Report of Geotechnical Investigation
Dam Safety Assessment of Coal Combustion Surface Impoundments
Kentucky Utilities, a Subsidiary of E.ON U.S.
Pineville Generating Station, Pineville, KY

AMEC Project No. 3-2106-0177.0003

Prepared By:

AMEC Earth & Environmental, Inc.
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, KY 40299

Prepared For:

Mr. Stephen Hoffman
U.S. EPA
Emergency Response Service Center
1200 Pennsylvania Ave., NW
Washington, DC 20460

September 2010

I certify that the management units referenced herein:

Kentucky Utilities a Subsidiary of E.ON U.S, Pineville Generating Station: Pineville Ash Pond was assessed on August 5, 2010.

Signature _____

James Black, PE
Project Engineer

List of AMEC Participants who have participated in the assessment of the management units and in preparation of the report:

- Chris Eger
  CADD Technician
- Dan Conn
  GIS Specialist
- Mary Sawitzki, PE
  Civil/Environmental Engineer
- Mary Swiderski, EIT
  Staff Engineer

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

1.1 Introduction

AMEC was contracted by the United States Environmental Protection Agency (EPA), via contract BPA EP09W001702, to perform site assessments of selected coal combustion byproducts surface impoundments. As part of this contract with EPA, AMEC was assigned to perform a site assessment of Kentucky Utilities (a Subsidiary of E.ON U.S.) Pineville Generating Station. Pineville Generating Station is located approximately 5 miles northwest of Pineville, Kentucky as shown on Figure 1, the Project Location Map.

A site visit to Pineville Generating Station was made by AMEC on August 5, 2010. The purpose of the visit was to perform visual observations, to inventory coal combustion waste (CCW) surface impoundments, assess the containment dikes, and to collect relevant historical impoundment documentation.

AMEC engineers, James Black, PE and Mary Swiderski, EIT were accompanied during the site visit by the following individuals:

Table 1. Site Visit Attendees

Company or Organization	Name and Title
E.ON U.S.	Barry Currens, Pineville Generating Station Manager
E.ON U.S.	Michael P. Luster, Contract Administrator
E.ON U.S.	Roger J. Medina, Senior Chemical Engineer
E.ON U.S.	David J. Millay, P.E., Civil Engineer

1.2 Project Background

CCW results from the power production processes at coal fired power plants like Kentucky Utilities (KU) Pineville Generating Station. Impoundments (dams) are designed and constructed to provide storage and disposal for the CCW that are produced. The Pineville Generating Station was retired in 2001 and is permanently out of service. Although the plant is retired, an ash pond on site contains previously generated CCW. KU refers to the CCW impoundment at the Pineville Generating Station as the “Pineville Ash Pond”.

The National Inventory of Dams (NID), administered by the U.S. Army Corps of Engineers (USACE), provides a list of many dams within the United States, as well as hazard potentials related to the listed dams. The Pineville Ash Pond is not listed in the database.

The Kentucky Department for Natural Resources and Environmental Protection’s (KDEP) Division of Water (KDOW) defines the term *dam*, as well as regulates dam design, construction and repair. According to KDOW, a dam is defined as “any structure that is 25 feet in height, measured from the downstream toe to the crest of the dam, or has a maximum impounding capacity of 50 acre-feet or more at the top of the structure.” KDOW also evaluates a dam’s structure and various other criteria related to the effects of dam failure to determine and assign

a dam hazard classification to each structure. KDOW's Engineering Memorandum No. 5 provides minimum hydrologic and hydraulics related design criteria, as well as hazard classification definitions for dam structures. Dam hazard classifications, outlined in KDOW's Engineering Memorandum No. 5, include Low Hazard (A), Moderate Hazard (B), and High Hazard (C).

- A Low Hazard (A) classification is assigned to structures "located such that failure would cause loss of the structure itself but little or no additional damage to other property."

- A Moderate Hazard (B) classification is assigned to structures that "are located such that failure may cause significant damage to property and project operation, but loss of human life is not envisioned."

- A High Hazard (C) classification is assigned to "structures located such that failure may cause loss of life or serious damage to houses, industrial or commercial buildings, important public utilities, main highways or major railroads."

According to KDOW, state inspections for dams with high (Class C) and moderate (Class B) classifications occur every two years, while dams with a low hazard (Class A) classification are inspected every five years. A Certification of Inspection is issued to the dam owner if, upon inspection, it is determined that the as-built structure meets all the necessary requirements as outlined in KDOW's Engineering Memorandum No. 5. Following successful construction completion and inspection, the owner is given permission to impound water and the dam is placed on the KDOW inventory of dams. KDOW has not classified Pineville Ash Pond. The Pineville Ash Pond does not meet the regulatory requirements and definition attributed to a „dam'.

As part of the observations and evaluations performed at Pineville Generating Station, AMEC completed EPA's Coal Combustion Dam Inspection Checklists and Coal Combustion Waste (CCW) Impoundment Inspection Forms. Copies of the ash Impoundment Inspection Forms are provided in Appendix A. The Impoundment Inspection Forms include a section that assigns a "Hazard Potential" that is used to indicate what would occur following failure of an impoundment. "Hazard Potential" choices include "Less than Low," "Low," "Significant," and "High." Based on the site visit evaluation of the impoundments, AMEC engineers assigned a "Low Hazard Potential" classification to the Pineville Ash Pond. As defined on the Inspection Form, dams assigned a "Low Hazard Potential" classification are those dams where failure or miss-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

1.2.1 State Issued Permits

KDOW has issued Kentucky Pollutant Discharge Elimination System (KPDES) Permit No. KY 0003620 to Kentucky Utilities Company. The permit provided by the KDOW authorizes Kentucky Utilities Company to discharge from Pineville Generating Station to the Cumberland River at mile point 649.4. The permit became effective on May 1, 2009 and will expire on April 30, 2014.

1.3 Site Description and Location

Kentucky Utilities Pineville Generating Station is located approximately 5 miles northwest of Pineville, Kentucky. The area surrounding the plant boundary is primarily rural. The Site

Location and Vicinity Map, included as Figure 1, illustrates the location of Pineville Generating Station relative to Pineville. The Cumberland River is located to the north, west, and south of the plant facilities. The distance between the closest point of the ash pond and the Cumberland River is approximately 425 feet. The Photo Site Plan, included as Figure 2, shows the location of the Ash Pond and its proximity to the Cumberland River.

An aerial photograph of the region indicating the location of Pineville Generating Station ash pond in relation to schools, hospitals, and other critical infrastructure located within approximately 5 miles down gradient of the structures is included as Figure 3, the Critical Infrastructure Map. A table that provides names and coordinate data for the infrastructure is included on the map.

1.4 Process Ponds

1.4.1 Ash Handling and Flow Summary

According to the Process Flows Narrative provided by KU, Pineville Generating Station is permanently out of service and no longer utilizes coal in the production of electricity. The Pineville Ash Pond has not received CCW since plant operations were discontinued in 2001. The pond does receive process water flow from the plant boiler-turbine basement sump pumps; however, these pumps receive only groundwater infiltration. Once the pond receives sump pump flows, the basin discharges from a concrete decant structure to a KPDES monitoring and sampling point. From this monitoring/sampling point, the flow discharges to a rip-rap lined channel which directs flow to the Cumberland River.

1.4.2 Pineville Ash Pond

The EPA Request for Information under Section 104(e) dated March 25, 2009 indicates that the Pineville Ash Pond was commissioned circa 1977. Design drawings (drawing C-1) indicate the pond storage capacity is approximately 70,000 cubic yards (43.4 acre-feet) with a corresponding surface area of 6.5 acres. Kentucky Utilities was unable to determine the total volume of materials currently stored in the ash pond. Drawing C-7 indicates a design dimension for the embankment crest width of 12 feet, and 2.5:1 (H:V) exterior and interior slopes. A 2010 inspection report prepared by ATC Associates Inc. reports a maximum embankment height of 16.5 feet. A drainage ditch located 10 feet to the north and south of the southern embankment appears to be designed to provide drainage for non-pond site surface runoff. Figures 5 and 6 illustrate the Pineville Ash Pond Plan View and Typical Cross Sections. Kentucky Utilities was unable to determine if the dam was constructed and designed under the supervision of a professional engineer, however documentation indicates the dam is currently inspected by a professional engineer.

A topographic plan view of the Pineville Ash Pond is included as Figure 7. This figure is based on a ground control survey dated December 22, 2009 by Kimball Associates, Inc. to provide KU with more accurate embankment elevations and other useful information regarding the facilities.

Hydrologically, the rainfall runoff from roof drains and the two substations immediately northeast of the plant boiler-turbine building are pumped to the ash basin, along with cleaned discharge from the oil water separator. Runoff from portions of a substation located uphill is tributary to the Ash Pond, as well.

1.5 Previously Identified Safety Issues

Discussions with plant personnel and review of provided documentation indicate that there are no current or previously identified safety issues at the Pineville Generating Station.

1.6 Site Geology

Based on published geologic information for the site (1974 USGS Artemus Quadrangle, Bell and Knox Counties, Kentucky), the site appears to be underlain by artificial fill (map unit „af') and Quaternary age alluvium (map unit „Qal'). The site is in the area of flood plain alluvial deposits which consist of silt, clay, sand, and gravel. The fill and alluvium are underlain by the Pennsylvanian Age, Breathitt Formation. The formation generally consists of alternating layers of sandstone, siltstone, shale, limestone, coal, and shale. The site location is shown on the USGS geologic quadrangle map presented as Figure 4.

1.7 Inventory of Provided Materials

Kentucky Utilities provided AMEC with numerous documents pertaining to the design and operation of Pineville Generating Station. These documents were used in the preparation of this report and are listed in Appendix C, Inventory of Provided Materials.

2.0 FIELD ASSESSMENT

2.1 Visual Observations

AMEC performed visual assessments of the Pineville ash pond unit on August 5, 2010. Assessment of the ash pond was completed in general accordance with *FEMA's Federal Guidelines for Dam Safety, Hazard Potential Classification System for Dams, April 2004*. The EPA Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Forms were completed for the ash pond during the site visit. The completed forms were provided to the EPA via email three business days following the site visit. Copies of the completed checklists are included in Appendix A. In addition to completing the checklist and assessment forms, photographs were taken of the impoundment during the site visit. A photo site location map and descriptive photos are included in Appendix B.

2.2 Pineville Ash Pond -Visual Observations

The Pineville Ash Pond contains fly ash, bottom ash, boiler slag, and other low volume wastes. The Pineville Generating Station was shut down permanently in 2001, and the ash pond has not received liquid borne CCW since that time. The pond currently receives rainfall runoff from several areas of the plant (see Section 1.4.2). At the time of AMEC's field inspection, the central and north sections of the pond were full of ash. Approximately 10 to 15 percent of the total area was covered with water at the south end of the pond.

