Structural Stability and Safety Factor Assessment Report

B.C. COBB GENERATING FACILITY

PONDS 0-8 STRUCTURAL STABILITY AND SAFETY FACTOR ASSESSMENT REPORT

Muskegon, Michigan

Pursuant to 40 CFR 257.73(d, e)

Submitted To: Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

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

October 2016 1652598

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.73(d)(3) & 257.73(e)(2)]

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 257.73 (40 CFR Part 257.73), I attest that this Structural Stability and Safety Factor Assessment 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 257.73(d) periodic structural stability assessments and 40 CFR Part 257.73(e) periodic safety factor assessments.

Golder Associates Inc.

Signature

October 14, 2016

Date of Report Certification

Matthew Wachholz, PE

Name

6201047513

Professional Engineer Certification Number

STATE OF MICHIGAN
MATTHEW J. WACHHOLZ
ENGINEER
No.
47513
LICENSED PROFESSIONAL ENGINEER

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1.0 INTRODUCTION

1.1 Purpose

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. The CCR RCRA Rule requires that existing CCR surface impoundments meeting the requirements of Section 257.73(b) conduct initial and periodic structural stability assessments in accordance with Section 257.73(d) and safety factor assessments in accordance with Section 257.73(e). This report provides the initial structural stability assessment and the safety factor assessment for Ponds 0-8 CCR surface impoundment (Ponds 0-8) at the B.C. Cobb Generating Facility (BC Cobb). A hazard potential classification was conducted for Ponds 0-8 pursuant to Section 257.73, which resulted in a significant hazard classification, thereby requiring the 1000-year flood elevation to be used in the safety factor assessment.

1.2 Site Description and Background

BC Cobb is a coal-fired power plant that formerly operated two coal burning baseload electrical power generating units. BC Cobb ceased operation on April 15, 2016 and is currently being decommissioned. An overview map of BC Cobb showing its wet CCR disposal area is provided on Figure 1 – Site Location Map.

Prior to April 2016, CCR (fly ash and bottom ash) from the coal-fired power generation was deposited into 10 ash ponds (Ponds 0-8 and the Bottom Ash Pond) near the facility using wet sluicing methods. Ponds 0-8 is a connected set of ponds considered one CCR surface impoundment as presented on Figure 2 – Borehole Location and Cross Section Location Map.

As of June 2016, negligible amounts of CCR contact wash water from decommissioning operations have been discharged to Ponds 0-8 in accordance with BC Cobb National Pollutant Discharge Elimination System (NPDES) permit which expires in October 2018. The final receipt of waste into Ponds 0-8 is estimated to occur by October 1, 2018.

1.3 Previous Evaluations

There are no certified records of previous slope stability analyses that have been performed for the Ponds 0-8 embankments. A Probable Failure Mode Analysis (PFMA) was previously completed for BC Cobb (AECOM 2009a) to identify structural (geotechnical) and environmental risks. Additionally, previous site inspections have been conducted to observe and document the structural conditions of the embankment dikes. A list of documents related to Ponds 0-8 reviewed for the structural stability assessment is provided in Table 1.3.1.

Table 1.3.1 - Previous Reviewed Documents Related to Structural Stability Assessment

Document	Date	Author
B.C. Cobb Ponds 0-8 Initial Annual Surface Impoundment Inspection – January 2016	January 2016	Golder Associates Inc.
B.C. Cobb Ash Disposal Area, Triennial Ash Dike Risk Assessment Report – Spring 2014	December 2014	Barr Engineering
B.C. Cobb Ash Disposal Area 2012 Ash Dike Risk Assessment FINAL Inspection Report	July 2012	AECOM Technical Services, Inc.
Inspection Report B.C. Cobb Generating Facility Ash Dike Risk Assessment, Muskegon, Michigan	December 2009	AECOM Technical Services, Inc.
Potential Failure Mode Analysis (PFMA) Report B.C. Cobb Generating Facility Ash Dike Risk Assessment, Muskegon, Michigan	December 2009	AECOM Technical Services, Inc.

2.0 SUBSURFACE CONDITIONS

The site is located on the western edge of the Michigan Basin, and bedrock ranges from approximately 200 to 250 feet below ground surface (bgs). A subsurface investigation that included laboratory testing was completed in 2015 and 2016 around Ponds 0-8 to develop site specific stratigraphy and engineering material properties, respectively. The subsurface investigation and testing identified that the native soil beneath Ponds 0-8 consists of sand underlain by silty clay. A topographic and bathymetric survey was completed in 2015 by Summit Surveying to develop geometry of Ponds 0-8. A bathymetric survey of the Muskegon River and discharge channel along the perimeter of Ponds 0-8 was conducted by Ayres Associates in May 2016. A follow up topographic survey along the northeastern perimeter of Pond 5 was completed by Engineering & Environmental Solutions, LLC (E&ES) in October 2016. All of the surveys reported above were used to develop the safety factor assessment.

3.0 STRUCTURAL STABILITY ASSESSMENT [40 CFR 257.73(d)(1)(i-vii)]

The CCR RCRA Rule requires conducting initial and periodic structural stability assessments by a qualified professional engineer (QPE) to document whether the design, construction, operation, and maintenance is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater that can be impounded therein. The following sections provide documentation on the initial structural stability assessment and rely mainly on the current and historic annual inspections performed at the site as well as the weekly field inspections performed by Consumers Energy Company (CEC). The most recent inspection was completed by Golder Associates Inc. (Golder) in May 2016 for the initial structural stability assessment. The summary inspection checklist for the May 2016 site inspection is included in Appendix A.

In accordance with the CCR RCRA Rule, in any calendar year in which both the periodic inspection by a QPE and the quinquennial (occurring every five years) structural stability assessment by a QPE required by Section 257.73(d) are required to be completed, the annual inspection is not required. If the annual inspection is not conducted in a year as provided by this paragraph, the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment. As a result, a certified annual inspection report for Ponds 0-8 will not be required until October 2017.

3.1 Foundations and Abutments [40 CFR 257.73(d)(1)(i)]

No certified construction documents were available on the original construction of the embankments or the conditions of the foundations and abutments. As previously noted, the foundation soils consist of native sand soils underlain by silty clay. There has been no indication of foundational or abutment instability in recent or historic site inspections and; therefore, the foundation soils and abutments are considered stable.

