

US EPA ARCHIVE DOCUMENT

Assessment of Dam Safety Coal Combustion Surface Impoundments (Task 3) Draft Report

Louisville Gas &
Electric Company
(A subsidiary of E.ON U.S.)

Cane Run Power Station
Louisville, Kentucky



Prepared for

Lockheed Martin

2890 Woodridge Ave #209
Edison, New Jersey 08837

December 18, 2009

CHA Project No. 20085.9000.1510



I acknowledge that the management units referenced herein:

- Ash Treatment Basin Complex/E-Pond
- Basin Pond/Dead Storage Pond

Have been assessed on October 28, 2009.

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TABLE OF CONTENTS

SECTION	PAGE NUMBER
1.0 INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Project Background.....	2
1.2.1 State Issued Permits	2
1.3 Site Description and Location.....	3
1.3.1 Ash Treatment Basin and E-Pond.....	4
1.3.2 Dead Storage / Basin Pond Complex.....	6
1.3.3 Other Impoundments	6
1.4 Previously Identified Safety Issues.....	6
1.5 Site Geology.....	7
1.6 Bibliography	7
2.0 FIELD ASSESSMENT.....	15
2.1 Visual Observations	15
2.2 Visual Observations – Ash Treatment Basin	16
2.2.1 ATB Embankments and Crest	16
2.2.1.1 ATB North Dike	16
2.2.1.2 ATB East Dike.....	17
2.2.1.3 ATB South Dike	17
2.2.2 ATB Control Structure and Discharge Channel	18
2.3 Visual Observations – Basin / Dead Storage Pond Complex	18
2.3.1 Basin / Dead Storage Pond Complex Embankments and Crest.....	18
2.3.1.1 Basin / Dead Storage Pond Complex East Dike	18
2.3.1.2 Basin / Dead Storage Pond Complex North Dike.....	19
2.3.2 Basin / Dead Storage Pond Complex Control Structure & Discharge Channel ...	19
2.4 Monitoring Instrumentation	19
3.0 DATA EVALUATION	49
3.1 Design Assumptions	49
3.2 Hydrologic and Hydraulic Design	49
3.3 Structural Adequacy & Stability.....	50
3.3.1 Stability Analyses of Former Ash Pond.....	51
3.3.2 Stability Analysis of Existing Ponds.....	52
3.4 Foundation Conditions.....	52
3.4.1 Geotechnical Reports	52
3.4.2 Record Drawings	52
3.4.3 Documentation of Foundation Preparations	53
3.5 Operations & Maintenance	53
3.6 Inspections	53
3.6.1 State Inspections	53
3.6.2 Inspections by Engineering Consultants.....	54



TABLE OF CONTENTS

SECTION	PAGE NUMBER
3.6.3 Inspection by Owner Representatives.....	54
4.0 CONCLUSIONS/RECOMMENDATIONS	58
4.1 Acknowledgement of Management Unit Condition	58
4.2 ATB General Condition Monitoring and Maintenance	58
4.3 Basin/Dead Storage Ponds.....	59
4.4 Engineering Analysis.....	60
5.0 CLOSING	61

TABLES

Table 1 - Approximate Precipitation Prior to Site Visit	15
Table 2 - Minimum Safety Factors Recommended by US Army Corps of Engineers.....	50
Table 3 – Summary of Safety Factors for Former Ash Pond	51

LIST OF FIGURES

Figure 1 – Project Location Map	9
Figure 2 – Photo Site Plan	10
Figure 3 – Critical Infrastructure Map.....	11
Figure 4 – Expansion Design Plan.....	12
Figure 5 – Present Topographical Data	13
Figure 6 – Regional Geology Map.....	14
Figure 7 – Photo Location Map	20
Figure 8 – Cross Section of Former Ash Pond	57

APPENDIX

Appendix A - Completed EPA Coal Combustion Dam Inspection Checklists and Coal Combustion Waste (CCW) Impoundment Inspection Forms
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1.0 INTRODUCTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United States Environmental Protection Agency (EPA)) to perform independent engineering reviews of selected coal combustion surface impoundment inspection reports (Project #0-381 Coal Combustion Surface Impoundments/Dam Safety Inspections – Task 3). As part of this contract, CHA was assigned to perform a site assessment of Louisville Gas & Electric Company’s (a subsidiary of E.ON U.S.) coal combustion waste (CCW) impoundments at the Cane Run Station, which is located in Louisville, Jefferson County, Kentucky as shown on Figure 1 – Project Location Map.

CHA made a site visit on October 28, 2009 to inventory CCW surface impoundments at the Cane Run facility, to perform visual observations of the containment dikes, and to collect relevant information regarding the site assessment.

CHA engineers Anthony Stellato, P.E. and Katherine Adnams, P.E. were accompanied by the following individuals:

Company or Organization Name	Name & Title
KY Dept. of Environmental Protection	Gary Wells, Dam Safety
E.ON U.S (Louisville Gas & Electric)	Steven Turner
E.ON U.S. (Louisville Gas & Electric)	Kevin Shaughnessy
E.ON U.S. (Louisville Gas & Electric)	Michael Winkler, Manager Environmental Programs
E.ON U.S. (Louisville Gas & Electric)	David Millay, Civil Engineer – Generation Engineering
E.ON U.S. (Louisville Gas & Electric)	Michael Hensley



1.2 Project Background

The Cane Run Station Ash Treatment Basin Dam (KY State ID No. 874, a.k.a. LG&E Waste Water Dam) is under the jurisdiction of the Commonwealth of Kentucky Department for Environmental Protection, Division of Water, Dam Safety and Flood Compliance Section of the Water Infrastructure Branch (KDEP). According to the Kentucky Revised Statute (KRS) Chapter 151, the KDEP Engineering Memo No. 5 (adopted 02-01-1975), Section B and KAR 401:030 – Design Criteria for Dams and Associated Structures the Ash Treatment Basin (ATB) Dam is classified by the Kentucky DEP as High Hazard, meaning the failure of the dam may cause loss of human life or major damage to dwellings, buildings, railroads, or important utilities. The ATB dam also meets the EPA criteria for a high hazard dam.

The Basin Pond/Dead Storage Pond Dam is not classified by the Kentucky DEP since this structure does not meet Kentucky's definition of a dam. As defined by the EPA criteria this structure would be classified as Low Hazard, meaning that failure of the dam would not be expected to cause loss of human life, and economic/environmental losses would be expected to be low.

1.2.1 State Issued Permits

Commonwealth of Kentucky Permit No. KY0002062 has been issued to Louisville Gas & Electric authorizing discharge under the National Pollutant Discharge Elimination System (NPDES) to the Ohio River in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective on November 1, 2002. LG&E submitted a permit renewal application prior to the scheduled expiration date and received letter of completeness regarding the permit from the Kentucky Department of Water (KDOW) on May 21, 2007 and, consistent with state regulations, Cane Run continues to operate under the current permit pending issuance of a new permit by the KDOW.

1.3 Site Description and Location

The Cane Run Power Station has five ponds in two complexes for process water and stormwater run-off:

1. ATB which receives bottom ash sluice, plant sump water, landfill run-off, coal pile run-off, FGD excess water, and precipitation run-off. This basin includes the E-Pond which receives landfill run-off where entrains solids settle before the water flows into the ATB.
2. Basin Pond receives precipitation and equipment wash-down run-off flows from the areas adjacent to the processing equipment for preparing residuals for the landfill. Solids primarily including calcium sulfites and fly ash used in scrubber sludge. Excess water is pumped to the Clearwater Pond.
3. Dead Storage Pond contains unused carbide-lime slurry and receives runoff from the portable lime-slakers and lime receiving areas. Excess water flows to the Basin Pond.
4. Clearwater Pond serves to settle suspended solids prior to limited reuse by FGD systems or discharge to the site ATB.
5. Coal Pile Run-Off Pond receives precipitation run-off from the coal pile, plant substation/roadway areas and adjacent grassy areas.

The location of these ponds is shown on Figure 2. This report focuses on the ATB/E-Pond Complex and the Basin Pond/Dead Storage Pond Complex because these ponds are impounded by earthen dikes and they receive coal combustion waste (CCW) products. While the Clearwater Pond has the potential to receive CCW, it is incised and therefore it is not discussed further in this report.

A map of the region indicating the location of the Cane Run Power Station, ATB/E-Pond Complex, and Dead Storage/Basin Pond Complex and identifying schools, hospitals, or other critical infrastructure located within approximately 5 miles down gradient of the impoundments is provided as Figure 3.

1.3.1 Ash Treatment Basin and E-Pond

The present day ATB (also referenced as the Main Ash Pond in other reports) has a surface area of approximately 40 acres. The ATB is situated approximately 1,200 feet east of the Ohio River. It was commissioned in 1972 as an expansion of an older ash pond that was in use prior to that time. The ATB was expanded in 1977 and reportedly contains bottom ash, fly ash, boiler slag and other materials (coal fines, process water drainage and treated sanitary wastewater). The pre-1972 pond was in the area now containing the Cane Run landfill.

Addition plans for the ATB, included herein as Figure 4, indicate that it was originally constructed as a partially incised, roughly triangular shaped basin with a bottom at El. 420 feet and the crest at El. 460 feet. The original ground was at about El. 450. It measured roughly 6,600 feet around the perimeter, of which approximately 1,440 feet along the west side abutted against the original ash pond and an existing flood wall (levee) for the Ohio River. Approximately 750 feet of the north basin perimeter, as measured from the flood wall at northwest corner of the pond, was incised where the original ground surface approached El. 460. The remaining basin wall perimeter was constructed as an earthen dike up to 14 feet high constructed with 3 horizontal to 1 vertical (3H:1V) exterior slopes, 1.5H:1V interior slopes, and a 15-foot wide crest. Flatter 3H:1V interior slopes were planned for the west basin wall abutting the flood wall. Proposed cross sections are included on Figure 4.

A note on the 1972 plan indicates an overflow at El. 456.5 thus creating a pool up to 36.5 feet deep with an operating level about 6.5 to 8.5 feet above the exterior ground surface. This plan shows a series of manholes along the northern side of the pond connecting two 24-inch-diameter RCPs which collect water from the coal pile and ash basin to the Ohio River and to an area west of the pond.

An Emergency Sludge Pond (or E-Pond), approximately 1.5 acres, was proposed in the southwest corner of the basin. The 1972 plan indicated that dikes creating this sludge pond were 15 feet

wide at the top with crest and floor elevations of 460 feet and 440 feet respectively. The E-Pond was designed with 1.5H:1V slopes for its interior and exterior slopes. Field observations by CHA suggest that the current E-Pond is off-set northeastward of the proposed 1972 plan location.