2.2.1 Pineville Ash Pond - Embankments and Crest

The Ash Pond has a side-hill configuration consisting of two constructed embankments along the south and west pond limits. A freeboard of approximately 6 feet between the top of ash and top of dike was observed during the site visit (photos 1-1 and 1-6). The crest and dikes (upstream and downstream) of the dam are primarily surfaced with grass (photos 1-1, 1-7, and 1-11 through 1-14). Vegetation was observed along the pond interior at the north and central sections of the pond (photos 1-1, 1-2, 1-4, 1-14 and 1-15). Vegetation along the interior slopes of the south end of the pond was noticeably less dense (photo 1-6). KU personnel reported they had used farm machinery on the higher central and north sections of the pond in 2009 to cut the vegetation. Two small repaired animal burrow areas were observed on the upstream slope of the south dike (photo 1-6). Uneven slopes were observed on the downstream slopes from the west half of the south dike extending around the southwest corner to the south end of the west dike (photos 1-11 and 1-12).

2.2.2 Pineville Ash Pond - Outlet Control Structure

Pineville Ash Pond's primary outlet structure, which is located along the pond's southern edge, is comprised of a concrete, vertical inlet and an 18-inch diameter corrugated metal discharge pipe (photo 1-6). This vertical concrete structure supports an adjustable skimmer and stop log unit which allows adjustment of the pond water level as facility operations require. Flow from the primary outlet structure is conveyed through the 18-inch corrugated metal pipe to a point which is located at the toe of the downstream embankment (photo 1-9). From there, flow travels through a natural ravine to the Cumberland River through a discharge outfall that is partially rock-lined (photo 1-10).

2.3 Monitoring Instrumentation

At the time of AMEC's site visit, no impoundment monitoring equipment was installed at the Pineville Generating Station.

3.0 DATA EVALUATION

3.1 Design Assumptions

This section provides a summary of accepted minimum design criteria for dams and impoundments with respect to hydrologic, hydraulic and stability design of those structures. The relevant, methodology, design criteria, data, and analyses information that was provided for the Pineville Generating Station ash pond concerning hydrologic and hydraulic issues, as well as for structural adequacy and stability issues is then presented and compared to the accepted minimum industry criteria.

3.2 Hydrologic and Hydraulic Design

KDOW

The Kentucky Department for Natural Resources and Environmental Protection, Division of Water, Engineering Memorandum No. 5 (EM No. 5), Section C, provides minimum hydrologic design criteria for all dams, as defined by KRS 151.100, and all other impounding obstructions which might create a hazard to life or property, that are constructed within the state of Kentucky. EM No. 5 provides equations to determine the minimum hydrologic criteria to be used in the development of emergency and spillway hydrographs for the structures. Definitions provided in EM No. 5 for emergency and hydrograph spillways are as follows:

> "The emergency-spillway hydrograph is that hydrograph used to establish the minimum design dimensions of the emergency spillway."
>
> "The freeboard hydrograph is the hydrograph used to establish the minimum elevation of the top of the dam."

Precipitation values to be used in determination of the emergency and freeboard hydrographs for low, moderate, and high hazard class dams are provided by EM No. 5 and are as follows.

Emergency Spillway Hydrograph

Class (A) Low Hazard Structure	$P_A = P_{100}$	(1)
Class (B) Moderate Hazard Structure	$P_B = P_{100} + [0.12 \times (PMP - P_{100})]$	(2)
Class (C) High Hazard Structure	$P_c = P_{100} + [0.26 \times (PMP - P_{100})]$	(3)

Freeboard Hydrograph

Class (A) Low Hazard Structure	$P_A = P_{100} + [0.12 \times (PMP - P_{100})]$	(4)
Class (B) Moderate Hazard Structure	$P_B = P_{100} + [0.40 \times (PMP - P_{100})]$	(5)
Class (C) High Hazard Structure	$P_c = PMP$	(6)

where, P refers to 6-hour precipitation, P_{100} refers to 6-hour, 100-year precipitation, and PMP refers to 6-hour Probable Maximum Precipitation.

According to EM No. 5, the freeboard hydrograph rainfall depth established by the equation "does not eliminate the need for sound engineering judgment but only establishes the lowest limit of design considered acceptable." Several sources are provided in EM No. 5 regarding where to obtain rainfall values to use in the equations. Engineering Memorandum No. 2 (EM No. 2), issued by KDOW and last revised on June 1, 1979, is entitled "Rainfall Frequency Values for Kentucky", and is noted as an acceptable data source for rainfall data for locations in Kentucky.

With respect to the principal spillway, EM No. 5 states that "It is desirable that the retarding pool be emptied in ten (10) days or less. It may be assumed that this requirement has been met if eighty (80) percent of the maximum volume of retarding storage has been evacuated in the ten (10) day period." KDOW defines retarding pool at "the reservoir space allotted to the temporary impoundment of floodwater. Its upper limit is the elevation of the crest of the emergency spillway." According to discussions with KDOW Dam Safety personnel, in the absence of an emergency spillway, the upper limit would be considered to be the crest of the dam.

Emergency spillway hydrographs are to be routed "through the reservoirs beginning at the water surface elevation of the principal spillway or the water surface elevation after 10 days drawdown, whichever is greater." Class (A) and (B) structures shall have freeboard "routed through the structure beginning at the same water surface elevation as for the emergency spillway hydrograph." The crest of the principal spillway shall be the starting point for routing hydrographs for Class (C) structures.

Additional discussions with the Dam Safety Division of KDOW indicate that in that absence of an emergency spillway, the crest of the dam is considered the uppermost elevation. A temporary water surface may exist within an impoundment as a result of the design storm occurrence; however, the discharge structure must be shown to be capable of returning the water surface elevation to normal levels within 10 days following the storm. Routing hydrographs are necessary to show the discharge capabilities of the principal spillway within the structure. Stability analyses that reflect adequate stability for the "pond full" condition are also important.

Mine Safety and Health Administration

Chapter 8 - Impoundment Design Guidelines of the Mining Safety and Health Administration (MSHA) Coal Mine Impoundment Inspection and Plan Review Handbook (Number PH07-01) published by the U.S. Department of Labor, Mine Safety and Health Administration, Coal Mine Safety and Health, October 2007 provides another source for minimum hydrologic design criteria.

When detailing impoundment design storm criteria, MSHA states that dams need "to be able to safely accommodate the inflow from a storm event that is appropriate for the size of the impoundment and the hazard potential in the event of failure of the dam." Additionally, MSHA notes that sufficient freeboard, adequate factors of safety for embankment stability, and the prevention of significant erosion to discharge facilities, are all design elements that are required for dam structures under their review. Additional impoundment and design storm criteria are as shown in Table 2, MSHA Minimum Long Term Hydrologic Design Criteria.

Table 2. MSHA* Minimum Long Term Hydrologic Design Criteria

Hazard Potential	Impoundment Size	
	< 1000 acre-feet < 40 feet deep	**≥ 1000 acre-feet ≥ 40 feet deep**
Low - Impoundments located where failure of the dam would result in no probable loss of human life and low economic and/or environmental losses.	100 - year rainfall**	½ PMF
Significant/Moderate - Impoundments located where failure of the dam would result in no probably loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities.	½ PMF	PMF
High - Facilities located where failure of the dam will probably cause loss of human life.	PMF	PMF

*Mining Safety and Health Administration (MSHA) Coal Mine Impoundment Inspection and Plan Review Handbook (Number PH07-01) published by the U.S. Department of Labor, Mine Safety and Health Administration, Coal Mine Safety and Health, October 2007

**Per MSHA, the 24-hour duration shall be used with the 100-year frequency rainfall.

Probable maximum flood (PMF) is, per MSHA, "the maximum runoff condition resulting from the most severe combination of hydrologic and meteorological conditions that are considered reasonably possible for the drainage area." Additionally, MSHA notes the designer should consider several components of the PMF that are site specific. These components are said to include: "antecedent storm; principal storm; subsequent storm; time and spatial distribution of the rainfall and snowmelt; and runoff conditions." Basic agreement, it was noted, exists between dam safety authorities regarding "combinations of conditions and events that comprise the PMF;" however, there are "differences in the individual components that are used." MSHA provided the following as a "reasonable set of conditions for the PMF:

- Antecedent Storm: 100-year frequency, 24 hour duration, with antecedent moisture condition II (AMC II), occurring 5 days prior to the principal storm.
- Principal Storm: Probable maximum precipitation (PMP), with AMC III. The principal storm rainfall must be distributed spatially and temporally to produce the most sever conditions with respect to impoundment freeboard and spillway discharge.
- Subsequent Storm: A subsequent storm is considered to be handled by meeting the "storm inflow drawdown criteria," as described subsequently in the document.

With regard to storm inflow drawdown criteria, MSHA Impoundment Design Guidelines noted that:

> *Impoundments must be capable of handling the design storms that occur in close succession. To accomplish this, the discharge facilities must be able to discharge, within 10 days, at least 90 percent of the volume of water stored during the design storm above the allowable normal operating water level. The 10-day drawdown criterion begins at the time the water surface reaches the maximum elevation attainable for*

the design storm. Alternatively, plans can provide for sufficient reservoir capacity to store the runoff from two design storms, while specifying means to evacuate the storage from both storms in a reasonable period of time - generally taken to be at a discharge rate that removes at least 90% of the second storm inflow volume within 30 days……When storms are stored, the potential for an elevated saturation level to affect the stability of the embankment needs to be taken into account.

In Mineral Resources Department of Labor Mine Safety and Health Administration Title *30 CFR § 77.216-2 Water, sediment, or slurry impoundments and impounding structures; minimum plan requirements; changes or modifications, certification*, information relevant to the duration of the probable maximum precipitation is given. Sub-section *(10)* of *77.216-2* states that a "statement of the runoff attributable to the probable maximum precipitation of 6-hour duration and the calculations used in determining such runoff" shall be provided at minimum in submitted plans for water, sediment or slurry impoundments and impounding structures.

The definition of design freeboard, according to the MSHA Guidelines, is "the vertical distance between the lowest point on the crest of the embankment and the maximum water surface elevation resulting from the design storm." Additionally, the Handbook states that "Sufficient documentation should be provided in impoundment plans to verify the adequacy of the freeboard." Recommended items to consider when determining freeboard include "potential wave run-up on the upstream slope, ability of the embankment to resist erosion, and potential for embankment foundation settlement." Lastly, the Handbook states, "Without documentation, and absent unusual conditions, a minimum freeboard of 3 feet is generally accepted for impoundments with a fetch of less than 1 mile."

3.2.1 Pineville Ash Pond

The Pineville Ash Pond is not classified by the KDOW; therefore, the owner (KU) is not required by the state of Kentucky to provide a hydrologic and hydraulic design for the ash pond that meets regulatory criteria.

