

**ALLIANT ENERGY**  
**Interstate Power and Light Company**  
**Ottumwa Generating Station**

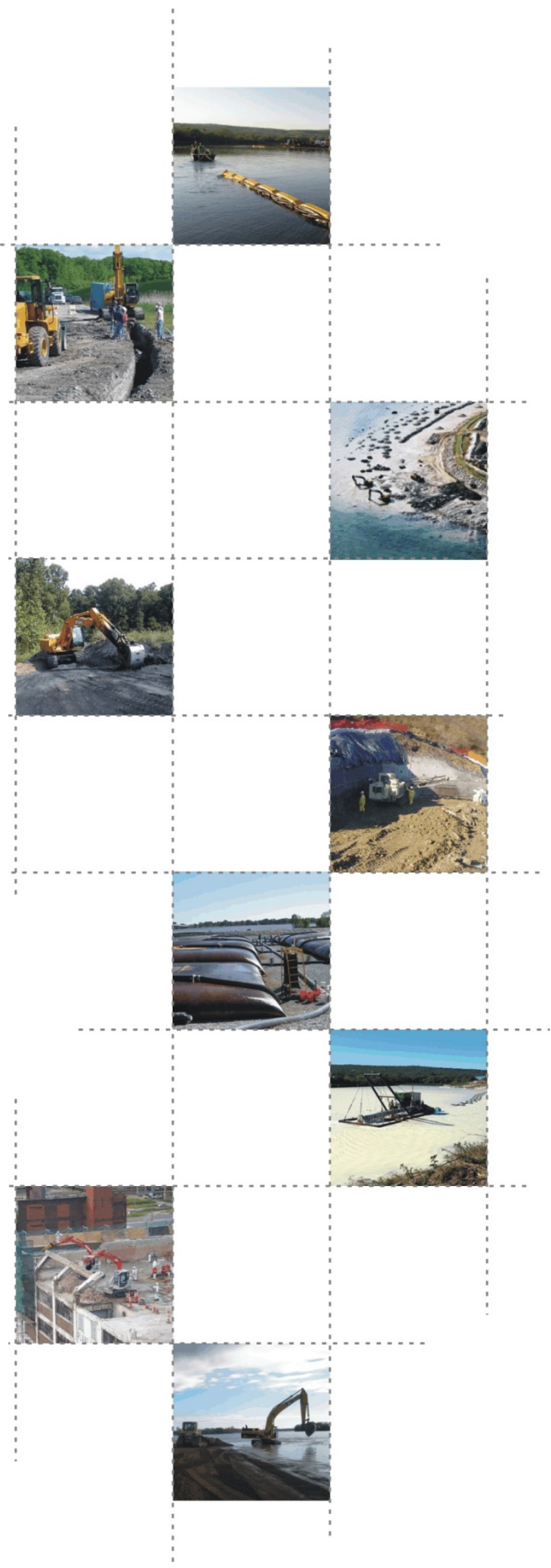
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**CCR SURFACE IMPOUNDMENT**

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**STRUCTURAL STABILITY ASSESSMENT**

Report Issued: September 29, 2016  
Revision 0



## EXECUTIVE SUMMARY

This Structural Stability Assessment (Report) is prepared in accordance with the requirements of the United States Environmental Protection Agency (USEPA) published Final Rule for Hazardous and Solid Waste Management System – Disposal of Coal Combustion Residual from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 and effective October 19, 2015.

This Report assesses the structural stability of each CCR unit at Ottumwa Generating Station in Ottumwa, Iowa in accordance with §257.73(b) and §257.73(d) of the CCR Rule. For purposes of this Report, “CCR unit” refers to an existing or inactive CCR surface impoundment.

Primarily, this Report is focused on documenting whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded within each CCR unit.



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# 1 Introduction

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. This Report is prepared in accordance with the requirements of §257.73(b) and §257.73(d) of the CCR Rule.

## 1.1 CCR Rule Applicability

The CCR Rule requires a periodic structural stability assessment by a qualified professional engineer (PE) for existing CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more; or the existing CCR surface impoundment has a height of 20 feet or more (§257.73(b)).

On August 5<sup>th</sup>, 2016, USEPA published revisions to the CCR Rule (the “Extension Rule”) that extend the above requirements to inactive CCR surface impoundments with different deadlines. The effective date of the Extension Rule is October 4<sup>th</sup>, 2016.

## 1.2 Structural Stability Assessment Applicability

The Ottumwa Generating Station (OGS) in Ottumwa, Iowa (Figure 1) has one existing and one inactive CCR surface impoundments that meet the requirements of §257.73(b)(1) or §257.73(b)(2) of the CCR Rule, which are identified as follows:

- OGS Ash Pond
- OGS Zero Liquid Discharge Pond



## 2 FACILITY DESCRIPTION

OGS is located approximately ten miles northwest of Ottumwa, Iowa on the western shore of the Des Moines River in Wapello County, at 20775 Power Plant Road, Ottumwa, Iowa (Figure 1). The McNeese Wildlife Area is located to the southeast of OGS. Middle Avery Creek, which flows to the northeast into the Des Moines River, is located to the south and east of OGS.

OGS is a fossil-fueled electric generating station consisting of one steam electric generating unit. Sub-bituminous coal is the primary fuel for producing steam. The burning of coal produces a by-product of CCR. The CCR at OGS is categorized into three types; bottom ash, fly ash, and flue gas desulfurization (scrubber) byproducts. The fly ash also can be subdivided into two types, economizer fly ash and precipitator fly ash.

The majority of precipitator fly ash is collected by the electrostatic precipitators and sent to the on-site storage silo located on the west side of the generating plant. Historically, the precipitator fly ash has then either been transported off-site for beneficial reuse or was placed in the fly ash reclamation processing area adjacent to the coal pile storage area for the purposes of producing hydrated fly ash. In the fly ash reclamation processing area, the fly ash was rolled out, compacted, hydrated, and allowed to dry into a very hard, cement-like material that was stored in this area until transported off-site. Although this fly ash hydrating process has occurred in the past, this process ceased prior to October 19, 2015.

The precipitator fly ash that is not collected by the electrostatic precipitators becomes part of the flue gas desulfurization pollution control process at OGS. Activated carbon is injected into the flue gas stream and binds with mercury. This flue gas stream travels to the spray dry desulfurization towers. From there, a water based slurry of hydrated (slaked) lime is injected into the spray dry desulfurization towers. The hydrated lime reacts with the sulfur compounds in the flue gas and the water evaporates. A precipitate is left that consists of activated carbon bound to mercury, calcium sulfate, calcium sulfite,



unreacted slaked lime, and some unreacted fly ash. This flue gas stream is directed to the bag house where the particulate matter is removed. A portion of the solids are recycled back to the process and the rest of the scrubber byproducts are sent to the air quality control system byproduct silo. The material from the byproduct silo is mixed with water in a pin mixer to reduce dust, loaded into trucks, and transported to the off-site Ottumwa-Midland CCR landfill for disposal.

The bottom ash and economizer fly ash at OGS are sluiced to a surface impoundment identified as the OGS Ash Pond (Figure 2). The OGS Ash Pond is located east of the generating plant and is presently the only existing CCR surface impoundment at OGS.

