LINER SYSTEM CERTIFICATION REPORT

GRAND HAVEN BOARD OF LIGHT AND POWER

J.B. SIMS GENERATING STATION

Documentation of Liner Construction

Pursuant to 40 CFR 257.71

Units 1 and 2 Inactive Ash Ponds, and Unit 3 Active East and West Ash Pond Surface Impoundments

Submitted To: Grand Haven Board of Light and Power
17000 Eaton Drive
Grand Haven, Michigan 49417

Prepared By: Golder Associates Inc.
15851 South US 27, Suite 50
Lansing, Michigan 48906

Original Revision April 2017
Updated January 2018

Project No. 1775416/1789024

Golder Associates

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CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.71(b)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.71 (40 CFR Part 257.71), I attest that this Documentation of Liner Construction report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.71.

Golder Associates Inc.

Signature

January 24, 2018

Date of Report Certification

Tiffany D. Johnson, P.E.

Name

6201049160

Michigan P.E. #

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Appendices

1.0 INTRODUCTION

On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the Coal Combustion Residual (CCR) Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) ("CCR RCRA Rule") to regulate the beneficial use and disposal of CCR materials generated at coal-fired electrical power generating complexes. Section 257.71 of the CCR RCRA Rule requires the owner or operator of an existing CCR surface impoundment to document whether or not the unit was constructed with a liner system meeting criteria outlined in Section 257.71(a)(1). According to 257.71(b), the documentation must be certified accurate by a qualified professional engineer in the State of Michigan.

Golder Associates Inc. (Golder) is submitting this report to describe the liner systems, where present, with regard to the requirements of 40 CFR 257.71, beneath the Units 1 and 2 Inactive Ash Ponds and beneath the Unit 3 Active East and West Bottom Ash Pond surface impoundments at the Grand Haven Board of Light and Power (GHBLP) J.B. Sims Generating Station (JBSGS, Site) located on Harbor Island, Grand Haven, Michigan.

The regulatory requirements are included below:

40 CFR 257.71(a)(1) - No later than October 17, 2016, the owner or operator of an existing CCR surface impoundment must document whether or not such unit was constructed with any one of the following:

- A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} centimeters per second (cm/sec);
- A composite liner that meets the requirements of § 257.70(b); or
- An alternative composite liner that meets the requirements of § 257.70(c).
- 257.71(a)(2) - The hydraulic conductivity of the compacted soil must be determined using recognized and generally accepted methods.
- 257.71(a)(3) - An existing CCR surface impoundment is considered to be an existing unlined CCR surface impoundment if either:
  - The owner or operator of the CCR unit determines that the CCR unit is not constructed with a liner that meets the requirements of paragraphs (a)(1)(i), (ii), or (iii) of this section; or
  - The owner or operator of the CCR unit fails to document whether the CCR unit was constructed with a liner that meets the requirements of paragraphs (a)(1)(i), (ii), or (iii) of this section.
- 257.71(a)(4) - All existing unlined CCR surface impoundments are subject to the requirements of § 257.101(a).
- 257.71(b) - The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer attesting that the documentation as to whether a CCR unit meets the requirements of paragraph (a) of this section is accurate.
- 257.71(c) - The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the Internet requirements specified in § 257.107(f).

2.0 HISTORICAL DOCUMENTATION

Golder performed a review of the following historic documentation relative to the Units 1, 2 and 3 surface impoundments:

- City of Grand Haven, Michigan Board of Light and Power J.B. Sims Station, Unit 3 Ash Pond Construction Report (Black & Veatch, 1983)
- DRAFT - Coal Combustion Residue Impoundment, Round 12 - Dam Assessment Report, JB Sims Power Plant (Site 04), East and West Bottom Ash Ponds, Grand Haven Board of Power and Light, Grand Haven, Michigan, Prepared for: United States Environmental Protection Agency Office of Resource Conservation and Recovery, Prepared by: Dewberry & Davis, LLC Fairfax, Virginia, Dated October 2012 (EPA, 2012)
- Final Report of Evaluation For Grand Haven Power Plant Ash Impoundment Grand Haven, Michigan (Soils & Structures, 2014)
- Annual Ash Impoundment Inspection Report (Soils & Structures, 2016)
- Coal Ash Delineation Sampling Results, Grand Haven Board of Light and Power, Grand Haven, Michigan (ERM, 2016)

The liner design criteria for existing CCR surface impoundments as described in 40 CFR 257.71 is as follows:

- A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec as required in Section 257.71(a)(1)(i);
- A composite liner that meets the requirements of Section 257.70(b); or
- An alternative composite liner that meets the requirements of Section 257.70(c).

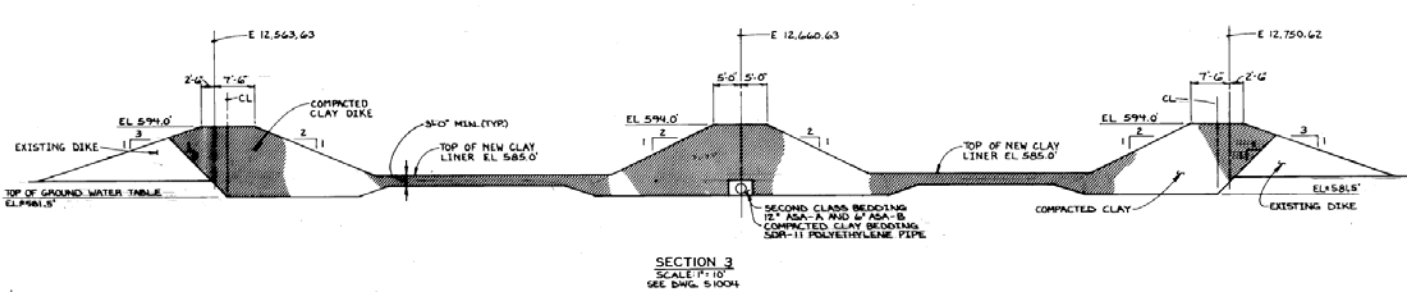
2.1 Units 1 and 2 Inactive Ash Ponds

In the 2016 subsurface investigation conducted by ERM (ERM, 2016, see Appendix C), two soil borings were advanced with the current bounds of Pond 1 and three within Pond 2, each to a depth of 10 feet below ground surface (bgs). One boring was advanced within the small projection of Pond 2 to the northwest, but encountered impenetrable material at 1 foot bgs. Clay was not encountered in any of borings. Soil types encountered included predominantly ash, sands, and silts. No hydraulic conductivity analysis was conducted, but none of the materials underlying Unit 1 or 2 ponds are likely to demonstrate a hydraulic conductivity of less than 1×10^{-7} cm/sec as required in Section 257.71(a)(1)(i) given the granular nature of the subsurface soils.

2.2 Unit 3 Active East and West Ponds

Evidence was found from review of the historic documentation that indicates the Unit 3 East and West Bottom Ash Pond surface impoundments were constructed with a 3-foot thick compacted clay liner system, see Figure 1-1, below.

Figure 1-1: Unit 3 East and West Bottom Ash Pond Liner Construction (From Black and Veatch, 1981)



According to the Black & Veatch construction report (Black & Veatch, 1983, see Appendix A), the Unit 3 East and West Bottom Ash Pond surface impoundments were constructed with clay dikes and a 3-foot thick compacted clay bottom.

In the 2014 Soils & Structures subsurface investigation (Soils & Structures, 2014), a seven foot thick clay layer was encountered below the Unit 3 East and West Bottom Ash Pond surface impoundments. Of the seven feet of clay soil, 3 feet or more consists of compacted clay with a hydraulic conductivity of no more than 1×10^{-8} feet per second (3×10^{-7} cm/sec) (Soils & Structures, 2014).

3.0 UNIT 3 ACTIVE EAST AND WEST BOTTOM ASH POND LINER CONSTRUCTION

The Unit 3 East and West Bottom Ash Pond surface impoundments were designed in 1983 by Black & Veatch of Michigan. In 2014 a structural stability analysis of the impoundments was conducted by Soils & Structures Inc. of Muskegon, Michigan. The following sections summarize the impoundment construction.

3.1 J.B. Sims Station Unit 3 East and West Bottom Ash Pond Construction (Black & Veatch, 1983)

The Unit 3 East and West Bottom Ash Ponds were designed for temporary storage of bottom ash, pulverizer rejects, and various wastewaters generated from the generating facility.