Based on its size, the Pineville Ash Pond qualifies for the first, smaller category as defined by MSHA in Table 2. The Chapter 8 of the MSHA Handbook states that a low hazard potential dam (as assigned by AMEC in the EPA CCW Impoundment Inspection form) that is sized such that it falls within the ranges of the smaller category shall use precipitation from the 100-year storm, 24-hour duration for hydrologic and hydraulic design purposes.

KU provided two Water Balance Diagrams to illustrate the flows entering the ash pond. The first Water Balance Diagram (Drawing WB-24-1) is for a 30-day peak monthly average process, and 1-day maximum rainfall conditions. The flows for the water balance are shown below:

- Groundwater Infiltration - 3,600 Gallons per Day (GPD)
- Roof Drains Area 5 - 100,900 GPD
- Switch Yards Area 2 - 123,100 GPD
- Precipitation Area 1 - 246,500 GPD
- Ash Pond Infiltration - 474,100 GPD

A second water balance diagram was provided (Drawing WB-24-2) and illustrated flows for a 30-day peak monthly average process and average rainfall conditions. Water balance WB-24-2

was included with the KPDES permit provided by KDOW. Corresponding flow volumes are shown below:

- Groundwater Infiltration - 2,400 Gallons per Day (GPD)
- Roof Drains Area 5 - 2,500 GPD
- Switch Yards Area 2 - 3,000 GPD
- Precipitation Area 1 - 6,100 GPD
- Ash Pond Infiltration - 14,000 GPD

3.3 Structural Adequacy & Stability

The June 1980 publication, entitled *Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams*, issued by The Commonwealth of Kentucky Department of Natural Resources Environmental Protection, Bureau of Environmental Protection, Division of Water, was written pursuant to the provisions set forth in KRS 151.125(2). Earthen dams, when analyzed to determine safety factors using the methods, guidelines, and procedures of the agencies listed in the guidelines, may be considered to have acceptable stability, according to the State of Kentucky, if the analyses yield at least the minimum safety factors shown in Table 2.

Two well regarded sources for embankment design and evaluation criteria include The United States Army Corps of Engineers (USACE) and the United States Mine Safety and Health Administration (MHSA). Minimum recommended factors of safety for different loading conditions can be found in those agency publications. Factors of safety recommended by these sources are shown in Table 2 in addition to those recommended by the Kentucky guidelines.

Table 3. Minimum Required Dam Safety Factors

Load Case	KDOW[1]	MSHA Criteria[2]	USACE[3]
Rapid Drawdown	1.2	1.3	1.1[4]-1.3[5]
Long- Term Steady State Seepage	1.5	1.5	1.5
Earthquake Loading	1.0	1.2	---[6]

[1] Guidelines for the Geotechnical Investigation and Analysis of Existing Earth Dams, 1980, Kentucky Division of Water
[2] Coal Mine Impoundment Inspection and Plan Review Handbook, 2007, US Mine Safety and Health Administration
[3] Slope Stability Publication, EM1110-2-1902, 2003, US Army Corps of Engineers, Table 3-1: New Earth and Rock-Fill Dams
[4] Applies to drawdown from maximum surcharge pool
[5] Applies to drawdown from maximum storage pool
[6] Refers to USACE Engineer Circular "Dynamic Analysis of Embankment Dams" document that is still in preparation

To analyze the structural adequacy and stability of the Ash Pond at Pineville Generating Station, AMEC reviewed the material provided by Kentucky Utilities with respect to the load cases shown in Table 2. Factors of safety documented in the provided material were compared with those factors outlined in Table 2 to help determine whether the impoundments meet the requirements for acceptable stability. The Pineville Ash Pond is not classified by the Division of Water; therefore, the owner (KU) is not required by the state to provide a stability analysis for the ash pond.

3.3.1 Pineville Ash Pond Structural Adequacy & Stability

2010 Slope Stability Analysis

MACTEC Engineering and Consulting, Inc. developed a geotechnical exploratory drilling program, piezometer installation program and a geotechnical laboratory testing program for the Pineville Ash Pond. The geotechnical exploration program was conducted in August, 2010 and included a two borings advanced at each of three cross-sections along the dam in areas judged to be "critical" based on the topography and nature of the exposed slope. Figure 8 illustrates the location of the three cross sections and related borings. Three of the borings were located along the embankment crest and were extended to a depth of up to 35 feet. The remaining three borings were located at corresponding locations along the toe of the embankment, and were extended to depths of up to 15 feet. A total of two piezometers were installed in crest Borings B-1C and B-5C to monitor pieziometeric levels within the dam.

Soil parameters were partially determined by a geotechnical laboratory testing program which consisted of classification tests including Atterberg Limits, grain-size analyses, specific gravity and unit weight determinations. Consolidated undrained triaxial shear tests with pore pressure measurements were performed on undisturbed samples in order to determine total stress and effective stress parameters. In addition to laboratory testing, Standard Penetration Test results were statistically analyzed to "delineate the general subsurface conditions and estimate anticipated soil properties based on correlations and published data."

MACTEC stated that:

> *In general, the dike was constructed of silty to sandy clay fill reportedly excavated from a nearby borrow area. The clay fill was placed overlying existing alluvial soils comprised predominantly of clay with some sandy soils. Soil parameters selected for the slope stability analyses were based on various resources including the preliminary results of the extensive laboratory testing described above, field testing and observations, published information on similar soil types and our experience on similar projects.*

Soil parameters selected by MACTEC for the stability analyses are shown in Table 4.

Table 4. Soil Parameters

Soil Type No.	Soil Description	Unit Weight		Effective Stress	
		Total (pcf)	Saturated (pcf)	Cohesion C' (psf)	Friction Angle Φ' (degrees)
1	CL (fill)	125	130	20	33
2	CL (alluvium)	125	130	0	30
3	SM (alluvium)	128	132	0	28
4	SW (alluvium)	135	140	0	37
5	CCW	90	95	0	30

Slope stability analyses were conducted using the computer program PCSTABL, developed by Purdue University. The program utilizes a "two-dimensional limit equilibrium method of analysis and calculates the factor of safety based on the Modified Bishop Method of Slices." The stability

of the existing dike was analyzed under steady-state/maximum flooding conditions, rapid drawdown and seismic (dynamic) conditions.

The geometry used in the analyses was based on construction drawings provided by KU and a topographic survey map dated December 2009. "The upstream slopes for Sections 1 through 3 were observed to range from 2.7H:1V to 5.6H:1V and the downstream slopes ranged from 1.8H:1V to 4.1H:1V. The upstream slopes below the current water or ash levels were projected from the topographic data provided by KU at each cross-section location from the portion of the upstream slope above the water/CCW level." On a related note, ATC Associates Inc. performed field measurements to determine the existing dam geometry during a January 2010 site inspection they completed at the Pineville Ash Pond. A report that was issued noted upstream slopes ranged from 2.2H:1V to 3.3H:1V and downstream slopes ranged from 2H:1V to 3.3H:1V. The dam height was determined at one location and was found to be 16.5 feet. It should be noted that the range of upstream and downstream slopes measured by ATC do not correlate with the slopes used by MACTEC in the 2010 slope stability analysis. Further information regarding the 2010 ATC inspection can be found in section 3.5.2.

MACTEC stated that "Seismic conditions for this site were modeled under dynamic loading conditions using a peak ground accelerating value of 0.126 g (horizontally) for a 2 percent probability of exceedance in 50 years. The value was obtained from published guidance based on the site location."

The maximum operating pool level was reported to be 1,015 feet National Geodetic Vertical Datum (NGVD). However, based on provided topographic mapping, the crest elevation of the three cross-sections ranged from 1013.7 feet to 1,014.6 feet NGVD. Water level readings were obtained from piezometers installed in the crest borings. These levels were used to model the pieziometeric surface through the embankment to simulate a "worst case" condition.

Results of the slope stability analyses as presented in MACTEC's report are shown in Table 5.

Table 5. Results of Slope Stability Analyses

Critical Section	Upstream Slope (H:V)	Downstream Slope (H:V)	Long-Term Steady State/Max Surcharge Pool		Rapid Drawdown		Seismic	
			Target FOS	FOS	Target FOS	FOS	Target FOS	FOS
1 Upstream	2.7 : 1.0 3.3 : 1.0 5.6 : 1.0	-	1.5	3.6	1.2	1.8	1.2	1.8
1 Downstream	-	1.8 : 1.0 2.9 : 1.0	1.5	1.6	1.2	1.6	1.2	1.2
2 Upstream	3.9: 1.0	-	1.5	3.9	1.2	1.9	1.2	1.8
2 Downstream	-	2.3: 1.0 3.1: 1.0	1.5	2.0	1.2	2.0	1.2	1.4
3 Upstream	2.9: 1.0	-	1.5	4.0	1.2	2.0	1.2	1.6
3 Downstream	-	4.1: 1.0	1.5	2.3	1.2	2.3	1.2	1.6

* Target Factor of Safety References:
Design Criteria for Dams & Associated Structures (401 KAR 4:030, KAR 4:040)
USACE EM 1110-2-1902: Slope Stability
MSHA Engineering and Design Manual

MACTEC's report states:

> *Our analysis, performed using the parameters and geometry described above, indicated that the cross-sections analyzed to date provide factors of safety that exceed the published factors of safety for the cases analyzed. We do not propose further analyses of the embankments at the Pineville Power Station.*

3.4 Foundation Conditions

Drawing B-66 prepared by Sargent & Lundy Engineers entitled "*Location Plan & Sections of Test Borings Unit No. 3 Pineville Power Station Kentucky Utilities Company Pineville, Kentucky*" dated April 28, 1944 and revised July 25, 1988 illustrates subsurface stratigraphy for the Unit No. 3 extension. Unit No. 3 is estimated to be approximately 500 feet northwest of the Ash Pond. A total of seven borings were completed for the extension. Typically the borings encountered 23 feet to 34 feet of yellow and blue clay. Beneath the clay stratum, the borings encountered intermixed layers of sandstone, coal, and slate. Cinders were noted in one boring.

The 2010 Slope Stability Analyses by MACTEC reports the existing alluvial soils to be composed predominantly of clay with some sandy soils.

3.5 Operations and Maintenance

Kentucky Utilities states that on-site personnel perform safety and surveillance inspections for the ash pond at the Pineville Generating Station every two weeks. However, no record of inspection dates or observations were provided to AMEC. Furthermore, no information was provided to indicate the general procedure or extent of the inspection area(s). ATC Associates provided an inspection report on the ash pond dated January 2010. The field inspection was performed October 23, 2009. The reports indicated presence of animal burrows and heavily vegetated areas along the upstream slopes, ruts and un-vegetated areas along the exterior slope, and also recommended plugging a pipe penetrating the west embankment. Details regarding the ATC inspection are discussed more fully in Section 3.5.2. No safety issues were noted in the ATC reports that were reviewed. The site visit and observation performed by AMEC in August 2010 showed no major operational or maintenance issues that needed to be addressed.

