ALLIANT ENERGY
Wisconsin Power and Light Company
Columbia Energy Center

CCR SURFACE IMPOUNDMENT

STRUCTURAL STABILITY ASSESSMENT

Report Issued: September 19, 2016
Revision 0

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

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 Columbia Energy Center in Pardeeville, Wisconsin 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 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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Appendices

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.

1.2 Structural Stability Assessment Applicability

The Columbia Energy Center (COL) in Pardeeville, Wisconsin (Figure 1) has one existing and one inactive CCR surface impoundment, identified as follows:

- COL Primary Ash Pond (existing)
- COL Secondary Ash Pond (inactive)

2 FACILITY DESCRIPTION

COL is located southeast of the City of Portage on the eastern shore of the Wisconsin River in Columbia County at W8375 Murray Road, Pardeeville, Wisconsin (Figure 1). Wisconsin River backwaters are located north of the generating station, while Lake Columbia, south of the generating plant, is a 480-acre non-contact cooling water pond.

COL is a fossil-fueled electric generating station that initiated operations in 1975. COL consists of two steam electric generating units. Sub-bituminous coal is the primary fuel for producing steam. The burning of coal produces a by-product of CCR. The CCR at COL includes bottom ash, fly ash, and spray dryer absorber waste from scrubbers. The fly ash can also be subdivided into two types, economizer fly ash and precipitator fly ash.

General Facility Information:

Date of Initial Facility Operations:	1975	
WPDES Permit Number:	WI-0002780-08-0	
Latitude / Longitude:	43° 29′ 9.73″ N	89° 25′ 8.40″ W
Unit Nameplate Ratings:	Unit 1 (1975): 512 MW	
	Unit 2 (1978): 511 MW	

2.1 COL Primary Ash Pond

The COL Primary Ash Pond is located north of the generating plant and west of the COL Secondary Pond. The COL Primary Ash Pond is the primary receiver of process flows from the generating plant. Process flows include CCR sluice water (bottom ash and economizer fly ash), boiler/precipitator wash water, plant floor drains, ash line freeze protection flows, bottom ash area sump water, demineralizer area sump water, and air heater sump water. Additionally, the COL Primary Ash Pond receives storm water runoff from the surrounding area, inclusive of the closed ash landfill, located south of the CCR surface impoundments.

The western half of the COL Primary Ash Pond is a CCR handling area. A shallow narrow drainage channel is located along the south, west, and north sides of the CCR handling area. The sluiced CCR is discharged into the southeast corner of the western half of the COL Primary Ash Pond. The sluiced CCR settles out through the water column as it follows the flow of the narrow channel around the southern, western, and northern sides of the existing CCR surface impoundment. The water in the channel flows to the east and discharges through a narrow cut-out of an interior dike into the northwest corner of the large open area in the eastern half of the COL Primary Ash Pond.

The majority of the CCR that is discharged into the COL Primary Ash Pond is removed during routine maintenance dredging activities of the shallow narrow channel. The CCR that is dredged is stockpiled in the western half of the COL Primary Ash Pond for dewatering. Once dewatered the CCR is run through a sieve shaker machine to separate the coarsely graded CCR from the finely graded CCR. The CCR is then transported off-site for beneficial reuse or to the on-site active dry ash landfill.

The water in the COL Primary Ash Pond is recirculated to the generating plant via effluent pumps located in the ash recirculating pump house in the northeast corner of the eastern half of the COL Primary Ash Pond. The recirculating pumps return water to the generating plant for reuse and/or treatment and disposal per the facility's Wisconsin Pollution Discharge Elimination System (WPDES) permit. Instrumentation associated with the pump house in the northeast corner of the COL Primary Ash Pond includes a submersible hydrostatic level transducer, as well as a visual staff gauge, for monitoring water elevations in the COL Primary Ash Pond. An 18-inch diameter corrugated metal pipe is located immediately south of the pump house, in the interior dike between the COL Primary Ash Pond and COL Secondary Pond. The pipe drains to the Secondary Ash Pond and is no longer used. The influent end of the hydraulic structure, on the COL Primary Ash Pond side, consists of a manually operated gate valve which is closed.

The surface area of the COL Primary Ash Pond is approximately 14.7 acres and has an embankment height of approximately 23 feet from the crest to the toe of the downstream slope. The interior storage depth of the COL Primary Ash Pond is approximately 15 feet. The total volume of impounded CCR and water within the COL Primary Ash Pond is approximately 330,000 cubic yards.

2.2 COL Secondary Ash Pond

The COL Secondary Pond is located north of the generating plant and east of the COL Primary Ash Pond. The COL Secondary Ash Pond was previously a downstream receiver of influent flows from the COL Primary Ash Pond. The water within the COL Secondary Pond, prior to 2004, was pumped to a surface impoundment identified as the polishing pond. The polishing pond was located east of the generating plant. The water pumped to the polishing pond would flow to the south through the facility's WPDES Outfall 002 into "Mint Ditch" and eventually flow into the backwaters of the Wisconsin River. Presently, the COL Secondary Pond acts as a storm water detention impoundment with the only influent sources being precipitation and storm water runoff from the surrounding area. The water within the COL Secondary Pond either infiltrates or evaporates. The water elevation within the COL Secondary Pond is normally the same as the ground water elevation under the CCR Ponds approximately 10 feet lower than the COL Primary Ash Pond.

The surface area of the COL Secondary Ash Pond is approximately 9.6 acres and has an embankment height of approximately 23 feet from the crest to the toe of the downstream slope. The interior storage depth of the COL Secondary Ash Pond is approximately 12 feet. The total volume of impounded CCR and water within the COL Secondary Ash Pond is approximately 185,000 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 COL Primary Ash Pond

The COL Primary Ash Pond was constructed in 1975 on the north end of the generating station. The western end of the impoundment is now filled with CCR and is used as the dewatering area for bottom ash discharged by COL. Facility construction documents indicate the embankments were constructed of the fine glacial till sand from the upland areas where the COL is located. The COL Primary Ash Pond area extends to the edge of the Wisconsin River Flood Plain to the north and unsuitable soils were stripped off of looser fine sand that likely resulted from river deposition over the till. Details of the original COL Primary Ash Pond are shown in drawings prepared by Sargent & Lundy in 1974, Appendix A.

The embankment is constructed with four horizontal to one vertical slopes which are vegetated and mowed to control the growth of woody vegetation. The COL Primary Ash Pond has a concrete wet well with pumps to recirculate water back to facility for reuse and discharge. There is a pipe that formerly allowed excess water in the COL Primary Ash Pond to overflow to the COL Secondary Ash Pond. The pipe has a valve on the inlet side that is closed and no water flows to the COL Secondary Ash Pond.

In 2011 and 2015, subsurface soil investigations were undertaken to collect soil samples and determine the in-situ density of the embankments and install monitoring wells. The soil borings were advanced using a Geoprobe and hollow stem augers and sampling was completed with a standard split spoon (ASTM D1556), Figure 2. The density information, Appendix B, indicates the current conditions of the embankments.

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

The COL Primary Ash Pond is constructed on an existing layer of loose fine sand that grades to very dense with depth. The exact thickness of the loose sand found near the toe of the embankment is not great and very dense sand is the likely foundation material at greater depths. Analysis of safety factor for the slope were completed for a soil profile that ignores the deeper very dense sand, COL Safety Factor Assessment Report §257.73. The results indicate the loose sand is an acceptable foundation for the long term stability of the embankment.

