MWG

Midwest Generation, LLC

Joliet 29 Generating Station

2024 Safety Factor Assessment for Ash Pond 2

Revision 0

October 13, 2024

Issue Purpose: Use

Project No.: A12661.188

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EXECUTIVE SUMMARY

This report presents the 2024 annual safety factor assessment for Ash Pond 2 at Midwest Generation, LLC's (MWG) Joliet 29's Generating Station. This annual assessment, prepared by Sargent & Lundy on behalf of MWG, documents whether the critical cross section at Ash Pond 2 achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a). To complete this assessment, S&L re-evaluated the bases for the most recent structural stability and liquefaction analyses performed for the pond to determine (1) if any changes have occurred and (2) whether identified changes warrant updating the subject structural stability or liquefaction analysis. Where no changes were noted for a given input, or where identified changes were determined to have no impact to the results and conclusions of the subject structural stability or liquefaction analysis, the previous evaluation of that input was considered to still be valid for this 2024 safety factor assessment.

The most recent structural stability and liquefaction analyses for Ash Pond 2 were performed in 2016 for the pond's initial federal safety factor assessment under 40 CFR 257.73(e). Since then, Joliet 29 has taken Ash Pond 2 out of service and has started dewatering the pond. In addition, the design seismic loading on the pond has been reduced due to updates made to the reference design standard (ASCE 7) used to calculate the seismic design parameters for the site. However, there have been no significant modifications to Ash Pond 2's embankments, underlying soils, adjacent topography, or groundwater levels. Moreover, the lower surface water elevation in Ash Pond 2 and the lower design seismic loading each reduce the driving forces on the pond's critical cross section calculated for the pond's initial federal safety factor assessment. Therefore, the 2016 structural stability and liquefaction analyses for Ash Pond 2 are conservative for the pond's current operating conditions. Thus, the initial factors of safety calculated for Ash Pond 2 in 2016 and the bases for these safety factors remain valid, albeit conservative, for this 2024 safety factor assessment.

Table ES-1 presents the 2024 factors of safety for the Ash Pond 2 as determined in this assessment in accordance with 35 Ill. Adm. Code 845.460(a).

Table ES-1 – 2024 Illinois CCR Rule Factors of Safety for Ash Pond 2 at the Joliet 29 Station

Loading Condition	Ash Pond 2	Min. Allowable Factor of Safety
Long-Term, Maximum Storage Pool	≥ 1.50	**1.50**
Maximum Surcharge Pool	≥ 1.40	**1.40**
Seismic	≥ 1.00	**1.00**
Liquefaction	Note 1	**1.20**

Notes: 1) The embankment soils for Ash Pond 2 are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system and depth to groundwater. Thus, liquefaction safety factors are not reported.

1.0 PURPOSE & SCOPE

1.1 PURPOSE

Ash Pond 2 at Midwest Generation, LLC's (MWG) Joliet 29 Station ("Joliet 29" or the "Station") is an existing coal combustion residual (CCR) surface impoundment that is regulated by the Illinois Pollution Control Board's "Standards for the Disposal of Coal Combustion Residuals in CCR Surface Impoundments." These regulations are codified in Part 845 to Title 35 of the Illinois Administrative Code (35 Ill. Adm. Code 845, Ref. 1) and are also referred to herein as the "Illinois CCR Rule." Pursuant to 35 Ill. Adm. Code 845.460(a), MWG must conduct and complete an annual safety factor assessment that documents whether the critical cross section at Ash Pond 2 achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a).

This report documents the 2024 safety factor assessment conducted and completed in accordance with the Illinois CCR Rule by Sargent & Lundy (S&L) on behalf of MWG for Ash Pond 2 at Joliet 29. This report:

- Lists the inputs and assumptions used in the 2024 safety factor assessment,
- Discusses the methodology used to conduct the 2024 safety factor assessment,
- Lists and compares the safety factor acceptance criteria for CCR surface impoundments promulgated by the Illinois CCR Rule and by the U.S. Environmental Protection Agency's (EPA) regulations for CCR surface impoundments,
- Summarizes the results from the initial federal safety factor assessment completed for Ash Pond 2 pursuant to the aforementioned U.S. EPA regulations,
- Evaluates potential changes to the inputs used in the initial federal safety factor assessment to determine whether new or updated liquefaction and/or structural stability analyses are warranted, and
- Provides the 2024 factors of safety for Ash Pond 2 in accordance with 35 Ill. Adm. Code 845.460(a).