According to the Black & Veatch Ash Pond Construction Report (Black & Veatch, 1983), the pond basin was designed and constructed with a clay liner 3 feet thick. The ponds were designed having a maximum depth of 9 feet, with clay perimeter dikes having a crest elevation of 594 feet and the pond bottoms recorded at 585 feet. Operating at a maximum suggested water surface elevation of 592 feet provided the ponds with 2 feet of freeboard. The storage volume of the ponds with the minimum 2 feet of freeboard were suggested to be 68,000 cubic feet and 77,000 cubic feet, for the eastern and western ponds respectively.

The interior dike separating the ponds into East and West was constructed with 2 horizontal to 1 vertical (2H: 1V) side slopes on both sides, and a 10 foot crest width. The exterior dikes to the west, east, and north were constructed with 2H: 1V interior slopes and 3H: 1V exterior slopes with a 10 foot wide crest. The interior of the northern dike was designed with a 3H: 1V slope and a 20 foot wide crest to facilitate ash hauling from the ponds.

3.2 Ash Impoundment Evaluation (Soils & Structures Inc., 2014)

At the time of investigation (Soils & Structures Inc., 2014), the Unit 3 East and West Bottom Ash Pond surface impoundments ranged from 4 feet to 6 feet in depth, and contained 1 foot to 2 feet of CCR. The exterior berms were reported to have a maximum slope 3H: 1V. A field investigation including soils borings and cone penetration tests was performed in the “corners” of the two impoundments. Testing was conducted to a depth of 25 feet below the ground surface.

Average clay permeability was approximated to be 1×10^{-8} feet per second based on the cone penetration testing results. The clay thickness at the bottom of the impoundment was approximated to be 3 feet or more.

3.3 Supplemental Field Investigation - Unit 3 West Bottom Ash Pond

Subsequent to the original submittal of this documentation report, on June 22, 2017, Golder performed a small scale field investigation of the soils at the bottom of the Unit 3 West Bottom Ash Pond. The west

pond was dewatered and cleaned out at that time as per GHBLP's usual cleaning and maintenance scheduled for the west pond. Golder advanced two Shelby tubes into the bottom of the west pond, using a dozer blade to slowly push the tubes perpendicular to the ground surface. Once the tubes were removed, the holes were backfilled and compacted with granular bentonite. The two Shelby tube samples were tested in Golder's Lansing, Michigan geotechnical soils laboratory for hydraulic conductivity per ASTM Method D5084. The Shelby tube sampling method is a standard method used to determine the in-situ permeability of soils, and this method is accepted for use in the State of Michigan. The results of the testing are shown is Table 1, below, also see Appendix B.

Table 1: Unit 3 West Pond Shelby Tube Permeability Results

Shelby Tube #	Northing	Easting	Elevation	Laboratory Permeability Results (per ASTM D 5084) cm/sec
ST-1	578,055	12,624,268	582.33	$2.4x10^{-8}$
ST-2	578,189	12,624,264	582.42	$2.6x10^{-8}$

4.0 DOCUMENTATION OF LINER SYSTEM CONSTRUCTION

The liner design criteria for existing CCR surface impoundments as described in 40 CFR 257.71 is as follows:

- A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec as required in Section 257.71(a)(1)(i);
- A composite liner that meets the requirements of Section 257.70(b); or
- An alternative composite liner that meets the requirements of Section 257.70(c).

4.1 Unit 1 and 2 Ponds

The currently available liner information indicates that the Units 1 and 2 inactive Ash Ponds were not constructed with a clay or synthetic liner that meets the liner design criteria in 40 CFR 257.71.

The GHBLP plans to close these impoundments in place.

4.2 Unit 3 East and West Ponds

Evidence was found from review of the historic documentation that indicates the Unit 3 East and West Bottom Ash Pond surface impoundments were constructed with a minimum 3-foot thick compacted clay liner system and a permeability of 1×10^{-8} feet per second (or 3×10^{-7} cm/sec). However, the supplemental field investigation resulted in an in-situ permeability result of less than 1×10^{-7} cm/sec (see Table 1) in two location at the bottom of the Unit 3 West Bottom Ash Pond. The permeability of the compacted clay liner is generally greater than 1×10^{-7} cm/sec and the site cannot demonstrate that there is a composite liner present (i.e. a geomembrane liner in addition to a compacted clay liner). The site can demonstrate that the Unit 3 West Bottom Ash pond meets the permeability requirement but cannot demonstrate that for the Unit 3 East Bottom Ash Pond CCR units, therefore the units do not meet the liner design criteria in 40 CFR 257.71.

The GHBLP plans to construct a new liner system for the Unit 3 East and West Bottom Ash Ponds in 2017 that will meet the requirements of 40 CFR 257.71.

5.0 CONCLUSIONS AND SUMMARY

Based on available historic documentation, Golder has determined that the Unit 1 and 2 ponds were constructed without a liner system, and therefore do not comply with 40 CFR 257.71(a)(1)(i). Based on the review of available historic documentation, Golder has determined a liner system exists beneath the Unit 3 East and West Bottom Ash Pond surface impoundments at the JB Sims Generation Station. The liner system does not currently meet the requirements set forth in 40 CFR 257.71(a)(1)(i) – (iii) for both East and West Ponds. This report must be placed in the facility's operating record in accordance with Section 257.105(f) and must be made available on the facility's publicly accessible internet site in accordance with Section 257.107(f).

6.0 AMENDMENTS

A record of all amendments to the plan will be tracked in the log below.

Amendments Log

Date	Name and Title of Reviewer(s)	Amendment(s) Made
April 2017	Paul Cederquist, Environmental Compliance Specialist	Documentation of Liner Issued
January 2018	Paul Cederquist, Environmental Compliance Specialist	Revision to include liner documentation for Units 1 and 2 Inactive Ash Ponds and additional information regarding permeability of the Unit 3 Bottom Ash Ponds.

7.0 REFERENCES

Black & Veatch. 1983. City of Grand Haven, Michigan Board of Light and Power J.B. Sims Station, Unit 3 Ash Pond Construction Report.

Environmental Resources Management Michigan, Inc. 2016, Coal Ash Delineation Sampling Results, Grand Haven Board of Light and Power, Grand Haven, Michigan.

Soils & Structures. 2014. Final Report of Evaluation for Grand Haven Power Plant Ash Impoundment Grand Haven, Michigan.

Soils & Structures. 2016. Annual Ash Impoundment Inspection Report.

USEPA. 2012. DRAFT - Coal Combustion Residue Impoundment, Round 12 - Dam Assessment Report, JB Sims Power Plant (Site 04), East and West Bottom Ash Ponds, Grand Haven Board of Power and Light, Grand Haven, Michigan, Prepared for: United States Environmental Protection Agency Office of Resource Conservation and Recovery, Prepared by: Dewberry & Davis, LLC Fairfax, Virginia, Dated October 2012.

USEPA (Environmental Protection Agency). 2015. Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 40 CFR Part 257. Effective Date October 19, 2015.

