AECOM

Initial Inflow Design Flood Control System Plan

Bottom Ash Impoundment

La Cygne Generating Station

Kansas City Power & Light Company

October 13, 2016

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Appendices

1 Introduction

1.1 Purpose

The purpose of this Initial Inflow Design Flood Control System Plan is to document that the requirements specified in 40 CFR §257.82 of the Coal Combusting Residual (CCR) Rule[1] have been met for the Bottom Ash Impoundment at Kansas City Power & Light Company's (KCP&L) La Cygne Generating Station. The Bottom Ash Impoundment is an existing CCR surface impoundment as defined by 40 CFR §257.53.

1.2 Regulatory Requirements

In accordance with the CCR Rule, this plan documents how the inflow design flood control system has been designed and constructed to meet the requirements of 40 CFR §257.82 referenced below and is supported by appropriate engineering calculations. This Initial Inflow Design Flood Control System Plan shall be completed no later than October 17, 2016. Periodic inflow design flood control system plans shall be prepared every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. This plan shall be amended whenever there is a change in conditions that would substantially affect the written plan in effect.

Regulatory Citation: 40 CFR §257.82 (a); Design, construct, operate, and maintain an inflow design flood control system as specified:

- *(1) Inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (3);*
- *(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (3);*
- *(3) The inflow design flood is: (i) For a high hazard potential CCR surface impoundment, the probable maximum flood; (ii) For a significant hazard potential CCR surface impoundment, the 1,000-year flood; (iii) For a low hazard potential CCR surface impoundment, the 100-year flood; or (iv) For an incised CCR surface impoundment, the 25-year flood.*

Regulatory Citation: 40 CFR §257.82 (b); Discharge from the CCR unit must be handled in accordance with the surface water requirements under: §257.3 – 3.

1.3 Brief Description of Impoundment

The La Cygne Generating Station is a coal-fired power plant located near La Cygne in Linn County, Kansas. The Station is located approximately 6.25 miles east of the City of La Cygne and is bordered to the west and north by La Cygnes Lake. The Bottom Ash Impoundment is located on plant property. A Location Map showing the area surrounding the station is in **Figure 1** of **Appendix A**.

1.3.1 Design and Construction

The impoundment was commissioned in approximately 1973. The Bottom Ash Impoundment was constructed approximately 12 feet above the level of La Cygnes Lake with a series of internal berms to enable solids separation and CCR removal. The unit is operated in two areas, the northwest and southeast, separated by a roadway berm and hydraulically connected by a series of culverts. The northwest portion has a minimum top elevation of 850.8, while the southeast portion has a minimum top elevation of 852.0. The unit as a whole has a surface water area of approximately 1.5 acres at the normal operating level of 848.2 feet[4].

1.3.2 Inflow from Plant Operations and Stormwater Runoff

Influent to the Bottom Ash Impoundment consists of stormwater runoff and sluiced CCR. The watershed is limited to a small area of upstream plant facilities, access roads and the active impoundment. CCR is currently sluiced into the southeast portion of the Bottom Ash Impoundment from Unit 2 for initial particle settling at an approximate rate of 1 million gallons per day (MGD) or 1.55 cubic feet per second (cfs). Water flows from the smaller southeast portion of the Bottom Ash Impoundment into the northwest portion through two 18- inch diameter steel pipes. An excavator removes the ash to the top of the slopes to allow water to drain. After dewatering is complete, material is loaded and transported for beneficial use or disposal. Excess water is discharged via a permitted outfall. Therefore, the storage capacity of the impoundment does not change significantly from year to year.

1.3.3 Outlet Structures

Water discharges from the northwest portion of the Bottom Ash Impoundment through five 12-inch diameter steel pipes and one 30-inch diameter high density polyethylene (HDPE) pipe located at the east side of the impoundment. Water flows through the outlet pipes which daylight on the exterior slope, then through the permitted NDPES outfall into the discharge canal.

1.4 Plan Approach

Analyses and calculations completed for the hydrologic and hydraulic assessments of the Bottom Ash Impoundment[2] are described in this plan. Data and analyses results are based on information shown on design drawings, topographic surveys, information about operational and maintenance procedures provided by KCP&L, and limited field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses are presented in the following sections. The results of this analysis will be used to confirm that the Bottom Ash Impoundment meets the hydrologic and hydraulic capacity requirements of the rules referenced above for CCR surface impoundments. **Table 1-1** cross references the Plan sections to the applicable CCR Rule requirements.