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

The COL Primary Ash Pond is incised on the west and south sides. The north embankment crest is about 20 feet wide. The upstream and downstream slopes are four feet horizontal to one foot vertical and is comprised of shallow rooting vegetation, which is adequate to protect against surface erosion. The east embankment separates the COL Primary Ash Pond and the COL Secondary Ash Pond and is about 20 feet wide. The upstream and downstream slopes are three feet horizontal to one foot vertical and is comprised of shallow rooting vegetation, which is adequate to protect against surface erosion.

Sudden drawdown is addressed in Section 3.1.7.

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

The embankment is constructed of fine sand that is native to the COL site. The results of soil borings taken in 2011 and 2015 show that the sand was compacted to near optimum density and the strength of the embankment sand is greater than the loose layer of sand that remains below the embankment. The stability of the four horizontal to one vertical embankment slope is controlled by the strength of the loose sand below the embankment and the embankment is stable for the normal and flood operating conditions of the COL Primary Ash Pond.

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, there were no identified appearances of an actual or potential structural weakness or disruptions to the inspection of the COL Primary Ash Pond that warranted additional investigation or remedial activities. The facility plans to continue managing the grassy vegetation on the embankments at a height that facilitates effective inspections.

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

The COL Primary Ash Pond is a zero liquid discharge impoundment and does not contain a spillway.

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

The COL Primary Ash Pond is a zero liquid discharge impoundment, which has a pump house that is no longer in use.

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

The toe of the embankment is in the floodplain of the Wisconsin River. When the plant was constructed in 1974, the USACE reported that the 100 year flood elevation would be 794 feet on the north embankment of the COL Primary Ash Pond due to construction in the floodplain, Appendix C. The drawdown caused by the flood receding would result in drainage from the toe of the embankment. The embankment is constructed of fine sand (expected permeability of 10^{-2} to 10^{-3} $^{cm}/_{sec}$) and is not susceptible to rapid drawdown hydraulic pressure. River flooding will not lead to toe stability issues.

3.2 COL Secondary Ash Pond

The COL Secondary Ash Pond was constructed in 1975 on the north end of the generating station. Plant construction documents indicate the embankments were constructed of the fine glacial till sand from the upland areas where COL is located. The COL Secondary Ash Pond area extends to the edge of the Wisconsin River flood plain to the north. Details of the original COL Secondary Ash Pond are shown in drawings prepared by Sargent & Lundy in 1974, Appendix A.

The embankment is constructed with four horizontal to one vertical side slopes that are vegetated and mowed to control the growth of woody vegetation. There is no groundwater gradient at the toe if the embankment since the water elevation in the impoundment is approximately the same elevation as the toe of slope.

The COL Secondary Ash Pond has a concrete wet well with pumps and an outlet structure that formerly allowed overflow to a ditch just east of the railroad tracks on the east side of the impoundment. The former discharge is closed and the COL Secondary Ash Pond is operated as a zero liquid discharge impoundment.

In 2011 and 2015, subsurface soil investigations were undertaken to collect soil samples and determine the in-situ density of the embankments and install monitoring wells. The soil borings were advanced using a Geoprobe and hollow stem augers and sampling was completed with a standard split spoon (ASTM D1556), Figure 2. The density information, Appendix B, indicates the current conditions of the embankments.

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

The COL Secondary Ash Pond is constructed on an existing layer of loose fine sand that grades to very dense with depth. The exact thickness of the loose sand found near the toe of the embankment is not great and very dense sand is the likely foundation material at greater depths. Analysis of safety factor for the slope was completed for a soil profile that ignores the deeper very dense sand, COL Safety Factor Assessment Report §257.73. The results indicate the loose sand is an acceptable foundation for the long term stability of the embankment.

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The toe of the embankment is in the floodplain of the Wisconsin River. When the plant was constructed in 1974, the USACE calculated the 100 year flood elevation would be 794 feet on the north embankment of COL due to construction in the floodplain, Appendix C. The drawdown caused by the flood receding would result in drainage from the toe of the embankment. The embankment is constructed of fine sand (expected permeability of 10^{-2} to 10^{-3} $^{cm}/_{sec}$) and is not susceptible to rapid drawdown hydraulic pressure[1]. River flooding will not lead to toe stability issues.

[1] USACE, Slope Stability, EM1110-2-1902, October 2003

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 Wisconsin; 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).

WISCONSIN
MARK W.
LOEROP
E-43783-6
NAPERVILLE
IL
PROFESSIONAL ENGINEER

By:______________________

Name: Mark Loerop

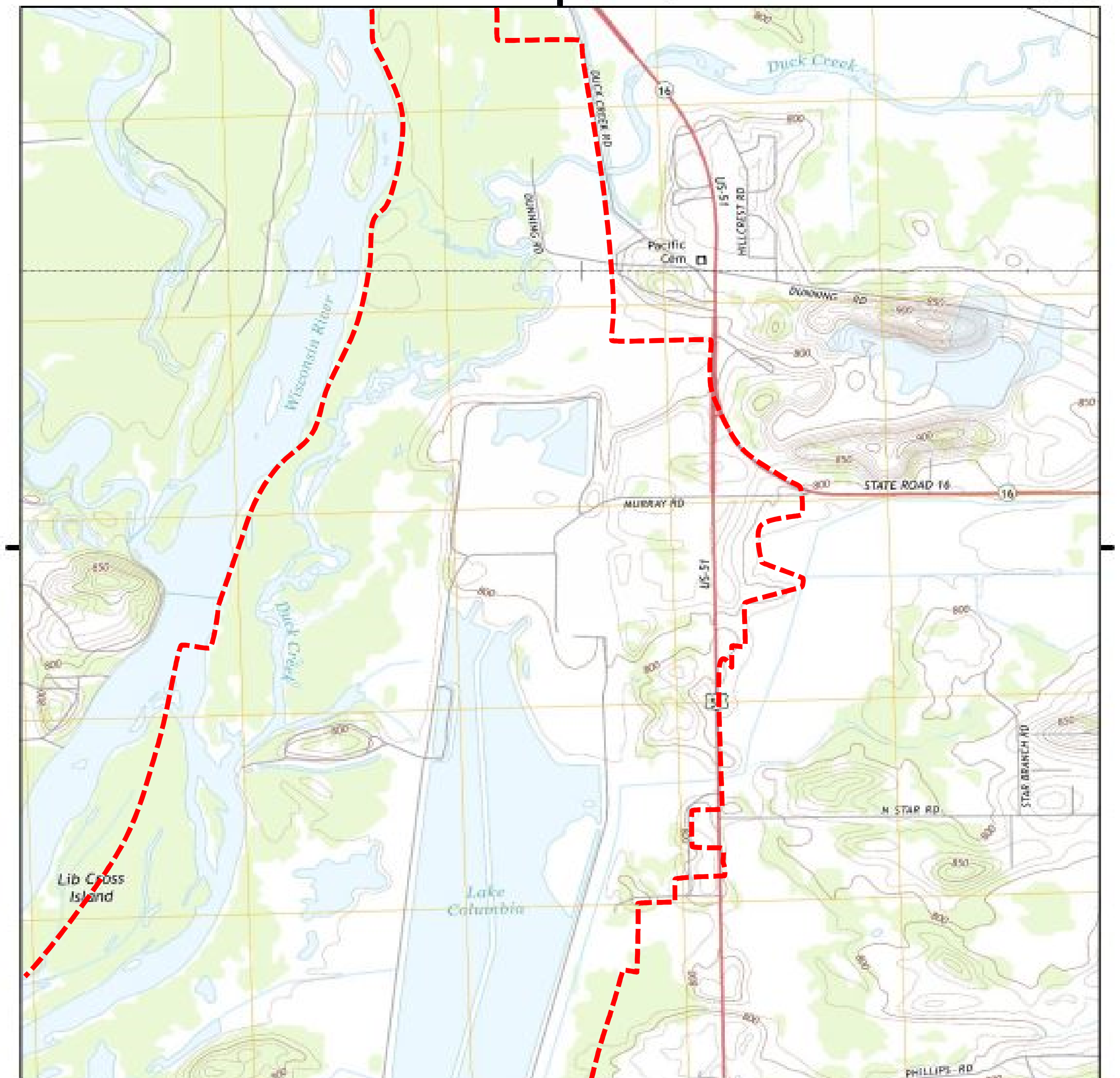
Date: Sep. 19, 2016

FIGURES

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Structural Stability Assessment

