GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

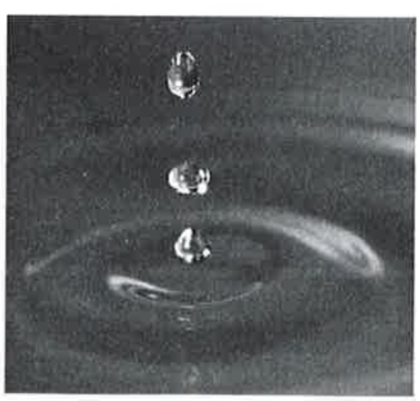
Specific Site Assessment for Coal Combustion Waste Impoundments at Duke Energy Indiana (DEI) Cayuga Generating Station

Cayuga, Indiana

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd., Suite 900
Denver, CO 80237

March 2011
Project 092882



Stephen G. Brown, P.E.
Senior Project Manager

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms and Abbreviations

CCW	coal combustion waste
CMP	corrugated metal pipe
DEI	Duke Energy Indiana, Inc.
DNR	Department of Natural Resources Division of Water
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GEI	GEI Consultants, Inc.
HDPE	High Density Polyethylene
IDF	inflow design flood
MW	megawatts
Patriot	Patriot Engineering and Environmental Co., LLC
PMF	probable maximum flood
PMP	probable maximum precipitation
RCP	Reinforced Concrete Pipe
SPT	Standard Penetration Tests
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey

1.0 Introduction

1.1 Purpose

This report presents the results of a specific site assessment of the dam safety of coal combustion waste (CCW) impoundments at the Cayuga Generating Station in Cayuga, Indiana. The Cayuga Generating Station is operated and owned by Duke Energy Indiana, Inc. (DEI). The impoundments are the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin. The specific site assessment was performed on August 10, 2010.

The specific site assessment was performed with reference to Federal Emergency Management Agency (FEMA) guidelines for dam safety, which includes other federal agency guidelines and regulations (such as U.S. Army Corps of Engineers [USACE] and U.S. Bureau of Reclamation [USBR]) for specific issues, and defaults to state requirements were not specifically addressed by federal guidance or if the state requirements were more stringent.

1.2 Scope of Work

The scope of work between GEI Consultants, Inc. (GEI) and the U.S. Environmental Protection Agency (EPA) for the specific site assessment is summarized in the following tasks:

1. Acquire and review existing reports and drawings relating to the safety of the project provided by the EPA and Owners.

2. Conduct detailed physical inspections of the project facilities. Document observed conditions on Field Assessment Check Lists provided by EPA for each management unit being assessed.

3. Review and evaluate stability analyses of the project's coal combustion waste impoundment structures.

4. Review the appropriateness of the inflow design flood (IDF), and adequacy of ability to store or safely pass the inflow design flood, provision for any spillways, including considering the hazard potential in light of conditions observed during the inspections or to the downstream channel.

5. Review existing dam safety performance monitoring programs and recommend additional monitoring, if required.

6. Review existing geologic assessments for the projects.

7. Submit draft and final reports.

1.3 Authorization

GEI performed the coal combustion waste impoundment assessment as a contractor to the EPA. This work was authorized by EPA under Contract No. EP09W001698, Order No. EP-CALL-0002 between EPA and GEI, dated July 28, 2010.

1.4 Project Personnel

The scope of work for this task order was completed by the following personnel from GEI:

Stephen G. Brown, P.E.	Project Manager/Task Leader
Gillian M. Hinchliff	Project Engineer
Steven R. Townsley, P.E.	Senior Reviewer

The Program Manager for the EPA was Stephen Hoffman.

1.5 Limitation of Liability

This report summarizes the assessment of dam safety of Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, Primary Ash Settling Basin, and Secondary Ash Settling Basin coal combustion waste impoundments at Cayuga Generating Station, Cayuga, Indiana. The purpose of each assessment is to evaluate the structural integrity of the impoundments and provide summaries and recommendations based on the available information and on engineering judgment. GEI used a professional standard of practice to review, analyze, and apply pertinent data. No warrantees, express or implied, are provided by GEI. Reuse of this report for any other purpose, in part or in whole, is at the sole risk of the user.

1.6 Project Datum

The project datum was not identified on the documents reviewed by the assessment team.

1.7 Prior Inspections

Quarterly inspections for the CCW impoundments by a DEI Cayuga Generating Station engineer began in 2010. Prior to 2010, inspections for the impoundments were performed on an annual basis. A third-party engineering firm performed a visual inspection of the embankments in March 2010; however neither state nor federal regulatory officials have inspected the embankments within the last five years.

2.0 Description of Project Facilities

2.1 General

Cayuga Generating Station is a coal-fired power plant consisting of two units that generate about 1,000 megawatts (MW) combined. The power plant is located in the town of Cayuga, Vermillion County, Indiana approximately 3 miles southeast of the Cayuga town center; see Figure 1. The CCW impoundments are located adjacent to and southeast of the power plant. The CCW impoundments include the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, Primary Ash Settling Basin, and Secondary Ash Settling Basin, which are actively used impoundments located within the Original Ash Pond as defined by the 1966 perimeter dike design (Figure 2). Both generating units are owned and operated by DEI, the first unit went online in 1970.

2.2 Impoundment Dams and Reservoirs

The embankment dams of the four CCW impoundments have not been previously assigned a hazard potential by a state or federal agency. Based on the geometry of the impoundments and the facilities downstream, recommended hazard potential classifications for the impoundments have been developed in Section 4.0 of this report. The basic dimensions and geometry of the CCW impoundments are summarized in Table 2-1.

In 1966, the Original Ash Pond was designed as a single 300-acre ash pond with one adjacent settling basin (currently known as the Secondary Ash Settling Basin). A perimeter dike was constructed to encompass the Original Ash Pond. The Secondary Ash Settling Basin is bounded on the west side by the perimeter dike and on the remaining sides by a separate dike. The perimeter dike and Secondary Ash Settling Basin east dike were designed as homogenous embankment dams constructed of on-site alluvial and aeolian deposits. Following construction of the Original Ash Pond perimeter dike, internal divider dikes were built to subdivide the Original Ash Pond and facilitate the management of sluiced ash. In 1998, a divider dike was constructed to create the Primary Ash Settling Pond in the southeastern portion of the Original Ash Pond. In 2004, a temporary cover was placed over ash deposits in the western portion of the Original Ash Pond for the construction of the FGD plant and parking areas. In 2007-2008, the Lined Ash Disposal Pond – Cell #1 was constructed on top of existing ash at a location just east of the FGD plant. Ash Disposal Area #1 includes two areas that have received temporary cover: Temporary Cover 2008 located in the northeastern portion of the Original Ash Pond and Temporary Cover 2010-2011 located over the northern half of Ash Disposal Area #1 (see Figure 2). The temporary cover areas have not been officially closed, but are vegetated for dust control.

The Lined Ash Disposal Pond – Cell #1 and Ash Disposal Area #1 store fly ash, pyrites, bottom ash, and boiler slag. The Primary Ash Settling Basin and Secondary Ash Settling Basin receive decant water from Ash Disposal Area #1 and the Lined Ash Disposal Pond – Cell #1 and store other materials identified by DEI as landfill leachate, water treatment, boiler blow down, coal pile runoff, stormwater runoff, fire protection, mill rejects, floor and laboratory drain discharges, and drain discharges from equipment cleaning.

The Lined Ash Disposal Pond – Cell #1 dam is a homogenous embankment constructed of co-mingled bottom and fly ash. The Original Ash Pond, Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin dams are homogenous embankments constructed of alluvial and aeolian deposits. The dam embankments have crests varying from 10 to 35 feet wide and side slopes varying from 2H:1V to 3H:1V.

Table 2-1: Summary Information for Impoundment Dam Parameters

Parameter	Value				
		Disposal Areas within Original Ash Pond			
Dam	Original Ash Pond	Lined Ash Disposal Pond – Cell #1	Ash Disposal Area #1	Primary Ash Settling Basin	Secondary Ash Settling Basin
Estimated Maximum Height (ft)	48	50.5	47	48	24
Estimated Perimeter Length (ft)	14,500	5,200	9,100	4,450	1,960
Crest Width (ft)	10-35	20	10-35	10-30	10
Crest Elevation[3] (ft)	530	562.5	529.0	529.0	500.0
Design Side Slopes Upstream/Downstream (H:V)	2:1/2:1	3:1/3:1	2:1 to 3:1/ 2:1 to 3:1	2:1 to 3:1/ 2:1 to 3:1	2:1/2:1
Estimated Freeboard (ft) at time of site visit	NA[2]	5.5	3.8	21.0	13.2
Storage Capacity[1] (ac-ft)	NA[2]	1,400	260	225	36
Surface Area[1] (acres)	300	40	26	15	3

1. Surface area and capacity based on CERCLA 104(e) Request for Information prepared by DEI at the request of the EPA, dated March 25, 2009, except for the Original Ash Pond which is based on conversations with DEI employees during the August 10, 2010 field inspection.
2. Estimated freeboard and storage capacity for the Original Ash Pond is provided separately under each active pond except for the FGD plant area and undeveloped areas within the perimeter dike.
3. Based on drawings provided by DEI, datum not specified.

The construction and stability of the Original Ash Pond was considered for this report; however, it is not considered one of the four active CCW impoundments and a checklist was not prepared. The four active CCW impoundments are the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin.

2.3 Spillways

The Lined Ash Disposal Pond – Cell #1 has an open channel emergency spillway. The emergency spillway was designed as a 2-foot-deep by 26-foot-wide rectangular channel. The emergency spillway contains about 18 inches of riprap and the riprap voids are filled with road base aggregate. The open space in the channel above the riprap is the shape of a trapezoidal channel 6 inches deep by 20 feet bottom width and 22 feet top width. Spillway rating curves were not provided by DEI. Based on a simplified evaluation for a broad-crested weir condition and assuming the filled void spaces of the riprap do not allow significant flow through the riprap, the spillway capacity is about 21 cubic feet per second (cfs).

Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin do not have emergency spillways.

2.4 Intakes and Outlet Works

The Lined Ash Disposal Pond – Cell #1 intake structure consists of a square concrete drop-inlet structure approximately 5.5 feet by 5.5 feet wide with a fixed weir set at elevation (El.) 556 that discharges through a 24-inch-diameter Reinforced Concrete Pipe (RCP) to a drainage ditch. The drainage ditch discharges into the Primary Ash Settling Basin.

The Ash Disposal Area #1 intake structure is a 6-foot-diameter concrete drop-inlet structure with a stop log weir that discharges through a 30-inch-diameter corrugated metal pipe (CMP) to the Primary Ash Settling Basin. Flow through the weir structure is controlled by manually adding or removing concrete stop logs into the guides.

The Primary Ash Settling Basin and Secondary Ash Settling Basin each have two square concrete drop-inlet intake structures approximately 6 feet by 6 feet wide with stop log weirs that discharge through 24-inch-diameter outlet conduits. The Secondary Ash Settling Basin service spillway was retrofitted with a 24-inch-diameter fiberglass extension to provide a submerged intake. The Primary Ash Settling Basin conduits discharge to the Secondary Ash Settling Basin, and the Secondary Ash Settling Basin conduits discharge to a small channel that discharges to the Wabash River. Flow through the weir structures is controlled by manually adding or removing concrete stop logs into the guides.

2.5 Vicinity Map

Cayuga Generating Station is located in Cayuga, Vermillion County, Indiana approximately 3 miles southeast of the Cayuga town center, as shown on Figure 1. The four CCW impoundments are located adjacent to and southeast of the station.

2.6 Plan and Sectional Drawings

Engineering drawings for the four CCW impoundments and the Original Ash Pond were prepared by Sargent & Lundy, LLC. Construction record drawings were not prepared.

2.7 Standard Operational Procedures

Cayuga Generating Station is a coal-fired power plant composed of two 500 MW units producing a total combined capacity of 1,000 MW. Coal is delivered to the power plant by train, where it is then combusted to power the steam turbines. The burning of coal produces several gases and fly ash which are vented from the boiler, and bottom ash, which is made of coarse fragments, falls to the bottom of the boiler, and is removed along with boiler slag. Coal combustion waste from Units 1 and 2 are wet sluiced into either the Lined Ash Disposal Pond – Cell #1 or Ash Disposal Area #1.

Lined Ash Disposal Pond – Cell #1 and Ash Disposal Area #1 are used for primary settling. The Lined Ash Disposal Pond – Cell #1 and Ash Disposal Area #1 discharge decant water into the Primary Ash Settling Basin. The water level in the Lined Ash Disposal Pond – Cell #1 is controlled by the fixed weir height elevation in the primary overflow structure. The Ash Disposal Area #1 water level is controlled by stop logs in the primary overflow structure to the Primary Ash Settling Basin. The Primary Ash Settling Basin also receives FGD landfill stormwater runoff and leachate from pipes that penetrate through the southwest dike of the Primary Ash Settling Basin. The Primary Ash Settling Basin provides further clarifying of solids before the effluent is discharged to the Secondary Ash Settling Basin. The discharge from the Primary Ash Settling Basin is controlled by stop logs in two overflow structures that discharge to the Secondary Ash Settling Basin. The Secondary Ash Settling Basin discharges to a small channel that discharges to the Wabash River.

3.0 Summary of Construction History and Operation

The perimeter dike, encompassing the Original Ash Pond, and the Secondary Ash Settling Basin east dike were designed in 1966 and commissioned in 1970. The first unit at Cayuga Generating Station went online in 1970. The second unit was online by 1972.

DEI reported that the Primary Ash Settling Basin was commissioned in 1970, however, the Primary Ash Settling Basin appears to be formed by construction of the divider dike in 1998 that subdivided Ash Disposal Area #1 and would have been put in service circa 1998. Some of the embankments at the Cayuga Generating Station are exterior dikes (similar to typical embankment dams) and some of the embankments are interior dikes (designed to separate one pond from another pond).

The perimeter dike and Secondary Ash Settling Basin east dike were constructed of homogeneous fill material. The 1998 divider dike for the Primary Ash Settling Basin was constructed of homogenous fill material. The divider dike may have been founded on CCW material since the dike was constructed after ash had been previously sluiced into the Original Ash Pond; however, one boring drilled to bedrock on the divider dike in August 2011 showed no evidence of ash in the embankment or foundation materials. The Lined Ash Disposal Pond – Cell #1 dikes were constructed of, and founded on, co-mingled bottom and fly ash that had been deposited into the Original Ash Pond. Typical geometries of the dikes are presented in Table 2-1 and Figure 3.

Original design drawings for the Original Ash Pond, Ash Disposal Area #1, Secondary Ash Settling Pond and their embankments were available; however, design reports and construction records were not available. A 1998 design plan for the Primary Ash Settling Basin divider dike was available. Alluvial and aeolian deposits excavated from onsite borrow areas were utilized in the construction of the embankments. Construction of the Original Ash Pond, Ash Disposal Area #1 and Secondary Ash Settling Basin coincided with the original construction of the power plant and was on natural ground, therefore, no CCW could have present in the footprint of the embankments. However, the Primary Ash Settling Basin constructed in 1998 appears to have required removal of CCW that was likely present as the dike was constructed to divide the Original Ash Pond. Riprap and grassy vegetation protect the upstream slopes of the impoundments.

The Lined Ash Disposal Pond – Cell #1 was commissioned in 2008. Original design drawings, design reports and construction compaction records were available for the Lined Ash Disposal Pond – Cell #1. No documentation of overexcavation or compaction of the embankment foundation fly ash/bottom ash materials were found on the drawings or in the design report. The Lined Ash Disposal Pond – Cell #1 interior embankment slopes were lined with a 60 mil double-sided textured High Density Polyethylene (HDPE) geomembrane liner. The bottom of the pond was lined with a 60 mil double-sided smooth HDPE geomembrane liner.

No evidence of prior releases, failures or patchwork construction was observed during the site visit or disclosed by plant personnel. The Original Ash Pond, Ash Disposal Area #1 and Secondary Ash Settling Basin dams were constructed on natural soils. It is possible the Primary Ash Settling Basin west and north dikes may have been constructed on CCW material because the dikes were constructed in 1998 after ash had been previously sluiced into the Original Ash Pond; however, no evidence of ash was encountered in the embankment or foundation materials in one boring drilled on the dike in August 2011. The Lined Ash Disposal Pond – Cell #1 was constructed on CCW material.