In addition to the OGS Ash Pond, OGS has one inactive CCR surface impoundment identified as the OGS Zero Liquid Discharge (ZLD) Pond. The OGS ZLD Pond is located northeast of the generating plant and north of the OGS Ash Pond. The OGS ZLD Pond, presently, only receives surface water runoff from the surrounding area.

General Facility Information:

- Date of Initial Facility Operations: 1981
- NPDES Permit Number: IA90-001-01
- Latitude / Longitude: 41°5'53"N 92°33'17"W
- Nameplate Ratings: Unit 1 (1981) 725 MW

## 2.1 OGS Ash Pond

The OGS Ash Pond is located east of the generating plant on the eastern portion of the site. The OGS Ash Pond receives influent flows from the generating plant floor drains, oil/water separator, boiler blow down water, solid contact unit sludge, sluiced CCR (bottom ash and economizer fly ash), recirculating media sanitary treatment plant, and surface water runoff from the generating site proper.



The sluiced CCR is discharged into the west end of the OGS Ash Pond. The sluiced CCR is discharged into a collection pad area where the majority of CCR is recovered. A dozer is used to scrape the collection pad and push the CCR into a stockpile for dewatering. Once dewatered, the CCR is then loaded into over-the-road haul trucks for transporting off-site. The sluiced water from the CCR drains into a narrow channel that flows into the southwest portion of the OGS Ash Pond. Routine maintenance dredging of the narrow channel occurs as the CCR settles out in the channel. Approximately 4 million gallons per day (MGD) of process water is recirculated back into OGS for reuse.

The water in the OGS Ash Pond from other sources flows to the east and discharges through the facility's National Pollution Discharge Elimination System (NPDES) Outfall 001, located in the northeast corner of the OGS Ash Pond. NPDES Outfall 001 consists of a concrete discharge structure with a six foot wide overflow weir and includes a Parshall flume and instrumentation to measure the flow of the discharged water. The water flows through the NPDES Outfall 001 and discharges into an unnamed creek at an average rate of 1.54 MGD. The water flows through the NPDES Outfall 001 and discharges into an unnamed creek. The unnamed creek flows into the Des Moines River downstream of the water intake structure and before the confluence of Middle Avery Creek.

The surface area of the OGS Ash Pond is approximately 18 acres and has an embankment height of approximately 25 feet from the crest to the toe of the downstream slope. The interior storage depth of the OGS Ash Pond is approximately 20 feet. Currently, the total volume of impounded CCR and water within the OGS Ash Pond is approximately 556,000 cubic yards.

## **2.2 OGS Zero Liquid Discharge Pond**

The OGS Zero Liquid Discharge (ZLD) Pond is located northeast of the generating plant on the eastern portion of the site and north of the OGS Ash Pond. The OGS ZLD Pond historically received influent flows from the generating plant that consisted of boiler wash water, air heater wash, turbine chemical cleaning water, and boiler chemical



cleaning water. Presently, the OGS ZLD Pond only receives storm water runoff from the surrounding area, which includes the inactive hydrated fly ash area located west of the surface impoundment, as well as occasional excess storm water runoff from the coal pile storage area. One 24-inch diameter high-density polyethylene culvert connects the coal pile runoff pond to the OGS ZLD Pond. The culvert is used as an emergency overflow to route storm water from the coal pile runoff pond into the OGS ZLD Pond.

The OGS ZLD Pond does not currently discharge. Two 48-inch diameter concrete culverts, located along the south embankment, previously connected the OGS ZLD Pond to the OGS Ash Pond prior to being permanently sealed off with concrete.

The OGS ZLD Pond covers a surface area of approximately 19 acres and has an embankment height of approximately 29 feet from crest to toe of the downstream slope. The interior storage depth of the OGS ZLD Pond is approximately 25 feet. Based on readily available information, the OGS ZLD Pond has a total storage capacity of approximately 515,000 cubic yards.





### **3 STRUCTURAL STABILITY ASSESSMENT- §257.73(d)**

This Report documents whether the design, construction, operation, and maintenance of each CCR unit is consistent with recognized and generally accepted good engineering practices for maximum volume of CCR and CCR wastewater which can be impounded.

#### **3.1 OGS Ash Pond**

The OGS Ash Pond was constructed in 1975 using native clay from onsite for construction of embankments for the impoundment. The embankments were constructed on the native clay and the impoundment is subject to water loss mainly from evaporation and the discharge of water that is not reused for sluicing.

Borings for the installation of monitoring wells were installed through the embankment in April of 2016 and form the current understanding of embankment and foundation soils for the OGS Ash Pond, Appendix A. The outfall structure for the OGS Ash Pond is a concrete weir box with six foot wide overflow weir and a Parshall flume for flow monitoring. The weir box discharges under the embankment through two 66-inch diameter reinforced concrete pipes, Appendix B

##### **3.1.1 CCR Unit Foundation and Abutments - §257.73(d)(1)(i)**

The foundation soil is a medium stiff to stiff low plasticity clay (CL) with an unconfined compressive strength of 2,000 psf. The clay is underlain by a deposit of very dense sand (SP) over rock at an elevation of approximately 625 feet. The foundation soils are adequate for the support of the approximately 24 foot high embankment with acceptable safety factors as shown in the OGS Safety Factor Assessment Report §257.73(b) and (e).

##### **3.1.2 Slope Protection - §257.73(d)(1)(ii)**

The impoundment is incised on the portions of the north side and all of the west side. The crest of the embankments is approximately 20 feet wide and the downstream slope of the embankment is approximately a 3:1 vegetated slope. The east and portion of the north sides also have an embankment crest of 20 feet and consist of a 3:1 vegetated slope.



Well established and managed vegetation will minimize surface erosion on both the upstream and downstream slopes. Additionally, storm water runoff is limited to the crest and downstream slope of the embankment, which limits the erosive force. Therefore the impoundment configuration protects against surface erosion. Additionally, erosion due to wave action will have minimal impacts to the embankments.

Sudden drawdown is addressed in Section 3.2.7.

### **3.1.3 CCR Embankment Density- §257.73(d)(1)(iii)**

The embankment is constructed of compacted low plasticity clay. The borings shown in Appendix A indicate an unconfined compressive strength of 3,200 psf. The strength of the clay indicates that the clay was compacted at optimum moisture during construction of the embankments and that the density of the embankments are adequate. Analysis of the slope safety factor in the OGS Safety Factor Assessment Report §257.73(b) and (e) indicate the foundation soils control the minimum safety factors for the slope.

### **3.1.4 Vegetation Management - §257.73(d)(1)(iv)**

Historically vegetation management has been conducted on a periodic basis. At the time of the initial Annual Inspection in October 2015, the select areas of the upstream and downstream slopes could not be properly inspected due to the presence of dense/tall grassy vegetation. Since the Annual Inspection, the facility has managed the vegetation to facilitate effective inspections. The facility plans to continue managing the vegetation on the embankments at a height that facilitates effective inspections.

