OCTOBER 2016

CLECO POWER LLC
BRAME ENERGY CENTER

HAZARD POTENTIAL CLASSIFICATION ASSESSMENT:

BOTTOM ASH POND

Prepared By:

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Project Number 002-186

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1.0 INTRODUCTION

Providence Engineering and Environmental Group LLC (Providence) was contracted by Cleco Power LLC (Cleco) to conduct a hazard potential classification assessment of the Bottom Ash Pond at Cleco's Brame Energy Center located in Lena, Louisiana. A site location map and site map are included as **Figures 1** and **2**, respectively.

Recent Coal Combustion Residual (CCR) regulations at 40 CFR 257.73(a)(2) established requirements for owners and operators to conduct a hazard potential classification assessment to assess the potential adverse incremental consequences that would occur if there was a failure of the CCR surface impoundment.

This hazard potential classification assessment pertains to the Bottom Ash surface impoundment (Pond) utilized for the Unit 2 coal-fired generation unit.

2.0 HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

Per the CCR regulations, a hazard potential classification provides an indication for danger to life, development, or the environment in the event of a release of CCR from a surface impoundment. The new rule requires an owner or operator of any existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to determine which of the following hazard potential classifications characterizes apply to their particular CCR unit. These potential classifications include the following:

- High Hazard Potential CCR Surface Impoundment – means a diked surface impoundment where failure or misoperation will probably cause loss of life.
- Significant Hazard Potential CCR Surface Impoundment – means a diked surface impoundment where failure or misoperation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.
- Low Hazard Potential CCR Surface Impoundment – means a diked surface impoundment 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 surface impoundment's owner's property.

The Bottom Ash Pond was analyzed to determine effects of a breach in the current levee system. Two scenarios were used in each model: Maximum and Most Probable Loss. In both scenarios, a shear break to the bottom of the levee was assumed. The Maximum scenario flow rate was calculated using a height of water measured from the bottom of pond to the top of levee. The Most Probable Loss scenario flow rate was calculated using a height of water measured from the bottom of pond to the normal operating elevation.

The flood elevations in the vicinity of the Bottom Ash Pond are highly influenced by the existing water surface elevations of Bayou Jean de Jean and the Red River. The surface elevation data used in this analysis for adjacent property is from Light Detection and Ranging (LIDAR) data and shows the drainage feature between the

Bottom Ash Pond and Interstate 49 at elevation 79 feet NAVD 88, Bayou Jean de Jean at elevation 74 feet NAVD 88, and the Red River at elevation 74 feet NAVD 88.

The results of the levee breach analysis for the Bottom Ash Pond shows that the rise in water is mostly contained in the drainage feature between the pond and Interstate 49. The outflow from the pond during this flood event has a very negligible volume to add to Bayou Jean de Jean and the Red River. The downstream flood area allows the floodwaters to spread into existing bodies of water over a large area, therefore adjacent property is not affected. Also not affected are the properties along Bayou Jean de Jean which are protected by levees. This is true for both the Maximum and the Most Probable Loss scenarios.

The bottom ash is sluiced to the southwest corner of the Bottom Ash Pond and only a small portion of that area contains the bottom ash. It is excavated and sold before any substantial amount accumulates in the pond, therefore a breach in the Bottom Ash Pond would only release a minimal amount of bottom ash and it would fall out quickly due to its specific gravity and grain size. The model shows that any release from the Bottom Ash Pond would go into the channel beside the pond and then enter Bayou Jean de Jean and thence the oxbow on the Red River.