Table 1-1 – CCR Rule Cross Reference Table

Plan Section	Title	CCR Rule Reference
4.1	Inflow Analysis	§257.82 (a)(1)
4.2	Outflow Analysis	§257.82 (a)(2)
4.3	Inflow Design Flood	§257.82 (a)(3)
4.4	Discharge handled in accordance with *§257.3 – 3*	§257.82 (b)

2 Hydrologic Analysis

2.1 Design Storm

The inflow design flood for the La Cygne Bottom Ash Impoundment is the 25-year return frequency design storm event since the impoundment is incised.

2.2 Rainfall Data

The rainfall information used in the analysis was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2[3] which provides rainfall data for storm events with average recurrence intervals ranging from 1 to 1,000 years and durations ranging from 5 minutes to 60 days. The design storm rainfall depth, obtained from the NOAA website, is 6.6 inches for the 24-hour, 25-year storm. The Soil Conservation Service (SCS) Type II rainfall distribution used by AECOM is appropriate to use for storms up to the 1,000-year flood at the project site.

2.3 Runoff Computations

The watershed areas for the Bottom Ash Impoundment were determined using a computer-aided design (CAD) analysis of the 2001 Topographic Survey by MJ Harden Associates, Inc. (MJ Harden) dated 2001[4] and aerial photography. The total watershed area to the impoundment is approximately 3.4 acres. See **Figure 2** in **Appendix A** for the Watershed Area Map.

Runoff was calculated using the SCS Curve Number Method, where curve numbers (CN) were assigned to each sub-catchment based on the type of land cover and soil type present. Using the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey[5], the soil type of the site was determined to be hydrologic soil group D. CN values for the land cover were selected from the CN Table available in HydroCAD. This data was obtained from the SCS NRCS Technical Release-55 publication[6]. Industrial areas and Water Surface land covers that are located on site were determined to have a CN value of 93 and 98, respectively. A composite CN was calculated for each sub-catchment area by summing the products of each CN multiplied by its percentage of the total area. Calculations for the weighted runoff curve numbers for each sub-watershed were performed in HydroCAD.

The time of concentration is commonly defined as the time required for runoff to travel from the most hydrologically distant point to the point of collection. Calculations for the time of concentration for each sub-watershed were performed in HydroCAD.

Stormwater runoff from the 25-year event into the southeast portion of the Bottom Ash Impoundment has a peak runoff inflow of 5.6 cfs and a runoff inflow volume is 0.3 acre-feet, while the northwest portion of the Bottom Ash Impoundment has a peak runoff inflow of 26.1 cfs and a runoff inflow volume of 1.4 acre-feet.

3 Hydraulic Analyses

3.1 Process Flows

CCR is currently sluiced from the plant into the southeast portion of the impoundment at a rate of 1 MGD or 1.55 cfs (3.1 acre-feet per day). These plant flows were added as constant inflow into the impoundment during and after the IDF. Due to the process flow into the impoundment from the plant, there is typically a discharge through the outlet structure when the unit is online.

3.2 Storage Capacity

The storage volumes for the Bottom Ash Impoundment were determined using a CAD analysis of the 2001 Topographic Survey by MJ Harden[4]. The calculated volume of the southeast portion of the Bottom Ash Impoundment is approximately 1.3 acre-feet of available storage measured from the normal operating pool elevation of 848.2 feet to the zero freeboard elevation of 852.0 feet. The calculated volume of the northwest portion of the Bottom Ash Impoundment is approximately 4.6 acre-feet of available storage measured from the normal operating pool elevation of 846.9 feet to the zero freeboard elevation of 850.8 feet.

3.3 Discharge Analysis

A hydraulic model was created in HydroCAD 10.00 to assess the capacity of the impoundments to store and convey the stormwater flows. HydroCAD has the capability to evaluate each impoundment within the network, to respond to variable tailwater, pumping rates, and reversing flows. HydroCAD routing calculations reevaluate the impoundment's discharge capability at each time increment, making the program an efficient and dynamic tool for this evaluation.