A 2008 aerial and hydrographic survey produced by Fuller Mossberger Scott and May (FMSM) as part of an ash pond planning study for the Cane Run Facility indicates that the original ash pond that existed prior to 1972 and flood wall along the west edge of the expanded basin have been buried and are no longer discernable. This plan is included as Figure 5. A landfill operation where combustion ash stabilized flue-gas desulfurization (FGD) by-product is disposed now occupies the original ash basin and an area south of the ash basin. Elevations in this landfill are currently on the order of 560 feet or more.

As much as one-third to one-half of the present basin no longer retains open water. This includes the southwest corner of the basin area where the E-Pond has been constructed and where a 30 to 50-foot wide drainage channel now conveys water through the filled in area toward the open portion of pond. Ground surface elevations range from approximately 457 to 500 feet in this filled area where two prominent partially vegetated knolls are presently located. Cane Run personnel indicated that these knolls were stockpiled materials related to landfill operations. The elevation of the dike crest ranges from approximately El. 458 at the southwest corner to El. 460 at the east corner, to El. 458 at the northwest corner. The water surface elevation was about 454.6 feet at the time of the 2008 survey. Plant personnel indicated that the water surface elevation was about 450 at the time of the CHA site visit. The water level is controlled by an outflow structure located at the northwest corner of the pond. This structure connects to the twin 24-inch-diameter RCPs that discharge to the Ohio River.

1.3.2 Dead Storage / Basin Pond Complex

The Basin Pond/Dead Storage/Clearwater Pond complex is approximately 1,300 feet northeast of the ATB. This complex is situated approximately 1,200 feet from the Ohio River.

The Basin Pond and Dead Storage Pond are separated by a common divider dike. The Basin Pond measures approximately 2 acres in surface area, and the Dead Storage Pond measures approximately 4 acres. Compacted fill embankments up to 10 feet high and about 1,100 feet long were constructed on the north and east sides of this complex. These ponds receive process water drainage from the plant and run-off from the FGD/fly ash mixing area. Water is pumped from these ponds for plant process reuse. At the time of CHA's site visit, the water level in these ponds was about El. 445.

We understand that the Basin/Dead Storage Ponds will likely be decommissioned within the next two to three years when the station reconfigures the north portion of the site to create a new landfill area. Permitting is planned for 2010 with construction anticipated to begin in 2011.

1.3.3 Other Impoundments

One additional impoundment, the Clearwater Pond, potentially contains Coal Combustion Byproducts. This pond is located directly west of the Dead Storage Pond. It measures approximately 1 acre in surface area and is fully incised.

1.4 Previously Identified Safety Issues

Based on our review of the information provided to CHA and as reported by Louisville Gas & Electric, there have been no identified safety issues at the Ash Pond Complex in the last 10 years.

1.5 Site Geology

The Cane Run Power Station, ATB, and Basin/Dead Storage Pond Complex, along with the surrounding industrial and residential areas, are located in the historic flood plain of the Ohio River in the southwest quadrant of the Louisville, Kentucky metropolitan area.

Based on a review of an available geology map included herein on Figure 6 (*Geologic map of parts of the Louisville West and Lanesville quadrangle, Jefferson County, Kentucky: U.S. Geological Survey, Geologic Quadrangle Map GQ-1202, 1974*), the west portion of the site, approximately from the center of the power station west to the Ohio River, is underlain by about 10 to 30 feet of alluvial silt, clay, and sand (noted as geologic unit Qal). Glacial outwash deposits consisting of a heterogeneous mixture of sand, gravel, silt, and clay is indicated on the east portion of the site (noted as geologic unit Qo). Artificial fill (geologic unit Af) is indicated within the power station; we assume that this fill is associated with earthwork activities at the plant.

1.6 Bibliography

CHA reviewed the following documents in preparing this report:

- *Ash Pond Addition – 1972*, Cane Run Generator Station, drawing prepared by Louisville Gas & Electric Co. Construction Department, August 10, 1972.
- *Ash Pond Hydrographic Survey Plan, Ash Pond Planning Study*, Cane Run Special Waste Disposal Facility, Fuller Massbarger Scott, & May Engineers, April 2008.
- *Geotechnical Investigation - Ash Pond Stability*, Cane Run Generating Station, Louisville Gas & Electric Company, ATEC Associates, November 20, 1976.
- *Louisville Gas and Electric Company, Cane Run/Maverick Steel Plant, 12" High Pressure Line*. Letter to Louisville Gas & Electric Company. Greenbaum Associates, Inc; September 2, 2005.

-
- *Response of Louisville Gas and Electric Company and Kentucky Utilities Company to Request for Information under Section 104(e) of the CERCLA.* Letter to U.S. Environmental Protection Agency, March 25, 2009.
 - *Scheduled Inspection, ID of Dam: 0874, LG&E Waste Water Dam, Jefferson County, KY, Hazard Class: High.* Commonwealth of Kentucky, Environmental and Public Protection Cabinet, June 25, 2004.
 - *Scheduled Inspection, ID of Dam: 0874, LG&E Waste Water Dam, Jefferson County, KY, Hazard Class: High.* Commonwealth of Kentucky, Environmental and Public Protection Cabinet, October 23, 2006.
 - *Scheduled Inspection, ID of Dam: 0874, LG&E Waste Water Dam, Jefferson County, KY, Hazard Class: High.* Commonwealth of Kentucky, Environmental and Public Protection Cabinet, October 21, 2008.
 - *Visual Site Assessment Report Eight Ash Pond Dams (sections applicable to Cane Run Station),* prepared for E. ON U.S., ATC Associates, Inc., February 20, 2009.



IMAGE DATE: 07/01/1983



Figure 1
Project Location Map

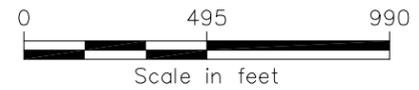
Scale: 1" = 1 mile

Project No.:
20085.9000.1510

Louisville Gas & Electric
Cane Run Power Station
Louisville, KY



IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATED MARCH 2005.



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PHOTO SITE PLAN

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO. 20085.9000
DATE: 12/2009
FIGURE 2

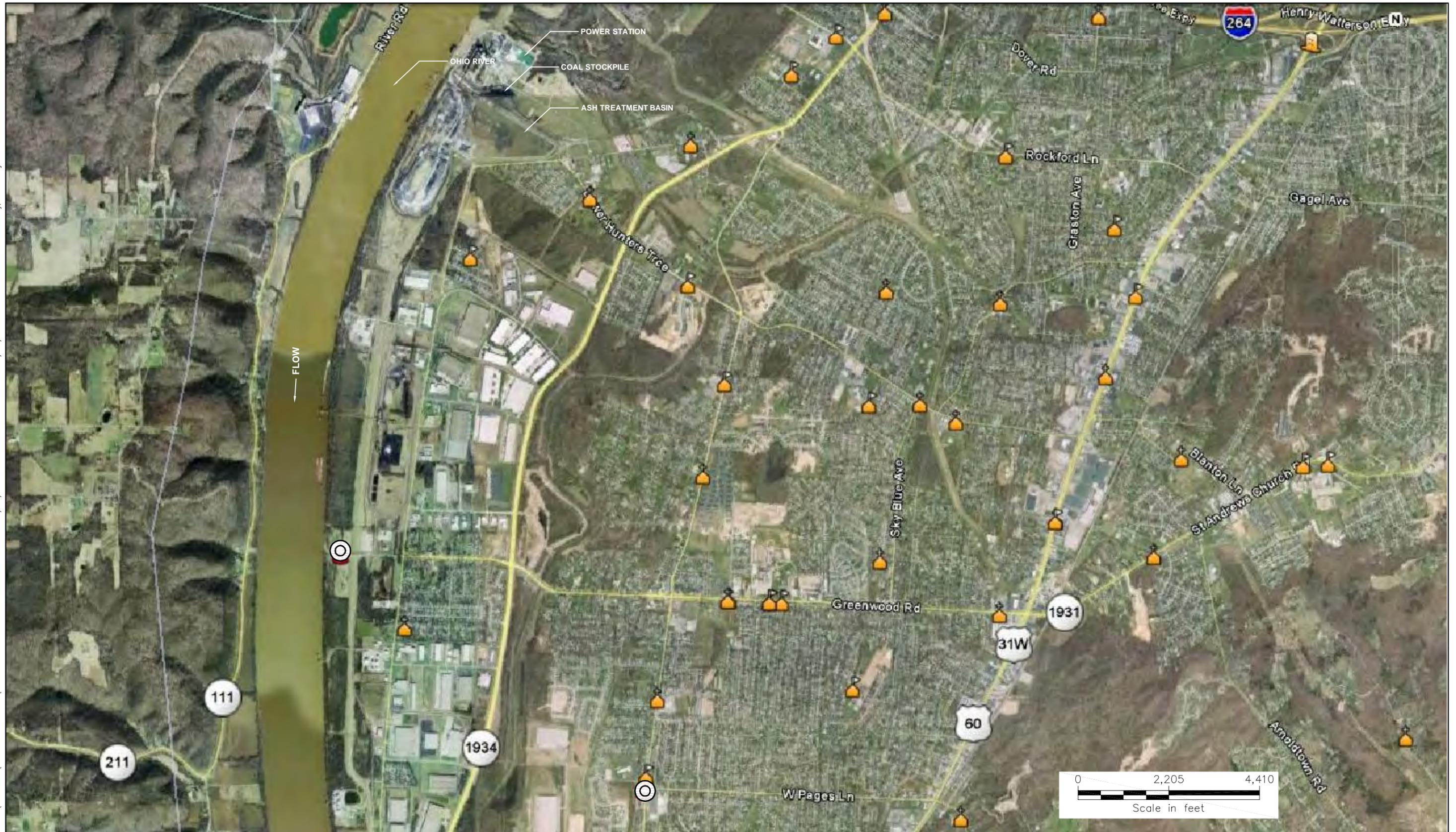
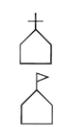


IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATED MARCH 2005.