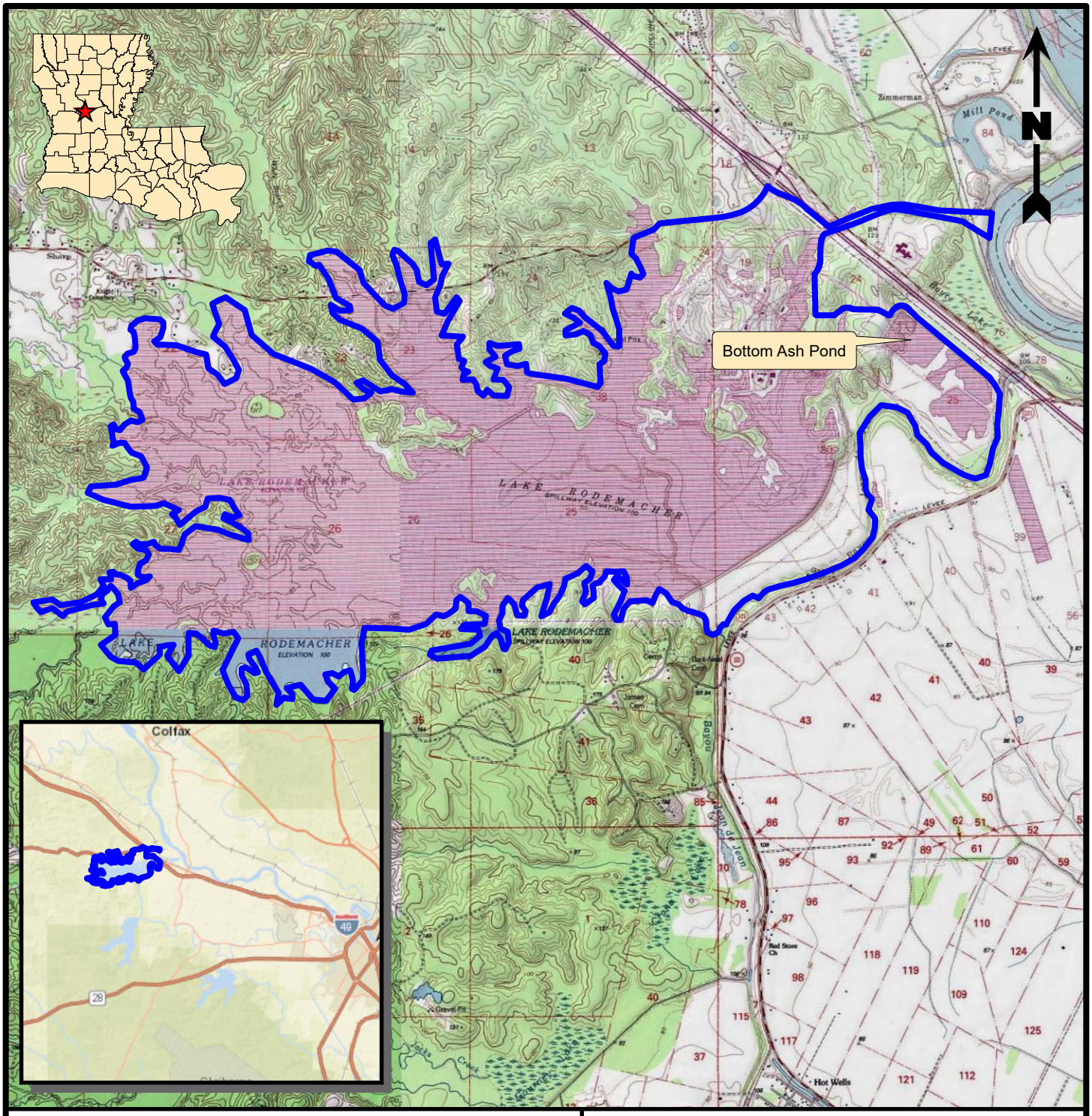
The complete Levee Breach Analysis can be found in **Appendix A.**

3.0 CONCLUSIONS

Based on the results of the Maximum and Most Probable Loss scenarios, the Bottom Ash Pond at Cleco's Brame Energy Center is classified as a significant hazard potential CCR surface impoundment due to the potential effects on Bayou Jean de Jean and the oxbow of the Red River. **Attachment B** contains a P.E. Certification that attests to this assessment.

FIGURE 1

SITE LOCATION MAP



Legend

Property Boundary

Reference

Base map comprised of U.S.G.S. 7.5 minute topographic maps, "Lena, LA", "Boyce, LA", "Jericho, LA", and "Gardner, LA".

Site Location Map

Hazard Potential Classification Assessment - Bottom Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

PROVIDENCE

Drawn By	LMM	10/04/16
Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

Project Number	002-186
Drawing Number	002-186-A003
1	Figure

FIGURE 2

SITE MAP

N

Legend

Property Boundary

Reference

Base map comprised of Google Earth aerial imagery from 10/03/14.