3.5.1 Instrumentation

Historically, impoundment monitoring equipment has not been used at the Pineville Generating Station. However, MACTEC Engineering recently installed two piezometers in support of the August 2010 slope stability analyses (subsequent to AMEC's site inspection). The piezometers were installed in crest Borings B-1C and B-3C. Each piezometer includes a 10-foot well screen placed within a sand stratum from 25 feet to 35 feet below ground surface in B-1C, and in a clay stratum from 15 feet to 25 feet in Borings B-3C. Due to the recent installation of the instrumentation, a trend in the phreatic surface cannot be developed at this time. Piezometer information was summarized by AMEC and is provided in Table 6.

Table 6. Piezometer Information

Piezometer ID	Boring Elevation MSL (ft)	Bottom of Borehole	Water Elevation 8/25/20
B-1C	1013.7	978.2	1000.2
B-3C	1014.6	979.1	998.2

3.5.2 Inspections

State Inspections

According to KDOW, a dam is defined as "any structure that is 25 feet in height, measured from the downstream toe to the crest of the dam, or has a maximum impounding capacity of 50 acre-feet or more at the top of the structure." The Pineville Ash Pond has a maximum embankment height of 16.5 feet and a maximum impounding capacity of 43.4 acre-feet. The Pineville Ash Pond is not considered a „*dam*' by KDOW definition. The pond is unclassified and therefore not inspected by KDOW.

2010 Inspection

ATC Associates Inc. completed an assessment of the Pineville Ash Pond in January 2010. ATC rated the overall condition of the Pineville Ash Pond as fair, which ATC defines as:

> *No existing dam safety deficiencies are recognized for normal loading conditions. Infrequent hydrologic and/or seismic events would probably result in a dam safety deficiency.*

The assessing professional engineer's comments concerning the overall condition of the pond included:

> *Repair numerous animal burrows on interior slopes, mow vegetation at water line, and spray with herbicide.*

The report noted a total of four action items. One item was regarded as „high' importance, which indicates that the action should be addressed as soon as possible. This item of high importance was noted to be:

1. Repair all animal burrows into upstream slope (13 locations noted)

The remaining three action items were considered of „moderate' importance; moderate meaning an item that should be addressed during the next construction season. These items of moderate importance included:

2. Mow then spray vegetation at waterline on upstream slopes with herbicide;
3. Repair ruts and replace vegetation where damaged from mowing;
4. Remove or plug 6 inch steel pipe penetrating west embankment.

While onsite at the Pineville Ash Pond, ATC performed field measurements to determine crest width, upstream and downstream slopes, dam height, and free board at various locations along the pond. Crest width measurements ranged from 15 to 19 feet. Upstream slopes varied from 2.2H:1V to 3.3H:1V and downstream slopes ranged from 2H:1V to 3.3H:1V. The dam height

was determined at one location and was found to be 16.5 feet. Freeboard varied from 4.4 to 5.0 feet.

It should be noted that a comment in ATC Associates assessment report regarding the principal spillway, stated that “debris at inlet to spillway has been cleared, water level lowered 18 inches since last inspection.” AMEC was not provided with any inspection reports other than the 2010 report by ATC Associates.

4.0 COMMENTS AND RECOMMENDATIONS

Condition assessment definitions, as accepted by the National Dam Safety Review Board, are as follows:

SATISFACTORY

No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

FAIR

No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

POOR

A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.

UNSATISFACTORY

A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

NOT RATED

The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

4.1 Acknowledgement of Management Unit Conditions

I certify that the management unit referenced herein (Pineville Ash Pond) was personally assessed by me and was found to be in the following condition:

Pineville Ash Pond: Poor

The Pineville Ash Pond is rated poor because further critical studies or investigations are needed to identify potential dam safety deficiencies.

4.1.1 Hydrologic and Hydraulic Recommendations

No hydrologic or hydraulic data was presented for the Pineville Ash Pond. Provided KPDES *Water Balance Diagrams* documentation indicates only volumes entering and exiting the pond. The current ash pond configuration with lower crest heights and steepened slopes are not as designed. The recent topographic mapping of the site indicates crest elevations at the pond

range from 1013.3 feet at the southwest corner to 1014.7 feet at the north portion of the west dike. The average crest elevation is about 1014 feet. The dimensions and pond stages used for the water balance diagrams are unknown. In order to confirm that the impoundment will not be overtopped during a design storm event, as well as determine whether acceptable freeboard conditions exist, the appropriate design storm rainfall (per MSHA guidelines), or 100-year, 24-hour (6.3 inches per Bell County, KY), should be applied to the impoundment's entire tributary watershed to determine the resulting water surface elevation in the pond. Accurate impoundment volumes and embankment elevations must be utilized in any model that is used to determine the structure's storage and/or routing capabilities.

4.1.2 Geotechnical and Stability Recommendations

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

The provided stability analysis by MACTEC dated August 31, 2010 analyzed three sections, one on the central portion of the west dike (Section 1), one near the southwest corner (Section 2) and one on the south dike (Section 3). The stability analyses were performed using the existing over-steepened slopes, existing loading conditions, and a seismic acceleration. The minimum safety factors are generally in line with the recommended criteria as stated above. The results generally indicate safety factors above the minimums with borderline acceptable values for the seismic analysis on Section 1. However, in the opinion of the assessing professional engineer, the analyses should be revised in accordance with the following recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic analysis will provide a phreatic surface through the embankment. The almost vertical phreatic surfaces shown in the 2010 Stability Analyses is not typically recognized as an acceptable condition. The friction angle value of 30 degrees used for the CCW (ash) in the analysis appears high. More typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for exhibited lower strengths or inconsistencies within the fill or foundation materials. Lowering the friction value by one or two degrees, or more for weaker soils would be conservative and more appropriate. More layering of the embankment materials is needed to model these lower strength materials. Phreatic levels in Sections 2 and 3 are lower than levels in Section 1. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. Some of the analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized. The analyses should include a discussion on how each parameter was derived and data sheets of the computer runs should be included to facilitate review.

4.1.3 Monitoring and Instrumentation Recommendations

Two piezometers were recently installed, August 2010, as part of the stability analysis investigation. It would be prudent for KU to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a

regular inspection and reading frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends that, at minimum, additional instrumentation be installed at the crest and toe of critical slopes. Installation should occur as budgets allow, or immediately upon development of future problems.

4.1.4 Inspection Recommendations

Kentucky Utilities stated that on-site personnel perform safety and surveillance inspections for the ash pond at the Pineville Generating Station every two weeks. However, no record of inspection dates or observations were provided to AMEC. Furthermore, no information was provided to indicate the general procedure or extent of the inspection area(s). AMEC recommends that the current inspection program by the plant be expanded to include at least monthly documented inspections which identify potential problems, areas inspected, instrumentation monitoring, and pond and river levels.

AMEC has reviewed provided information consisting of one inspection record by ATC dated January 10, 2010 for the Pineville Ash Pond. This inspection indicates there are past inspections by an engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the recommended monthly inspections by facility personnel, for this ash pond.