1.2 SCOPE

In addition to being regulated under the Illinois CCR Rule, Joliet 29's Ash Pond 2 is also regulated by the U.S. EPA's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," 40 CFR Part 257 Subpart D (Ref. 2), also referred to herein as the "Federal CCR Rule." Per the 2016 Water Infrastructure Improvements for the Nation (WIIN) Act, Ash Pond 2 will continue to be subject to both the Illinois and Federal CCR Rules until the U.S. EPA approves the Illinois EPA's CCR permit program; the Illinois EPA has yet to publish a timeline for submitting its proposed CCR permit program to the U.S. EPA for approval. However, the scope of this 2024 safety factor assessment is strictly limited to demonstrating compliance with the Illinois CCR Rule. Pursuant to 40 CFR 257.73(f)(3), the next safety factor assessment for demonstrating compliance with the Federal CCR Rule is not required until 2026, five years after the last federal assessment was completed (2021).

2.0 INPUTS

Safety Factor Acceptance Criteria for CCR Surface Impoundments

The Illinois CCR Rule (Ref. 1, § 845.460) requires all existing CCR surface impoundments to achieve four minimum safety factors at the impoundment's critical cross section, which is defined by the Illinois CCR Rule as "the cross section anticipated to be the most susceptible of all cross-sections to structural failure based on appropriate engineering considerations, including loading conditions." The Federal CCR Rule (Ref. 2, § 257.73(e)) has the same safety factor acceptance criteria as the Illinois CCR Rule. Table 2-1 presents the safety factor acceptance criteria promulgated by both sets of regulations for existing CCR surface impoundments.

Table 2-1 – Safety Factor Acceptance Criteria for Existing CCR Surface Impoundments

Loading Condition	Minimum Allowable Factor of Safety	Illinois CCR Rule Reference	Federal CCR Rule Reference
Long-Term, Maximum Storage Pool	1.50	§ 845.460(a)(2)	§ 257.73(e)(1)(i)
Maximum Surcharge Pool	1.40	§ 845.460(a)(3)	§ 257.73(e)(1)(ii)
Seismic	1.00	§ 845.460(a)(4)	§ 257.73(e)(1)(iii)
Liquefaction	1.20	§ 845.460(a)(5)	§ 257.73(e)(1)(iv)

Initial Federal Safety Factor Assessment

Appendix A provides the initial federal safety factor assessment conducted by Geosyntec Consultants in 2016 for Ash Pond 2 (Ref. 3).

Site Topography & Aerial Images

Topographic data for Ash Pond 2 and the adjacent areas was obtained from an aerial survey flown at the site in June 2008 (Ref. 4). Historical and recent aerial images of Ash Pond 2 and adjacent areas were obtained from Google Earth Pro (Ref. 5).

Groundwater

Static water elevation data for groundwater at the site was obtained from annual groundwater monitoring reports prepared by KPRG and Associates, Inc. for the CCR surface impoundment in accordance with 40 CFR 257.90(e) and 35 Ill. Adm. Code 845.610(e)(1) (Refs. 14 through 20).

Ash Pond Conditions

The operating and physical conditions for Ash Pond 2 were based on the following inputs:

- Observations made by S&L during a site visit on September 26, 2024.