1,000 500 0 1,000
Feet

Site Map

Hazard Potential Classification Assessment - Bottom Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

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Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

Project Number 002-186

Drawing Number 002-186-B004

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Figure

APPENDIX A

LEVEE BREACH ANALYSIS

JULY 2016

CLECO BRAME ENERGY CENTER
CLECO POWER LLC
RAPIDES PARISH, LENA, LOUISIANA

LEVEE BREACH ANALYSIS REPORT:

BOTTOM ASH POND

Prepared By:

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1.0 PROJECT DESCRIPTION

Brame Energy Center is a 6,000-acre site located west of Interstate 49 (I-49) in Lena, Louisiana. The site has a Bottom Ash Pond that accepts the byproducts derived from burning coal for the generation of electricity. This report documents the effort undertaken to study the effects of a breach of the Bottom Ash Pond levees.

2.0 DATA ACQUISITION

The proposed project is located on Federal Emergency Management Agency (FEMA) map panel 0125B in Rapides Parish and is bound by Interstate 49 and the Red River to the east, LA 28 to the south, and LA 8 to the west and north. The study area is presented in **Figure 1**.

The flood elevations are highly influenced by the existing water surface elevations of Bayou Jean de Jean and the Red River. The water surface elevation data used in this analysis is from Light Detection And Ranging (LIDAR) data and shows Bayou Jean de Jean at elevation 74' NAVD88 and the Red River at 74' NAVD88. The channel adjacent to the pond has a bottom elevation ranging from 84' NAVD88 at the most upstream point to 74' NAVD88 at the junction with Bayou Jean de Jean.

3.0 HYDRAULIC MODEL DEVELOPMENT

LIDAR information was obtained and used to develop a ground model of existing conditions for the project area. This information was imported into a hydraulic analysis program in order to model the effects of breaking the levee system. An elevation terrain was generated based on LIDAR data. Channel geometry for the outflows from the Bottom Ash Pond was created using raindrop analysis, and cross sections were created by referencing the elevation terrain. Cross sections were extended to cover any area of concern both within and surrounding the project area.

The Bottom Ash Pond was analyzed as two separate events. Two scenarios were used in each model: Maximum and Most Probable Loss. In both scenarios, a shear break to the bottom of the levee was assumed. The Maximum scenario flow rate was calculated using a height of water measured from the bottom of pond to the top of levee. The Most Probable Loss scenario flow rate was calculated using a height of water measured from the bottom of pond to the normal operating elevation.

The outflow was modeled in GeoHEC-RAS by inputting the steady flow data for each scenario. The upstream boundary for the Most Probable Loss scenario was the normal operating elevation of this pond. The upstream boundary for the Maximum scenario was the top of levee elevation for this pond. The analysis was then computed on the steady flow data. The results for the flood maps and for the cross sections were then generated. It should be noted that these models

were generated based on a continuous outflow from the pond as this was determined to be the most conservative way to model a levee breach. Real-world scenarios should be less impactful as the flow rate will steadily decrease as the pond empties.

4.0 MODELING RESULTS

The results of the levee breach analysis for the Bottom Ash Pond shows that the rise in water is mostly contained to the channel area adjacent to the pond. The outflow from the pond during this flood event has a very negligible volume to add to Bayou Jean de Jean and the Red River. The downstream flood area allows the floodwaters to spread into existing bodies of water, therefore adjacent property is not affected. Also not affected are the properties along Bayou Jean de Jean which are protected by levees. This is true for both the Maximum and the Most Probable Loss scenarios.

For the Bottom Ash Pond, the Most Probable Loss condition results in no more than a 3’ increase which is localized to the channel adjacent to the pond and has no effects to surrounding properties or Interstate 49. The Maximum condition results in no more than a 7’ increase which is localized to the channel adjacent to the pond and has no effects to surrounding properties or Interstate 49. The Bottom Ash Pond results are presented in **Figure 2 and Figure 3**.

The Bottom Ash Pond is sluiced to the southwest corner of the pond and only a small portion of that area contains the bottom ash. It is excavated and sold before any substantial amount accumulates in the pond, therefore a breach in the Bottom Ash Pond would only release a minimal amount of bottom ash and it would fall out quickly due to its specific gravity and grain size.