3.2 Slope Protection [40 CFR 257.73(d)(1)(ii)]

Water surface elevations can vary in Muskegon Lake due to wind setup and storms. Moderate size waves have been observed by plant personnel in the event of a strong westerly wind, and ice buildup and ice flows are possible along the discharge channel and the Muskegon River. Waves created by the wind have the potential to reach the perimeter dikes. To reduce the impact of rising water surface elevations, large waves on the perimeter dike, or ice sheets; portions of the discharge channel and Muskegon River shorelines are protected with riprap. Additionally, the slopes are inspected weekly for erosion, signs of seepage, animal burrows, sloughing, and vegetation condition that could negatively impact the embankment. The 2016 summary inspection checklist (Appendix A) did not identify items relating to slope protection that required investigation or repair. The existing slope protection measures are considered adequate to provide protection against surface erosion, wave action, and adverse effects of sudden drawdown.

3.3 Dikes (Embankment) [40 CFR 257.73(d)(1)(iii)]

No certified construction documents were available on the original construction of the embankments or the conditions of the foundations and abutments. Based on the subsurface investigation information, it is believed that the perimeter dike was constructed with standard earthwork equipment and compacted and/or proof rolled before subsequent lifts were placed based on the compact relative density of the CCR material generally observed from Standard Penetration Test (SPT) sampling during recent subsurface investigations. Results of the safety factor assessment detailed in Section 4.0 provide additional details on the stability of the external dike. Based on the relative density of the material encountered during the subsurface investigations, historic inspections, recent observations, and results of the stability analysis; the embankment dikes are considered sufficient to withstand the range of loading conditions in Ponds 0-8.

3.4 Vegetated Slopes [40 CFR 257.73(d)(1)(iv)]

The EPA has vacated the requirement that vegetative cover on surface impoundment dikes be maintained at no more than six inches. A new rule establishing requirements relating to the use of vegetation as slope protection for CCR surface impoundments is still pending.

3.5 Spillways [40 CFR 257.73(d)(1)(v)]

There are no spillways located in Ponds 0-8. Flow is conveyed between ponds via an interconnected subsurface pipe network as described in Section 3.6.

3.6 Hydraulic Structures [40 CFR 257.73(d)(1)(v)]

Ponds 0-8 are interconnected by a subsurface pipe network that discharges from Pond 4 via one primary reinforced concrete pipe (RCP) outflow pipe (24-inch diameter) to the site's permitted NPDES outfall. Pond 4 also includes two corrugated polyethylene (CPE) outflow pipes (18-inch diameter) which are expected to serve as emergency outflow pipes. These three pipes were identified as the hydraulic structures that were underlying the base or passing through the external dike of the CCR unit. Each discharge pipe was reported to be in good to fair condition in the 2014 Triennial Ash Dike Risk Assessment Report (Barr 2014a), which was based on a closed circuit television (CCTV) inspection of the hydraulic structures. No changes to the pipes' conditions were noted in the 2016 summary inspection checklist (Appendix A).

No significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris were observed which may negatively affect the operation of the hydraulic structure.

3.7 Downstream Slopes Adjacent to Water Body [40 CFR 257.73(d)(1)(vii)]

The northwest side of Ponds 0-8 borders the Muskegon River, which flows into Muskegon Lake. The southwest side of Ponds 0-8 border the BC Cobb discharge channel, which also flows into Muskegon Lake. The normal water elevation of Muskegon Lake (Lake Michigan) reported by the National Oceanic and Atmospheric Administration (NOAA 2016) is 579.4 feet (NAVD88); and the 1000-year flood elevation for

Muskegon Lake is 585.7 feet (NAVD88), as provided in Golder's B.C. Cobb Generating Facility Ponds 0-8, Inflow Design Flood Control System Plan (Golder 2016c). The safety factor assessment, described in Section 4.0 of this report, assumes that water elevation of Ponds 0-8 will be at groundwater level and will generally maintain equilibrium with the water elevation of Muskegon Lake [assumed at 580.0 feet (NAVD88)], since Ponds 0-8 are managing substantially lower flows of non-CCR waste. Temporary rises in the pond water elevation due to rainfall and collection of site stormwater run-off may occur, although the water elevation in Ponds 0-8 is primarily controlled by the phreatic surface, which generally maintains equilibrium with the surrounding water body. As a result, rapid-drawdown was not considered a potential mechanism for structural instability in the exterior slope.

3.8 Structural Stability Deficiencies [40 CFR 257.73(d)(2)]

Based on the structural stability assessment contained herein, no structural stability deficiencies were identified.

4.0 SAFETY FACTOR ASSESSMENT [40 CFR 257.73(e)]

According to Section 257.73(e)(1) of the CCR RCRA Rule, periodic safety factor assessments must be conducted for each CCR unit. The safety factor assessment must document the calculated factor of safety for the dike slopes under the following loading scenarios:

- Maximum Pool Storage - Section 257.73(e)(1)(i) – Defined as the long-term, maximum storage pool (or operating) elevation and equal to the assumed phreatic surface [elevation = 580.0 feet (NAVD88)] for Pond 4 since it is no longer being actively filled; static factor of safety must equal or exceed 1.50
- Maximum Pool Surcharge - Section 257.73(e)(1)(ii) – Defined as the temporary raised pond level above the maximum pool storage elevation due to an inflow design flood [elevation = 581.73 feet (NAVD88)] for Pond 4; static factor of safety must equal or exceed 1.40
- Seismic Loading Conditions - Section 257.73(e)(1)(iii) – Seismic factor of safety must equal or exceed 1.00
- Liquefaction Potential - Section 257.73(e)(1)(iv) – Only necessary for dikes constructed of soils that have susceptibility to liquefaction; factor of safety must equal or exceed 1.20

The following sections provide details on the methods used to complete the factor of safety assessment.

4.1 Slope Stability Analysis

Slope stability analyses were performed to evaluate the factor of safety for the maximum pool storage, maximum pool surcharge, and seismic loading scenarios. In the Preamble to Sections 257 and 261 of the CCR RCRA Rule *General Safety Factor Assessment Considerations* [VI (E)(3)(b)(ii)(a)], limit equilibrium methods are identified as conventional analysis procedures for calculating the factor of safety and specific common methods are identified, including the Morgenstern and Price method of slices (Abramson et al. 2002), which was used for this stability analysis.