### **3.1.5 Spillway Management - §257.73(d)(1)(v)**

The OGS Ash Pond is equipped with two side-by-side 66-inch diameter reinforced concrete pipes to drain process water and storm water from the concrete box structure in east corner of the impoundment, Figure 2. The culverts and drainage structure are constructed of non-erodible material and designed to carry sustained flows.

The culverts are checked for malfunction (e.g., blockages, deformations) during the weekly inspections by the facility personnel.



This impoundment currently has a hazard potential classification of “Low,” which in turn requires an evaluation of the impacts of a 100 year rainfall event. The Inflow Flood Control Plan, which is a separate document developed to comply with §257.82, shows that the precipitation from this event will drain through the culverts without overtopping the embankments of the impoundment.

### **3.1.6 Hydraulic Structures - §257.73(d)(1)(vi)**

The two 66-inch diameter outlet pipes under the embankment provide adequate discharge capacity that is independent of the flood stage in Middle Avery Creek. On June 20, 2016 the pipes were inspected using remote camera video inspection. The inspection showed that there was minimal deterioration, deformation, distortion, sedimentation, debris, and no bedding deficiencies were observed.

### **3.1.7 Sudden Drawdown - §257.73(d)(1)(vii)**

The toe of the embankment could be flooded if the Des Moines River exceeds flood elevation of 656 feet. The embankments and the foundation soils are clay and there will be no sudden drawdown seepage pressure from the short-term impacts from floodwaters receding.

## **3.2 OGS Zero Liquid Discharge Pond**

The OGS ZLD Pond was constructed in 1975 using native clay from the site for construction of embankments for the impoundment. The embankments were constructed on the native clay and the impoundment is subject to water loss from evaporation. The impoundment presently does not discharge water and the former discharge pipes to the OGS Ash Pond are permanently sealed. The OGS ZLD Pond could accept water from the coal pile runoff pond under certain severe storm events.

Borings for the installation of monitoring wells were installed through the embankment in April of 2016 and form the current understanding of embankment and foundation soils for the impoundment, Appendix A.



### **3.2.1 CCR Unit Foundation and Abutments - §257.73(d)(1)(i)**

The foundation soil is a medium stiff to stiff low plasticity clay (CL) with an unconfined compressive strength of 2,000 psf. The clay is underlain by a deposit of very dense sand (SP) over rock at an elevation of approximately 625 feet. The foundation soils are adequate for the support of the approximately 30 foot high embankment with acceptable safety factors as shown in the OGS Safety Factor Assessment Report §257.73(b) and (e).

### **3.2.2 Slope Protection - §257.73(d)(1)(ii)**

The impoundment is incised on the west side. The south, east and north crest of the embankments is approximately 20 feet wide and the downstream slope of the embankment is approximately a 3:1 vegetated slope.

Well established and managed vegetation will minimize surface erosion on both the upstream and downstream slopes. Additionally, storm water runoff is limited to the crest and downstream slope of the embankment, which limits the erosive force. Therefore the impoundment configuration protects against surface erosion. Additionally, erosion due to wave action will have minimal impacts to the embankments.

Sudden drawdown is addressed in Section 3.2.7.

### **3.2.3 CCR Embankment Density- §257.73(d)(1)(iii)**

The embankment is constructed of compacted low plasticity clay. The borings shown in Appendix A indicate an unconfined compressive strength of 3,200 psf. The strength of the clay indicates that the clay was compacted at optimum moisture during construction of the embankments and that the density of the embankments are adequate. Analysis of the slope safety factor in the OGS Safety Factor Assessment Report §257.73(b) and (e) indicate the foundation soils control the minimum safety factors for the slope.

### **3.2.4 Vegetation Management - §257.73(d)(1)(iv)**

Historically vegetation management has been conducted on a periodic basis. From previous inspections, select areas of the upstream slopes have had the presence of shrub



vegetation. The facility plans to continue managing the vegetation on the embankments at a height that facilitates effective inspections.

### **3.2.5 Spillway Management - §257.73(d)(1)(v)**

The OGS ZLD Pond is a zero liquid discharge impoundment. The former spillway, which consisted of two 48-inch RCP pipes are permanently sealed. The storm water that collects within the OGS ZLD Pond exfiltrates and evaporates, Figure 2.

This impoundment currently has a hazard potential classification of “Low,” which in turn requires an evaluation of the impacts of a 100 year rainfall event. The Inflow Flood Control Plan, which is a separate document developed to comply with §257.82, shows that the precipitation from this event will be contained within the limits of the impoundment without overtopping the embankments.

### **3.2.6 Hydraulic Structures - §257.73(d)(1)(vi)**

No active hydraulic structures are associated with this OGS ZLD Pond. The abandoned discharge pipe is filled with concrete and the June 20, 2016 pipe inspection showed no signs of deterioration, deformation, or distortion.

### **3.2.7 Sudden Drawdown - §257.73(d)(1)(vii)**

The toe of the embankment could be flooded if the Des Moines River exceeds flood elevation of 652 feet. The embankments and the foundation soils are both clay and there will be no sudden drawdown seepage pressure from the short-term impacts of toe flooding.



## 4 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(d)(3), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(d).



