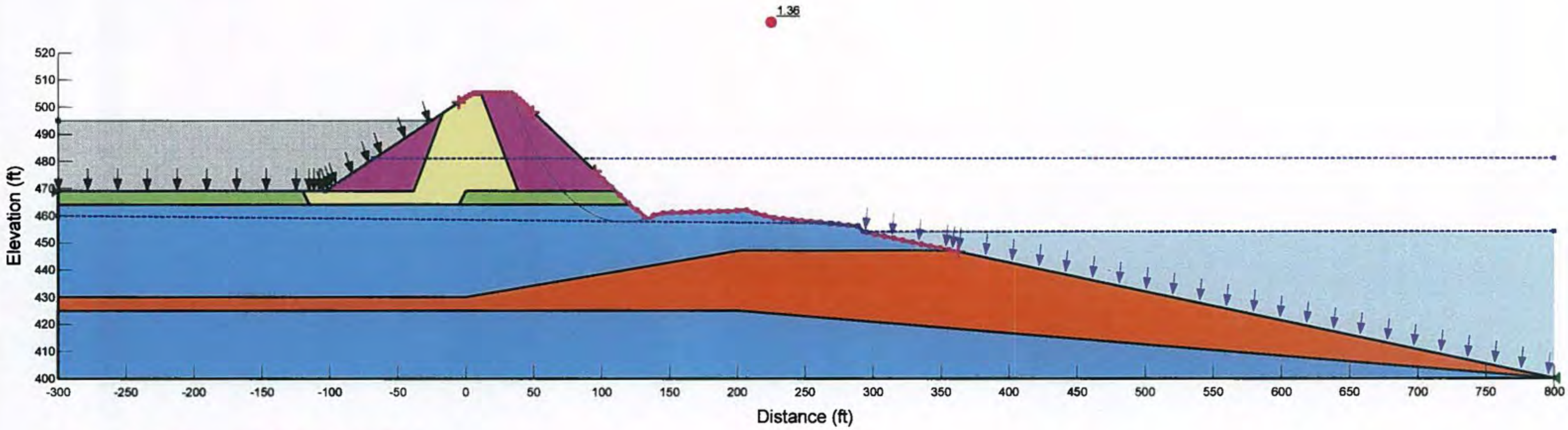
Scale Exaggerated 1H unit per 2V unit

Section D-D': Rapid Drawdown Conditions - Full Basin (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



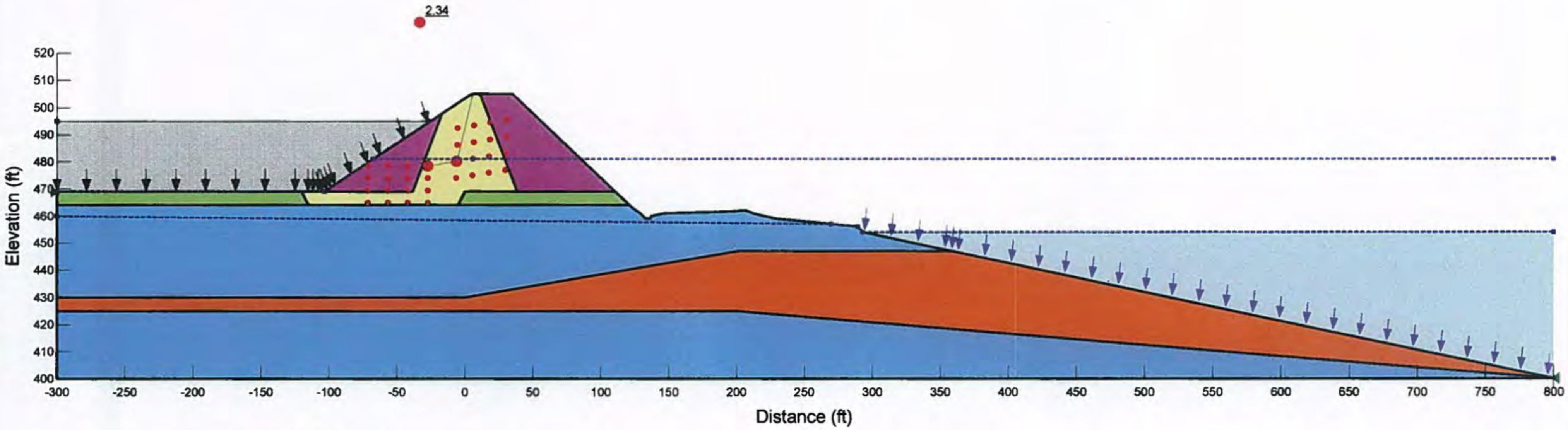
Scale Exaggerated 1H unit per 2V unit

Section D-D': Rapid Drawdown Conditions - Full Basin (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



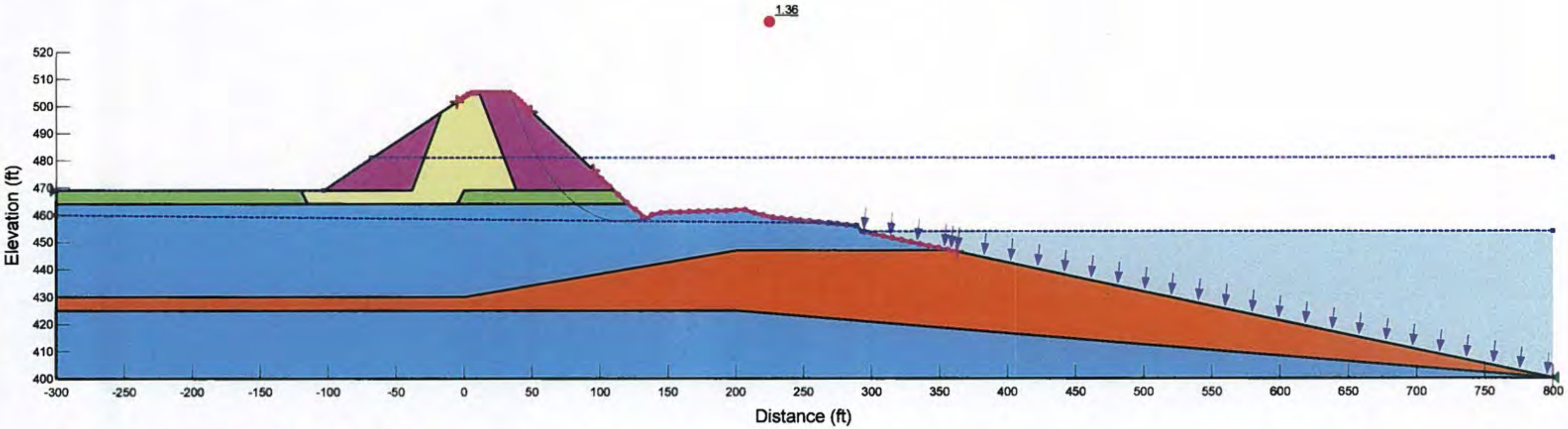
Scale Exaggerated 1H unit per 2V unit

Section D-D': Rapid Drawdown Conditions - Empty Basin (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



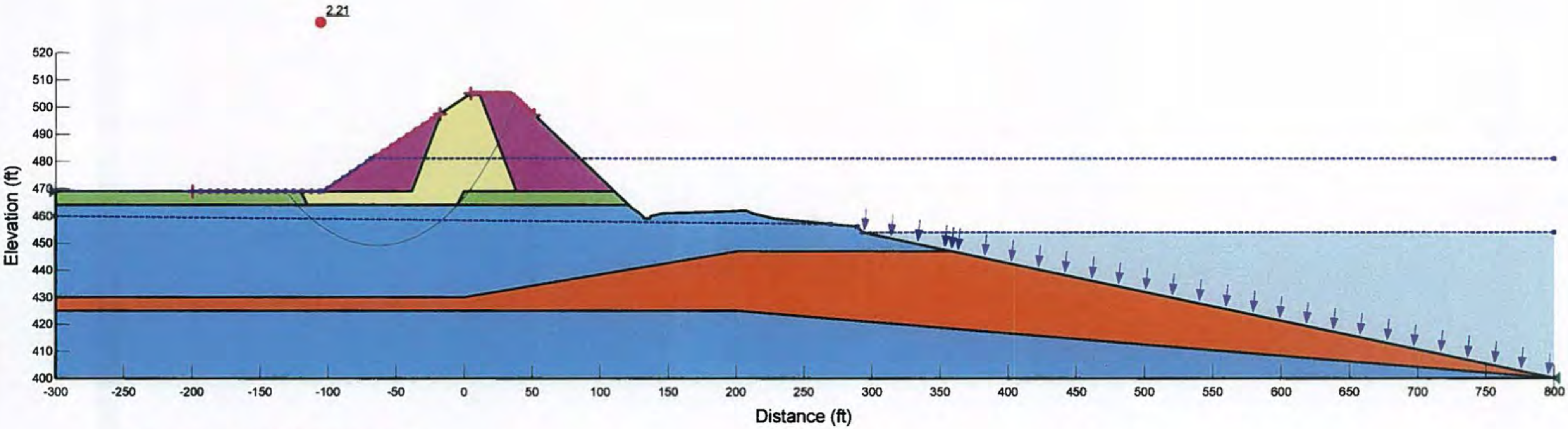
Scale Exaggerated 1H unit per 2V unit

Section D-D': Rapid Drawdown Conditions - Empty Basin (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



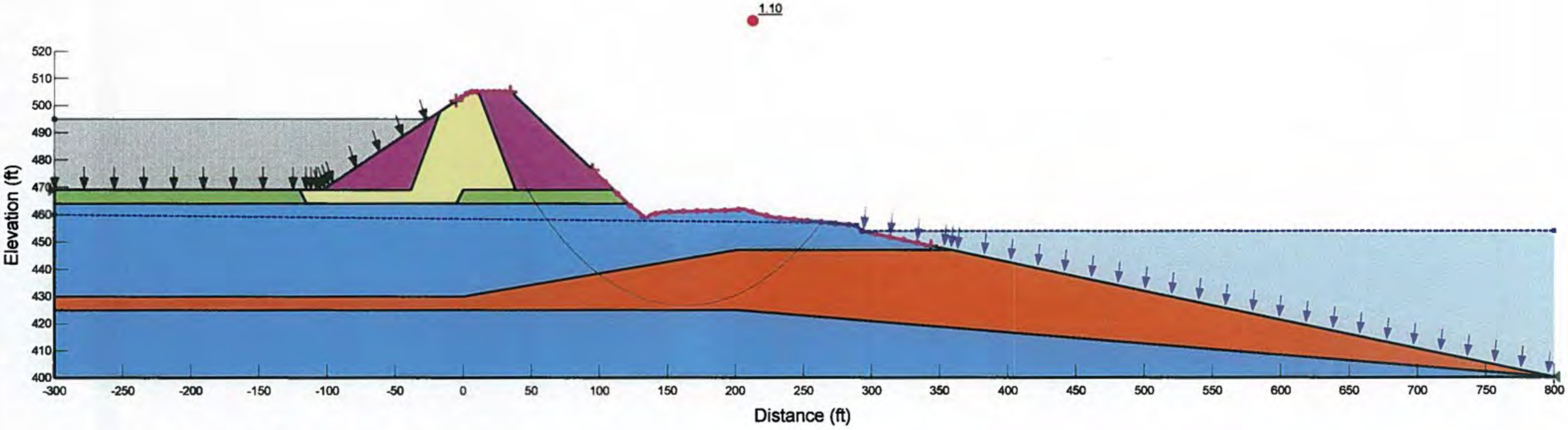
Scale Exaggerated 1H unit per 2V unit

Section D-D': Pseudo-Static Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



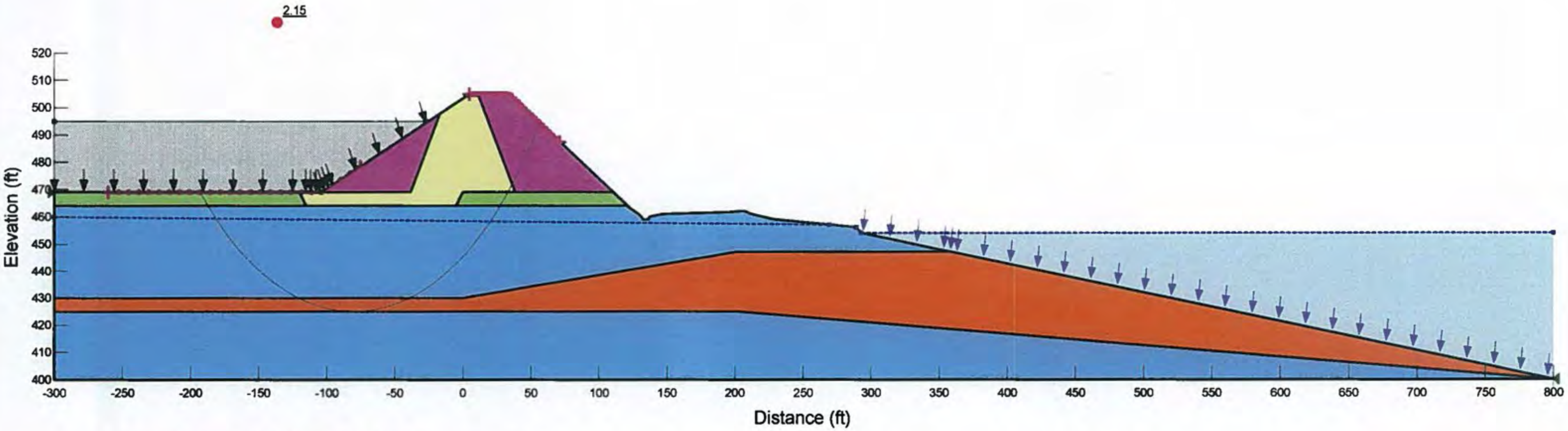
Scale Exaggerated 1H unit per 2V unit

Section D-D': Pseudo-Static Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



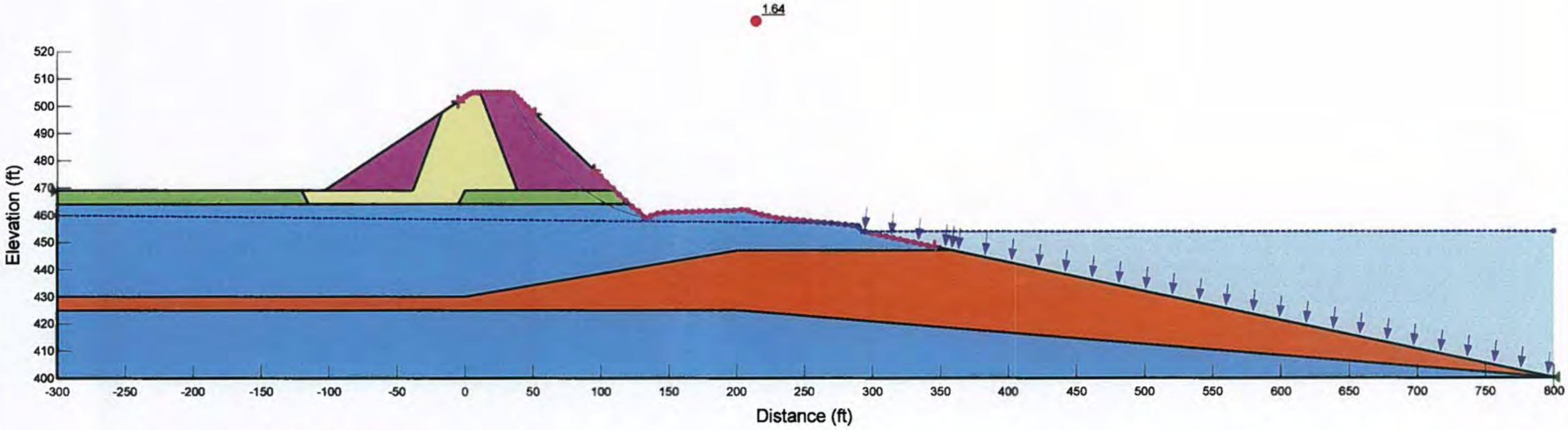
Scale Exaggerated 1H unit per 2V unit

Section D-D': Phase 2 Construction Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



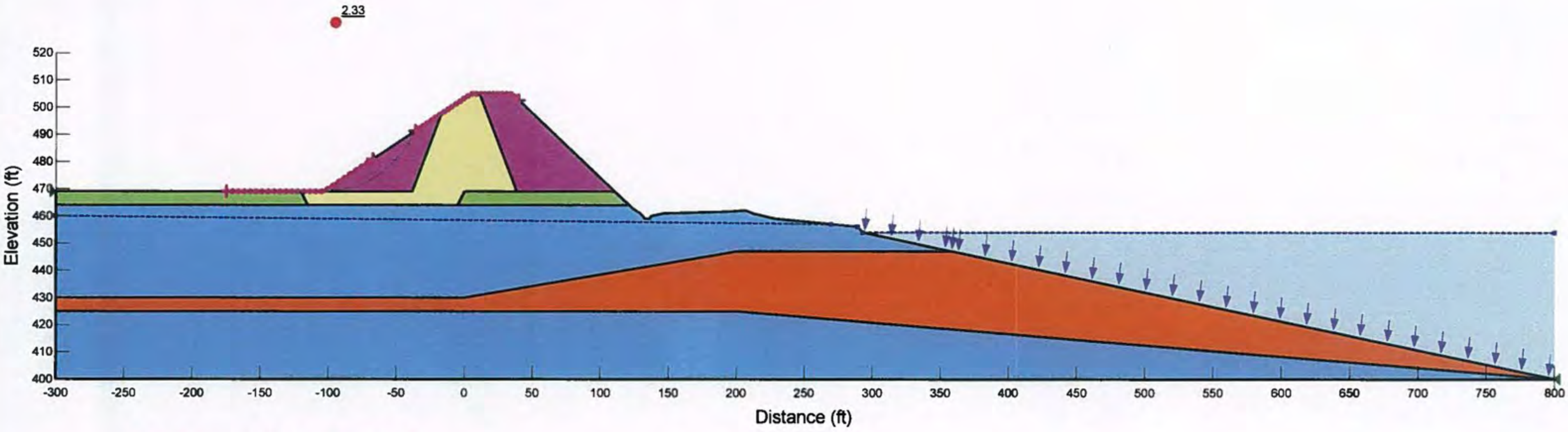
Scale Exaggerated 1H unit per 2V unit

Section D-D': Phase 2 Construction Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton D-D'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



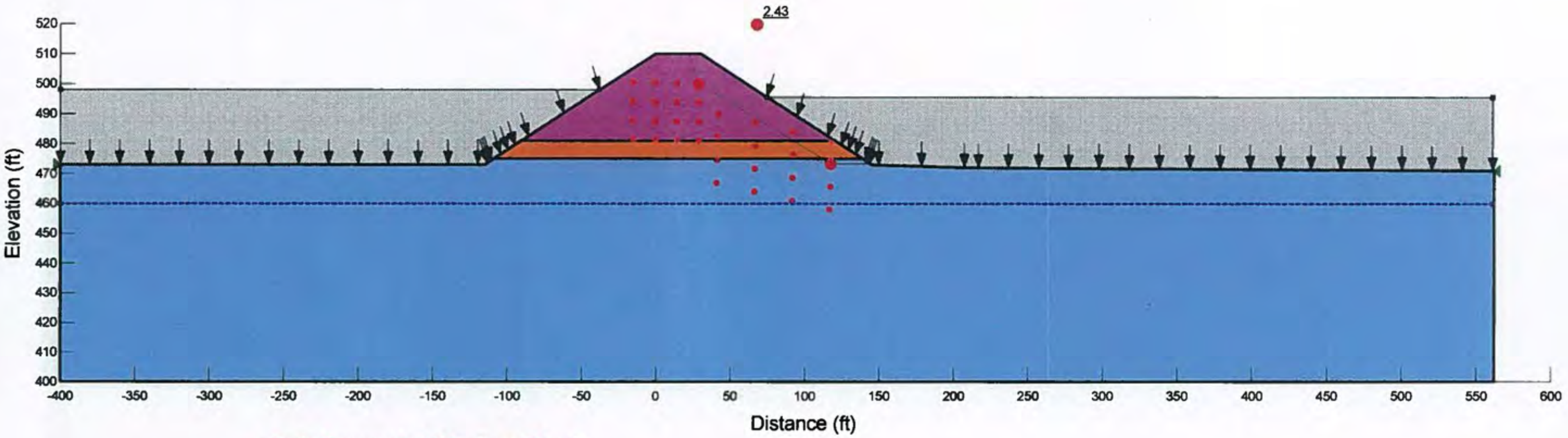
Scale Exaggerated 1H unit per 2V unit

Section F-F': Normal Operating Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/19/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



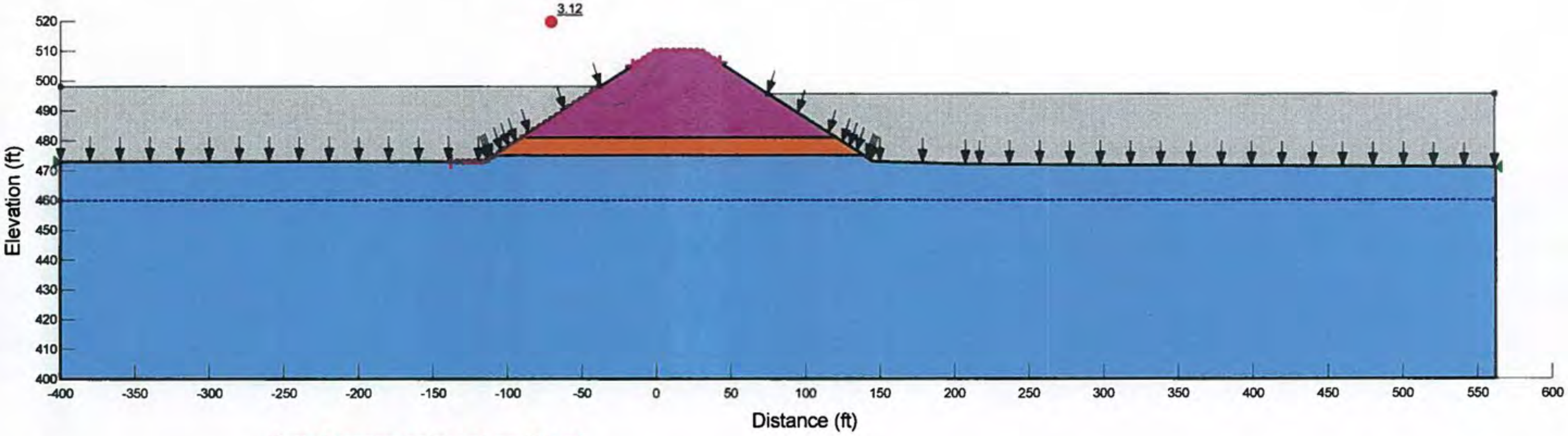
Scale Exaggerated 1H unit per 2V unit

Section F-F': Normal Operating Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/19/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