It should be noted that the average elevation shown in **Figure 2** and **Figure 3** represents the average elevation of the entire outflow path.

5.0 COST ANALYSIS

A cost analysis was completed based on the information obtained in the Flood Analysis and available historical cost data. A cost estimate was determined for both the Most Probable Loss and the Maximum Loss scenarios for the pond. The flood area was broken into categories of wooded land, existing channels, plant property, and structures. As noted in the Flood Analysis section, for all of the failures, the majority of the pond water would spread across wooded land.

It is assumed that the levee breach and resulting flood waters would negatively impact all surrounding timber to the point that the timber would be declared a total loss. This is very conservative, as the flood waters should dissipate in a relatively short amount of time depending on site conditions at the time of the event.

Cleanup costs associated with a levee breach are a substantial portion of the total cost for this analysis. Clearing & Grubbing of the impacted properties will be necessary to clear the existing timber that is damaged and was estimated at $2,000 per acre of affected wooded land.

A breach in the Bottom Ash Pond would release a minimal amount of bottom ash, which would fall out quickly due to its specific gravity and grain size. The quantity of ash in the pond is constantly changing; therefore, it was assumed that the pond was half full of ash before the levee breach. Elevation data for the Bottom Ash Pond is included in **Appendix A**. Multiple percentages of ash loss were analyzed, all of which were minimal (ranging from 10% to 20% for the Bottom Ash Pond). For the purpose of this report, the costs of a 20% ash loss for the Bottom Ash Pond have been included in the final cost for each scenario of each pond. The volume and cost for all assumed percentages can be found in **Appendix B**. The material would be returned to the pond, as there is no landfill for the bottom ash. The cost for removal and hauling ash back to the pond was estimated at $25 per cubic yard of ash.

It is assumed that the length of exposure of pond water to ash would be minimal and would not cause contamination of drinking water, nor would it contaminate the topsoil. For this reason, removal of topsoil is not necessary and was not included in the cost estimate.

It is assumed that any vegetation impacted by a levee breach would need to be reestablished to original conditions. Site Preparation/Planting includes the reestablishment of pine/hardwood timber and the spraying of underbrush vegetation during re-establishment and was priced at $500 per acre of affected wooded land. The Loss of Timber Value assumes that valuable timber (pine/hardwood) was present and was priced at $750 per acre. Seeding and Fertilizing was also considered and includes the re-establishment of grass for erosion control of the cleared and grubbed acreage. This was priced at $2,500 per acre of land. Any value of the timber harvested was not included as a discount to the total cost.

It was also assumed that the affected levee of the pond would be rebuilt immediately, and no temporary measures for levee replacement would be necessary. The failure shape of the levee is assumed to be a shear type failure. In order to reconstruct the levee, an additional removal of material is anticipated to safely reconstruct the levee. The cost to reestablish the levee was estimated at $25 per cubic yard and $6.84 per square foot.

As mentioned in the Flood Analysis, the rise in water is mostly contained in the drainage feature between the pond and I-49. The downstream flood area allows the floodwaters to spread into existing bodies of water over a large area; therefore, no structures within or surrounding the plant are affected. This is true for both the Maximum and the Most Probable Loss scenarios for the pond.
Details of the Levee Risk Assessment Costs are included in **Appendix B**. The calculations show a total cost for each scenario of the pond. These costs are

broken down into the different percentages of ash loss. The total clean-up cost is then divided into the cost of on-site clean-up and the cost of off-site clean-up. These totals are also broken down into the different percentages of ash loss.

A cost for Mobilization/Demobilization was added to each total. For the on-site costs, mobilization/demobilization was estimated at $12,000. For the off-site costs, mobilization/demobilization was estimated at 8%.

The total costs for each scenario of each pond, assuming a 20% ash loss for the Bottom Ash Pond are as follows:

- For the Bottom Ash Pond, clean-up costs for the Most Probable Loss scenario total $2.8 million, and clean-up costs for the Maximum Loss scenario total $4.7 million.

The on-site scenario of the pond includes only the levee repair costs and assumes that any ash that falls on-site is in the levee repair area. The on-site costs for each scenario of the pond are as follows:

- For the Bottom Ash Pond, on-site clean-up costs for the Most Probable Loss scenario total $106,603, and on-site clean-up costs for the Maximum Loss scenario total $106,603.