LEGEND



111 STREET, HIGHWAY
 FIRE DEPARTMENT



CHURCH
 SCHOOL



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CRITICAL INFRASTRUCTURE MAP
 CANE RUN POWER STATION
 LOUISVILLE, KENTUCKY

PROJECT NO.
 20085.9000
 DATE: 12/2009
 FIGURE 3

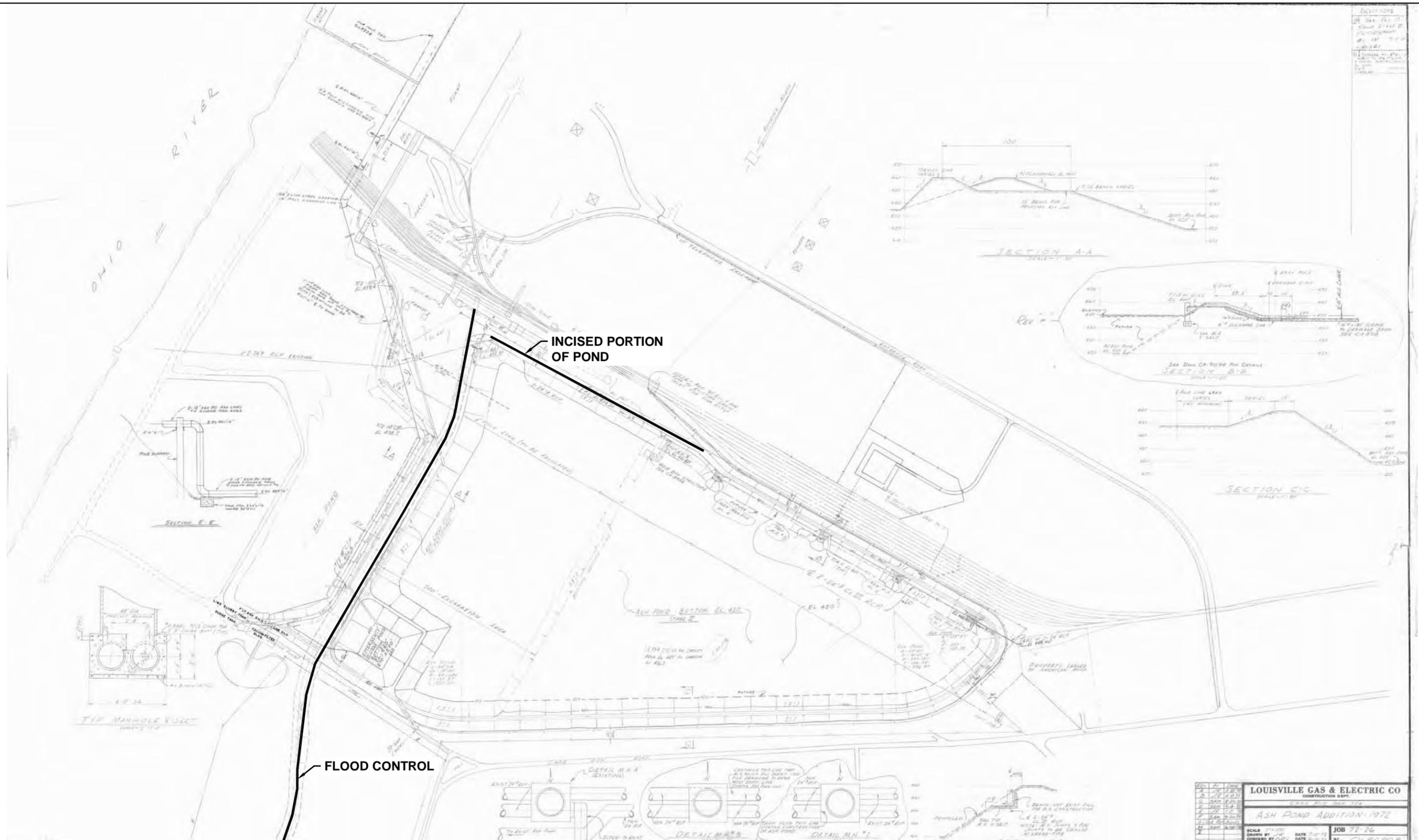


IMAGE REFERENCE: LOUISVILLE GAS & ELECTRIC CO., ASH POND ADDITION - 1972

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EXPANSION DESIGN PLAN

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO. 20085.9000
DATE: 12/2009
FIGURE 4

NO.	DATE	BY	DESCRIPTION
1	12/17/09	Gray, Timmelyn	Final
2	12/17/09	Gray, Timmelyn	Revised
3	12/17/09	Gray, Timmelyn	Revised
4	12/17/09	Gray, Timmelyn	Revised
5	12/17/09	Gray, Timmelyn	Revised
6	12/17/09	Gray, Timmelyn	Revised
7	12/17/09	Gray, Timmelyn	Revised
8	12/17/09	Gray, Timmelyn	Revised
9	12/17/09	Gray, Timmelyn	Revised
10	12/17/09	Gray, Timmelyn	Revised

LOUISVILLE GAS & ELECTRIC CO	
CONSTRUCTION DEPT.	
ASH POND ADDITION - 1972	
SCALE: 1"=40'	DATE: 12/17/09
DRAWN BY: Gray, Timmelyn	CHECKED BY: Gray, Timmelyn
JOB 72-26	

File: K:\20085\CADD\FIGURES\9000 CANE RUN FIGURES.DWG Saved: 12/18/2009 11:25:43 AM Plotted: 12/18/2009 11:27:14 AM User: Gray, Timmolyn

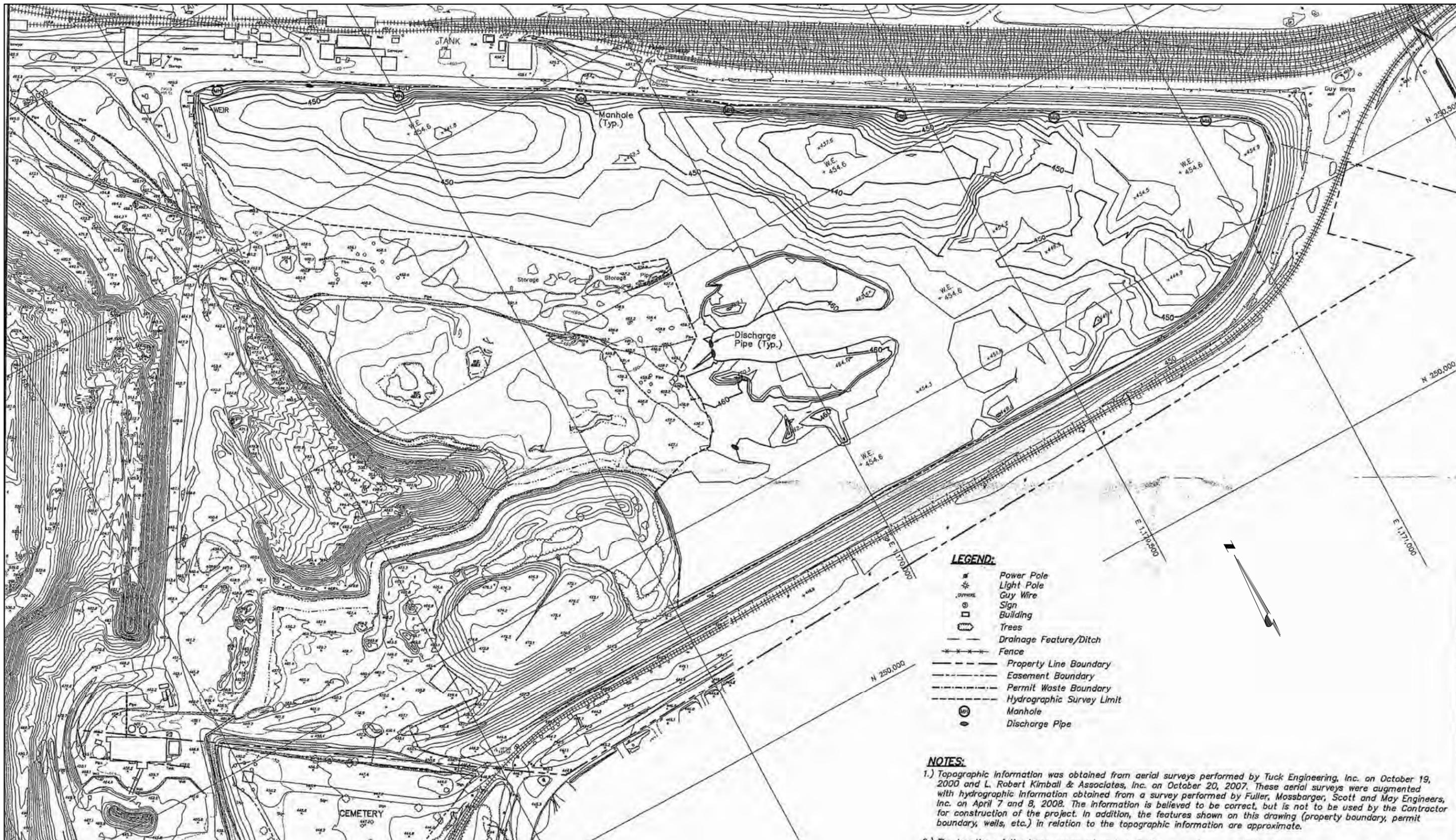
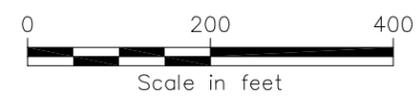


IMAGE REFERENCE: FULLER, MOSSBARGER, SCOTT & MAY ENGINEERS INC., ASH POND PLANNING STUDY, APRIL 2008, ASH POND HYDROGRAPHIC SURVEY PLAN, SHEET 1 OF 2.