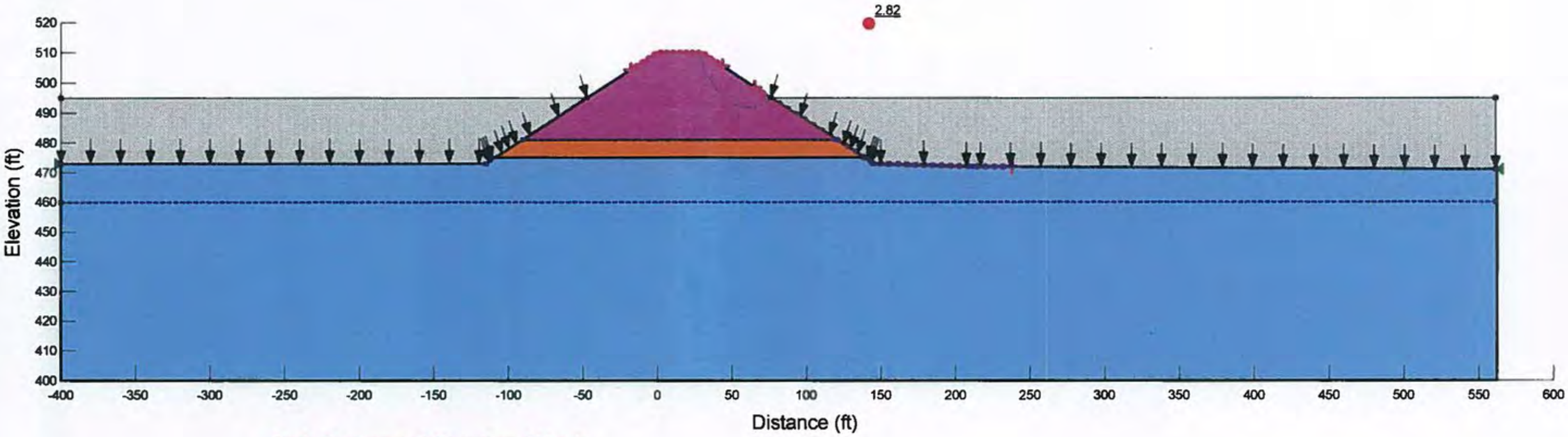
Scale Exaggerated 1H unit per 2V unit

Section F-F': Rapid Drawdown Conditions - Full Basin (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



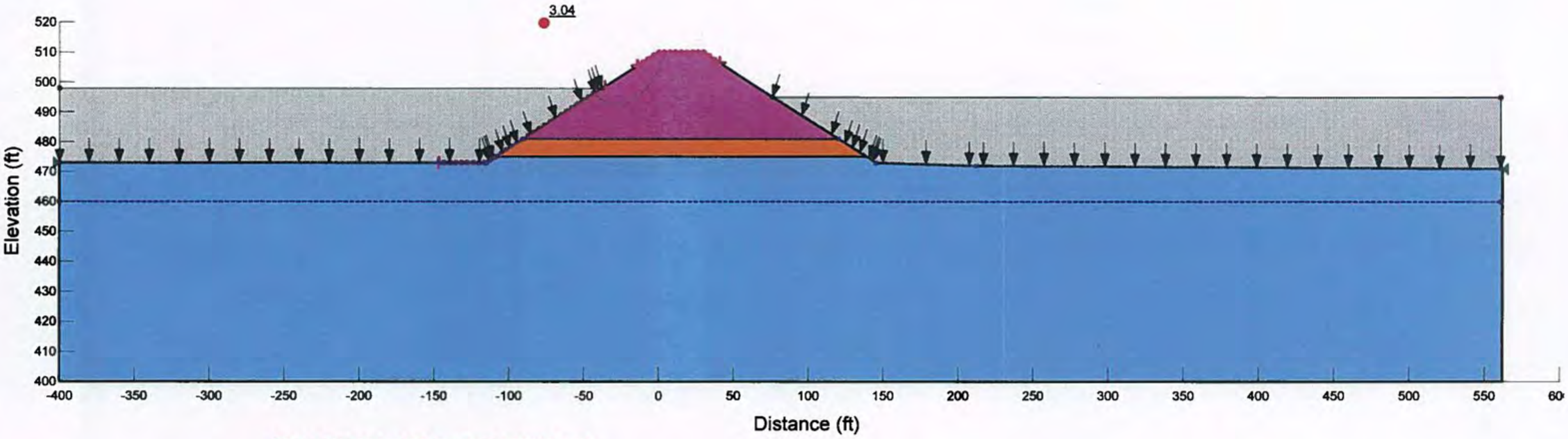
Scale Exaggerated 1H unit per 2V unit

Section F-F': Rapid Drawdown Conditions - Full Basin (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



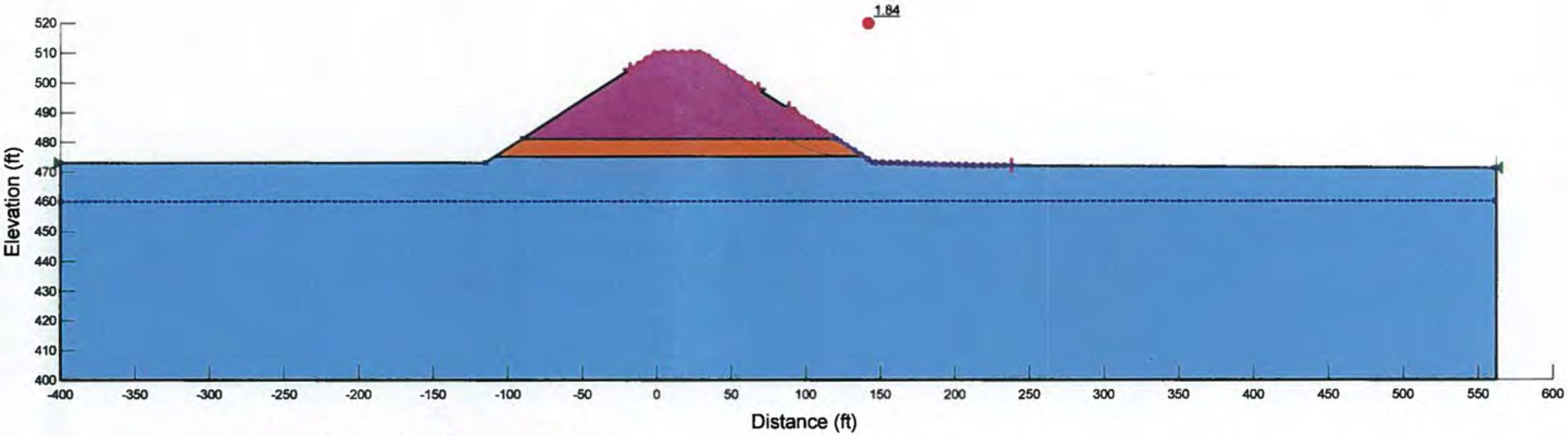
Scale Exaggerated 1H unit per 2V unit

Section F-F': Rapid Drawdown Conditions - Empty Basin (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



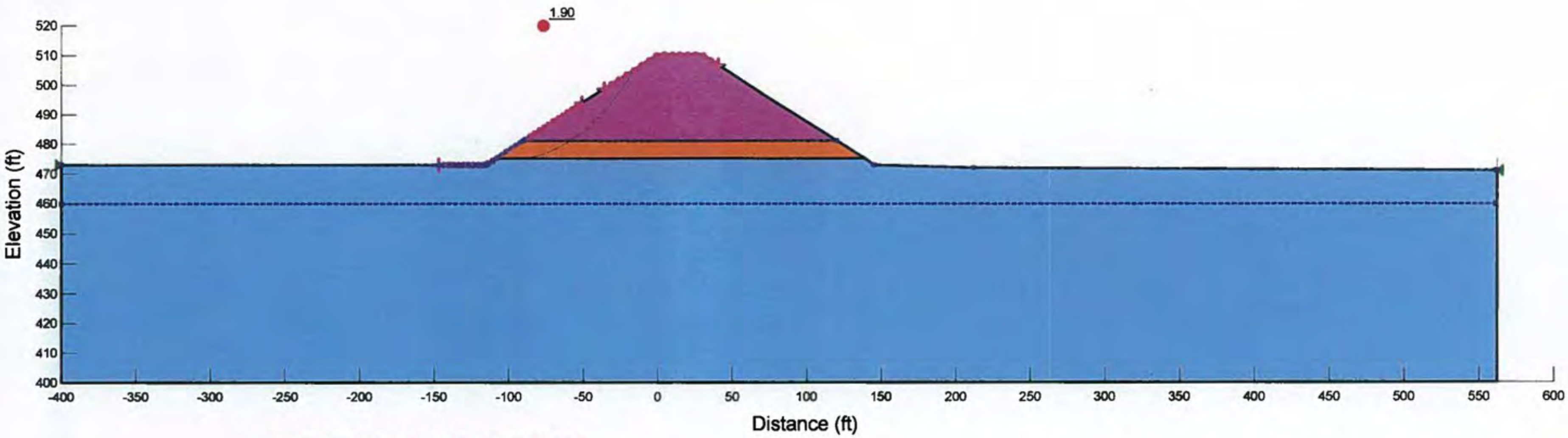
Scale Exaggerated 1H unit per 2V unit

Section F-F': Rapid Drawdown Conditions - Empty Basin (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 8/5/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



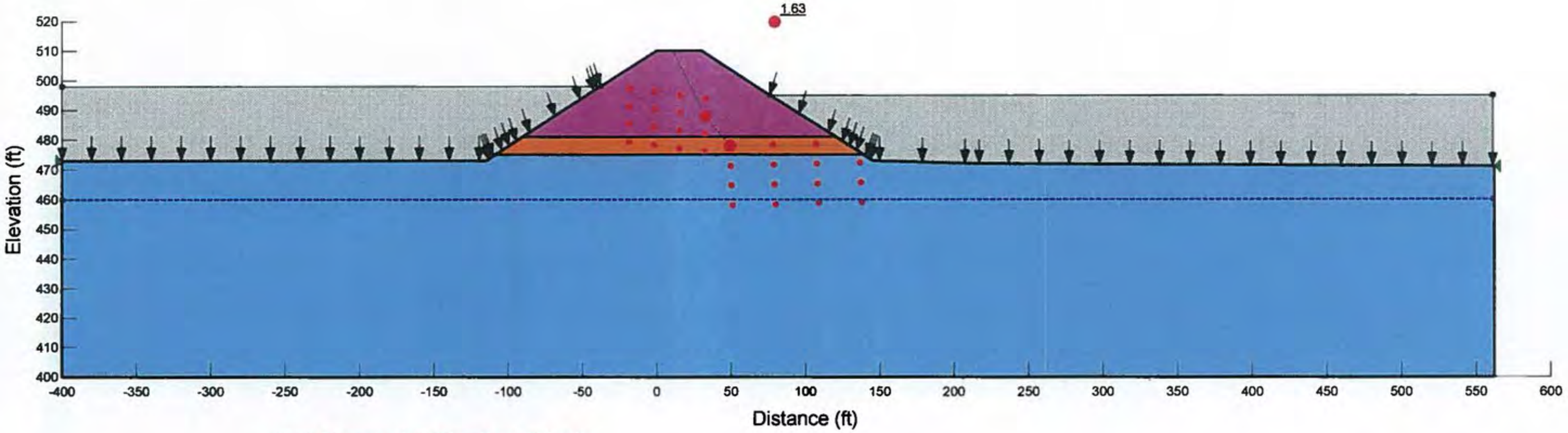
Scale Exaggerated 1H unit per 2V unit

Section F-F': Pseudo-Static Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



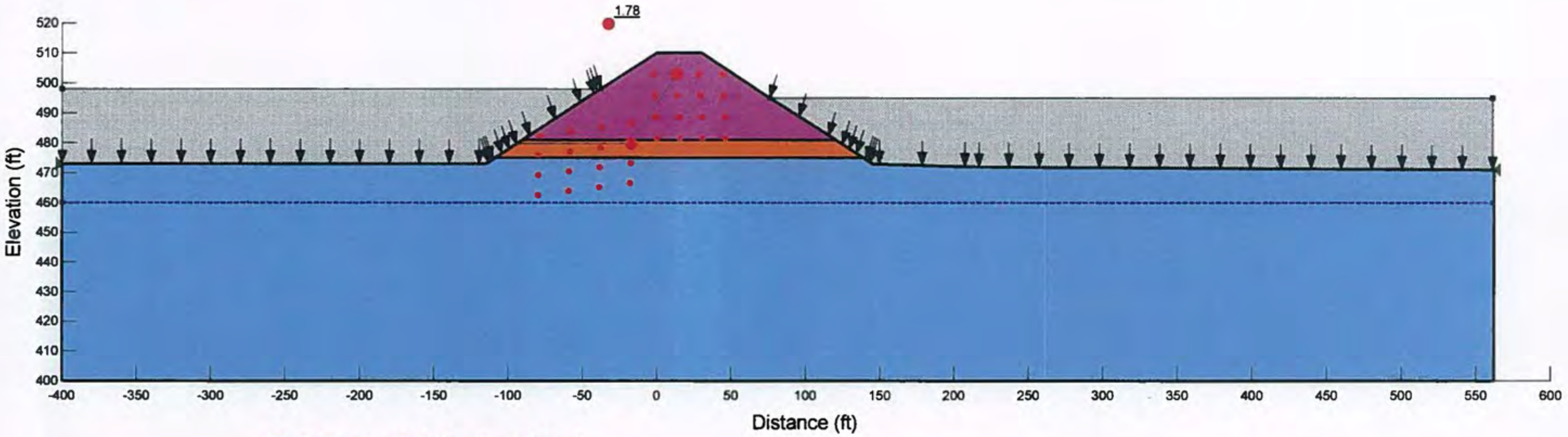
Scale Exaggerated 1H unit per 2V unit

Section F-F': Pseudo-Static Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



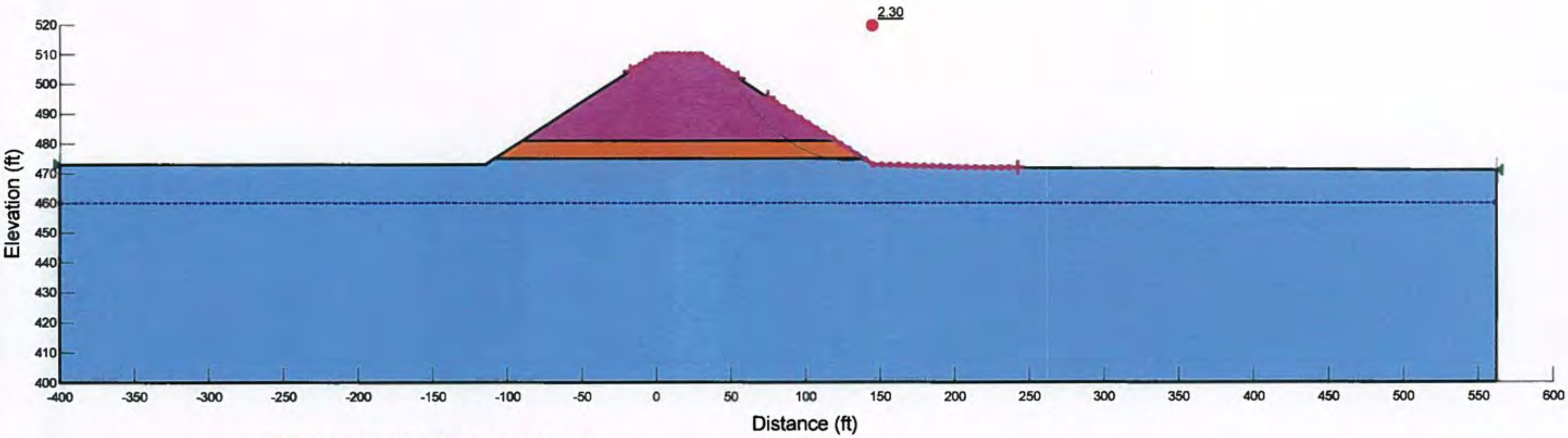
Scale Exaggerated 1H unit per 2V unit

Section F-F': Phase 1 Construction Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/19/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



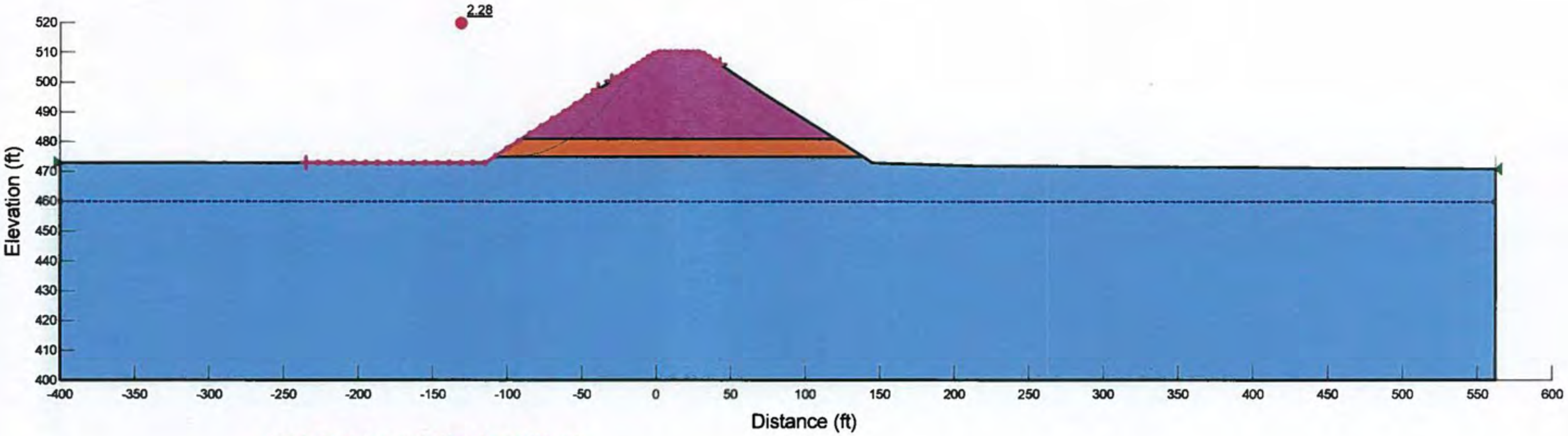
Scale Exaggerated 1H unit per 2V unit

Section F-F': Phase 1 Construction Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/19/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions, (b) rapid drawdown conditions, (c) pseudo-static conditions, and (d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



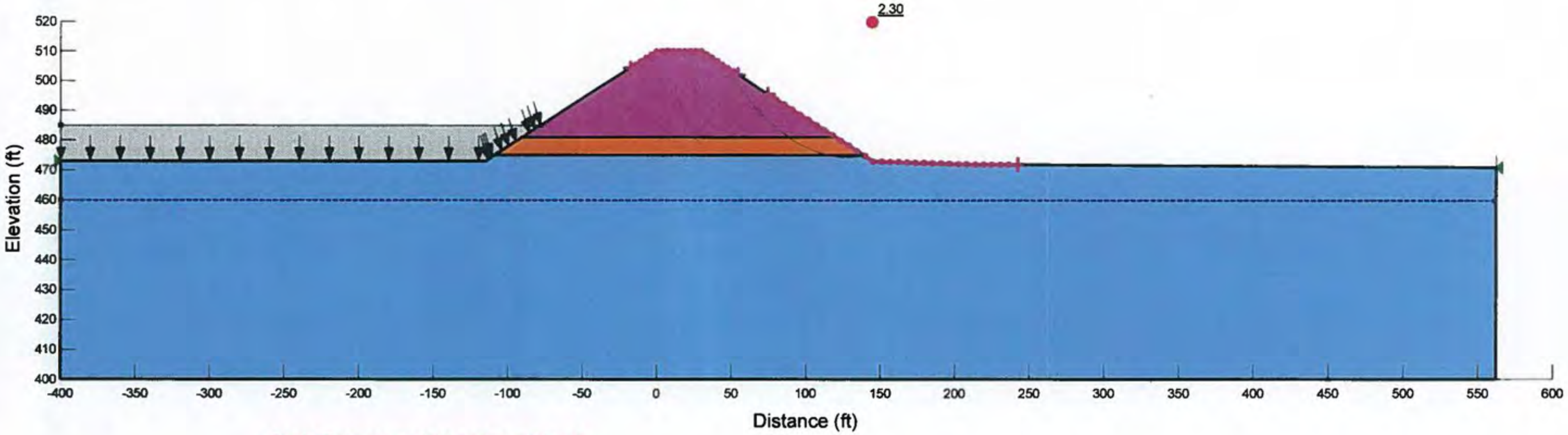
Scale Exaggerated 1H unit per 2V unit

Section F-F': Phase 2 Construction Conditions (Downstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



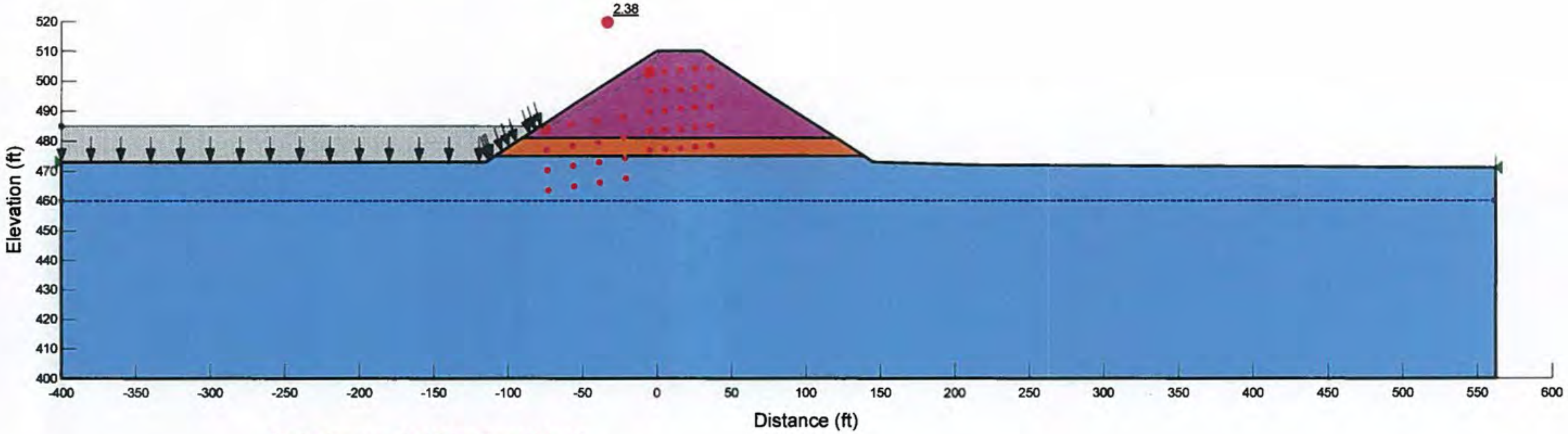
Scale Exaggerated 1H unit per 2V unit

Section F-F': Phase 2 Construction Conditions (Upstream)

Title: Proposed Retention Basin Stability Analysis
Created By: Matt Bishop
Date: 9/23/2016
Comments: Stability Modeling at Secton F-F'.

Analyses cases consist of the following: (a) normal operating conditions,
(b) rapid drawdown conditions, (c) pseudo-static conditions, and
(d) end of construction conditions.

Each analysis case shows the results for the critical failure surface geometry.



Scale Exaggerated 1H unit per 2V unit

Attachment E

Liner Veneer Stability Analyses

Calculation Title:
Retention Basin Liner System – Liner Veneer Stability Calculation

Summary:

The objective of this calculation is to evaluate the static and pseudo-static veneer stability of the liner system for the East Bend Station Retention Basin. The recommended minimum interface friction angle for the retention basin liner system is 28.8 degrees.