4.0 Hazard Potential Classification

4.1 Overview

According to the Federal Guidelines for Dam Safety the hazard potential classification for the CCW impoundments is based on the possible adverse incremental consequences that result from release of stored contents due to failure of the dam or misoperation of the dam or appurtenances. Impoundments are classified as Low, Significant, or High hazard, depending on the potential for loss of human life and/or economic and environmental damages.

4.2 Original Ash Pond

The Original Ash Pond perimeter dike with a surface area of about 300 acres and a height of about 48 feet would be considered an "Intermediate" sized dam in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

The sections of the perimeter dike that currently bound the Ash Disposal Area #1, Primary Settling Pond and Secondary Ash Settling Pond are rated with those ponds. The western and northern sections of the perimeter dike are rated in this section. The western section of the perimeter dike bounds the FGD plant and parking areas, and the northern section of the perimeter dike contains the fly ash/bottom ash that forms the foundation for the Lined Ash Disposal Pond – Cell #1 northern dike.

In the event of a breach of the western perimeter dike, the outflow direction would involve Duke Energy plant roads, parking areas and facilities. CCW could potentially reach the Wabash River to the north. Based on observed current operations, the ash pond contents in the western portion include CCW material that may be moist due to infiltrating precipitation, but is not likely saturated, though no monitoring wells are available within the stored ash. The associated flood depths and flow velocities would be relatively small and are not considered to pose a significant hazard to vehicles or plant personnel.

A breach of the northern perimeter dike would likely cause failure of the Lined Ash Disposal Pond – Cell #1 northern dike since the perimeter dike contains the foundation fly ash/bottom ash of the Lined Ash Disposal Pond – Cell #1 dike. The crest of the Lined Ash Disposal Pond – Cell #1 is set back approximately 290 feet south of the Original Ash Pond perimeter dike crest. The outflow direction would involve Duke Energy plant roads, parking areas and facilities. CCW could potentially reach the hot water canal and the Wabash River to the north. However, once the outflow reaches the river, the river flood waters would likely be widespread with shallow depths and gradually rising waters. The associated flood depths and flow velocities would be relatively small and are not considered to pose a significant hazard to plant personnel.

Consistent with the Federal Guidelines for Dam Safety and the Department of Natural Resources Division of Water (DNR), Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana, we recommend the Original Ash Pond perimeter dam be classified as a "Significant" hazard structure.

4.3 Lined Ash Disposal Pond – Cell #1

The Lined Ash Disposal Pond – Cell #1 has a maximum height of approximately 50.5 feet and the storage capacity is 1,400 acre-feet (ac-ft) which classifies the pond as an "Intermediate" sized dam in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

An uncontrolled release of the north dike of the Lined Ash Disposal Pond – Cell #1 dam contents due to a failure or misoperation could cause CCW to flow into areas surrounding the pond and potentially involve the Duke Energy plant facilities and ultimately reach the hot water canal and the Wabash River. However, once the outflow reaches the river, the river flood waters would likely be widespread with shallow depths and gradually rising waters. The associated flood depths and flow velocities would be relatively small and are not considered to pose a significant hazard to plant personnel. Based on potential environmental impacts to the Wabash River and associated economic impacts, and consistent with the Federal Guidelines for Dam Safety and the Department of Natural Resources Division of Water (DNR), Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana, we recommend the Lined Ash Disposal Pond – Cell #1 dams be classified as "Significant" hazard structures.

4.4 Ash Disposal Area #1 and Primary Ash Settling Basin

The pond size and capacity of each unit provided by Duke Energy is summarized in Table 4-1. The dam height is estimated based on available design drawings and topographic information.

Table 4-1: DEI Cayuga Generating Station – Summary of Impoundment Parameters

Pond Name	Height (ft)	Storage (ac-ft)	Surface Area (acres)
Ash Disposal Area #1	47	260	26
Primary Ash Settling Basin	48	225	15

Based on current pond heights and storage capacity shown in Table 4-1 the size classification for the Ash Disposal Area #1 and Primary Ash Settling Basin is "Intermediate" in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life; however, CCW could flow into the Wabash River and areas surrounding the pond. River flood waters would likely be widespread with shallow depths and gradually rising waters. Based on the pond height and volume, the majority of inundation would be limited to the Wabash River northeast and east of the ponds or the underdeveloped area southwest of the Ash Disposal Area #1 pond. It is unlikely that, in the event of a failure, CCW material would reach E County Road 200 N and the industrial company located south of the ponds because the road and structures are located on higher ground. Due to potential environmental impacts to the Wabash River and associated economic impacts, and consistent with the Federal Guidelines for Dam Safety and the DNR Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana, we recommend the Ash Disposal Area #1 and Primary Ash Settling Basin dams be classified as "Significant" hazard structures.

4.5 Secondary Ash Settling Pond

The Secondary Ash Settling Pond has a maximum embankment height of about 24 feet and a storage capacity of 36 ac-ft and classifies as a "Small" dam in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life or significant economic/environmental losses because the facility has relatively low hydraulic head, the contained water quality is improved by secondary level decanting, and the small capacity of the facility. Pond contents would flow at a shallow depth into the Wabash River and undeveloped areas immediately surrounding the pond. There are no habitable structures between the Wabash River and the Secondary Ash Settling Pond. Consistent with the Federal Guidelines for Dam Safety and the DNR Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana, we recommend the dams be classified as "Low" hazard structures.

5.0 Hydrology and Hydraulics

5.1 Floods of Record

Floods of record have not been evaluated and documented for the CCW impoundments at the Cayuga Generating Station.

5.2 Inflow Design Floods

Currently there is no hazard classification for the four CCW impoundments at the Cayuga Generating Station. Based on observations during the field inspection, we recommend the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1 and Primary Ash Settling Pond be rated "Significant" hazard dams (see Section 4.0). Based on the recommended "Significant" hazard classification, the DNR General Guidelines for New Dams and Improvements to Existing Dams in Indiana specifies "Significant" hazard dams be capable of passing the 50 percent probable maximum precipitation (PMP) without overtopping the dam. The USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 recommends an intermediate "Significant" hazard dam be capable of passing 50 to 100 percent of the probable maximum flood (PMF) without overtopping the dam. Considering the "Significant" hazard rating, the scale of the economic and environmental damages that could potentially occur upon failure, and the recommended range of inflow design storms, it is reasonable to select 50 percent of the PMP as the inflow design storm for the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, and Primary Ash Settling Pond. According to the DNR Guidelines, the 6-hour PMP event should be used to analyze the inflow design floods for the ash pond because the time of concentration for the basins is less than 6 hours. Accordingly, the 6-hour 50 percent PMP precipitation at the Cayuga Generating Station is about 13.6 inches based on DNR Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana 6-hour PMP data.

We recommend the Secondary Ash Settling Basin be rated "Low" hazard (Section 4.0). Based on the recommended "Low" hazard classification, the DNR General Guidelines for New Dams and Improvements to Existing Dams in Indiana specifies "Low" hazard dams be capable of passing a flood event that ranges from the 100-year storm to the 50 percent probable maximum precipitation (PMP) without overtopping the dam. The USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 recommends a small "Low" hazard dam be capable of passing the 50- to 100-year storm event without overtopping the dam. Considering the relatively low economic and environmental damages that could potentially occur upon failure, and the recommended range of inflow design storms, it is reasonable to select the 6-hour 100-year storm event as the inflow design storm. The 6-hour 100-year precipitation event at the Cayuga Generating Station is about 4.5 inches based on DNR Indiana General Guidelines for New Dams and Improvements to Existing Dams in Indiana 6-hour 100-year storm event data.

5.2.1 Original Ash Pond

The Original Ash Pond was constructed with a perimeter dike, so the contributing drainage areas for this section are assumed to only be the areas within the perimeter dike, except for the FGD landfill runoff which is conveyed by pipes to the Primary Ash Settling Basin. The topography on the design drawings provided by DEI is difficult to read, as a result, the flow direction of runoff from the western portion of the Original Ash Pond cannot be conclusively determined. For purposes of this report, we assumed the runoff from these areas would flow into the drainage ditch and enter the Primary Ash Settling Basin.

5.2.2 Lined Ash Disposal Pond – Cell #1

The Lined Ash Disposal Pond – Cell #1 contributing drainage area is limited to the impoundment area because of the dikes. The normal operating water surface elevation is about El. 557.0 with 5.5 feet of freeboard. Based on the 6-hour 50 percent PMP, the Lined Ash Disposal Pond – Cell #1 would have a water surface elevation of about El. 558.2, providing about 4.3 feet of freeboard assuming no discharge through the service spillway intake structure. The water level in the pond during the 50 percent PMP event would not reach the emergency spillway crest.

5.2.3 Ash Disposal Area #1

The Ash Disposal Area #1 contributing drainage area includes both Temporary Cover 2008 and 2010-2011 areas. The Temporary Cover 2008 area could flow into the Ash Disposal Area #1 or Primary Ash Settling Basin because the interior divider dikes are at a lower elevation than the perimeter dike. The evaluation requires an estimate of how much of the Temporary Cover 2008 runoff would flow into the Ash Disposal Area #1. For the purposes of this report, we assumed all of the Temporary Cover 2008 and 2010-2011 areas would flow into Ash Disposal Area #1.

Ash Disposal Area #1 is normally operated at El. 525.2, providing about 3.8 feet of freeboard. The Ash Disposal Area #1 including the Temporary Cover 2008 and Temporary Cover 2010-2011 areas is about 85 acres. The pool area of the Ash Disposal Area #1 is about 26 acres. The water elevation in the event of the 50 percent PMP would raise the water surface in the pool to about El. 528.9 based on 26 acres of pond surface area, providing about 0.1 feet of freeboard.

It is also possible that some runoff from the Original Ash Pond area and from the drainage ditch would overflow and enter Ash Disposal Area #1, which could cause overtopping of the dam. Inflow to Ash Disposal Area #1 is discharged through the overflow weir into the Primary Ash Settling Basin, however, small outlet structures are typically considered to be partially or fully clogged during these large, rare precipitation events. This very simplified evaluation, which assumes all runoff from the Temporary Cover areas accumulates in the

Ash Disposal Area #1 pond, indicates potentially inadequate capacity to store the design storm event.

5.2.4 Primary Ash Settling Basin

The Primary Ash Settling Basin receives discharge water from the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, and the FGD landfill stormwater and leachate. However, runoff contributions from the FGD landfill are expected to be very limited because of the limited capacity of the stormwater conveyance pipes. It is possible that in the event of the 50 percent PMP, runoff from the Original Ash Pond may also enter the drainage ditch and contribute to the Primary Ash Settling Basin drainage area. It is difficult to determine how much of the Original Ash Pond runoff will contribute. For the purposes of this report, we assumed that all of the runoff from the Original Ash Pond, Ash Disposal Area #1 and the Lined Ash Disposal Pond – Cell #1 would contribute to the drainage area, but that the FGD landfill conveyance pipes would become clogged and would not contribute to the Primary Ash Settling Basin inflow.

The Primary Ash Settling Basin pool area reported by DEI and shown in Table 2-1 is 15 acres; however, the total pond area appears to be about 28.5 acres based on scaling dimensions from aerial photos. The normal water surface elevation is about El. 508, providing 21 feet of freeboard. The Original Ash Pond area is about 112 acres. The total area of the Lined Ash Disposal Pond – Cell #1 and Ash Disposal Area #1 is about 125 acres. The 6-hour 50 percent PMP water level in the Primary Ash Settling Basin would be about El. 518.6 using the 28.5-acre pond surface area, which provides about 10.4 feet of freeboard. Based on these results, the Primary Ash Settling Basin meets the regulatory requirements for storage of the 6-hour 50 percent PMP inflow design flood without overtopping the dam.

5.2.5 Secondary Ash Settling Basin

The contributing drainage area for the Secondary Ash Settling Basin is considered to be only the area encompassed by the dikes that form the pond. Potential discharges to the Secondary Ash Settling Basin from the Primary Ash Settling Basin service spillway intake structure is neglected due to the potential for the intake structure to clog during a large storm event. Discharge to the Wabash River through the Secondary Ash Settling Basin service spillway is also assumed to be negligible because of the potential for the discharge outlet to become clogged.

The normal water surface elevation in the Secondary Ash Settling Basin is about El. 486.8, providing about 13.2 feet of freeboard. The Secondary Ash Settling Pond pool area reported by DEI and shown on Table 2-1 is 3 acres, but the contributing drainage area within the dikes extends beyond the pool surface area for a total of about 7.5 acres. A 100-year storm event would result in a water surface elevation of about El. 487.7 based on 3 acres of pond surface area, providing 12.3 feet of freeboard. The freeboard at the Secondary Ash Settling Basin meets the regulatory requirements for storage of the 6-hour 100-year inflow design flood without overtopping the dam.

5.2.6 Determination of the PMF

Not applicable.

5.2.7 Freeboard Adequacy

Based on a very simplified evaluation using conservative assumptions, the freeboard appears to be adequate at the Lined Ash Disposal Pond – Cell #1, Primary Ash Settling Basin and Secondary Ash Settling Basin. Freeboard for the Ash Disposal Area #1 is marginal and may compromise the integrity of the dam during the 50 percent PMP event. A hydraulic and hydrology assessment for the Cayuga Generating Station ash impoundments should be performed to confirm the available freeboard.

5.2.8 Dam Break Analysis

Dam break analyses have not been performed for the four CCW impoundments at the Cayuga Generating Station.

5.3 Spillway Rating Curves

Spillway rating curves were not provided for the Lined Ash Disposal Pond – Cell #1. Based on a simplified evaluation for a broad-crested weir condition and assuming the filled void spaces of the riprap do not allow significant flow through the riprap, the spillway capacity is about 21 cfs.

5.4 Evaluation

Based on the current facility operations and inflow design floods documents, three of the four CCW impoundments at the Cayuga Generating Station appear to have adequate capacity to store the regulatory design floods without overtopping the dams. Ash Disposal Area #1 appears to have marginal freeboard if there is significant runoff from Temporary Cover 2008 that fully contributes to Ash Disposal Area #1. If supplemental runoff contributions occur from the Original Ash Pond, the available freeboard could be further compromised. Based on the simplified evaluation performed for this inspection, and lacking any prior hydrologic studies of the facilities, it appears the Ash Disposal Area #1 would not meet the requirement to safely store or pass the regulatory design flood for a Significant Hazard Structure. A hydrology and hydraulics study should be performed to confirm that adequate freeboard is available in each pond for the regulatory design flood.

6.0 Geologic and Seismic Considerations

Based on the Sargent & Lundy Cayuga Generating Station Pond Examination Report (2010):

> *The Cayuga Generating Station ponds are located in the Wabash Lowland Physiographic Unit. Glacial outwash sediments consisting of sands and gravels exist in the Wabash River Valley. These unconsolidated sediments vary in thickness from 20 to 60 feet in this area. River alluvium sediments consisting of silts, clays, sand and gravel are underlain by Pennsylvanian age shales and sandstones.*
>
> *Post-Pennsylvanian faults are present south of the area in Gibson and Posey Counties. They trend north-northeast and are parallel to faults in Kentucky and Illinois. The stability analysis for the dikes included a horizontal seismic acceleration of 0.167g.*

The seismic coefficient of 0.167g corresponds to a peak ground acceleration of 0.334g. This value is higher than an acceleration of approximately 0.11g as shown on the 2008 U.S. Geological Survey (USGS) probabilistic seismic hazard map for 2 percent Probability of Exceedance within 50 years (recurrence interval of approximately 2,500 years). Application of a pseudo-static seismic coefficient of 0.167g in the facility design would be greater than the 2,500-year earthquake, which is acceptable based on federal dam safety guidance.

7.0 Field Assessment

7.1 General

A site visit to assess the condition of the CCW impoundments at the Cayuga Generating Station was performed on August 10, 2010, by Stephen G. Brown, P.E., and Gillian M. Hinchliff of GEI. Tom Knapke, Peter Massa, Owen Schwartz, John Hayes and Ron Ehlers of Duke Energy assisted in the assessment.

The weather during the site visit (August 10, 2010) was generally sunny, with temperatures around 90 degrees Fahrenheit and periodic light rain. The majority of the ground was dry at the time of the site visit.

At the time of inspection, GEI completed an EPA inspection checklist, which is provided in Appendix A, and photographs, which are provided in Appendix B. Field assessment of the four CCW impoundments included a site walk to observe the dam crest, upstream slope, downstream slope, and intake structures.

7.2 Embankment Dam

7.2.1 Dam Crest

The dam crest of the four active CCW impoundments appeared to be in good condition. No signs of cracking, settlement, movement, erosion or deterioration were observed during the assessment. The dam crest surface is generally composed of road base material that traverses the length of the dam for vehicle access.