4.1.1 Cross Sections Analyzed

The critical section was determined by considering the geometry of the slopes, interpreted soil profile from the subsurface investigations, and phreatic surface. The critical cross section is anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The critical section used for the slope stability analysis was located along the southwestern dike along the discharge channel and is shown as Section A-A’ in Figure 2 – Borehole Location and Cross Section Location Map.

4.1.2 Geotechnical Material Properties

Representative material properties based on the subsurface investigations and laboratory testing were selected for use in the safety factor assessment. Applicable engineering material properties were developed for three separate material units: 1) dike fill consisting of CCR; 2) sand (native foundation soil); and 3) riprap.

4.1.3 Pond Elevations and Phreatic Surface/Groundwater

The safety factor assessment assumes that normal operating level elevation of Ponds 0-8 will be at groundwater level and will generally maintain equilibrium with the water elevation of Muskegon Lake, since the ponds are managing substantially lower flows. For the maximum pool storage scenario, this results in a static groundwater level at 580.0 feet (NAVD88) with no seepage. The maximum pool surcharge scenario considers the temporary rise of the normal operating water elevation due to rainfall and collection of site stormwater run-off during a design event. The water elevations for Ponds 0-8 were calculated for the 1000-year storm event based on a significant hazard potential classification resulting in an increase in the Pond 4 elevation to 581.73 feet NAVD88.

The phreatic surface for the maximum pool surcharge scenario was then estimated using steady state seepage, assuming the pond elevation remained elevated but the exterior water elevation (discharge channel or Muskegon River) receded back to 580.0 feet.

4.1.4 Vehicle Loading

The crest of the embankments are periodically used by maintenance vehicles as access roads around Ponds 0-8 and; therefore, a vehicle load was applied to the critical cross section for the maximum pool storage and maximum pool surcharge cases to model the loading effects of vehicle traffic. The vehicle load was modeled based on American Association of State Highway and Transportation Officials (AASHTO) recommended loading for truck loads acting perpendicular to traffic (AASHTO 2012).

4.1.5 Seismic Loading Conditions

Factors of safety for stability under seismic conditions were calculated using the pseudo-static method. The peak ground acceleration (PGA) based on the 2008 United States Geological Survey (USGS) seismic hazard maps with a two percent probability of exceedance in 50 years (2,475-year return period) is 0.037g; however, the Natural Resources Conservation Service (NRCS) recommends a minimum seismic coefficient of 0.05g for Michigan, so a seismic coefficient of 0.05g was used in seismic analyses.

4.2 Stability Analysis Results

Slope stability analyses were performed for long-term static conditions fort he critical cross section considered under maximum pool storage and maximum pool surcharge scenarios as well as the seismic scenario. The results of the safety factor assessment are presented in Table 4.2.1, and critical failure surface result outputs are contained in Appendix B. The results indicate that the Ponds 0-8 exterior slopes meet or exceed the required safety factors under considered loading scenarios.

Table 4.2.1 - Slope Stability Analysis Results – Ponds 0-8 External Dike

Scenarios	Maximum Pool Storage	Maximum Pool Surcharge	Seismic
Required Safety Factor	**1.50**	**1.40**	**1.00**
Section	**Calculated Safety Factor**		
Section A-A'	1.54	1.52	1.41

4.3 Liquefaction Potential Assessment

Embankment and foundation soils were screened for seismically-induced liquefaction susceptibility using methods recommended by the National Center for Earthquake Research (NCEER), which uses Cone Penetrometer Test (CPT) data (Youd and Idriss 2001; Robertson and Wride 1998). The calculated factor of safety against seismically-induced liquefaction is shown in Appendix C and was calculated to be greater than 1.20 throughout the depth of the embankments and underlying foundation in the evaluated CPT soundings for the considered earthquake loading. These screening-level results indicate that the CCR in the embankments and foundation soils for Ponds 0-8 is not susceptible to seismically-induced liquefaction for the seismic loading considered.

5.0 SUMMARY

Based on our review of the information provided by CEC and the results of the structural stability assessment and onsite inspections, no structural stability deficiencies were identified in the surface impoundments during this assessment. Based on the information identified above and on our safety factor assessment, the calculated factors of safety through the critical cross section in Ponds 0-8 meet or exceed the minimum values listed in Section 257.73(e)(1)(i-iv).

6.0 CLOSING

This report summarizes the results of the structural stability and safety factor assessment to fulfill the provisions of Title 40 of the Code of Federal Regulations Section 257.73 (40 CFR 257.73) for Ponds 0-8 at BC Cobb.

GOLDER ASSOCIATES INC.

Jeffrey Piaskowski, P.E.
Project Engineer

Jeffrey Schneider, P.E.
Senior Project Engineer

Matthew Wachholz, P.E.
Senior Engineer

7.0 REFERENCES

AASHTO, 2012. American Association of State Highway and Transportation Officials, Load Resistant Factor Design (LFRD) Bridge Design Specifications, 2012.

Abramson, L.W., T.S. Lee, S. Sharma, and G.M. Boyce (2002), Slope Stability and Stabilization Methods, 2nd edition, John Wiley & Sons, New York.

AECOM, 2009a. Potential Failure Mode Analysis (PFMA) Report, B.C. Cobb Generating Facility Ash Dike Risk Assessment, Muskegon, Michigan AECOM Technical Services, Inc., December 2009.

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AECOM, 2012. B.C. Cobb Ash Disposal Area 2012 Ash Dike Risk Assessment FINAL Inspection Report, AECOM Technical Services, Inc., July 2012.

Barr, 2014a. B.C. Cobb Ash Disposal Area, Triennial Ash Dike Risk Assessment Report – Spring 2014, Barr Engineering Company, December 8, 2014.

Golder, 2016a. J.H. Campbell Pond A Annual RCRA CCR Surface Impoundment Inspection Report – January 2016.

Golder (2016b). “B.C. Cobb Ponds 0-8, Annual RCRA CCR Surface Impoundment Inspection Report” Golder Associates, Inc. report, January 2016.