Interface friction testing should be performed prior to construction using site specific soils and the specified geosynthetic materials proposed for the liner system. The interface friction test conditions should be specified in accordance with the expected field conditions.

Notes:

Revision Log:

No.	Description	Originator	Verifier	Technical Reviewer
00	Initial Submittal	7/27/16 Basak Gulec Basak Gulec Dincer	8/8/2016 Aaron Jordan Aaron Jordan	7/28/16 Thomas B Maier Thomas Maier, P.E.

OBJECTIVE:

The objective of this calculation is to evaluate the static and pseudo-static veneer stability of the liner system for the East Bend Station Retention Basin. Liner system will be constructed on 3 horizontal to 1 vertical (3H:1V) slopes at the retention basin. The veneer stability will be evaluated for the following conditions:

1. Side slope with protective cover – no water;
2. Side slope with protective cover – with water build-up;
3. Pseudo-static (Seismic) Conditions; and
4. Side slope with protective cover – with construction load.

Since the specific materials to be used in liner system construction are not known, minimum interface friction angles that satisfy the minimum factors of safety are back-calculated in this calculation package.

Method of analysis was selected based on the Ash Basin Closure Master Programmatic Document of the Duke Energy Coal Combustion Product Management Program [Ref 1] (referred to as the Programmatic Document hereafter).

METHOD:

Veneer stability was evaluated using Matasovic 1991 [Ref.2] method as described in the "Geotechnical and Stability Analysis for Ohio Waste Containment Facilities" report [Ref. 3]. This method is preferred since it tends to be more conservative than the other applicable methods. Seismic coefficients used for this calculation package were obtained from Phase 2 Reconstitution of Ash Pond Designs Final Report [Ref. 4].

The minimum interface friction angle for stability of the typical side slope condition was estimated using the infinite slope method described in Matasovic 1991 [Ref. 2] and presented as follows:

$$FS = \frac{\frac{c}{\gamma z cos^2\beta} + tan\Phi\left[1-\gamma_w\frac{z-d_w}{\gamma z}\right] - k_s tan\beta tan\Phi}{k_s + tan\beta} \qquad \text{[Ref. 2]}$$

The minimum interface friction angle can be estimated by re-arranging terms as follows:

$$\Phi_{min} = tan^{-1}\frac{FS(k_s+tan\beta)-\frac{c}{\gamma z cos^2\beta}}{1-\gamma_w\frac{z-d_w}{\gamma z}-k_s tan\beta}$$

where:

β = slope angle;
γ = unit weight of soils;
γ_w = unit weight of water;
Φ = minimum internal/interface friction angle;

c = cohesion of soils;
z = vertical depth of soil;
d_w = depth to water from ground surface;
k_s = seismic coefficient (k_s equals 0 for static conditions); and
FS = safety factor.

Seismic stability analysis is performed as described in the following steps [Ref. 5]:

1. Evaluate the seismic coefficient, k_s. The seismic coefficient "k_s" is assumed to be equal to one-half the peak horizontal acceleration at the top of the landfill for the analysis of the system [Ref. 5].
2. Perform the pseudo-static stability analysis. If the minimum factor of safety exceeds 1.0, the seismic stability analysis is complete.
3. If the pseudo-static factor of safety is less than 1.0, perform a Newark deformation analysis:
    a. Calculate the yield acceleration, k_y. The yield acceleration is the horizontal acceleration that would produce a factor of safety of 1.0.
    b. Calculate the permanent seismic deformation using simplified charts and compare the calculated permanent seismic deformation to the maximum allowable displacements.
    According to the Programmatic Document (Table 12-2), up to 2 ft displacement is allowable for ash basin embankment slopes (inferred to represent repairable damage).

LINER SYSTEM:

The liner system will consist of the following components from bottom to top:

- Compacted subgrade;
- Geosynthetic Clay Liner (GCL);
- 60-mil double-sided textured HDPE geomembrane;
- 16 oz. geotextile;
- Granular cover material (12-in. thick); and
- Riprap (15-in. thick).

For the purposes of these analyses, soil materials used in the liner system soil were assumed to have a unit weight (γ) of 130 pcf and a cohesion (c) of 0 psf.

CALCULATIONS:

1.0 Define safety factors for veneer stability

Minimum factors of safety for each analyzed condition are as follows:

1. Side slope with protective cover – no water: 1.5
2. Side slope with protective cover – with water build-up: 1.3
3. Pseudo-static (Seismic) Conditions: >1.0

4. Side slope with protective cover – with construction load: 1.2.

2.0 Calculate minimum friction angle for static stability

The minimum interface friction angle to achieve static stability was evaluated for the conditions as described in the following sections. The retention basin liner system will be constructed at 3H:1V side slope (β = 18.43 degrees).

2.1 Condition 1 – Side slope with protective cover – no water

The minimum interface friction angle to achieve a factor of safety of 1.5 was estimated as shown in the following table:

Table 1: Minimum Interface Friction Angle for Typical Liner System Slope 3H:1V

Required Safety Factor {FS}	Seismic Coefficient {k_s} (%g)	Slope Angle {β} (degrees)	Cover Soil Cohesion {c} (psf) [assumed]	Unit Weight of Cover Soil {γ} (pcf) [assumed]	Vertical Depth of Cover Soil {z} (ft)	Unit Weight of Water {γ_w} (pcf)	Depth to Water {d_w} (ft)	Minimum Interface Friction Angle {ϕ} (degrees)
1.5	0.00	18.43	0	130	2.25	62.4	2.25	26.6

The minimum interface friction angle for side slope with protective cover is 26.6 degrees.

2.2 Condition 2 – Side slope with protective cover – with water build-up

Assuming the overlying granular cover material (excluding riprap) is saturated, depth to water from ground surface (d_w) equals 1.25 ft in this calculation. The minimum interface friction angle was estimated as shown in the following table:

Table 2: Minimum Interface Friction Angle for Typical Liner System Slope 3H:1V - water build-up

Required Safety Factor {FS}	Seismic Coefficient {k_s} (%g)	Slope Angle {β} (degrees)	Cover Soil Cohesion {c} (psf) [assumed]	Unit Weight of Cover Soil {γ} (pcf) [assumed]	Vertical Depth of Cover Soil {z} (ft)	Unit Weight of Water {γ_w} (pcf)	Depth to Water {d_w} (ft)	Minimum Interface Friction Angle {ϕ} (degrees)
1.3	0.00	18.43	0	130	2.25	62.4	1.25	28.8

The minimum interface friction for side slope with protective cover with water build-up is 28.8 degrees. A factor of safety of 1.3 was used for this case since it represents a temporary loading condition.

2.3 Minimum friction angle for static stability

Minimum required interface friction angles were calculated for the empty pond and temporary water build-up conditions. The minimum friction angle for static stability is 28.8 degrees. A description of interface friction testing requirements is provided in the Discussion section of this calculation.

3.0 Evaluate stability for pseudo-static conditions

The PGA_{design} and PGA_{crest} were calculated as 0.085g and 0.31g, respectively for pseudo-static conditions in the East Bend Phase 2 Final Report [Ref. 4]. Assuming that deformations of 1 foot are acceptable, the seismic coefficient "k_s" is equal to one-half the PGA_{crest} [Ref. 5].

The liner system veneer stability safety factor for pseudo-static conditions was estimated as shown in the following table. In this calculation, the interface friction angle that would give a factor of safety of 1.0 under the design seismic loading was back-calculated. If the minimum factor of safety exceeds 1.0 and 1 ft of seismic deformation is acceptable, the seismic analysis is complete [Ref. 5].

Table 3: Pseudo-Static Veneer Stability for Typical Liner System Slope 3H:1V

Seismic Coefficient {k_s} (%g)	Slope Angle {β} (degrees)	Cover Soil Cohesion {c} (psf) [assumed]	Unit Weight of Cover Soil {γ} (pcf) [assumed]	Vertical Depth of Cover Soil {z} (ft)	Unit Weight of Water {γ_w} (pcf)	Depth to Water {d_w} (ft)	Minimum Interface Friction Angle {ϕ} (degrees)	Calculated Safety Factor {FS}
0.155	18.43	0	130	2.25	62.4	2.25	27.2	1.00

A minimum interface friction angle of 27.2 degrees gives a factor of safety of 1.0 and acceptable deformations.

4.0 Evaluate stability for construction load

Veneer stability under construction load is evaluated assuming that the construction equipment will be operating on the liner system side slopes. Veneer stability during construction was evaluated for two conditions: for 2.25-ft thick protective cover (top of riprap), and 1-ft thick protective cover (top of granular cover material). A Caterpillar D60 was assumed to be used to place riprap on the side slopes. A Caterpillar D5H LGP was assumed to be used to place the granular cover material on the side slopes. Specifications for these construction equipment are presented in Attachment 1.

The factor of safety against sliding under the dozer track was calculated using Thiel and Narejo, 2005 [Ref 6]. The governing equations and factor of safety calculations are presented in Attachment 1. The shear strength parameters calculated in the previous sections for no construction load were used for this analysis. Factor of safety was calculated for minimum interface friction angle of 28.8 degrees.

As seen Attachment 1, calculated factors of safety for construction loading are 1.2 and 1.0 for 2.25-ft thick protective cover and 1-ft thick protective cover, respectively. Calculated factors of safety are acceptable since the Thiel and Narejo method adds extra 30% loading to the driving force calculation to account for inertial force.

Based on the calculated factors of safety, there is no tension in the geosynthetic components of the liner system due to construction loading with the assumed construction equipment. For the placement of the granular cover soil (1-ft thick on top of the geomembrane), a maximum dozer weight of 33,000 lbs and maximum ground pressure of 4.5 psi are recommended. Sudden dozer acceleration and deceleration will be avoided on the slopes.

DISCUSSION:

The minimum required interface friction angle is 28.8 degrees for the static condition. The minimum required interface friction angle for the seismic conditions (based on an acceptable deformation of 1 ft) is 27.2 degrees. Therefore, the controlling minimum interface friction angle for the East Bend retention basin is reported as 28.8 degrees. Prior to liner system construction, interface friction testing should be performed on the liner system materials to demonstrate that a minimum interface friction angle of 28.8 degrees is achieved.

Interface friction testing should be performed prior to construction using site specific soils and the specified geosynthetic materials proposed for the liner system to report the actual interface friction angle. Interface friction testing should be performed at each interface including a geosynthetic, anticipated to include:

- Subgrade to GCL;
- GCL to geomembrane;
- Geomembrane to geotextile; and
- Geotextile to protective cover.

Geosynthetic products may have different texturing or surface treatments on each side. If such a geosynthetic is proposed for the liner system, all possible interfaces should be tested.

The interface friction test conditions should be specified in accordance with the final conditions. For instance, the liner system soils should be tested at the compaction rate anticipated for final conditions. Testing should be performed at the highest anticipated moisture content as this condition coincides with the weakest material shear strength. The specified testing normal loads should be consistent with anticipated final conditions. Assuming 2.25 feet of liner system protective soil materials with a unit weight of 130 pcf, the interface friction testing normal loads would be on the order of 125 psf, 250 psf, and 500 psf.

Accurate interpretation of interface friction test results is important. Some interfaces may exhibit adhesion and friction angle shear strength components. The recommended minimum interface friction angle is to be understood as representing a shear strength threshold. Any combination of friction and adhesion exceeding the threshold at the specified normal loads is acceptable.
Proposed liner system includes a GCL under the HDPE geomembrane. Proper storage and handling of GCL is crucial to prevent hydration of the GCL. Hydrated GCL exhibits reduced shear strength.

Tension in the geosynthetics of the liner system was estimated assuming that the construction equipment will be operating on the liner system side slopes and that dozers will only push upslope and not downslope. Sudden dozer acceleration and deceleration will be avoided on the slopes.

There is no tension in the geosynthetic components of the liner system due to construction loading with the assumed construction equipment.

REFERENCES:

1. Duke Energy. "Duke Energy Coal Combustion Product Management Program, Ash Basin Closure Master Programmatic Document", January 13, 2016.
2. Matasovic, Neven. "Selection of Method for Seismic Slope Stability Analysis", Proceedings: Second International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, March 11-15, 1991, St. Louis, MO, Paper No. 7.20.
3. Ohio EPA. "Geotechnical and Stability Analysis for Ohio Waste Containment Facilities", Geotechnical Resource Group, 2004.
4. Duke Energy. "Duke Energy Coal Combustion Product Management Program, Phase 2 Reconstitution of Ash Pond Designs Final Report Submittal", March 13, 2015.
5. USEPA. "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities", EPA/600/R-95-051, April 1995.
6. Thiel, R. and Narejo, D. "Lamination Strength Requirements for Geonet Drainage Geocomposites", Proceedings of the Geo-Frontiers 2005, Austin, Texas, January 24-26, 2005.

ATTACHMENT 1

LINER STABILITY DURING CONSTRUCTION

Stability during Construction - 2.25-ft thick Protective Cover

Using Thiel and Narejo (2005):

$$FS = \frac{Resisting Stress}{Driving Stress}$$

$$FS = \frac{C_a + [(h.\gamma) + P]\cos\beta \tan\phi}{[(h.\gamma) + P]\sin\beta + 0.3P}$$

$$P = \frac{W}{2(x + 2h)(y + 2h)}$$

Ca: adhesion between geosynthetics;
h: soil depth (ft);
γ: soil unit weight (psf);
P: vertical stress from dozer at geosynthetics surface (psf);
(30% addtional force is added to account for inertial force)
β: slope angle;
ϕ: friction angle between geosnthetics;
W: weight of dozer (lb)
x: width of tracks (ft); and
y: length of tracks (ft)

Vertical Stress from Dozer (for CAT 60)

Ground pressure = 9 psi

W (lb):	31,460
x (ft):	1.5
y (ft):	7.7
h (ft):	2.25
P (psf)	**214.9**

Resisting Stress & Driving Stress

Ca (psf):	0
γ (pcf)	130
β (deg)	18.43
ϕ (deg)	28.8

Resisting Stress (psf)	264.63
Driving Stress (psf)	224.88
FS	**1.2**

Stability during Construction - 1-ft thick Protective Cover

Using Thiel and Narejo (2005):

$$FS = \frac{\text{ResistingStress}}{\text{DrivingStress}}$$

$$FS = \frac{C_a + [(h.\gamma) + P]\cos\beta\tan\phi}{[(h.\gamma) + P]\sin\beta + 0.3P}$$

$$P = \frac{W}{2(x + 2h)(y + 2h)}$$

Ca: adhesion between geosynthetics;
h: soil depth (ft);
γ: soil unit weight (psf);
P: vertical stress from dozer at geosynthetics surface (psf);
(30% addtional force is added to account for inertial force)
β: slope angle;
ϕ: friction angle between geosnthetics;
W: weight of dozer (lb)
x: width of tracks (ft); and
y: length of tracks (ft)

Vertical Stress from Dozer (for CAT D5H LGP)

Ground pressure = 4.2 psi

W (lb):	32,380
x (ft):	2.83
y (ft):	10.2
h (ft):	1
P (psf)	**275.0**

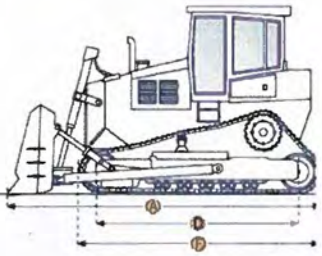
Resisting Stress & Driving Stress

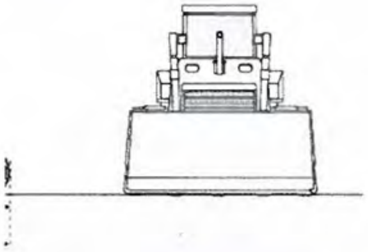
Ca (psf):	0
γ (pcf)	130
β (deg)	18.43
ϕ (deg)	28.8

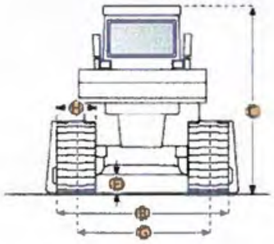
Resisting Stress (psf)	211.25
Driving Stress (psf)	210.56
FS	**1.00**

RITCHIE Specs Everything about Equipment

CATERPILLAR D60 CRAWLER TRACTOR







Dimensions		
A. LENGTH W/ BLADE	15.7 ft in	4800 mm
B. WIDTH OVER TRACKS	7.7 ft in	2360 mm
C. HEIGHT TO TOP OF CAB	9.4 ft in	2870 mm
D. LENGTH OF TRACK ON GROUND	7.7 ft in	2360 mm
E. GROUND CLEARANCE	1 ft in	310 mm
F. LENGTH W/O BLADE	12.2 ft in	3730 mm
Undercarriage		
G. TRACK GAUGE	6.2 ft in	1880 mm
H. STANDARD SHOE SIZE	18 in	457 mm

RITCHIESpecs Everything about Equipment

CATERPILLAR D60 CRAWLER TRACTOR

Specification

Engine

MODEL	3306	
GROSS POWER	140 hp	104.4 kw
DISPLACEMENT	640.7 cu in	10.5 L

Operational

OPERATING WEIGHT	31460 lb	14270 kg
FUEL CAPACITY	77.9 gal	295 L

Transmission

TYPE	powershift	
NUMBER OF FORWARD GEARS	3	
NUMBER OF REVERSE GEARS	3	
MAX SPEED - FORWARD	6.7 mph	10.8 km/h
MAX SPEED - REVERSE	8 mph	12.9 km/h

Undercarriage

GROUND PRESSURE	9.2 psi	63.4 kPa
GROUND CONTACT AREA	3348 in2	2.2 m2
STANDARD SHOE SIZE	18 in	457 mm
NUMBER OF TRACK ROLLERS PER SIDE	6	
TRACK GAUGE	6.2 ft in	1880 mm

Standard Blade

WIDTH	10.5 ft in	3200 mm

Dimensions

LENGTH W/O BLADE	12.2 ft in	3730 mm
LENGTH W/ BLADE	15.7 ft in	4800 mm
WIDTH OVER TRACKS	7.7 ft in	2360 mm
HEIGHT TO TOP OF CAB	9.4 ft in	2870 mm
LENGTH OF TRACK ON GROUND	7.7 ft in	2360 mm
GROUND CLEARANCE	1 ft in	310 mm

RITCHIE Specs Everything about Equipment

Select language

Current number of specifications

Home → Spec Search → Co → Crawler Tractor → Caterpillar → D5H LGP

CATERPILLAR D5H LGP CRAWLER TRACTOR

VIEW ARTICLES ON THIS ITEM

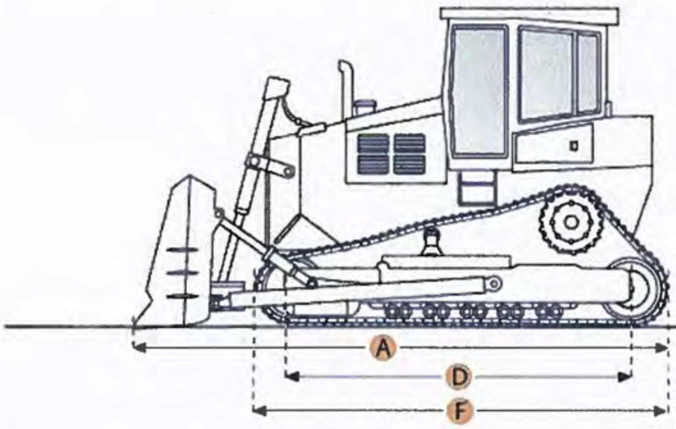
Print specification

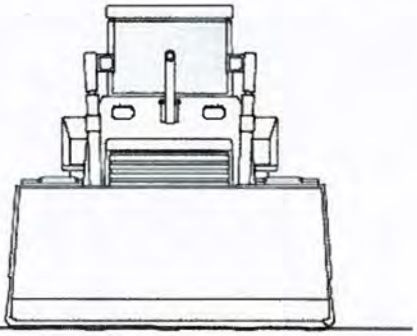
Looking to purchase this item?

Find a Caterpillar D5H LGP Crawler Tractor being sold at Ritchie Bros. auctions.

Need to sell equipment?

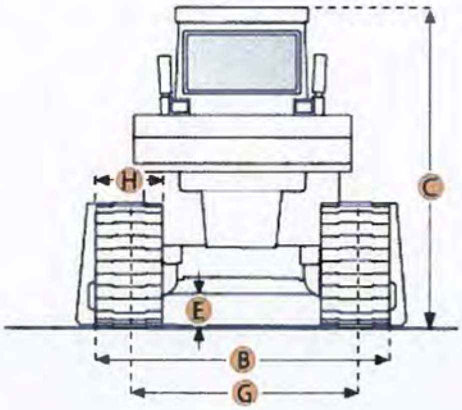
Complete this form and a Ritchie Bros. representative will contact you.





Selected Dimensions

Dimensions		
A. LENGTH W/ BLADE	17.4 ft in	5300 mm
B. WIDTH OVER TRACKS	9.9 ft in	3020 mm
C. HEIGHT TO TOP OF CAB	10.1 ft in	3069 mm
D. LENGTH OF TRACK ON GROUND	10.2 ft in	3121 mm
E. GROUND CLEARANCE	1.5 ft in	444 mm
F. LENGTH W/O BLADE	13.5 ft in	4130 mm
Undercarriage		
G. TRACK GAUGE	7.1 ft in	2160 mm
H. STANDARD SHOE SIZE	33.9 in	860 mm



Specification

Engine		
MAKE	Caterpillar	
MODEL	3304	
GROSS POWER	129 hp	96.2 kw
NET POWER	120 hp	89.5 kw
POWER MEASURED @	2200 rpm	
DISPLACEMENT	427.2 cu in	7 L
ASPIRATION	turbocharged	
NUMBER OF CYLINDERS	4	
Operational		
OPERATING WEIGHT	32380 lb	14687.3 kg
FUEL CAPACITY	65 gal	246 L
COOLING SYSTEM FLUID CAPACITY	7.4 gal	27.9 L
ENGINE OIL CAPACITY	4.7 gal	17.8 L
HYDRAULIC FLUID CAPACITY	18.5 gal	70 L
FINAL DRIVES FLUID CAPACITY	1.8 gal	7 L
OPERATING VOLTAGE	24 V	
ALTERNATOR SUPPLIED AMPERAGE	50 amps	
Transmission		
TYPE	Planetary powershift	
NUMBER OF FORWARD GEARS	3	
NUMBER OF REVERSE GEARS	3	

Viewing Photo 1 of 5

MAX SPEED - FORWARD	6.2 mph	10 km/h
MAX SPEED - REVERSE	7.8 mph	12.5 km/h
Undercarriage		
GROUND PRESSURE	3.9 psi	26.8 kPa
GROUND CONTACT AREA	8308 in2	5.4 m2
STANDARD SHOE SIZE	33.9 in	860 mm
NUMBER OF SHOES PER SIDE	46	
NUMBER OF TRACK ROLLERS PER SIDE	8	
TRACK GAUGE	7.1 ft in	2160 mm
Hydraulic System		
PUMP TYPE	Load sensing hydraulics, variable displacement piston pump	
RELIEF VALVE PRESSURE	3000 psi	20684.3 kPa
PUMP FLOW CAPACITY	28.7 gal/min	108.8 L/min
Standard Blade		
WIDTH	13.1 ft in	3980 mm
HEIGHT	40.4 in	1025 mm
CAPACITY	4.2 yd3	3.2 m3
BLADE ANGLE (BOTH DIRECTIONS)	degrees	
CUTTING DEPTH	19.3 in	491 mm
Dimensions		
LENGTH W/O BLADE	13.5 ft in	4130 mm
LENGTH W/ BLADE	17.4 ft in	5300 mm
WIDTH OVER TRACKS	9.9 ft in	3020 mm
HEIGHT TO TOP OF CAB	10.1 ft in	3069 mm
LENGTH OF TRACK ON GROUND	10.2 ft in	3121 mm
GROUND CLEARANCE	1.5 ft in	444 mm

COMMONWEALTH OF KENTUCKY
ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER

APPLICATION FOR PERMIT TO CONSTRUCT ACROSS OR ALONG A STREAM AND / OR WATER QUALITY CERTIFICATION

Chapter 151 of the Kentucky Revised Statutes requires approval from the Division of Water prior to any construction or other activity in or along a stream that could in any way obstruct flood flows or adversely impact water quality. *If the project involves work in a stream, such as bank stabilization, dredging or relocation, a 401 Water Quality Certification (WQC) from the Division of Water will be required.* This completed form will be forwarded to the Water Quality Branch for WQC processing. The project may not start until all necessary approvals are received from the KDOW. For questions concerning the WQC process, contact the WQC section at 502/564-3410.