The analyzed scenario assumes the starting water surface elevation of the southeast portion of the Bottom Ash Impoundment is 848.2 feet, while the northwest portion of the Bottom Ash Impoundment is 846.9 feet. The invert elevation of the northwest portion of the Bottom Ash Impoundment was estimated to be elevation 846.7 based on limited available records. At these initial water surface and outlet pipe elevations, 1.55 cfs discharges through the outlet pipes achieving balanced water flow at the site. The process flows from the plant and the stormwater runoff from the 25-year event are combined to produce the total inflow into the Bottom Ash Impoundment. This total inflow is treated in the impoundment before being discharged through the outlet pipes into the hot water discharge canal under the NPDES Permit.

4 Results

The hydrologic and hydraulic conditions of the Bottom Ash Impoundment were modeled with the peak discharge of the 25-year storm event and the current process flow from the plant.

4.1 Inflow Analysis – §257.82 (a)(1)

Adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood

Background and Assessment

The rainfall runoff from the upstream watershed is added to the process flow from the plant to produce the total inflow to the Bottom Ash Impoundment. Using the HydroCAD model, the total inflow was stored and routed through the outlet pipes of the Bottom Ash Impoundment to determine the peak water surface elevations.

Table 4-1 summarizes the water surface elevations of the Bottom Ash Impoundment prior to and after the inflow design flood.

Table 4-1 - Summary of Hydrologic and Hydraulic Analysis
25-Year, 24-Hour Storm

CCR Unit	Beginning WSE*' (feet)	Peak WSE (feet)	Min. Crest Elevation[4] (feet)	Freeboard Above Peak WSE (feet)
Bottom Ash Impoundment (SE)	848.2	848.5	852.0	3.5
Bottom Ash Impoundment (NW)	846.9	847.4	850.8	3.4

Notes:
* WSE = Water Surface Elevation

Conclusion and Recommendation

As there is adequate storage within the Bottom Ash Impoundment to manage the inflow design flood as well as the process flow from the plant, there is no anticipated overtopping, which meets the requirements in §257.82 (a)(1).

4.2 Outflow Analysis – §257.82 (a)(2)

Adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

Background and Assessment

The rainfall runoff from the upstream watershed is added to the process flow from the plant to produce the total inflow to the Bottom Ash Impoundment. Using the HydroCAD model, the total inflow was stored and routed through the outlet pipes of the Bottom Ash Impoundment to determine the peak water surface elevations.

Table 4-2 summarizes the peak flowrates and velocities through each of the outlet devices.

Table 4-2 - Summary of Outlet Pipes
25-Year, 24-Hour Storm

Outlet Device	Type and Size	Invert Elevation (feet)	Peak Flowrate (cfs)	Velocity at Peak Flowrate (fps)
Outlet Pipe(s)	5-12-inch dia. Steel	846.7	1.7 (each pipe)	2.9 (each pipe)
Outlet Pipe	30-inch dia. HDPE	846.7	3.3	2.9

Conclusion and Recommendation

As the Bottom Ash Impoundment outlet pipes manage the discharge of the inflow design flood and the process flow from the plant without the peak water surface elevation overtopping, the impoundment meets the requirements in §257.82 (a)(2).

4.3 Inflow Design Flood – §257.82 (a)(3)

Required Inflow design flood for Incised Surface Impoundments.

Background and Assessment

The calculations for the inflow design flood are based on the requirements for an incised impoundment.

Conclusion and Recommendation

Since the impoundment is incised, the 25 year design storm was utilized in the analysis, which meets the requirements in §257.82 (a)(3).

4.4 Discharge – §257.82 (b)

Discharge from the CCR unit handled in accordance with the surface water requirements under: §257.3 – 3.

Background and Assessment

The discharge from the Bottom Ash Impoundment outlet pipes enters the discharge channel that leads to La Cygnes Lake. The discharge must meet the requirements of the NDPES under section 402 of the Clean Water Act to meet the CCR rule.

Conclusion and Recommendation

Runoff discharges from the impoundment through a permitted NPDES outfall. As per the current NPDES permit, all discharged water is tested for pollutants and the discharge meets the minimum regulatory requirements of the permit. Therefore, the facility does not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under section 402 of the Clean Water Act, and thereby meets the requirements in §257.82 (b).