The off-site costs for each scenario of the pond, assuming a 20% ash loss for the Bottom Ash Pond are as follows:

- For the Bottom Ash Pond, off-site clean-up costs for the Most Probable Loss scenario total $2.7 million, and off-site clean-up costs for the Maximum Loss scenario total $4.6 million.

FIGURE 1

LEVEE BREACH STUDY AREA

Legend

Channel Alignment

Note:

Base map comprised of ESRI World Imagery

500 250 0 500 1000 1500

Bottom Ash Pond
Levee Breach Study Area

Lena, Rapides Parish, Louisiana

Cleco Power, LLC
Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

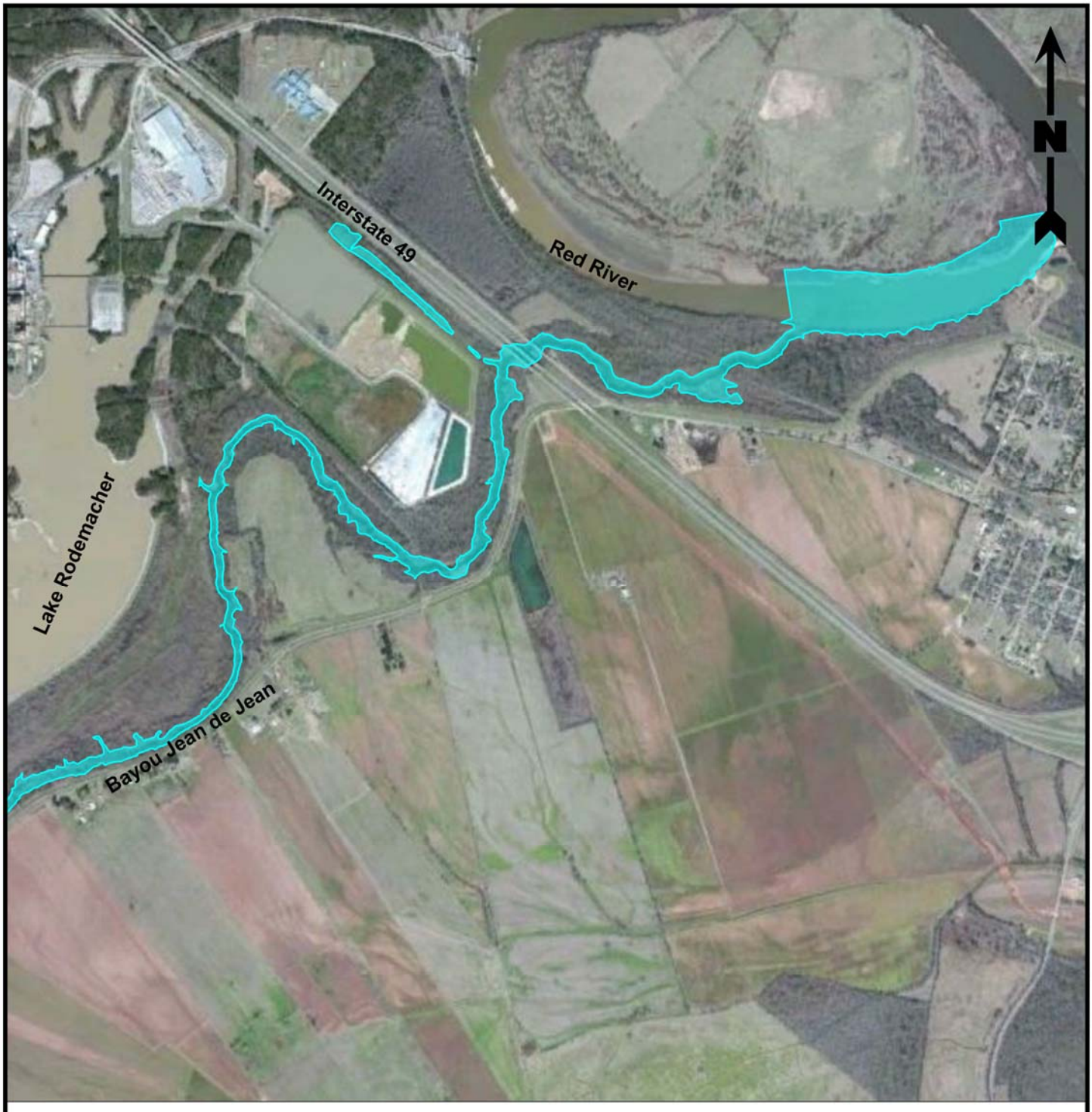
Project Number
002-186

Drawing Number
002-186-A007

1
Figure

FIGURE 2

BOTTOM ASH POND MOST PROBABLE LOSS



Legend

Most Probable Loss (Avg. El. 75.98')

Note:

Base map comprised of ESRI World Imagery

1000 500 0 1000 2000 3000

Bottom Ash Pond
Most Probable Loss

Lena, Rapides Parish, Louisiana

Cleco Power, LLC
Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

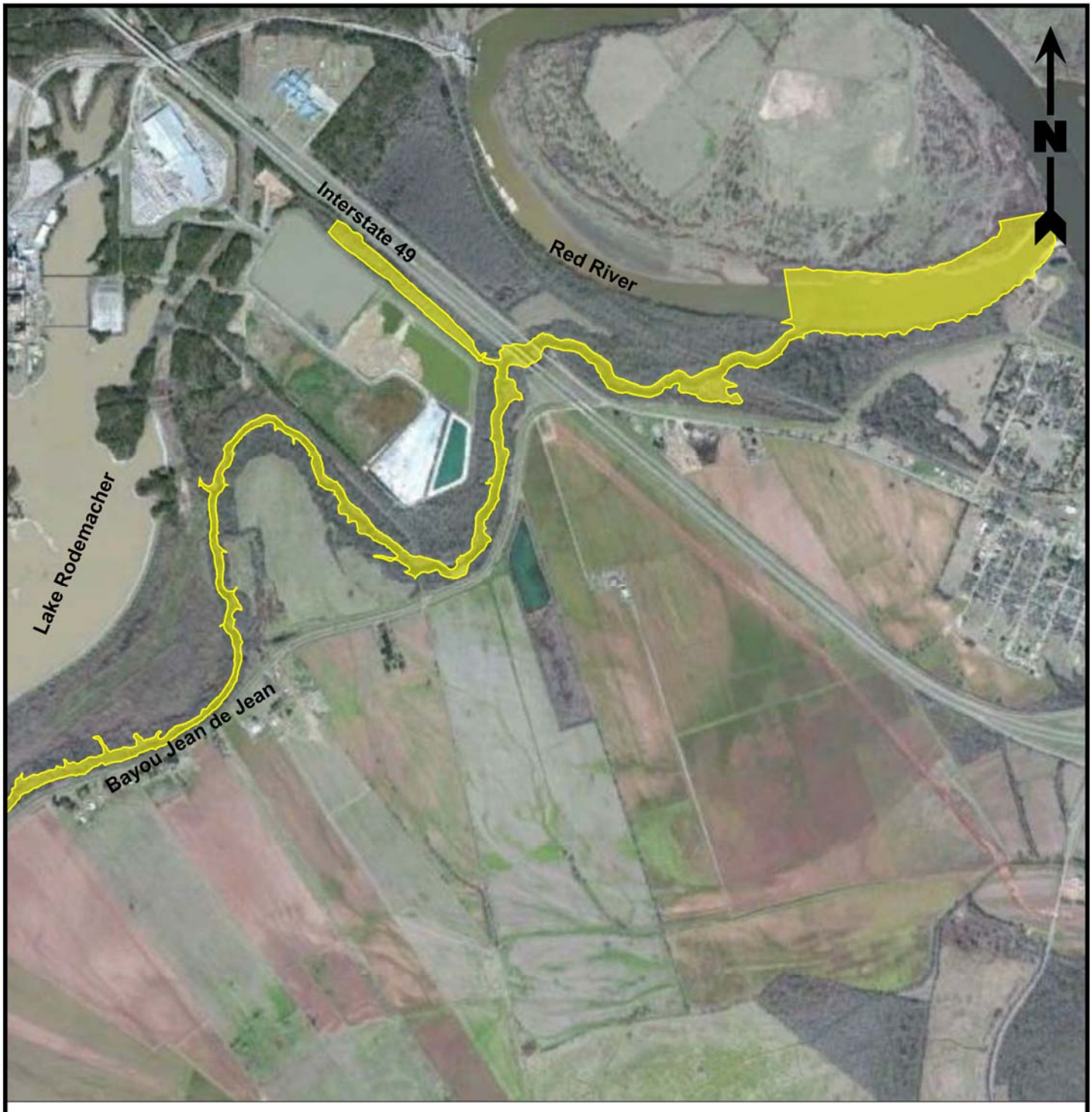
Project Number
002-186

Drawing Number
002-186-A009

2
Figure

FIGURE 3

BOTTOM ASH POND MAXIMUM LOSS



Legend

Maximum Loss (Avg. El. 76.38')

Note:

Base map comprised of ESRI World Imagery

1000 500 0 1000 2000 3000

Bottom Ash Pond Maximum Loss

Lena, Rapides Parish, Louisiana

Cleco Power, LLC

Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

Project Number 002-186

Drawing Number 002-186-A010

3 Figure

APPENDIX A

ACQUIRED DATA

Facility Name:		Cleco Brame Energy Center	
Address:		275 Rodemacher Rd. Lena, LA	
Surface Impoundment Name :	Bottom Ash Pond	**Owner:**	Cleco Power LLC
Surface Impoundment ID:	P-0005	**Operator:**	Cleco Power LLC
Nearest City:	Boyce	**Parish:**	Rapides
GENERAL			
Dam Status:	Operational	**Year Built:**	1982
Latitude:	31° 23.83' N	**Longitude:**	92° 42.27' W
Dam Size:	760.5 Acre-Feet (3' Freeboard)		
Bottom of Pond Elevation Information:	85 ft. MSL	**Top of Dike Elevation:**	106 ft. NAVD 88
Low Operating Level Elevation:	90 ft. NAVD 88	**High Operating Level Elevation:**	96 ft. NAVD 88
High Operating Level Storage:	464.75 acre-feet @ elevation 96.0 ft. NAVD 88		
Maximum Storage:	760.5 acre feet @ elevation 103.0 ft. NAVD 88		
Maximum Surface Area:	42.25 Acres		