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PRESENT TOPOGRAPHICAL DATA

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO.
20085.9000

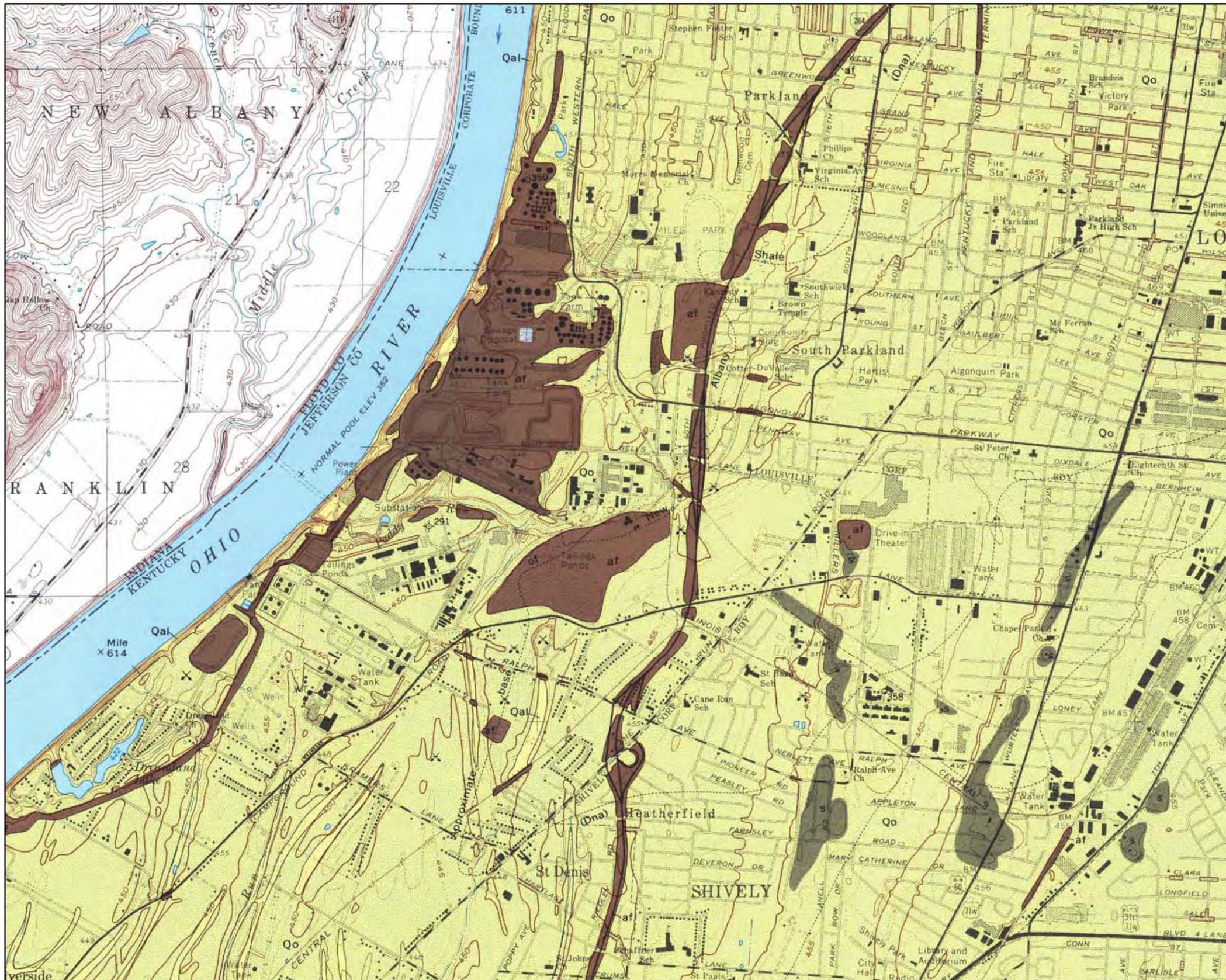
DATE: 12/2009

FIGURE 5

- LEGEND:**
- Power Pole
 - Light Pole
 - Guy Wire
 - Sign
 - Building
 - Trees
 - Drainage Feature/Ditch
 - Fence
 - Property Line Boundary
 - Easement Boundary
 - Permit Waste Boundary
 - Hydrographic Survey Limit
 - Manhole
 - Discharge Pipe

- NOTES:**
- 1.) Topographic Information was obtained from aerial surveys performed by Tuck Engineering, Inc. on October 19, 2000 and L. Robert Kimball & Associates, Inc. on October 20, 2007. These aerial surveys were augmented with hydrographic information obtained from a survey performed by Fuller, Mossbarger, Scott and May Engineers, Inc. on April 7 and 8, 2008. The information is believed to be correct, but is not to be used by the Contractor for construction of the project. In addition, the features shown on this drawing (property boundary, permit boundary, wells, etc.) in relation to the topographic information are approximate.
 - 2.) The location of the transmission line is approximate.

File: K:\20085\CADD\FIGURES\9000 CANE RUN FIGURES.DWG Saved: 12/17/2009 3:11:02 PM Plotted: 12/17/2009 3:14:18 PM User: Gray, Timmoly



GEOLOGIC QUADRANGLE MAP
LOUISVILLE WEST AND LANESVILLE
QUADRANGLES, KENTUCKY
GQ-1202

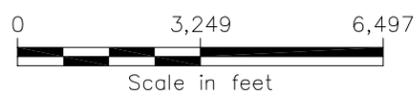
EXPLANATION

- | | | | | |
|---------------------------------|--|----------------------------|---|---------------|
| Holocene | | Qal | *Alluvium | QUATERNARY |
| | | Qla | *Lacustrine deposits | |
| | | Qo | Outwash
s, sand | |
| | | Ql | *Loess and eolian sand
s, sand | |
| | | Qt | *Terrace deposits
s, sand | |
| Pleistocene | | Mbn
Mbnp
Mbk
Mbnp | Borden Formation | MISSISSIPPIAN |
| | | | Mbn, Holtsiaw Siltstone Member
Mbn, Nancy Member
Mbk, Kenwood Siltstone Member
Mbnp, New Providence Shale Member | |
| pre-Wisconsin
and Wisconsin | | Mr | Rockford Limestone | DEVONIAN |
| | Shown by outcrop symbol where exposed at time of mapping; exposures subsequently covered | | | |
| Middle
and Upper
Devonian | | Dna | New Albany Shale | DEVONIAN |
| | Where Rockford Limestone is present, uppermost part may be of Early Mississippian age | | | |
| | | af | *Artificial fill | |

*Adapted in part from soil map of Jefferson County (Zimmerman, 1966). In urban area, chiefly north of Watterson Expressway, mapped by photogeologic methods

Letter symbols shown in parentheses indicate formations concealed by mapped surficial deposits

IMAGE REFERENCE: USGS: GEOLOGIC MAP OF PARTS OF THE LOUISVILLE WEST AND LANESVILLE QUADRANGLE, JFFERSON COUNTY, KENTUCKY; U.S. GEOLOGICAL SURVEY, GEOLOGIC QUADRANGLE MAP GQ-1202, 1974



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REGIONAL GEOLOGY

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO.
20085.9000

DATE: 12/2009

FIGURE 6

2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of the ATB and Dead Storage/Basin Pond complexes following the general procedures and considerations contained in Federal Emergency Management Agency’s (FEMA’s) *Federal Guidelines for Dam Safety* (April 2004), and Federal Energy Regulatory Commission (FERC) Part 12 Subpart D to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Forms, prepared by the US Environmental Protection Agency, were completed on-site during the site visit. Copies of the completed forms were submitted via email to Lockheed Martin representatives approximately three days following the site visit to the Cane Run Power Station. Copies of these completed forms are included in Appendix A. A photo log and Site Photo Location Plan (Figure 7) are located at the end of Section 2.4.

CHA’s visual observations were made on October 28, 2009. The weather was mostly cloudy with temperatures between 50 and 60 degrees Fahrenheit. Prior to the days we made our visual observations the following approximate rainfall amounts occurred (as reported by www.wunderground.com).

Table 1 - Approximate Precipitation Prior to Site Visit

Date of Site Visit – October 28, 2009		
Day	Date	Precipitation (inches)
Tuesday	October 20, 2009	0.00
Wednesday	October 21, 2009	0.00
Thursday	October 22, 2009	0.00
Friday	October 23, 2009	0.53
Saturday	October 24, 2009	0.00
Sunday	October 25, 2009	0.00
Monday	October 26, 2009	0.00
Tuesday	October 27, 2009	1.16
Wednesday	October 28, 2009	0.02
Total	Week Prior to Site Visit	1.71
Total	Month of October	5.94



2.2 Visual Observations – Ash Treatment Basin

CHA performed visual observations of the ATB Dike which is approximately 5,200 feet long and 10 to 14 feet high.

2.2.1 ATB Embankments and Crest

In general, the ATB dikes do not show signs of changes in horizontal alignment from the proposed alignment. The crest is uniformly graded and surfaced with crushed stone.

2.2.1.1 ATB North Dike

Photo 1 shows the north dike downstream slope is reasonably uniformly graded and appropriately vegetated with grass. Slope measurements indicate a variation from 2.5H :1V near the crest to 2H:1V near the toe. Occasional erosion rills have developed on the downstream slopes as shown in Photo 2. Photo 4 shows a slight irregularity in slope grading which occurs over a limited area of the downstream slope. This appears to be an overfilled repair, but could indicate soil creep. Tire ruts from mowers also exist in this area. This is common on earthen embankments, and requires observation to ensure that erosion and sloughing do not occur. Poor drainage at the toe of the slope results in ponding along much of the north dike. Photos 3, 5, and 6 show standing water and erosion at the toe likely resulting from this condition. E.ON U.S. is working with a consultant to design drainage improvements in this area. A small rodent hole, as shown in Photo 7 was seen in this area. A large area at the east end of the north dike has recently been re-graded (Summer 2009) with one to two feet of additional clay fill and sodded to address drainage problems, as shown in Photo 8. According to E.ON U.S., sod was used to avoid the difficulty of establishing grass on the slope from seed during the rainy summer season. Photos 9 through 12 show the north dike upstream embankment, which is covered with rip rap.

2.2.1.2 ATB East Dike

The east dike downstream slope is shown in Photos 13 to 16. The surface appears uniformly graded and appropriately vegetated with grass. White utility markers run along the toe of slope indicating the location of a high-pressure gas line installed by open cutting along the toe of the embankment in 2005. The upstream slope is rip rap covered and similar in appearance to the north dike upstream slope as shown in Photo 17.

2.2.1.3 ATB South Dike

The gas line continues along the downstream toe of the south dike as shown in Photo 18. Photo 21 shows slight settlement which has occurred over the gas line in this area. Photo 19 shows a concrete lined swale running along the toe, which intercepts storm water and carries it to a culvert running under the adjacent railroad embankment (Photo 20). Photos 21 to 24 show the surface treatment and condition of both the upstream and downstream slopes are similar to the east dike, except for the west end, where soil material for use at the landfill has been stockpiled on the upstream side of the embankment (Photo 25).

The ATB south dike continues along the E-Pond. The downstream embankment of the western 420 feet of the south dike, as shown in Photos 26 through 30, becomes over-steepened and irregular, and vegetation appears predominantly weedy. Surface probing indicated soft conditions, with up to 18" of penetration observed. A concrete barrier runs between the crest and the downstream face. Photo 29 shows several erosion rills which have developed under this barrier. Photo 31 shows the E-Pond which was excavated within previously deposited ash slightly to the northeast of the E-Pond location indicated on a 1972 proposed site plan. Storm water runoff from capped and uncapped areas of the landfill to the west discharge into the E-Pond via a culvert shown in Photo 32. Overflows from the E-Pond enter the ATB.

2.2.2 ATB Control Structure and Discharge Channel

Photos Nos. 33 and 34 show the outlet control structure for the ATB. Outlet pipes flow to a NPDES permitted outfall on the Ohio River.