If the project will disturb more than 1 acre of soil, A Notice of Intent for Storm Water Discharges will also be required. Forms can be obtained at http://water.ky.gov/permitting/pages/generalpermits.aspx

1. **OWNER:** Gary Cook (Owner), Adam Deller (Point of Contact) Duke Energy
   Give name of person(s), company, governmental unit, or other owner of proposed project.
   MAILING ADDRESS: 6293 Beaver Road, Union, KY 41091
   TELEPHONE #: (513) 287-1239 **EMAIL:** Gary.Cook@duke-energy.com or Adam.Deller@duke-energy.com
2. **AGENT:** Gil M. Haines (Amec Foster Wheeler)
   Give name of person(s) submitting application, if other than owner.
   ADDRESS: 1075 Big Shanty Road, Kennesaw, GA 30144
   TELEPHONE #: (770) 421-3400 **EMAIL:** gil.haines@amecfw.com
3. **ENGINEER:** James L. Studer, PE (Amec Foster Wheeler) **P.E. NUMBER:** 20495
   Contact Division of Water if waiver can be granted.
   TELEPHONE #: (770) 421-3400 **EMAIL:** jim.studer@amecfw.com
4. **DESCRIPTION OF CONSTRUCTION:** See Attached
   List the items to be constructed in the floodplain
5. **COUNTY:** Boone **NEAREST COMMUNITY:** Union, KY
6. **USGS QUAD NAME** Rising Sun **LATITUDE/LONGITUDE:** 38.9019 N / 84.8411 W
7. **STREAM NAME:** Ohio River (approx. River Mile 511.5) **WATERSHED SIZE (in acres):** approx. 76,580 sq mi
8. **LINEAR FEET OF STREAM IMPACTED:** No impact to the stream (3,400 linear feet construction at the fringe of the Ohio River 100-year flood plain above the 100-year flood elevation)
9. **DIRECTIONS TO SITE:**
   6293 Beaver Road, Union, KY 41091
   See Attached Maps

10. **IS ANY PORTION OF THE REQUESTED PROJECT NOW COMPLETE?** ☐ Yes ☒ No If yes, identify the completed portion on the drawings you submit and indicate the date activity was completed. DATE: ____________

11. **ESTIMATED BEGIN CONSTRUCTION DATE:** January 2018

12. **ESTIMATED END CONSTRUCTION DATE:** January 2021

13. **HAS A PERMIT BEEN RECEIVED FROM THE US ARMY, CORPS of ENGINEERS?** ☐ Yes ☒ No If yes, attach a copy of that permit.

14. **THE APPLICANT *MUST* ADDRESS PUBLIC NOTICE:**

(a) PUBLIC NOTICE HAS BEEN GIVEN FOR THIS PROPOSAL BY THE FOLLOWING MEANS:

_X_ **Public notice in newspaper having greatest circulation in area** (provide newspaper clipping or affidavit)
____ **Adjacent property owner(s) affidavits** (Contact Division of Water for requirements.)

(b) ____ **I REQUEST WAIVER OF PUBLIC NOTICE BECAUSE:**

____
Contact Division of Water for requirements.

15. **I HAVE CONTACTED THE FOLLOWING CITY OR COUNTY OFFICIALS CONCERNING THIS PROJECT:**

Local floodplain administrator, Boone County - Mark Martin (P.O. Box 960 Burlington, KY 41005 PH: 859-334-2218)
Give name and title of person(s) contacted and provide copy of any approval city or county may have issued.

16. **LIST OF ATTACHMENTS:** ____
List plans, profiles, or other drawings and data submitted. Attach a copy of a 7.5 minute USGS topographic map clearly showing the project location.

Figure 1: Topographic Map
Figure 2: Site Location Map
Figure 3: Floodplain Map
Design Drawings for Retention Basin

17. **I, ________ (owners initials) CERTIFY THAT THE OWNER OWNS OR HAS EASEMENT RIGHTS ON ALL PROPERTY ON WHICH THIS PROJECT WILL BE LOCATED OR ON WHICH RELATED CONSTRUCTION WILL OCCUR** (for dams, this includes the area that would be impounded during the design flood).

18. **REMARKS:** ____

This application is being submitted concurrently to KDEP Division of Water and the Boone County Floodplain Manager.

I hereby request approval for construction across or along a stream as described in this application and any accompanying documents. To the best of my knowledge, all the information provided is true and correct.

SIGNATURE: ____
Owner or Agent sign here. (If signed by Agent, a Power of Attorney should be attached.)

DATE: 11-9-16

SIGNATURE OF LOCAL FLOODPLAIN COORDINATOR:

____
Permit application will be returned to applicant if not properly endorsed by the local floodplain coordinator.

DATE: 11-9-16

SUBMIT APPLICATION AND ATTACHMENTS TO:

Floodplain Management Section
Division of Water
300 Sower Boulevard
Frankfort, KY 40601

Attachment 1: Description of Construction

Duke Energy is proposing to excavate the coal combustion residual (CCR) materials in the East Bend Station Ash Basin and use the structure as a retention basin as part of the site-wide water management strategy. East Bend Station is located on the east banks of the Ohio River near River Mile 511.5 (**Figures 1 and 2**).

The existing Ash Basin will be repurposed as a retention basin to provide site water storage and treatment necessary for the larger site-wide water management strategy. Following the permitting and approval by Kentucky Department for Environmental Protection (KDEP), the former Ash Basin will be regraded to the proposed design grades and an intermediate dike constructed. The new retention basin will consist of West and East Basins separated by the intermediate dike. The proposed retention basin will be lined with a composite liner system including a geosynthetic clay liner (GCL) and an HDPE double-sided textured geomembrane. The design drawings for the proposed retention basin are attached to this permit application. As part of repurposing efforts; the dam crest will be lowered approximately 14 feet; existing 2 horizontal: 1 vertical (2H:1V) slopes of the embankments will be reduced to 3H:1V; and an intermediate dike will be installed to create two interconnected basin units (East and West Basins).

The project will be completed in two phases. Phase 1 will consist of removing CCR material from the west side of the existing Ash Basin. During the CCR removal a sheet pile wall will be constructed to separate the west and east. A peninsula will be constructed on the south side of the pond so that the sheet pile wall will not penetrate the core of the existing dike. Once the sheet pile wall is in place, existing water in the west side will be pumped into the east side and remaining CCR material will be removed from the west side of the pond. An intermediate dike will then be constructed in the cleaned portion of the new west basin to permanently separate the two new basins. The west side dike will also be lowered in this phase from the existing elevation of 520 feet to a new top of dike elevation of 505 feet. Once all CCR material has been removed, the pond bottom will also be regraded to aid in the installation of the liner system. Any storm water that will accumulate in the West Basin will be pumped over the temporary divider dike into the existing east side of the Ash Basin, where the current outfall is located.

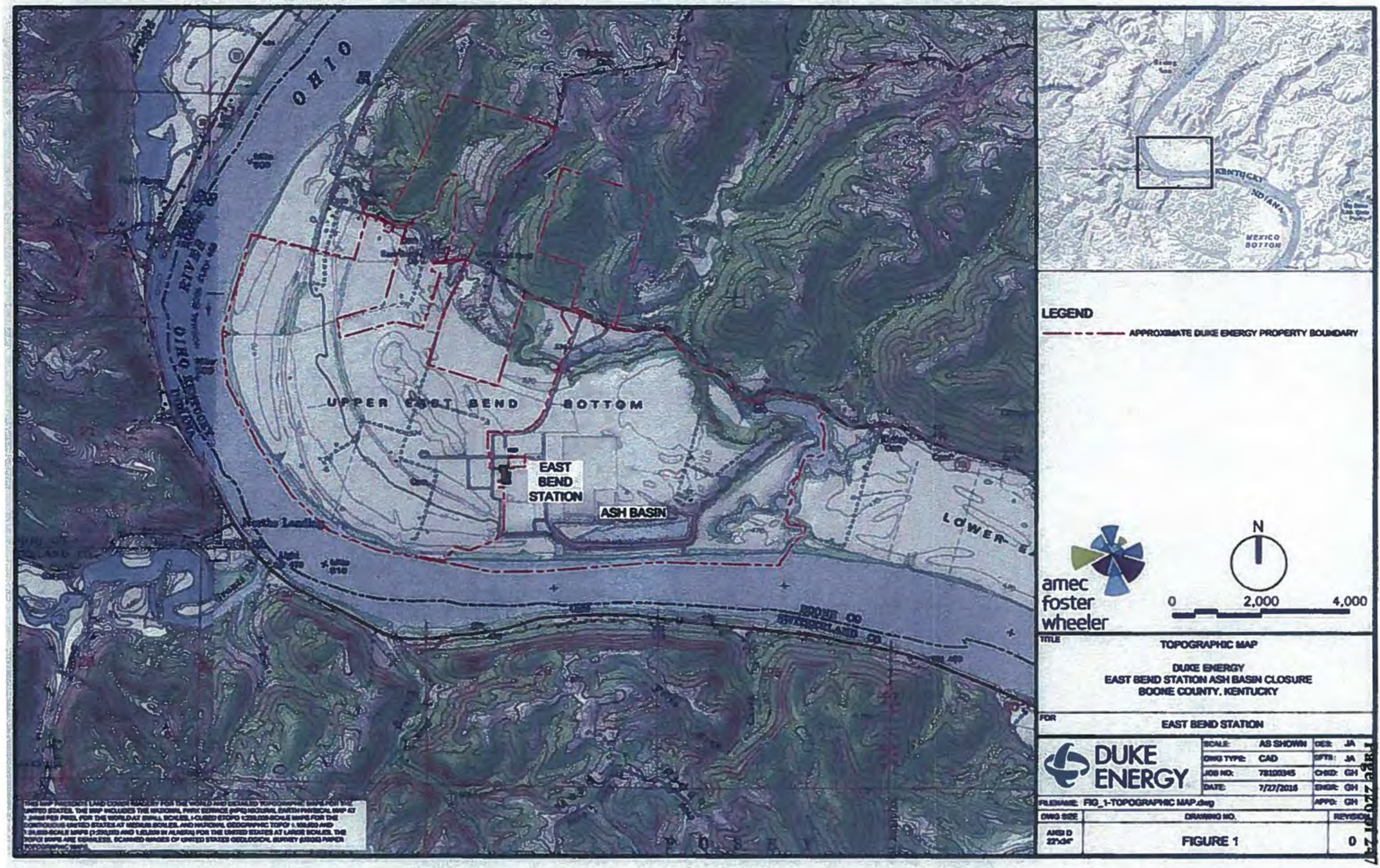
Phase 2 will repurpose the east side of the basin similar to the west side, with one minor difference. Since the intermediate dike will already be installed there is no need to install sheet pile wall for this phase. The east side will be dewatered and pumped into the West Basin. The West Basin water levels will be kept much lower in order to prevent flows from entering the newly installed concrete weir structure connecting the two basins. The CCR will be removed, pond bottom regraded, dike lowered to 505 feet and side slopes adjusted to 3H:1V slopes similar to the West Basin. The existing emergency spillway will be modified (lowered to invert elevation 503 feet) to accommodate the lower dike elevation.

The project site is located between Cross Sections E and F within the Ohio River FEMA hydraulic model as shown on Flood Insurance Panel (FIRM) Map #21015C0190C with effective date of June 4, 2007 (**Figure 3**). The 100-year flood elevation at the project site is 481 feet (NAVD). Construction will be within the fringe of the Ohio River 100-year flood plain. New crest elevation (505 ft) and emergency spillway elevation (503 feet) are both higher than the 100-year flood elevation.

The proposed construction is not expected to impact the Ohio River floodplain because the proposed construction is located outside the floodway of the Ohio River.

Attached:

Figure 1: Topographic Map
Figure 2: Site Location Map
Figure 3: Floodplain Map
Design Drawings for Retention Basin



LEGEND

APPROXIMATE DUKE ENERGY PROPERTY BOUNDARY

THIS MAP PRESENTS LAND COVER IMAGERY FOR THE WORLD AND DETAILED TOPOGRAPHIC MAPS FOR THE UNITED STATES. THE MAP INCLUDES THE NATIONAL PARK SERVICE (NPS) NATURAL EARTH PHYSICAL MAP AT 1.24KM PER PIXEL FOR THE WORLD AT SMALL SCALES, I-CUBED ETOPO 1:250,000-SCALE MAPS FOR THE CONTIGUOUS UNITED STATES AT MEDIUM SCALES, AND NATIONAL GEOGRAPHIC TOPO! 1:100,000 AND 1:24,000-SCALE MAPS (1:250,000 AND 1:63,360 IN ALASKA) FOR THE UNITED STATES AT LARGE SCALES. THE TOPO! MAPS ARE SEAMLESS, SCANNED IMAGES OF UNITED STATES GEOLOGICAL SURVEY (USGS) PAPER TOPOGRAPHIC MAPS.

amec foster wheeler

TITLE

TOPOGRAPHIC MAP

DUKE ENERGY
EAST BEND STATION ASH BASIN CLOSURE
BOONE COUNTY, KENTUCKY

FOR

EAST BEND STATION

DUKE ENERGY

SCALE:	AS SHOWN	DES:	JA
DWG TYPE:	CAD	DFTR:	JA
JOB NO:	78100345	CHKD:	GH
DATE:	7/27/2016	ENGR:	GH
FILENAME:	FIG_1-TOPOGRAPHIC MAP.dwg	APPD:	GH

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	FIGURE 1	0

EXHIBIT 2

15 0345_Duke EastBend\Exhibit\TOPOGRAPHIC MAP\FIG_1-TOPOGRAPHIC MAP.dwg

amec foster wheeler

LEGEND

● OUTFALL ★ EAST BEND STATION ▭ APPROXIMATE CCR FACILITY BOUNDARY

NOTE: THIS FIGURE IS FOR REFERENCE ONLY.

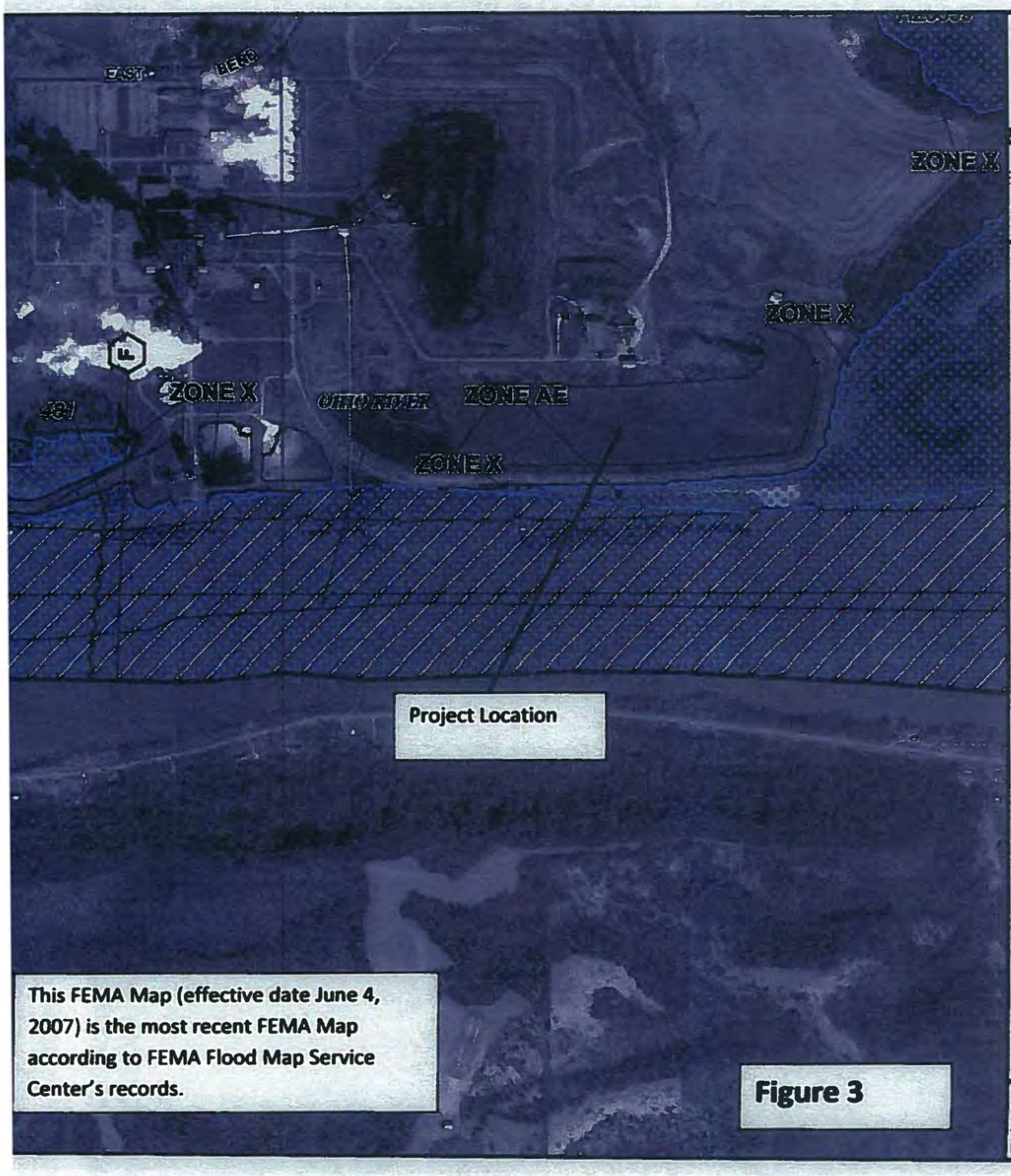
EAST BEND ASH BASIN CLOSURE PLAN
SITE LOCATION AND FACILITIES MAP

EAST BEND STATION
BOONE COUNTY, KENTUCKY

PROJECT NO: 7810-15-0345	FIGURE NO:

DUKE ENERGY.

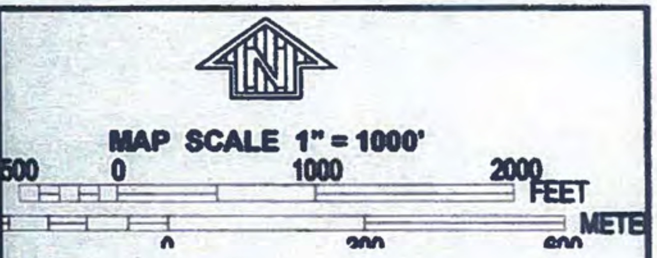
F:\AMEC_Projects\2014\7810-14-0183_OM\7810-14-0183_01_04_East_Bend_OM\Fig-1_Site_Map.mxd, User: maddison.sutton; Date: 6/22/2016 12:08:32 PM, Checked by: AJ Date: 6/22/2016



Project Location

This FEMA Map (effective date June 4, 2007) is the most recent FEMA Map according to FEMA Flood Map Service Center's records.