Offsite Drainage Area:	Discharges to Lake Rodemacher via LPDES Outfall 401		
Spillway Type:	None, Pumped through HDPE discharge pipe		

APPENDIX B

LEVEE BREACH COST ANALYSIS

APPENDIX B
LEVEE BREACH COST ANALYSIS
BRAME ENERGY CENTER
BOTTOM ASH POND

Description	Unit	Most Probable Loss	Maximum Loss
Wooded land	acres	112	118
Existing channel/bayou/river	acres	40	40
Area of levee repair	sq ft	5,712	5,712
Volume of levee repair	cu yd	2,221	2,221
10% ash leaving pond	cu yd	37,490	71,572
15% ash leaving pond	cu yd	56,235	107,357
20% ash leaving pond	cu yd	74,980	143,143
Plant property	acres	none	none
Structures other than levee wall	each	none	none

Bottom Ash Pond Costs

Description	Unit	Unit price	Most Probable Loss	Maximum Loss
Site prep/planting[1]	acre	$500	$55,970	$58,760
Loss of timber value[2]	acre	$750	$83,955	$88,140
Clearing & grubbing	acre	$2,000	$223,880	$235,040
Seeding & fertilizing [3]	acre	$2,500	$279,850	$293,800

Levee Repair	Unit	Unit price	Most Probable Loss	Maximum Loss
Incorporation of lime, reprocessing, recompacting clay material on exterior of slope	cu yd	$25	$55,533	$55,533
Purchase and installation of structural geogrid material	sq ft	$0.50	$2,856	$2,856
Purchase and installation of HDPE membrane	sq ft	$0.42	$2,399	$2,399
Purchase and installation of fabric formed concrete revetment	sq ft	$5.50	$31,416	$31,416
Purchase and placement of erosion control matting	sq ft	$0.35	$1,999	$1,999
Seeding and fertilization	sq ft	$0.07	$400	$400
		Levee repair total	**$94,603**	**$94,603**