FIGURES

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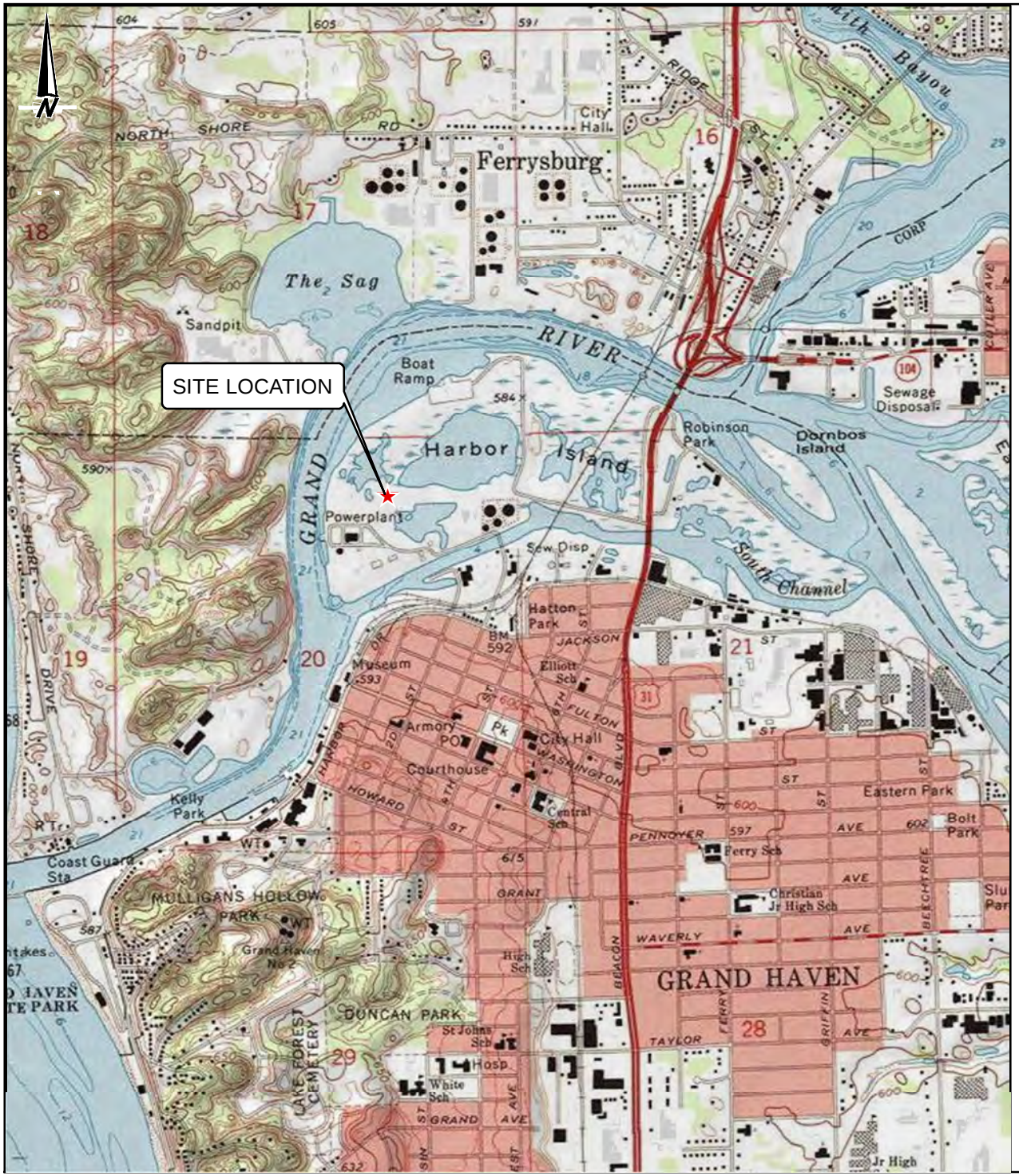

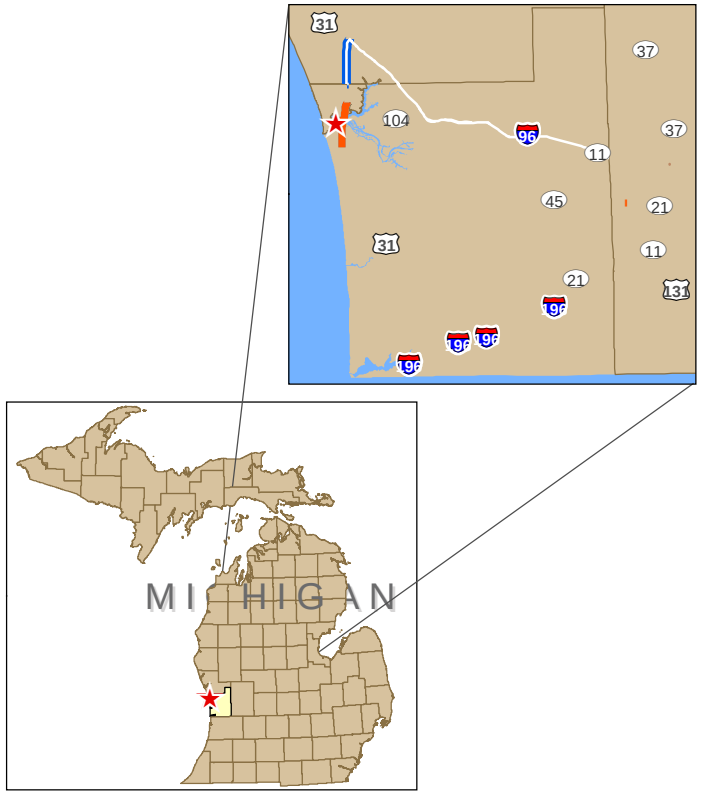

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
HARBOR ISLAND DRIVE
GRAND HAVEN, MI

PROJECT
CCR RULE COMPLIANCE

TITLE
SITE LOCATION MAP

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-20
PREPARED	JJS
DESIGN	JJS
REVIEW	
APPROVED	

PROJECT No.	CONTROL	Rev.	FIGURE
1775461	1775461A000-GIS.mxd	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A
1 in
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0 150 300
1" = 300' FEET

REFERENCE(S)

Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
HARBOR ISLAND DRIVE
GRAND HAVEN, MI

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-03-20
DESIGNED	JJS
PREPARED	JJS
REVIEWED	
APPROVED	

PROJECT
CCR RULE COMPLIANCE

TITLE
OVERALL SITE PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
1775461			2

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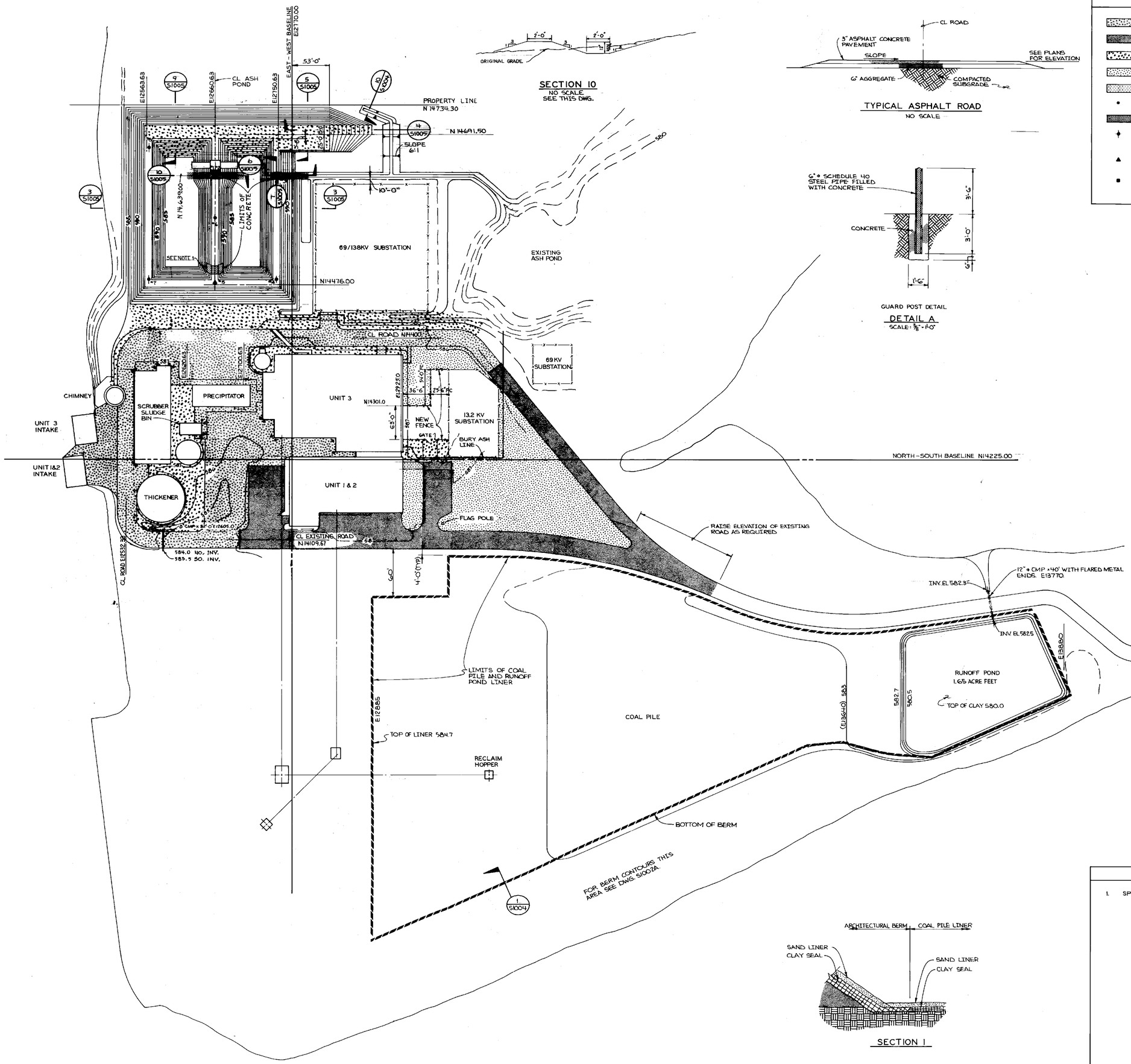
0 1in

APPENDIX A
COPY OF BLACK & VEATCH - CITY OF GRAND HAVEN, MICHIGAN BOARD OF LIGHT AND POWER J.B. SIMS STATION, UNIT 3 ASH POND CONSTRUCTION REPORT, 1983



SECTION 10
NO SCALE
SEE TH15 DWG.