7.2.2 Upstream Slope

The upstream slope of the four active CCW impoundments is protected by either riprap, grassy vegetation or, in the case of the Lined Ash Disposal Pond – Cell #1, a geomembrane liner. The upstream slope protection appeared to be in satisfactory condition. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the four CCW impoundments. Several trees up to 2 feet in diameter were observed on the southern slopes of the Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin embankments. DEI indicated that the southern slopes of these ponds are natural ground and not constructed dikes that are contained within the Original Ash Pond perimeter dike and this information is consistent with our field observations.

7.2.3 Downstream Slope

The downstream slopes of the four CCW impoundments have well-established stands of grass, which provides some erosion protection. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the Lined Ash Disposal Pond – Cell #1, Ash Disposal Area #1, and Secondary Ash Settling Basin.

Evidence of possible erosion, settlement or seepage was observed on the Primary Ash Settling Basin east dike downstream slope. The erosion was observed along the alignment of the outlet pipe connecting the Primary Ash Settling Basin to the Secondary Ash Settling Basin. Duke Energy had filled in areas of erosion above the outlet pipe alignment near the crest and toe of the downstream slope with riprap. Duke Energy also indicated that large river otter burrows had been filled in with riprap at a location at the downstream toe of the Primary Ash Settling Basin east dike. The river otters have since been removed.

Several trees (up to 2-foot-diameter) were observed at the toe of the downstream slope of the Secondary Ash Settling Basin east dike and the Temporary Cover 2008 area of the Ash Disposal Area #1. A dense growth of large trees and shrubs were also observed on the downstream slope of the Original Ash Pond perimeter north dike, which forms the north dike of the Ash Disposal Area #1 and the supporting dike for the Lined Ash Disposal Pond – Cell #1 and its underlying older ash foundation.

7.3 Seepage and Stability

No evidence of ongoing seepage was observed at the Lined Ash Disposal Pond – Cell #1. No evidence of slumps, sloughs, or settlement associated with slope instability was observed.

Evidence of potential seepage and erosion was observed on the Primary Ash Settling Basin east dike downstream slope at the location of the outlet pipe, as discussed in the Downstream Slope section above. Duke Energy also reported a wet area at the Primary Ash Settling Basin east dike at the southeastern end of the dam at the downstream toe. Seepage could be occurring through the dam embankment and foundation and through existing natural deposits and flowing downstream into the Secondary Ash Settling basin. Seepage is not measured at this location.

Foundation and/or embankment seepage was observed flowing at several gallons per minute at the downstream toe of the Secondary Ash Settling Basin east dike. The water was flowing clear at the time of the inspection. Duke Energy indicated the water has been seeping unchanged for many years. The seepage could be a result of seepage from the Primary Ash Settling Basin through the natural slope that forms the southern limit of the Secondary Ash Settling Basin and could be unrelated to the Secondary Ash Settling Basin east dike, or could be influenced by groundwater. Seepage is not measured at this location. There was no visible sign of movement or disturbance along the downstream slope or toe of the east dike.

A seep and/or natural spring was observed at the natural hillside downstream of the northeast dike bounding the Temporary Cover 2008 area. Clear water flowing at a couple of gallons per minute was visible during inspection. Duke Energy indicated the seeps and natural springs daylight within the natural ground strata beneath the dike and have been observed since shortly after construction of the dike with no significant change. Duke Energy has recently begun monitoring the seepage and taking flow measurements. There were no visible signs of movement or other disturbance in the area of the seep/natural spring.

7.4 Appurtenant Structures

7.4.1 Overflow Structures

The concrete overflow structures at the four CCW impoundments appeared to be in fair to good condition consistent with their age. The structures were observed to be working properly and were discharging decant water to the downstream facility. The outlet conduits from the Primary Ash Settling Basin to the Secondary Ash Settling Basin showed signs of severe corrosion based on the Sargent & Lundy (2010) report, and evidence of erosion on the downstream slope above the pipe alignment could be evidence of pipe deterioration or collapse. The outlet conduits for the Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin consist of CMP, which is susceptible to corrosion, and which has generally exceeded a design service life of less than 30 years that is typically considered for CMP in a critical function application. The Primary Ash Settling Basin and Secondary Ash Settling Basin CMP outlet conduits have been in service for about 40 years. The Ash Disposal Area #1 outlet conduit has been in service for about 12 years based on the 1998 drawings.

7.4.2 Pump Structures

No pump structures are present at the four CCW impoundments.

7.4.3 Emergency Spillway

The Lined Ash Disposal Pond – Cell #1 emergency spillway is in good condition. A minor amount of vegetation was observed growing through the riprap in the channel.

7.4.4 Water Surface Elevations and Reservoir Discharge

Duke Energy provided reservoir water surface elevations for the four CCW impoundments as of January 1, 2010. Duke Energy indicated the ponds were kept at constant water surface elevations for the prior several years. The reservoir water surface elevations for the Lined Ash Disposal Pond – Cell #1 is generally maintained at about El. 557.0, or about 5.5 feet of freeboard. The Ash Disposal Area #1 is generally maintained at about El. 525.2, or about 3.8 feet of freeboard. The Primary Ash Settling Basin is generally maintained at about El. 508.0, or about 21 feet of freeboard, and the Secondary Ash Settling Basin is generally maintained at about El. 486.8, or about 13.2 feet of freeboard.

8.0 Structural Stability

8.1 Visual Observations

The assessment team saw no visible signs of instability associated with the interior or exterior dikes of the four impoundments or Original Ash Pond perimeter dikes during the August 10, 2010 site assessment.

8.2 Field Investigations

No subsurface investigation reports were provided for the Original Ash Pond, Ash Disposal Area #1, Primary Ash Settling Basin or Secondary Ash Settling Basin. Based on the design drawings, the following subsurface investigations were performed at the site:

- Nine borings performed in about 1965-1966 to investigate the subsurface conditions of the natural ground below the Original Ash Pond. These borings were completed as part of a larger program for the original design of the generating station. Standard Penetration Tests (SPT) were performed as part of the investigation, with borings extending to depths of 35 feet to 45 feet. The logs of these borings are included in the original Cayuga Generating Station drawings prepared by Sargent & Lundy in 1966.

- In 1998, four borings were performed in candidate borrow areas for the construction of the Ash Disposal Area #1 and Primary Ash Settling Basin divider dike. No borings logs or location plan were provided for any borings along the dike alignment. The borings were completed to depths of 20 feet to 30 feet. Logs and location plan for these borings are shown on the 1998 Ash Pond Modifications design drawings.

- In August 2011, one boring was performed along the divider dike between the Ash Disposal Area #1 and Primary Ash Settling Basin. The boring extended through the embankment materials to bedrock at about 57 feet below the dike crest.

A subsurface investigation report (Patriot Engineering and Environmental Co., LLC [Patriot], 2006) was provided for Lined Ash Disposal Pond – Cell #1. This investigation included:

- Ten borings were drilled along the dam alignment and in the middle of the pond for the Lined Ash Disposal Pond – Cell #1 and penetrated through up to 48 feet of old ash that comprises the foundation of the dikes and into the underlying natural ground. Limited laboratory tests were performed including natural moisture content, Atterberg limits, grain size analysis, unconfined compression, direct shear, and triaxial hydraulic conductivity.

8.3 Methods of Analysis

8.3.1 Original Ash Pond, Ash Disposal Area #1, Primary and Secondary Ash Settling Basins

Sargent & Lundy performed a slope stability analysis on the northeast corner of the Original Ash Pond / Ash Disposal Area #1 as part of their Pond Examination Report (2010). The analyzed section has a dam height of 45 feet, a natural hillside slope beneath the dam on the downstream slope, and the pond is filled with dry ash. This section was considered by Sargent & Lundy to be representative of the Original Ash Pond, Secondary Ash Settling Basin, Primary Ash Settling Basin and Ash Disposal Area #1. Long-term (steady seepage) and pseudo-static loading cases were considered in the analysis, and only the downstream slope stability was analyzed. The phreatic surface was assumed to be within the natural foundation soils. A seismic coefficient 0.167g was used in the pseudo-static analysis. The section has a height of 45 feet, a crest width of 10 feet, and downstream slopes of about 2H:1V for the constructed dike and 2.2H:1V for the natural hillside extending below the dam. The stability analyses were performed using the computer program SLOPE/W V.5.11 developed by GEO-SLOPE International.

8.3.2 Lined Ash Disposal Pond – Cell #1

The slope stability analyses for the Lined Ash Disposal Pond – Cell #1 were conducted by Sargent & Lundy and reported in Issue Summary, Form SOP-0402-07, Revision 7A for the Cayuga Ash Pond Life Extension (2006). Interior slope stability was considered for the long-term (steady seepage) loading, and exterior slope stability was considered for long-term (steady seepage) loading and pseudo-static loading cases. The exterior slope stability assumed the pond was filled with dry ash. A seismic coefficient of 0.167g was used in the pseudo-static analyses. The stability model was analyzed with upstream and downstream slopes of 3H:1V and a 20-foot wide crest. The geomembrane liner was considered to be intact and impermeable, and no phreatic surface was used in the analysis. The stability analyses were performed using the computer program SLOPE/W V.5.11 developed by GEO-SLOPE International.

A rapid drawdown analysis was not performed for any of the structures, which is consistent with a pond configuration that does not have a low level outlet and which precludes development of a rapid drawdown condition.

8.4 Discussion of Stability Analysis and Results

Pseudo-static stability was evaluated for all the impoundments using a seismic coefficient to represent the earthquake loading. It is typical to apply a seismic coefficient equal to one-half of the peak acceleration in the stability analysis. The peak acceleration for an earthquake with an approximate return period of 2,500 years is 0.11g as described in Section 6.0.

Therefore, use of a seismic coefficient of 0.167g is greater than an earthquake with an approximate return period of 2,500 years, which is within the appropriate range for application to a significant hazard classification impoundment.

8.4.1 Original Ash Pond, Ash Disposal Area #1, Primary and Secondary Ash Settling Basins

The material properties used in the Sargent & Lundy 2010 stability evaluations for the Original Ash Pond, Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin representative slope stability section indicate a cohesion for the dam embankment material of 75 pounds per square foot (psf) and a friction angle of 36 degrees. The native soil beneath the embankment was assigned a cohesion of 0 psf and a friction angle of 37 degrees. The load from the ash fill contained in the pond was considered to have a cohesion of 0 psf, a friction angle of 30 degrees, and a unit weight of 80 pounds per cubic foot (pcf). These parameters are considered consistent with drained parameters. The minimum factors of safety for each load case are shown in Table 8-1.

Table 8-1: Original Ash Pond Stability Factors of Safety and Guidance Values

Loading Condition	Min. Calculated FOS*	Min. Required FOS (FERC)
Full Reservoir – Steady Seepage	1.66	1.5
Full Reservoir – Steady Seepage – Seismic (0.167g)	1.12	1.0

*Sargent & Lundy, 2010

As indicated in Table 8-1, the factors of safety calculated by Sargent & Lundy for the loading cases considered are greater than the guidance values. However, the phreatic surface for the cross-section was located in the dam foundation soils and not within the dam embankment. This phreatic surface is not representative for all of the impoundments. For example, the dam separating the Primary Ash Settling Basin and Secondary Ash Settling Basin is expected to have a phreatic surface extending from the pond water surface elevation on the upstream slope and following a curved downward path towards the downstream toe for a homogenous dam. Also, the height of this dam is 11 feet higher (total height of about 56 feet) than the cross-section analyzed.

8.4.2 Lined Ash Disposal Pond – Cell #1

The material properties used in the Sargent & Lundy 2006 stability evaluations for the Lined Ash Disposal Pond – Cell #1 include dam embankment material with a cohesion of 0 psf and a friction angle of 34 degrees and co-mingled bottom and fly ash foundation materials with a cohesion of 0 psf and a friction angle of 30 degrees. The load from the ash fill contained in the pond used in the exterior slope stability analyses was considered to have a cohesion of 0 psf, a friction angle of 30 degrees, and a unit weight of 80 pcf. These parameters are considered consistent with drained strength parameters for the ash. However, isolated layers of weaker fly ash material could be present in the foundation based on the typical sluiced

CCW deposition, and indicated by the boring logs, and were not included in the stability model. The minimum factors of safety for each load case are shown in Table 8-2.

Table 8-2: Lined Ash Disposal Pond – Cell #1 Stability Factors of Safety and Guidance Values

Loading Condition	Min. Calculated FOS[1]	Min. Required FOS (FERC)
Interior Slope – Steady Seepage	1.71	1.5
Interior Slope – Steady Seepage – Seismic (0.167g)	NP[2]	1.0
Exterior Slope – Steady Seepage	2.07	1.5
Exterior Slope – Steady Seepage – Seismic (0.167g)	1.50	1.0

1. Sargent & Lundy, 2010
2. NP = Analysis Not Performed

The factors of safety calculated by Sargent & Lundy for the Lined Ash Disposal Pond – Cell #1 are greater than the guidance values; however, no phreatic surface was included in the analyses and the simplified foundation material strata and properties may not have captured the potential layers of weak fly ash. Typically, even though the pond has a single-layer geomembrane, a phreatic surface is included in the slope stability analysis in case of a puncture or tear to the geomembrane lining and to address the fundamental stability of the dike. In addition, the influence of the stability of the existing perimeter dike located to the north of the Lined Ash Disposal Pond – Cell #1 was not included in the analysis. Inclusion of a phreatic surface, weaker layers of fly ash in the foundation, and consideration of the perimeter dike would be expected to result in a more critical section than the one analyzed in the Issue Summary, Form SOP-0402-07, Revision 7A 2006 study.

8.5 Seismic Stability - Liquefaction Potential

The liquefaction potential at the CCW impoundments has not been previously evaluated based on review of the available documents. Conditions necessary for liquefaction include saturated, loose, granular soils and an earthquake of sufficient magnitude and duration to cause significant strength loss in the soil. Based on the boring profiles included in the 1966 and 1998 design drawings that are pertinent to the Original Ash Pond, Ash Disposal Area #1, and Secondary Settling Basins, the natural granular foundation soils range mostly from medium dense to dense. Isolated locations of loose, wet natural soils are identified in borings B-15, B-16 and B-23; however, these boring locations do not appear to underlie the impoundment dams.

All of the borings at the Lined Ash Disposal Pond – Cell #1, except for C-1 and C-9, encountered wet fly ash that is described as very loose to loose with SPT N-values as low as 2 ranging from depths of about 25 to 45 feet below ground surface at the time of drilling. The loose to very loose, saturated, fly ash may be susceptible to strength loss as the result of earthquake shaking.

8.6 Summary of Results

The slope stability sections analyzed do not represent the critical sections. The section analyzed at the northeast corner of the Original Ash Pond/Ash Disposal Area #1 is not the highest section and a phreatic surface within the dike embankment was not considered. The Original Ash Pond, Ash Disposal Area #1, Primary Ash Settling Basin, and Secondary Ash Settling Basin representative section should analyze the maximum section of the divider dike that is located between the Primary and Secondary Ash Settling Ponds with a phreatic surface representative of steady seepage with normal water surface conditions. For the Lined Ash Disposal Pond – Cell #1 section, consideration should be given to using a phreatic surface representative of steady seepage with normal water surface conditions without a geomembrane liner, the presence of weaker layers of foundation fly ash, and inclusion of the perimeter dam. The resulting factors of safety could be lower than those determined in the currently available stability analysis.

The liquefaction potential of the foundation soils has not been analyzed. Loose to very loose, saturated, granular soils are potentially susceptible to liquefaction. Based on the boring logs provided to us, the foundation soils for the Original Ash Pond, Ash Disposal Area #1, and Secondary Ash Settling Basin appear to be mostly medium dense to dense and likely not susceptible to liquefaction. Foundation soils ranging from 25 to 45 feet below grade at the time of drilling for the Lined Ash Disposal Pond – Cell #1 contain layers of very loose to loose, saturated fly ash. The saturated fly ash may be susceptible to strength loss as a result of earthquake shaking.

The divider dikes between the Ash Disposal Area #1 and Primary Ash Settling Basin could have ash in the foundation materials since the divider dikes were constructed in 1998 after ash had been sluiced into the Original Ash Pond. One boring performed along the divider dike in August 2011 showed no evidence of ash in the embankment or foundations materials; however, one isolated boring may not be representative of the conditions along the entire divider dike. Consideration should be given to the potential for CCW to be in the foundation materials in slope stability analyses of the divider dike. Consideration should also be given to potential for liquefaction if loose, wet, CCW could be present in the divider dike foundation.