Historical Topo Map 2013



Miles 0.25 0.5 1 1.5

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

NW N NE
W E
SW S SE

TP, Poynette, 2013, 7.5-minute

N, Portage, 2013, 7.5-minute

SITE NAME: Columbia Energy Center
ADDRESS: W8375 Murray Road
Pardeeville, WI 53954
CLIENT: Environmental Site Assessors

N

4555570 - 7 page 4

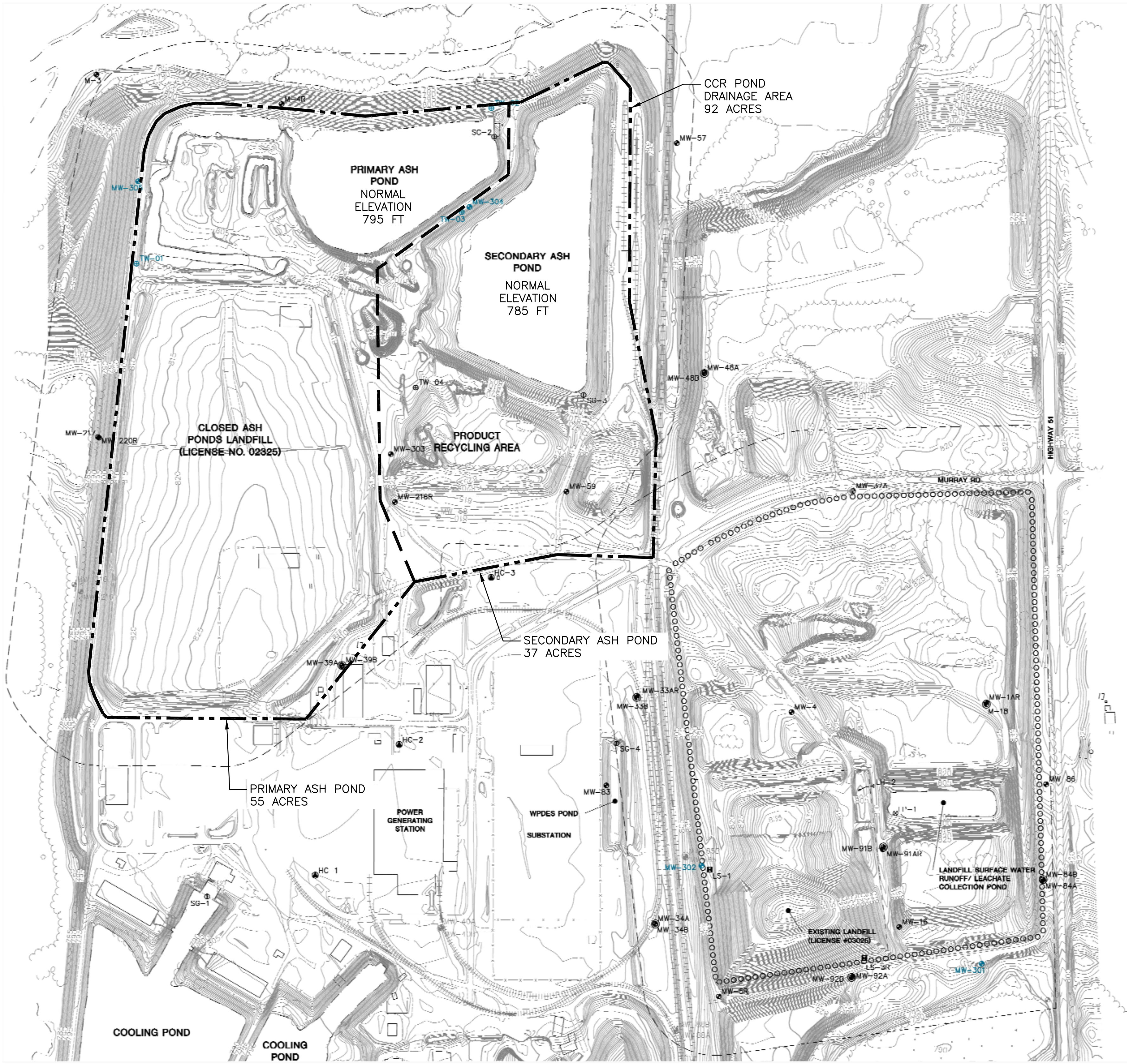
Historical Aerial Photo 6/12/2014

Approximate Property Boundary

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

Site Location
Columbia Energy Center
Wisconsin Power and Light Company

Drawing	Figure 1
Date	7/12/2016



MAP SOURCE:
SCS ENGINEERS
COLUMBIA ASH PONDS AND DRY ASH DISPOSAL FACILITIES;
WELL LOCATION MAP; FIGURE 2
REV. DATE 2-2-16

LEGEND

- EXISTING MAJOR CONTOUR (10' INTERVAL)
- EXISTING MINOR CONTOUR (2' CONTOUR)
- EXISTING FENCELINE
- EXISTING TRACKS
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EDGE OF WATER
- DESIGN MANAGEMENT ZONE
- APPROVED LIMITS OF WASTE
- CONSTRUCTED LIMITS OF WASTE
- WATER SUPPLY WELL
- STAFF GAUGE
- WATER TABLE WELL
- PIEZOMETER
- SURFACE WATER SAMPLE LOCATION
- LYSIMETER
- ABANDONED WATER TABLE WELL
- ABANDONED PIEZOMETER
- LEACHATE HEADWELL
- TEMPORARY WELL
- NEW WATERTABLE WELL

NOTES:

1. BASE MAP CREATED FROM AERIAL SURVEY BY KBM, FLOWN DECEMBER 1, 2014.
2. MONITORING WELL LOCATIONS AND ELEVATIONS SURVEYED BY WISCONSIN POWER AND LIGHT, INC. IN DECEMBER 1994, NOVEMBER 1996, APRIL 2003, AND AUGUST 2012.
3. SUPPLY WELL LOCATIONS ARE APPROXIMATE AND ASSUMED BASED ON JANUARY 2013 DRAWINGS BY TRC.
4. THE LOCATIONS OF THE ASH PONDS FACILITY DESIGN MANAGEMENT ZONE DEMARCATION LINES ARE APPROXIMATE AND BASED ON THE WATER TABLE MAP (OCTOBER 2012) FIGURE BY RMT.
5. THE LOCATION OF THE ACTIVE DRY ASH LANDFILL DESIGN MANAGEMENT ZONE DEMARCATION LINE IS BASED ON A 300 FOOT OFFSET FROM THE DESIGN LIMITS OF ASH EXCEPT WHERE OFFSET WOULD EXTEND LINE BEYOND PROPERTY LINE.