APPENDIX B
LEVEE BREACH COST ANALYSIS
BRAME ENERGY CENTER
BOTTOM ASH POND

Ash Removal and Haul to landfill[4]	Unit	Unit price	Most Probable Loss	Maximum Loss
10% ash leaving pond	cu yd	$25	$937,246	$1,789,288
15% ash leaving pond	cu yd	$25	$1,405,869	$2,683,931
20% ash leaving pond	cu yd	$25	$1,874,492	$3,578,575

Mobilization/Demobilization on-site	$12,000	$12,000
Mobilization/Demobilization off-site	8%	8%

On-site Costs[5]	**$106,603**	**$106,603**

Off-site Costs

10% ash loss	**$1,707,373**	**$2,662,230**
15% ash loss	**$2,213,486**	**$3,628,445**
20% ash loss	**$2,719,598**	**$4,594,660**

Total Costs

10% ash loss	**$1,813,976**	**$2,768,833**
15% ash loss	**$2,320,089**	**$3,735,048**
20% ash loss	**$2,826,202**	**$4,701,264**

NOTES:

1. Includes the re-establishment of pine/hardwood timber and the spraying of underbrush vegetation.

2. Assumes that valuable timber (pine/hardwood) is present. Also assumes that cost for haul/cut is included.

3. Includes the re-establishment of grass for erosion control.

4. Assumes that half of the pond is filled with ash, and minimal amounts would be released.

5. Includes levee repair costs and assumes that any ash that falls on-site is in the levee repair area.

6. Timber value once purchased and brought to mill is not included.

7. Assume no contamination of topsoil; therefore, no removal necessary.

8. Assume length of exposure of pond water to ash is minimal and will not cause contamination of drinking water.

9. Assume affected pond is being rebuilt immediately and no temporary measures for levee replacement are necessary.

APPENDIX B
LEVEE BREACH COST ANALYSIS
BRAME ENERGY CENTER
BOTTOM ASH POND

Bottom Ash Pond Ash

Pond area (acre) 42.25

	Most Probable Loss	Maximum Loss
High Operating Level (ft)	96	
Top of Levee (ft)		106
Levee Toe (ft)	85	85
Half Full of Ash (ft)	6	10.5
Volume of Existing Ash (yd^3)	374,898	715,715

Volume of Ash Leaving Pond (yd^3):	Most Probable Loss	Maximum Loss
10%	37,490	71,572
15%	56,235	107,357
20%	74,980	143,143

Bottom Ash Pond Levee

Slope = 3:1

	Most Probable Loss	Maximum Loss
Width At Break (ft)	126	126
Length Across Top	42	42
Volume of Repair	2,221	2,221

APPENDIX B

P.E. CERTIFICATION

CLECO BRAME ENERGY CENTER
BOTTOM ASH POND
CCR HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

PROFESSIONAL ENGINEER CERTIFICATION

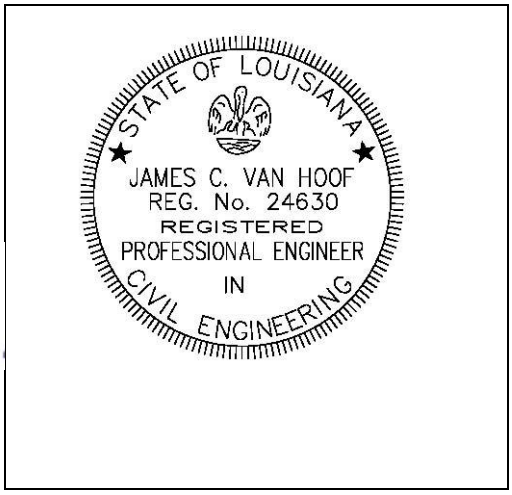
I hereby certify that I have performed a hazard potential classification assessment for Cleco's Brame Energy Center Bottom Ash Pond in accordance with the CCR requirements at 40 CFR 257.73(a)(2). This hazard potential classification assessment has determined that the Bottom Ash Pond is classified as a significant hazard potential surface impoundment.

James C. Van Hoof
Name

24630 **LA**
Registration No. State

James C. Van Hoof, P.E.
Signature

10/12/2016
Date



(Seal)