9.0 Maintenance and Methods of Operation

9.1 Procedures

Quarterly inspections of the four CCW impoundments began in 2010 and are documented by DEI. Prior to 2010, visual inspections of the CWW impoundments were made on an annual basis. A third-party inspection by a consulting engineering firm was performed in March 2010.

9.2 Maintenance of Impoundments

Maintenance of the four CCW impoundments is performed by DEI staff under the guidance of DEI managers and engineers. Visual inspections of the four CCW impoundments were performed in March 2010 by an independent engineering firm. However, dam safety-related inspections have not been previously made by state or federal agencies.

9.3 Surveillance

The ash ponds and settling basins are not regularly patrolled by DEI operations personnel. Plant personnel are available at the power plant and on 24-hour call for emergencies that may arise.

10.0 Conclusions

10.1 Assessment of Dams

10.1.1 Overall Assessment

The dams and outlet works facilities associated with the four CCW impoundments and Original Ash Pond at the Cayuga Generating Station were generally found to be in **POOR** condition as indicated in Section 11.5.

10.1.2 Field Assessment

Issues of potential concern for the four CCW impoundments and Original Ash Pond were identified from our field assessment as follows:

- The Secondary Ash Settling Pond east dike downstream slope and the Ash Disposal Area #1 northeast dike downstream slope have trees up to 2 feet in diameter in close proximity to the downstream toe. A thick growth of trees was observed on the Original Ash Pond north perimeter dike downstream slope.
- The Primary Ash Settling Pond east dike downstream slope and toe area show evidence of seepage at the location of the outlet pipe and erosion/settlement above the outlet pipe alignment. Duke Energy also reported a wet area at the Primary Ash Settling Basin east dike at the southeastern end of the dam at the downstream toe.
- There was evidence of seepage at the downstream toe of the Secondary Ash Settling Basin east dike.
- A seep / natural spring was observed at the natural hillside downstream of the Ash Disposal Area #1 northeast dike downstream toe.

10.1.3 Adequacy of Structural Stability

The critical slope stability cases were not analyzed for the CCW impoundments. The section analyzed at the northeast corner of the Original Ash Pond/Ash Disposal Area #1 is not the highest section and a phreatic surface within the dike embankment was not considered. The section at the northeast corner of the Original Ash Pond/Ash Disposal Area #1 is not considered representative of the Original Ash Pond, Ash Disposal Area #1, Primary Ash Settling Basin and Secondary Ash Settling Basin. Analyses of critical sections should include the divider dike between the Primary and Secondary Ash Settling Ponds with a phreatic surface representative of steady seepage with normal water surface conditions.

Based on inspection, this section would likely have a factor of safety lower than the factor of safety for the northeast corner of the Original Ash Pond / Ash Disposal Area #1 section.

For the Lined Ash Disposal Pond – Cell #1 section, consideration should be given to including an analysis with a phreatic surface representative of steady seepage at normal water surface conditions without a geomembrane liner, addressing weaker layers of foundation fly ash, and including the perimeter dam. This condition would likely have a factor of safety lower than the section analyzed.

The potential for liquefaction was not evaluated. The Lined Ash Disposal Pond – Cell #1 dam foundation includes loose, saturated, fly ash, which may be susceptible to significant strength loss or settlement under the anticipated earthquake loading.

The divider dikes between the Ash Disposal Area #1 and Primary Ash Settling Basin could have ash in the foundation materials since the divider dikes were constructed in 1998 after ash had been sluiced into the Original Ash Pond. One boring performed along the divider dike in August 2011 showed no evidence of ash in the embankment or foundations materials; however, one isolated boring may not be representative of the conditions along the entire divider dike. Consideration should be given to the potential for CCW to be in the foundation materials in slope stability analyses of the divider dike. Consideration should also be given to potential for liquefaction if loose, wet, CCW could be present in the divider dike foundation.

10.1.4 Adequacy of Hydrologic/Hydraulic Safety

Three out of the four active CCW impoundments at the Cayuga Generating Station currently have adequate freeboard and storage capacity to safely store the 6-hour 50 percent PMP inflow design flood. The Ash Disposal Area #1 does not appear to have sufficient capacity and freeboard to contain the design storm event. However, the flood routing was difficult to determine without a comprehensive hydrology and hydraulics study, which should be performed to confirm adequate freeboard at the ash ponds, and in particular for Ash Disposal Area #1.

10.1.5 Adequacy of Instrumentation and Monitoring of Instrumentation

Instrumentation and monitoring programs are considered inadequate for the current facility operations. Daily water levels are not being measured and recorded, and there is no staff gage for reference in any of the ponds. No piezometers or settlement monuments are installed at any of the ash pond or settling basin dams. Several groundwater quality observation wells and a monitoring program are in place; however, the location of these wells may not provide useful information for dam safety purposes.

10.1.6 Adequacy of Maintenance and Surveillance

The four CCW impoundments at the Cayuga Generating Station have fair maintenance and surveillance programs. The facilities are generally adequately maintained and routine surveillance is performed by Duke Energy staff. However, the 40 year old CMP outlet conduits are at the limit of their service life and their condition has not been fully assessed and addressed. Quarterly inspections are performed and documented by DEI Cayuga Generating Station engineers.

10.1.7 Adequacy of Project Operations

Operating personnel are knowledgeable and are well trained in the operation of the project. The current operations of the facilities are satisfactory.

11.0 Recommendations

11.1 Corrective Measures and Analyses for the Structures

1. A thick growth of trees, many up to 2 feet in diameter, was observed on the Original Ash Pond north perimeter dike downstream slope. The trees should be removed to prevent root systems from creating seepage paths through the embankment slopes. A minimum of about 25 feet of clear space should be provided between the downstream toe and the tree line. Removal of root balls of large trees can cause additional damage to a dike and is not recommended without proper engineering planning and consideration.

2. Trees were observed near the downstream slope of the Secondary Ash Settling Basin east dike and the Original Ash Pond/Ash Disposal Area #1 northeast dike. A minimum of about 25 feet of clear space should be provided between the downstream toe and the tree line. The trees within these areas should be removed within the next year. Removal of root balls of large trees can cause additional damage to a dike and is not recommended without proper engineering planning and consideration.

3. Former animal holes at the toe of the Primary Ash Settling Basin east dike downstream slope have been filled with riprap. The riprap should be further filled with low strength cement fill to prevent erosion and seepage through these areas.

4. Seepage observed along the downstream toe of the Secondary Ash Settling Pond should be measured and monitored for changes. Piezometers should be installed in the east dike to monitor the phreatic surface through the embankment.

5. Seepage should continue to be monitored at the Original Ash Pond / Ash Disposal Area #1 northeast dike. Piezometers should be installed in the dike to monitor the phreatic surface through the embankment.

6. Video inspect the Primary Ash Settling Basin and Secondary Ash Settling Basin CMP outlets for corrosion and damage. Based on the results of the video inspection, additional corrective measures may be required. Seepage through the dike at the outlet locations should be closely monitored. Piezometers should be installed in the dike to monitor the phreatic surface through the embankment.

7. Slope stability analyses for the Original Ash Pond, Ash Disposal Area #1 and Primary Ash Settling Basin and Secondary Ash Settling Basin should analyze the appropriate maximum, or critical, sections. Evaluation of maximum, or critical, sections should include the divider dike between the Primary and Secondary Ash Settling Ponds with a phreatic surface representative of steady seepage at normal water surface conditions. For the Lined Ash Disposal Pond – Cell #1 section, the stability analyses should include a phreatic surface representative of steady

seepage at normal water surface conditions without a geomembrane liner, weaker layers of foundation fly ash in the foundation, and evaluate the influence of the perimeter dam.

8. A liquefaction potential analysis should be conducted for the Lined Ash Disposal Pond – Cell #1 impoundment. Based on the results of this analysis, additional corrective measures may be required.

9. A slope stability and liquefaction analysis should be performed for the divider dike between the Ash Disposal Area #1 and Primary Ash Settling Basin if it is possible that CCW is a foundation material.

10. Based on the simplified evaluation performed for this inspection, and lacking any prior hydrologic studies of the facilities, it appears the Ash Disposal Area #1 would not meet the requirement to safely store or pass the regulatory design flood for a Significant Hazard Structure. The storage capacity and water level of the ash pond units can vary depending on operations. Due to this variability, we recommend Duke Energy maintain the four CCW impoundments at a level that ensures sufficient storage capacity within the units to accept the inflow design storm volume without overtopping the dam. A hydrology and hydraulics study should be completed to ensure adequate freeboard in the ponds, and in particular for Ash Disposal Area #1.

11.2 Corrective Measures Required for Instrumentation and Monitoring Procedures

Daily water levels are not measured and there are no staff gages for reference in any of the ponds or basins. No piezometers or settlement monuments are installed at the ash pond or settling basin dams. We recommend an instrumentation and monitoring program be developed and implemented that would include, at a minimum, piezometers and settlement monuments installed along the dikes of any impoundments that will continue to receive wet coal combustion waste or any dikes currently experiencing seepage. Seepage should be measured and monitored at the observed seepage locations.

11.3 Corrective Measures Required for Maintenance and Surveillance Procedures

Currently, the four CCW impoundments are visually inspected quarterly by Duke Energy staff. We recommend Duke Energy develop and document formal inspections of the ash ponds and settling basins, and include an inspection at a minimum of every 5 years by a third-party professional engineer with experience in dam safety evaluations. We also recommend a brief daily check inspection of the facilities and seepage areas be conducted by DEI personnel.

11.4 Corrective Measures Required for the Methods of Operation of the Project Works

None.

11.5 Acknowledgement of Assessment

I acknowledge that the management unit(s) referenced herein was personally inspected by me and was found to be in the following condition **(select one only):**

SATISFACTORY

FAIR

POOR

UNSATISFACTORY

DEFINITIONS:

SATISFACTORY: No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR: Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

POOR: A management unit safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) 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 any potential dam safety deficiencies.

UNSATISFACTORY: Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

I acknowledge that the management unit referenced herein:

Has been assessed on August 10, 2010

Signature: ______________________

COLORADO REGISTERED PROFESSIONAL ENGINEER STEPHEN G. BROWN 26679 3-10-2011

List of Participants:

Stephen G. Brown, P.E.,	Project Manager/Task Leader, GEI Consultants, Inc.
Gillian M. Hinchliff,	Project Engineer, GEI Consultants, Inc.
Tom Knapke,	Environmental Coordinator, Duke Energy
Owen Schwartz,	Environmental Specialist, Duke Energy
Ron Ehlers,	Senior Engineer, Duke Energy
Peter Massa,	Senior Civil Engineer, Duke Energy

12.0 References

Duke Energy Indiana (DEI) (2009). "CERCLA 104(e) Request for Information Response," prepared for U.S. Environmental Protection Agency, March 25.

Indiana Department of Natural Resources Division of Water (DNR) (2001). General Guidelines for New Dams and Improvements to Existing Dams in Indiana. January.

Patriot Engineering and Environmental, Inc. (Patriot) (2006). "Report of Geotechnical Engineering Investigation Ash Pond Expansion – Cell 1," prepared for Cayuga Generating Station, Duke Energy Indiana, September 10.

Patriot Engineering and Environmental, Inc. (Patriot) (2006). Cayuga Ash Pond Expansion, Field Reports 12/11 – 12/16/06, prepared for Duke Energy, Cayuga Generating Station.

Sargent & Lundy (1966). Design drawings for Cayuga Generating Station including Revisions, prepared for Public Service Indiana. Revisions dated later.

Sargent & Lundy (1998). Design drawings for Cayuga Generating Station including Revisions, prepared for PSI Energy. Revisions dated later.

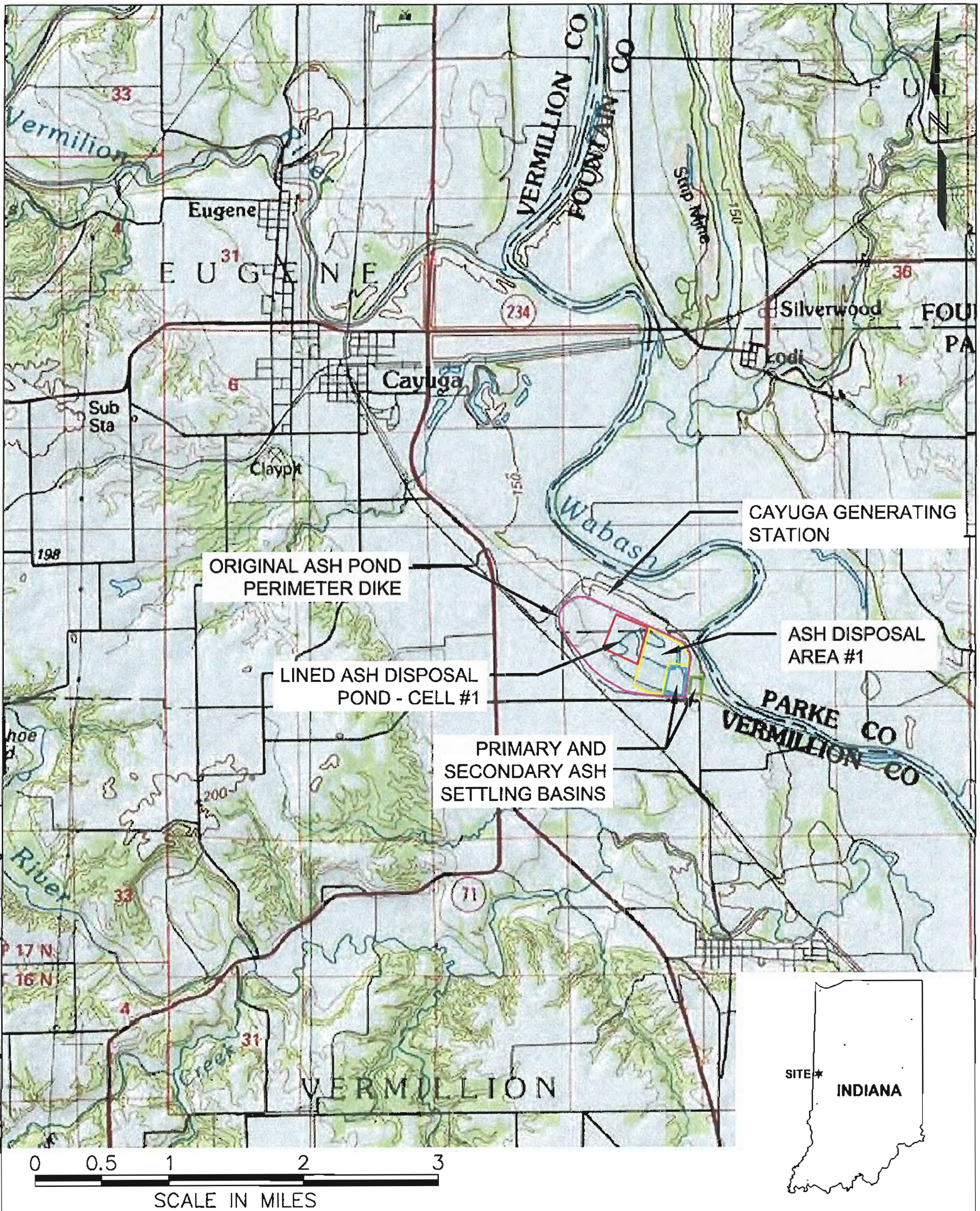
Sargent & Lundy (2006). Design drawings for Lined Ash Disposal Pond – Cell #1, Cayuga Generating Station including Revisions, prepared for Cinergy. Revisions dated later.

Sargent & Lundy (2006). Issue Summary Form SOP-0402-07, Revision 7A. September 26. Revisions dated later.

Sargent & Lundy, LLC (2010). "Cayuga Generating Station Pond Examination Report, SL-010200", prepared for Duke Energy Indiana, May 20.