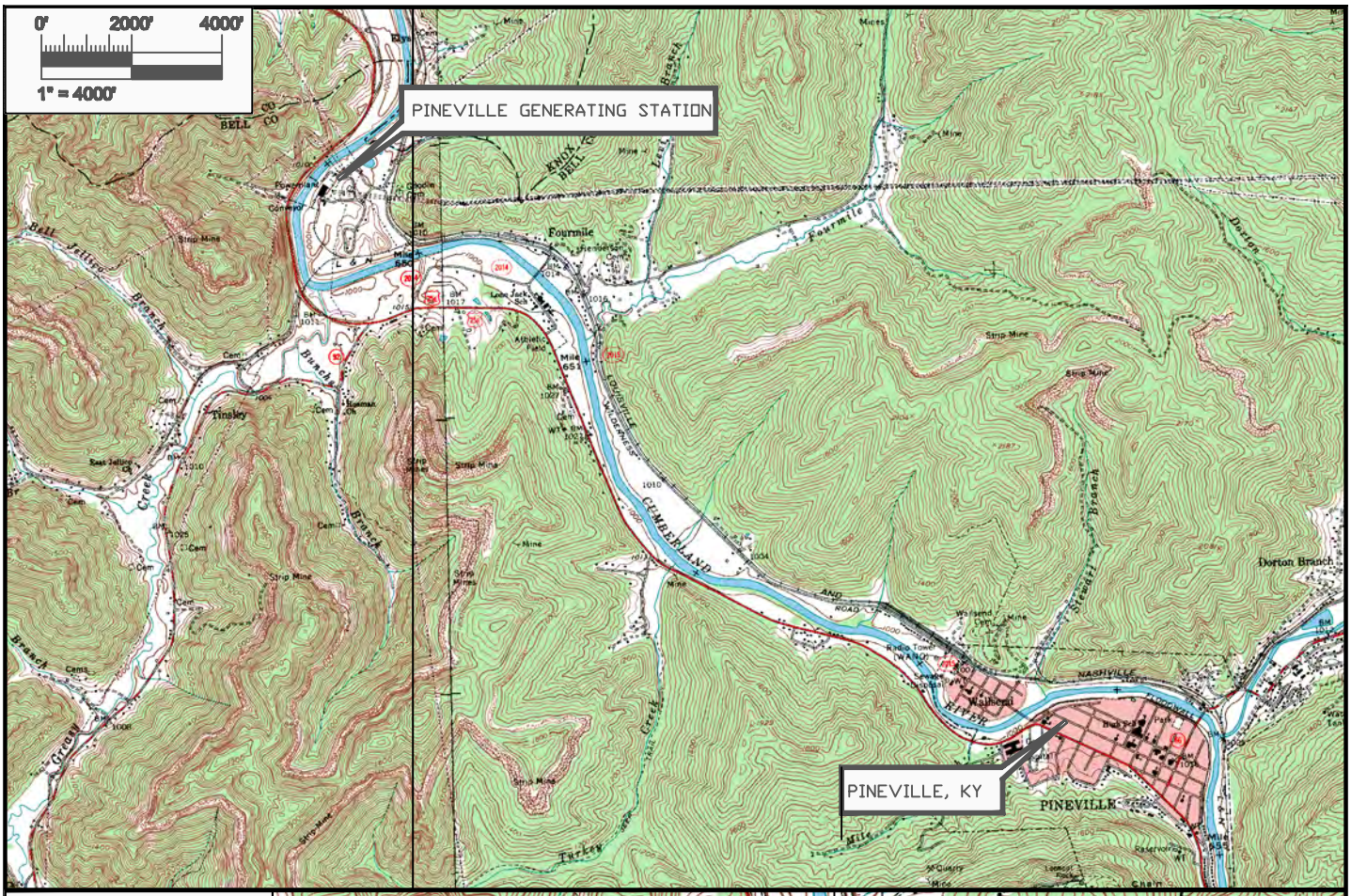
5.0 CLOSING

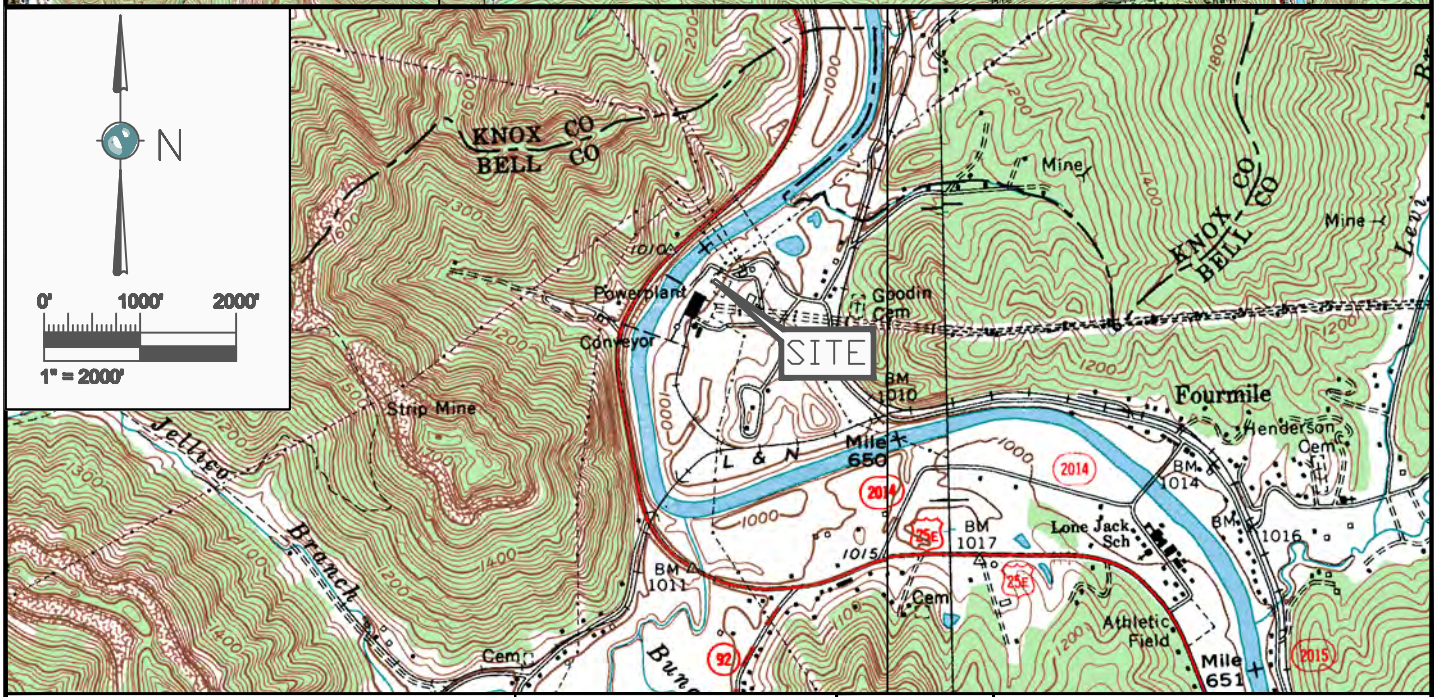
This report is prepared for the exclusive use of the Environmental Protection Agency for the site and criteria stipulated herein. This report does not address regulatory issues associated with storm water runoff, the identification and modification of regulated wetlands, or ground water recharge areas. Further, this report does not include review or analysis of environmental or regional geo-hydrologic aspects of the site, except as noted herein. Questions or interpretation regarding any portion of the report should be addressed directly by the geotechnical engineer.

Any use, reliance on, or decisions to be made based on this report by a third party are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions and recommendations given in this report are based on visual observations, our partial knowledge of the history of Pineville Generating Station impoundments, and information provided to us by others. This report has been prepared in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

FIGURES





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(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
SITE LOCATION & VICINITY MAP

DWN BY: CAE	DATUM:	DATE: 9/1/10	
CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003	
PROJECTION:	SCALE:	FIGURE NO: 1	

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DWN BY: DJC
CKD BY: MS
Datum: NAD 83
Projection: Albers
Scale: As Shown

ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
SITE PLAN

REV. No.: A
Date: 5-21-10
Project No: 3-2106-0177-0003
Figure No: 2

Critical Infrastructure	ID Number	Latitude	Longitude
Davis Chapel	1	36.83092	-83.863
Friendship Church	2	36.88898	-83.8269
Hosman Church	3	36.78453	-83.758
Lower Coalport Churcl	4	36.80981	-83.823
Myrick Church	5	36.80536	-83.8463
Napier Church	6	36.86453	-83.621
Poplar Grove Church	7	36.81148	-83.7821
Trace Branch Church	8	36.90425	-83.8619
Turkey Creek Mission	9	36.86092	-83.7958
Union Mission Church	10	36.84731	-83.7316
Young Grove Church	11	36.89342	-83.7369
Walker Church	12	36.88259	-83.6935
Dorton Branch School	13	36.7787	-83.6799
Lone Jack School	14	36.79009	-83.7433
Carnes School	15	36.88231	-83.6974
Mission School	16	36.88564	-83.6877

Cumberland River Flow Direction

Pineville Plant

Legend
- Church
- Schools
- Railroad

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DRAWN BY: DJC
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DATUM: NAD83
PROJECTION: Albers
SCALE: AS SHOWN
DATE: 5/21/2010

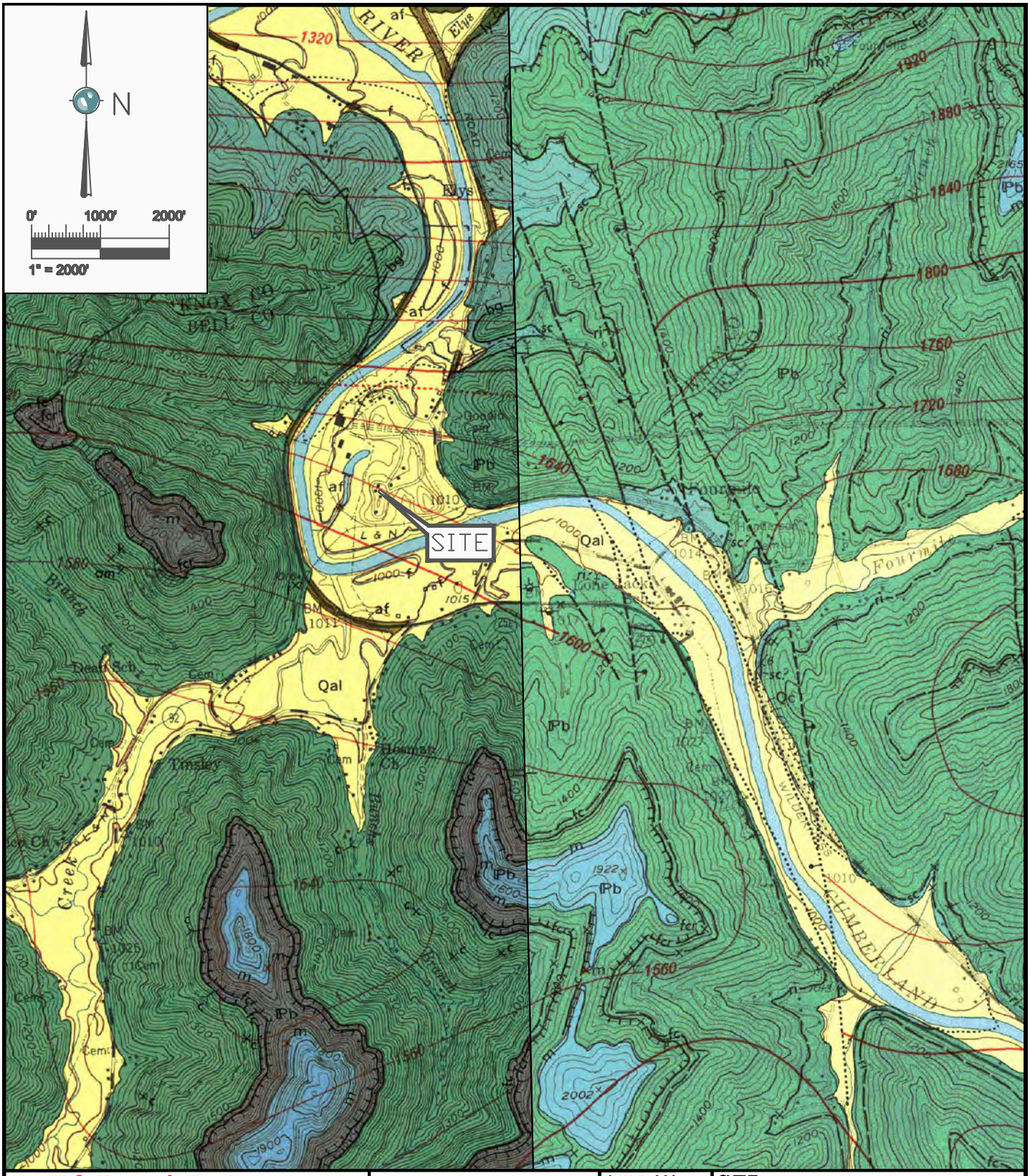
ASSESSMENT OF DAM SAFETY OF
COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
CRITICAL INFRASTRUCTURE