0 250' 500'
SCALE: 1"=250'

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

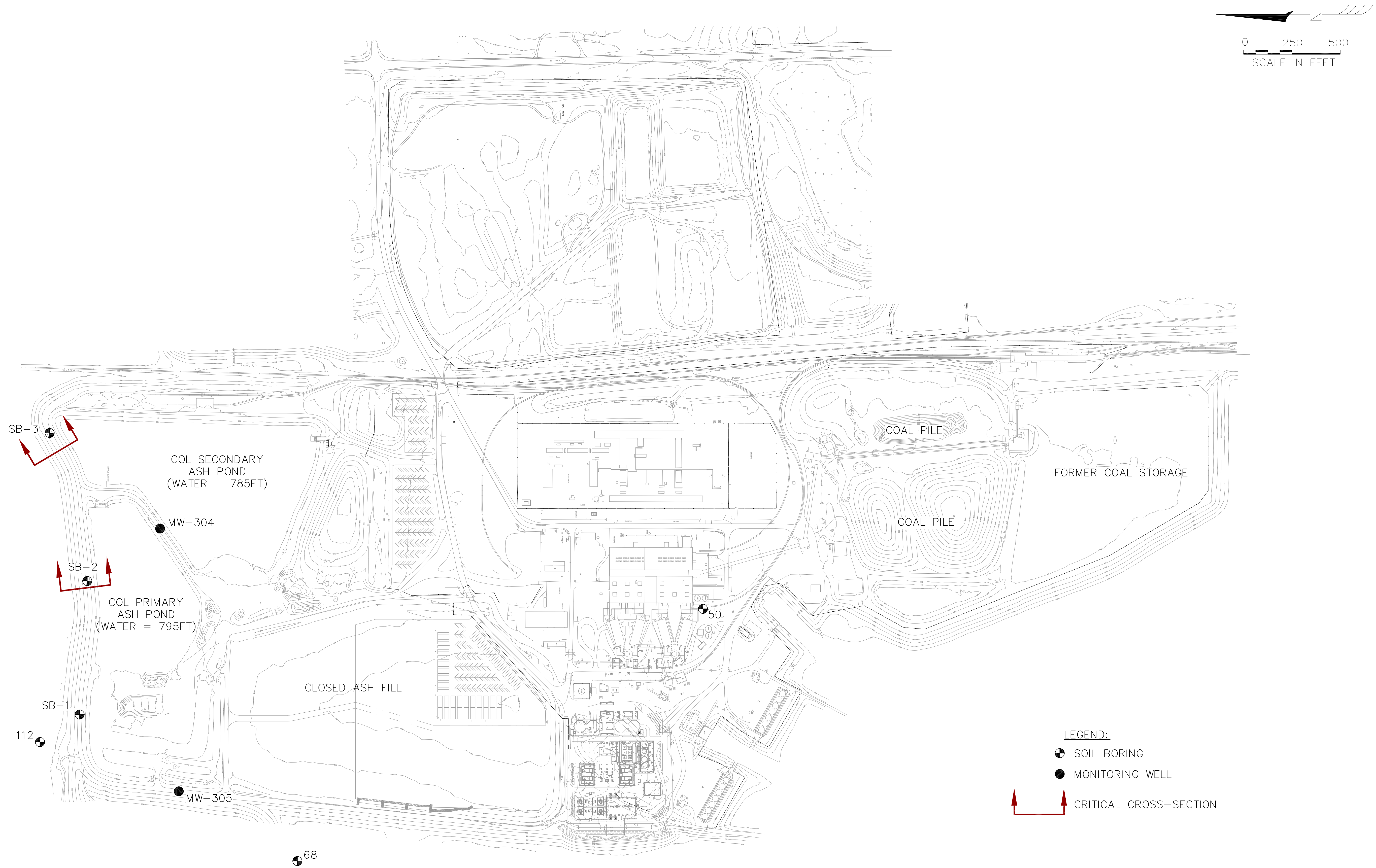
hard hat™ SERVICES

SCALE:	AS SHOWN
DATE:	8-1-16
DRAWN BY:	JFD
CHKD BY:	TJH
APRVD BY:	MWL

CLIENT / LOCATION
WISCONSIN POWER AND LIGHT (WPL) COMPANY
COLUMBIA ENERGY CENTER
PARDEEVILLE, WISCONSIN

DRAWING DESCRIPTION
Structural Stability Assessment
STORM WATER ROUTING

JOB 154.010.025
SHT. FIGURE 2
DWG. 154.010.025-D1



REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

hard hat™ SERVICES

SCALE:	AS SHOWN
DATE:	8-22-16
DRAWN BY:	JFD
CHKD BY:	TJH
APRVD BY:	MWL

CLIENT / LOCATION
WISCONSIN POWER AND LIGHT (WPL) COMPANY
COLUMBIA ENERGY CENTER
PARDEEVILLE, WISCONSIN

DRAWING DESCRIPTION
STABILITY ASSESSMENT REPORT
SITE PLAN

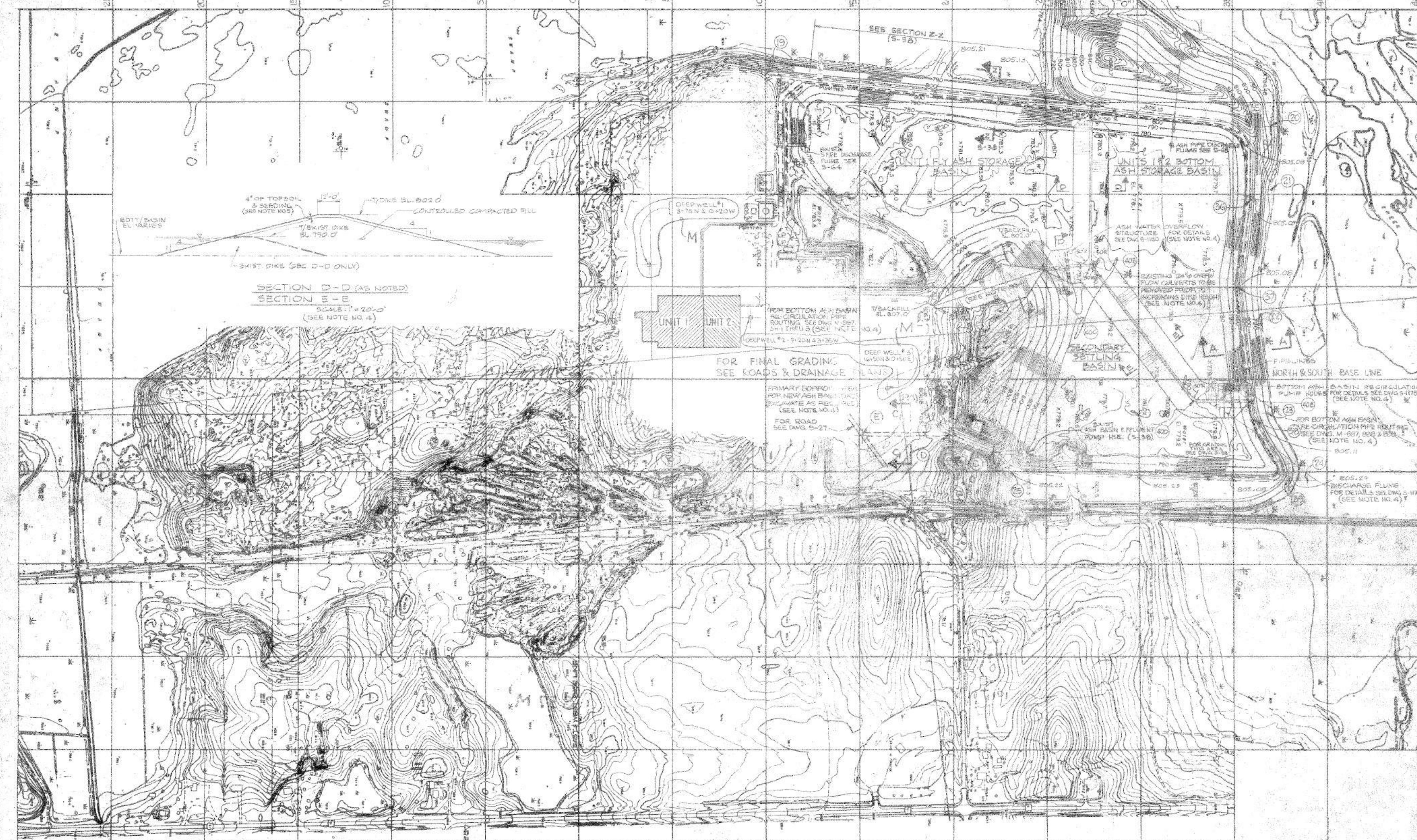
JOB 154.010.025
SHT. FIGURE 3
DWG. 154.010.025-SAR