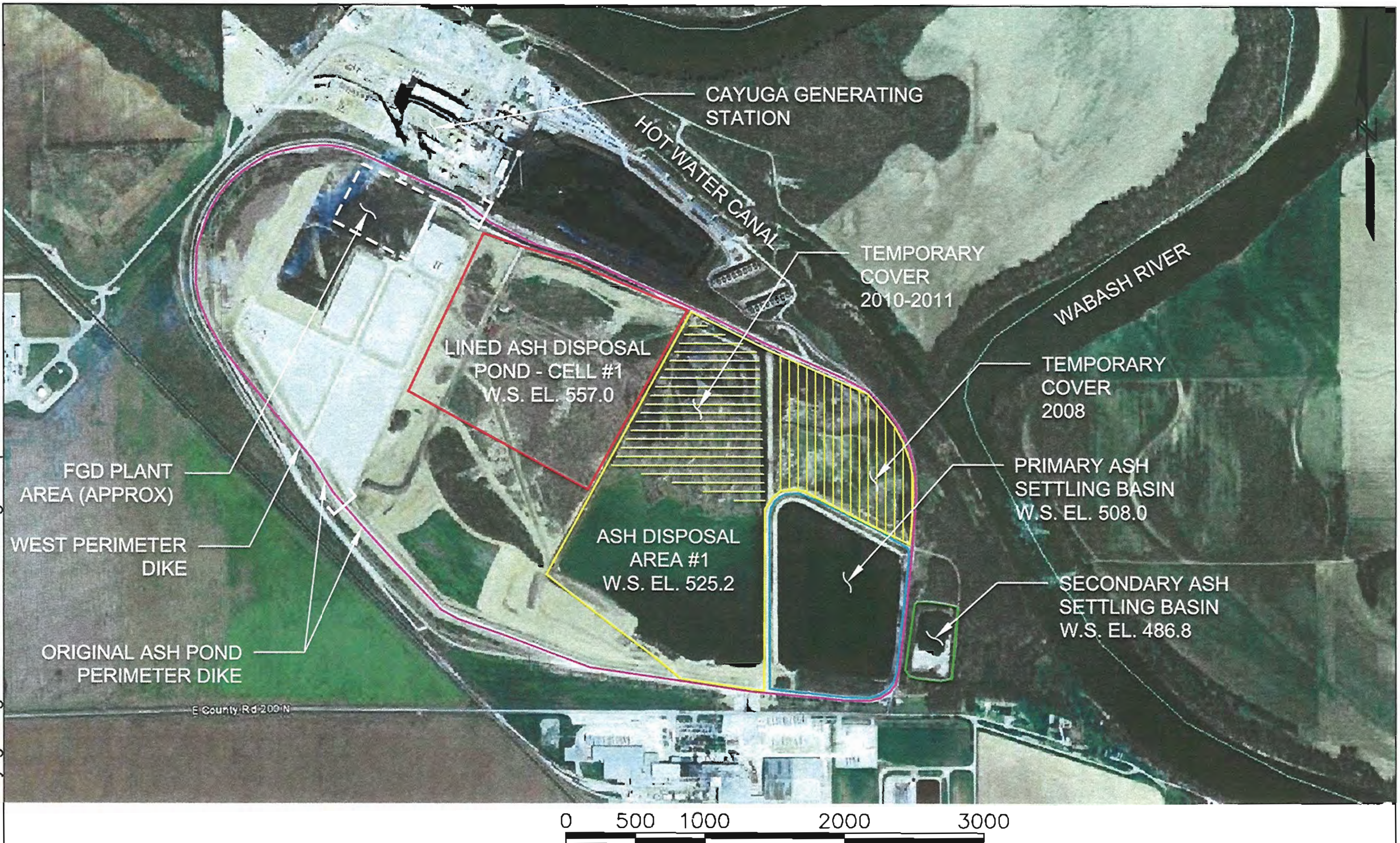
U.S. Army Corps of Engineers (USACE) (1979). "Recommended Guidelines for Safety Inspections of Dams. (ER 1110-2-106)." September 26.

Figures



Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station	GEI Consultants	VICINITY MAP	
Environmental Protection Agency Washington, D.C.	Project 092882	September 2010	Figure 1

P:\092882 - EPA Duke Cayuga\ Figure 1 - Vicinity Map.dwg Sep 2010

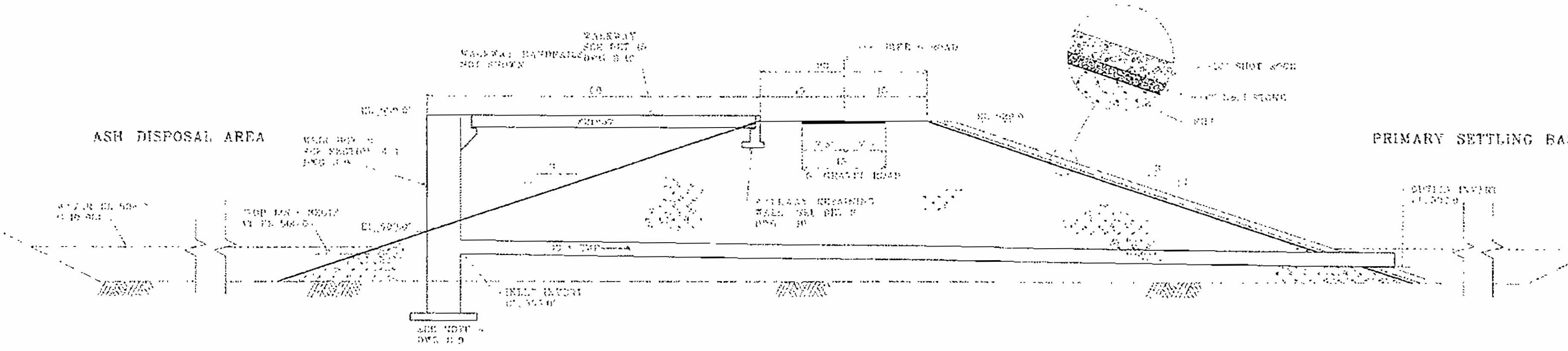


P:\092882 - EPA Duke Cayuga\ Figure 2 - Aerial Plan.dwg Sep 2010

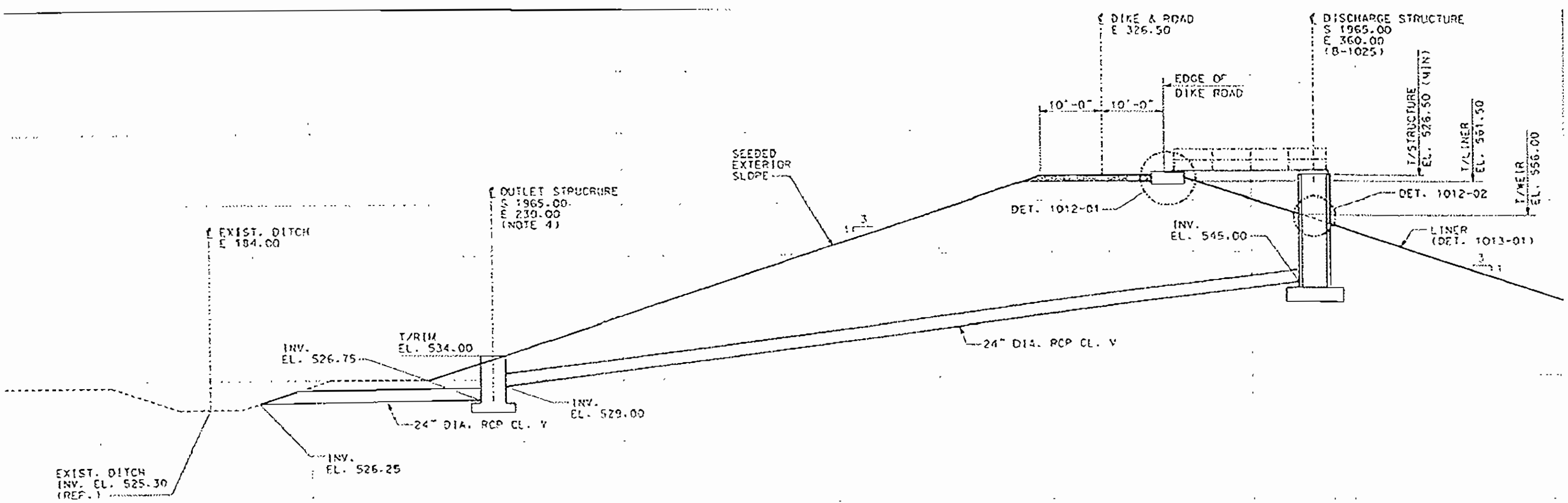
NOTES:

1. PLAN ESTIMATED FROM CAYUGA STATION ASH POND CONFIGURATION MAP AS OF JAN 1, 2010 PREPARED BY DUKE ENERGY.

Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station	GEI Consultants	PLAN OF ASH IMPOUNDMENTS
Environmental Protection Agency Washington, D.C.	Project 092882	September 2010 Figure 2



ORIGINAL PERIMETER DIKE / DIVIDER DIKE - TYPICAL SECTION



LINED ASH DISPOSAL POND - CELL #1 - TYPICAL SECTION

NOTES:

1. SECTIONS FROM CAYUGA GENERATING STATION DESIGN DRAWINGS PREPARD BY SARGENT & LUNDY, 1998 AND 2006.

Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station	GEI Consultants	TYPICAL DAM EMBANKMENT SECTIONS	
Environmental Protection Agency Washington, D.C.	Project 092882	September 2010	Figure 3

P:\092882 - EPA Duke Cayuga\ Figure 3 - Typical Dam Section.dwg Aug 2010

Appendix A

Inspection Checklists

August 10, 2010

Site Name: **Duke Energy Corp., Cayuga Station, IN** Date: **August 10, 2010**

Unit Name: **Ash Disposal Area #1** Operator's Name: **Duke Energy Corporation**

Unit ID: **IN002763** Hazard Potential Classification: High Significant Low **(see P.3)**

Inspector's Name: **Steve Brown/GEI Consultants, Gillian Hinchliff/GEI Consultants**

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?	Quarterly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	~EL.525.2		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	~El. 525		20. Decant Pipes Exit was submerged		
4. Open channel spillway elevation (operator records)?	NA		Is water entering inlet, but not exiting outlet?	NA	
5. Lowest dam crest elevation (operator records)?	EL.529.0		Is water exiting outlet, but not entering inlet?	NA	
6. If instrumentation is present, are readings recorded (operator records)?		X	Is water exiting outlet flowing clear?	NA	
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 sink holes 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
1. Quarterly inspections by DEC engineers started in 2010.	4. There is no open channel spillway
6. There is no instrumentation.	23. Water surface of the downstream Primary Ash Settling Basin is against the dam toe.
9. Trees with ~2' dia. were noted on the Temporary Cover Area, northeastern embankment, downstream slope.	
12. Floating boom serves to catch floating debris.	
21. Seeps/springs were observed on the natural ground below the Temporary Cover Area northeastern embankment downstream slope.	
Duke has recently began monitoring the amount of seepage.	

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # **IN002763** INSPECTOR **Steve Brown/GEI**

Date **August 10, 2010**

Impoundment Name **Ash Disposal Area #1, Duke Energy, Cayuga Station, IN**

Impoundment Company **Duke Energy Corporation**

EPA Region **5**

State Agency (Field Office) Address **Indiana Department of Environmental Management**

100 North Senate Avenue, Indianapolis, IN 46204

Name of Impoundment **Ash Disposal Area #1**
(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: **Impounds fly ash, bottom ash, boiler slag, and other materials**

Nearest Downstream Town: Name **Newport, IN**
Distance from the impoundment **~3 miles**
Impoundment
Location:

Longitude	**87**	Degrees	**25**	Minutes	**15**	Seconds	**W**
Latitude	**39**	Degrees	**54**	Minutes	**53**	Seconds	**N**
State	**IN**	County	**Vermillion**				

Does a state agency regulate this impoundment? YES **X** NO ______

If So Which Sate Agency? **Indiana Department of Natural Resources**

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.

______ **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.

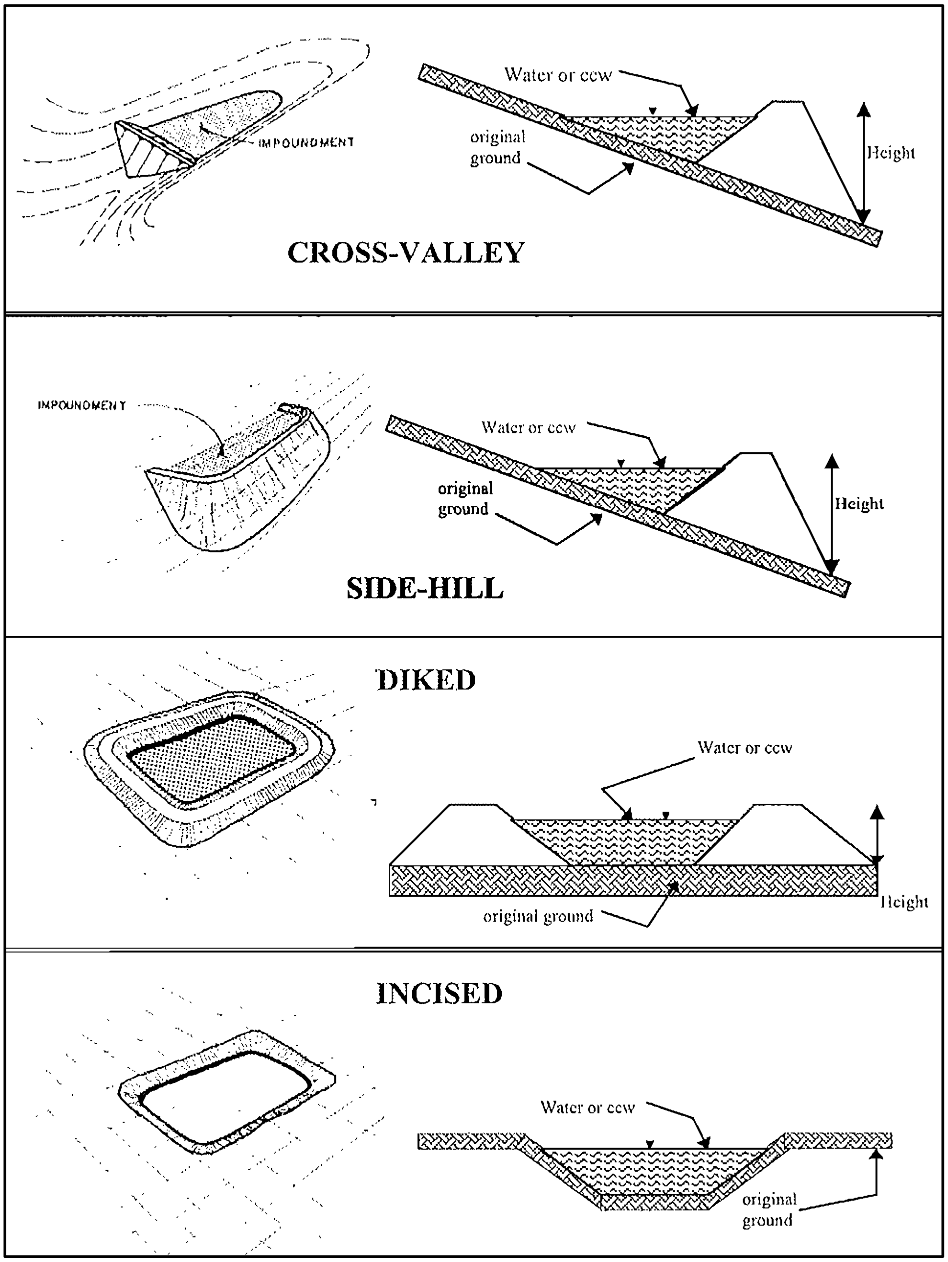
__X__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life, however, CCW would flow into the Wabash River and areas surrounding the pond. River flood waters would likely be widespread with shallow depths and gradually rising waters. Based on potential environmental impacts to the Wabash River and associated economic impacts, the dam should be classified as a "Significant" hazard structure which is consistent with Federal Guidelines for Dam Safety.