N
0 1 Miles
0 1 Kilometers

Notes: Critical infrastructure data provided by ESRI

FIGURE 3



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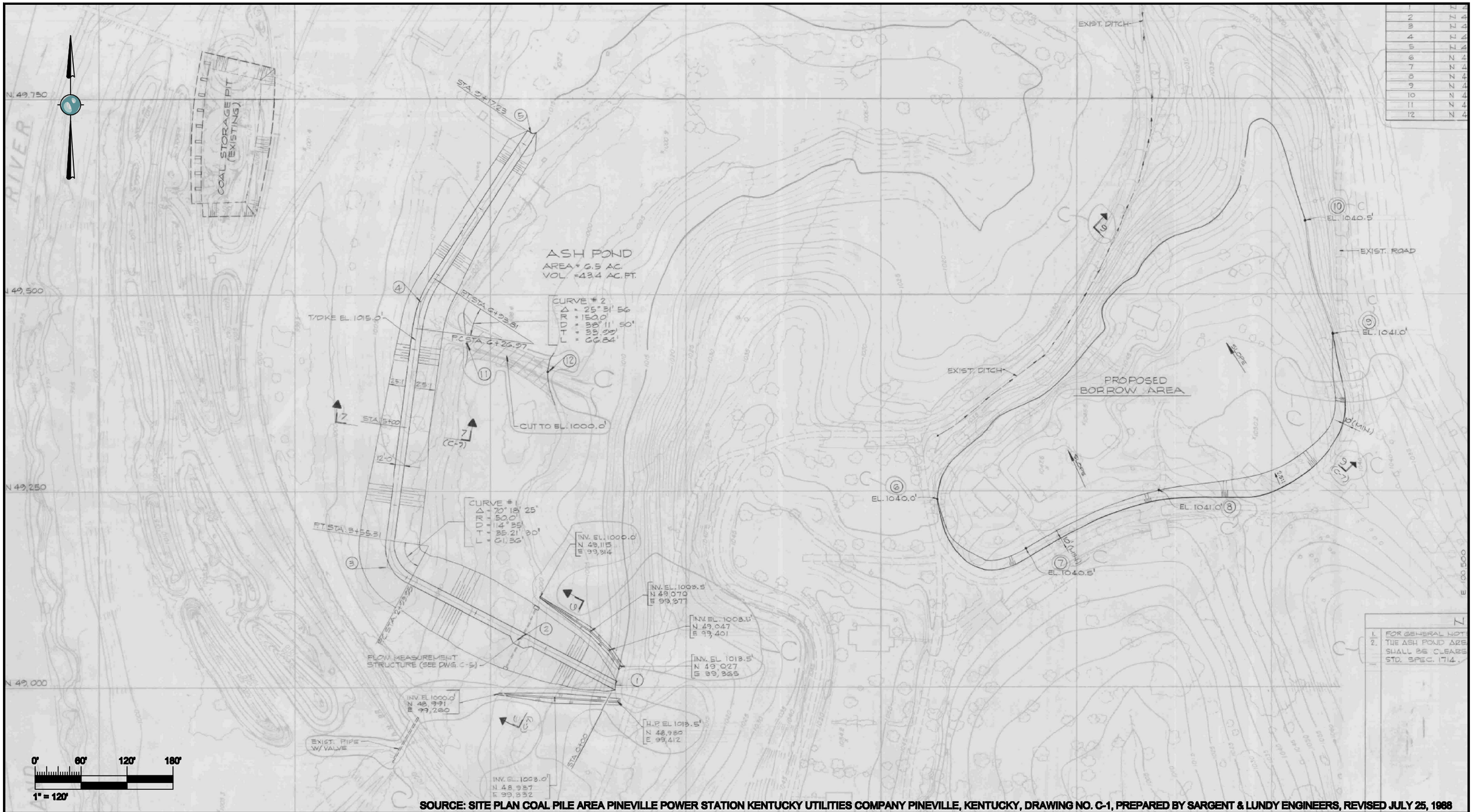
PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 9/1/10
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY GEOLOGIC MAP	CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
	PROJECTION:	SCALE:	FIGURE NO: 4



1	N 4
2	N 4
3	N 4
4	N 4
5	N 4
6	N 4
7	N 4
8	N 4
9	N 4
10	N 4
11	N 4
12	N 4

N

1. FOR GENERAL NOT
2. THE ASH POND ARE SHALL BE CLEARE STD. SPEC. 1714.

SOURCE: SITE PLAN COAL PILE AREA PINEVILLE POWER STATION KENTUCKY UTILITIES COMPANY PINEVILLE, KENTUCKY, DRAWING NO. C-1, PREPARED BY SARGENT & LUNDY ENGINEERS, REVISED JULY 25, 1988

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

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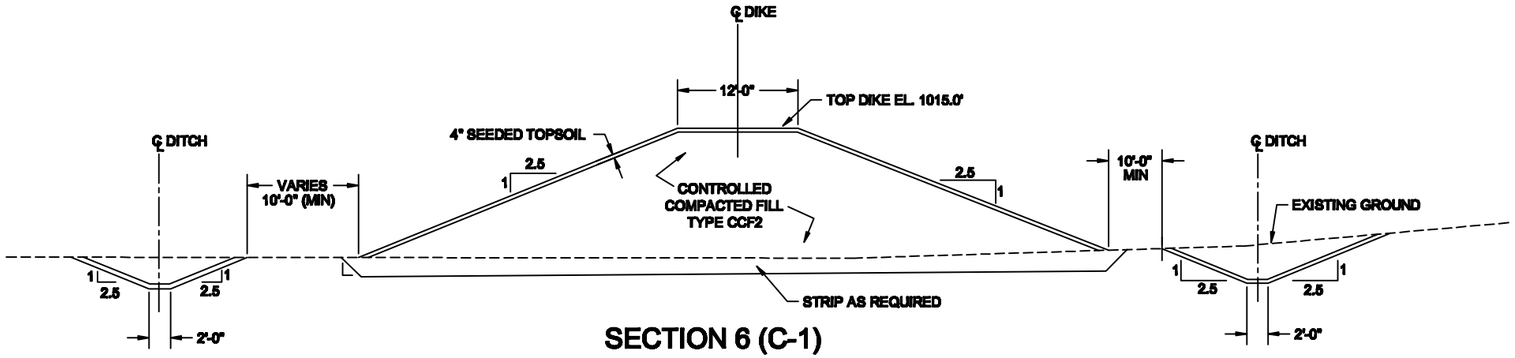
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

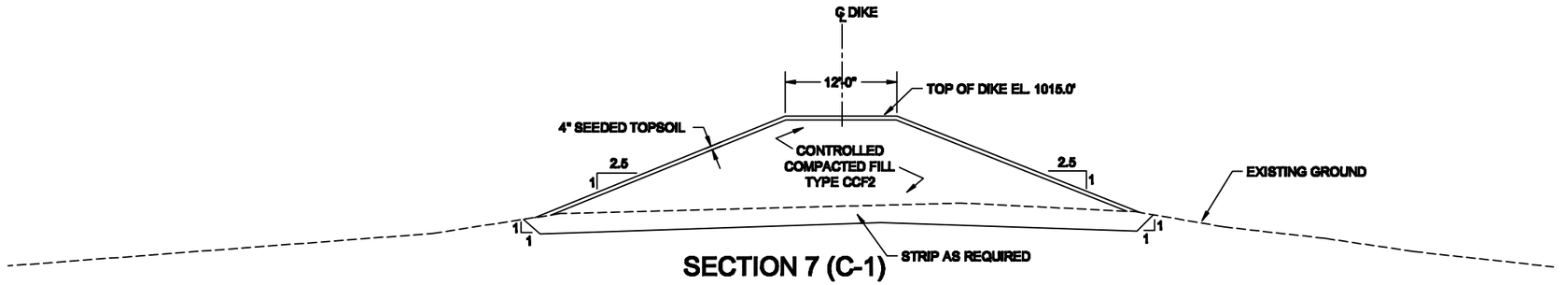
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY
PINEVILLE ASH POND PLAN VIEW

DATE:	9/1/10
PROJECT NO:	3-2106-0177-0003
REV. NO.:	
FIGURE No.	5

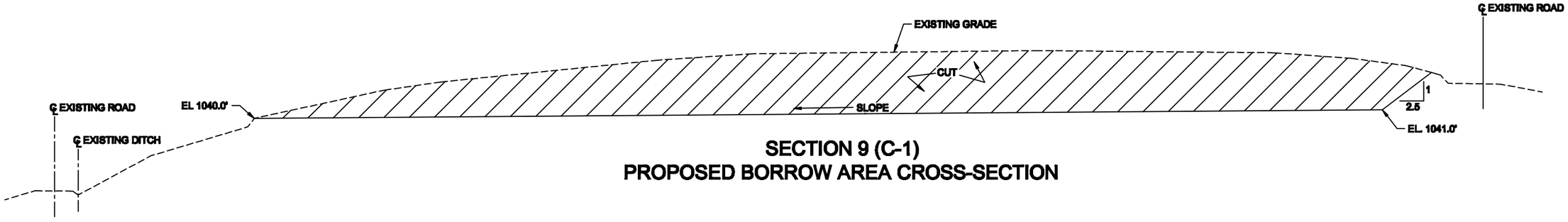
S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Pineville\CAD and GIS Files\pinvillefig5.dwg – Layout1 – Sep. 07, 2010 1:49pm – chris.eger



SECTION 6 (C-1)
PINEVILLE ASH POND TYPICAL SOUTHEASTERN DIKE CROSS-SECTION



SECTION 7 (C-1)
PINEVILLE ASH POND TYPICAL WESTERN DIKE CROSS-SECTION



SECTION 9 (C-1)
PROPOSED BORROW AREA CROSS-SECTION

SOURCE: ASH POND AREA SECTIONS & DETAILS PINEVILLE POWER STATION KENTUCKY UTILITIES COMPANY PINEVILLE, KENTUCKY, DRAWING NO. C-7, PREPARED BY SARGENT & LUNDY ENGINEERS, REVISED JULY 25, 1988

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

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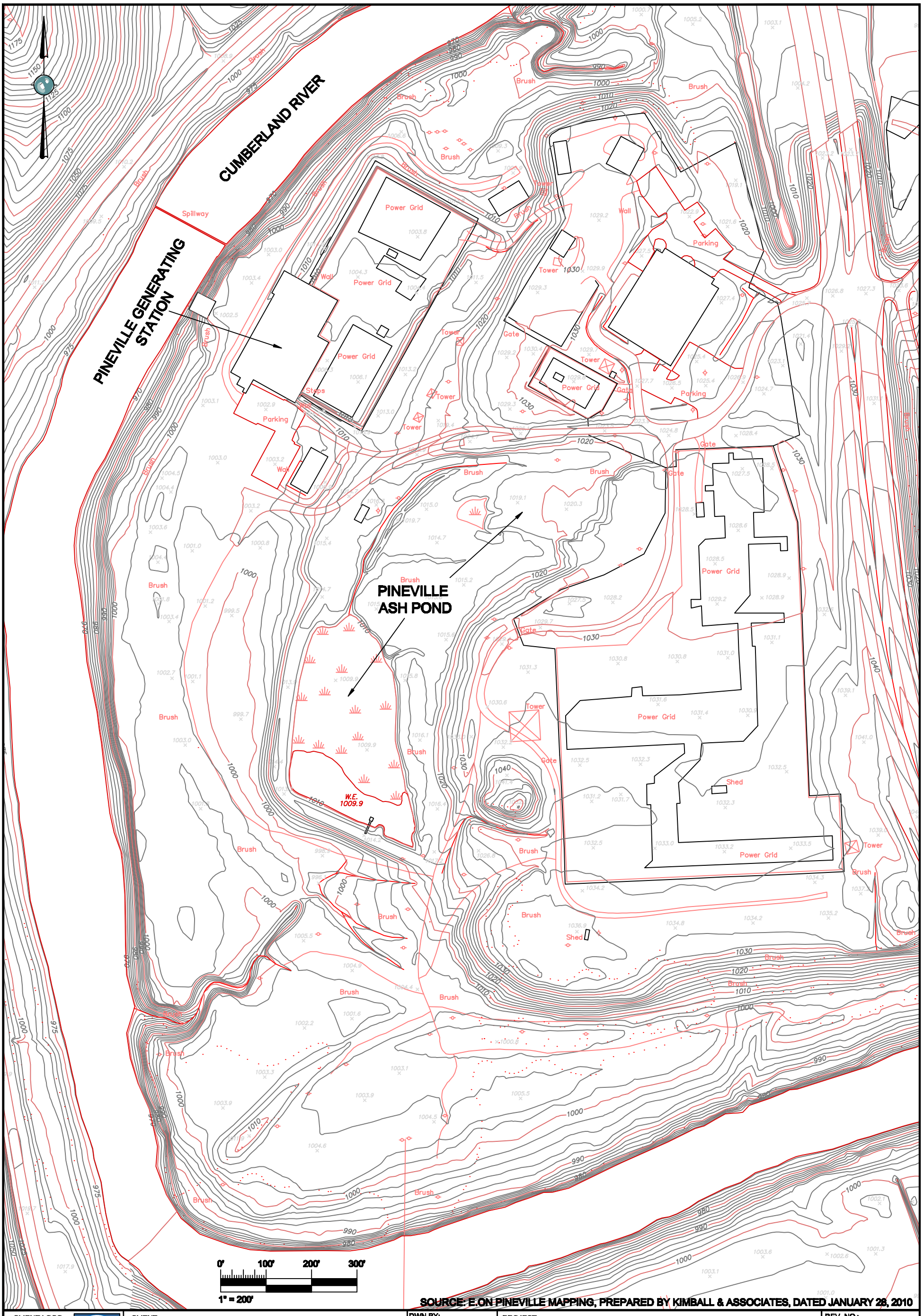
SCALE: AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
PINEVILLE ASH POND TYPICAL CROSS-SECTIONS