APPENDIX A – Ash Pond Construction Drawing

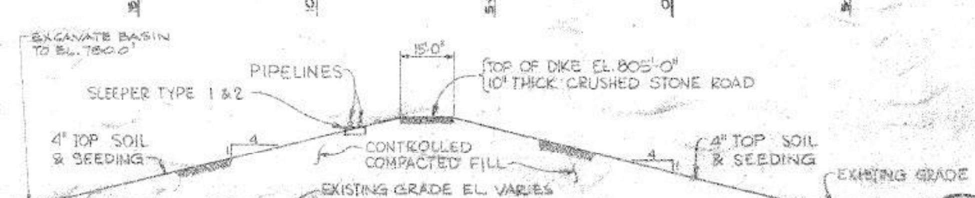
Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Structural Stability Assessment

S-37



POINT NO.	LOCATION		POINT NO.	LOCATION	
19	1000.0N	1650.0W	36	5610.0N	215.0E
20	5702.49N	1870.0W	39	5799.66N	544.9E
21	5702.49N	1027.96W	404	2746.0N	1464.0W
22	5654.87N	524.07W	408	2734.0N	623.0W
23	5088.25N	182.95E	400	2484.0N	596.0W
24	[illegible]	547.90E	401	3289.57N	115.55E
25	2800.0N	300.0E	402	3599.57N	115.55E
32	1500.0N	600.0E			
35	5590.0N	1979.0W			
36	5590.0N	1972.0W			
37	5588.0N	500.0W			



SECTION A-A
SCALE: 1"=20'-0"

NORTH

NOTES

1. GRID SYSTEM -

PLANT COORDINATES	WIS. STATE PLAN COORDINATE SYSTEM
0+00N	541500N
0+00E	2164500E

2. ALL DIKE CENTERLINE CURVES SHALL HAVE A RADIUS OF 200 FEET EXCEPT AS NOTED.
3. FOR LOCATION & PROFILE OF ACCESS ROAD TO ASH BASIN EFFLUENT PUMP HOUSE & DIKE SEE DWG. S-38.
4. ALL NEW WORK SHOWN SHALL BE DONE BY THE ASH HANDLING SYSTEM CONTRACTOR IN ACCORDANCE WITH SPECIFICATION W-2908.
5. TOPSOIL & SEEDING SHALL BE DONE FROM T/DIKE (EL 802.0) DOWN TO THE WATER LEVEL OF THE BASIN AT THE TIME OF PLACEMENT.

REFERENCE DRAWINGS

S-7	DIKE & STENCIL PLAN - SHEET 3
S-25	ROADS & DRAINAGE PLAN - SOUTH AREA
S-26	ROADS & DRAINAGE PLAN - NORTH AREA
S-27	ROADS & DRAINAGE PLAN - EAST AREA
S-38	ASH BASIN SECTIONS & DETAILS
S-59	ASH BASIN EFFLUENT PUMP HOUSE - PLAN & SECTIONS
S-60	ASH BASIN EFFLUENT PUMP HOUSE - SECTIONS & DETAILS
S-1175	BOTTOM ASH WATER RECIRCULATION PUMP HOUSE
M887-SH.1	BOTTOM ASH WATER RECIRCULATION PUMP HOUSE - PIPING
M887-SH.2	BOTTOM ASH WATER RECIRCULATION PUMP HOUSE - OUTDOOR PIPING
M887-SH.3	BOTTOM ASH WATER RECIRCULATION PUMP HOUSE - OUTDOOR PIPING
S-64	ASH PIPE DISCHARGE FLUME
S-1176	BOTTOM ASH WATER RECIRCULATION FOUNDATIONS - SECTION & DETAILS - SHEET 1
S-1180	ASH WATER OVERFLOW STRUCTURE - PLAN & SECTIONS

Drawing Revision Record

Rev.	Date	Init.	Description
[illegible]	3-10-72	[illegible]	FOR PERMITS
A	6-6-72	[illegible]	FOR CONST.
B	9-24-73	[illegible]	[illegible]
C	3-26-74	[illegible]	[illegible]
	6-17-74	G.N.	[illegible]
D	1-24-75	[illegible]	[illegible]
E	7-28-76	[illegible]	[illegible]
F	10-12-76	[illegible]	[illegible]
G	12-27-76	[illegible]	[illegible]
H	2-24-77	[illegible]	[illegible]
J	8-23-77		[illegible]
K	8-29-77	[illegible]	[illegible]
L	5-18-78	[illegible]	[illegible]
M	[illegible]	[illegible]	[illegible]

ASH BASIN

COLUMBIA GENERATING STATION
WISCONSIN POWER & LIGHT CO.
PORTAGE, WISCONSIN

SCALE 1"=200'-0" UNLESS NOTED
DRAWN [illegible] 1-19-72
CHECKED [illegible] 2-3-72
ENGINEER [illegible] 2-9-72
APPROVED [illegible] 3-3-7[illegible]
JOB NO. 4287-03

SANGENT & LUNDY
CHICAGO

DRAWING NO.
S-37

M. ZAR
HIGHLAND PARK, ILLINOIS
PROFESSIONAL ENGINEER

REDRAWN 1-24-75

APPENDIX B – Soil Borings on Embankment and Foundation Soils

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Structural Stability Assessment

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

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

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
WPL-Columbia SCS#: 25215135.00		MW-304

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Kevin Durst Badger State Drilling	11/12/2015	11/12/2015	hollow stem auger

WI Unique Well No.	DNR Well ID No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
VY703			Feet	802.50 Feet	8.5 in.

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 544671 N, 2122897 E /C/N
1/4 of 1/4 of Section 27, T 12 N, R 9 E
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ S Feet ☐ E ☐ W Feet

Facility ID	County	County Code	Civil Town/City/ or Village
	Columbia	11	Portage

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	Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL.	TOPSOIL									
			1	SILTY SAND, mostly fine, brown/tan (10YR 5/6).	SM									
S1	24	7 8 10 12	2							M				
			3											
S2	24	14 22 26 31	4–5	Same as above except, trace gravel, brown tan to grey (top to bottom) 10YR 5/4.						M				
S3	24	16 18 22 24	6–7	Same as above except, brown/tan/grey assorted coloring.						M				
			8											
S4	24	11 15 15 14	9–10	Same as above except, black/grey/brown, saturated area about 2" thick.						M				
S5	24	23 31 30 29	11–12	Same as above except, 10YR 5/3.						M				
			13											
S6	20	9 10 7 5	14–15	trace gravel.						M				

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

Signature: [signature] for Zach Watson
Firm: SCS Engineers, 2830 Dairy Drive Madison, WI 53711 Tel: (608) 224-2830 Fax:

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-304 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: 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: Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			16	SILTY SAND, mostly fine, brown/tan (10YR 5/6).										
S7	4		17							W				dropped spoon
			18											
			19	Same as above except, 10YR 6/3.	SM									
S8										W				
			20											
			21											
			22											
			23	End of boring at 23 ft bgs.										