CONFIGURATION:



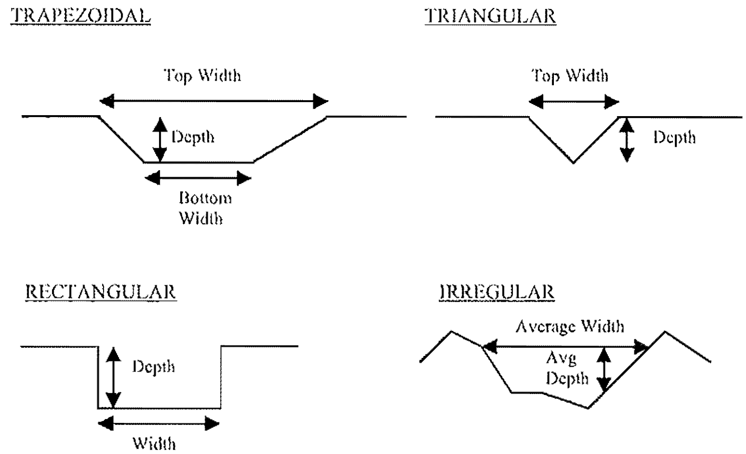
______ Cross-Valley
______ Side-Hill
__X__ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

Embankment Height 47* feet
Embankment Material Alluvial and Eolian Deposits
Pool Area 26** acres
Liner No Liner
Current Freeboard 3.8 ft
Liner Permeability NA

*Based on bottom of pool ~El. 482

**Pool area does not include areas of Temporary Cover

TYPE OF OUTLET (Mark all that apply)

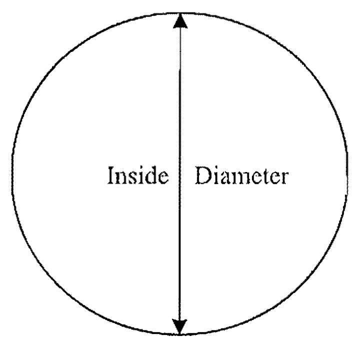


None **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular

______ Depth
______ Bottom (or average) width
______ Top width

X **Outlet**

30" 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 & Lundy Engineers, LLC, Chicago, IL
Impoundment was commissioned in 1970, divider dike with Primary Ash Settling Basin designed 1998.

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 X NO

If So When? **Seep/Natural Springs were observed during GEI's inspection**

If So Please Describe:

Seeps and natural springs were observed at the natural hillside downstream of the northeast dike bounding the Temporary Cover 2008 area. Clear flowing water was visible during inspection. The northeast dike was part of the original perimeter dike constructed in 1970 out of on-site alluvial and eolian deposits. Duke Energy indicated the seeps and natural springs have been observed since shortly after construction with no change. Duke Energy informed GEI that monitoring of the seepage has recently begun. There were no visible signs of movement or other disturbance at the areas of the seeps / natural springs.

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:

Site Name: **Duke Energy Corp., Cayuga Station, IN** Date: **August 10, 2010**

Unit Name: **Lined Ash Pond - Cell #1** Operator's Name: **Duke Energy Corporation**

Unit ID: **IN002763** Hazard Potential Classification: High Significant Low **(see P.3)**

Inspector's Name: **Steve Brown/GEI Consultants, Gillian Hinchliff/GEI Consultants**

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?	Quarterly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	~EL.557.0		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	El. 556.0		20. Decant Pipes		
4. Open channel spillway elevation (operator records)?	El. 562.0		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	EL.562.50		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 sink holes 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
1. Quarterly inspections by DEC engineers started in 2010.	
6. There is no instrumentation.	
8. Constructed over existing co-mingled ash. No overexcavation.	
12. Trashracks were not present.	

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # **IN002763** INSPECTOR **Steve Brown/GEI**

Date **August 10, 2010**

Impoundment Name **Lined Ash Pond - Cell #1, Duke Energy, Cayuga Station, IN**

Impoundment Company **Duke Energy Corporation**

EPA Region **5**

State Agency (Field Office) Address **Indiana Department of Environmental Management**

100 North Senate Avenue, Indianapolis, IN 46204

Name of Impoundment **Lined Ash Pond - Cell #1**
(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: **Impounds fly ash, bottom ash, boiler slag**

Nearest Downstream Town: Name **Newport, IN**
Distance from the impoundment **~3 miles**

Impoundment Location:								
	Longitude	**87**	Degrees	**25**	Minutes	**26**	Seconds	**W**
	Latitude	**39**	Degrees	**55**	Minutes	**9**	Seconds	**N**
	State	**IN**	County	**Vermillion**				

Does a state agency regulate this impoundment? YES **X** NO ____

If So Which Sate Agency? **Indiana Department of Natural Resources**

<u>HAZARD POTENTIAL</u> (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.

______ **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.

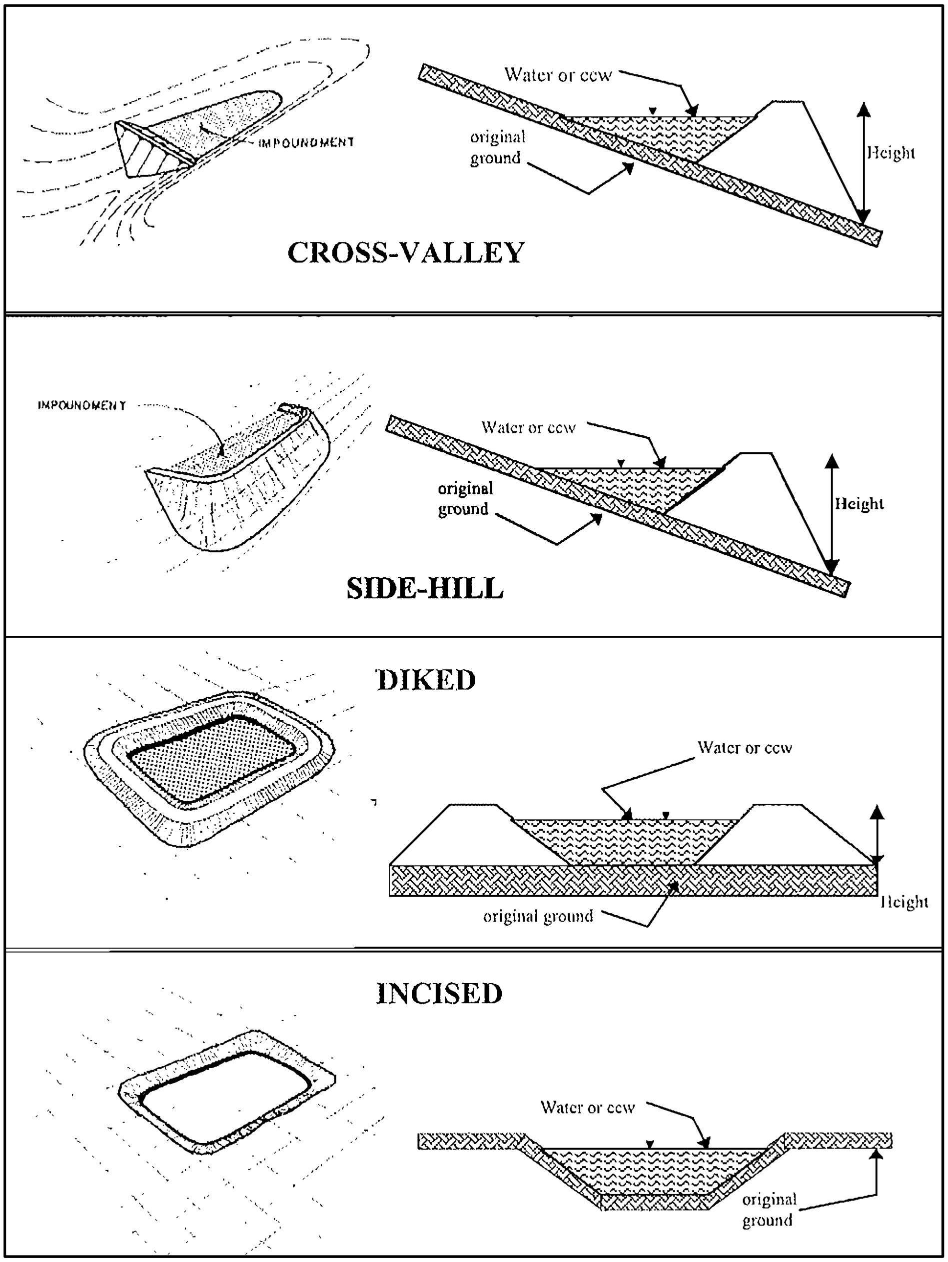
__X__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life, however, CCW would flow into the Wabash River and areas surrounding the pond. River flood waters would likely be widespread with shallow depths and gradually rising waters. Based on potential environmental impacts to the Wabash River and associated economic impacts, the dam should be classified as a "Significant" hazard structure which is consistent with Federal Guidelines for Dam Safety.

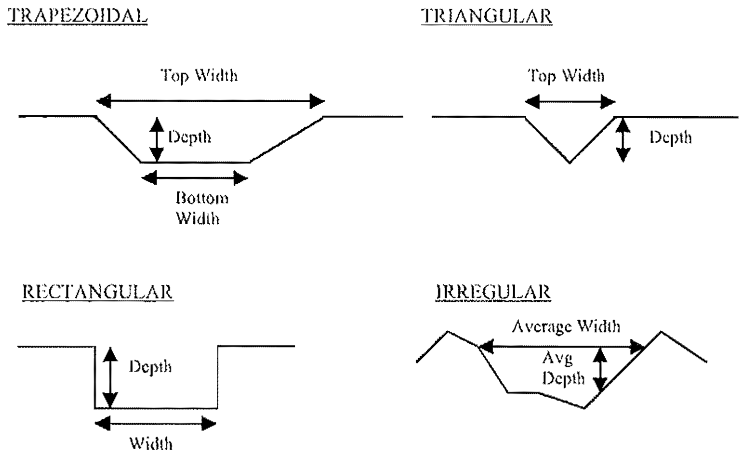
CONFIGURATION:



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

Embankment Height _50.5_ feet Embankment Material _Compacted co-mingled ash_
Pool Area __40__ acres Liner _60 mil HDPE Liner_
Current Freeboard _5.5 ft_ Liner Permeability _HDPE (~1e-8 cm/sec)_

TYPE OF OUTLET (Mark all that apply)

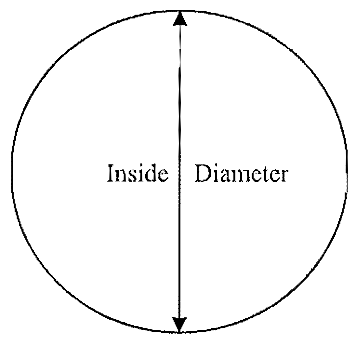


__X__ **Open Channel Spillway**
__X__ Trapezoidal
____ Triangular
____ Rectangular

__0.5'__ Depth
__20'__ Bottom (or average) width
__22'__ Top width

__X__ **Outlet**

__24"__ inside diameter



Material
____ corrugated metal
____ welded steel
__X__ 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 & Lundy Engineers, LLC, Chicago, IL**
Impoundment was commissioned in 2008.

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:

Site Name: **Duke Energy Corp., Cayuga Station, IN** Date: **August 10, 2010**

Unit Name: **Primary Ash Settling Basin** Operator's Name: **Duke Energy Corporation**

Unit ID: **IN002763** Hazard Potential Classification: High Significant Low **(see P.3)**

Inspector's Name: **Steve Brown/GEI Consultants, Gillian Hinchliff/GEI Consultants**

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?	Quarterly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	~EL.508		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	~El. 508		20. Decant Pipes		
4. Open channel spillway elevation (operator records)?	NA		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	EL.529.0		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 sink holes 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
1. Quarterly inspections by DEC engineers started in 2010.	**Evidence of potential seepage was also noted at the southeast dike (divider**
6. There is no instrumentation.	**dike with the Secondary Ash Settling Basin).**
12. Floating trash barrier clear and in place.	**4. There is no open channel spillway.**
21. Evidence of seepage and/or settling was observed on the downstream slope of the east dike at the location of the decant	**23. Water surface of the downstream Secondary Ash Settling Basin is against the downstream toe.**
pipe. Erosion control repairs had been made prior by placing rip rap.	

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # **IN002763** INSPECTOR **Steve Brown/GEI**

Date **August 10, 2010**

Impoundment Name **Pimary Ash Settling Basin, Duke Energy, Cayuga Station, IN**

Impoundment Company **Duke Energy Corporation**

EPA Region **5**

State Agency (Field Office) Address **Indiana Department of Environmental Management**
100 North Senate Avenue, Indianapolis, IN 46204

Name of Impoundment **Primary Ash Settling Basin**
(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: **Impounds ash pond decant water, landfill leachate, and other materials**

Nearest Downstream Town: Name **Newport, IN**
Distance from the impoundment **~3 miles**

Impoundment Location:								
	Longitude	**87**	Degrees	**25**	Minutes	**0**	Seconds	**W**
	Latitude	**39**	Degrees	**54**	Minutes	**51**	Seconds	**N**
	State	**IN**	County	**Vermillion**				

Does a state agency regulate this impoundment? YES **X** NO ______

If So Which Sate Agency? **Indiana Department of Natural Resources**

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.

_____ **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.

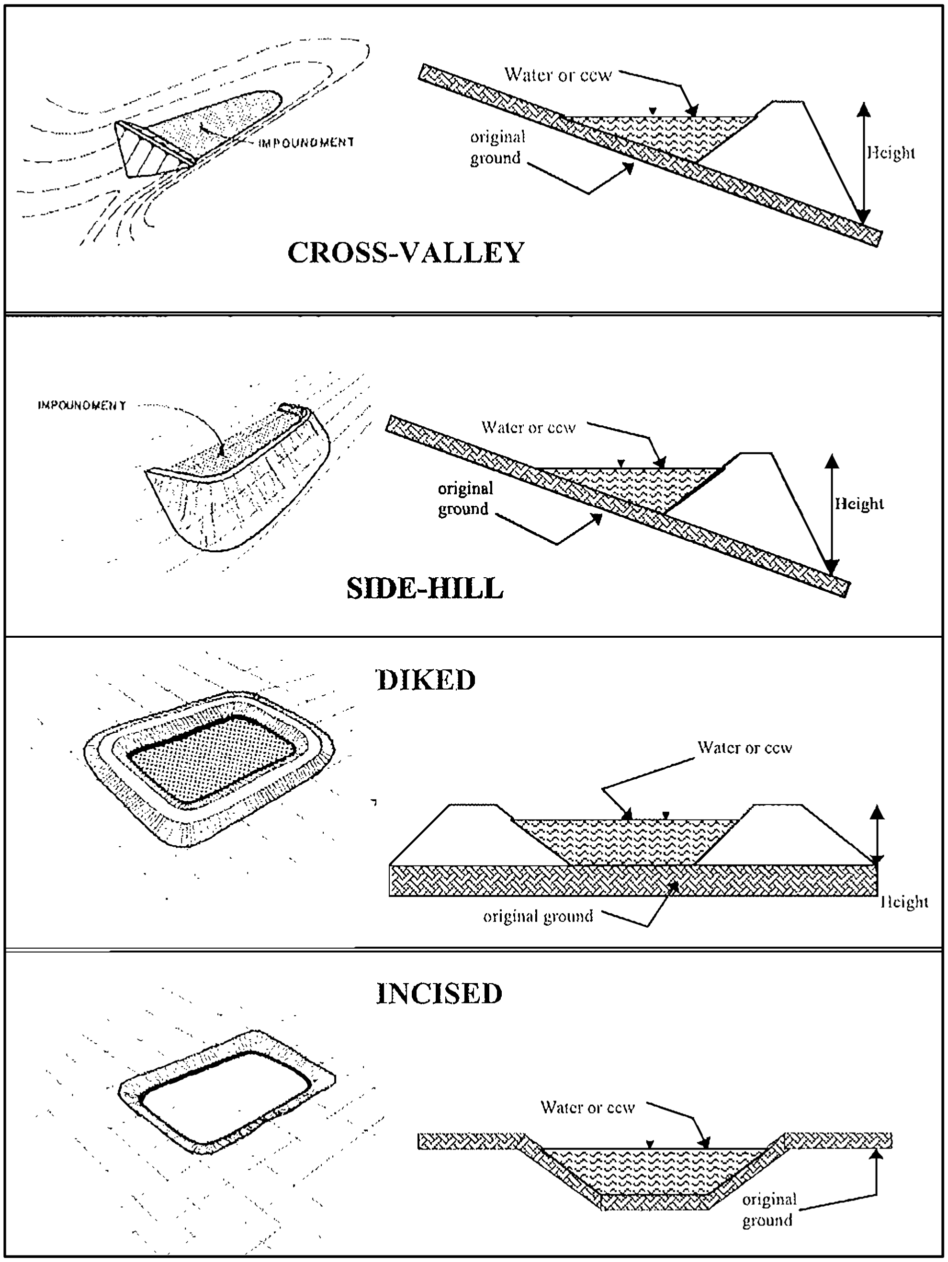
__X__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life, however, pond contents would flow into the Wabash River and areas surrounding the pond. River flood waters would likely be widespread with shallow depths and gradually rising waters. Based on potential environmental impacts to the Wabash River and associated economic impacts, the dam should be classified as a "Significant" hazard structure which is consistent with Federal Guidelines for Dam Safety.