2.3 Visual Observations – Basin / Dead Storage Pond Complex

CHA performed visual observations of the Basin Pond/Dead Storage Pond Dike, which is approximately 120 feet long and about 10 feet high.

2.3.1 Basin / Dead Storage Pond Complex Embankments and Crest

The Basin and Dead Storage Ponds share the east dike and the north dike impounds the northern side of the Dead Storage Pond. The south and west sides of this complex are incised.

2.3.1.1 Basin / Dead Storage Pond Complex East Dike

Vegetation is weedy and non-uniform. Photos 35 through 38, and 44 show typical slope conditions along the east dike. Photo Nos. 39 and 40 show woody brush and tree stumps on the downstream slope that have been recently cut following an inspection by E.ON U.S.'s independent consultant. Photo 41 shows an erosion rill that has developed on the east dike which is typical of the condition of the east dike. Both downstream and upstream slopes are steep and irregular as shown in Photo Nos. 42, 43, and 44. Photo 42 shows a depression that was observed near the toe at the corner between the east and north dikes. The crest road surface is crushed gravel, and water ponds in areas (Photo 45) due to wind-rowing of gravel along the edges from routine access road repair and maintenance.

2.3.1.2 Basin / Dead Storage Pond Complex North Dike

Surface irregularities as shown in Photos 46, 47, 50, 51 are typical along the downstream slope of the north dike, consisting of surface slumps, erosion rills and tire ruts. Surface probing indicated firm soils approximately 9 inches below the surface. Photos 48, 49, 52, 54, and 55 show recent repairs near the north dike crest which have not yet established vegetation. Surface irregularities are also apparent on the upstream slope as shown in Photo 53.

2.3.2 Basin / Dead Storage Pond Complex Control Structure and Discharge Channel

There is no outlet from the Basin Pond or Dead Storage Pond. These ponds drain into the incised Clearwater Pond (Photo 56), where water is re-used for plant processes.

2.4 Monitoring Instrumentation

No instrumentation is in place on the impounding dikes for the ATB, Basin Pond, or Dead Storage Pond.



IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATED MARCH 2005.



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SITE PHOTO LOCATION MAP

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO.
20085.9000

DATE: 12/2009

FIGURE 7

1



Downstream slope of north dike of the Ash Treatment Basin (ATB) from west intersection with county flood control dike looking east.

2



Slight erosion rill from crest on ATB north dike looking east.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

3



Downstream slope of north dike at ATB looking east. Poor drainage results in standing water at the toe of this dike. E.ON U.S. is working with a consultant to regrade this area for better drainage.

4



Downstream slope of north dike at ATB looking east. Slight irregularity in slope grading difficult to distinguish as an "as constructed" condition or soil creep.



CHA Project No.: 20085.9000.1510

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CANE RUN POWER STATION
LOUISVILLE, KY**

October 28, 2009

5



East end of north dike at ATB looking east. Mower ruts, and toe erosion from stormwater were observed.

6



Close up of toe erosion on ATB north dike.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

7



Small rodent hole on ATB north dike.

8



East end of ATB north dike has been regarded and had sod placed to address drainage problems. E.ON U.S elected to place new sod rather than seed because of this year's excessive rain.



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LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

9



Upstream slope of ATB north dike looking east from outlet structure.

10



Upstream slope and crest of ATB north dike looking east.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

11



Upstream slope and crest of ATB north dike looking west.

12



Upstream slope and crest of ATB north dike looking east near east corner.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

13



Downstream slope of ATB east dike looking south. The area at the toe was raised 1 to 2 feet in summer 2009 and sod placed to prevent stormwater pooling in this area. White markers indicate the location of a high pressure gas line installed in 2005.

14



Downstream slope of ATB east dike looking south. White markers indicate the location of a high pressure gas line installed in 2005.



CHA Project No.: 20085.9000.1510

**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

October 28, 2009

15



Downstream slope of ATB east dike at southwest corner.
White markers indicate the location of a high pressure gas line installed in 2005.

16



Crest of ATB east dike looking south.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

17



Upstream slope of ATB east dike looking south.

18



Downstream slope of ATB south dike looking west. White markers indicate the location of a high pressure gas line installed in 2005. Drainage swale between dike and railroad tracks was cleaned out of sediment and debris in the summer of 2009.



CHA Project No.: 20085.9000.1510

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CANE RUN POWER STATION
LOUISVILLE, KY**

October 28, 2009

19



Downstream slope of ATB south dike looking west.

20



Drainage swale outlet along ATB south dike looking south.



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LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

21



Downstream slope of ATB south dike looking east. White marker indicates locations of gas line. Slight depression appears to be over the pipe alignment along the south dike.

22



Crest of ATB south dike looking west.



CHA Project No.: 20085.9000.1510

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LOUISVILLE, KY**

October 28, 2009

23



Upstream slope of ATB south dike looking west.

24



Crest of ATB south dike looking east.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

25



Stockpiled material for use at the landfill adjacent to ATB south dike looking west.

26



Downstream slope and crest of west end of ATB south dike where adjacent to the E-Pond, looking west.



**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

27



Downstream slope of west end of ATB south dike. Note tree at the toe is on the adjacent property looking west.

28



Downstream slope of west end of ATB south dike looking east. Note weedy vegetation and irregular grading.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

29



Erosion rills under concrete barriers at crest of south dike adjacent to the E-Pond.

30



South dike of ATB adjacent to the E- Pond is quite steep.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

31



E-Pond (left of people) is excavated within previously deposited ash. Original ATB south dike and ash create south side of the impoundment.

32



Stormwater flows from landfill (capped and uncapped) areas and discharges into E-Pond within the ATB.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

33



ATB discharge structure.

34



ATB discharge to NPDES permitted outfall. Pipes (beyond flap gates) discharges at Ohio River.

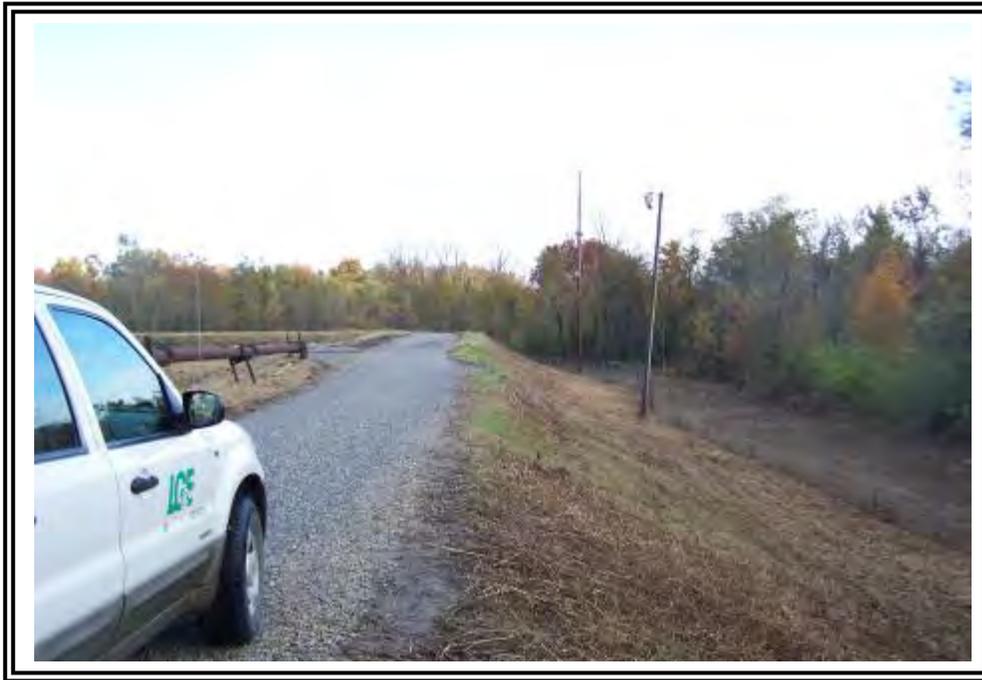


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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

35



Crest and downstream slope of east dike at Basin/ Dead Storage Pond looking north.

36



Downstream slope of east dike at Basin/ Dead Storage Pond at toe looking north.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

37



Looking towards south abutment at Basin/ Dead Storage Pond.

38



Downstream slope of east dike at Basin/ Dead Storage Pond looking south.
Note steepness of the embankment and irregularity of grading.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

39



Example of woody brush recently cut following E.ON U.S.'s consultant's independent inspection.

40



Example of cut, stump left in place following E.ON U.S.'s consultant's independent inspection.



**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

41



Erosion rill about 6 inches deep, 1.5 feet wide on east dike at Basin/ Dead Storage Pond.

42



Depressions and irregular grading at northeast corner of Basin/ Dead storage pond dike.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

43



Upstream slope of east dike at Basin/ Dead storage Pond looking north along south cell.

44



Upstream slope of east dike at Basin/ Dead Storage Pond looking north along north cell.



**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

45



Standing water on east dike at Basin/ Dead storage Pond looking south.

46



Downstream slope of north dike at Basin/ Dead Storage Pond looking west.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

47



Irregularity on north dike at Basin/ Dead Storage Pond.
Combination of surface slumps, erosion rills, etc. Probes soft to about 9" then firm.

48



Recent patchwork repair along crest of north dike at Basin/ Dead storage Pond.



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49



Repair area at north dike of Basin/ dead Storage Pond not yet reseeded.

50



Tire ruts in north dike of Basin/ Dead Storage Pond.



**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

51



Downstream slope of north dike at Basin/ Dead Storage Pond looking west.

52



Irregularity on north dike at Basin/ Dead Storage Pond.
Combination of surface slumps, erosion rills, etc. Probes soft to about 9" then firm.



**LOUISVILLE GAS & ELECTRIC
CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

53



Upstream slope of north dike at Basin/ Dead Storage Pond looking west.

54



Recent regarding along crest of north dike of Basin/ Dead Storage Pond to improve stormwater control.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

55



Crest of Basin/ Dead Storage Pond north dike looking east.

56



Clearwater Pond west of Basin/ Dead Storage Pond is incised.



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CANE RUN POWER STATION
LOUISVILLE, KY**

CHA Project No.: 20085.9000.1510

October 28, 2009

3.0 DATA EVALUATION

3.1 Design Assumptions

CHA has reviewed information related to the design and analysis of the stability and hydraulic adequacy of the ATB and Basin/Dead Storage Pond Complex which were available at the time of our site visits and provided to us by Louisville Gas & Electric and E.ON U.S. The design assumptions are listed with the applicable summary of analysis in the following sections.