- Discussions with MWG personnel
- The annual inspection reports prepared for the pond in accordance with 40 CFR 257.83(b) and 35 Ill. Adm. Code 845.540(b) (Refs. 6 through 13).
- The weekly inspection reports prepared in accordance with 35 Ill. Adm. Code 845.540(a) since the 2023 safety factor assessment was issued (Ref. 23)

Horizontal Seismic Coefficient

Pursuant to 35 Ill. Adm. Code 845.460(a)(4), Ash Pond 2 must have a minimum factor of safety of 1.00 when analyzed under a seismic loading condition. This loading condition is represented by a horizontal seismic coefficient that is based on a peak ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years in accordance with the definition of "maximum horizontal acceleration in lithified earth material" promulgated by 35 Ill. Adm. Code 845.120. The design horizontal seismic coefficient is also based on the mapped spectral response acceleration at a period of 1 second adjusted for site-specific soil conditions (S_{M1}). Table 2-2 presents the seismic response parameters obtained from ASCE 7-22 (Ref. 21) on which Ash Pond 2's seismic loading condition was based.

Table 2-2 – Horizontal Seismic Coefficient Inputs

Parameter	Symbol	Value
Peak Ground Acceleration	PGA	0.094
Mapped Spectral Response, 1-Second Period, Adjusted for Site Effects	S_{M1}	0.16

3.0 ASSUMPTIONS

There are no assumptions in this document that require verification.

4.0 METHODOLOGY

As documented in last year's safety factor assessment, the 2023 factors of safety for Ash Pond 2 were based on the initial factors of safety calculated for the pond pursuant to the Federal CCR Rule after it was determined that the bases for the initial federal safety factor assessment were still valid. Accordingly, the bases for Ash Pond 2's initial factors of safety as documented within the pond's initial safety factor assessment were re-evaluated to determine if any changes have occurred since the initial federal assessment was completed. Identified changes were then evaluated to determine if updates to the pond's previous structural stability and/or liquefaction analyses were warranted. Where no changes were noted for a given input, or where identified changes were determined to have no impact on the results and conclusions

of the initial federal safety factor assessment, the previous evaluation of that input was considered to still be valid for this 2024 assessment.

5.0 ASSESSMENT

5.1 SUMMARY OF 2023 SAFETY FACTOR ASSESSMENT

The previous safety factor assessment for Ash Pond 2 was completed on September 14, 2023. The 2023 factors of safety for Ash Pond 2 were based on the factors of safety calculated in the initial federal safety factor assessment after it was determined that the bases for the initial federal safety factor assessment were still valid. The initial federal safety factor assessment for Ash Pond 2 concluded the pond's critical cross-sections are stable and meet the safety factor requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv). Because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, the 2023 safety factor assessment concluded that the factors of safety calculated for the pond in the initial federal safety factor assessment are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

5.2 SUMMARY OF INITIAL FEDERAL SAFETY FACTOR ASSESSMENT

The initial federal safety factor assessment for Ash Pond 2 was completed in October 2016 and is included in its entirety in Appendix A. As previously stated, the results of this assessment indicated that the pond's critical cross-sections are stable and meet the factor of safety requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv).

In addition to evaluating the pond's earthen dikes, the initial federal safety factor assessment also evaluated a reinforced concrete cantilever retaining wall located along the southwest portion of Ash Pond 2's southern dike. This wall section was analyzed to confirm it meets or exceeds the minimum factors of safety for bearing capacity, overturning, and sliding that are generally accepted industry standards.

5.3 CHANGES IN BASES FOR INITIAL FEDERAL SAFETY FACTORS

The following subsections summarize the evaluation conducted to determine if (1) changes to the design inputs used in Ash Pond 2's initial federal safety factor assessment have occurred since the assessment was completed in 2016, and (2) whether the 2016 structural stability and liquefaction analyses can be accepted as-is for this 2024 assessment or if further analysis is required.

5.3.1 CHANGES IN GEOTECHNICAL DATA

Based on reviews of the annual inspection reports (Refs. 6 through 13) and Google Earth aerial images (Ref. 5), there have been no significant changes to the embankments or underlying soils that would require updating the geotechnical parameters used in the 2016 analysis (Ref. 3).