By: *Mark Loerop*

Name: *Mark Loerop*

Date: *9/30/2016*



## FIGURES

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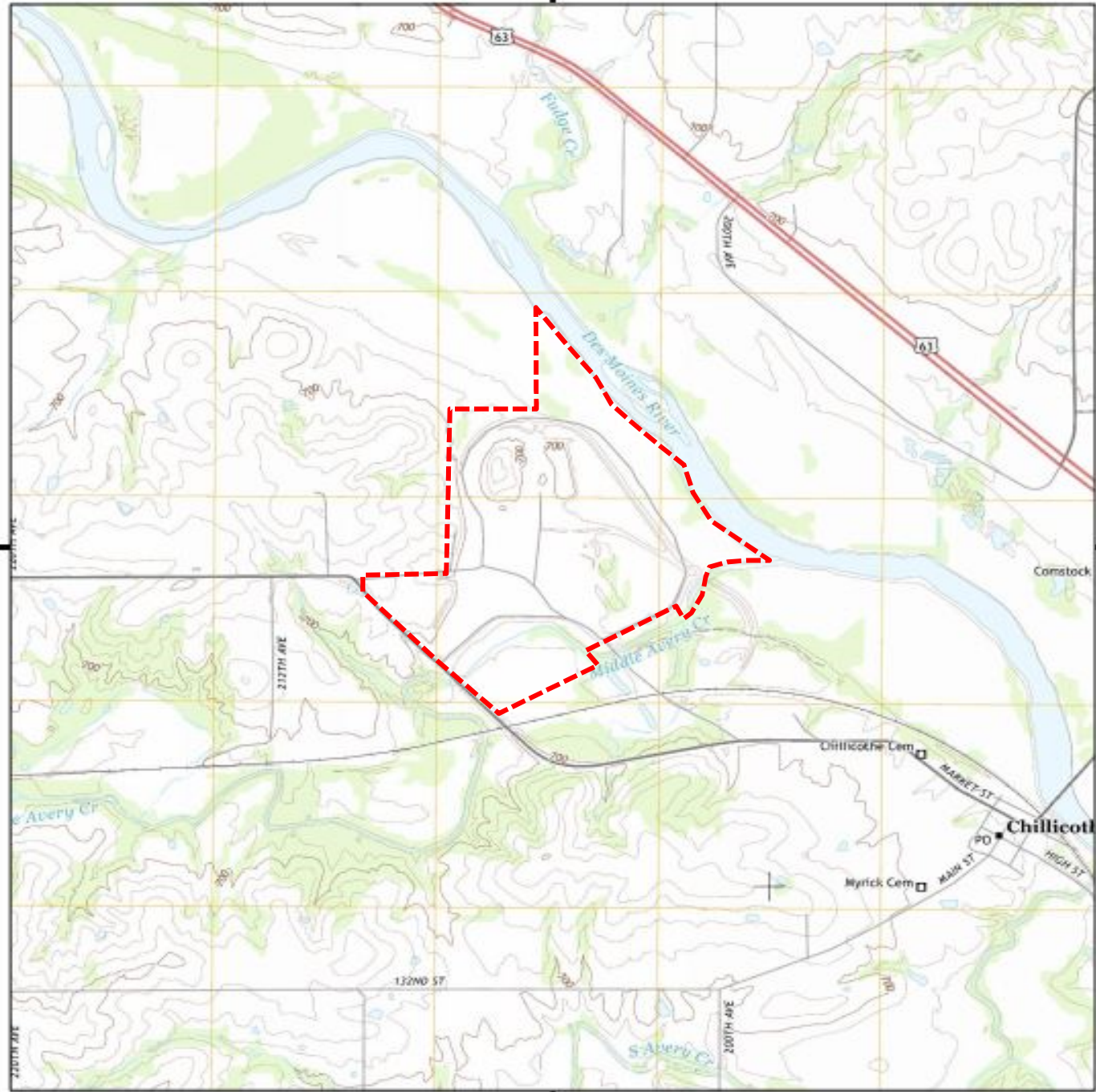
Alliant Energy  
Interstate Power and Light Company  
Ottumwa Generating Station  
Ottumwa, Iowa

Structural Stability Assessment

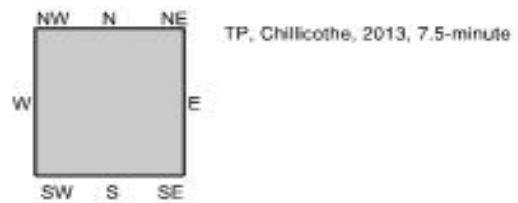


Historical Topo Map

2013



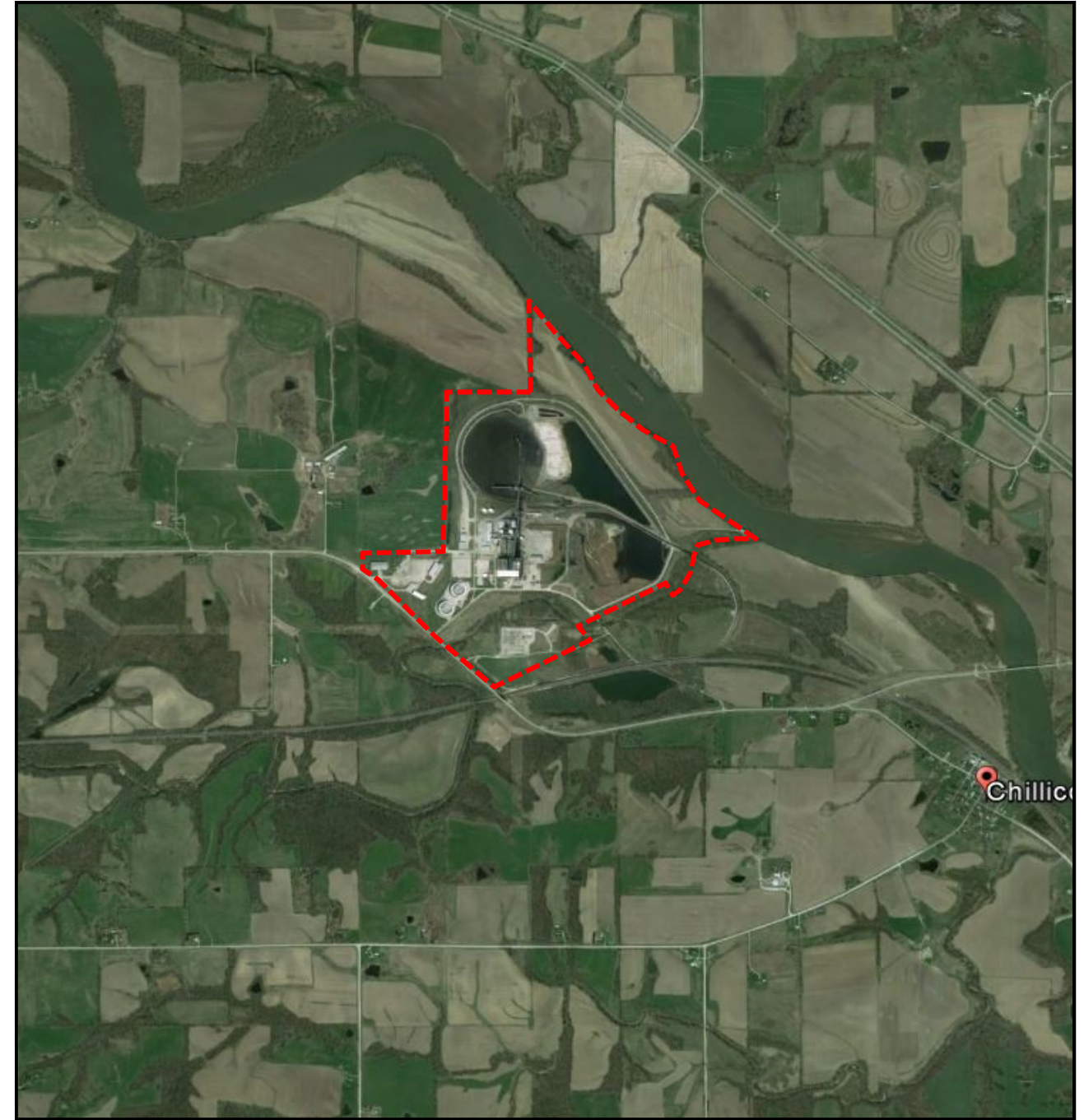
This report includes information from the following map sheet(s).