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122 Rev. 7-98

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

Facility/Project Name: WPL-Columbia SCS#: 25215135.00	License/Permit/Monitoring Number	Boring Number: MW-305	
Boring Drilled By: Name of crew chief (first, last) and Firm: Kevin Durst, Badger State Drilling	Date Drilling Started: 11/13/2015	Date Drilling Completed: 11/13/2015	Drilling Method: hollow stem auger
WI Unique Well No.: VY716 / DNR Well ID No. / Common Well Name	Final Static Water Level: Feet	Surface Elevation: 803.95 Feet	Borehole Diameter: 8.5 in.
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒ State Plane 544776.1 N, 2121537 E S/C/N; 1/4 of 1/4 of Section 27, T 12 N, R 9 E	Lat ° ' " Long ° ' "	Local Grid Location: Feet ☐ N ☐ S	Feet ☐ E ☐ W
Facility ID / County: Columbia	County Code: 11	Civil Town/City/ or Village: Portage	

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	Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			0–1	TOPSOIL	TOPSOIL									
			1	SILTY SAND, mostly fine, brown/tan 10YR 5/8.	SM									
S1	18	5 8 9 7	2							M				
S2	18	2 3 3 4	5							M				
			6	Same as above except, trace gravel, tan 10YR 6/8 at bottom.										
S3	18	2 8 9 8	7							M				
			9	Same as above except, light tan 10YR 6/6, trace gravel, some large gravel chunks.										
S4	20	5 7 6 5	10							M				
			11	POORLY GRADED SAND, tan (10YR 6/8), trace gravel, some saturated areas.	SP									
S5	20	9 12 17 22	12							M				
			13.5	SILTY SAND, trace gravel, tan (10YR 5/6).	SM									
S6	24	16 19 22 34	15							W				

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

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SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-305 Use only as an attachment to Form 4400-122.

Sample: Number and Type	Sample: 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: Pocket Penetration (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S7		31 30 41 50/2	16 17 18	SILTY SAND, trace gravel, tan (10YR 5/6), some large dolomite chunks.	SM					W				
				End of boring at 18 ft bgs.										

Boring Log
Legend

Sample
No: (Number) Soil samples are numbered consecutively from the ground surface. Core samples are numbered consecutively from the first core run.

Type: A= Auger Cuttings CR= Core Run MS= Modified Spoon PB= Pitcher Barrel
PT= Piston Tube ST= Shelby Tube SS= Split Spoon (2" O.D.) WC= Wash Cuttings

Interval: The depth of sampling interval in feet below ground surface

Blow Count
The number of blows required to drive a 2-inch O.D. split-spoon sampler with a 140 pound hammer falling 30-inches. When appropriate, the sampler is driven 18 inches and blow counts are reported for each 6-inch interval. The sum of blow counts for the last two 6-inch intervals is designated as the standard penetration resistance (N) expressed as blows per foot.

Recovery in Inches
The length of sample recovered by the sampling device.

U.S.C.S. Soil Type
The Unified Soil Classification System symbol for recovered soil samples determined by visual examination or laboratory tests. Refer to ASTM D2487-69 for a detailed description of procedure and symbols. Underlined symbols denote classifications based on laboratory tests (i.e. ML), all others are based on visual classification only.

Percent Moisture
Natural moisture content of sample expressed as percent of dry weight.

q_u TSF
Unconfined compressive strength in tons per square foot obtained by hand penetrometer. Laboratory compression test values are indicated by underlining.

Contact Depth
The contact depth between soil layers is interpreted from significant changes in recovered samples and observations during drilling. Actual changes between soil layers often occur gradually and the contact depths shown on the boring logs should be considered as approximate.

Soil Description and Remarks
Soil descriptions include consistency or density, color, predominant soil types and modifying constituents.

Cohesive Soils			Cohesionless Soils	
Consistency	q_u (TSF)	Blows/ft.	Density	Blows/ft.
Very Soft	less than 0.25	0-1	Very Loose	4 or less
Soft	0.25 to 0.50	2-4	Loose	5 to 10
Medium Stiff	0.50 to 1.00	5-8	Medium Dense	11 to 30
Stiff	1.00 to 2.00	9-15	Dense	30 to 50
Very Stiff	2.00 to 4.00	15-30	Very Dense	Over 50
Hard	more than 4.00	Over 30		

Particle Size Description

Boulder =	Larger than 12 inches
Cobble =	3 to 12 inches
Gravel =	0.187 to 3 inches
Sand =	0.074 to 4.76 mm
Silt and Clay =	smaller than 0.074 mm

Definition of Terms

Trace =	5 to 12 percent by weight
Some =	12 to 30 percent by weight
And =	Approximately equal fractions
( ) =	Driller's observation

Piezo.
(Piezometer) Screened interval of the piezometer installation is denoted by cross-hatching.

General Note
The boring log and related information depicted subsurface conditions only at the specified locations and date indicated. Soil conditions and water levels at other locations may differ from conditions occurring at these boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Soil Test Boring Refusal
Defined as any material causing a blow count greater that 50 blows/6 inches. Such material may include bedrock, "floating" rock slabs, boulders, dense gravel seams, hard pan clay, or cemented soils. Refusal is usually indicated in fractional notation showing number of blows as the numerator and inches of penetration as the denominator.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Alliant Columbia Station

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

BORING NO.: *SB1*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND & GRAVEL; light brown to orange; fine to coarse grained; well graded; dry to moist. (Fill)
	SP1	4.7'/5'						SAND; light brown; fine grained; poorly graded; moist. (Fill)
						-5		
	SP2	5'/5'						
▽								@ 8.5' grades wet
						-10		
	SP3	4'/5'						@ 13' grades yellow to light tan
						-15		@ 15' grades fine to coarse, well graded
	SP4	5'/5'						@ 17' grades fine sand w/ well rounded gravels, trace silt/clay
						-20		Bottom of boring @ 19'
						-25		

BORING LOG

CABENO
Environmental Field Services, LLC

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED* / *E NOT SURVEYED*

PROJECT: Alliant Columbia Station

BORING NO.: *SB2*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0	SAND	SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
						-5		@ 5' grades trace silt
	SP2	5'/5'						
						-10		@ 10' to 13', very hard & dense; seems overconsolidated; more recovery than push
	SP3	5'/3'						
						-15		Bottom of boring @ 13' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