Figure 3



PANEL 0190C

FIRM

FLOOD INSURANCE RATE MAP

BOONE COUNTY, KENTUCKY

AND INCORPORATED AREAS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 190 OF 325

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOONE COUNTY	210013	0190	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
21015C0190C

EFFECTIVE DATE
JUNE 4, 2007

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

DUKE ENERGY

East Bend Station Unit 2
Boone County, Kentucky

2016

88869

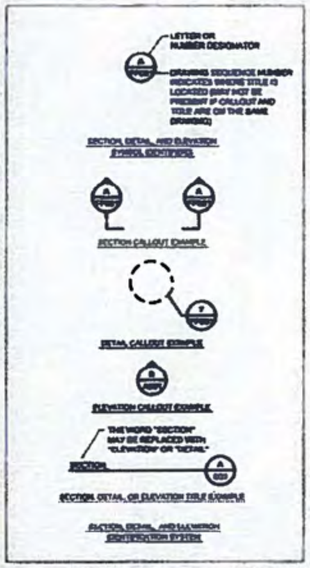
Contract Drawings

GENERAL DRAWINGS

DWG. NO.	TITLE
[illegible]	COVER-INDEX
[illegible]	LEGEND, ABBREVIATIONS, VICINITY MAP & GENERAL NOTES

CIVIL DRAWINGS

DWG. NO.	TITLE
[illegible]	EXISTING CONDITIONS
[illegible]	EROSION CONTROL PLAN
[illegible]	SITE PLAN - TEMPORARY (1)
[illegible]	OVERALL GRADING PLAN - TEMPORARY (1)
[illegible]	GRADING SECTIONS - SHEET 1 - TEMPORARY (1)
[illegible]	GRADING SECTIONS - SHEET 2 - TEMPORARY (1)
[illegible]	SITE PLAN - TEMPORARY (2)
[illegible]	OVERALL GRADING PLAN - TEMPORARY (2)
[illegible]	GRADING SECTIONS - SHEET 1 - TEMPORARY (2)
[illegible]	GRADING SECTIONS - SHEET 2 - TEMPORARY (2)
[illegible]	SITE PLAN - FUTURE
[illegible]	OVERALL GRADING PLAN - FUTURE
[illegible]	GRADING SECTIONS - SHEET 1 - FUTURE
[illegible]	GRADING SECTIONS - SHEET 2 - FUTURE
[illegible]	EROSION CONTROL DETAILS
[illegible]	LINER DETAILS
[illegible]	CIVIL DETAILS - SHEET 1



no.	date	by	chd	description
A	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
B	[illegible]	[illegible]	[illegible]	ISSUED FOR OWNER REVIEW
C	[illegible]	[illegible]	[illegible]	ISSUED FOR PERMITTING

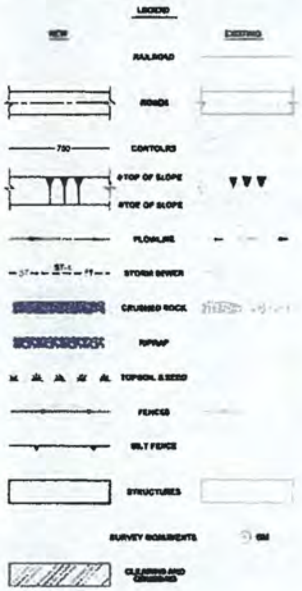
BURNS MCDONNELL

PRELIMINARY - NOT FOR CONSTRUCTION

Water Redirection Program
ISSUED FOR PERMITTING
Retention Basin

Cover-Index

LEGEND



\# TOP OR TOE OF SLOPE TO MATCH EXISTING GRADE UNLESS AN ELEVATION OR SLOPE IS INDICATED

ALL SYMBOLS ARE STANDARD WITHOUT RESPECT TO CONTRACTS

ABBREVIATIONS

ABBREVIATION	TERM	ABBREVIATION	TERM
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	MO	MID ORDINATE
AC	ACRE	N	NORTH
@	AT	NAD	NORTH AMERICAN DATUM
AHD	AHEAD	NGVD	NATIONAL GEODETIC VERTICAL DATUM
APPROX	APPROXIMATE	NO	NUMBER
ASPH	ASPHALT	OC	ON CENTER
ASTM	AMERICAN SOCIETY OF TESTING AND MATERIALS	OD	OUTSIDE DIAMETER
AUX	AUXILIARY	OPNG	OPENING
BK	BACK	OZ	OUNCE
BLDG	BUILDING	±	PLUS OR MINUS
BM	BENCHMARK	PC	POINT OF CURVE
BOT	BOTTOM	PCC	PORTLAND CEMENT CONCRETE
CB	CATCH BASIN	PI	POINT OF INTERSECTION
C TO C	CENTER TO CENTER	PL	PROPERTY LINE
CL	CENTERLINE	PT	POINT OF TANGENT
CLMS	CONTROLLED LOW STRENGTH MATERIAL	PRC	POINT OF REVERSE CURVE
CHDPE	CORRUGATED HIGH DENSITY POLYETHYLENE	PSI	POUNDS PER SQUARE INCH
CJ	CONSTRUCTION JOINT	PVC	POINT OF VERTICAL CURVE
CMAP	CORRUGATED METAL ARCH PIPE	PVI	POINT OF VERTICAL INTERSECTION
CMP	CORRUGATED METAL PIPE	PVRC	POINT OF VERTICAL REVERSE CURVE
CONC	CONCRETE	PVT	POINT OF VERTICAL TANGENT
CPT	CORRUGATED POLYETHYLENE TUBING	R	RADIUS
CIV	CIVIL	RBR	REBAR
DBL	DOUBLE	RCC	ROLLER COMPACTED CONCRETE
DET	DETAIL	RD	ROAD
DI	DROP INLET	RPT	RADIUS POINT
DIA	DIAMETER	RCP	REINFORCED CONCRETE PIPE
DWG	DRAWING	RR	RAILROAD
ECB	EXISTING CATCH BASIN	RT	RIGHT
EDB	ELECTRICAL DUCT BANK	ROW	RIGHT OF WAY
E	EAST	S	SOUTH
EF	EACH FACE	SLP	SLOPE
EJ	EXPANSION JOINT	SS	STAINLESS STEEL
EL	ELEVATION	SHLDR	SHOULDER
EMH	ELECTRICAL MANHOLE	STD	STANDARD
EQN	EQUATION	ST	STORM SEWER
EXIST	EXISTING	STA	STATION
EW	EACH WAY	SWG	SWING
FBD	FLAT BOTTOM DITCH	SY	SQUARE YARD
FFE	FINISHED FLOOR ELEVATION	T&B	TOP AND BOTTOM
FL	FLOWLINE	TEMP	TEMPORARY
FT	FEET, FOOT	TOA	TOP OF ASPHALT
GA	GAGE	TOC	TOP OF CONCRETE
GALV	GALVANIZED	TO GRATING	TOP OF GRATING
GCL	GEOSYNTHETIC CLAY LINER	TOM	TOP OF MANHOLE
H	HORIZONTAL	TOP	TOP OF PIPE
HDPE	HIGH DENSITY POLYETHYLENE	TOR	TOP OF RAIL
HORIZ	HORIZONTAL	TOSB	TOP OF SUBBALLAST
HPT	HIGH POINT	TOSG	TOP OF SUBGRADE
HWY	HIGHWAY	TPI	THREADS PER INCH
ID	INSIDE DIAMETER	TYP	TYPICAL
IF	INSIDE FACE	UON	UNLESS OTHERWISE NOTED
INTSCT	INTERSECTION	V	VERTICAL
INV	INVERT	VC	VERTICAL CURVE
KYTC	KENTUCKY TRANSPORTATION CABINET	VERT	VERTICAL
L	LONG	W	WEST
LB	POUND	W/	WITH
LF	LINEAR FEET	W/O	WITH OUT
LT	LEFT	WT	WEIGHT
MAX	MAXIMUM	WWF	WELDED WIRE FABRIC
MH	MANHOLE		
ML	MIL INCH		
MIN	MINIMUM		
MISC	MISCELLANEOUS		

NOTES:

1. ALL ABBREVIATIONS ARE BURNS &McDONNELL STANDARDS WITHOUT RESPECT TO CONTRACTS.
2. ABBREVIATIONS ARE APPLICABLE TO ALL DWGS

VICINITY MAP
NOT TO SCALE

GENERAL NOTES:

1. ALL COORDINATES AND ELEVATIONS OF PERMANENT BENCHMARKS ARE PROVIDED BY DUKE ENERGY PRIOR TO THE START OF CONSTRUCTION. THE COORDINATES AND ELEVATIONS SHALL BE VERIFIED PRIOR TO THE START OF WORK. COORDINATES ARE STATE PLANE, NAD 83 KENTUCKY NORTH 1601.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL MEANS AND METHODS OF CONSTRUCTION UNLESS NOTED OTHERWISE. CONTRACTOR SHALL FURNISH ALL LABOR, EQUIPMENT, MATERIALS, AND TOOLS NECESSARY TO COMPLETELY PERFORM THE WORK IN SAFE, EXPEDITIOUS, AND WORKMANLIKE MANNER. CONTRACTOR SHALL COORDINATE SCHEDULE OF THE WORK WITH OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPER HANDLING AND INSTALLATION OF MATERIALS.
3. CONTRACTOR SHALL UNDERTAKE ALL NECESSARY MEASURES TO ENSURE SAFETY OF ALL PERSONS AND STRUCTURES AT THE SITE AND ADJACENT TO THE SITE. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY CLAIMS RESULTING FROM CONTRACTOR OR SUBCONTRACTOR ACTIVITIES. VISITS TO THE SITE BY THE ENGINEER OR OWNER SHALL NOT RELIEVE THE CONTRACTOR OF SUCH RESPONSIBILITY.
4. THE CONTRACTOR SHALL ACCEPT FULL RESPONSIBILITY FOR MATERIALS THROUGH PROJECT COMPLETION. CONTRACTOR SHALL STORE MATERIALS IN A SECURE LOCATION (ON OR OFF-SITE).
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER SAFEGUARDING OF THE INSTALLATION AND MATERIALS STORED ON THE SITE TO PREVENT THEFT, VANDALISM OR DAMAGE.
6. CONTRACTOR SHALL NOT DISTURB ADJACENT PROPERTIES THAT ARE NOT THE PROPERTY WHERE THE PROJECT IS LOCATED.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL CONSTRUCTION PERMITS REQUIRED TO PERFORM THE WORK. CONTRACTOR SHALL PROVIDE CERTIFICATES OF INSURANCE AND OTHER DOCUMENTATION REQUIRED BEFORE PERFORMING THE WORK.
8. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH OSHA STANDARDS.
9. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS.
10. THESE NOTES AND OTHER DRAWING NOTES CONTAINED HEREWITH ARE PROVIDED TO MEET SPECIFIC REQUIREMENTS AND TO SUPPLEMENT THE CONTRACT DOCUMENTS. THESE NOTES NEITHER REPLACE NOR OVERRIDE THE PROVISIONS AND REQUIREMENTS OF THE CONTRACT DOCUMENTS.
11. UNKNOWN SITUATIONS OR CONDITIONS NOT COVERED IN THE CONTRACT DOCUMENTS MAY ARISE DURING CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE OWNER IF SUCH A CONDITION IS IDENTIFIED WITHIN 24 HOURS.
12. ALL DIMENSIONS, ELEVATIONS, AND CONDITIONS SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR AND ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER FOR CLARIFICATION BEFORE PROCEEDING WITH THE AFFECTED PART OF WORK.
13. THE CONTRACTOR SHALL VISIT THE SITE AND FAMILIARIZE THEMSELVES WITH THE EXISTING CONDITIONS BEFORE SUBMITTING THEIR BID.
14. IF CERTAIN FEATURES ARE NOT FULLY SHOWN OR CALLED FOR ON THE CONTRACT DRAWINGS OR SPECIFICATIONS, THEIR CONSTRUCTION SHALL BE OF THE SAME CHARACTER AS FOR SIMILAR CONDITIONS THAT ARE SHOWN OR CALLED FOR, SUBJECT TO THE APPROVAL OF THE ENGINEER AND THE OWNER.
15. ALL WORK SHALL BE DONE TO THE LINES, SLOPES, THICKNESS, AND GRADES INDICATED IN THE CONTRACT DRAWINGS. MAXIMUM SLOPE SHALL BE 3H:1V UNLESS INDICATED OTHERWISE. ALL ESTABLISHED MONUMENTS, BENCHMARKS, REFERENCE POINTS, STAKES, AND OTHER CONTROL POINTS SHALL BE CAREFULLY PRESERVED BY THE CONTRACTOR. CONTRACTOR SHALL NOTIFY OWNER IN WRITING OF BENCHMARKS, REFERENCE LINES, OR OTHER CONTROL POINTS WHICH MAY HAVE BEEN DISTURBED OR WHICH APPEAR TO BE OFF LINE OR GRADE.
16. ONCE THE WORK HAS BEEN STARTED, THE CONTRACTOR SHALL COMPLETE THE WORK WITHOUT ANY INTERRUPTIONS.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING POWER & WATER AND TEMPORARY SANITARY FACILITIES FOR CONTRACTOR'S PERSONNEL. CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR INSTALLING AND REMOVING ANY REQUIRED TEMPORARY UTILITY CONNECTIONS.
18. GRADES AND ELEVATIONS SHOWN ARE FINISHED SURFACING.
19. INSTALL EROSION CONTROL MEASURES FOR THE SWPPP AND AS NECESSARY TO PERFORM WORK IN ACCORDANCE WITH ALL APPLICABLE LAND DISTURBANCE ORDINANCES AND REGULATIONS.
20. CONTRACTOR SHALL PROVIDE ANY CLEAN-UP WORK NECESSARY TO LEAVE THE SITE IN A CONDITION ACCEPTABLE TO OWNER.

GENERAL DEMOLITION NOTES:

1. ALL DEMOLITION, WASTE, DEBRIS AND UNSATISFACTORY MATERIALS SHALL BE DISPOSED OF OFF THE SITE. ITEMS WITHIN THE PROJECT LIMITS, EVEN IF NOT IDENTIFIED, SHALL BE REMOVED AND PROPERLY DISPOSED OFF SITE.
2. DEBRIS REMOVAL MAY CONTAIN ANY OF THE FOLLOWING MATERIALS: AGGREGATE, CONCRETE, ASPHALT, MASONRY, FOUNDATIONS, REBAR, FENCE MATERIAL, PIPING, LIGHT POLES, SILT FENCE, AND MISCELLANEOUS STRUCTURES. LARGE PIECES OF MATERIAL MAY NEED TO BE CRUSHED AND/OR BROKEN UP FURTHER IN ORDER TO BE HAULED AWAY TO THE WASTE DISPOSAL SITE.
3. ANY DAMAGE TO PAVEMENT AREAS DESIGNATED TO REMAIN SHALL BE REPAIRED OR REMOVED AND REPLACED AT NO ADDITIONAL COST TO OWNER.
4. CONTRACTOR SHALL PRESERVE EXISTING TREES AND VEGETATION WHENEVER PRACTICABLE.

UTILITY DEMOLITION NOTES:

1. CONTRACTOR SHALL COORDINATE WITH THE OWNER PRIOR TO REMOVAL OF EXISTING UTILITIES IN SERVICE. RELOCATED UTILITIES SHALL BE CONSTRUCTED BEFORE REMOVAL OF EXISTING UTILITIES TO ENSURE UNINTERRUPTED SERVICE TO THE FACILITIES SERVED BY THE UTILITY. ALL RELOCATIONS SHALL BE COORDINATED WITH THE OWNER.
2. UTILITY CAPPING METHODS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS FOR SPECIFIC PIPE MATERIAL IN SERVICE. ALL CAPPING SHALL BE INSPECTED AND APPROVED BY THE OWNER.
3. ALL STRUCTURES, VALVES, ETC. TO REMAIN SHALL BE PROTECTED AND ADJUSTED TO FINISH GRADE.
4. IN AREAS OF UTILITY REMOVAL OF ABANDONED LINES, THE PORTION OF EXISTING ABANDONED LINES TO REMAIN SHALL BE CAPPED OR PLUGGED AT REMOVAL INTERFACE.
5. ALL UTILITIES EQUAL TO OR GREATER THAN [illegible] INCHES IN DIAMETER AND INDICATED TO BE ABANDONED IN PLACE SHALL BE FILLED WITH A LOW STRENGTH FLOWABLE FILL. END SECTIONS SHALL BE PLUGGED TO CONTAIN FLOWABLE FILL. FLOWABLE FILL SHALL BE A CEMENTITIOUS MIX WITH A COMPRESSIVE STRENGTH OF 75-100 psi

EXCAVATION AND BACKFILL NOTES:

1. THE SITE SHOULD BE STRIPPED OF ALL UNSUITABLE MATERIAL, SUCH AS BUT NOT LIMITED TO BITUMINOUS PAVEMENT, DEBRIS, GRAVEL, CONCRETE AND ANY FILL OR STOCKPILES IDENTIFIED FROM THE PREVIOUS ON-SITE CONSTRUCTION ACTIVITIES.
2. ALL EXCESS CUT MATERIAL SHALL BE DISPOSED OF ON-SITE IN A MANNER AND AT A LOCATION DESIGNATED BY THE OWNER.
3. EXCAVATIONS SHALL BE SLOPED OR SHORED IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS, INCLUDING OSHA CFR PART 1926 EXCAVATION TRENCH SAFETY STANDARDS. CONTRACTOR SHALL DESIGN, PROVIDE, INSTALL, AND LATER REMOVE ALL TEMPORARY SHORING, OR BRACING AS REQUIRED TO MAINTAIN EXCAVATIONS AND BANKS IN A SAFE AND STABLE CONDITION UNLESS NOTIFIED OTHERWISE.
4. THE CONTRACTOR SHALL PROVIDE TEMPORARY SHORING AS REQUIRED TO ENSURE STABILITY OF SURROUNDING STRUCTURES AS REQUIRED.
5. THE EFFECTS OF PROPOSED CUT EXCAVATIONS ON THE LOAD BEARING MATERIALS SUPPORTING EXISTING ADJACENT STRUCTURE FOUNDATIONS SHALL BE INVESTIGATED BY A QUALIFIED ENGINEER. THE FINAL PLANS FOR LIMITING EXCAVATION DEPTH AND DISTANCE FROM THE EXISTING FOUNDATIONS SHALL BE REVIEWED TO VERIFY EXCAVATION STABILITY. SHEETING AND SHORING, OR OTHER MEANS OF BRACING THE EXCAVATION SHALL BE UTILIZED IF NECESSARY.
6. THE BEARING SURFACES THAT ARE DEGRADED BY EXPOSURE TO THE ELEMENTS OR CONSTRUCTION ACTIVITIES, SHALL BE RE-EXCAVATED TO OR RECONSTRUCTED OF SUITABLE BEARING MATERIALS.
7. MINIMUM OF 6 INCHES OF COMPACTED STRUCTURAL FILL AGGREGATE MATERIAL SHALL BE PLACED BELOW THE BASE OF ALL FOUNDATIONS. THE AGGREGATE MATERIAL SHALL BE AASHTO NO. 57 OR IN CASES WHERE THE AGGREGATE WILL BE PROMPTLY COVERED AND NOT EXPOSED TO WEATHER, THE AGGREGATE MATERIAL CAN BE TYPE B CRUSHER RUN COMPACTED PER THE GEOTECHNICAL REPORT.
8. ROAD EMBANKMENT PLACEMENT CRITERIA: MATERIAL SHALL BE PLACED IN LIFTS NOT EXCEEDING 8 INCHES LOOSE. FILL SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF STANDARD PROCTOR AS PER ASTM D698 WITH THE MOISTURE CONTENT DEVIATING FROM THE OPTIMUM DRY DENSITY BY NO MORE THAN 2%. IF APPLICABLE FOR COHESIONLESS MATERIAL, THE BACKFILL SHALL BE COMPACTED TO A MINIMUM 70% RELATIVE DENSITY AS PER ASTM D-4253 AND D-4254.

no.	date	by	ckd	description
E	[illegible]	[illegible]	RMD	ISSUED FOR OWNER REVIEW
D	[illegible]	[illegible]	RMD	ISSUED FOR REVIEW
C	[illegible]	[illegible]	RMD	ISSUED FOR REVIEW
B	[illegible]	[illegible]	RMD	ISSUED FOR 60% REVIEW
A	[illegible]	[illegible]	RMD	ISSUED FOR 30% REVIEW

no.	date	by	ckd	description
F	[illegible]	[illegible]	RMD	ISSUED FOR PERMITTING

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS & McDONNELL
[illegible] PARKWAY
KANSAS CITY, MO 64114
[illegible]
FIRM LICENSE NO. 43

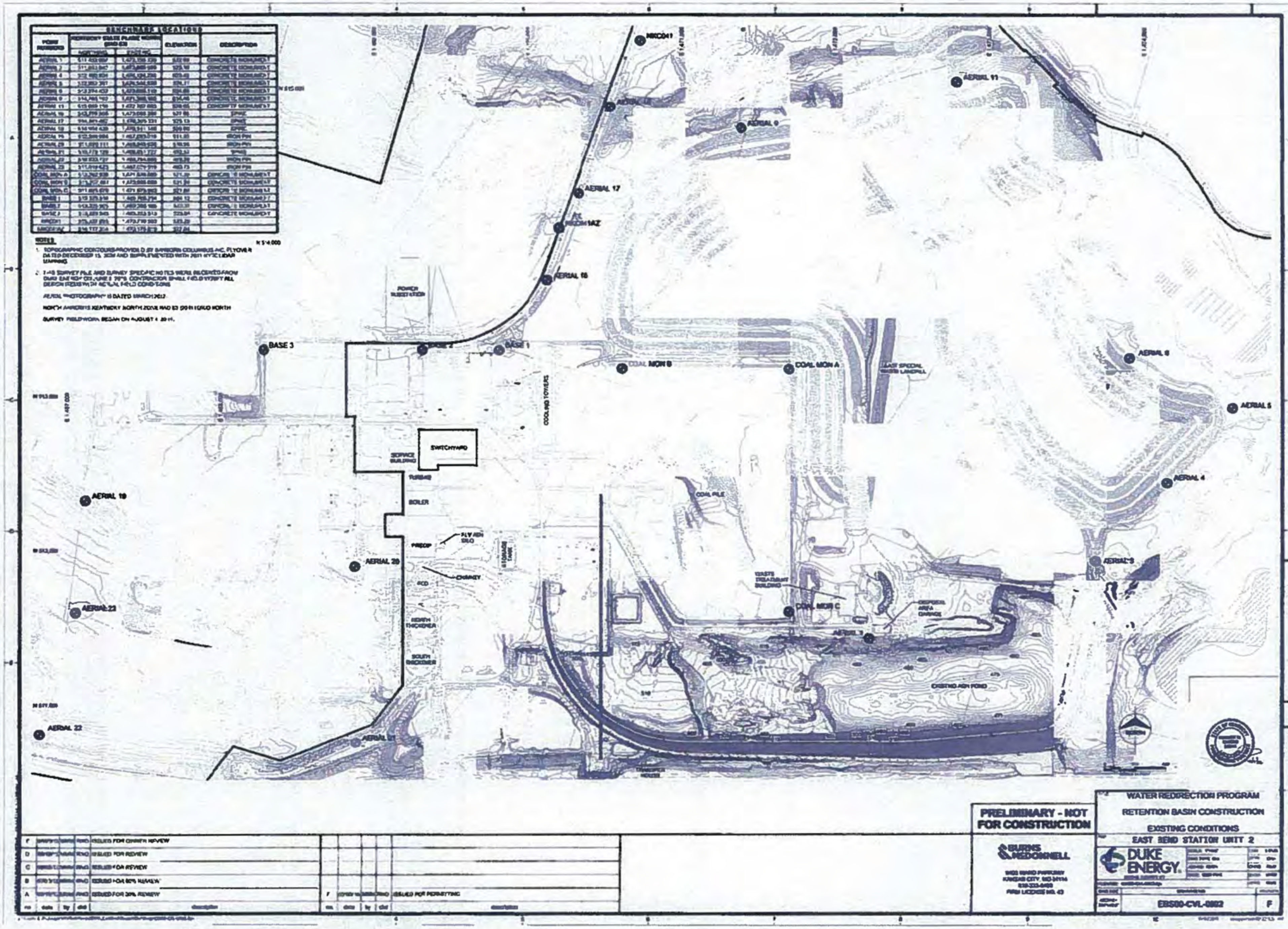
WATER REDIRECTION PROGRAM

RETENTION BASIN CONSTRUCTION
LEGEND, ABBREVIATIONS,
VICINITY MAP & GENERAL NOTES

EAST BEND STATION UNIT 2

DUKE ENERGY.

EB500-CVL-0001 | F



BENCHMARK LOCATIONS

POINT NUMBER	KENTUCKY STATE PLANE NORTH (NAD 83) NORTHING	KENTUCKY STATE PLANE NORTH (NAD 83) EASTING	ELEVATION	DESCRIPTION
AERIAL 1	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 2	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 4	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 5	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 6	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 9	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 11	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
AERIAL 16	[illegible]	[illegible]	[illegible]	SPIKE
AERIAL 17	[illegible]	[illegible]	[illegible]	SPIKE
AERIAL 18	[illegible]	[illegible]	[illegible]	SPIKE
AERIAL 19	[illegible]	[illegible]	[illegible]	IRON PIN
AERIAL 20	[illegible]	[illegible]	[illegible]	IRON PIN
AERIAL 21	[illegible]	[illegible]	[illegible]	SPIKE
AERIAL 22	[illegible]	[illegible]	[illegible]	IRON PIN
AERIAL 23	[illegible]	[illegible]	[illegible]	IRON PIN
COAL MON A	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
COAL MON B	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
COAL MON C	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
BASE 1	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
BASE 2	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
BASE 3	[illegible]	[illegible]	[illegible]	CONCRETE MONUMENT
NRCO41	[illegible]	[illegible]	[illegible]	
NRCO1AZ	[illegible]	[illegible]	[illegible]	

NOTES:

1. TOPOGRAPHIC CONTOURS PROVIDED BY [illegible] COLUMBUS INC. FLYOVER DATED DECEMBER 13, [illegible] AND SUPPLEMENTED WITH 2011 KYTC LIDAR MAPPING.
2. [illegible] SURVEY FILE AND SURVEY SPECIFIC NOTES WERE RECEIVED FROM DUKE ENERGY ON JUNE [illegible]. CONTRACTOR SHALL FIELD VERIFY ALL DESIGN [illegible] ACTUAL FIELD CONDITIONS.

AERIAL PHOTOGRAPHY IS DATED MARCH 2012.