SITE NAME: Otumwa Generating Station  
 ADDRESS: 20775 Power Plant Road  
 Otumwa, IA 52501  
 CLIENT: Environmental Site Assessors

4555570 - 5 page 4

Historical Aerial Photo 4/13/2016



----- Approximate Property Boundary

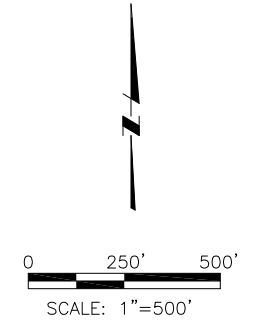
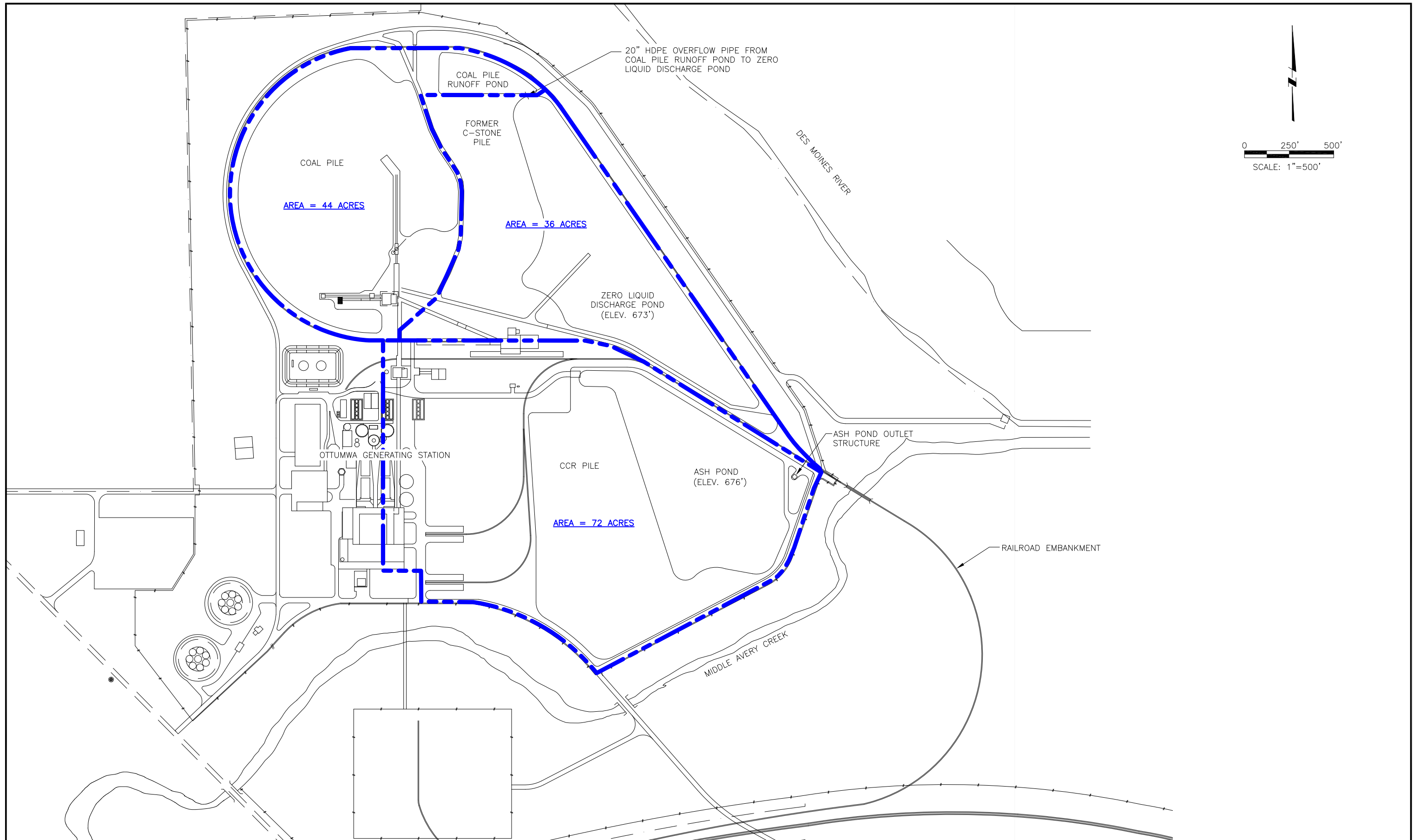


**HARD HAT SERVICES**<sup>TM</sup>  
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Site Location  
 Otumwa Generating Station  
 Intersate Power and Light Company