Golder (2016c). “B.C. Cobb Generating Facility Ponds 0-8, Inflow Design Flood Control System Plan” Golder Associates, Inc. report, October 2016.

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Robertson, R. and Wride, C. 1998. Evaluating Cyclic Liquefaction Potential Using the Cone Penetration Test, Canadian Geotechnical Journal, vol. 35, pp. 442-459.

“Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments,” Title 40 – Protection of the Environment Part 257 – Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.

Youd, T., and Idriss, I., 2001. Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, April 2001, pp. 297-313.

FIGURES

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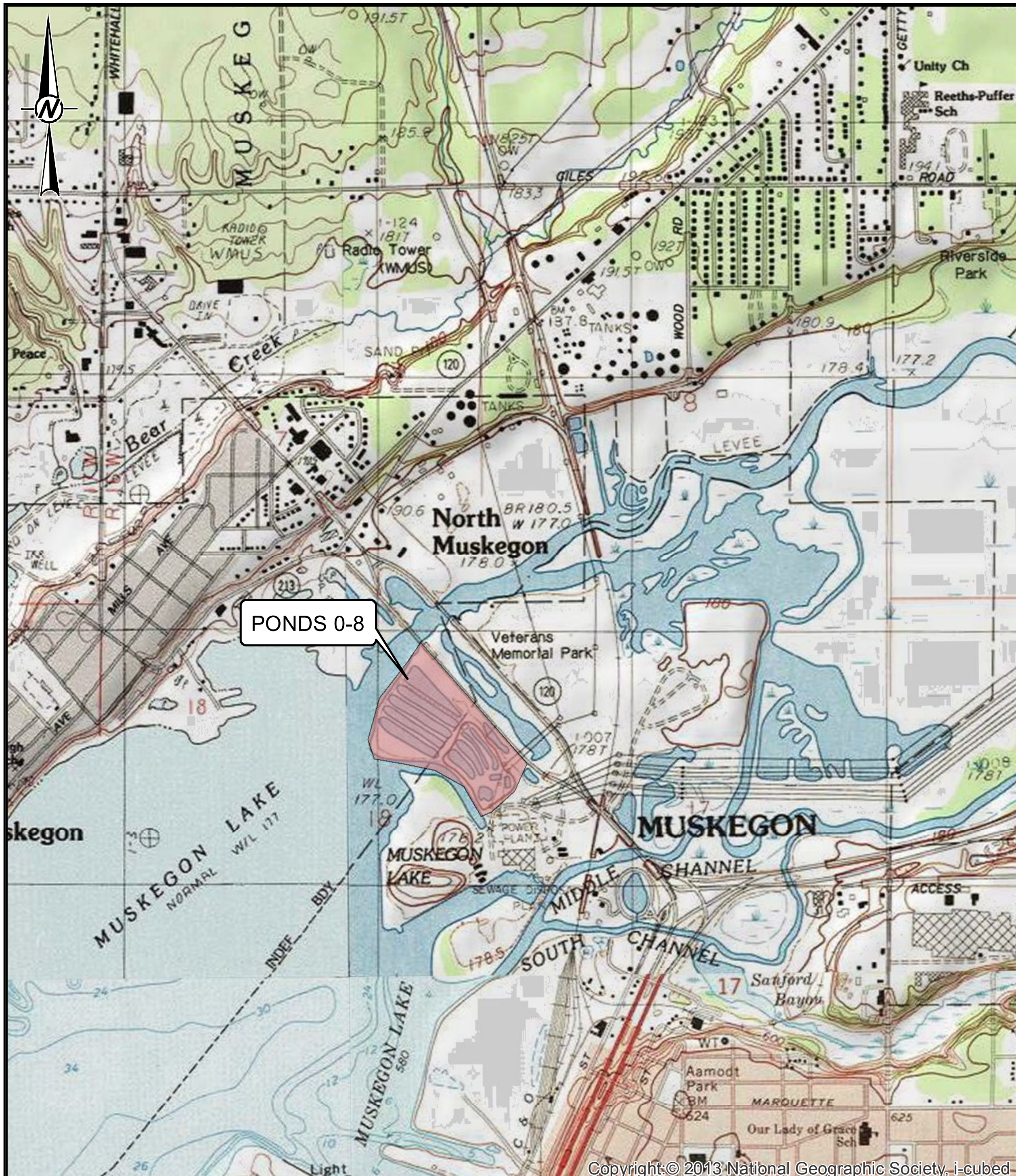

NOTE

ASH STORAGE AREAS ARE APPROXIMATE LIMITS BASED ON REVIEW OF REPORTS AND INTERVIEWS WITH CEC PERSONNEL

0 1000 2000

Feet

CLIENT

CONSUMERS ENERGY COMPANY
151 N. CAUSEWAY
MUSKEGON, MI 49445

PROJECT

B.C. COBB
2016 RCRA COMPLIANCE
STRUCTURAL STABILITY & SAFETY FACTOR ASSESSMENT

TITLE

SITE LOCATION MAP

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-10-06
PREPARED	DJC
DESIGN	JS
REVIEW	JP
APPROVED	MW

PROJECT No.	CONTROL	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

1 in

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LEGEND

- 2016 CPT LOCATION
- 2016 BOREHOLE LOCATION (50-FT DEPTH)
- 2016 BOREHOLE LOCATION (100-FT DEPTH)
- POND SAMPLING LOCATION
- EQUALIZATION BASIN SAMPLING LOCATION
- INTERIOR BERM SAMPLING LOCATION
- EXTERIOR BERM SAMPLING LOCATION
- BACKGROUND SAMPLING LOCATION

REFERENCE

TOPOGRAPHIC SURVEY PROVIDED BY SUMMIT SURVEYING, INC.; DATED JANUARY 28, 2015.