5.3.2 CHANGES IN TOPOGRAPHY ADJACENT TO ASH POND 2

Based on reviews of the annual inspection reports (Refs. 6 through 13) and Google Earth aerial images (Ref. 5), there have been no significant modifications to the ground surfaces adjacent to Ash Pond 2 (mass excavations, mass fill placement, *etc*.) since the initial federal safety factor assessment was completed. Therefore, the topographic data collected for the site in 2008 (Ref. 4) remains valid for use in this 2024 assessment.

5.3.3 CHANGES IN GROUNDWATER LEVEL

Based on reviews of the annual groundwater monitoring and corrective action reports for Ash Pond 2 (Refs. 14 through 20), no significant variations in seasonal groundwater elevations were noted. Because Ash Pond 2 is lined with a geomembrane liner, the embankments are not hydraulically connected to the water levels within the pond, and a typical phreatic surface normally associated with seepage through an earthen embankment is not applicable. The reported static groundwater elevation is valid for this analysis, and there have been no significant changes in the surface water conditions near the site that would impact the site's groundwater levels.

5.3.4 CHANGES IN EMBANKMENT GEOMETRY

Based on reviews of the annual inspection reports (Refs. 6 through 13), Google Earth aerial images (Ref. 5), and visual observations made by S&L in September 2024, there have been no significant modifications to the pond's embankments since the initial federal safety factor assessment was completed. Therefore, there is no basis to re-evaluate Ash Pond 2's embankment geometry for this 2024 assessment.

5.3.5 CHANGES IN EARTHQUAKE DESIGN BASIS

The design horizontal seismic coefficient utilized in the initial technical analysis (Ref. 3) was based on published data in ASCE 7-10 (Ref. 22). Since the initial technical analysis was developed, an updated publication of the reference material has been produced (ASCE 7-22 (Ref. 21)), which provides updated values for the parameters used to determine the design horizontal seismic coefficient (see Table 2-2 and Table 5-1). Per Table 5-1, both PGA and S_{M1} have lower values under ASCE 7-22 than under ASCE 7-10. Based on the reduction in the site seismic loading parameters from ASCE 7-10 to ASCE 7-22, the horizontal seismic coefficient for Ash Pond 2's seismic loading condition will be less than the value used in the initial federal safety factor assessment. Therefore, the horizontal seismic coefficient used for the 2016 analysis is

conservative. Thus, it is not necessary to change the earthquake design basis used to conduct the initial safety factor assessment for Ash Pond 2.

Table 5-1 – Seismic Loading Parameters Comparison

Parameter	Symbol	2016 Values per ASCE 7-10	2023 Values per ASCE 7-22
Peak Ground Acceleration	PGA	0.132	0.094
Mapped Spectral Response, 1-Second Period, Adjusted for Site Class Effects	S_{M1}	0.17	0.16

5.3.6 CHANGES IN ASH POND OPERATIONS

Ash Pond 2 was originally designed to manage CCR and miscellaneous non-CCR wastestreams from the Station. Following the conversion of Joliet 29's coal-fired units to natural gas, the pond was no longer used to manage CCR wastestreams and was eventually taken out of service. Accordingly, the station ceased sending all process and wastewater streams to Ash Pond 2, effectively isolating the pond. In accordance with the Station's ash pond maintenance practices, the Station then began dewatering and removing CCR from the pond. In April 2021, MWG filed a notice of intent to close Ash Pond 2 in accordance with the Federal CCR Rule's closure criteria (Ref. 2, § 257.102). In January 2022, MWG submitted the closure construction permit application for Ash Pond 2 to the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule. Closure construction activities will commence at the pond upon receipt of a closure construction permit from the Illinois EPA.

As documented in the pond's most recent 2023 annual inspection report (Ref. 13), there is no CCR remaining in Ash Pond 2. In addition, the station is actively taking measures to limit the water level in the pond. Per the weekly inspection reports prepared in accordance with 35 Ill. Adm. Code 845.540(a) since the 2023 safety factor assessment was issued (Ref. 23), the station pumped water out of the pond in June 2024 to a depth of approximately 6 inches. Since July 2024, the water in Ash Pond 2 has been maintained at around 2 feet. Indeed, during S&L's site visit on September 26, 2024, no CCR and approximately 1.8 feet of water were visually observed in Ash Pond 2. The Station will continue to periodically dewater Ash Pond 2 to maintain relatively low operating levels.