5 Conclusions

The inflow design flood control system of the Bottom Ash Impoundment adequately manages flow into the CCR unit during and following the peak discharge of the 25-year, 24-hour frequency storm event inflow design flood. The inflow design flood control system of the Bottom Ash Impoundment adequately manages flow from the CCR unit to collect and control the peak discharge resulting from the 25-year, 24-hour frequency storm event inflow design flood. Discharge from the Bottom Ash Impoundment is handled in accordance with the surface water requirements of §257.3 – 3 during the 25-year, 24-hour flood event. Therefore, the Bottom Ash Impoundment meets the requirements for certification.

The contents of this plan, specifically **Sections 1** through **5**, represent the Initial Inflow Design Flood Control System Plan for this unit.

6 Limitations

Background information, design basis, and other data have been furnished to AECOM by KCP&L, which AECOM has used in preparing this plan. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this plan are intended only for the purpose, site location, and project indicated. The recommendations presented in this plan should not be used for other projects or purposes. Conclusions or recommendations made from this data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by KCP&L. Changes in any of these operations or procedures may invalidate the findings in this plan until AECOM has had the opportunity to review the findings, and revise the plan if necessary.

This hydrologic and hydraulic analysis was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the hydrologic and hydraulic engineering profession. The conclusions presented in this plan are professional opinions based on the indicated project criteria and data available at the time this plan was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

7 Certification Statement

CCR Unit: KCP&L; La Cygne Generating Station; Bottom Ash Impoundment

I, Brian D. Linnan, being a Registered Professional Engineer in good standing in the State of Kansas, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the Initial Inflow Design Flood Control System Plan dated October 13, 2016, which includes all pages in Sections 1 through 5, meets the requirements of 40 CFR § 257.82.

_________Brian D. Linnan_________
Printed Name

_________October 13, 2016_________
Date

AECOM
2380 McGee Street, Suite 200
Kansas City, Missouri 64108
1-816-561-4443

8 References

1. U.S. Environmental Protection Agency, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, 40 CFR §257, Federal Register 80, Subpart D, April 17, 2015.

2. AECOM, Hydrologic and Hydraulic Support Calculations, Initial Inflow Design Flood Control System Plan, Bottom Ash Impoundment, La Cygne Generating Station, Kansas City Power & Light Company, dated October 13, 2016.

3. National Oceanic and Atmospheric Administration, NOAA Atlas 14 Point Precipitation Frequency Estimates, Volume 8, Version 2, http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=il, dated 2016.

4. MJ Harden Associates, Inc., Topographic Survey Plans for the La Cygne Generating Station, dated 2001.

5. USDA Natural Resources Conservation Service, Web Soil Survey, http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, dated 2016.