NORTH ARROW IS KENTUCKY NORTH ZONE NAD 83 (2011) GRID NORTH

SURVEY FIELDWORK BEGAN ON AUGUST 4 2011.

F	ISSUED FOR OWNER REVIEW	
D	ISSUED FOR REVIEW	
C	ISSUED FOR REVIEW	
B	ISSUED FOR 60% REVIEW	
A	ISSUED FOR 30% REVIEW	
no.	date / by / ckd	description

F	ISSUED FOR PERMITTING
no.	date / by / ckd / description

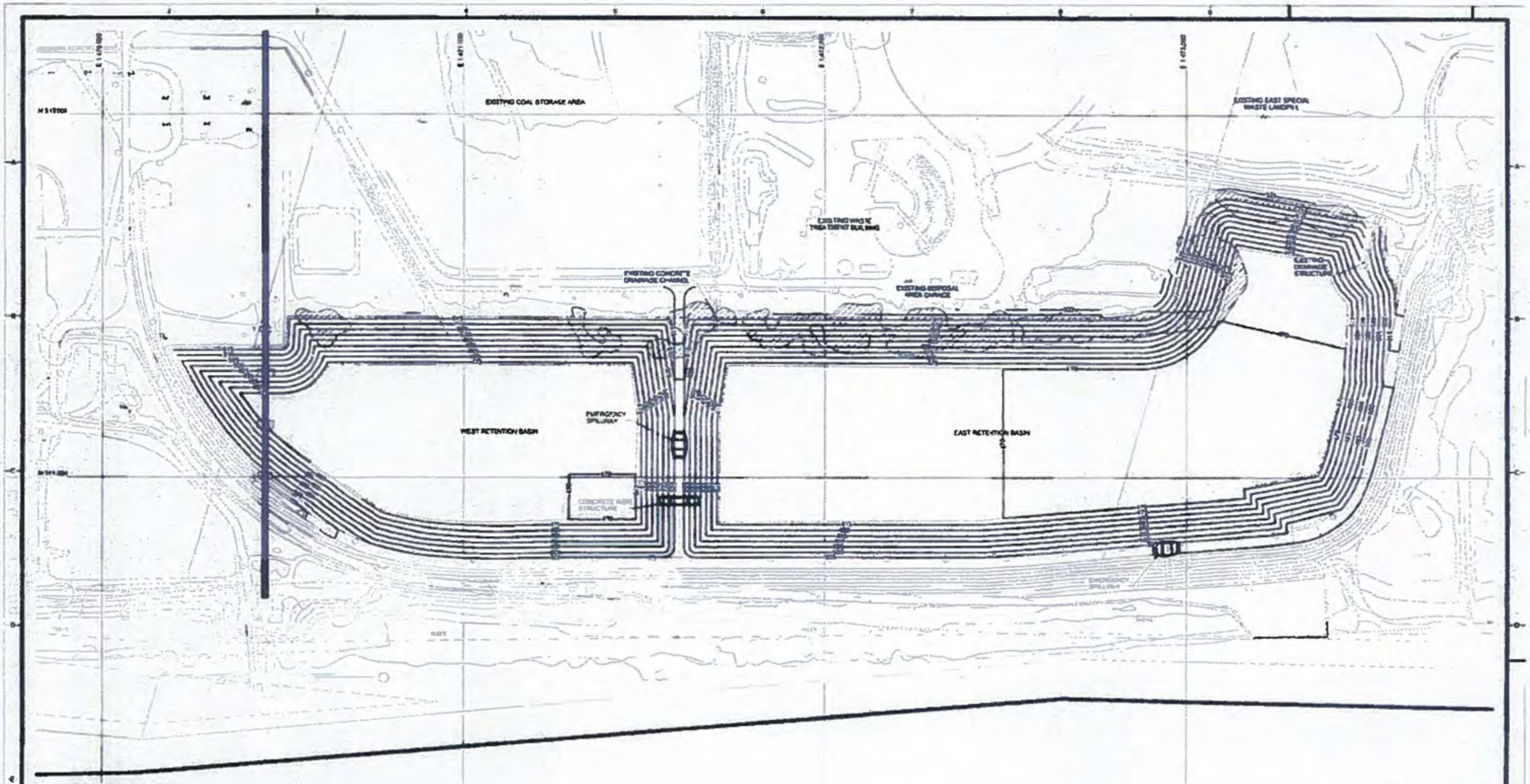
PRELIMINARY - NOT FOR CONSTRUCTION

BURNS & MCDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
[illegible]
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
EXISTING CONDITIONS
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0002
F



EROSION AND SEDIMENT CONTROL NOTES:

BEST MANAGEMENT PRACTICES

1. CONSTRUCTION ACTIVITY POLLUTION PREVENTION IS REQUIRED FOR THIS PROJECT. PREVENTION OF POLLUTION RESULTING FROM CONSTRUCTION ACTIVITIES SHALL BE ACCOMPLISHED BY CONTROLLING SOIL EROSION, WATERBORNE SEDIMENTATION AND AIRBORNE DUST GENERATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT EROSION AND SEDIMENTATION ARE CONTROLLED TO THE EXTENT PRACTICABLE.
2. SOIL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED AND MAINTAINED THROUGHOUT THE DURATION OF CONSTRUCTION ACTIVITIES. PRIOR TO INITIATING CONSTRUCTION IN AN AREA, ALL TEMPORARY EROSION AND SEDIMENT CONTROL PRACTICES SHALL BE IN PLACE. UPON PROJECT COMPLETION ALL TEMPORARY SOIL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED.
3. TEMPORARY EROSION CONTROL SHALL BE THE CONTRACTOR'S RESPONSIBILITY, WHO SHALL UTILIZE APPROPRIATE BEST MANAGEMENT PRACTICES (BMPS). THOSE BMPS SHALL CONSIST OF SILT FENCE, FIBER LOGS OR OTHER MEANS TO CONTROL EROSION AS NEEDED. THE CONTRACTOR SHALL FOLLOW THE OWNER'S EROSION AND SWPPP PLANS AS NEEDED.
4. CONTRACTOR SHALL PLACE SILT FENCE AS SHOWN PRIOR TO BEGINNING WORK. THE DEVICES SHALL BE PLACED DOWN SLOPE OF DISTURBED AREAS WHERE SHEET EROSION WOULD OCCUR. THE IDEAL LOCATION IS ON THE SAME CONTOUR. SILT FENCE SHALL BE CLEANED AND REPAIRED WHEN SEDIMENT BUILDUP REACHES ONE THIRD OF SILT FENCE HEIGHT. AFTER SIGNIFICANT RUNOFF EVENTS THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL STRUCTURES FOR SILT BUILDUP THAT INTERFERES WITH THE PERFORMANCE OF THE EROSION CONTROL STRUCTURE AND REPAIR OR REPLACE THOSE STRUCTURES AS NECESSARY.
5. ALL STORM DRAIN INLETS SHALL BE PROTECTED BY APPROPRIATE BMPS DURING CONSTRUCTION, UNTIL ALL SOURCES WITH POTENTIAL FOR DISCHARGE TO THE INLETS HAVE BEEN STABILIZED.

no.	date	by	ckd	description
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C	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
B	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
A	[illegible]	[illegible]	[illegible]	ISSUED FOR 60% REVIEW

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS & McDONNELL

9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

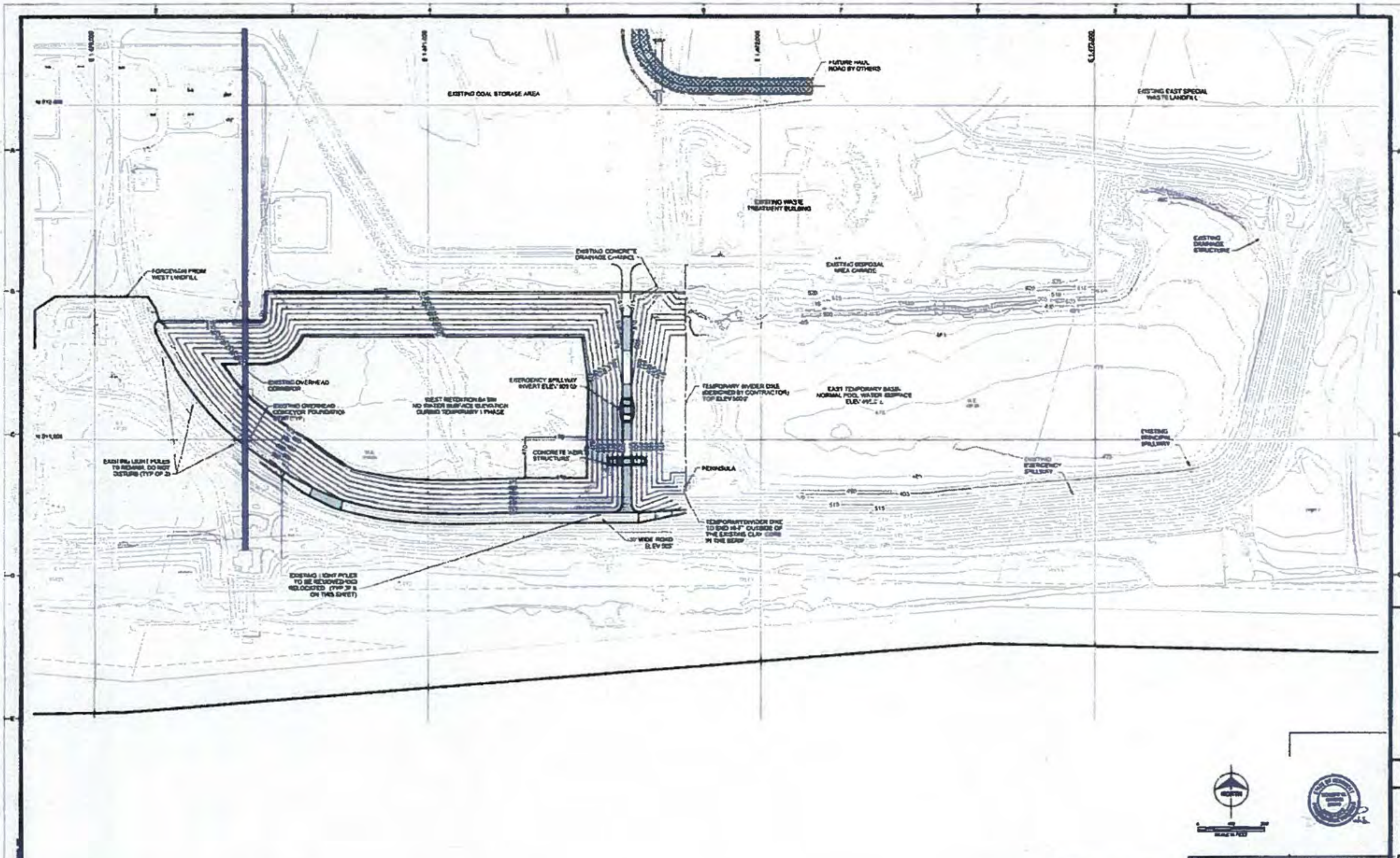
WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
EROSION CONTROL PLAN
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0803

E

EXHIBIT 2



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C	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
B	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
A	[illegible]	[illegible]	[illegible]	ISSUED FOR 60% REVIEW

PRELIMINARY - NOT FOR CONSTRUCTION

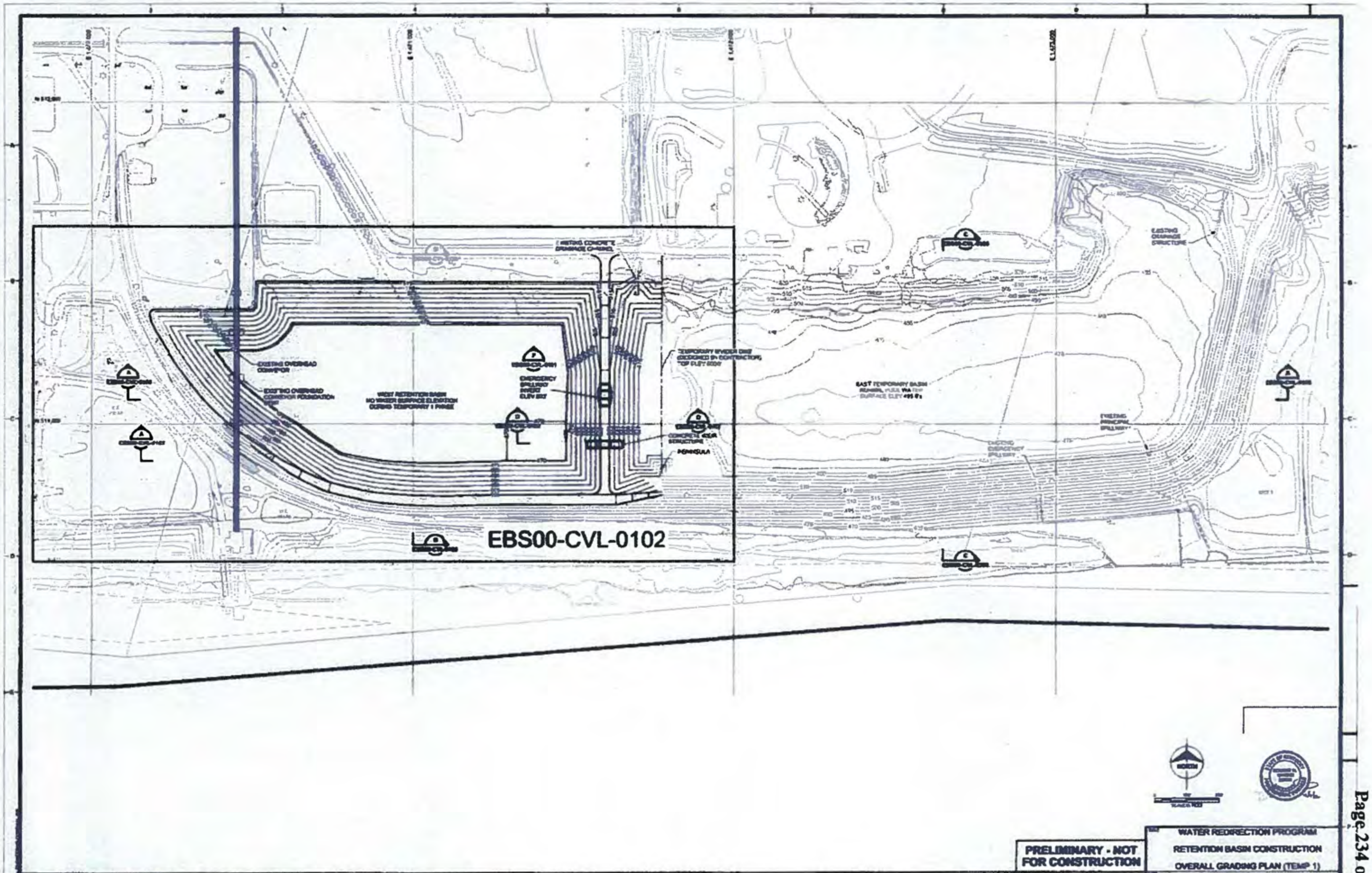
BURNS & McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
SITE PLAN (TEMP 1)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0100
E

EXHIBIT 2



PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL

9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM

RETENTION BASIN CONSTRUCTION

OVERALL GRADING PLAN (TEMP 1)

EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0101

F

no.	date	by	chd	description
E	[illegible]	[illegible]	RNO	ISSUED FOR OWNER REVIEW
D	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
C	[illegible]	[illegible]	RNO	ISSUED FOR REVIEW
B	[illegible]	[illegible]	RNO	ISSUED FOR 60% REVIEW
A	[illegible]	[illegible]	RNO	ISSUED FOR 30% REVIEW

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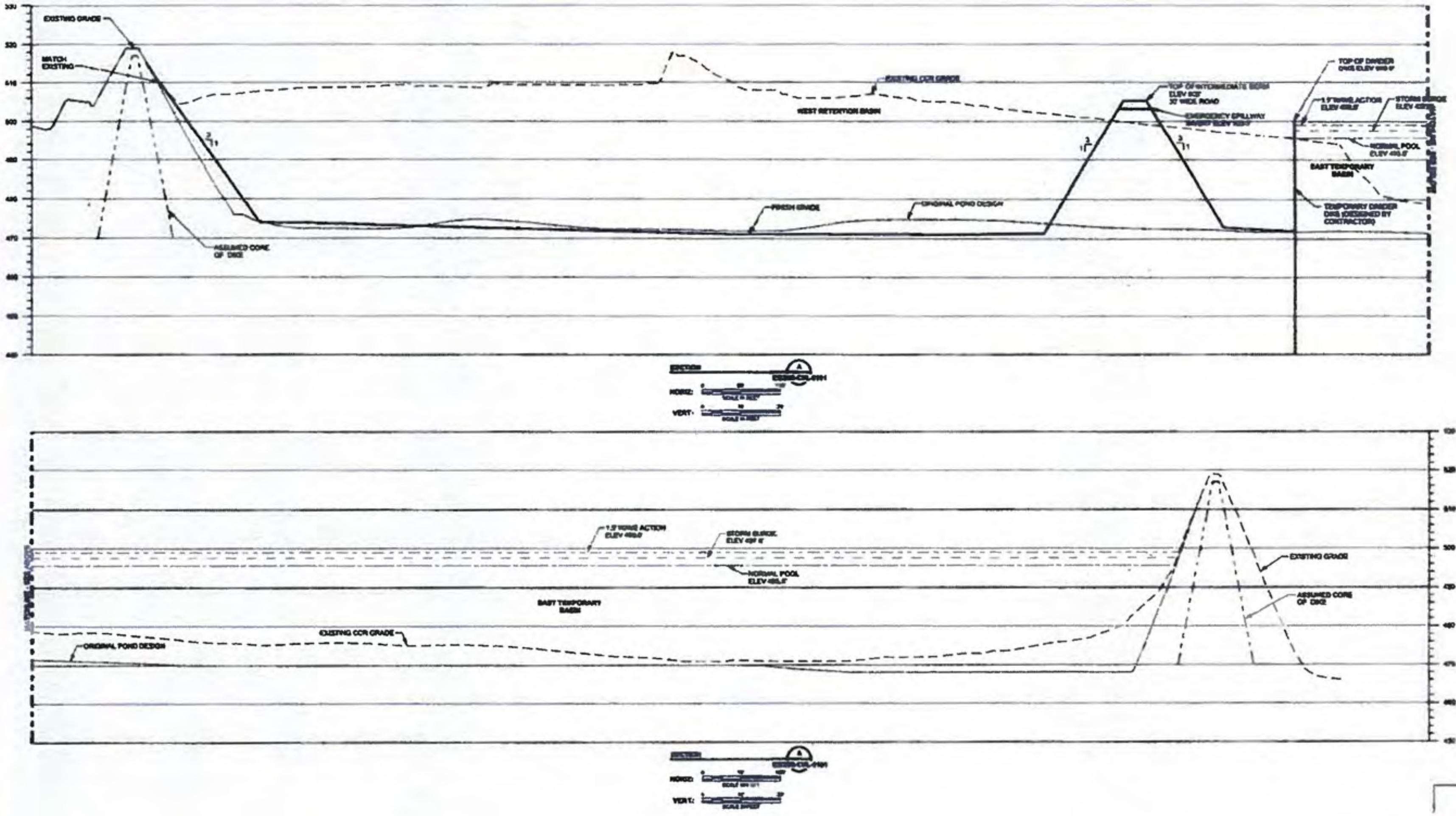

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C	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
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A	[illegible]	[illegible]	[illegible]	ISSUED FOR 30% REVIEW

no.	date	by	chk'd	description
F	[illegible]	[illegible]	[illegible]	ISSUED FOR PERMITTING

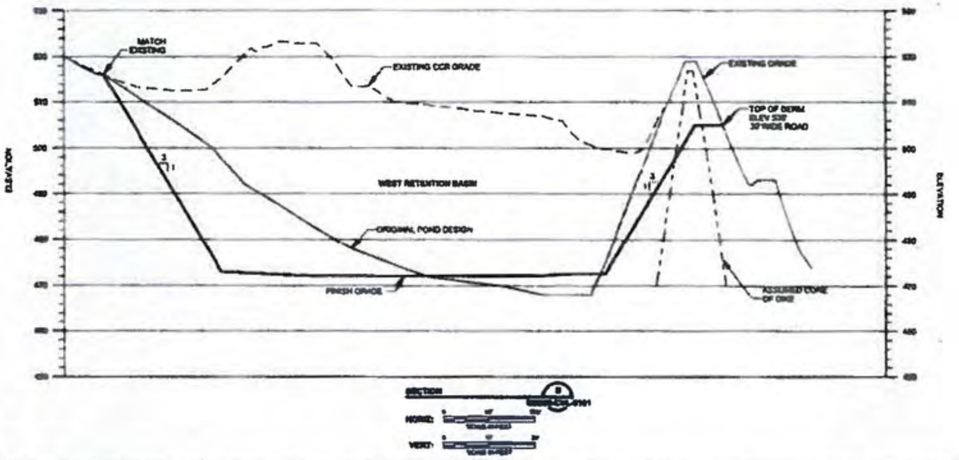
PRELIMINARY - NOT FOR CONSTRUCTION

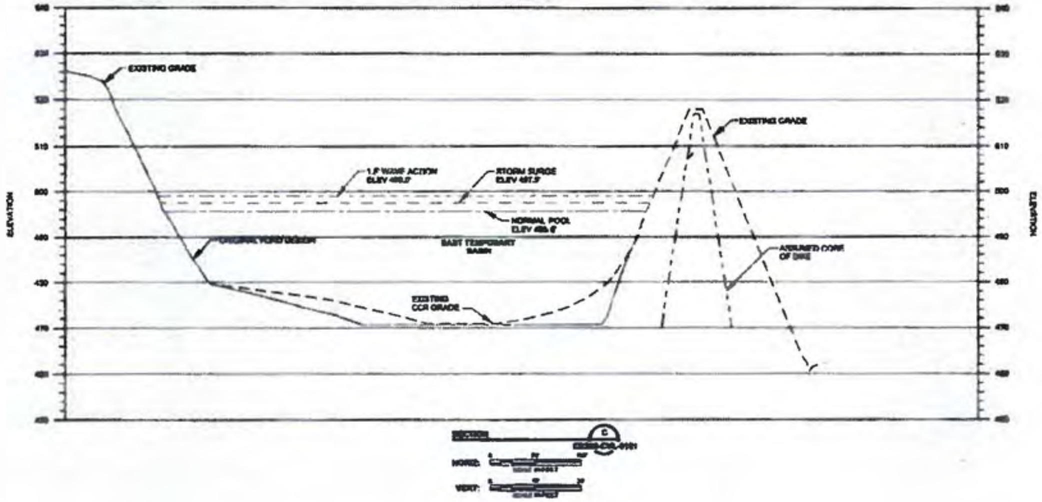
BURNS & McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 1 (TEMP 1)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EB300-CVL-0105
F





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D			RND	ISSUED FOR REVIEW
C			RND	ISSUED FOR REVIEW
B			RND	ISSUED FOR 90% REVIEW
A			RND	ISSUED FOR 30% REVIEW

no.	date	by	chd	description
F			RND	ISSUED FOR PERMITTING

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS MCDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 2 (TEMP 1)
EAST BEND STATION UNIT 2