CONFIGURATION:



______ Cross-Valley

______ Side-Hill

__X__ Diked

______ Incised (form completion optional)

______ Combination Incised/Diked

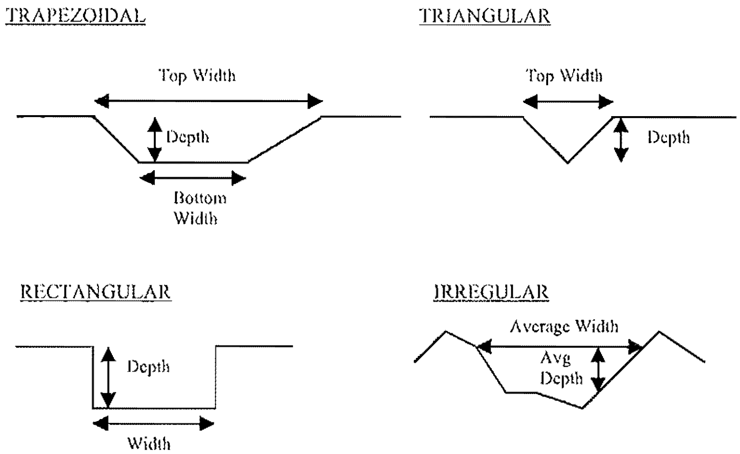
Embankment Height _48*_ feet Embankment Material Alluvial and Eolian Deposits

Pool Area _15_ acres Liner No Liner

Current Freeboard _21 ft_ Liner Permeability NA

*Based on bottom of pool ~El. 481

TYPE OF OUTLET (Mark all that apply)

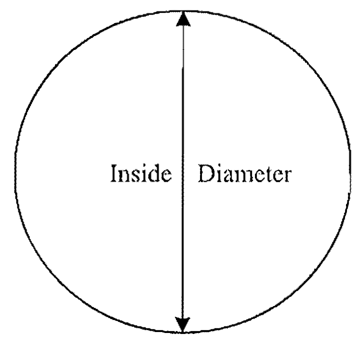


None **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular

______ Depth
______ Bottom (or average) width
______ Top width

_2_ **Outlet**

_24"_ 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 & Lundy Engineers, LLC, Chicago, IL**
Impoundment was commissioned in 1970.

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 X NO ____

If So When? ____

If So Please Describe:

Seepage and/or settlement and erosion were observed on the Primary Ash Settling Basin east dike (divider dike with Secondary Ash Settling Basin) downstream slope. The seepage / settlement is aligned with the location of the decant pipe. Duke Energy has previously placed rip rap at this location to prevent further erosion. The divider dike is part of the original 1970 perimeter dike constructed of alluvial and eolian deposits with no internal drainage system. Seepage is not measured at this location.

Duke Energy reported a wet area at the Primary Ash Settling Basin east dike (divider dike with the Secondary Ash Settling Basin) at the southeastern end of the dam at the downstream toe. Seepage could be occurring through the dam embankment and foundation and through existing natural deposits and flowing downstream into the Secondary Ash Settling Basin. Seepage is not measured at this location.

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:

Site Name: **Duke Energy Corp., Cayuga Station, IN** Date: **August 10, 2010**

Unit Name: **Secondary Ash Settling Basin** Operator's Name: **Duke Energy Corporation**

Unit ID: **IN002763** Hazard Potential Classification: High Significant Low (see P.3)

Inspector's Name: **Steve Brown/GEI Consultants, Gillian Hinchliff/GEI Consultants**

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?	Quarterly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	~EL.486.8		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	~El. 484.8		20. Decant Pipes		
4. Open channel spillway elevation (operator records)?	NA		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	EL.500.0		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 sink holes 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
1. Quarterly inspections by DEC engineers started in 2010.	
6. There is no instrumentation.	
9. Trees up to 2' dia. were observed close to east dike downstream toe.	
12. Duke indicated there is a wire screen to control rodent activity around decant pipe.	
21. Evidence of foundation and/or embankment seepage was observed at the downstream toe of the east dike.	

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # **IN002763**　　INSPECTOR **Steve Brown/GEI**

Date **August 10, 2010**

Impoundment Name **Secondary Ash Settling Basin, Duke Energy, Cayuga Station, IN**

Impoundment Company **Duke Energy Corporation**

EPA Region **5**

State Agency (Field Office) Address **Indiana Department of Environmental Management**
100 North Senate Avenue, Indianapolis, IN 46204

Name of Impoundment **Secondary Ash Settling Basin**
(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: **Impounds ash pond decant water, landfill leachate, and other materials**

Nearest Downstream Town: Name **Newport, IN**
Distance from the impoundment **~3 miles**
Impoundment
Location:

Longitude	**87**	Degrees	**24**	Minutes	**51**	Seconds	**W**
Latitude	**39**	Degrees	**54**	Minutes	**49**	Seconds	**N**
State	**IN**	County	**Vermillion**				

Does a state agency regulate this impoundment? YES **X** NO ______

If So Which Sate Agency? **Indiana Department of Natural Resources**

<u>HAZARD POTENTIAL</u> (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.

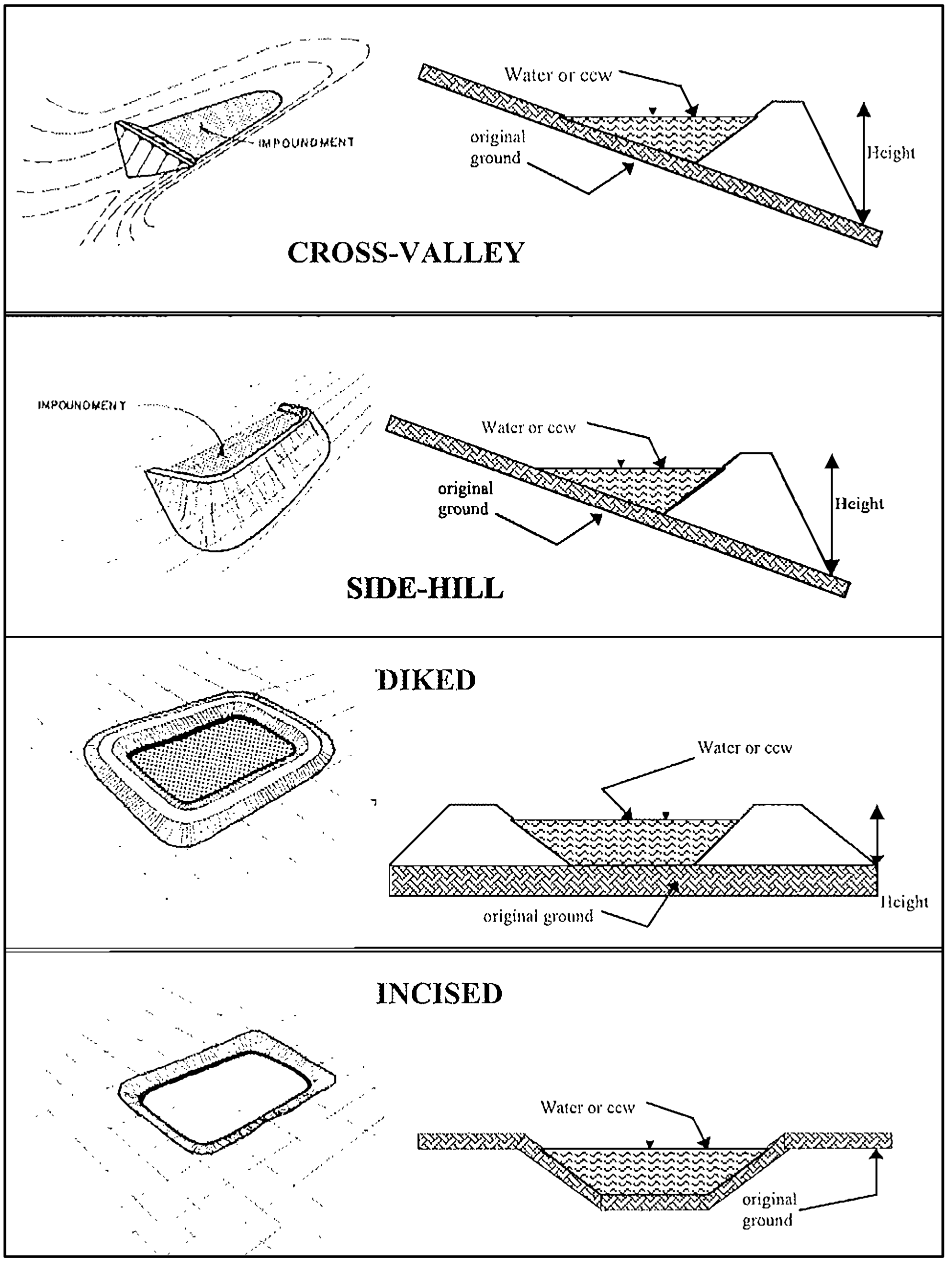
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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:

An uncontrolled release of the structure's contents due to a failure or misoperation is not considered to cause loss of human life or economic / environmental losses as a result of the low hydraulic head, secondary level decanted water quality, and small capacity of the facility. Pond contents would flow into the Wabash River and area immediately surrounding the pond to a shallow depth.

CONFIGURATION:



______ Cross-Valley

______ Side-Hill

__X__ Diked

______ Incised (form completion optional)

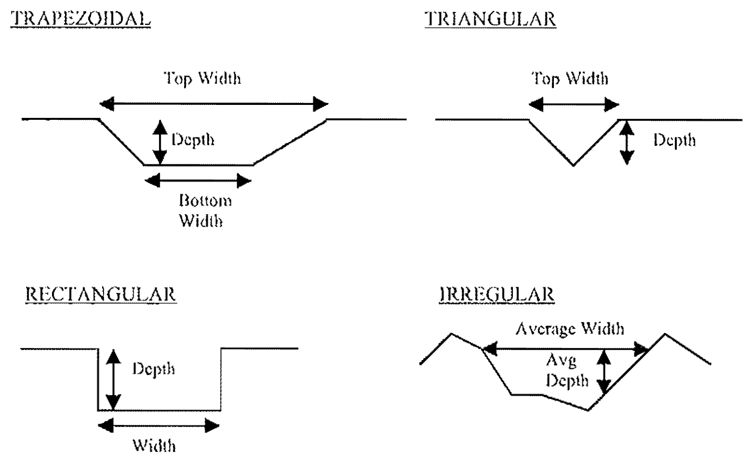
______ Combination Incised/Diked

Embankment Height ~24 feet Embankment Material Alluvial and Eolian Deposits

Pool Area 3 acres Liner No Liner

Current Freeboard 13.2 feet Liner Permeability NA

TYPE OF OUTLET (Mark all that apply)

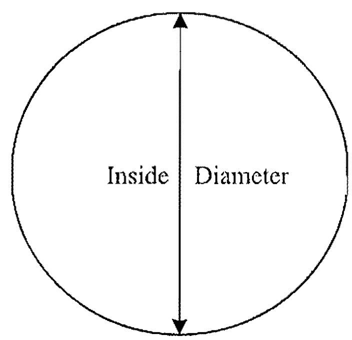


None **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular

______ Depth
______ Bottom (or average) width
______ Top width

X **Outlet**

24" inside diameter



Material
______ corrugated metal
______ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
X other (specify Fiberglass

Is water flowing through the outlet? YES X NO ______

______ **No Outlet**

X **Other Type of Outlet (Specify)** Two 24" CMP

The Impoundment was Designed By Sargent & Lundy Engineers, LLC, Chicago, IL
Impoundment was commissioned in 1970.

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 X NO ____

If So When? Seepage was observed at the time of GEI's inspection

If So Please Describe:

Foundation and/or embankment seepage was observed at the downstream toe of the east dike. The water was flowing clear at the time of the inspection. Duke Energy indicated the water could be the result of seepage from the Primary Ash Settling Basin or seepage through the natural embankment located southeast of the Secondary Ash Settling Basin and could be unrelated to the Secondary Ash Settling Basin east dike. The Secondary Ash Settling Basin dike is part of the original 1970 perimeter dike and is constructed of alluvial and eolian deposits with no internal drainage system. Seepage is not measured at this location. There was no visible sign of movement or disturbance at the downstream toe of the east dike.

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___

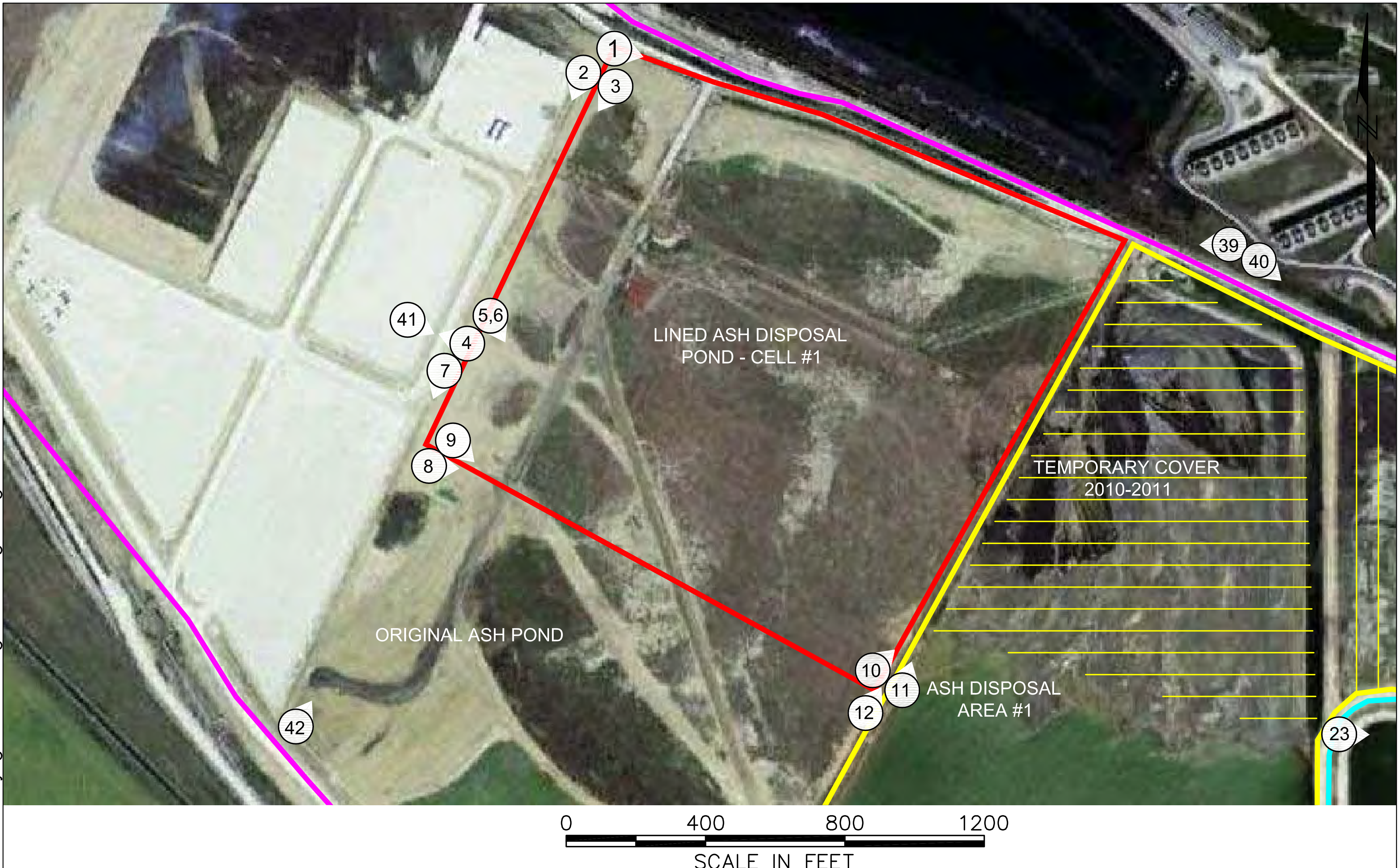
If So which method (e.g., piezometers, gw pumping, …)? ________________________

If So Please Describe:

Appendix B

Inspection Photographs

August 10, 2010



P:\092882 - EPA Duke Cayuga\ Photo Log Aerial.dwg Aug 2010

Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station	GEI Consultants	PHOTO LOCATION MAP (SHEET 1 OF 3)
Environmental Protection Agency Washington, D.C.	Project 092882	September 2010

Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station

Environmental Protection Agency
Washington, D.C.