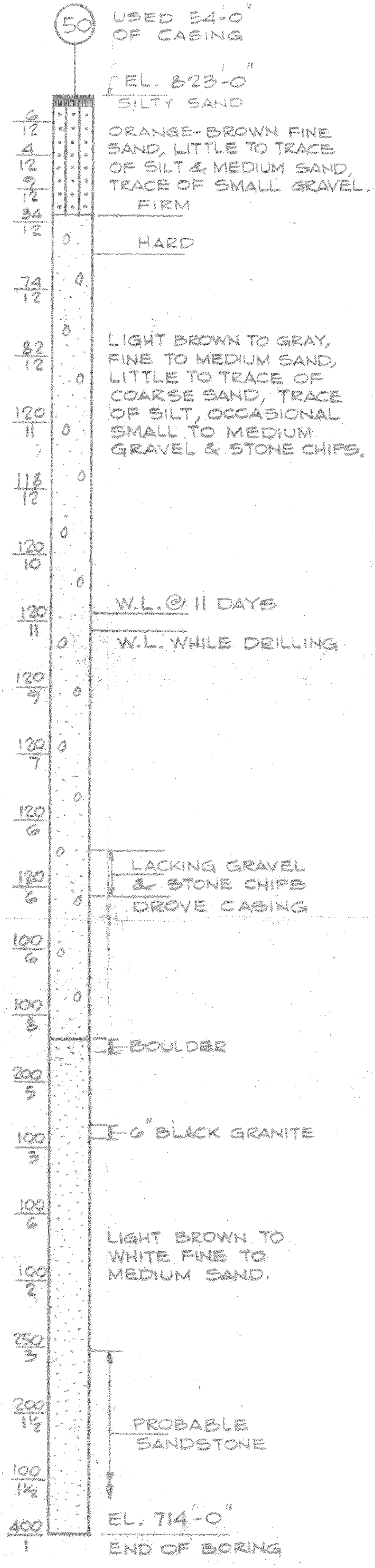
COORDINATES: *N NOT SURVEYED* / *E NOT SURVEYED*

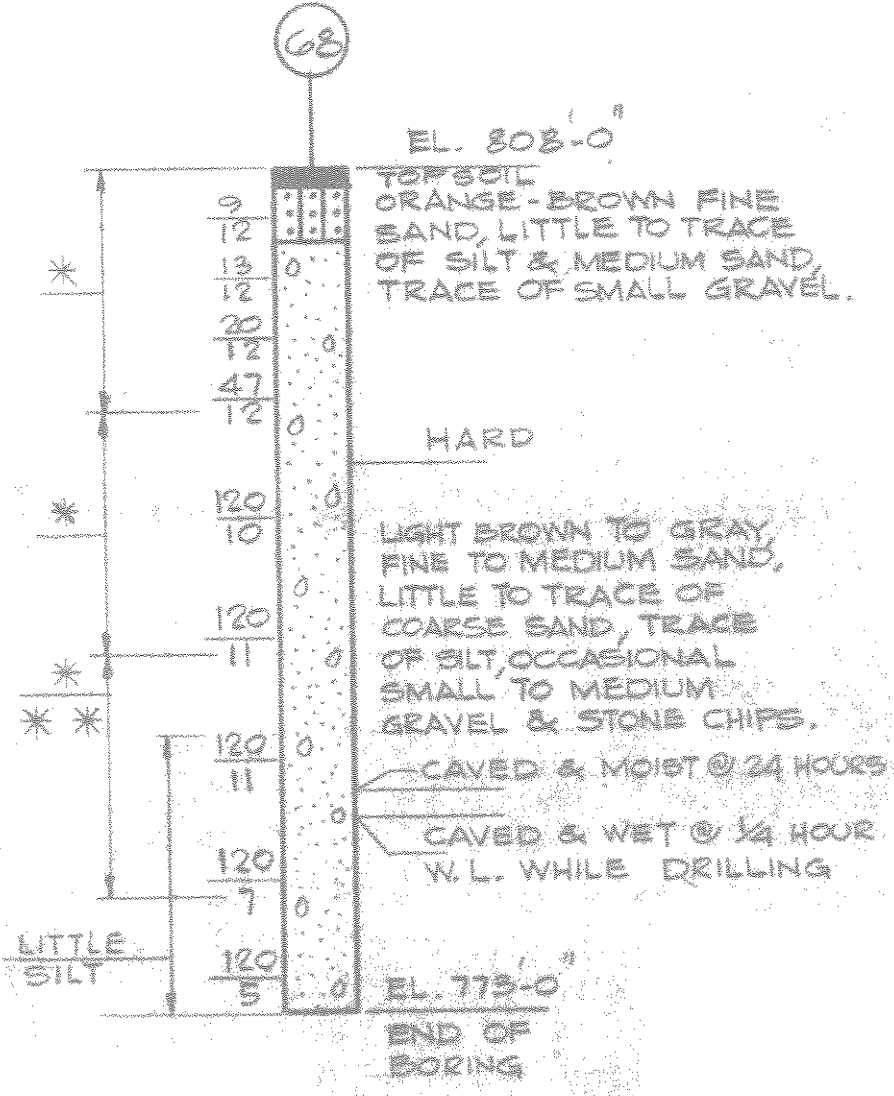
PROJECT: Alliant Columbia Station

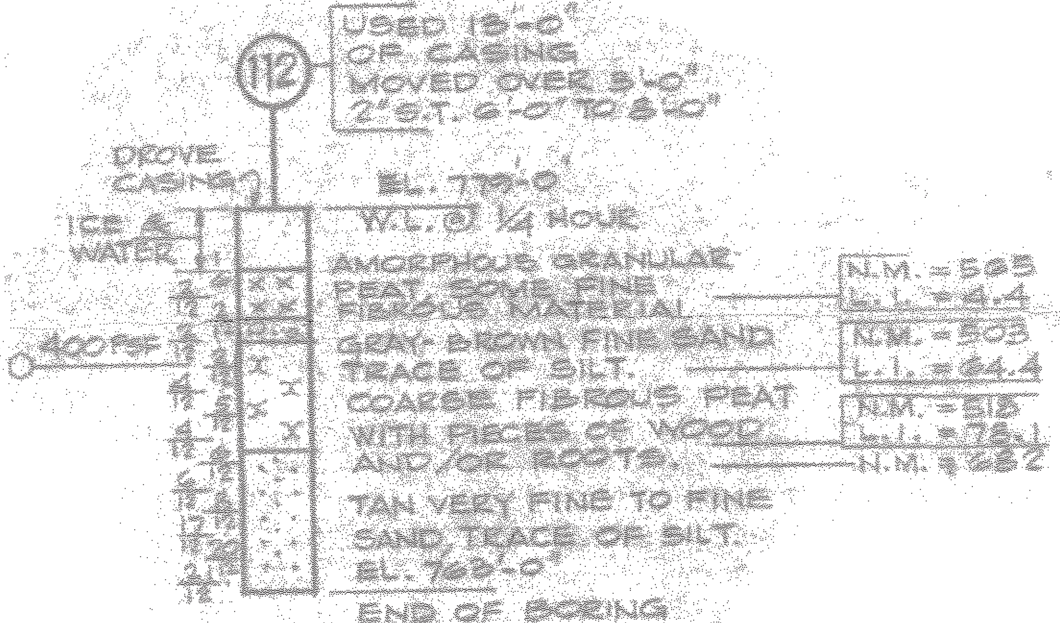
BORING NO.: *SB3*

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
						-5		
	SP2	5'/5'						
						-10		
	SP3	5'/5'						
						-15		
▽								@ 16' grades gray and wet.
	SP4	5'/5'						
						-20		
	SP5	5'/5'						
						-25		PEAT; brown; dry; non-plastic. (PT)
	SP6	1'/1'						Clayey SILT; gray; non-plastic; hard; moist. (ML)
								Bottom of boring @ 26' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-30		