DUKE ENERGY

EBS00-CVL-0106
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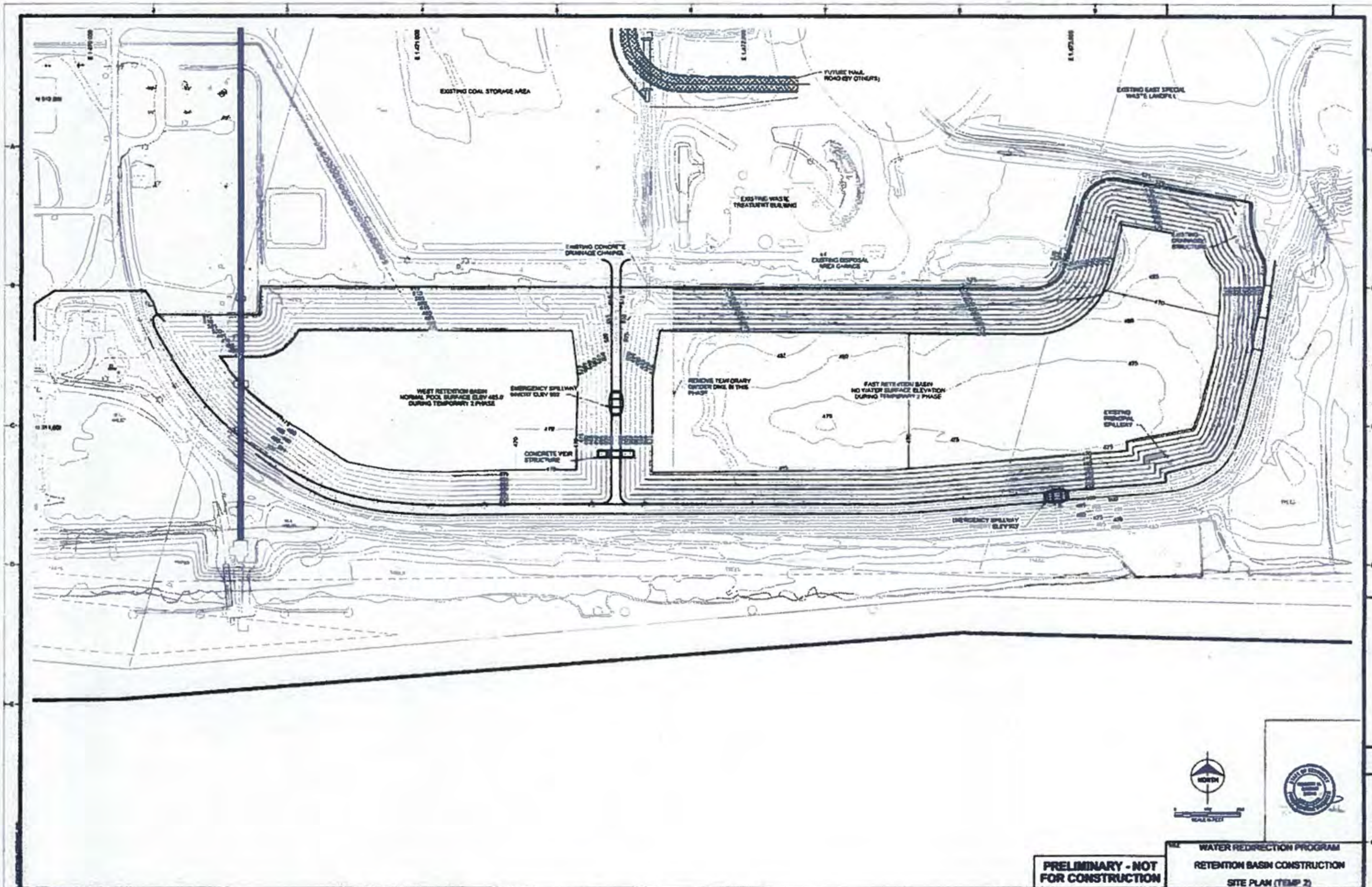

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS & McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
SITE PLAN (TEMP 2)

EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0200

E

no.	date	by	ckd	description
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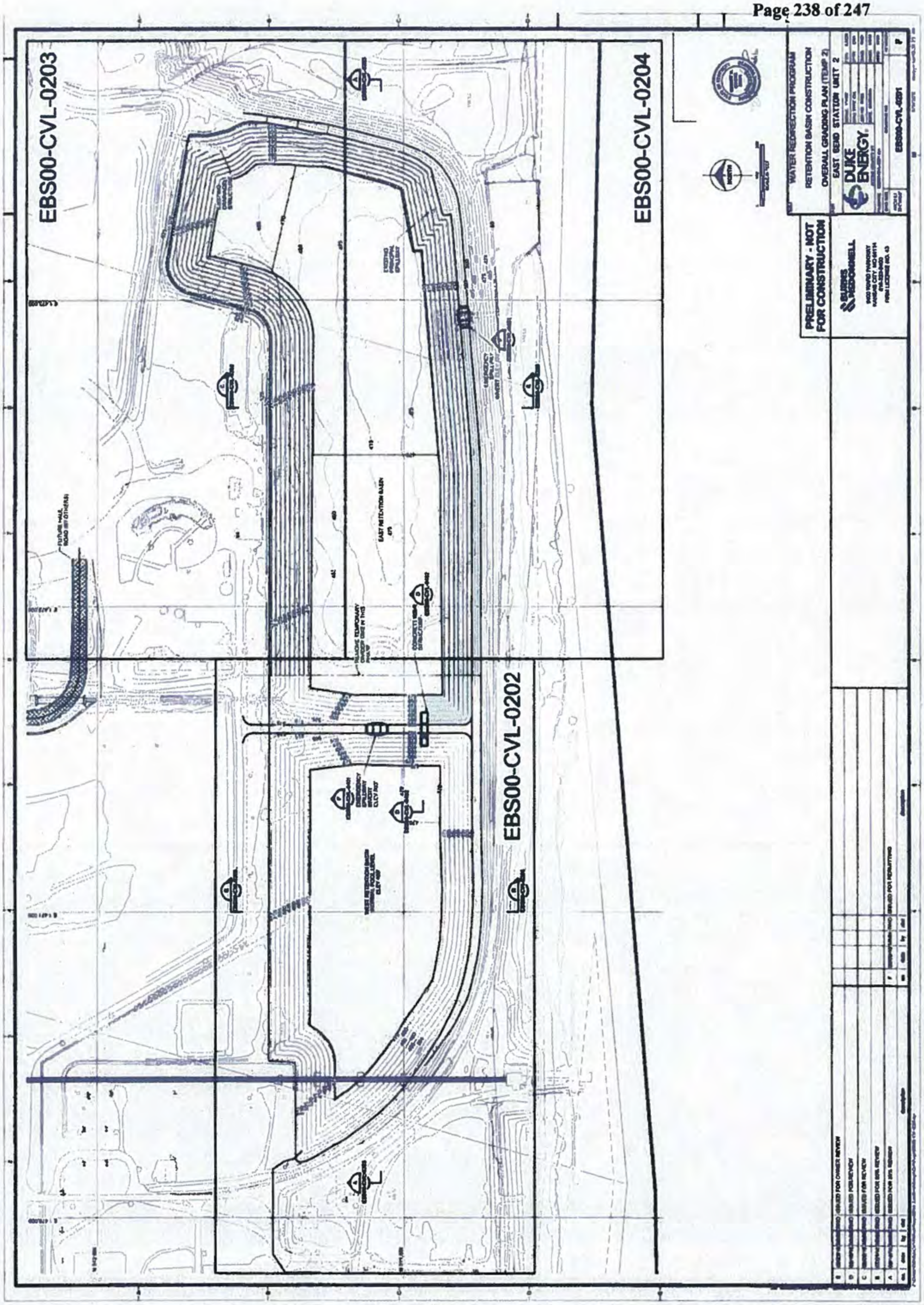
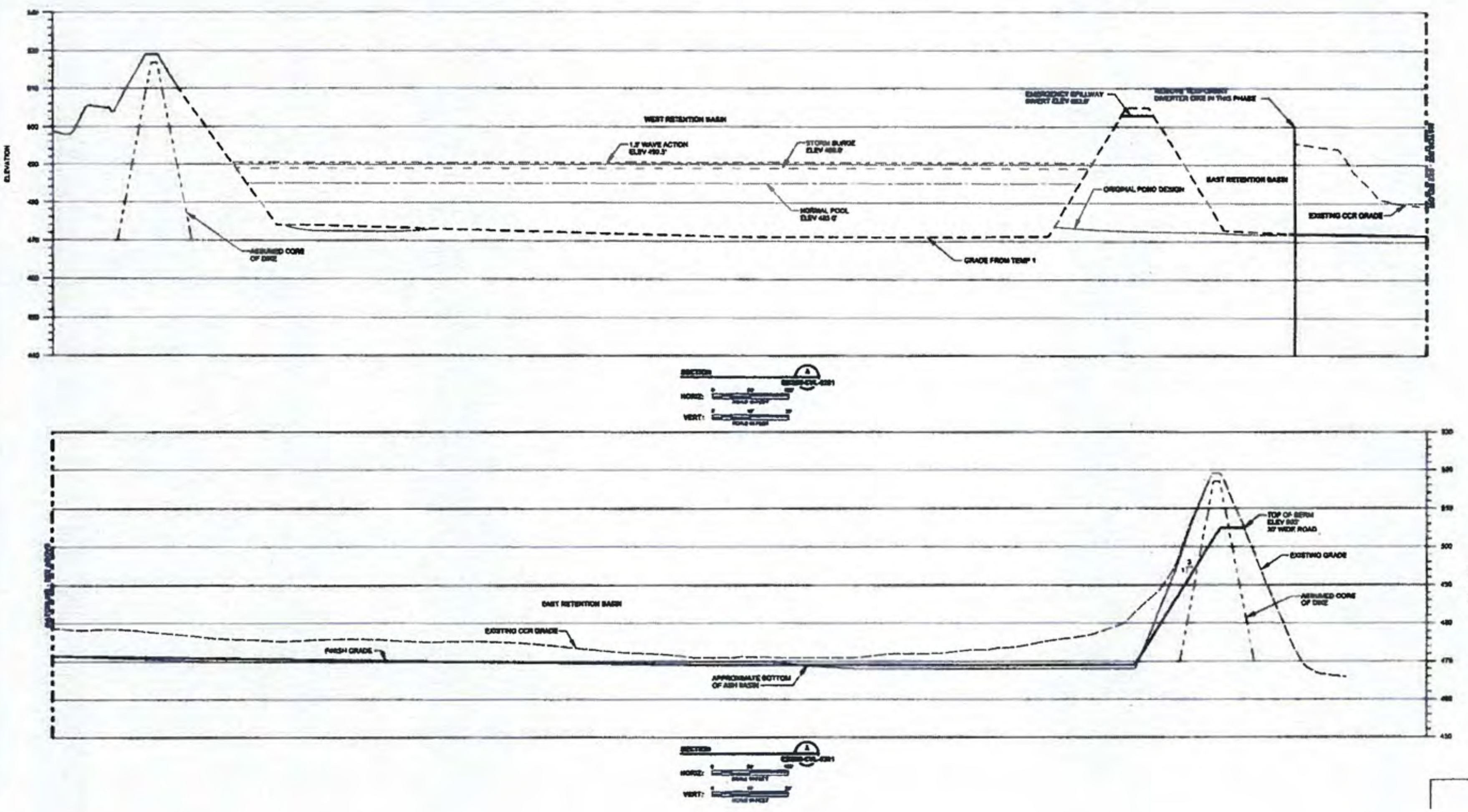

EBS00-CVL-0203
EBS00-CVL-0204
EBS00-CVL-0202
FUTURE HAUL ROAD (BY OTHERS)
EAST RETENTION BASIN
PRELIMINARY - NOT FOR CONSTRUCTION
BURNS & McDONNELL
WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
OVERALL GRADING PLAN (TEMP 2)
EAST BEND STATION UNIT 2
DUKE ENERGY
ISSUED FOR OWNER'S REVIEW
ISSUED FOR REVIEW
ISSUED FOR REVIEW
ISSUED FOR 60% REVIEW
ISSUED FOR 30% REVIEW
ISSUED FOR PERMITTING



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KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 1 (TEMP 2)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0205
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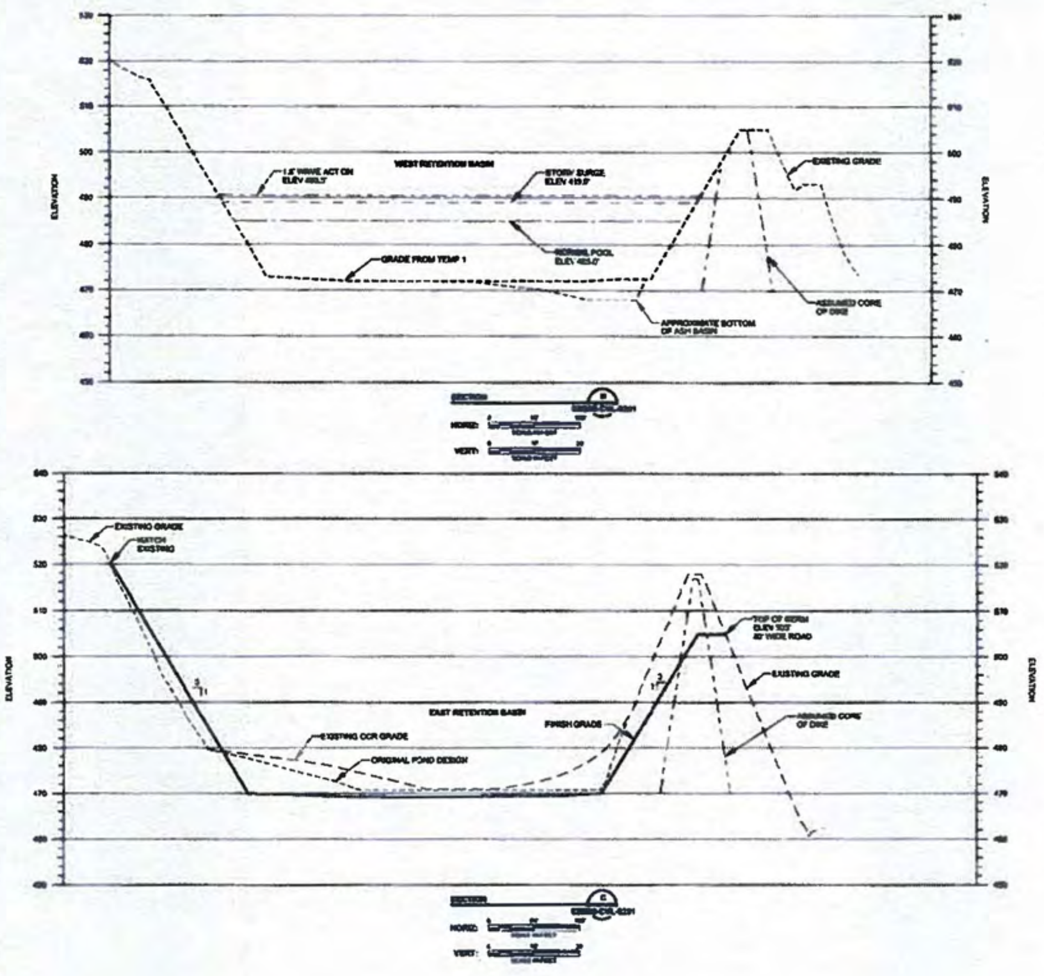

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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 2 (TEMP 2)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0206

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EXHIBIT 2
Page 241 of 247

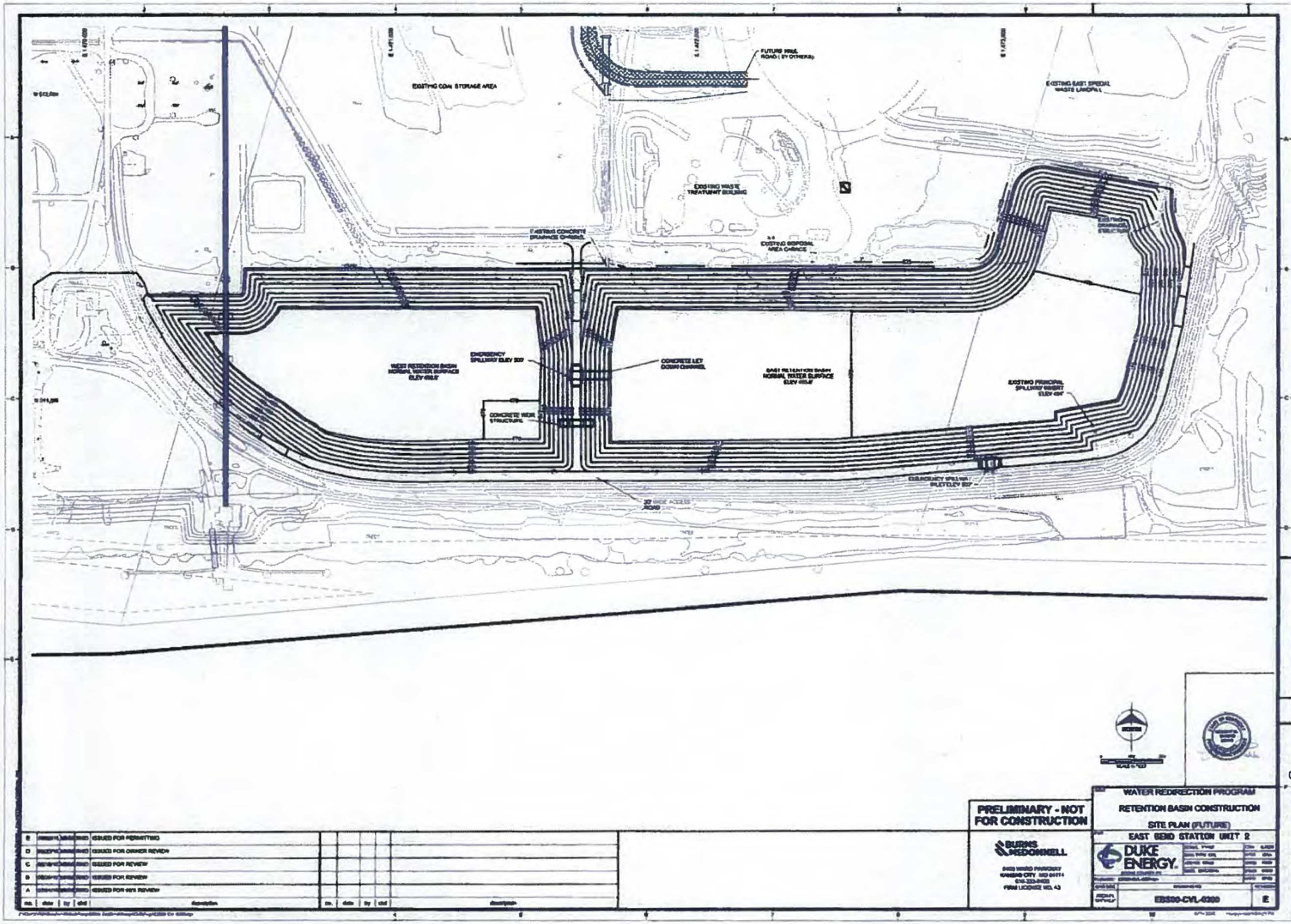

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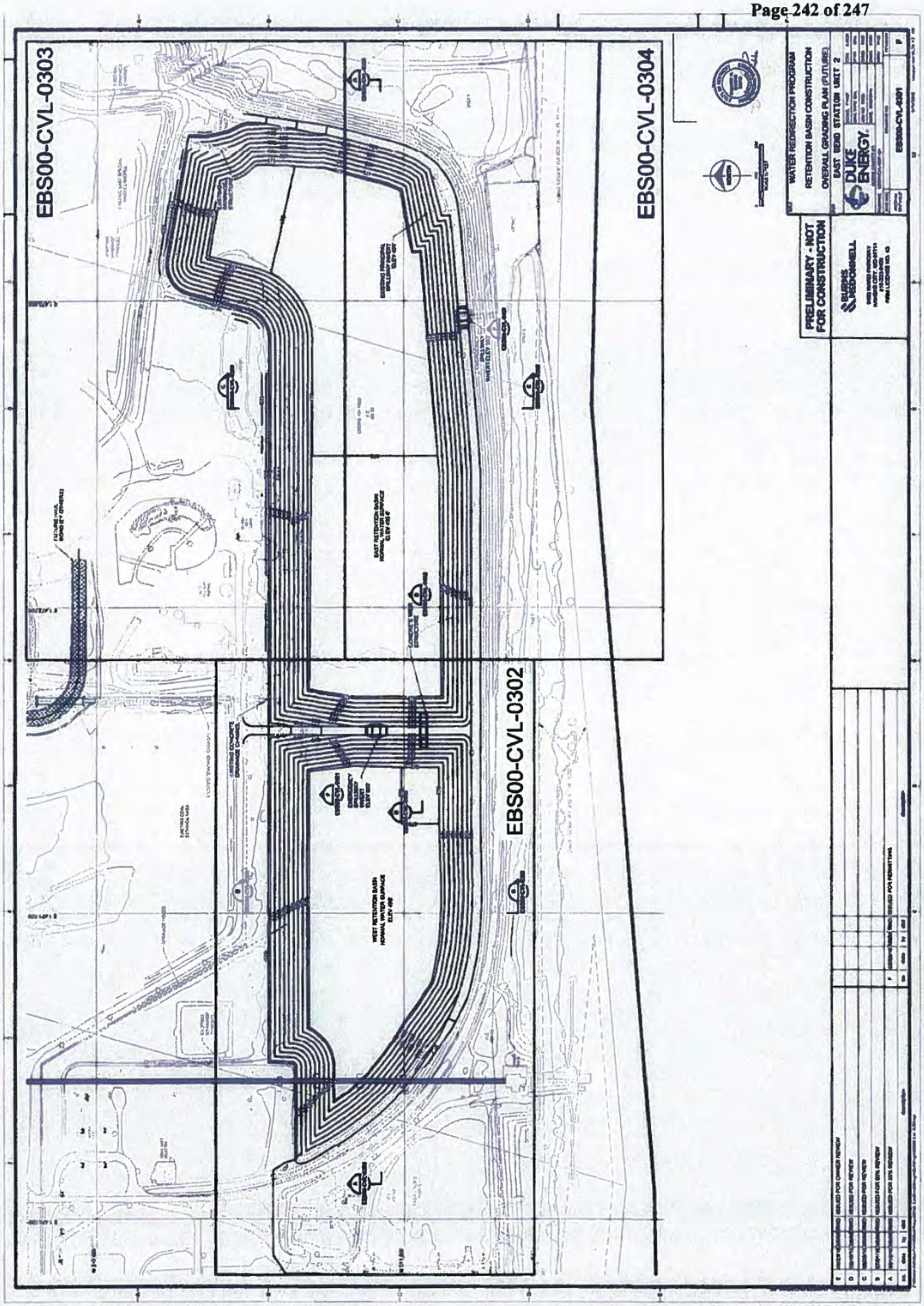
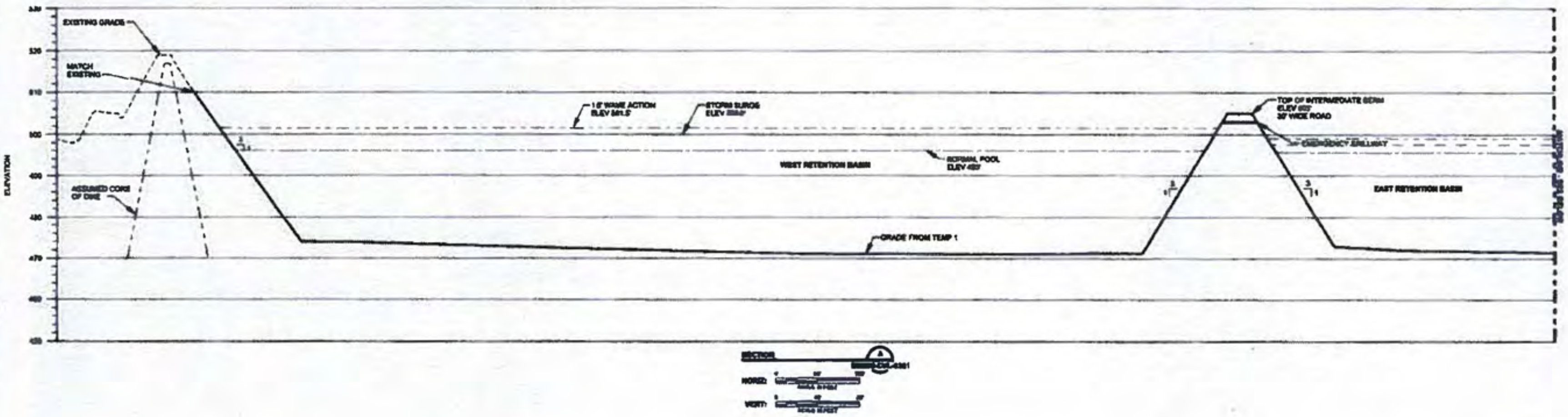
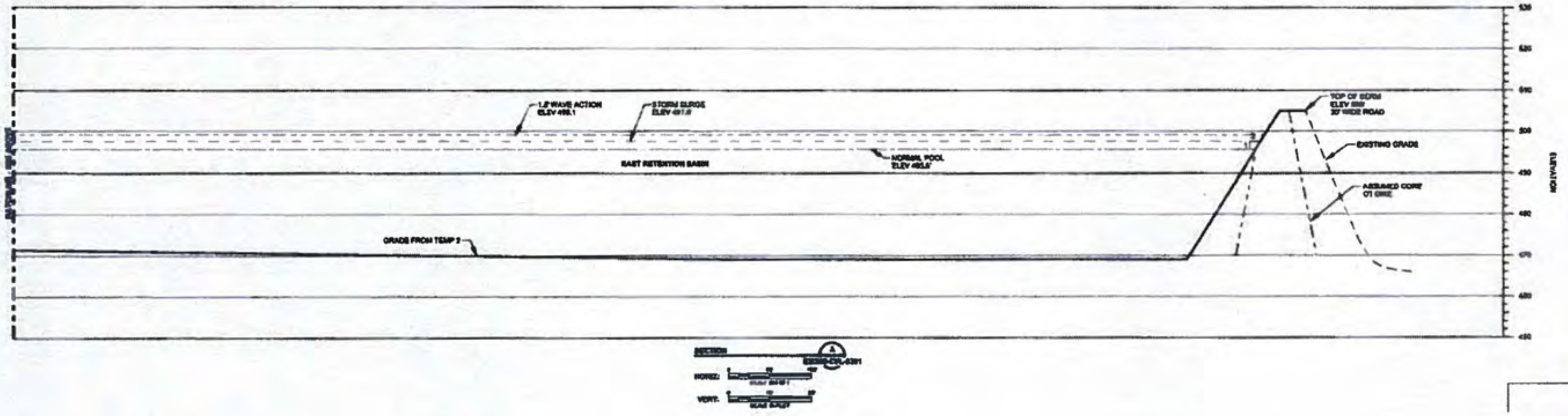
EXHIBIT 2
Page 242 of 247