DATE: 9/1/10
PROJECT NO: 3-2106-0177-0003
REV. NO.:
FIGURE No. 6

S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Pineville\CAD and GIS Files\pinvillefig6.dwg – Layout1 – Sep. 07, 2010 1:50pm – chris.eger



SOURCE: E.ON PINEVILLE MAPPING, PREPARED BY KIMBALL & ASSOCIATES, DATED JANUARY 28, 2010

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PROJECT
ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE
KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
TOPOGRAPHIC MAP

REV. NO.:	
DATE:	9/1/10
PROJECT NO:	3-2106-0177-0003
FIGURE No.	7

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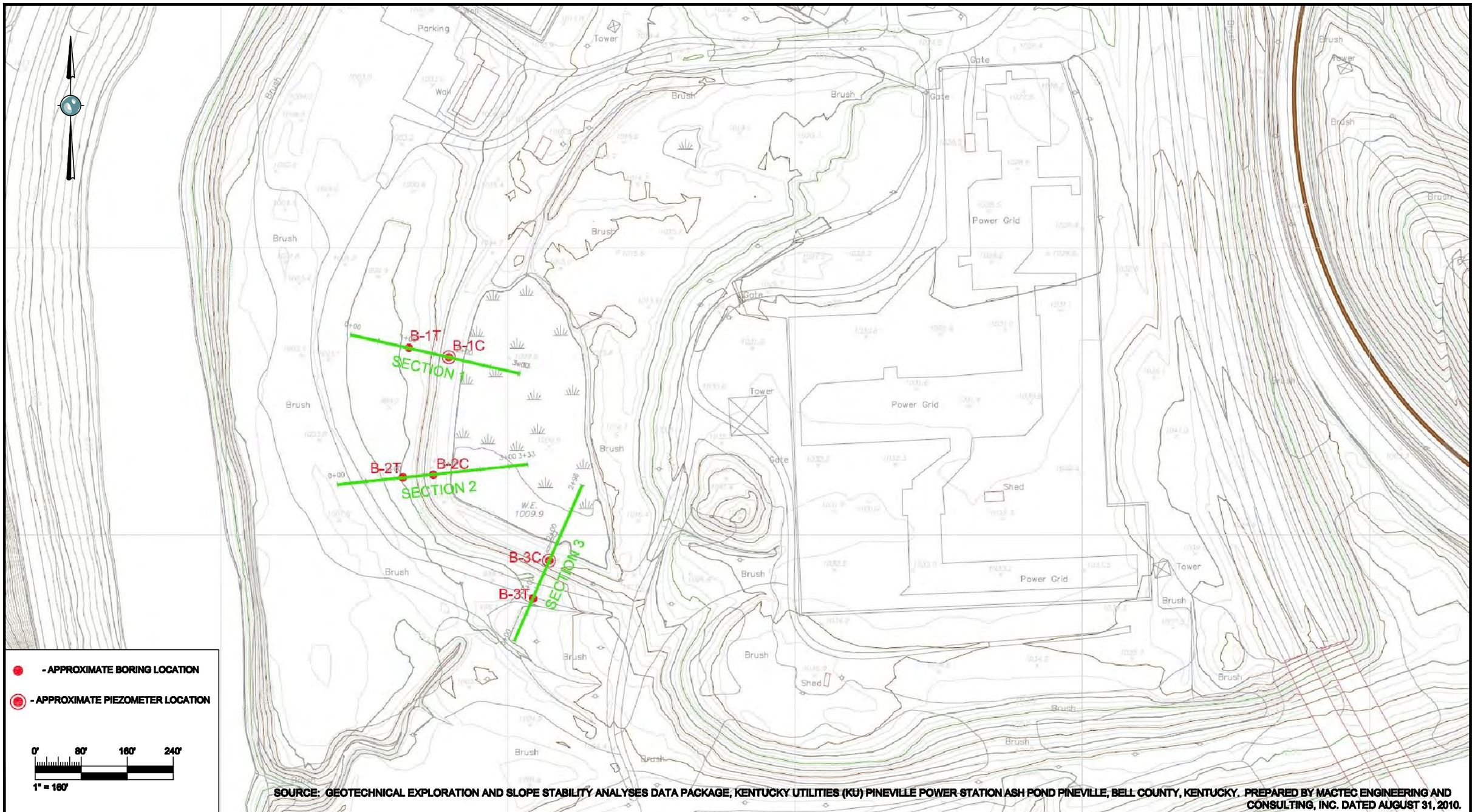

SOURCE: GEOTECHNICAL EXPLORATION AND SLOPE STABILITY ANALYSES DATA PACKAGE, KENTUCKY UTILITIES (KU) PINEVILLE POWER STATION ASH POND PINEVILLE, BELL COUNTY, KENTUCKY. PREPARED BY MACTEC ENGINEERING AND CONSULTING, INC. DATED AUGUST 31, 2010.

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT

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DWN BY:	CAE
CHK'D BY:	MGS
DATUM:	
PROJECTION:	
SCALE:	AS SHOWN

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
PINEVILLE ASH POND PIEZOMETER LOCATIONS AND 2010 STABILITY ANALYSIS CROSS-SECTIONS

DATE:	9/1/10
PROJECT NO:	3-2106-0177-0003
REV. NO.:	
FIGURE No.	8

S:\Geosciences\Proposals\EPA Coal Impoundment Inspection\EPA CCW June Round 6\KU E-ON Pineville\CAD and GIS Files\pinvillefig8.dwg – Layout1 – Sep. 01, 2010 1:32pm – chris.eger

APPENDICES

APPENDIX A
Waste Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Pineville Generating Substation	Date: August 5, 2010
Unit Name: Pineville Ash Pond	Operator's Name: KU (Subsidiary of EON)
Unit I.D.: Pineville Ash Pond	Hazard Potential Classification: **High** **Significant** **Low**
Inspector's Name: James Black, Mary Swiderski	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Every 2 weeks		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	1010.2'		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	varies		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	1013.3'		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?		X	From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		X	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments
3	Stop Log Inlet Structure
6	Weir along KPDES outfall 001
12	Skimmer present

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # KY 0003620 INSPECTOR Black/Swiderski

Date August 5, 2010

Impoundment Name Pineville Generating Station - Pineville Ash Pond

Impoundment Company KU Subsidiary of EON

EPA Region 4

State Agency (Field Office) Address

200 Fair Oaks Lane
Frankfort, KY 40601

Name of Impoundment Pineville Ash Pond

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

New X Update _____

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X	

IMPOUNDMENT FUNCTION: Currently receives groundwater infilitration from basement of plant, and surface drainage from adjacent substation

Nearest Downstream Town : Name Barborville, KY

Distance from the impoundment Approximately 18 miles

Impoundment Location: Longitude -83 Degrees 45 Minutes 29 Seconds
Latitude 36 Degrees 47 Minutes 44 Seconds
State KY County Bell

Does a state agency regulate this impoundment? YES _____ NO X

If So Which State Agency? Considered "Less than Low" Hazard Potential by State of KY Division of Water due to dam height less than 25 feet, therefore the state does not inspect the impoundment.

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____**LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

__X__**LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

_____**SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

_____**HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

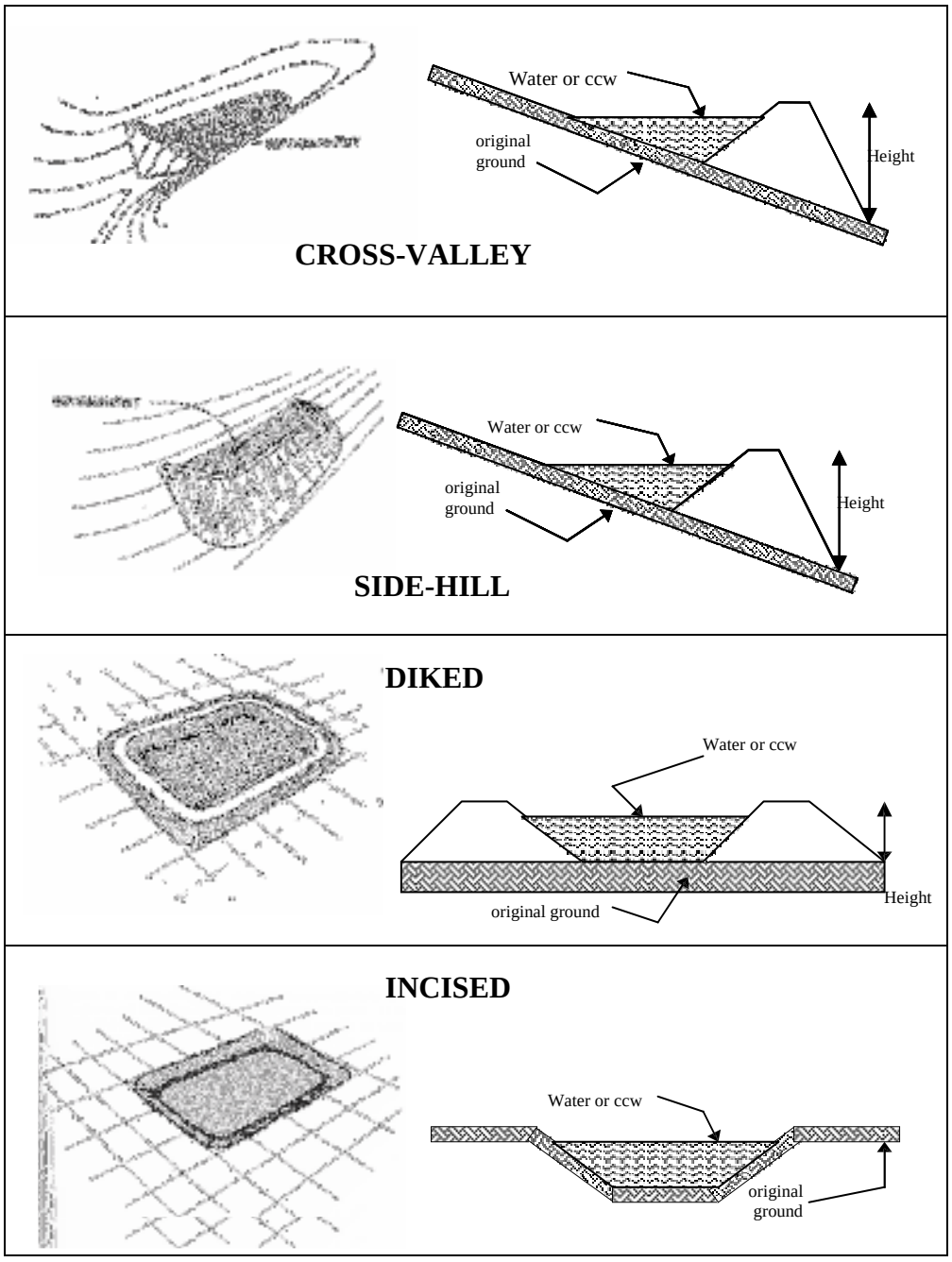
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Plant is shut down, no longer being used as ash pond.