CLIENT
CONSUMERS ENERGY COMPANY
151 N. CAUSEWAY
MUSKEGON, MI 49445

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-10-17
DESIGNED	-
PREPARED	JMS
REVIEWED	JP
APPROVED	MW

PROJECT
2016 B.C. COBB RCRA COMPLIANCE
FACTOR OF SAFETY (FOS) ASSESSMENT

TITLE
BOREHOLE LOCATION AND CROSS SECTION LOCATION MAP

PROJECT NO.	PHASE	REV.	FIGURE
1652598B	0001	0	2

Path: — | File Name: BC_Cobb_2016_RCRA_FOS.dwg

1 in
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX A
SUMMARY INSPECTION CHECKLIST

CCR SURFACE IMPOUNDMENT VISUAL INSPECTION CHECKLIST

Facility Name: B.C. Cobb Ponds 0-8
Owner: Consumers Energy Company (CEC)
Purpose of Facility: Detention and settlement sluiced fly ash and process water
County, State: Muskegon County, Michigan
Inspected By: Tiffany Johnson ***Inspection Date: 05/19/16***
Weather: Sunny, 70-degrees F

ITEM		Acceptable	Monitor/Maintain	Investigate	Repair	REMARKS
1.	General Conditions					
a.	Year Minimum Water Elevation					Elevation: See Note 2
b.	Year Average Water Elevation					Elevation: See Note 2
c.	Year Maximum Water Elevation					Elevation: See Note 2
d.	Current water level					Elevation: Water levels are approximately 5 feet below the elevations in Note 1, Pond 0-8 are currently being dewatered for decommissioning
e.	Current storage capacity					Volume: ~ 562,000 CY (See Note 2)
f.	Current volume of impounded water and CCR					Volume: ~ 480,700 CY (See Note 2)
g.	Alterations	X				
h.	Development of downstream plain	X				
i.	Grass cover	X				
j.	Settlement/misalignment/cracks	X				
k.	Sudden drops in water level?	X				Water levels have dropped due to intentional dewatering.
2.	Inflow Structure					Inflow structure considered as inflow pipes to Pond 8, 6, and 5 and forcemain pipe into eastern concrete box vault.
a.	Settlement	X				
b.	Cracking	X				
c.	Corrosion		X			Observed corrosion on pipe, continue maintenance controls. See Note 3.
d.	Obstacles in inlet	X				
e.	Riprap/erosion control	X				
3.	Outflow Structure					Outflow structure considered as discharge pipe from Pond A.
a.	Settlement	X				
b.	Cracking	X				
c.	Corrosion	X				
d.	Obstacles in outlet	X				
e.	Riprap/erosion control	X				
f.	Seepage	X				
4.	Upstream slope					Upstream Slope Considered North, South, and East Slopes
a.	Erosion		X			Steep interior pond slopes were observed likely due to the dewatering and sediment removal from the ponds. Maintain erosion and grading controls during pond cleaning. See Note 3.
b.	Rodent burrows	X				
c.	Vegetation	X				
d.	Cracks/settlement	X				
e.	Riprap/other erosion protection	X				
f.	Slide, Slough, Scarp	X				
5.	Crest					
a.	Soil condition	X				
b.	Comparable to width from previous inspection		X			Wave action appears to be eroding the inside slopes of Pond 0, primarily on the eastern interior slopes. Maintain erosion and grading controls for interior slopes. See Note 3.
c.	Vegetation		X			Pine trees that remain intended to act as visual screening and dust suppression, maintain vegetation controls. See Note 3.
d.	Rodent burrows		X			Small rodent burrows present along interior pond slopes, maintain animal control procedures. See Note 3.
e.	Exposed to heavy traffic		X			Truck traffic is present along the crest due to decommissioning efforts, maintain erosion controls. See Note 3.
f.	Damage from vehicles/machinery	X				
6.	Downstream slope					Downstream slope considered the west slope along the discharge channel.
a.	Erosion		X			Erosion observed along west slope of Pond 8 and ash stockpile area, maintain erosion controls. See Note 3.
b.	Vegetation		X			Areas of bare vegetation observed along west slope of Pond 8, maintain vegetation controls. See Note 3.
c.	Rodent burrows		X			Several rodent burrows were observed along west slopes of Pond 8 and ash stockpile area, maintain animal control procedures. See Note 3.

ITEM		Acceptable	Monitor/Maintain	Investigate	Repair	REMARKS
d.	Slide, Slough, Scarp	X				
e.	Drain conditions	X				
f.	Seepage	X				
7.	Toe					
a.	Vegetation	X				
b.	Rodent burrows	X				
c.	Settlement	X				
d.	Drainage conditions	X				
e.	Seepage	X				Apparent seepage near a well on the northeast side of Pond 0 that wasobserved during the 2015 inspection was not observed during this inspection.

Notes:

1) Pond water surface elevations (amsl) surveyed in October 2015 are as follows (current water levels are approximately 5 feet lower due to intentional dewatering as part of the decommissioning process):
   - Pond 0: 587.3
   - Pond 1: 587.3
   - Pond 2: 587.2
   - Pond 3: 586.7
   - Pond 4: 585.8
   - Pond 5: 587.5
   - Pond 6: 588.0
   - Pond 7: 592.0
   - Pond 8: 592.0
2) The following elevations were applied to approximate the combined capacity and current volume of Ponds 0-8:
   - Average top of embankment elevation: 590.0
   - Average water surface elevation: 588.2
   - Average pond bottom elevation: 575.0
3) Features observed and documented in this checklist were not considered a deficiency or release as classified under 40 CFR 257.83(b)(5) and required no immediate action beyond periodic inspection in accordance with the SMP and typical maintenance.

Name of Engineer: Tiffany D. Johnson, P.E.