The decrease in surface water elevation in Ash Pond 2 compared to the design operating water level decreases the driving forces in the embankment; therefore, the surface water elevation used for the 2016 analysis is conservative for the pond's current operating condition. Therefore, it is not necessary to re-evaluate the surface water elevations used to conduct the initial federal safety factor assessment for Ash Pond 2.

5.4 2024 SAFETY FACTOR ASSESSMENT

Per the preceding subsections, excluding the operational changes to Ash Pond 2, there have been no significant changes to the pond's embankments, the underlying soils, the adjacent topography, or groundwater levels. The operational changes to Ash Pond 2 further decrease the surface water elevation being held at the pond, therefore, the surface water elevation used for the 2016 analysis is still conservative for the pond's current operating condition. While the seismic design criteria for Ash Pond 2 has changed, the horizontal seismic coefficient calculated using the updated seismic design parameters will be less than the value used in the initial federal safety factor assessment, thereby making the 2016 analysis conservative under present design criteria. Therefore, the initial federal safety factor assessment completed in 2016 for Ash Pond 2 remains valid.

Based on the preceding observations, the initial factors of safety calculated for Ash Pond 2 in 2016 pursuant to the Federal CCR Rule and the bases for these safety factors remain valid for this 2024 assessment. As previously discussed, because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, these factors of safety for Ash Pond 2 are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

6.0 CONCLUSIONS

This assessment re-evaluated the factors and design inputs used as the bases for the initial federal safety factor assessment completed in 2016 in accordance with the Federal CCR Rule for Joliet 29's Ash Pond 2 (Ref. 3). It was determined that no significant changes have occurred within the last eight years that would invalidate the conclusions of the initial federal safety factor assessment. Therefore, the factors of safety reported in the initial federal safety factor assessment for Ash Pond 2's earthen dikes and retaining wall remain valid for this 2024 assessment. Moreover, because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, these federal factors of safety for Ash Pond 2 are in conformance with the safety factor criteria promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

Table 6-1 presents the 2024 factors of safety for Ash Pond 2's earthen dikes as determined in accordance with 35 Ill. Adm. Code 845.460(a).

Table 6-1 – 2024 Illinois CCR Rule Factors of Safety for Ash Pond 2 at the Joliet 29 Station

Loading Condition	Ash Pond 2	Min. Allowable Factor of Safety
Long-Term, Maximum Storage Pool	≥ 1.50	**1.50**
Maximum Surcharge Pool	≥ 1.40	**1.40**
Seismic	≥ 1.00	**1.00**
Liquefaction	Note 1	**1.20**

Notes: 1) The embankment soils for Ash Pond 2 are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system and depth to groundwater. Thus, liquefaction safety factors are not reported.

7.0 CERTIFICATION

I certify that:

- This safety factor assessment was prepared by me or under my direct supervision.
- The work was conducted in accordance with the requirements of 35 Ill. Adm. Code 845.460.
- I am a registered professional engineer under the laws of the State of Illinois.

Certified By: Thomas J. Dehlin Date: October 13, 2024

Seal:

Digitally signed by Thomas Dehlin
Date: 2024.10.13 11:27:08-05'00'

8.0 REFERENCES

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APPENDIX A: 2016 FEDERAL SAFETY FACTOR ASSESSMENT FOR ASH POND 2

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STRUCTURAL STABILITY AND FACTOR OF SAFETY ASSESSMENT
ASH POND 2
JOLIET 29 STATION
OCTOBER 2016

This report presents the initial periodic structural stability and initial safety factor assessment of the Ash Pond 2 at the Joliet 29 Station (Site) in Joliet, Illinois (Figure 1). This report addresses the initial structural stability and safety factor assessment requirements of the Coal Combustion Residuals (CCR) regulations, Code of Federal Regulations Title 40, Part 257, Subpart D (referred to as the CCR Rule). These regulations were published in the Federal Register on 17 April 2015 and became effective on 19 October 2015. The Joliet 29 Station is owned and operated by Midwest Generation, LLC (Midwest Generation). Based on the results provided in this report, Ash Pond 2 meets the requirements of §257.73(d) and §257.73(e) of the CCR Rule.