Drawing  
**Figure 1**  
 Date  
 7/12/2016





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REV	DATE	BY	DESCRIPTION

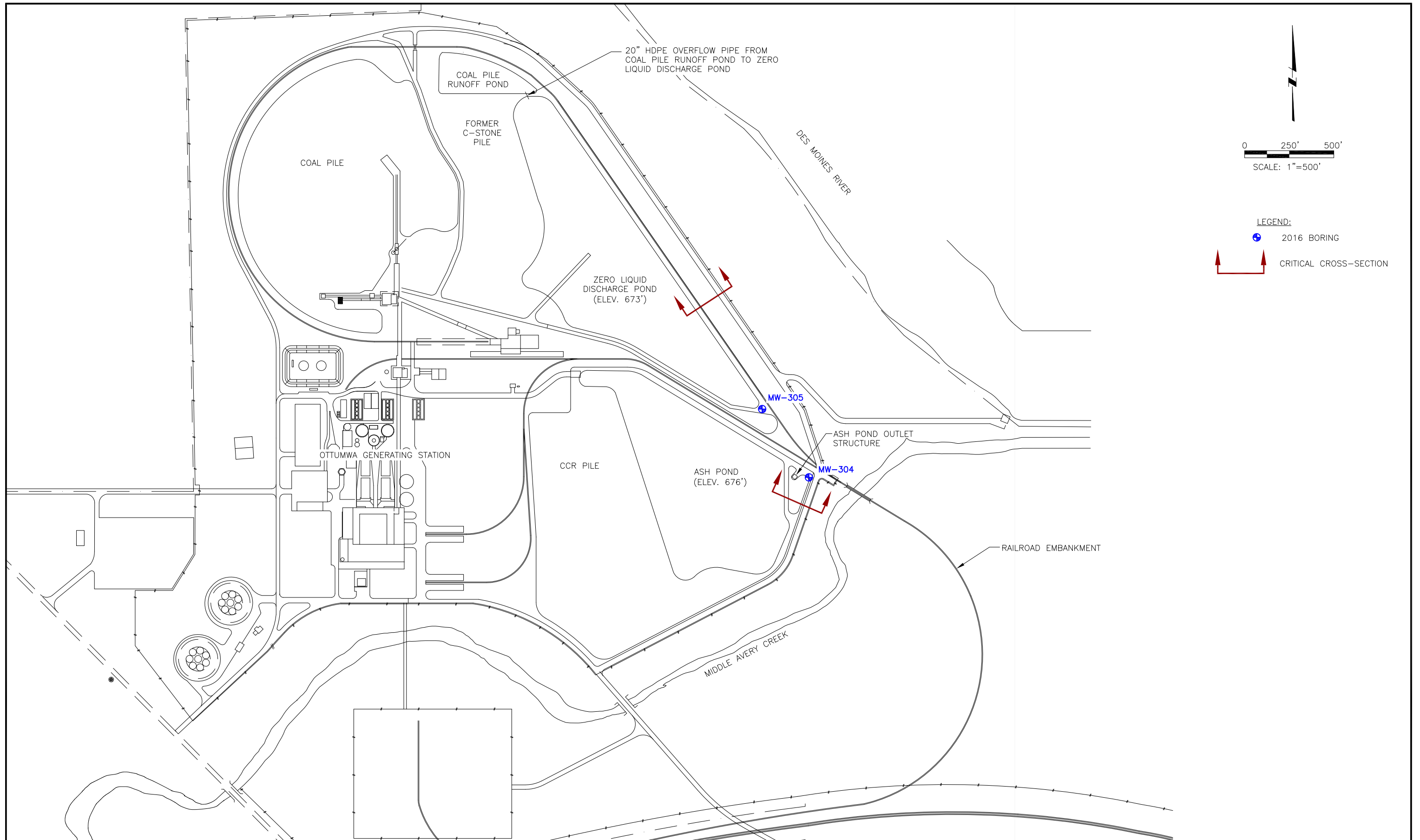


SCALE:	AS SHOWN
DATE:	8-29-16
DRAWN BY:	JFD
CHKD BY:	THJ
APRVD BY:	MWL

CLIENT / LOCATION	INTERSTATE POWER AND LIGHT (IPL) OTTUMWA GENERATING STATION OTTUMWA, IA
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DRAWING DESCRIPTION	Structural Stability Assessment
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JOB	154.018.002.003
SHT.	FIGURE 2
DWG.	154.018.002.003-D2



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APRVD BY:	MWL

CLIENT / LOCATION	INTERSTATE POWER AND LIGHT (IPL) OTTUMWA GENERATING STATION OTTUMWA, IA
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DRAWING DESCRIPTION	STRUCTURAL STABILITY ASSESSMENT CCR POND FEATURES
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JOB	154.018.002.003
SHT.	Figure 3
DWG.	154.018.002.003-D2

## **APPENDIX A – 2016 Boring Logs**

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Alliant Energy  
Interstate Power and Light Company  
Ottumwa Generating Station  
Ottumwa, Iowa

Structural Stability Assessment



Route To:  Watershed/Wastewater  Waste Management   
 Remediation/Redevelopment  Other

Facility/Project Name <b>IPL- Ottumwa Generating Station</b> SCS#: 25215135.40		License/Permit/Monitoring Number		Boring Number <b>MW-304</b>	
Boring Drilled By: Name of crew chief (first, last) and Firm <b>Todd Schmalfeld Cascade Drilling</b>		Date Drilling Started <b>11/11/2015</b>		Date Drilling Completed <b>11/11/2015</b>	
Unique Well No.		DNR Well ID No.		Common Well Name <b>MW-304</b>	
Final Static Water Level <b>Feet</b>		Surface Elevation <b>680.1 Feet</b>		Borehole Diameter <b>8.5 in</b>	
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/> ) or Boring Location <input checked="" type="checkbox"/> State Plane <b>401,152 N, 1,903,287 E S/C/N</b>		Lat _____ " _____ "		Local Grid Location <input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W	
SE 1/4 of NE 1/4 of Section <b>26, T 73 N, R 15 W</b>		Long _____ " _____ "		Feet <input type="checkbox"/> S Feet <input type="checkbox"/> W	
Facility ID		County <b>Wapello</b>		Civil Town/City/ or Village <b>Ottumwa</b>	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments	
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200		
			1	TOPSOIL.	TOPSOIL										
			2	FAT CLAY, black (10YR 2/1).											
			3												
			4												
			5												
			6												
			7		CH										
			8												
			9												
			10												
S1	23	4 5 4 5	11									M			
			12												
			13	FAT CLAY, yellowish brown (10YR 5/4).											
S2	19.5	4 4 5 5	14		CH							M			
			15	FAT CLAY, yellowish brown (10YR 3/4).	CH										
			16												

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer

Firm **SCS Engineers**  
2830 Dairy Drive Madison, WI 53718

Tel: (608) 224-2830  
Fax:

Boring Number MW-304

Page 2 of 3

Sample			Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments		
Number and Type	Length Att. & Recovered (in)	Blow Counts						Depth In Feet	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index		P 200	
S3	12	33 45	FAT CLAY, yellowish brown (10YR 3/4). (continued)	CH											
															17
															18
S4	22	43 712													19
															20
S5	23	27 89													21
															22
															23
S6	23	34 86													24
															25
S7	23	511 1511													26
															27
															28
S8	15	44 56	29												
			30												
S9	18	46 99	31												
			32												
			33												
S10	24	46 76	34												
			35												
			36												
S11	16	22 46	FAT CLAY, DARK OLIVE BROWN (2.5Y 3/3).												
															37
															38
S12	24	43 55													39
															40
S13	18	23 33													41
															42



Route To:  Watershed/Wastewater  Waste Management   
 Remediation/Redevelopment  Other

Facility/Project Name <b>IPL- Ottumwa Generating Station</b> SCS#: 25215135.40		License/Permit/Monitoring Number		Boring Number <b>MW-305</b>	
Boring Drilled By: Name of crew chief (first, last) and Firm <b>Todd Schmalfeld Cascade Drilling</b>		Date Drilling Started <b>12/7/2015</b>		Date Drilling Completed <b>12/8/2015</b>	
Unique Well No.		DNR Well ID No.		Common Well Name <b>MW-305</b>	
Final Static Water Level <b>Feet</b>		Surface Elevation <b>681.5 Feet</b>		Borehole Diameter <b>8.5 in</b>	
Local Grid Origin <input type="checkbox"/> (estimated: <input type="checkbox"/> ) or Boring Location <input checked="" type="checkbox"/> State Plane <b>401,473 N, 1,903,023 E S/C/N</b>		Lat <input type="checkbox"/> ° <input type="checkbox"/> ' <input type="checkbox"/> "		Local Grid Location <input type="checkbox"/> N <input type="checkbox"/> E <input type="checkbox"/> S <input type="checkbox"/> W	
SE 1/4 of NE 1/4 of Section 26, T 73 N, R 15 W		Long <input type="checkbox"/> ° <input type="checkbox"/> ' <input type="checkbox"/> "		Feet <input type="checkbox"/> S <input type="checkbox"/> W	
Facility ID		County <b>Wapello</b>		Civil Town/City/ or Village <b>Ottumwa</b>	


Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments		
									Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200			
			0	TOPSOIL	TOPSOIL											
			1	GRAVEL	GP											
			2	FAT CLAY												
			3													
			4													
			5													
			6													
			7													
			8													
			9		CH											
			10													
			11	FAT CLAY, very dark grayish brown (10YR 3/2).												
S1	18	36 9 11	11													
			12													
			13	same as above except, brown (10YR 4/3).												
S2	22	37 14 22	13													
			14													
			15													
			16													

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature 	Firm <b>SCS Engineers</b> 2830 Dairy Drive Madison, WI 53718	Tel: (608) 224-2830 Fax:
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Boring Number MW-305

Page 2 of 3

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
S3	22	5 15 14 15	17	FAT CLAY (continued)										
S4	20	3 5 13 15	18 19		CH									
S5	24	4 5 7 11	20 21 22	FAT CLAY WITH SILT, dark gray (10YR 4/1).					M					
S6	20	7 11 15 20	23 24	same as above except, very dark brown (10YR 2/2).					M					
S7	24	4 8 11 12	25 26 27	same as above except, very dark gray (10YR 3/1).	CH				M					
S8	24	8 12 16 21	28 29						M					
S9	13	4 4 7 12	30 31 32						M					
S10	24	5 6 9	33 34	LEAN CLAY, very dark brown (10YR 2/2).					W					
S11	24	4 4 5 7	35 36 37		CL				W					
S12	22	2 2 3 5	38 39	same as above except, very dark grayish brown (10YR 3/2).					W					
S13	6	3 9 11	40 41 42	POORLY GRADED SANDY GRAVEL, fine, brown (10YR 4/3).	GPS				W				water @ 41.0 ft bgs.	