TYPICAL ASPHALT ROAD
NO SCALE

GUARD POST DETAIL
DETAIL A
SCALE: 3/8" = 1'-0"

SECTION 1

LEGEND

- ADDITIONAL ASPHALT
- REMOVE EXISTING ASPHALT AND INSTALL NEW
- WHITE CRUSHED STONE
- NEW SEEDING
- NEW SIDEWALKS
- CONCRETE FILLED PIPE FOR BUMPERS. PAINT YELLOW (SEE DETAIL A)
- CONCRETE
- SETTLEMENT MONITORING POINTS- 1½" DIAMETER GALVINIZED PIPE SET IN CONCRETE.
- SETTLEMENT POINT ON TOP OF WYE OF BOTTOM ASH LINE.
- SETTLEMENT POINT ON TOP OF TIMBER PIPE SUPPORT AT THE PAINTED NAIL.

GENERAL NOTES

1. SPLASH PAD CONSTRUCTED WITH 4" HIGH CURBS.

NO	DATE	REVISIONS	DWN	CK	ACC	APP
7	4-26-83	REVISED AS CIRCLED	WJH	LJA	WJL	
6	4-20-83	MODIFY DRAINAGE SWALE	WJH	LJA		
5	4-15-83	MODIFY ASH POND	MJJ			
4	3-16-83	REVISED AS CIRCLED	SE	WJL		
3	11-9-81	REVISED AS CIRCLED	SE			
2	7-30-81	ISSUED FOR CONST. OF COAL PILE LINER	SE			
1	2-4-81	ISSUED FOR ADD. 1 SPEC 71.0200	SE			
0	1-14-81	ISSUED FOR BID SPEC 71.0200	SE			
9	8-19-83	CONFORMED TO CONSTRUCTION RECORDS	WW	WJL		
8	6-3-83	ISSUED FOR BID, SPEC. 82.2627	LKK	WJL		

SCALE: 1" = 50'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MICHIGAN.
SIGNED Thomas E. Kalin
DATE _____ REG. NO. _____

THOMAS E. KALIN ENGINEER No. 26965 REGISTERED PROFESSIONAL ENGINEER STATE OF MICHIGAN

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 7728

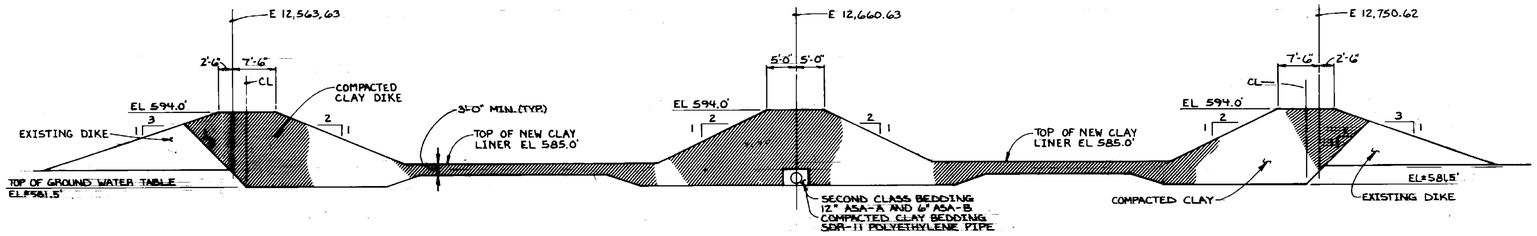
GRAND HAVEN BOARD OF LIGHT AND POWER
J. B. SIMS STATION UNIT 3

FINISH GRADING AND PAVING PLAN

DAV DWG NO. S1004 REV. 9

SECTION 1
SEE THIS SHEET

TYP. RAMP
SECTION 2
SEE THIS SHEET



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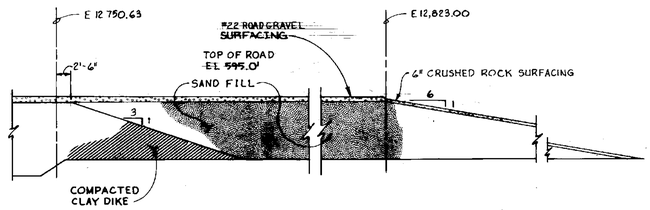
SEE DWG. S1004



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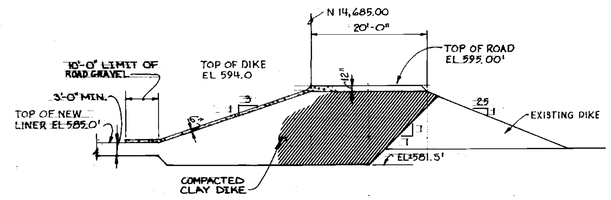

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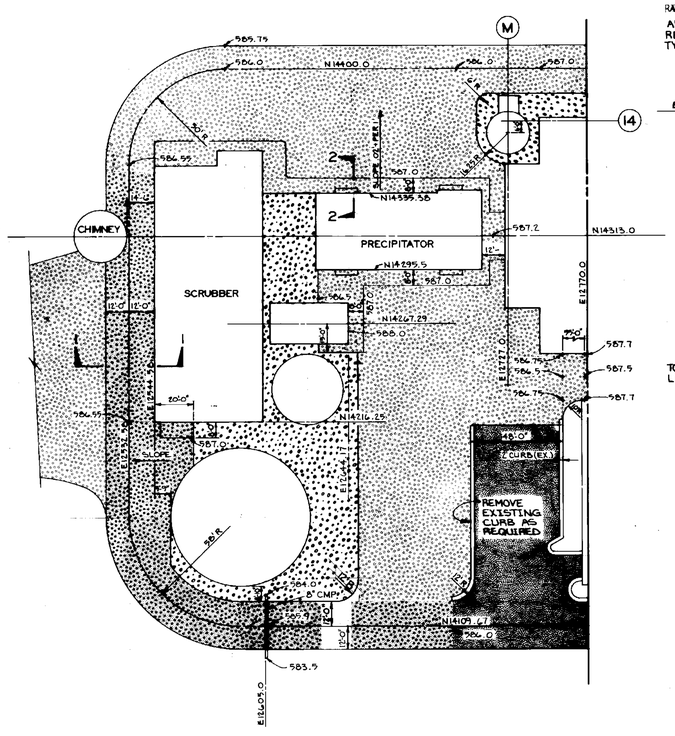

PARTIAL PAVING PLAN
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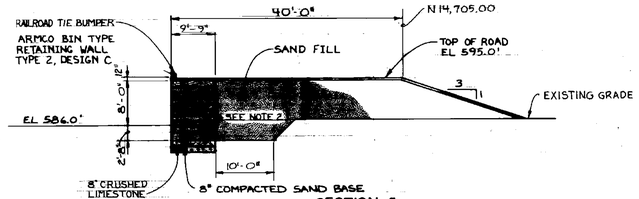