3.2 Hydrologic and Hydraulic Design

The ATB dam at the Cane Run Power Station is classified as high hazard (Class C) suggesting that loss of life is probable in the event of a failure by Kentucky regulations. The Basin/Dead Storage Pond dams are classified as low hazard (Class A). This is based on the fact that a sudden breach or failure would cause loss of the structure itself but would result in little or no additional damage to other property.

Kentucky regulations (as found in as found in DNR&EP Engineering Memorandum 5 pertaining to KRS 151.250) require low hazard impoundments without emergency spillways to safely store or pass the 100-year, 6-hour storm (P100) and require high hazard impoundments without emergency spillways to safely store or pass the Probable Maximum Precipitation (PMP). The Kentucky guidelines suggest that the principal spillway have the capacity to drain the stored volume of storm flows in 10 days or less. This requirement is considered to be met if 80 percent of the maximum storm storage is drained within 10 days.

Stantec provided E.ON U.S. with information on a hydrologic and hydraulic analysis for the ATB in an e-mail message dated October 21, 2009. Their analysis was based upon the following assumptions:

- Normal pool at El. 454.5 based on the spillway elevation.
- Normal inflow of 6,000 gallons per minute (gpm) from sluicing.
- Peak additional inflow of 378.72 cfs (170,000 gpm) during a 100-year, 24-hour event.
- Peak additional inflow of 456.10 cfs (204,700 gpm) during a 500-year, 24-hour event.

The analysis indicated that the water level in the ATB would rise to El. 455.82 following the 100 year, 24 hour event and El. 456.10 following the 500-year, 24-hour event. Both of these water levels are below the top of the ATB at El. 460.0.

Stantec did not provide information regarding the drainage area used to compute these storm water flows, or information correlating the 500-year, 24-hour event with the PMP.

3.3 Structural Adequacy & Stability

The Kentucky regulations and guidelines for dam safety do not provide specific factors of safety for slope stability. Therefore, CHA recommends following industry guidelines such as those found in the US Army Corps of Engineers Engineering Manual (EM) 1110-2-1902. Table 5 below summarizes the guidance values for minimum factors of safety for earthen embankment dams.

Table 2 - Minimum Safety Factors Recommended by US Army Corps of Engineers

Load Case	Required Minimum Factor of Safety
Steady State Seepage at Normal Pool	1.5
Maximum Surcharge Pool (Flood) Condition	1.4
Rapid Drawdown Condition	1.3
Seismic Conditions from Present Pool Elevation	1.0

Louisville, Kentucky falls into Seismic Zone 1, which for deterministic based evaluation of seismic acceleration results in a typical acceleration value of 0.05g for seismic analysis.

In Sections 3.3.1 and 3.3.2 we discuss our review of stability analyses for the former Ash Pond and the ATB, respectively.

3.3.1 Stability Analyses of Former Ash Pond

CHA reviewed the stability analyses performed by ATEC Associates in 1976 for the Ash Pond located west of the flood control levees and east of the Ohio River. This area is currently utilized as the CCW Landfill.

At the time of ATEC’s analysis, sand fill was being stockpiled on the west side of the ash waste area. The intent of the stability analyses was to assess the influence of the sand stockpile on the stability of the river side embankment at two cross sections. E.ON U.S. provided this analysis to CHA in the absence of a stability analysis specific to the current ATB.

Four borings were advanced, two at each cross section, to determine the subsurface conditions. The cross sections are shown on Figure 8. The west dike sloped at approximately 3H:1V. The soil properties used for these analyses were not provided in the report. However, the report indicated that drained strength parameters were used in the clayey soil strata. Groundwater was observed in the sand below the fill at approximately El. 395. ATEC assumed that the wet samples within the ash were the result of localized zones of water. The computed factors of safety for the downstream side of the west dike are summarized in Table 6.

Table 3 – Summary of Safety Factors for Former Ash Pond

Load Case	Required Minimum Factor of Safety	Calculated Minimum Factor of Safety
Steady State Condition	1.5	2.04
Rapid Drawdown	1.3	Not performed
Seismic (ground motion of 0.05g)	1.0	1.75

3.3.2 Stability Analysis of Existing Ponds

CHA has not been provided with an engineering assessment for the stability of the existing dikes around the ATB or Basin/Dead Storage Pond Complexes. Based upon our review of the regional geology map as shown in Figure 6, the ATB and Basin/Dead Storage Ponds are located within the glacial outwash deposits whereas the former ash pond was underlain by more recent alluvial deposits. Although slope heights and geometries were similar to those discussed in Section 3.3.1, because the subsurface data provided was for a different geologic stratum, CHA did not have enough data to use as the basis for a preliminary stability assessment.

3.4 Foundation Conditions

3.4.1 Geotechnical Reports

A TEC Associates advanced 4 borings in 1976 as part of their subsurface exploration and stability assessment of the former ash pond which is located within the footprint of the existing CCW Landfill. Cross sections from this exploration program are included on Figure 8. The borings were advanced through the embankment or ash fill and extended into the underlying natural clay and sandy silty. These natural soils are consistent with the anticipated conditions based upon the regional geology maps as described in Section 1.5.

We understand that geotechnical explorations have not been advanced within the existing ATB, Basin Pond, or Dead Storage Pond for embankment design or since construction.

3.4.2 Record Drawings

The 1972 design drawing for the ATB does not provide information regarding subgrade preparation, embankment fill gradation, or embankment fill compaction criteria. CHA has not received drawings related to the Basin Pond or Dead Storage Pond.

3.4.3 Documentation of Foundation Preparations

CHA has not been provided with files related to construction of the ATB, Basin Pond, or Dead Storage Pond that may provide information relative to foundation preparations during construction.

3.5 Operations & Maintenance

CHA has not been provided with a copy of an Operation, Maintenance, and Inspection (OM&I) Manual or Emergency Action Plan (EAP) for the Cane Run Power Station. Based upon conversations during our site visit, we understand that staff perform security type observations twice per shift (i.e., 6 times each day) of the ATB and Basin/Dead Storage Ponds. The production support leader typically makes observations 1 to 3 times a week.

3.6 Inspections

3.6.1 State Inspections

Kentucky Revised Statutes Chapter 151 (KRS 151) and associated regulations establishes minimum maintenance and design criteria for dams.

Kentucky DEP performs dam safety inspections of the ATB every 2 years based on its high hazard rating. Representatives of the Natural Resources and Environmental Protection Cabinet, Division of Water inspected the dike on October 16, 2008. The following required remedial measures were identified:

- Reseed the downstream slope
- Repair erosion areas.

3.6.2 Inspections by Engineering Consultants

E.ON U.S. hired a consultant to perform a visual inspection of the ATB in February 2009. The findings and recommendations outlined in the visual inspections report included:

- Conduct another visual inspection of each facility during the growing season in 2009. Field work was performed in January and the ground was frozen in some cases was covered with snow.
- Prepare or update an Operations and Maintenance Manual for each facility.
- Prepare and Emergency Action Plan for each structure.
- Prepare or update topographical mapping of the facility.
- Institute and document regular structure inspections. These inspections will allow changes in the facility to be observed in a timely fashion and allow preventative measures to be taken during regular maintenance rather than on an emergency basis.
- The Dam Safety Regulations require that specific records be maintained for each facility. These include design drawings, as-built plans, subsurface exploration records, stability analyses of the dams and embankments as well as hydraulic and hydrologic design calculations. It was recommended that these records be maintained both at each Power Station as well as a central location such as a corporate office.

We understand that the consultant performed a follow-up visual inspection of the ATB and Basin/Dead Storage Pond on November 10, 2009 and that the report will be issued in the first quarter of 2010.

3.6.3 Inspection by Owner Representatives

Based on e-mail correspondence with Mr. David Millay of E.ON U.S. following CHA's site visit, we understand that members of the E.ON U.S engineering staff conducted a visual site assessment of the Basin Pond, Dead Storage Ponds, Emergency Pond and Clearwater Pond on

March 17, 2009. An Action Items list was prepared for each pond and the action items are summarized below. These items were considered to be 'Normal Priority', meaning it was recommended that these action items be addressed as part of the ongoing maintenance of the structures.

- Basin Pond
 - Upstream Slope - Evaluate need to repair inner bank erosion;
 - Downstream Slope - Cut/mow vegetation; and
 - Downstream Slope - Monitor outer bank erosion gullies.

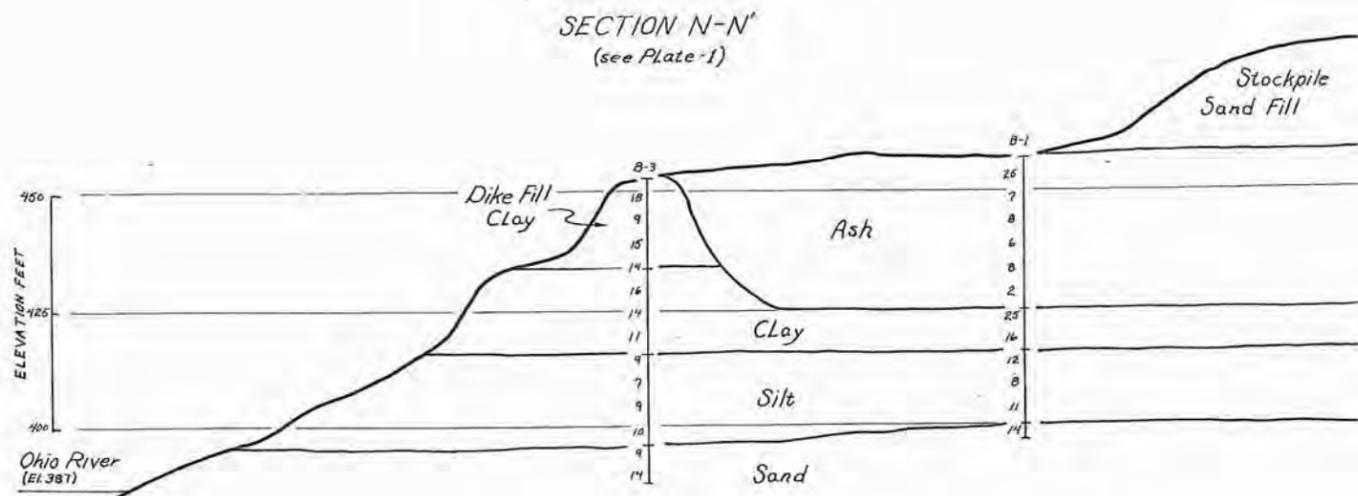
- Dead Storage Pond
 - Crest - Evaluate need to establish stable road bed around perimeter of pond to improve access;
 - Upstream Slope - Evaluate need to repair inner bank erosion;
 - Upstream Slope - Relocate hoses to prevent bank erosion;
 - Upstream & Downstream Slopes - Cut/mow vegetation; and
 - Downstream Slope - Monitor outer bank erosion gullies.