North two-thirds of impoundment is full and somewhat consolidated (KU maintenance can drive on this section).

Estimate release would be material from lower one-third of pond and would principally stay on owners property.

CONFIGURATION:



_____Cross-Valley
__X__Side-Hill
_____Diked
_____Incised (form completion optional)
_____Combination Incised/Diked

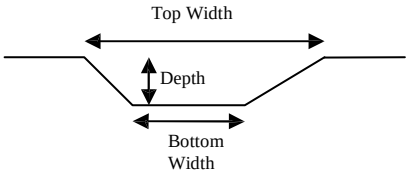
Embankment Height __16.5_____feet Embankment Material_Earthern Fill____
Pool Area _____6.5_____ acres Liner _N/A_____
Current Freeboard ___5.8'_____ feet Liner Permeability _N/A_____

TYPE OF OUTLET (Mark all that apply)

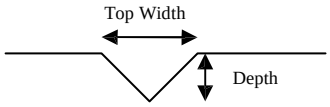
_N/A_ Open Channel Spillway
_____Trapezoidal
_____Triangular
_____Rectangular
_____Irregular

_____depth
_____bottom (or average) width
_____top width

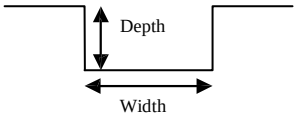
TRAPEZOIDAL



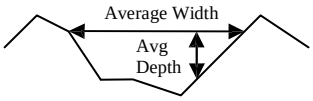
TRIANGULAR



RECTANGULAR

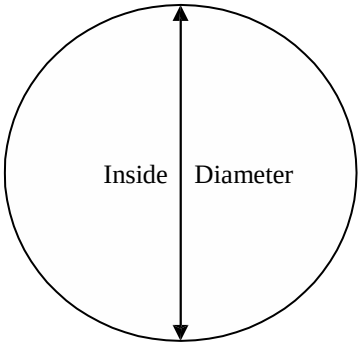


IRREGULAR



__X__ **Outlet**

_18”_ inside diameter



Material
__X__corrugated metal
_____welded steel
_____concrete
_____plastic (hdpe, pvc, etc.)
_____other (specify) _____

Is water flowing through the outlet? YES __X__ NO _____

_____**No Outlet**

_____**Other Type of Outlet** (specify) _____

The Impoundment was Designed By Sargent and Lundy, JM McLaughlin KY #9039

Has there ever been a failure at this site? YES _____ NO ____X____

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO ___X___

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES _____ NO __X__

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____

APPENDIX B
Site Photo Log Map and Site Photos

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

AMEC Earth & Environmental
690 Commonwealth Business Center
11003 Bluegrass Parkway
Louisville, KY 40299

DWN BY: DJC
CKD BY: MS
Datum: NAD 83
Projection: Albers
Scale: As Shown

ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
ASH POND
PHOTO LOCATION MAP

REV. No.: A
Date: 5-21-10
Project No: 3-2106-0177-0003
Figure No: B-1

1-1

SOUTHWEST INTERIOR SLOPE AND CREST

1-2

FROM SOUTHWEST DIKE LOOKING SOUTHEAST AT POND INTERIOR

AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO	CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY		
PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS	CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
	PROJECTION:	SCALE:	PAGE NO.: B-2

1-3

FROM SOUTHWEST DIKE LOOKING EAST TOWARDS OUTLET STRUCTURE

1-4

FROM SOUTH DIKE LOOKING NORTH TOWARDS SUBSTATION

AMEC Earth & Environmental 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	amec	CLIENT LOGO	CLIENT UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
		PROJECTION:	SCALE:	PAGE NO.. B-3

1-5

FROM SOUTH DIKE LOOKING EAST TOWARDS SUBSTATION

1-6

FROM EAST END OF SOUTH DIKE LOOKING NORTHWEST TOWARDS OUTLET STRUCTURE

AMEC Earth & Environmental 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	amec	CLIENT LOGO	CLIENT UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
		PROJECTION:	SCALE:	PAGE NO.. B-4

1-7

LOOKING EAST AT TIE-IN TO ORIGINAL GROUND AT SOUTHEAST CORNER

1-8

LOOKING NORTH AT SOUTHEAST CORNER

AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
ASH POND SITE PHOTOS

DWN BY:	DATUM:	DATE:
CAE		8/10/10
CHK'D BY:	REV. NO.:	PROJECT NO:
MGS		3-2106-0177-0003
PROJECTION:	SCALE:	PAGE NO..
		B-5

1-9

POND OUTLET AND KPDES OUTFALL 001 AT TOE OF SOUTH DIKE

1-10

LOOKING SOUTH AT DRAINAGE CHANNEL FROM OUTFALL TO CUMBERLAND RIVER

AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS	CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
	PROJECTION:	SCALE:	PAGE NO.. B-6

1-11

LOOKING EAST AT SOUTH DIKE DOWNSTREAM SLOPE

1-12

LOOKING NORTH AT SOUTHWEST DOWNSTREAM SLOPE

AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO	CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY		
PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS	DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS	CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
	PROJECTION:	SCALE:	PAGE NO.: B-7

1-13

LOOKING NORTHEAST AT UPPER SECTION OF WEST DIKE, TIE-IN TO ORIGINAL GROUND

1-14

LOOKING NORTHEAST AT WEST CORNER OF NORTH SIDE OF POND

AMEC Earth & Environmental 690 Commonwealth Center 11003 Bluegrass Parkway Louisville, Ky 40299 (502) 267-0700	amec	CLIENT LOGO	CLIENT UNITED STATES ENVIRONMENTAL PROTECTION AGENCY	
PROJECT ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS		DWN BY: CAE	DATUM:	DATE: 8/10/10
TITLE KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S. PINEVILLE GENERATING STATION, PINEVILLE, KY ASH POND SITE PHOTOS		CHK'D BY: MGS	REV. NO.:	PROJECT NO: 3-2106-0177-0003
		PROJECTION:	SCALE:	PAGE NO.. B-8

1-15

POND INLET NEAR WEST CORNER OF NORTH SIDE OF POND

AMEC Earth & Environmental
690 Commonwealth Center
11003 Bluegrass Parkway
Louisville, Ky 40299
(502) 267-0700

CLIENT LOGO

CLIENT: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROJECT: ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS

TITLE: KENTUCKY UTILITIES, SUBSIDIARY OF E.ON U.S.
PINEVILLE GENERATING STATION, PINEVILLE, KY
ASH POND SITE PHOTOS

DWN BY:	DATUM:	DATE:
CAE		8/10/10
CHK'D BY:	REV. NO.:	PROJECT NO:
MGS		3-2106-0177-0003
PROJECTION:	SCALE:	PAGE NO..
		B-9

APPENDIX C
Inventory of Provided Materials

PINEVILLE

Item	Description/File Name
1	C-1 Site Plan Coal Pile Area.pdf *(included in July 30 2010 email transmittal)*
2	C-5 Pond Flow Measurement Plan and Sections.pdf *(included in July 30 2010 email transmittal)*
3	C-7 Ash Pond Area Sections and Details.pdf *(included in July 30 2010 email transmittal)*
4	EON-Pineville-MAP.dwg *(included in July 30 2010 email transmittal)*
5	S-11 Ash Pond Weir Box Structure.pdf *(included in July 30 2010 email transmittal)*
6	Aerial Pineville1 2009.pdf
7	Appendix E Pineville.pdf - appendix from the 2009 Growing Season Visual Site Assessment Report, prepared by *ATC Associates Inc.*, March 19, 2010
8	Folder contains 5 years of Discharge Monitoring Reports (DMRs) from 2006 through 2010

If you have any questions, please call me.

David Millay
Civil Engineer
T 502-627-2468

Generation Engineering
220 West Main Street
Louisville, Kentucky 40202
T 1-502-627-2985

TRANSMITTAL LETTER

Date: August 17, 2010

To: James Black, AMEC Earth and Environmental
Mary Swiderski, AMEC Earth and Environmental

Re: Additional information for Tyrone Generating Station and Pineville Station

The following additional information has been provided on the CD included with this letter:

TYRONE

Item	Description/File Name
1	KU-Tyrone WB Diag-1-KPDES.jpg – Water Balance Diagram, 1-Day Max Rainfall
2	KU-Tyrone WB Diag-AVG-KPDES – Water Balance Diagram, Average Rainfall
3	Tyrone Process Flows Narrative.pdf - August 2010

PINEVILLE

Item	Description/File Name
1	B-66.pdf – Location Plan & Sections of Test Borings Unit No. 3
2	KU-Pineville WB Diagram.pdf – Water Balance Diagram, 30 Day Peak Monthly Average Process and 1-Day Max Rainfall Conditions
3	Pineville Process Flows Narrative.pdf – August 2010

If you have any questions, please call me.

David Millay
Civil Engineer
T 502-627-2468

Generation Engineering
220 West Main Street
Louisville, Kentucky 40202
T 1-502-627-2985

TRANSMITTAL LETTER

Date: August 31, 2010

To: James Black, AMEC Earth and Environmental
Mary Swiderski, AMEC Earth and Environmental

Re: Additional information for the Pineville Station

The following additional information has been provided on the CD included with this letter:

PINEVILLE

Item	Description/File Name
1	2010-08-30 Pineville Data Package.pdf

If you have any questions, please call me.

David Millay
Civil Engineer
T 502-627-2468