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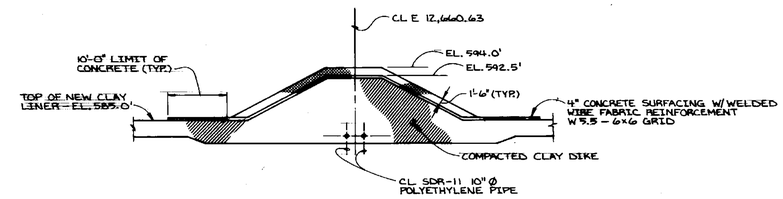

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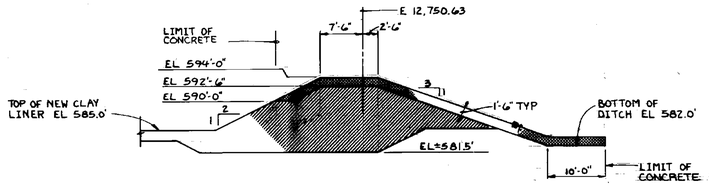

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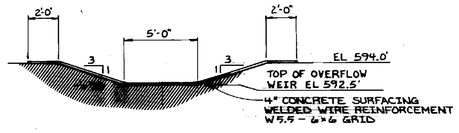

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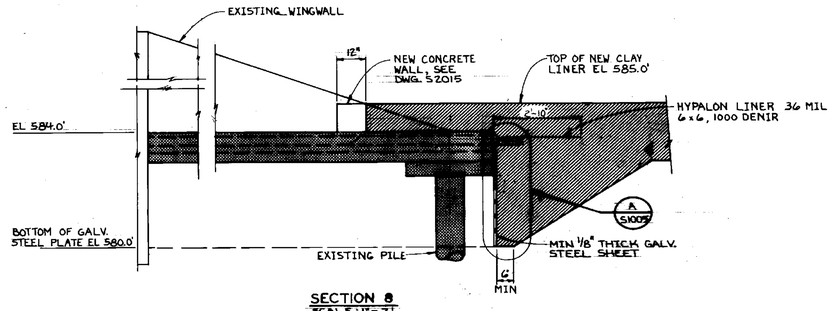

SECTION 8
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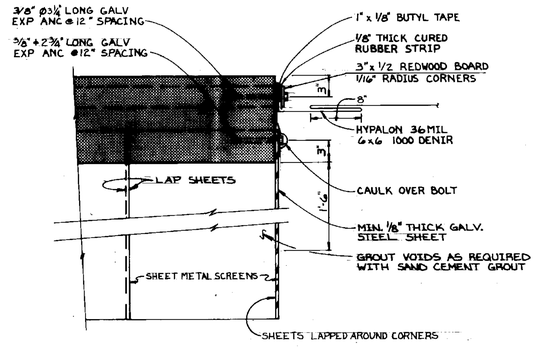


DETAIL A
NO SCALE
SEE THIS DWG.

NOTES

1. SEE DWG. S1004 FOR LEGENDS.
2. PLACE TREVIRA GRADE S1135 GEOTEXTILE OVER INSIDE OF EXTERIOR WALL OF RETAINING WALL.

NO	DATE	REVISIONS	DRWN	CK	ADD	APP
6	8-19-85	CONFORMED TO CONSTRUCTION RECORDS	KMS		MJL	
5	4-26-85	REVISED AS CIRCLED	MJM	LJA	WIL	
4	4-20-85	GENERAL REVISIONS	MJL	LJA		
3	4-15-85	GENERAL REVISIONS				
2	11-6-84	ISSUED FOR CONST. SPEC. 71.0200		KE		
1	2-4-81	ISSUED FOR ADD 1 SPEC 71.0200	SE			
0	1-14-81	ISSUED FOR BID SPEC. 71.0200.	SE			

SCALE:

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MICHIGAN.
SIGNED Thomas E. Kalin
DATE 11-5-81 REG. NO.

STATE OF MICHIGAN — THOMAS E. KALIN — ENGINEER No. 20965 — REGISTERED PROFESSIONAL ENGINEER

BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 7728

GRAND HAVEN BOARD OF LIGHT AND POWER
J. B. SIMS STATION UNIT 3

FINISH GRADE AND PAVING SECTIONS AND DETAILS

S&V DWG NO. S1005
REV. 6

APPENDIX B
ADDITIONAL PERMEABILITY TESTING FOR UNIT 3 ACTIVE EAST AND WEST BOTTOM ASH PONDS

HYDRAULIC CONDUCTIVITY / ASTM D 5084 - CONSTANT VOLUME METHOD F

PROJECT NAME:	GHBLP CCR Compliance
PROJECT NUMBE	177-5416
SAMPLE ID:	ST-1

Cell Pressure =	55	psi
Sample Pressure =	50	psi
Run Number =	1	

Sample Data	Initial	Final	
Height, cm	9.857	9.952	
Diameter, cm	7.173	7.277	
Area, cm^2	40.41	41.59	
Volume, cm^3	398.37	413.92	
Wet Mass, g	896.18	902.98	
Moisture Content, %	16.05%	17.35%	
Dry Density, pcf	121.0	116.0	
Specific Gravity	2.65	2.65	(Assumed)
Void Ratio	0.37	0.43	
Saturation, %	116	108	
Effective stress, psi	5	5	

Initial Manometer Readings

Pipette = 16.50 cm

Annulus = 1.40 cm

Gradient = 20.00

16.05% MC

Manometer Constants:

M1 = 0.03 cm^2

M2 = 1.04

Sample Constants:

S = 0.24 cm^{-1}

Specific Gravity Constant:

Gs = 12.57

Test Constant:

C = 0.0006

Trial Constant:

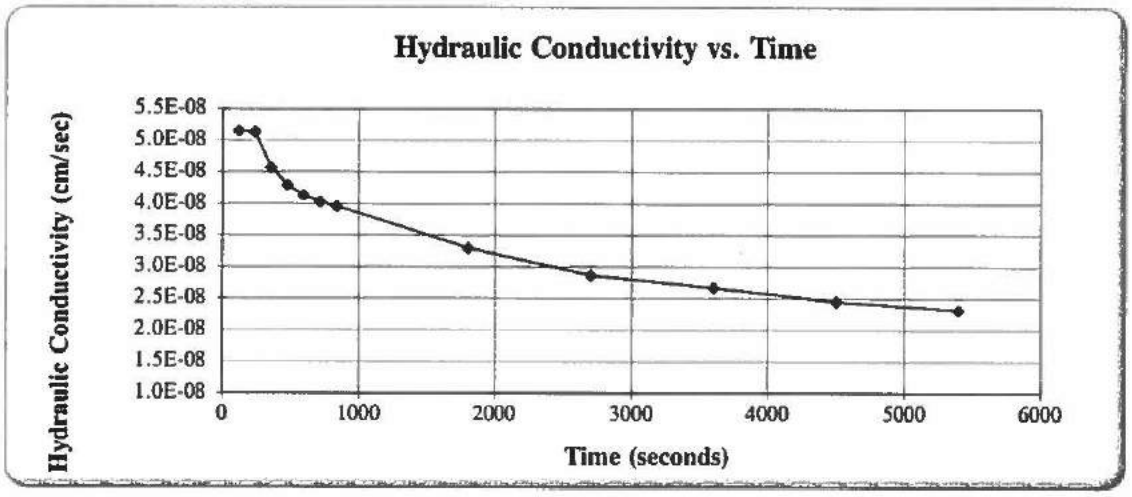
T = 0.07

Temperature (°C) = 21.8

Minutes	Seconds	Δt, cum. (sec)	Tail (cm)	Delta Zo (cm)	C/t	(1-delta Zo* T)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (cm/sec) @ 20°C
2	0	120	16.35	0.15258	4.9E-06	0.989	5.2E-08	4.9E-08
4	0	240	16.20	0.30258	2.4E-06	0.979	5.1E-08	4.9E-08
6	0	360	16.10	0.40258	1.6E-06	0.972	4.6E-08	4.4E-08
8	0	480	16.00	0.50258	1.2E-06	0.965	4.3E-08	4.1E-08
10	0	600	15.90	0.60258	9.8E-07	0.958	4.1E-08	4.0E-08
12	0	720	15.80	0.70258	8.1E-07	0.952	4.0E-08	3.9E-08
14	0	840	15.70	0.80258	7.0E-07	0.945	4.0E-08	3.8E-08
30	0	1800	15.10	1.40258	3.3E-07	0.903	3.3E-08	3.2E-08
45	0	2700	14.70	1.80258	2.2E-07	0.876	2.9E-08	2.8E-08
60	0	3600	14.30	2.20258	1.6E-07	0.848	2.7E-08	2.6E-08
75	0	4500	14.00	2.50258	1.3E-07	0.827	2.5E-08	2.4E-08
90	0	5400	13.70	2.80258	1.1E-07	0.807	2.3E-08	2.2E-08