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no.	date	by	chk	description
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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 1 (FUTURE)

EAST BEND STATION UNIT 2

DUKE ENERGY.

EB000-CVL-0305

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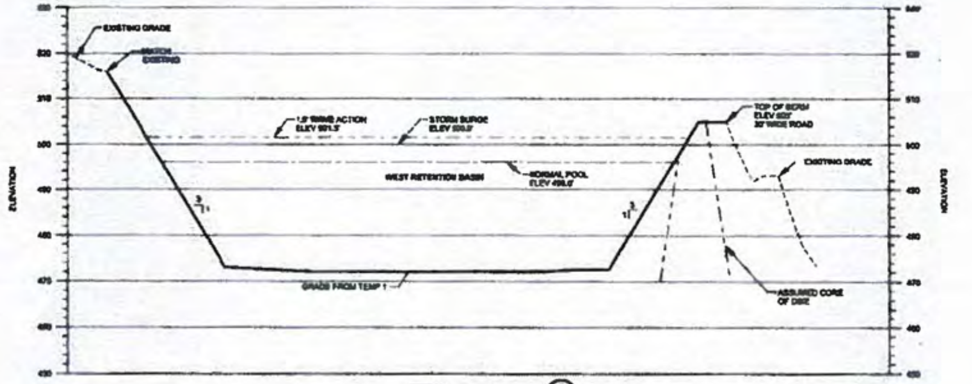
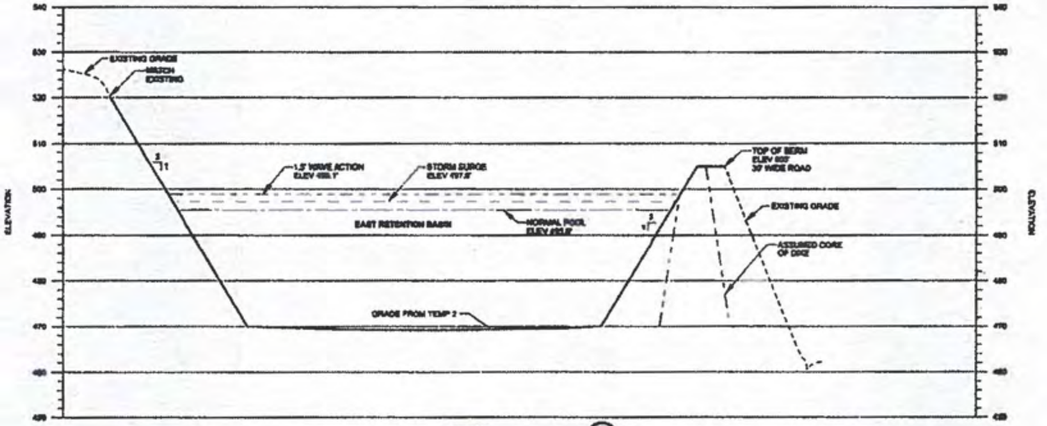


SECTION B
EBS00-CVL-0301

HORIZ: 0 50' 100'

VERT: 0 10' 20'



SECTION C
EBS00-CVL-0301

HORIZ: 0 50' 100'

VERT: 0 10' 20'

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C	[illegible]	[illegible]	RHD	ISSUED FOR REVIEW
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A	[illegible]	[illegible]	RHD	ISSUED FOR 30% REVIEW

no.	date	by	chk	description
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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
GRADING SECTIONS - SHEET 2 (FUTURE)
EAST BEND STATION UNIT 2

DUKE ENERGY.

EBS00-CVL-0308

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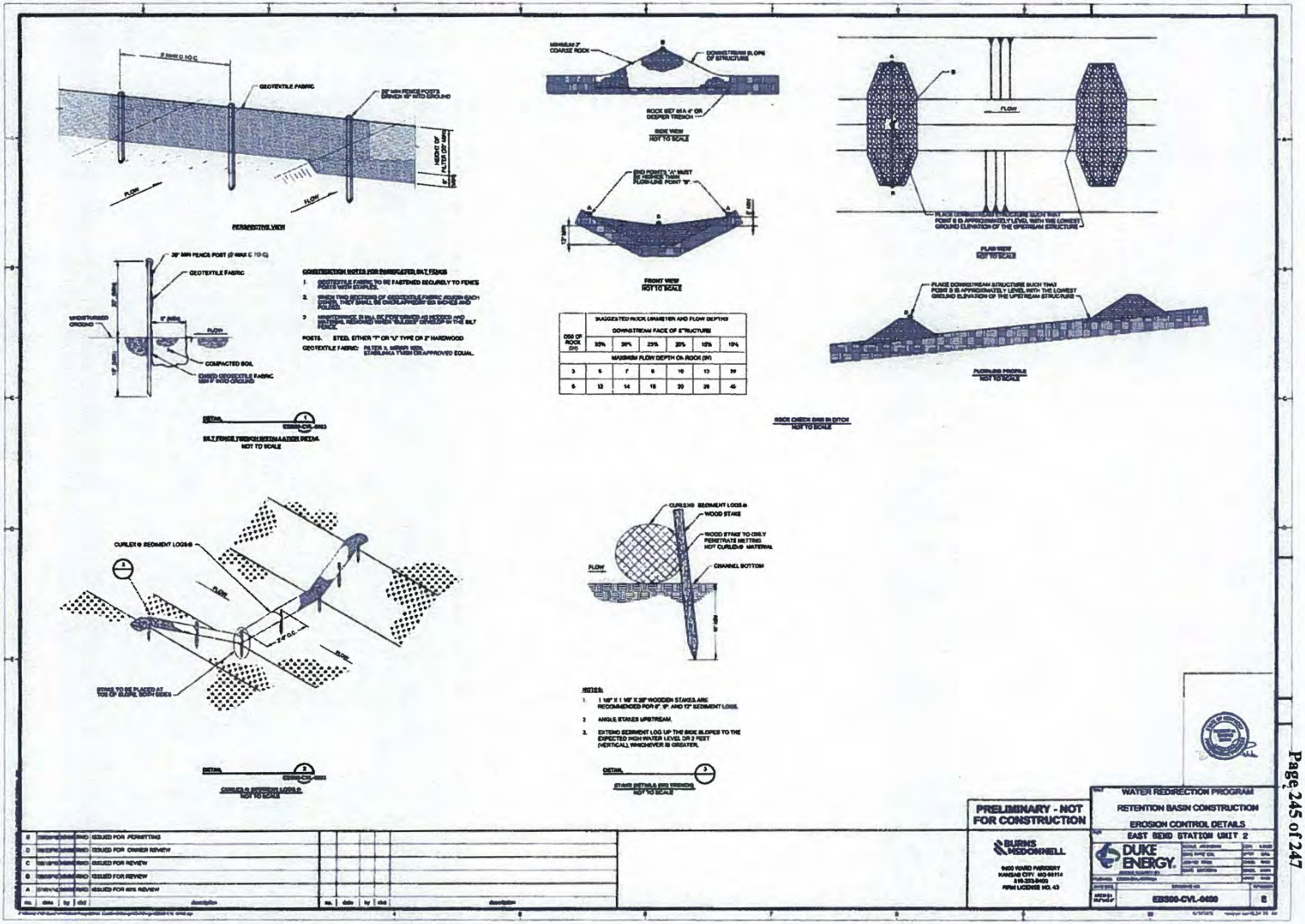

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. GEOTEXTILE FABRIC TO BE FASTENED SECURELY TO FENCE POSTS WITH STAPLES.
2. WHEN TWO SECTIONS OF GEOTEXTILE FABRIC ADJOIN EACH OTHER, THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
3. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: STEEL EITHER "T" OR "U" TYPE OR 2" HARDWOOD

GEOTEXTILE FABRIC: FILTER X, MIRAFI 100X, STABILINKA T140N OR APPROVED EQUAL.

D50 OF ROCK (IN)	SUGGESTED ROCK DIAMETER AND FLOW DEPTHS DOWNSTREAM FACE OF STRUCTURE					
	33%	30%	25%	20%	15%	10%
MAXIMUM FLOW DEPTH ON ROCK (IN)						
3	6	7	8	10	13	[illegible]
6	12	14	16	20	26	[illegible]

NOTES:

1. 1 1/2" X 1 1/2" X 36" WOODEN STAKES ARE RECOMMENDED FOR 6", 9" AND 12" SEDIMENT LOGS.
2. ANGLE STAKES UPSTREAM.
3. EXTEND SEDIMENT LOG UP THE SIDE SLOPES TO THE EXPECTED HIGH WATER LEVEL OR 2 FEET (VERTICAL), WHICHEVER IS GREATER.

rev	date	by	chk	description
E				ISSUED FOR PERMITTING
D				ISSUED FOR OWNER REVIEW
C				ISSUED FOR REVIEW
B				ISSUED FOR REVIEW
A				ISSUED FOR 60% REVIEW

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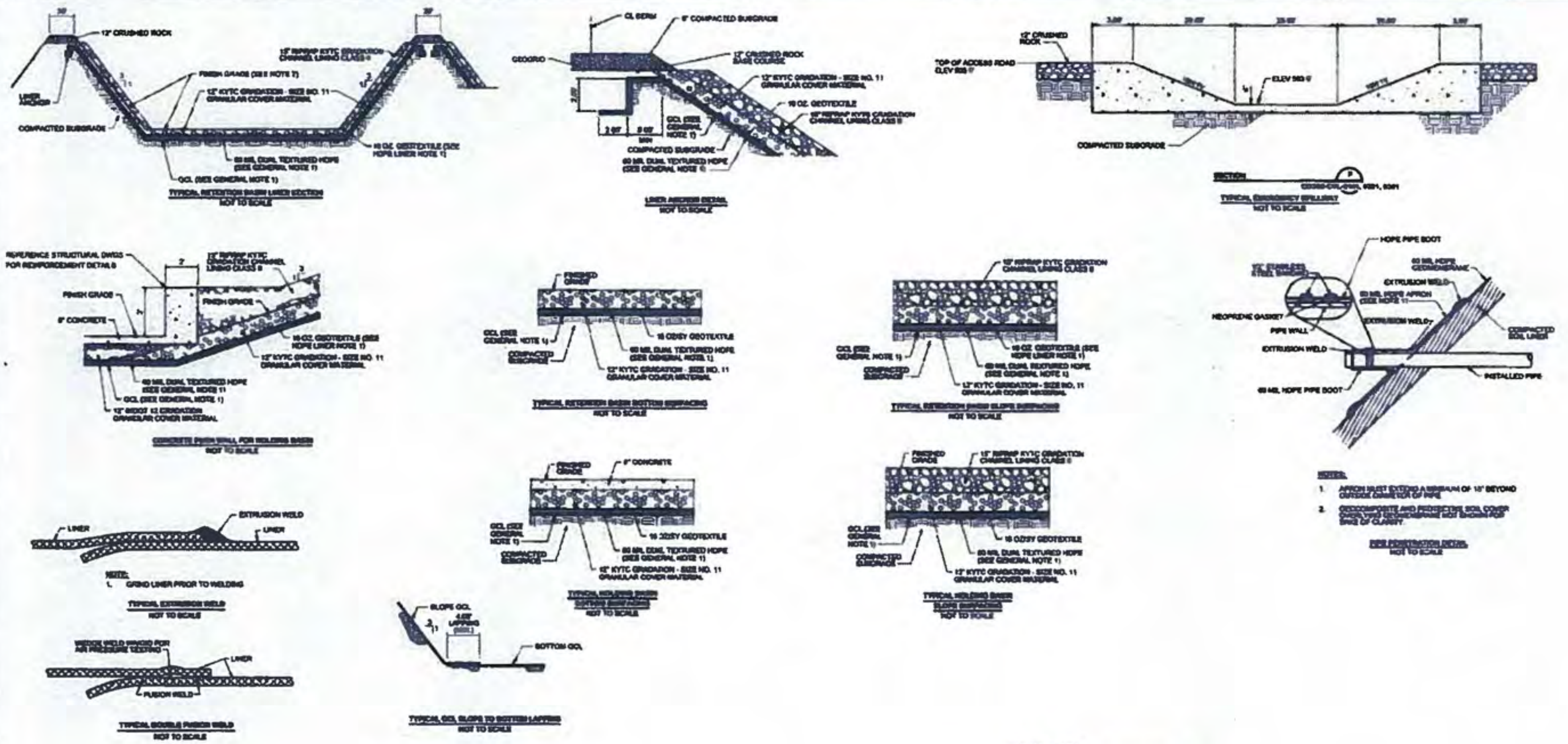
FIRM LICENSE NO. 43

WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
EROSION CONTROL DETAILS
EAST BEND STATION UNIT 2
DUKE ENERGY.

EBS00-CVL-0400 E



NOTES:

1. APRON MUST EXTEND A MINIMUM OF 18" BEYOND OUTSIDE DIAMETER OF PIPE.
2. GEOCOMPOSITE AND PROTECTIVE SOIL COVER OVER HDPE GEOMEMBRANE NOT SHOWN FOR SAKE OF CLARITY.

HDPE LINER NOTES:

1. THE CONTRACTOR SHALL USE CAUTION WHEN INSTALLING LINER SECTION COMPONENTS. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
2. IN LIEU OF INSTALLING A LINER ANCHOR TRENCH, THE CONTRACTOR MAY EXTEND THE LINER BEYOND THE TOP OF THE SLOPE AROUND STRUCTURES. THE CONTRACTOR SHALL PROVIDE ENGINEERING CALCULATIONS AND LINER DESIGN INFORMATION AND APPROVAL IN LIEU OF THE ANCHOR TRENCH.
3. IN LIEU OF INSTALLING A LINER ANCHOR TRENCHES BETWEEN THE PRIMARY AND SECONDARY BASINS, THE CONTRACTOR MAY EXTEND THE LINER BEYOND THE TOP OF THE SLOPE TO THE ADJACENT BASIN. THE CONTRACTOR SHALL PROVIDE ENGINEERING CALCULATIONS AND LINER DESIGN INFORMATION AND APPROVAL IN LIEU OF THE ANCHOR TRENCHES.
4. THE CONTRACTOR SHALL PROVIDE LINER DESIGN INFORMATION AND APPROVAL FOR THE ACCESS RAMP LOCATIONS. THE LINER SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS WITHOUT WRINKLES, OVERLAPS, AND CREASES.
5. THE CONTRACTOR SHALL PROVIDE LINER DESIGN INFORMATION AND APPROVAL FOR THE PENETRATIONS.

GENERAL NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR PROPER STORAGE OF THE MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.
2. ALL FINISH GRADE ELEVATIONS ARE TO FINAL SURFACE ELEVATIONS EXCEPT FOR THE AREAS OF RIPRAP. [illegible] 18 INCH OF [illegible] THICKNESS ABOVE THE FINISH GRADE.
3. INSTALL ALL MATERIALS PER MANUFACTURER'S RECOMMENDATIONS.

no.	date	by	ckd	description
E	[illegible]	[illegible]	[illegible]	ISSUED FOR OWNER REVIEW
D	[illegible]	[illegible]	[illegible]	ISSUED FOR REVIEW
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B	[illegible]	[illegible]	[illegible]	ISSUED FOR 60% REVIEW
A	[illegible]	[illegible]	[illegible]	ISSUED FOR 30% REVIEW

no.	date	by	ckd	description
F	[illegible]	[illegible]	[illegible]	ISSUED FOR PERMITTING

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WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
LINER DETAILS
EAST BEND STATION UNIT 2

DUKE ENERGY.

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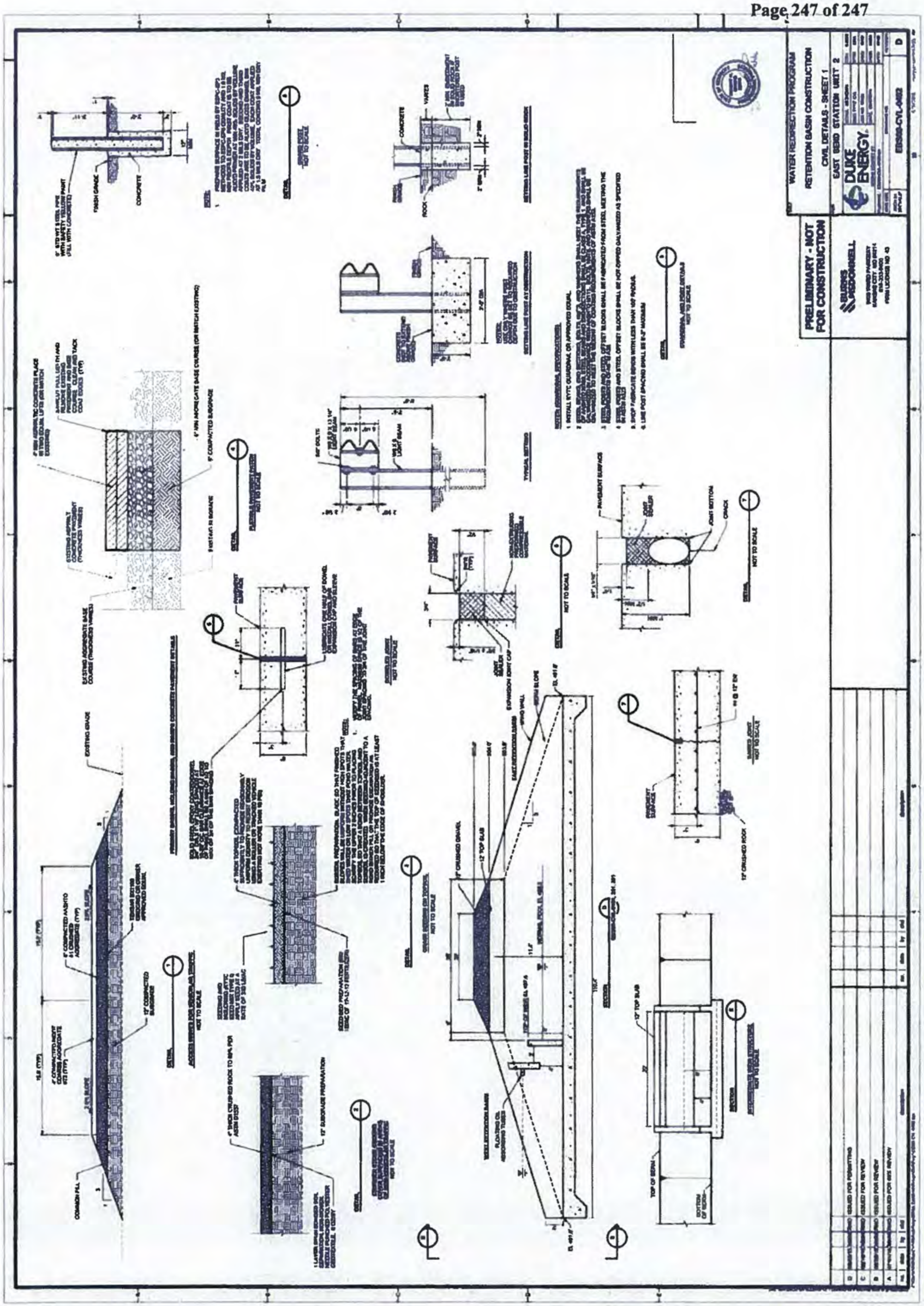
WATER REDIRECTION PROGRAM
RETENTION BASIN CONSTRUCTION
CIVIL DETAILS - SHEET 1
EAST BEND STATION UNIT 2
DUKE ENERGY
PRELIMINARY - NOT FOR CONSTRUCTION
BURNS McDONNELL
D
ISSUED FOR PERMITTING
ISSUED FOR REVIEW
ISSUED FOR REVIEW
ISSUED FOR 90% REVIEW
NOT TO SCALE