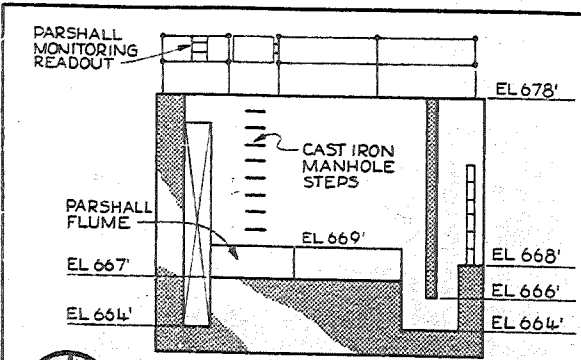
## **APPENDIX B – Impoundment Outfall Details**

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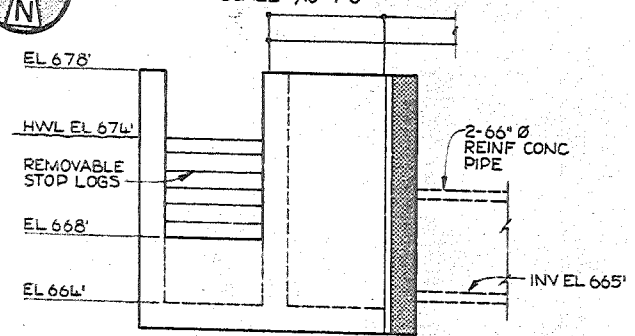
Alliant Energy  
Interstate Power and Light Company  
Ottumwa Generating Station  
Ottumwa, Iowa

Structural Stability Assessment

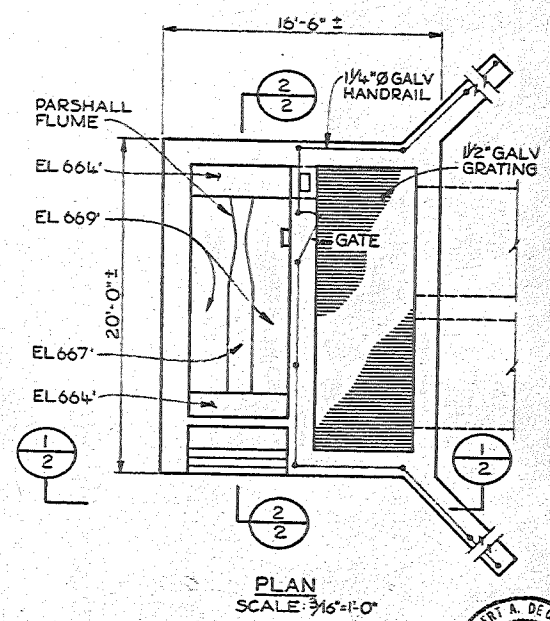




SECTION 2  
SCALE: 3/16"=1'-0"



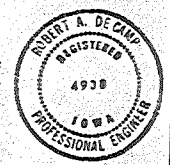
SECTION 1  
SCALE: 3/16"=1'-0"



PLAN  
SCALE: 3/16"=1'-0"

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A FULLY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