HYDRAULIC CONDUCTIVITY REPORTED AS 2.4E-08 cm/sec

NOTE: Specimen was intact; Permeant was water/$CaSO_4$



TECH:	JB
DATE:	7/22/2017

CHECK:

REVIEW:

GOLDER ASSOCIATES INC.
LANSING, MICHIGAN

HYDRAULIC CONDUCTIVITY / ASTM D 5084 - CONSTANT VOLUME METHOD F

PROJECT NAME:	GHBLP CCR Compliance
PROJECT NUMBE	177-5416
SAMPLE ID:	ST-2

Cell Pressure =	55	psi
Sample Pressure =	50	psi
Run Number =	1	

Sample Data	Initial	Final	
Height, cm	8.614	8.691	
Diameter, cm	7.328	7.283	
Area, cm^2	42.18	41.66	
Volume, cm^3	363.29	362.03	
Wet Mass, g	743.70	752.35	
Moisture Content, %	24.11%	22.52%	
Dry Density, pcf	102.9	105.8	
Specific Gravity	2.65	2.65	(Assumed)
Void Ratio	0.61	0.56	
Saturation, %	105	106	
Effective stress, psi	5	5	

Initial Manometer Readings

Pipette = 14.67 cm

Annulus = 1.50 cm

Gradient = 20.00

24.11% MC

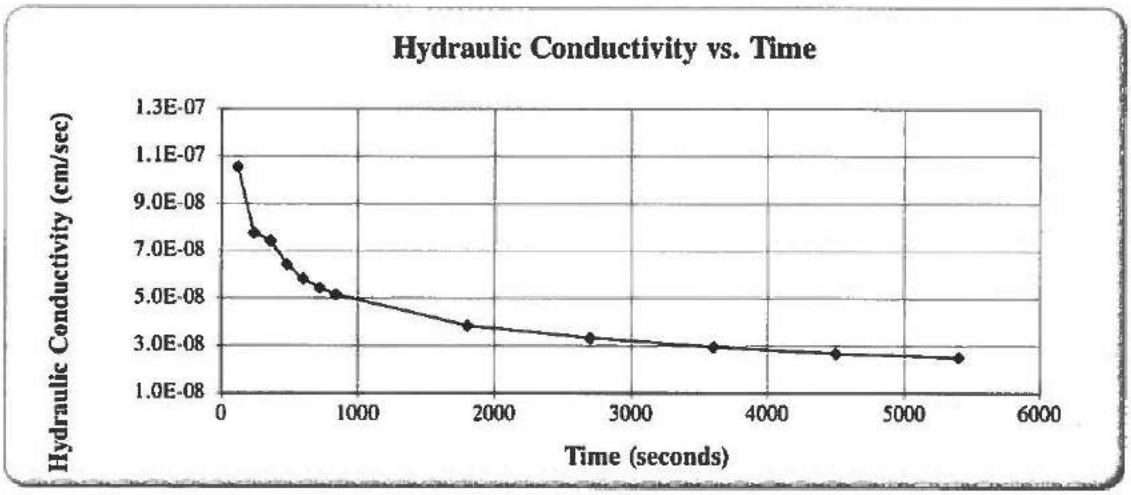
Manometer Constants:		
M1 =	0.03	cm^2
M2 =	1.04	
Sample Constants:		
S =	0.20	cm^{-1}
Specific Gravity Constant:		
Gs =	12.57	
Test Constant:		
C =	0.0005	
Trial Constant:		
T =	0.08	

Temperature (°C) = 21.6

Minutes	Seconds	Δt, cum. (sec)	Tail (cm)	Delta Zo (cm)	C/t	(1-delta Zo* T)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (cm/sec) @ 20°C
2	0	120	14.35	0.32284	4.1E-06	0.974	1.1E-07	1.0E-07
4	0	240	14.20	0.47284	2.0E-06	0.963	7.8E-08	7.5E-08
6	0	360	14.00	0.67284	1.4E-06	0.947	7.4E-08	7.2E-08
8	0	480	13.90	0.77284	1.0E-06	0.939	6.4E-08	6.2E-08
10	0	600	13.80	0.87284	8.2E-07	0.931	5.8E-08	5.6E-08
12	0	720	13.70	0.97284	6.8E-07	0.923	5.4E-08	5.2E-08
14	0	840	13.60	1.07284	5.8E-07	0.915	5.2E-08	5.0E-08
30	0	1800	13.00	1.67284	2.7E-07	0.868	3.9E-08	3.7E-08
45	0	2700	12.55	2.12284	1.8E-07	0.832	3.3E-08	3.2E-08
60	0	3600	12.20	2.47284	1.4E-07	0.805	3.0E-08	2.9E-08
75	0	4500	11.90	2.77284	1.1E-07	0.781	2.7E-08	2.6E-08
90	0	5400	11.60	3.07284	9.1E-08	0.757	2.5E-08	2.4E-08

HYDRAULIC CONDUCTIVITY REPORTED AS 2.6E-08 cm/sec

NOTE: Specimen was intact; Permeant was water/$CaSO_4$



TECH:	TDS
DATE:	6/26/2017

CHECK: ERA

REVIEW:

GOLDER ASSOCIATES INC.
LANSING, MICHIGAN

APPENDIX C
EXCERPTS FROM ENVIRONMENTAL RESOURCE MANAGEMENT MICHIGAN INC., COAL ASH DELINEATION SAMPLING RESULTS, GRAND HAVEN BOARD OF LIGHT AND POWER, GRAND HAVEN, MICHIGAN, 2016

Environmental
Resources
Management
Michigan, Inc.

3352 128th Avenue
Holland, MI 49424-9263
(616) 399-3500
(616) 399-3777 (fax)
http://www.erm.com

08 February 2016
Reference: 0297876

Ms. Christine Veldkamp
Michigan Department of Environmental Quality
Grand Rapids District Office
State Office Building, 5th Floor
350 Ottawa Avenue NW, Unit 10
Grand Rapids, Michigan 49503-2341

Re: Coal Ash Delineation Sampling Results
Grand Haven Board of Light & Power, Grand Haven, Michigan

Dear Ms. Veldkamp:

On behalf of the Grand Haven Board of Light & Power (GHBLP), Environmental Resources Management Michigan, Inc. (ERM) completed an investigation to delineate the vertical and horizontal extent of coal ash residuals at the J.B. Sims Generating Station in Grand Haven, Michigan. The investigation was conducted in accordance with the 8 June 2015 *Work Plan for Ash Delineation Sampling* (Work Plan) which was approved by the Michigan Department of Environmental Quality (MDEQ) in a letter dated 12 August 2015.