- Emergency Pond
 - Downstream Slope - Cut/mow vegetation;
 - Upstream Slope - Evaluate need to repair inner bank erosion; and
 - Upstream Slope - Evaluate need to repair embankment at SPP discharge piping.

- Clearwater Pond
 - Upstream Slope - Evaluate need to repair bank erosion;
 - Crest - Remove vegetation from inner crest; and
 - Upstream & Downstream Slopes - Cut/mow vegetation

Review of the items and comparison of E.ON U.S.'s photos from their March 19, 2009 site visit and the conditions observed on October 28, 2009, it is apparent that corrective actions have been undertaken at each of the ponds to address the noted deficiencies.

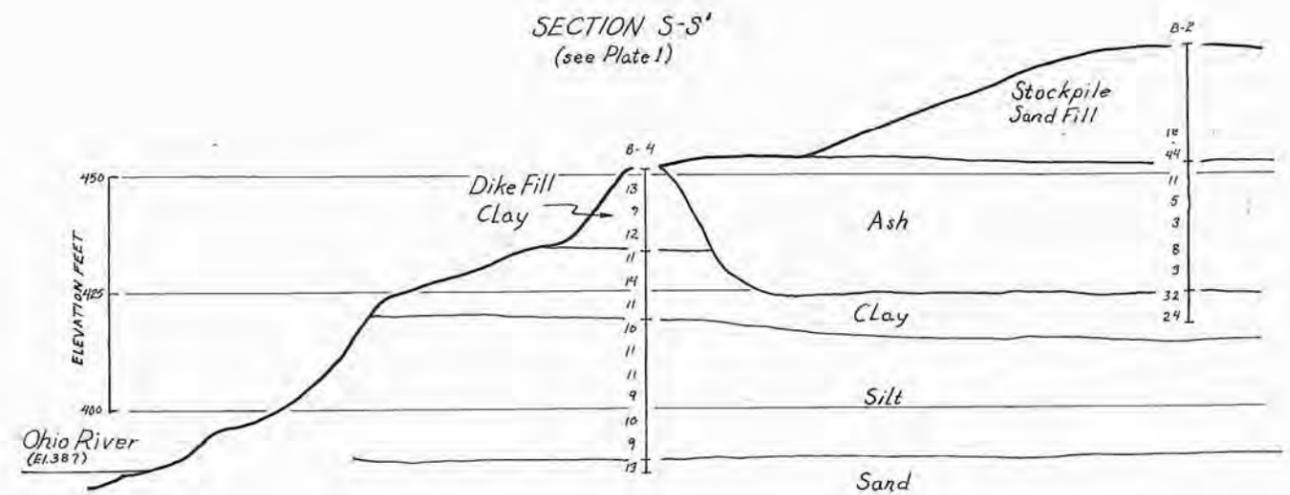
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HORIZONTAL SCALE 1"=40'

GENERALIZED SOIL PROFILE
SECTION N-N'
OLD ASH POND
CANE RUN GENERATING STATION

PLATE 2

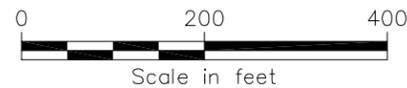


HORIZONTAL SCALE 1"=40'

GENERALIZED SOIL PROFILE
SECTION S-S'
OLD ASH POND
CANE RUN GENERATING STATION

PLATE 3

IMAGE REFERENCE: FULLER, MOSSBARGER, SCOTT & MAY ENGINEERS INC., ASH POND PLANNING STUDY, APRIL 2008, ASH POND HYDROGRAPHIC SURVEY PLAN, SHEET 1 OF 2.



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CROSS SECTION OF FORMER ASH POND

CANE RUN POWER STATION
LOUISVILLE, KENTUCKY

PROJECT NO.
20085.9000

DATE: 12/2009

FIGURE 8

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management units referenced herein were personally inspected by me and was found to be in the following condition: **Poor**. The EPA has defined a poor condition rating when “management unit safety deficiency is recognized for any required loading condition in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify and potential dam safety deficiencies.

CHA’s assessment of the ATB and Basin/Dead Storage Pond dikes indicate that they are in poor condition based on the following observations:

- Slope stability concerns on the Basin/Dead Storage dikes;
- Slope stability concern of the southwest portion of the ATB dike adjacent to the E. Pond;
- Absence of subsurface information and engineering stability analysis.

CHA presents the following recommendations for maintenance and updating of analyses for more complete record keeping.

4.2 ATB General Condition Monitoring and Maintenance

Visually, a majority of the ATB dikes were found to be in satisfactory condition. A few areas were observed that warrant monitoring on a routine basis to confirm that changes are not occurring. These areas are as follows:

- Regrade and/or stabilize the south dike section adjacent to the E-Pond.

-
- Fill the shallow erosion rills and rodent borrows on the downstream slope along the north side of the dike, and monitor for the development of similar features.
 - Monitor the irregularity in the north downstream slope grading to assess if the irregularity is the result of an overfill repair or signs of slope creep.
 - Tire ruts from mowing operations should be monitored to ensure they are not worsening or resulting in localized surficial sloughing or erosion. Periodic maintenance may be warranted.
 - Continue efforts to improve drainage at the bottom of the downstream slope of the north dike.
 - The 1972 construction drawing indicates that the twin 24-inch-diameter drainage pipes extend below the ATB dike at the eastern corner. We recommend that the condition of these pipes below the dike be assessed and the pipe outlet be located.

4.3 Basin/Dead Storage Ponds

Visually the upstream and downstream slopes of the Basin / Dead Storage Ponds were found to be in poor condition. As discussed in Section 3.6, E.ON U.S. has undertaken remedial measures at these ponds following their March 19, 2009 inspection. The following areas were observed that warrant additional corrective measures and monitoring on a routine basis to confirm that changes are not occurring or periodic maintenance. These areas are as follows:

- Establish routine mowing to promote growth of grass ground cover.
- Stump where woody brush and trees were cut monitored for decay. If depressions develop from stump decay, remove and backfilled with compacted fill under the supervision of a Professional Engineer.
- Fill the shallow erosion rills on the upstream and downstream slopes along the east dike.
- Monitor the irregularity in the grading on the downstream side of the east and north dikes to assess if the irregularity is the result of slope creep. Irregularities include surface slumps, erosion rills and tire ruts.

-
- Improve grading along crest road surface to prevent water ponding.

4.4 Engineering Analysis

E.ON U.S., now the parent company of LG&E, could not provide CHA with engineering analyses for the ATB. We recommend for the ATB and Basin/Dead Storage Ponds dikes that:

- Slope stability analyses be performed include the following cases: steady state seepage at normal pool, maximum surcharge pool (flood) condition, rapid drawdown condition, and seismic conditions from present pool elevation, including static and seismic conditions where stockpiled soil has been placed adjacent to the dike crest on the ATB.
- Piezometers be installed to establish and monitor pheratic surface within the dikes.
- Additional information is required to clarify the Stantec hydrologic and hydraulic analysis for the ATB regarding their analysis parameters and how they relate to the Kentucky regulations.
- Provide hydrologic and hydraulic analysis for the Basin/Dead Storage Ponds.

5.0 CLOSING

The information presented in this report is based on visual field observations, review of reports by others and this limited knowledge of the history of the Cane Run Power Station surface impoundments. The recommendations presented are based, in part, on project information available at the time of this report. No other warranty, expressed or implied is made. Should additional information or changes in field conditions occur the conclusions and recommendations provided in this report should be re-evaluated by an experienced engineer.

APPENDIX A

Completed EPA Coal Combustion Dam Inspection Checklist Forms

&

Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Forms



*Draft Report
Assessment of Dam Safety of
Coal Combustion Surface Impoundments
E-On/Louisville Gas & Light
Cane Run Power Station
Louisville, Kentucky*



Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # _____ INSPECTOR _____
Date _____

Impoundment Name _____
Impoundment Company _____
EPA Region _____
State Agency (Field Office) Address _____

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

New _____ Update _____

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

IMPOUNDMENT FUNCTION: _____

Nearest Downstream Town : Name _____

Distance from the impoundment _____

Impoundment

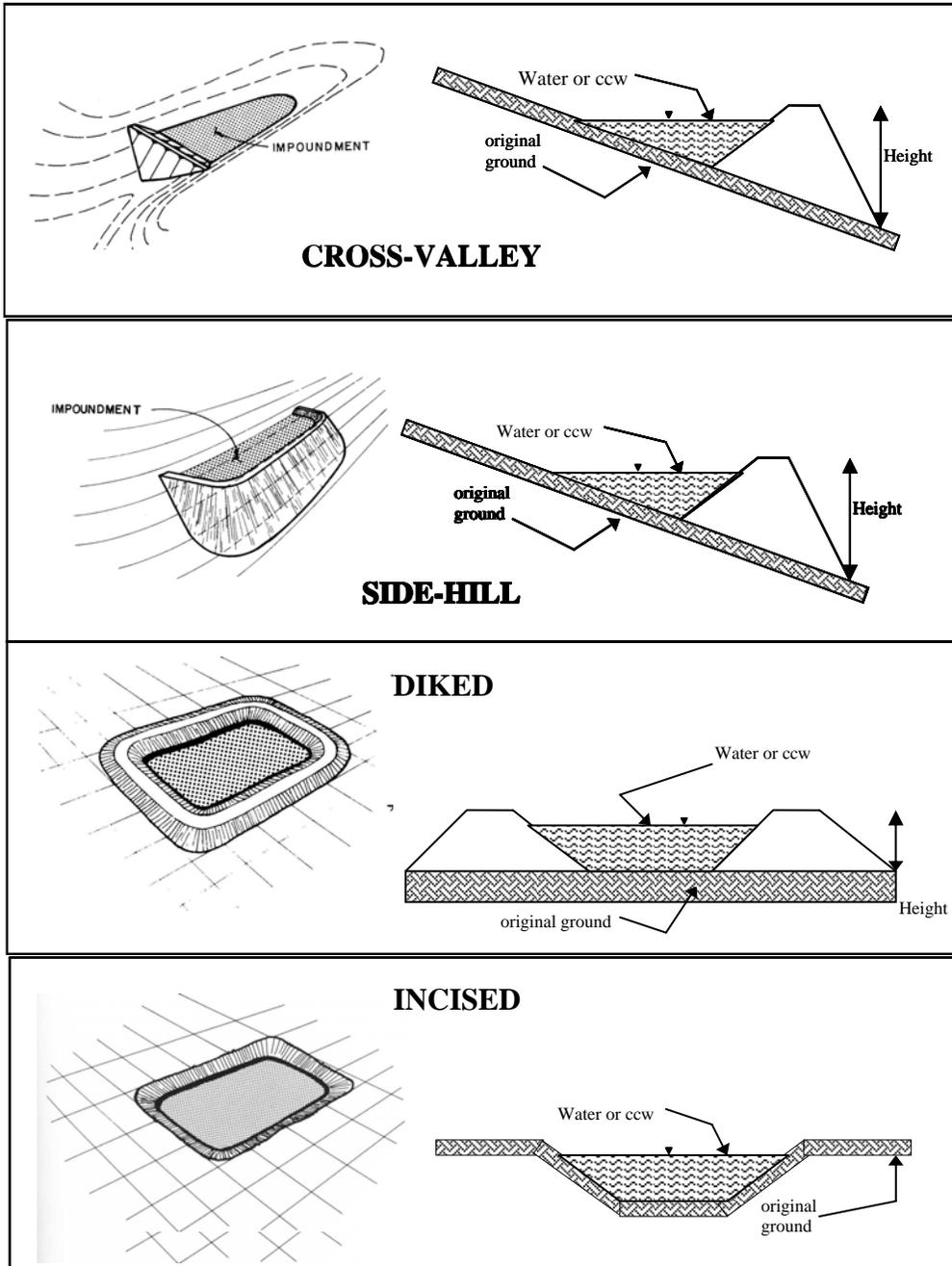
Location: Longitude _____ Degrees _____ Minutes _____ Seconds
Latitude _____ Degrees _____ Minutes _____ Seconds
State _____ County _____