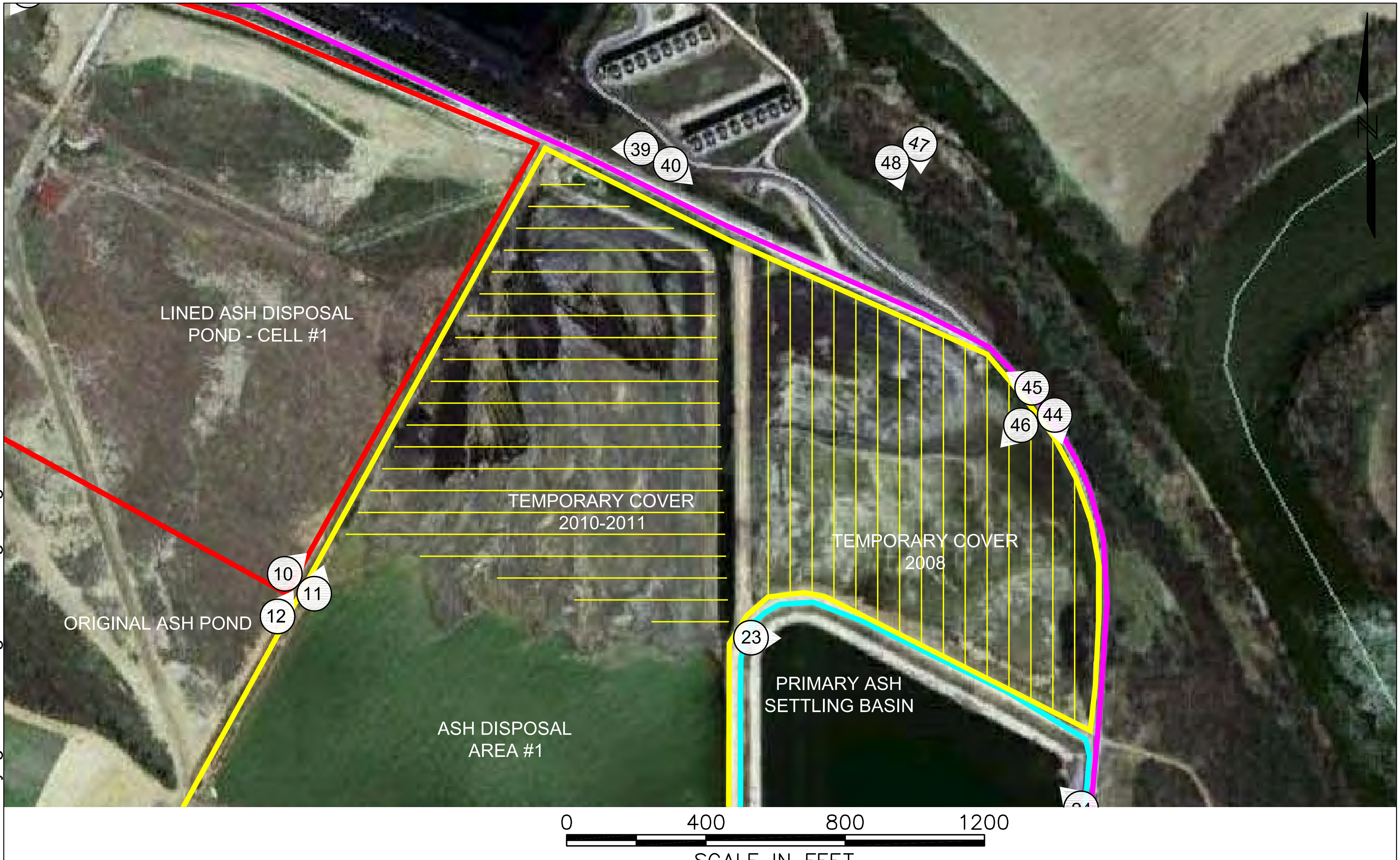
GEI Consultants

Project 092882

PHOTO LOCATION MAP
(SHEET 2 OF 3)

September 2010

P:\092882 - EPA Duke Cayuga\ Photo Log Aerial.dwg Aug 2010



P:\092882 - EPA Duke Cayuga\ Photo Log Aerial.dwg Aug 2010

Assessment of Dam Safety of Coal Combustion Waste Impoundments at DEI Cayuga Generating Station	GEI Consultants	PHOTO LOCATION MAP (SHEET 3 OF 3)
Environmental Protection Agency Washington, D.C.	Project 092882	September 2010

Photo 1: Lined Ash Disposal Pond – Cell #1 - North dike upstream slope and crest, looking east

Photo 2: Lined Ash Disposal Pond – Cell #1 – West dike downstream slope, looking southwest

Photo 3: Lined Ash Disposal Pond – Cell #1 – West dike upstream slope, looking south

Photo 4: Lined Ash Disposal Pond – Cell #1 – Emergency spillway, west dike, looking west

Photo 5: Lined Ash Disposal Pond – Cell #1 – Intake structure, west dike, looking southeast

Photo 6: Lined Ash Disposal Pond – Cell #1 – Intake structure, fixed concrete weir

Photo 7: Lined Ash Disposal Pond – Cell #1 – West dike downstream slope, looking south

Photo 8: Lined Ash Disposal Pond – Cell #1 – South dike downstream slope and crest, looking east

Photo 9: Lined Ash Disposal Pond – Cell #1 – South dike upstream slope, looking east

Photo 10: Lined Ash Disposal Pond – Cell #1 – East dike upstream slope (divider dike with Ash Disposal Area #1), looking north

Photo 11: Ash Disposal Area #1 – West dike upstream slope (divider dike with Lined Ash Disposal Pond – Cell #1), looking north

Photo 12: Divider dike between Lined Ash Disposal Pond – Cell #1 and Ash Disposal Area #1, crest, looking north

Photo 13: Drainage ditch located south of Ash Disposal Area #1, looking east

Photo 14: Ash Disposal Area #1 – South embankment upstream slope, looking east

Photo 15: Ash Disposal Area #1 – South embankment upstream slope, looking west

Photo 16: Ash Disposal Area #1 – East dike upstream slope (divider dike with Primary Ash Settling Pond), looking north

Photo 17: Primary Ash Settling Pond – West dike upstream slope (divider dike with Ash Disposal Area #1), looking north

Photo 18: Primary Ash Settling Pond – South embankment upstream slope, looking east

Photo 19: Ash Disposal Area #1 – Intake structure, weir #5, east dike, looking west

Photo 20: Ash Disposal Area #1 – Intake structure, concrete weir #5

Photo 21: Primary Ash Settling Pond – West dike upstream slope (divider dike with Ash Disposal Area #1), looking north

Photo 22: Ash Disposal Area #1 – East dike upstream slope (divider dike with Primary Ash Settling Pond), looking north

Photo 23: Primary Ash Settling Pond – North dike, upstream slope, looking east

Photo 24: Primary Ash Settling Pond – Intake structure on west dike, concrete weir #2, looking northwest

Photo 25: Primary Ash Settling Pond – Intake structure, concrete weir #2

Photo 26: Primary Ash Settling Pond – East dike upstream slope (divider dike with Secondary Ash Settling Pond), looking south

Photo 27: Primary Ash Settling Pond – East dike upstream slope and south embankment upstream slope, looking south

Photo 28: Secondary Ash Settling Pond – looking southeast

Photo 29: Secondary Ash Settling Pond – West dike upstream slope (divider dike with Primary Ash Settling Pond), note erosion, looking south

Photo 30: Secondary Ash Settling Basin – West dike upstream slope (divider dike with Primary Ash Settling Basin), note erosion, looking north

Photo 31: Secondary Ash Settling Pond – East dike upstream slope, Intake structure weir #3 and #4, looking east

Photo 32: Secondary Ash Settling Basin – West dike upstream slope, note rip rap covering animal holes, looking west

Photo 33: Secondary Ash Settling Pond – East dike upstream slope, looking north

Photo 34: Secondary Ash Settling Basin – East dike downstream slope, note trees within 25' of dam toe, looking north

Photo 35: Secondary Ash Settling Basin – East dike downstream toe, outlet and outlet structure to Wabash River, note seepage along downstream toe of dike at right side of photo, looking northeast

Photo 36: Secondary Ash Settling Basin – Intake structure, weir #4, looking west

Photo 37: Secondary Ash Settling Basin – Outlet to Wabash River, looking east

Photo 38: Secondary Ash Settling Basin – East dike downstream slope, note trees within 25' of dam toe, looking north

Photo 39: Original Ash Pond – North dike downstream slope, note trees, looking southwest

Photo 40: Original Ash Pond – North dike downstream slope, note trees, looking east

Photo 41: Lined Ash Disposal Pond – Cell #1 – Emergency spillway and outlet pipe, looking east

Photo 42: Lined Ash Disposal Pond – Cell #1 – South dike downstream slope and drainage ditch, looking north

Photo 43: Primary Ash Settling Basin – Southwest corner, inlet pipes from drainage ditch, looking west

Photo 44: Ash Disposal Area #1 – Northeast dike downstream slope, looking southeast

Photo 45: Ash Disposal Area #1 – Northeast corner downstream slope, looking northwest

Photo 46: Ash Disposal Area #1 – Temporary Cover 2008 area, looking southwest

Photo 47: Ash Disposal Area #1 – Downstream of northeast dike downstream toe, note seeps / natural springs, looking southeast

Photo 48: Ash Disposal Area #1 – Downstream of northeast dike downstream toe, note seeps / natural springs, looking southeast

Appendix C

Reply to Request for Information Under Section 104(e)

Duke Energy®

DUKE ENERGY CORPORATION
WP994 / 1000 East Main Street
Plainfield, IN 46168-1782

Via Certified Mail 7008 2810 0000 0830 9178

March 25, 2009

Mr. Richard Kinch
US Environmental Protection Agency (5306P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: CERCLA 104(e) Request for Information
Cayuga Generating Station
3300 North State Road Route 63
Cayuga Indiana 47928

Dear Mr. Kinch,

Duke Energy Indiana, Inc. (DEI) hereby responds to the request for information the EPA submitted to the Cayuga Generating Station, letter dated March 9, 2009, under Section 104(e) of CERCLA, 42 USC § 9604(e), relating to surface impoundments or similar diked / bermed management units which receive liquid-borne material for storage or disposal of residuals or by-products from the combustion of coal DEI received this request on March 14, 2009, and today's response complies with the 10-business day deadline.

The attached responses are full and complete and were developed under my supervision with assistance from Duke Energy's Engineering and Technical Services group. The following clarifications should be noted for the attached responses.

- The responses in this submittal are for surface impoundments and the associated secondary / clarifying ponds used for temporary or permanent storage of flyash, bottom ash, boiler slag, and flue gas emission control residues at this station (hereinafter "coal combustion by-products").
    - These ponds are also an integral part of the station's wastewater treatment system used to manage wastewater before discharge.
- The response to the questions does not include ponds that are retired / closed and which no longer contain free liquids.
- The response to questions does not include landfill runoff collection ponds or any other miscellaneous ponds / impoundments that are not designed to or do not regularly receive and store coal combustion by-products.
- Where actual measurements could not be collected within the timeframe allotted by EPA, DEI has provided estimations, which are noted as such.
- The criteria that DEI used to identify any spills or unpermitted releases over the last 10 years in the response to Question #9 include the failure of physical pond or impoundment structures (i.e. berms, dikes, and discharge structures); the criteria do not include exceedances of the NPDES discharge limits that have not already been reported in the discharge monitoring report.

I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate, and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

If you have any questions regarding today's submittal please contact Richard Meiers at our corporate offices at 317-838-1955.

Sincerely,
Duke Energy Indiana, Inc.

Barry E. Pulskamp
Senior Vice President Regulated Fleet Operations

Attachments (3)

Responses to Enclosure A
Inspection Report
Confidential Business Information

cc John Frazier
Cayuga Generating Station
General Manager II Regulated Fossil Fleet
Tom Knapke
Sr. EHS Professional
Richard J. Meiers
Principal Environmental Scientist

Attachment # 1

Response to Questions in Enclosure A

Cayuga Generating Station

March 24, 2009

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less than Low Hazard Potential, please provide the rating for each management unit and indicate which State or federal regulatory agency assigned that rating. If the unit does not have a rating, please note that fact.

Duke Energy Indiana (DEI) is not aware that any National Inventory of Dams criteria rating that has been assigned by a State or Federal Agency for the management units at the Cayuga Generating Station.

2. What year was each management unit commissioned and expanded?

Lined Ash Disposal Pond – Cell #1 was commissioned in 2008.

Ash Disposal Area #1 was commissioned in 1970.

Primary Ash Settling Basin was commissioned in 1970.

Secondary Ash Settling Basin was commissioned in 1970.

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).

Management Unit	Lined Ash Disposal Pond Cell #1	Ash Disposal Area #1	Primary and Secondary Ash Settling Basins
Contents	1, 2, 3	1,2,3,5*	5*

* "Other" includes landfill leachate, water treatment, boiler blow down, coal pile runoff, stormwater runoff, fire protection, mill rejects, floor and laboratory drains and drains from equipment cleaning.

4. Do you have a Professional Engineer's certification for the safety (structural integrity) of the management unit(s)? Please provide a copy if you have one. If you do not have such a certification, do you have other documentation attesting to the safety (structural integrity) of the management unit(s)? If so, please provide a copy of such documentation.

The safety (structural integrity) was certified through the design documents when the Cayuga Generating Station management units were designed and constructed. The Engineering firm responsible for the design was Sargent and Lundy Engineers. Copies of the design documents may be available from our drawing archives. Due to the expediency of the requested reply, DEI is not submitting these documents as part of our response; however, we can research our archival information should there be a future need to submit original design documentation.

5. When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)?

All management units listed in the response to question #2 were last inspected in January, 2009.

Briefly describe the credentials of those conducting the structural integrity assessments/evaluations.

The employee conducting the inspection works at the Cayuga Generating Station is a Senior Civil Engineer, a licensed PE and land surveyor.

Identify actions taken or planned by facility personnel as a result of these assessments or evaluations.

See attached inspection report (Attachment 2).

If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors.

See attached Inspection report (Attachment 2).

If the company plans an assessment or evaluation in the future, when is it expected to occur?

December, 2009 to January, 2010.

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.

The Cayuga Station has not had State or Federal regulatory officials performing ash pond dike inspections in the last five years. DEI is not aware of any federal or state agency inspection reports. The state regulatory agency governing dams would be the Indiana Department of Natural Resources (IDNR).

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.

> DEI is not aware of any State or Federal regulatory officials conducting assessments, evaluations or inspections at the Cayuga Generating Station within the past year.

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of material currently stored in each of the management unit(s). Please provide the date that the volume measurement was taken.

> The response to this question contains Confidential Business Information, which is of a competitive and commercial nature, pursuant to 40 C.F.R. Part 2. Our response is therefore provided in a separate attachment (Attachment 3), which has been labeled "CBI." DEI requests that EPA treat the information in Attachment 3 as CBI and safeguard it from inadvertent disclosure and contact DEI if EPA receives a request for this CBI.

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

> There have been no spills or unpermitted releases from any of the management units listed in response #2 over the past ten years.

10. Please identify all current legal owner(s) and operator(s) at the facility.

> Duke Energy Indiana, Inc. is the legal owner and operator at the facility.

Attachment #3

CBI

This attachment contains Confidential Business Information, which is of a competitive and commercial nature, pursuant to 40 C.F.R. Part 2. DEI requests that EPA treat the information in Attachment 3 as CBI and safeguard it from inadvertent disclosure and contact DEI if EPA receives a request for this CBI.

Cayuga Generating Station
Response to Question # 8

Lined Ash Disposal Pond – Cell #1 was commissioned in 2008.

- 40 acres in total surface area with 1,400 acre/feet of total storage volume
- The station estimated in December 2008 that the pond was approximately 5% full

Ash Disposal Area #1 was commissioned in 1970.

- 26 acres in total surface area with 260 acre/feet of total storage volume
- The station estimated in December 2008 that the pond was approximately 89% full

Primary Ash Settling Basin was commissioned in 1970.

- 15 acres in total surface area with 225 acre/feet of total storage volume
- There is only a small amount of residual solids in pond

Secondary Ash Settling Basin was commissioned in 1970.

- 3 acres in total surface area with 36 acre/feet of total storage volume
- There is only a small amount of residual solids in pond