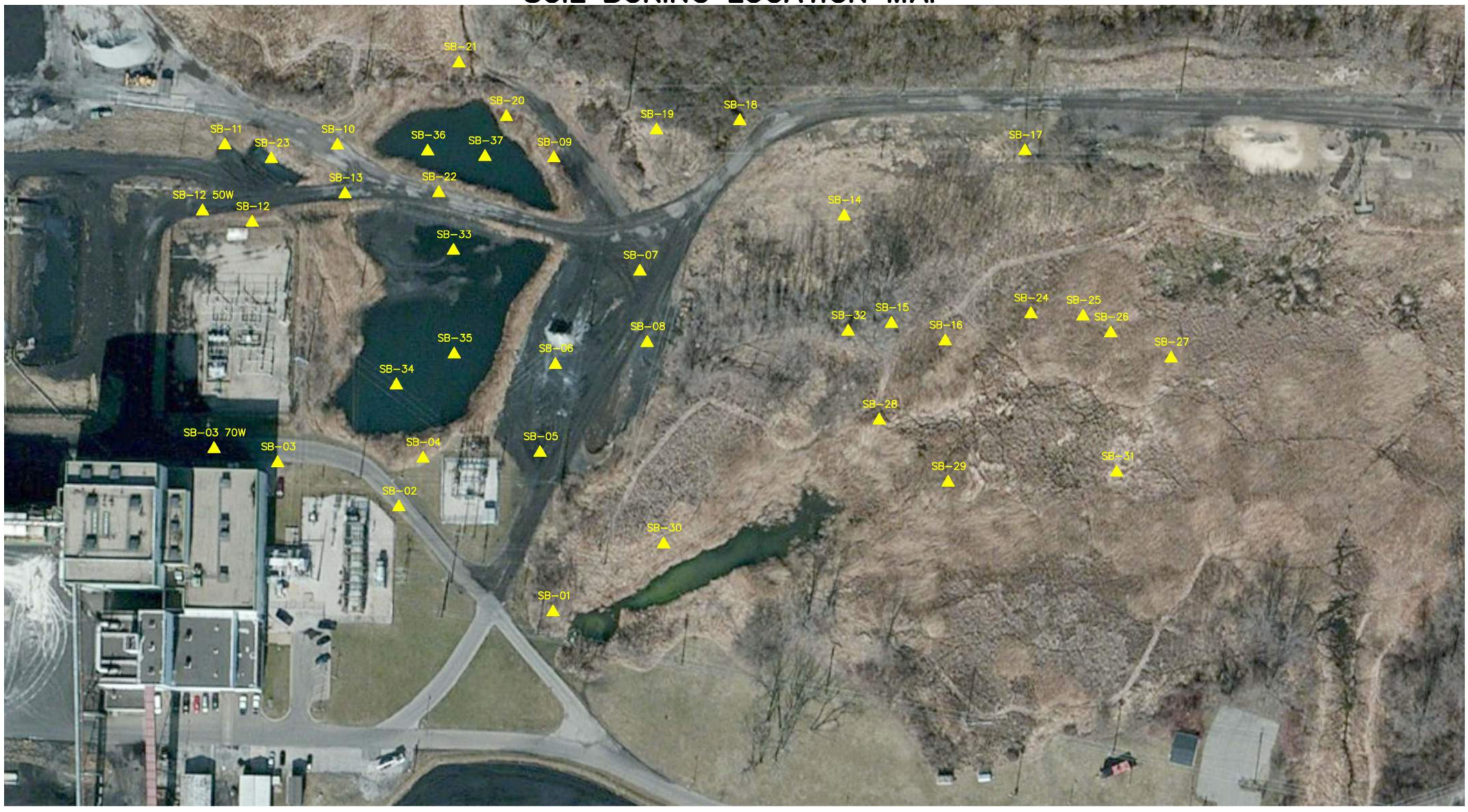
BACKGROUND

The J.B. Sims Generating Station ("Site") is located at 1231 North 3rd Street in Grand Haven, Michigan (Figure 1). On 10 March 2015, the GHBLP met with representatives of the MDEQ to discuss closure alternatives to address the historical use of the former coal ash and secondary settling ponds. In that meeting, it was agreed that the first step in assessment of the ponds was delineation of the extent of the coal ash and residuals.

The MDEQ requested a work plan to determine the vertical and horizontal extent of coal ash that needs to be removed, including:

- Historical construction and use of the ponds;
- How coal ash residuals were placed or conveyed to the ponds;
- Aerial photography;
- The number and location of soil borings;
- The basis for the number of soil borings;

SOIL BORING LOCATION MAP



N

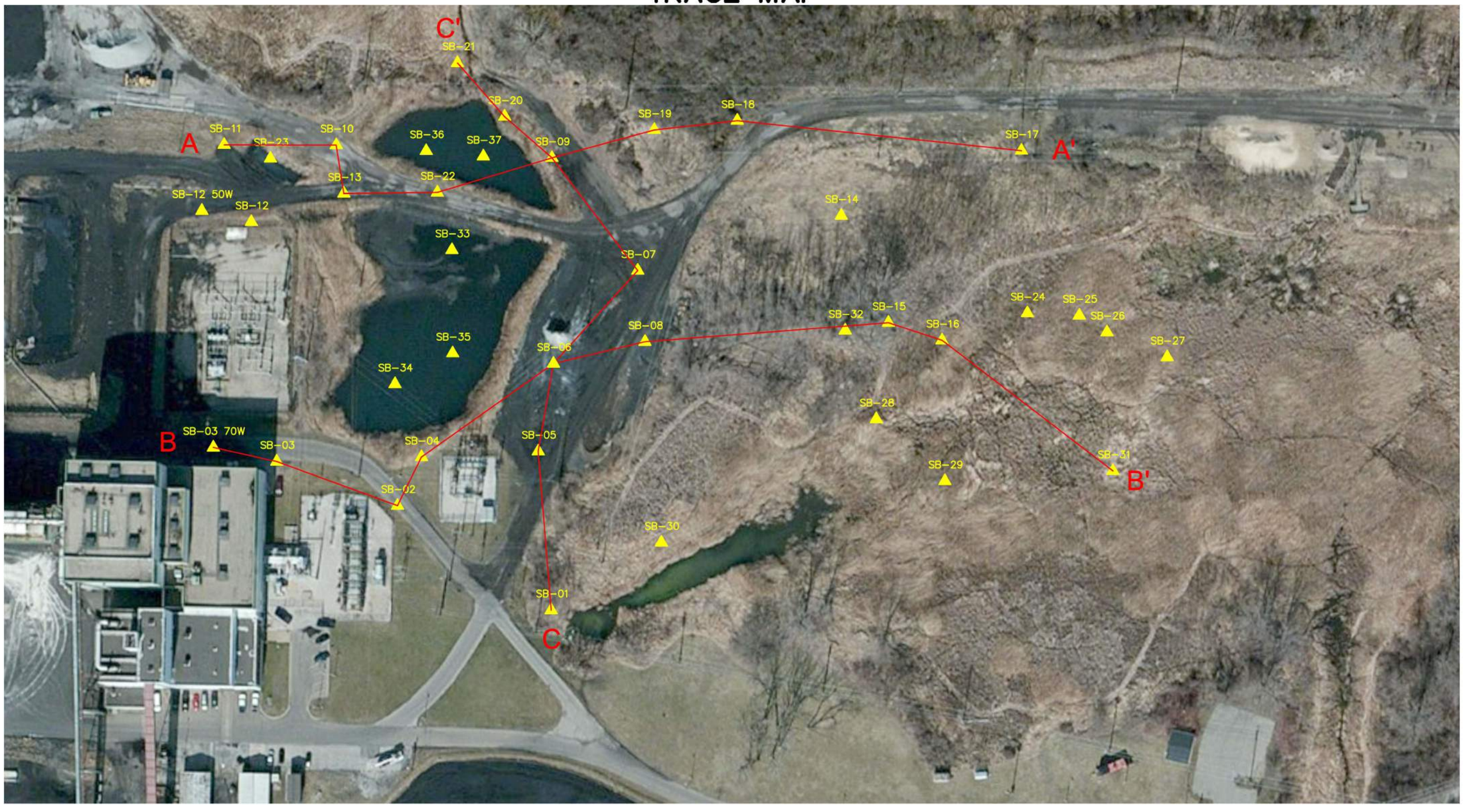
0 100 200

SCALE (IN FEET)

Drawn By GML	ERM®	GRAND HAVEN BOARD OF LIGHT AND POWER 1231 NORTH 3RD STREET GRAND HAVEN, MICHIGAN	CHK'D BAB
CADD Review RMK			0318810
Date Drawn/Rev'd 12/18/15		Environmental Resources Management	FIGURE ____

R:\Cadd\CintE-H\Grand Haven BLP\0318810\base.dwg, SOIL BORING LOC, 12/18/2015 2:02:42 PM, GML

TRACE MAP



N

0 100 200

SCALE (IN FEET)

Drawn By GML	ERM®	GRAND HAVEN BOARD OF LIGHT AND POWER 1231 NORTH 3rd STREET GRAND HAVEN, MICHIGAN	CHK'D BAB
CADD Review RMK			0318810
Date Drawn/Rev'd 12/4/15		Environmental Resources Management	FIGURE ____

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CROSS SECTION A–A'