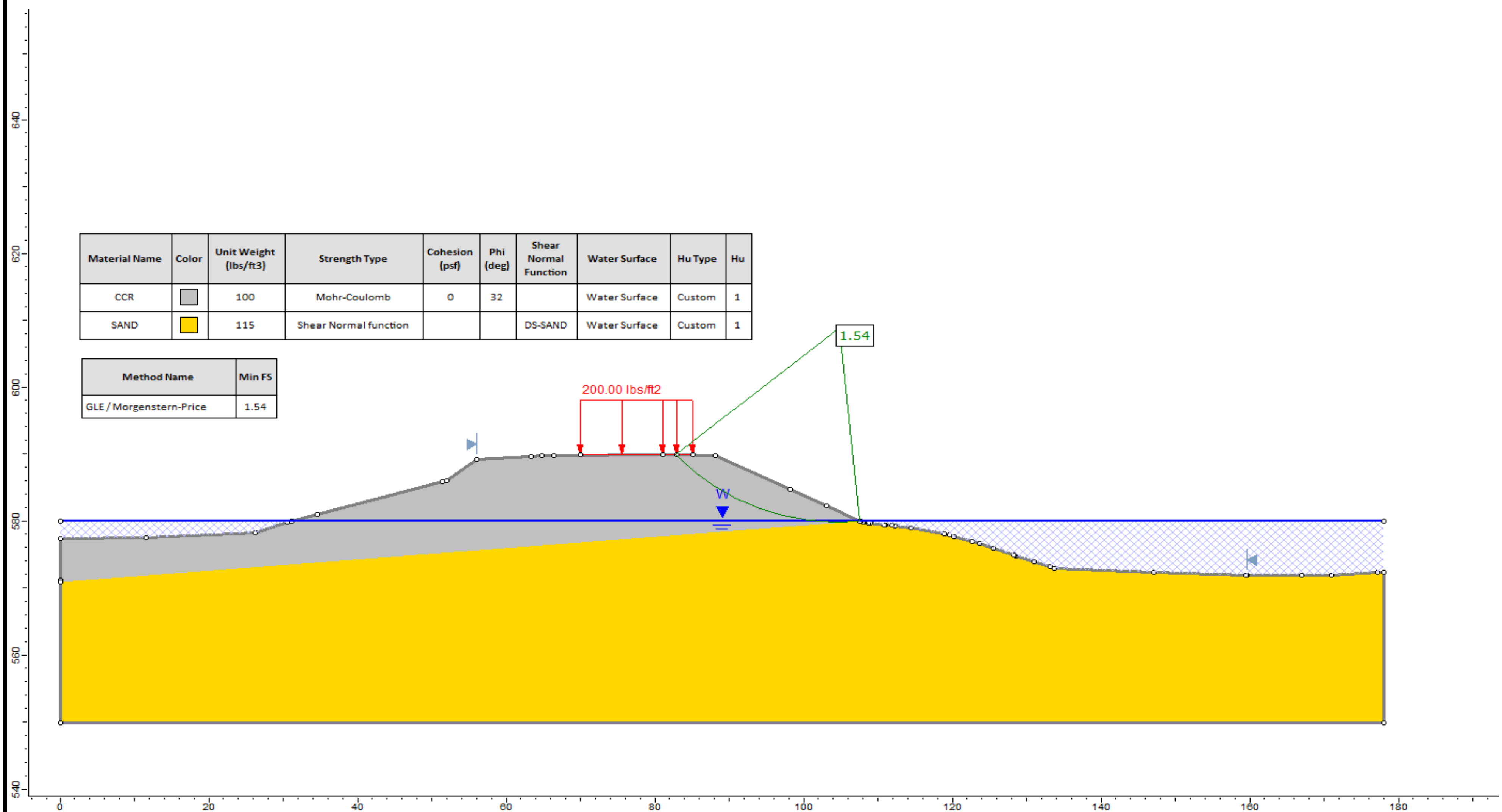
Date: October 14, 2016

Engineering Firm: Golder Associates Inc.

Signature: Tiffany D Johnson

PROFESSIONAL ENGINEER SEAL

APPENDIX B
SLOPE STABILITY ANALYSIS RESULTS



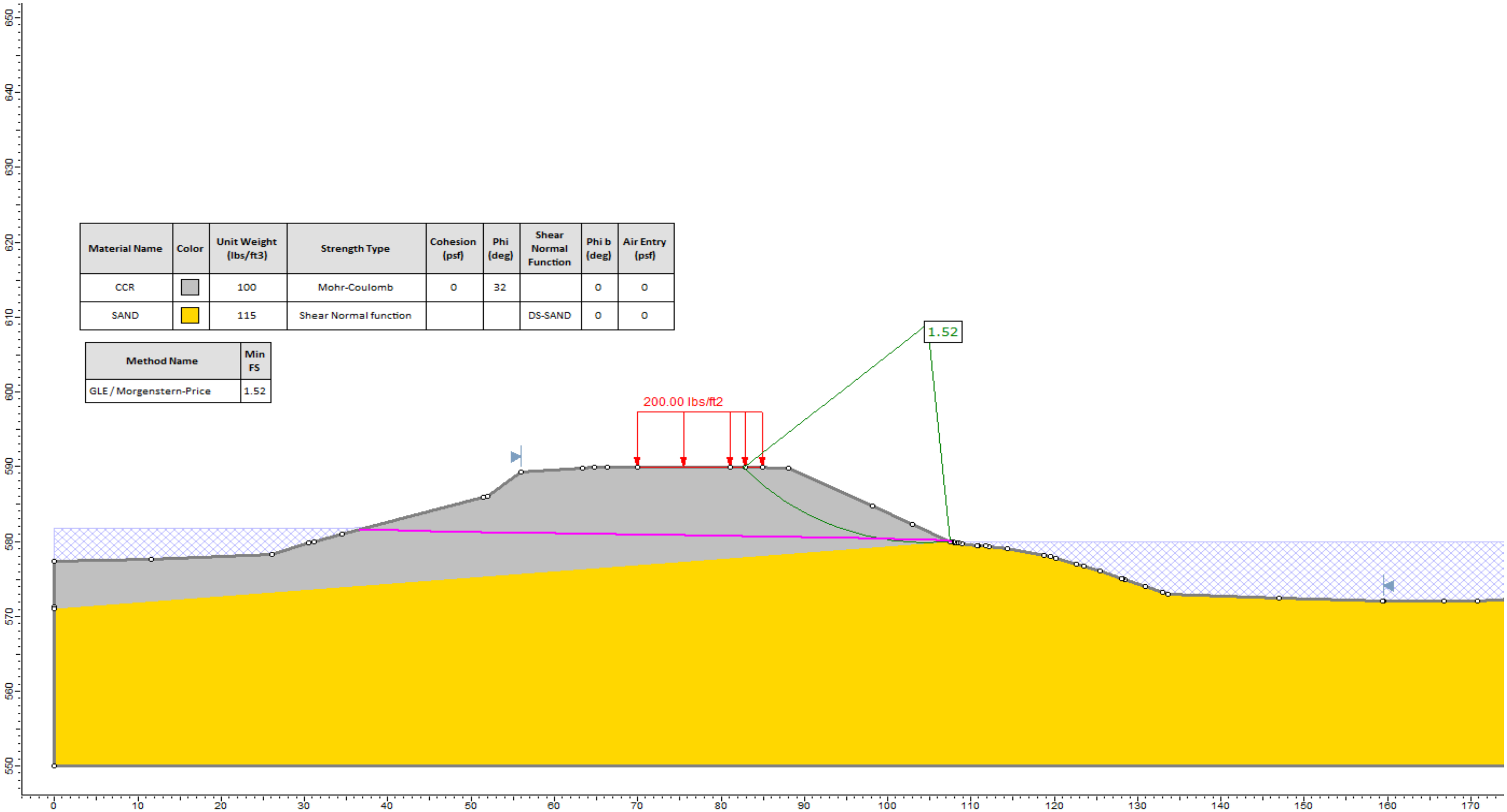
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
CCR		100	Mohr-Coulomb	0	32		Water Surface	Custom	1
SAND		115	Shear Normal function			DS-SAND	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.54