The work presented in this report was performed under the direction of Ms. Jane Soule, P.E., of Geosyntec Consultants, Inc. (Geosyntec) in accordance with §257.73(d) and §257.73(e). Mr. Robert White reviewed this report in accordance with Geosyntec's senior review policy.

1. Regulation Requirements - §257.73

Structural integrity criteria for existing CCR impoundments is described in §257.73 and includes structural stability and factor of safety assessments. Ash Pond 2 meets the minimum size and capacity criteria under §257.73(b) and is subject to the periodic structural stability and safety factor assessments required.

2. Site Conditions

Ash Pond 2 is approximately 500 feet by 280 feet in plan area and is located approximately 70 feet south of U.S. Route 6, east of Pond 1, west of the east entrance to the Joliet 29 Station, and north of the silo building at the Site. The pond is surrounded by embankments on the south, east, and west. There are no embankments on the north side of the pond where existing ground elevations generally increase to the north toward U.S. Route 6. Ash Pond 2 is currently lined with a 60-mil high density polyethylene (HDPE) geomembrane. A concrete retaining wall is located along the southern perimeter of Ash Pond 2, north of the silo building.

Based on available documentation and discussions with site personnel, Ash Pond 2, in its current configuration, was constructed in the late 1970s. A history of construction for the pond was prepared in accordance with §257.73(c) and describes the design of the Ash Pond 2 and its construction (Geosyntec, 2016a).

3. Structural Stability Assessment

The following subsections address the components of §257.73(d)(1).

3.1 Foundations and Abutments – §257.73(d)(1)(i)

Site observations and construction documents show Ash Pond 2 is surrounded by embankments on the south, east, and west. There are no embankments on the north side of the pond where existing ground elevations generally increase to the north; however, Site investigations indicate that fill material may be present along the northern boundary. For engineering purposes, material located along the northern embankment is considered consistent with embankment fill. Native materials do not provide lateral support for the embankments and therefore the pond does not include abutments. The remainder of this section addresses the foundation materials for the pond's embankments.

Previous subsurface investigations performed at the Site indicate that the foundation materials underlying the embankments for Ash Pond 2 generally consist of approximately 20 to 30 feet of medium dense to very dense sand and gravel (Geosyntec, 2016b). Due to the granular nature of the foundation soils (sand and gravel), foundation settlement associated with the construction and operation of Ash Pond 2 is anticipated to be predominately elastic settlement, which would have likely occurred soon after construction in the late 1970s. Because of the age of the embankments (over 35 years old), it is very likely that any potential consolidation and secondary compression settlement has also occurred. Further, the Ash Pond 2 embankments were not constructed with abutments or separate engineered zones that would be most susceptible to the adverse effects of differential settlement. During the initial annual inspection performed for Ash Pond 2 in accordance with §257.83(b), no visual evidence of adverse effects resulting from settlement was observed (Geosyntec, 2016c). There are no proposed changes in operation which would increase loading conditions on the foundation; therefore, no significant settlement of the foundation materials underlying the embankments is anticipated to occur in the future and the settlement of the foundation is not anticipated to impact the integrity of the impoundment embankments.

A factor of safety against the triggering of liquefaction was calculated for saturated foundation materials underlying the Ash Pond 2 embankments. The factor of safety was calculated based methods outlined in Idriss and Boulanger (2008) using information obtained from field explorations, including borings, Cone Penetration Test (CPT) soundings, and laboratory data (Geosyntec, 2016b) and seismic data (Geosyntec, 2016d). The triggering analysis indicated a very low likelihood of liquefaction occurring in the foundation materials underlying the embankments (Geosyntec, 2016d).