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

If So Which State Agency? _____

US EPA ARCHIVE DOCUMENT

CONFIGURATION:



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

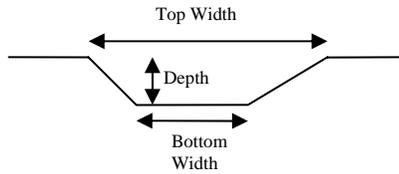
Embankment Height _____ feet Embankment Material _____
 Pool Area _____ acres Liner _____
 Current Freeboard _____ feet Liner Permeability _____

TYPE OF OUTLET (Mark all that apply)

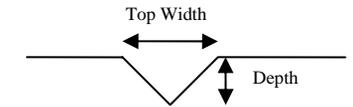
 Open Channel Spillway

- Trapezoidal
- Triangular
- Rectangular
- Irregular

TRAPEZOIDAL

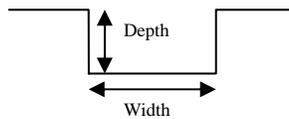


TRIANGULAR

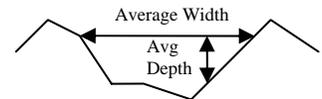


- depth
- bottom (or average) width
- top width

RECTANGULAR



IRREGULAR

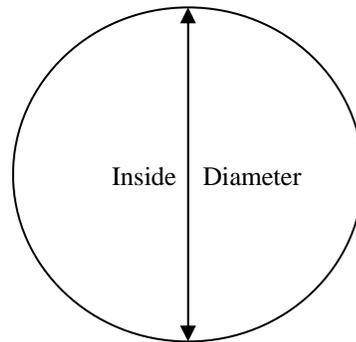


 Outlet

- inside diameter

Material

- corrugated metal
- welded steel
- concrete
- plastic (hdpe, pvc, etc.)
- other (specify) _____



Is water flowing through the outlet? YES _____ NO _____

 No Outlet

 Other Type of Outlet (specify) _____

The Impoundment was Designed By _____



Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # KY0002062
Date October 28, 2009

INSPECTOR Adnams/Stellato

Impoundment Name Basin Pond/Dead Storage Pond

Impoundment Company Louisville Gas & Electric

EPA Region 3

State Agency (Field Office) Address 9116 Leesgate Road
Louisville, KY 40222-5084

Name of Impoundment Basin Pond/Dead Storage Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New Update X

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

IMPOUNDMENT FUNCTION: Process water drainage from the plant, and runoff from the FGD/fly ash mixing area. FGD/fly ash is landfilled.

Nearest Downstream Town : Name Shively, KY

Distance from the impoundment Plant within community.

Impoundment

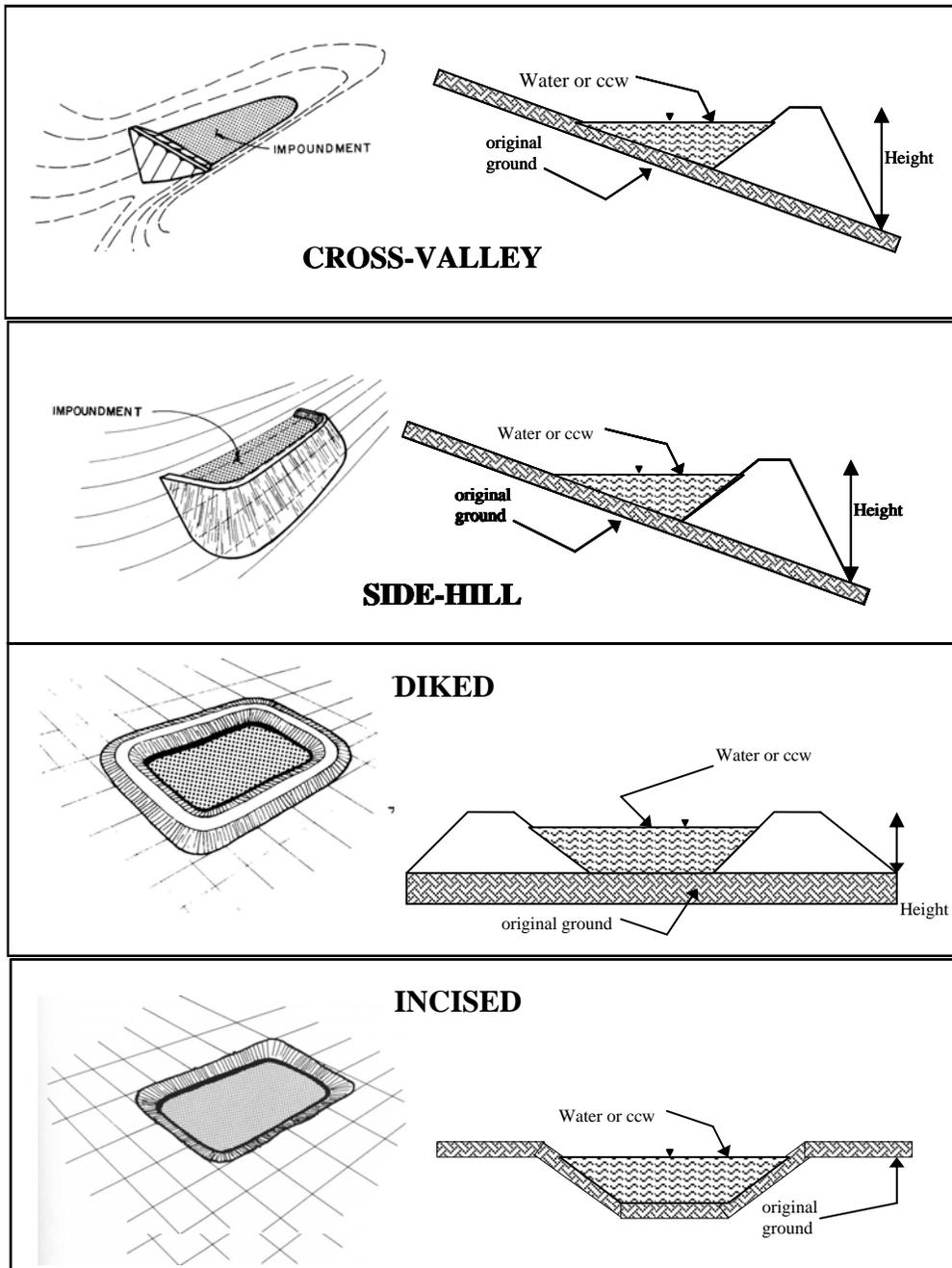
Location: Longitude 85 Degrees 53 Minutes 05 Seconds
Latitude 38 Degrees 10 Minutes 59 Seconds
State KY County Jefferson

Does a state agency regulate this impoundment? YES X NO

If So Which State Agency? KY Department of Environmental Protection - Dam Safety

US EPA ARCHIVE DOCUMENT

CONFIGURATION:



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

Embankment Height 10 feet Embankment Material Homogeneous compacted fill
 Pool Area 5 acres Liner None
 Current Freeboard ~5 to 7 feet Liner Permeability Not Applicable

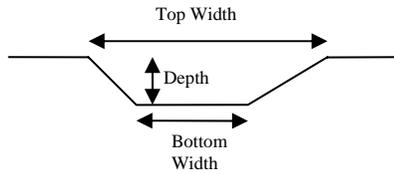
TYPE OF OUTLET (Mark all that apply)

 Open Channel Spillway

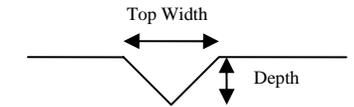
- Trapezoidal
- Triangular
- Rectangular
- Irregular

- depth
- bottom (or average) width
- top width

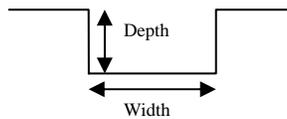
TRAPEZOIDAL



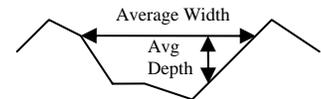
TRIANGULAR



RECTANGULAR



IRREGULAR

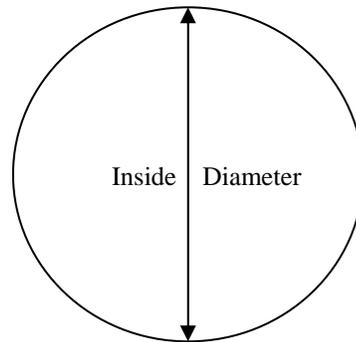


 Outlet

- inside diameter

Material

- corrugated metal
- welded steel
- concrete
- plastic (hdpe, pvc, etc.)
- other (specify) _____



Is water flowing through the outlet? YES _____ NO _____

 X **No Outlet** Water levels are controlled through pump system for plant process reuse.

 Other Type of Outlet (specify) _____

The Impoundment was Designed By LG&E Internal Engineers