Golder Associates

SCALE	AS SHOWN	PROJECT	B.C. Cobb Structural Stability Assessments
DATE	Jul 2016	TITLE	Ponds 0-8 Section A-A' Slope Factor of Safety Max Pool Storage Scenario
MADE BY	JGM		
CAD	-		
CHECK	JMS	CLIENT	Consumers Energy Company
REVIEW	MJW	FIGURE	B-A1

FILE	STABILITY		
PROJECT No.	1652598B	REV.	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Phi b (deg)	Air Entry (psf)
CCR		100	Mohr-Coulomb	0	32		0	0
SAND		115	Shear Normal function			DS-SAND	0	0

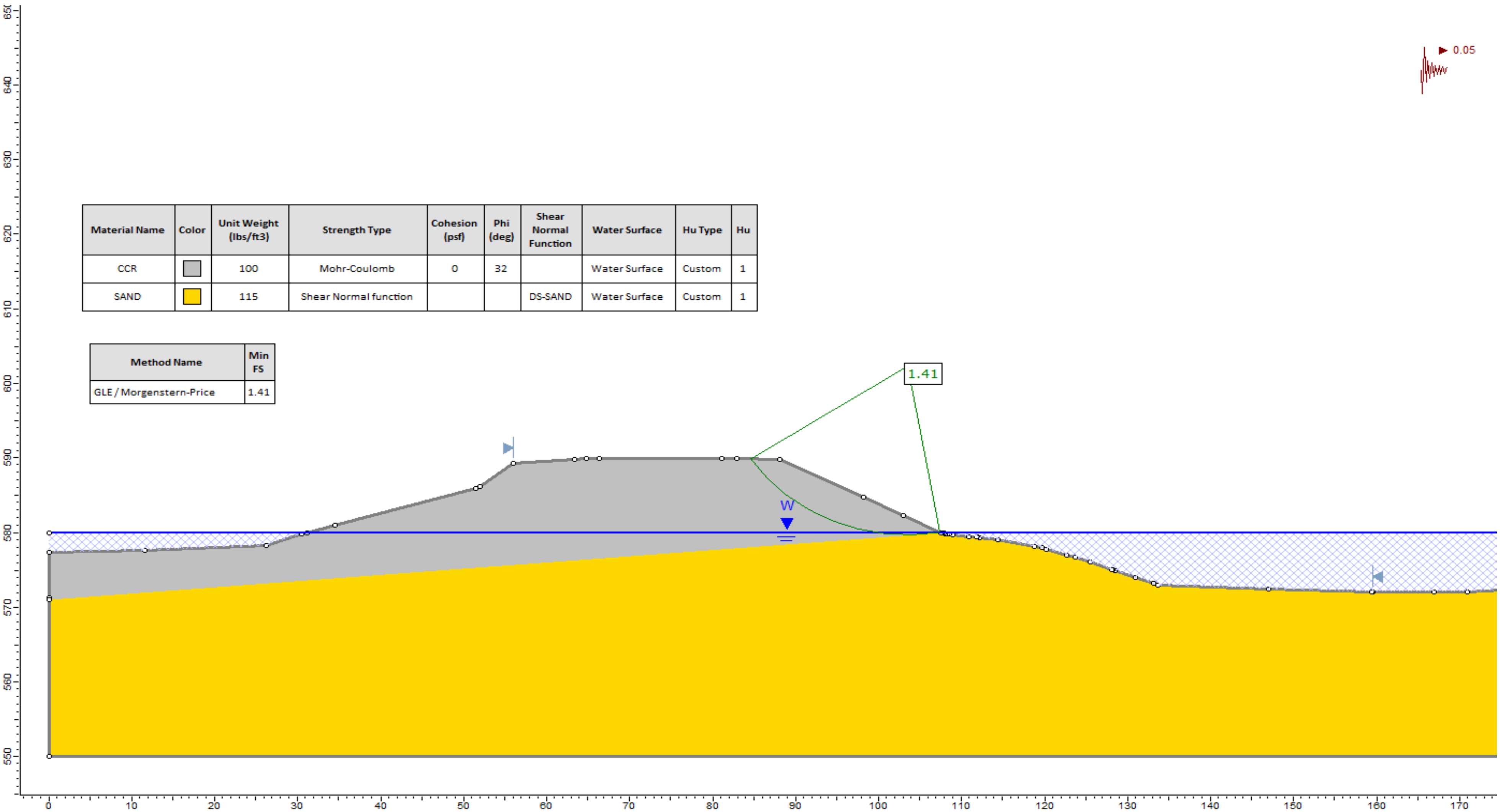
Method Name	Min FS
GLE / Morgenstern-Price	1.52

Golder Associates

SCALE	AS SHOWN	PROJECT	B.C. Cobb Structural Stability Assessments
DATE	Jul 2016	TITLE	Ponds 0-8 Section A-A' Slope Factor of Safety Maximum Pool Surcharge Scenario
MADE BY	JGM		
CAD	-		
CHECK	JMS	CLIENT	Consumers Energy Company
REVIEW	MJW	FIGURE	B-A2