6. USDA Natural Resources Conservation Service, Technical Release 55, dated June 1986.

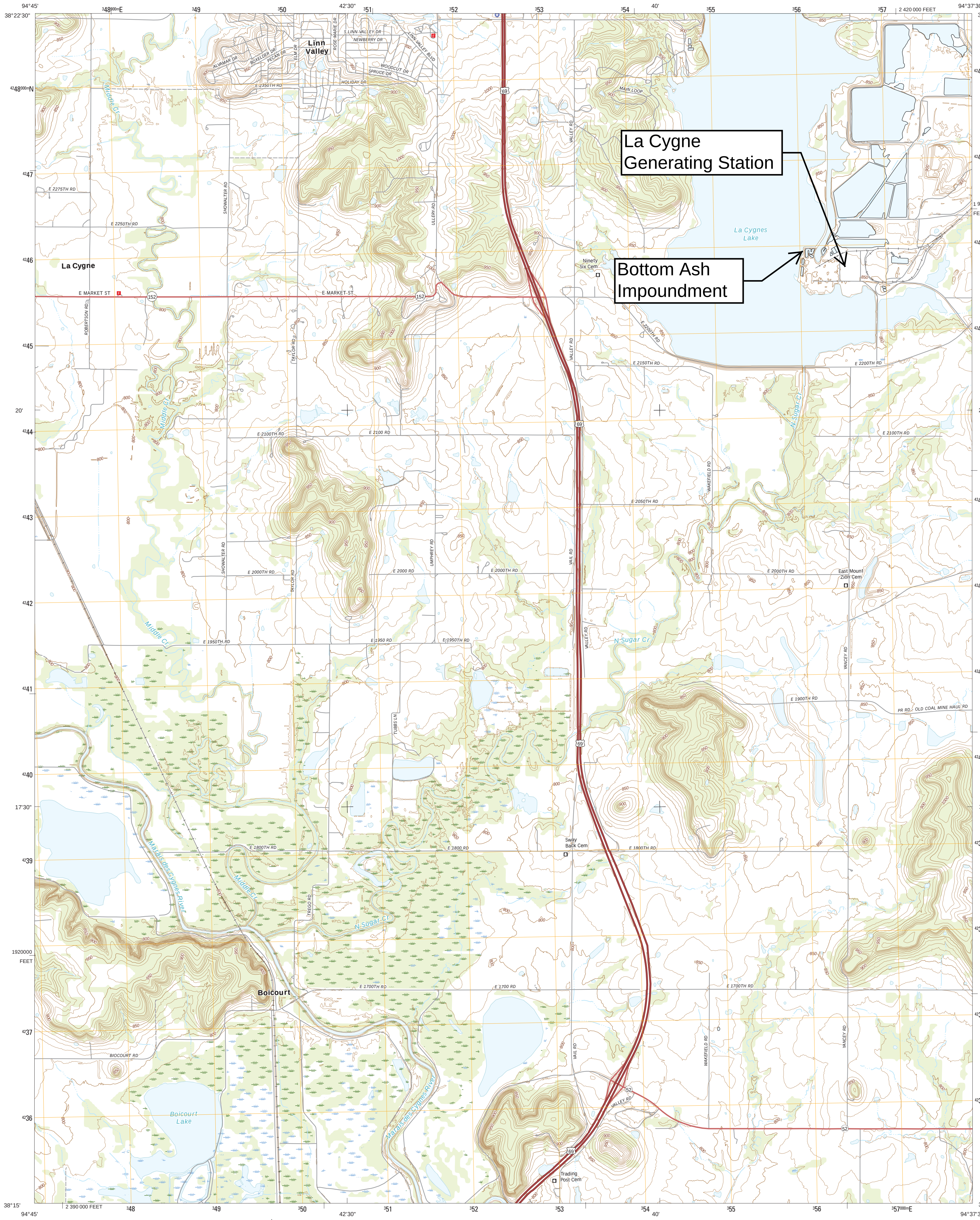
Appendix A
Figures

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

BOICOURT QUADRANGLE
KANSAS-LINN CO.
7.5-MINUTE SERIES



Produced by the United States Geological Survey

North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 15S
10 000-foot ticks: Kansas Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, July 2014
Roads.....U.S. Census Bureau, 2014 - 2015
Names.....GNIS, 2015
Hydrography.....National Hydrography Dataset, 2014
Contours.....National Elevation Dataset, 2014
Boundaries.....Multiple sources; see metadata file 1972 - 2015
Public Land Survey System.....BLM, 2015
Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
UC
Grid Zone Designation
15S

SCALE 1:24 000

KILOMETERS · METERS · MILES · FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

QUADRANGLE LOCATION

1 Fontana
2 New Lancaster
3 Drexel
4 La Cygne
5 Amoret
6 Mound City
7 Pleasanton
8 Worland

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway · Local Connector
Secondary Hwy · Local Road
Ramp · 4WD
Interstate Route · US Route · State Route

BOICOURT, KS
2015

NSN. 7643016384272
NGA REF NO. USGSX24K47702

Figure 1 - Location Map

AECOM
1555 N RiverCenter Drive, Suite 214
Milwaukee, Wisconsin
414-944-6080 (phone)
414-944-6081 (fax)

KANSAS CITY POWER & LIGHT COMPANY
1200 Main Street
Kansas City, Missouri

Initial Inflow Design Flood Control System Plan

Bottom Ash Impoundment
KCP&L La Cygne Generating Station

REVISIONS

NO.	DESCRIPTION	DATE
△		
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AECOM PROJECT NO:	60505810
DRAWN BY:	PDD
DESIGNED BY:	PDD
CHECKED BY:	BDL
DATE CREATED:	7/26/2016
PLOT DATE:	9/01/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

Watershed Area Map

Figure 2

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