50
USED 54'-0" OF CASING
EL. 823'-0"
SILTY SAND
ORANGE-BROWN FINE SAND, LITTLE TO TRACE OF SILT & MEDIUM SAND, TRACE OF SMALL GRAVEL.
FIRM
HARD
LIGHT BROWN TO GRAY, FINE TO MEDIUM SAND, LITTLE TO TRACE OF COARSE SAND, TRACE OF SILT, OCCASIONAL SMALL TO MEDIUM GRAVEL & STONE CHIPS.
W.L. @ 11 DAYS
W.L. WHILE DRILLING
LACKING GRAVEL & STONE CHIPS
DROVE CASING
BOULDER
6" BLACK GRANITE
LIGHT BROWN TO WHITE FINE TO MEDIUM SAND.
PROBABLE SANDSTONE
EL. 714'-0"
END OF BORING
6/12
4/12
9/12
34/12
74/12
82/12
120/11
118/12
120/10
120/11
120/9
120/7
120/6
120/6
100/6
100/8
200/5
100/3
100/6
100/2
250/3
200/1½
100/1½
400/1

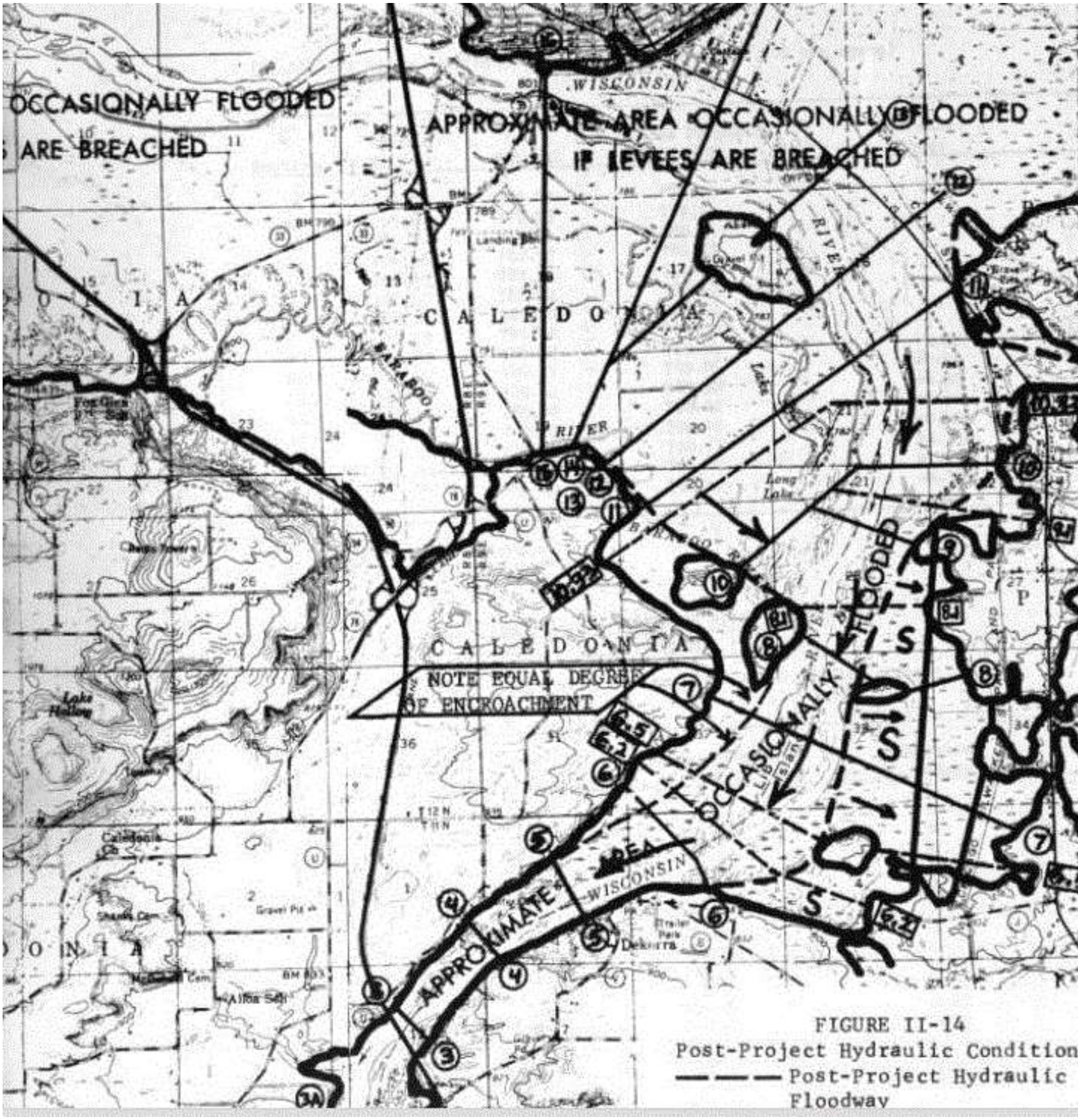

68
EL. 803'-0"
TOPSOIL
ORANGE-BROWN FINE SAND, LITTLE TO TRACE OF SILT & MEDIUM SAND, TRACE OF SMALL GRAVEL.
9/12
13/12
20/12
47/12
HARD
120/10
LIGHT BROWN TO GRAY, FINE TO MEDIUM SAND, LITTLE TO TRACE OF COARSE SAND, TRACE OF SILT, OCCASIONAL SMALL TO MEDIUM GRAVEL & STONE CHIPS.
120/11
120/11
CAVED & MOIST @ 24 HOURS
CAVED & WET @ 1/4 HOUR
W.L. WHILE DRILLING
120/7
LITTLE SILT
120/5
EL. 779'-0"
END OF BORING


112
USED 18'-0"
OF CASING
MOVED OVER 3'-0"
2" S.T. 6'-0" TO 8'-0"
DROVE
CASING
EL. 779-0
W.L. @ 1/4 HOUR
ICE &
WATER
AMORPHOUS GRANULAR
PEAT, SOME FINE
FIBROUS MATERIAL
GRAY-BROWN FINE SAND
TRACE OF SILT.
COARSE FIBROUS PEAT
WITH PIECES OF WOOD
AND/OR ROOTS.
TAN VERY FINE TO FINE
SAND TRACE OF SILT.
EL. 763-0
END OF BORING
400 PSF
N.M. = 565

APPENDIX C – 100 Year Flood Prediction

Alliant Energy
Wisconsin Power and Light Company
Columbia Energy Center
Pardeeville, Wisconsin

Structural Stability Assessment



HEC Analysis
1974 Draft Environmental Impact Report/Impact of Construction of Columbia Energy Center
Prepared by USACE
River Cross-Section 8 and 10 at North End of COL

Flood Elevation Prediction by Section with COL construction in Flood Plaim

TABLE II-11 - WISCONSIN RIVER LEVELS*
REGIONAL FLOOD (100 Year)

(123,000 cfs below confluence with Baraboo River & 115,000 cfs above)

Section	River Mile	Natural	w/Dike Proposal** of 5/26/71	Increased Stage
1A	102.0	780.00	780.00	0
2A	103.6	782.60	782.60	0
3A	105.3	784.68	784.68	0
3	106.15	786.69	786.69	0
4	106.85	789.07	789.07	0
5	107.65	790.89	790.89	0
6	108.50	792.40	792.40	0
7	109.55	793.11	793.11	0
8	110.50	793.39	793.69	+0.30
8A	110.60	793.43	793.74	+0.31
10	112.10	794.23	794.66	+0.43
11	112.70	794.46	794.97	+0.51
12	113.00	794.56	795.06	+0.50
13	113.50	794.79	795.26	+0.47
14	114.35	795.29	795.78	+0.49
16	115.75	797.73	797.99	+0.26

*After revision, represents a flood with a 100+ year frequency.
**Equal degree of encroachment.