SIGNED: *Robert A. DeCamp*  
DATE: 8-8-77 REG. NO. 4938

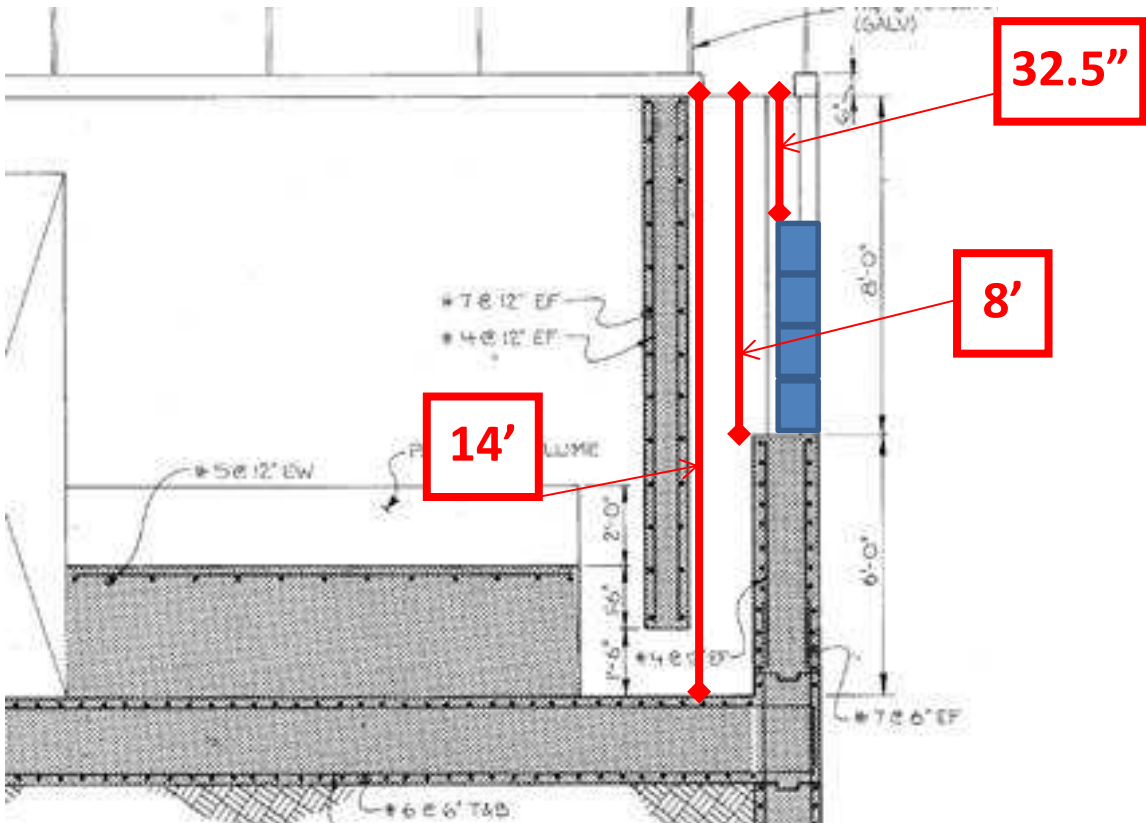
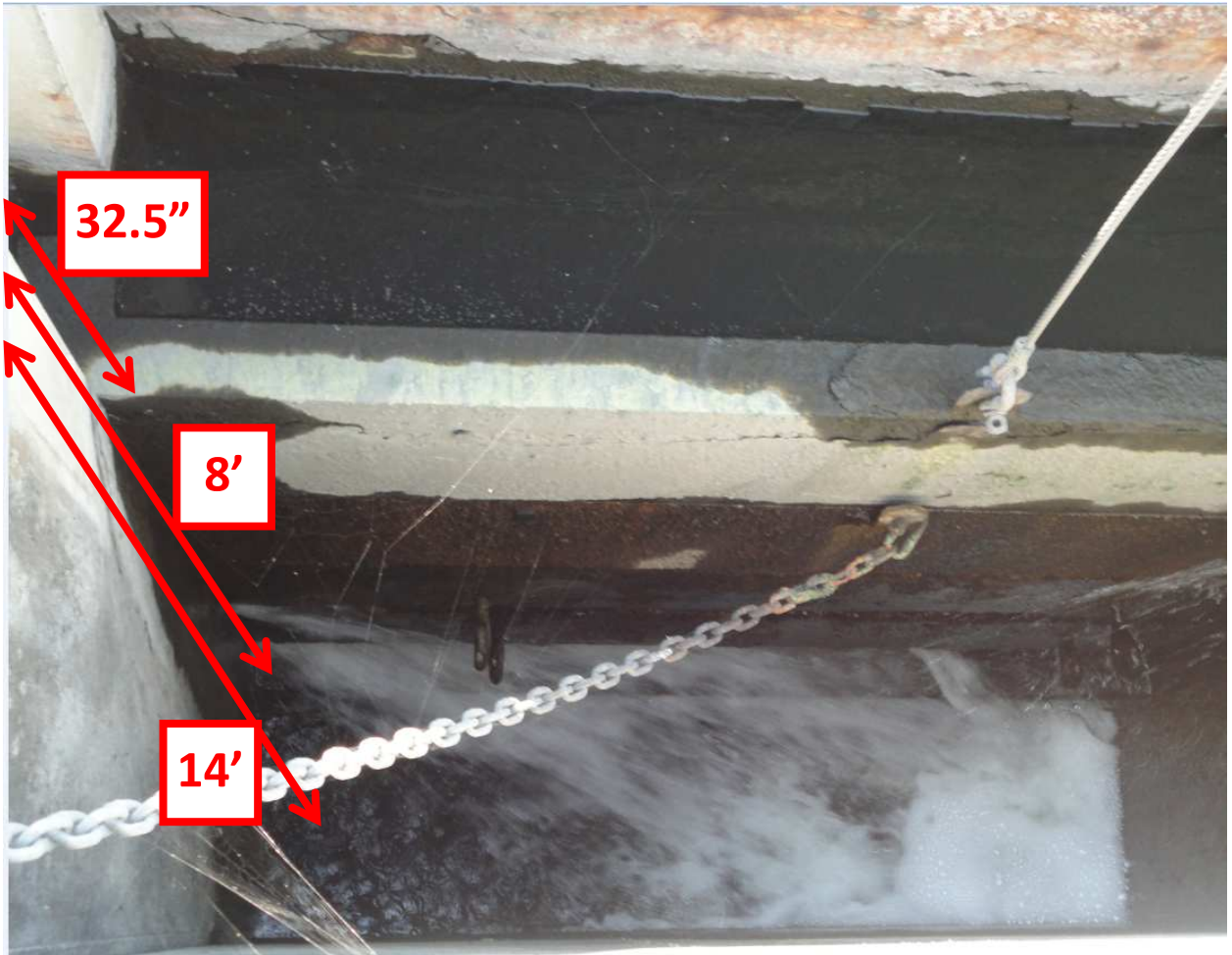


NO.	DATE	REVISION OR ISSUE	ED.	BY	CR	APP.

**BLACK & VEATCH**  
CONSULTING ENGINEERS  
PROJECT 6713

Iowa Southern Utilities Company  
Ottumwa Generating Station - UNIT 1  
ASH POND  
OUTFALL STRUCTURE

SK-S-080877-2



## OSG - Slag Pond Outlet Discharge Curve

SINGLE OUTLET PIPE !!!!!

SUMMERGED OUTLET

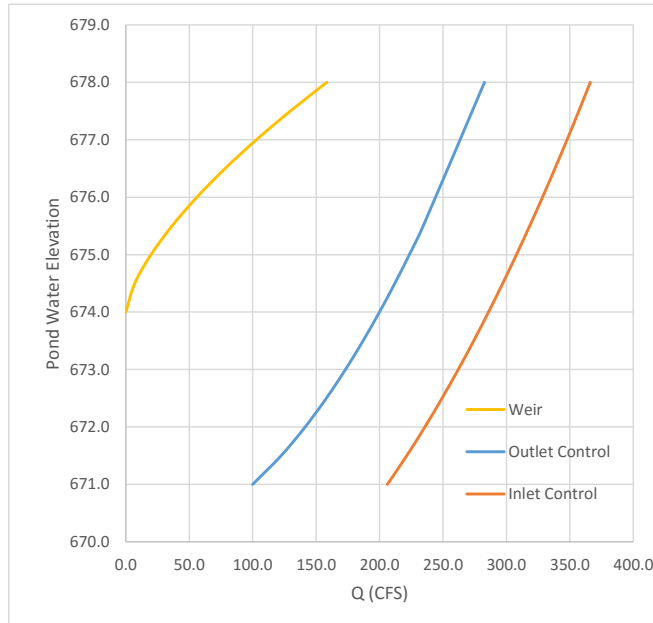
- 5.5 FT = Pipe Diameter Steel
- 1.375 FT = Hydraulic Radius
- 3.636 k in Q outlet control equation
- 665 FT = Pipe Inlet Invert Elevation
- 180 FT = Length
- 0.025 = n for RCP
- 0.6 = Co for Inlet Control
- 670 FT = Tail Water Elevation
- 6 FT = Weir Width
- 3.3 = Weir Coefficient

OUTLET CONTROL / BARROW CONTROL

Q CFS	Elevation	Head Ft
99.947	671.0	1.0
122.41	671.5	1.5
141.35	672.0	2.0
158.03	672.5	2.5
173.11	673.0	3.0
186.98	673.5	3.5
199.89	674.0	4.0
212.02	674.5	4.5
223.49	675.0	5.0
234.4	675.5	5.5
282.69	678.0	8.0

INLET CONTROL

Q CFS	Elevation	Head (to pipe middle) Ft
206.15	671.0	3.25
221.44	671.5	3.75
235.74	672.0	4.25
249.22	672.5	4.75
262.01	673.0	5.25
274.2	673.5	5.75
285.87	674.0	6.25
297.09	674.5	6.75
307.9	675.0	7.25
318.34	675.5	7.75
328.44	676.0	8.25
338.25	676.5	8.75
347.78	677.0	9.25
357.06	677.5	9.75
366.1	678.0	10.25



Weir Equation

$$Q = C_w * L * H^{1.5}$$

H Ft	Q CFS
674.0	0.0
674.5	7.0
675.0	19.8
675.5	36.4
676.0	56.0
676.5	78.3
677.0	102.9
677.5	129.6
678.0	158.4

The two Wier outlet pipes can easily handle high flows even if one pipe is plugged and the outlet submerged (15' + above the flood plain).