A
WEST

A'
EAST

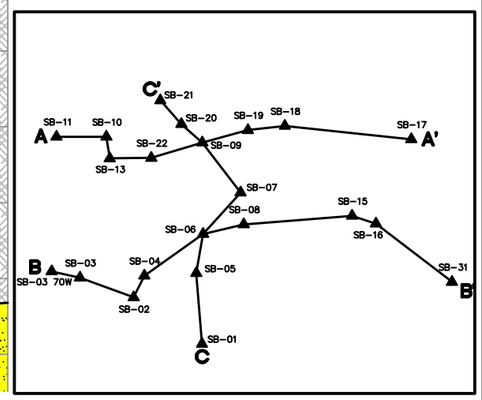
SB–11
SB–10
SB–13
SB–22
POND #2
SB–09
SB–19
SB–18
SB–17

ELEVATION IN FEET

101
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86

LEGEND

- NATIVE SAND
- DARK GRAY TO BLACK FINE GRINDED SAND
- SILT
- SILT LOAM
- BOTTOM ASH
- TRASH DUMP
- MUCK
- NON ASH BEARING SAND
- SOIL BORING
- WATER ELEVATION



2
0
0
80
SCALE (IN FEET)

Drawn By GML	GRAND HAVEN BOARD OF LIGHT AND POWER 1231 NORTH 3rd STREET GRAND HAVEN, MICHIGAN	CHK'D BAB
CADD Review RMK		0318810
Date Drawn/Rev'd 11/23/15	Environmental Resources Management	FIGURE 4

ERM®

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CROSS SECTION B–B'

B
WEST

B'
EAST

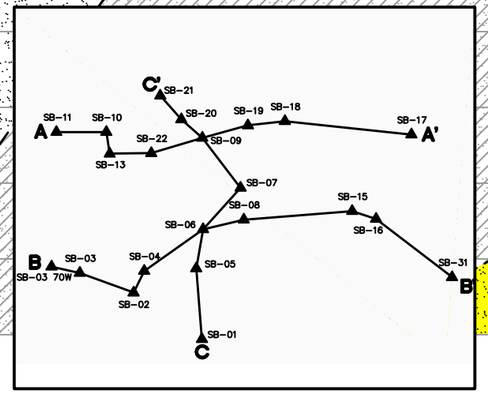
SB–03 70W
SB–03
SB–02
SB–04
SB–06
SB–08
SB–15
SB–16
SB–31

ELEVATION IN FEET
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86
85

0
2
0
80
SCALE (IN FEET)

SOIL BORING
WATER ELEVATION

LEGEND
NATIVE SAND
DARK GRAY TO BLACK FINE GRINDED SAND
SILT
SILT LOAM
BOTTOM ASH
TRASH DUMP
MUCK
NON ASH BEARING SAND



Drawn By GML	GRAND HAVEN BOARD OF LIGHT AND POWER 1231 NORTH 3rd STREET GRAND HAVEN, MICHIGAN	CHK'D BAB
CADD Review RMK		0318810
Date Drawn/Rev'd 11/23/15	Environmental Resources Management	FIGURE 5

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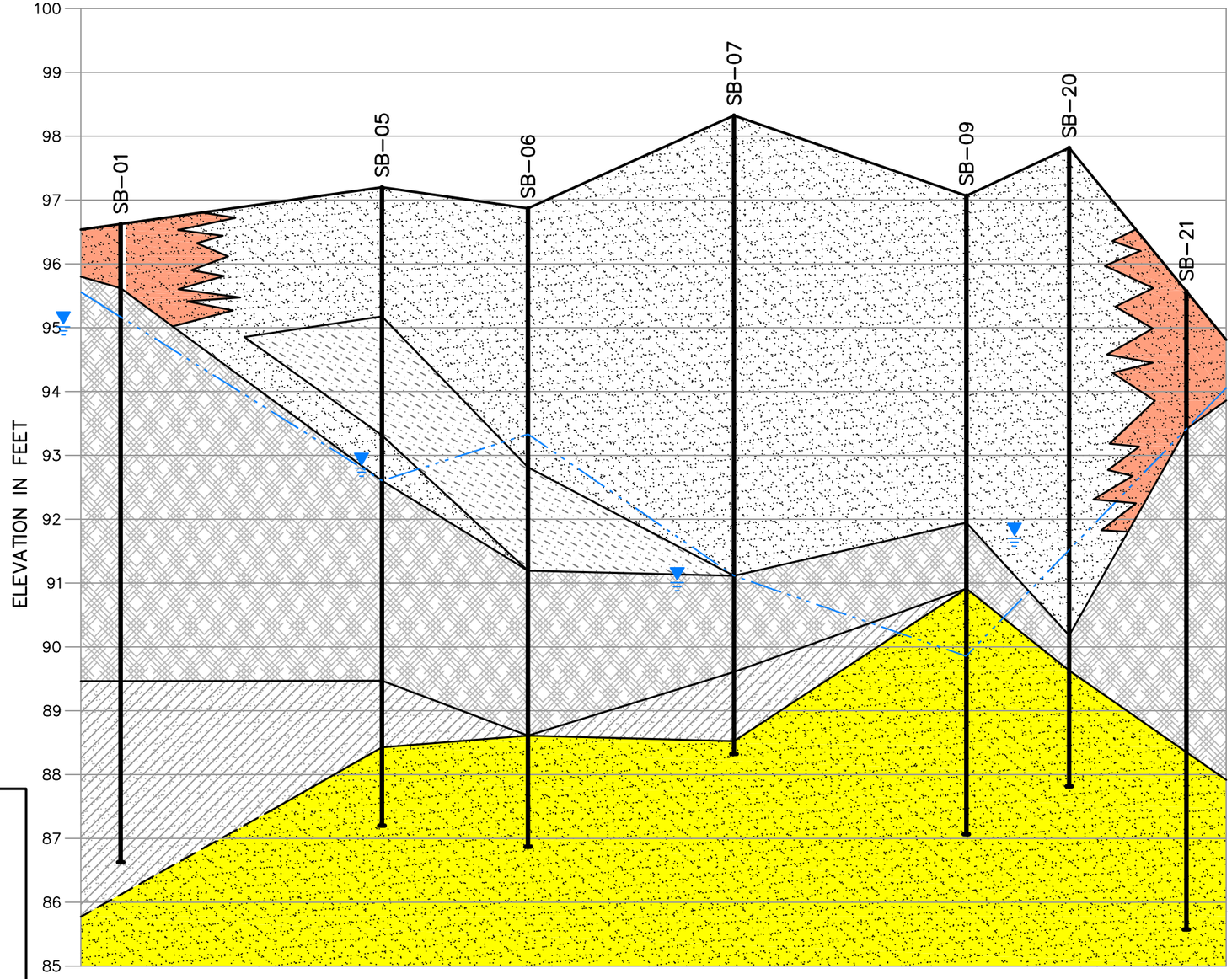
CROSS SECTION C–C'

C
SOUTH

C'
NORTH

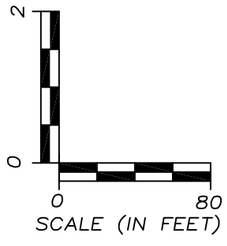


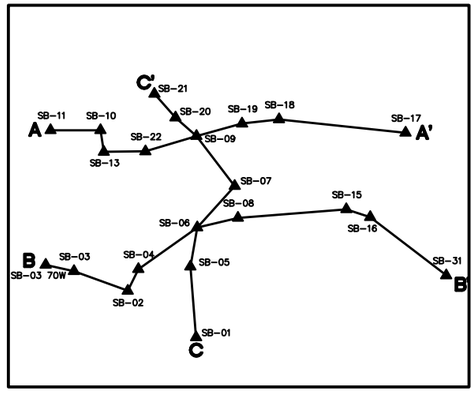
LEGEND

- NATIVE SAND
- DARK GRAY TO BLACK FINE GRINDED SAND
- SILT
- SILT LOAM
- BOTTOM ASH
- TRASH DUMP
- MUCK
- NON ASH BEARING SAND

SOIL BORING

WATER ELEVATION





Drawn By GML	GRAND HAVEN BOARD OF LIGHT AND POWER 1231 NORTH 3rd STREET GRAND HAVEN, MICHIGAN	CHK'D BAB
CADD Review RMK		0318810
Date Drawn/Rev'd 11/23/15	Environmental Resources Management	FIGURE 6

ERM®

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Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Golder Associates

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