FILE STABILITY

PROJECT No. 1652598B REV. 0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
CCR		100	Mohr-Coulomb	0	32		Water Surface	Custom	1
SAND		115	Shear Normal function			DS-SAND	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.41

SCALE	AS SHOWN	PROJECT	B.C. Cobb Structural Stability Assessments
DATE	Jul 2016	TITLE	Ponds 0-8 Section A-A' Slope Factor of Safety Seismic Scenario
MADE BY	JGM		
CAD	-		
CHECK	JMS	CLIENT	Consumers Energy Company
REVIEW	MJW	FIGURE	B-A3

FILE STABILITY

PROJECT No. 1652598B REV. 0

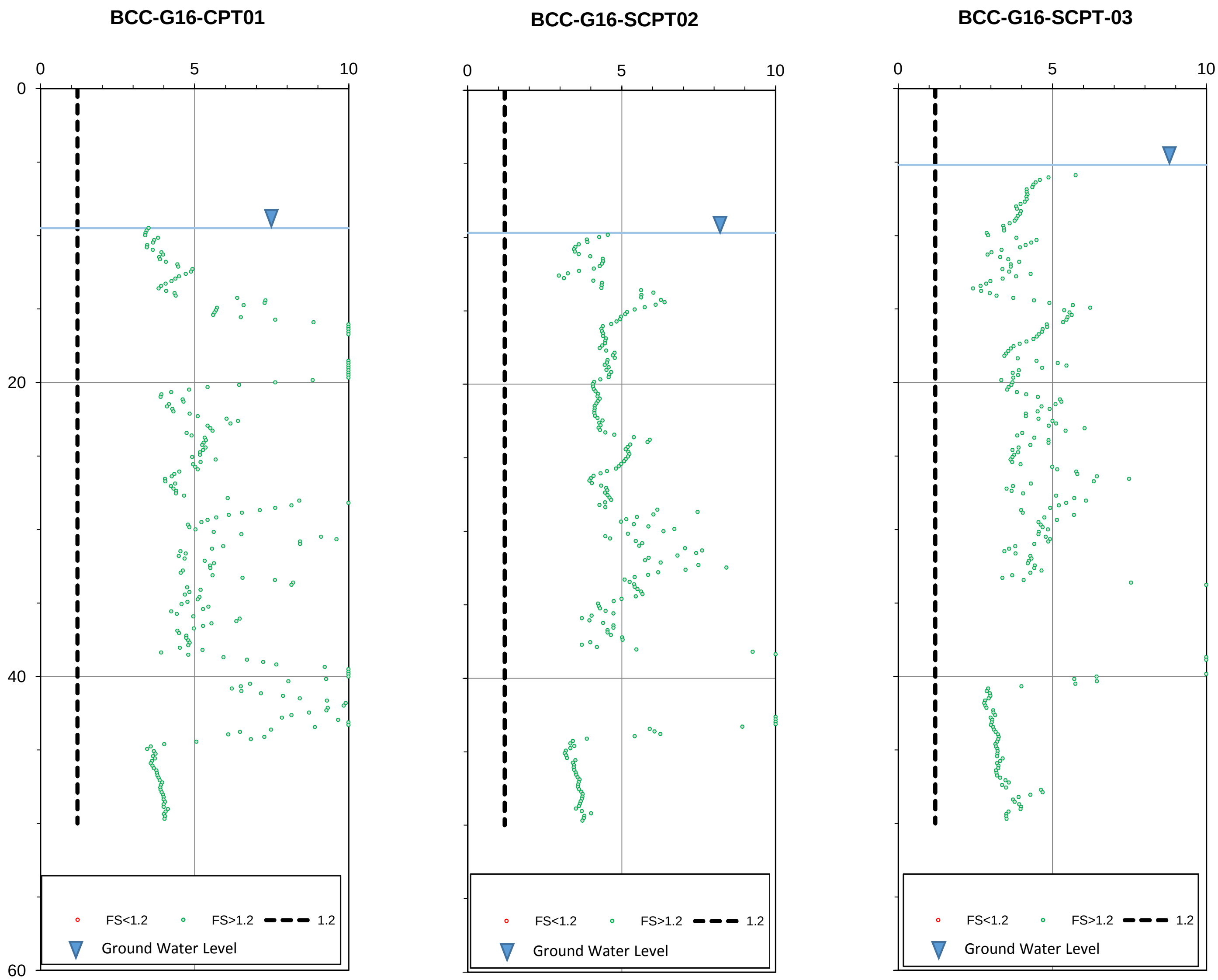
APPENDIX C
LIQUEFACTION ANALYSIS RESULTS

Project:	BC Cobb RCRA	**Test Type:**	CPTU	**Golder Eng:**	AK
Location:	Muskegon, MI	**Device:**	15 cm^2, Type 2 filter	**Check**	AF
Client:	CEC	**Standard:**	ASTM D5778	**Review:**	JS
Proj No.:	1652598B	**Push Co.:**	ConeTec	**Max Depth:**	50.0 ft
Termination:	Target Depth	**Operator:**	Thomas Carpenter		

Design EQ 1 Magnitude: 6.2

CPT ID:	BCC-G16-CPT01	**CPT ID:**	BCC-G16-SCPT02	**CPT ID:**	BCC-G16-SCPT03
Test Date:	5/17/2016	**Test Date:**	5/17/2016	**Test Date:**	5/17/2016
Northing:	646608	**Northing:**	646876	**Northing:**	646240
Easting:	12623358	**Easting:**	12622209	**Easting:**	12622241
Elevation:	591.0 ft	**Elevation:**	590.0 ft	**Elevation:**	586.0 ft
a_{max}:	0.05 g	a_{max}:	0.05 g	a_{max}:	0.05 g
Water Table:	9.5 ft	**Water Table:**	9.7 ft	**Water Table:**	5.2 ft

FACTOR OF SAFETY AGAINST LIQUEFACTION



Notes: Factors of safety (FS) greater than 10 are shown equal to 10.
NCEER (2001) method was used to calculate factors of safety against liquefaction.
The ground water levels shown here are the interpreted ground water levels at the time of CPT investigation.
No liquefaction assumed to be possible above the water table or if qc1Ncs > 160.

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