3.2 Upstream Slope Protection – §257.73(d)(1)(ii)

Ash Pond 2 is lined with a 60-mil high density polyethylene (HDPE) geomembrane that protects the interior pond slopes from erosion, the effects of wave action, and mitigates effects of rapid drawdown.

3.3 Dike Compaction – §257.73(d)(1)(iii)

Because as-built construction documentation for Ash Pond 2 was not available at the time of this assessment, no quantitative evaluation of the degree of compaction of the embankments was performed. However, slope stability analyses show that the embankments for Ash Pond 2 are sufficient to withstand the range of loading conditions in the CCR unit (Geosyntec, 2016e).

3.4 Downstream Slope Protection – §257.73(d)(1)(iv)

The western downstream slope for Ash Pond 2 is the interior slope of Pond 1 and is lined with a geomembrane that provides erosion protection. Based on site observations in October 2015, the surfaces of eastern and southern downstream slopes for the Ash Pond 2 embankments consist of sandy gravel, gravelly sand, gravel, and some cobbles and include sparse vegetation. Based on site observations, the existing surface conditions of the slopes provide adequate slope protection.

3.5 Spillway – §257.73(d)(1)(v)

Ash Pond 2 was designed and constructed, and is operated and maintained, without an emergency spillway. Ash Pond 2 was constructed with elevated embankments on the south, east, and west perimeters. There are no embankments on the north side of the pond where existing ground elevations generally increase to the north. There is a 5-foot high, non-structural berm that exists between Ash Pond 2 and US route 6, which prevents run-on from US route 6. There is no significant run-on to the basins. Inflows for the pond consist solely of regulated flows from plant operations and precipitation that falls within the surface area of the pond and embankment crests. Surface water levels are maintained by regulating inflow from plant operations and maintaining operating levels. An inflow design flood control system plan has been prepared to document that the Basins adequately manage flow from the 1,000 year flood event (Geosyntec, 2016f).

3.6 Structural Integrity of Hydraulic Structures – §257.73(d)(1)(vi)

Hydraulic structures passing through or beneath the embankments of Ash Pond 2 consist of outlet pipes associated with Pond 1 and Ash Pond 2, as presented in Figure 2. These pipes were inspected on 9 June 2016 by a company specializing in video camera pipe inspections. No significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or

debris that would negatively affect operation of the pipes was observed during inspection of these outlet pipes.

3.7 Downstream Slopes Adjacent to Water Bodies – §257.73(d)(1)(vii)

The only water body adjacent to Ash Pond 2 is Pond 1, located west of Ash Pond 2. When operated, Pond 1 will impound water against the western downstream slope of Ash Pond 2. The slope stability analyses presented in Geosyntec (2016e) consider a "low pool" condition for Pond 1 where no water is present in Pond 1 to provide a stabilizing force on the downstream face of the western slope of Ash Pond 2.

When Pond 1 is operated and water is impounded against the downstream face of the western slope of Ash Pond 2, the impounded water is unlikely to infiltrate into the embankment because Pond 1 is lined with a 60-mil HDPE geomembrane. Therefore, a rapid drawdown condition is not applicable to the western embankment of Ash Pond 2 and was not analyzed.

3.8 Structural Stability Assessment Deficiencies - §257.73(d)(2)

No structural stability deficiencies associated with Ash Pond 2 were identified in this initial structural stability assessment and no corrective measures are required.

3.9 Annual Inspection Requirement - §257.83(b)(4)(ii)

In accordance with §257.83(b)(4)(ii), submittal of this structural stability assessment precludes the requirement of an annual inspection under §257.83(b) for Ash Pond 2 during the 2016 calendar year.

4. Safety Factor Assessment

This section describes the initial safety factor assessment for Ash Pond 2 and the methodology used to perform the assessment in accordance with §257.73(e)(1). This assessment summarizes slope stability analyses of the critical embankment cross-section, shown in Figure 3, and evaluation of stability of the retaining wall southeast of the pond.

4.1 Slope Stability Methodology

Limit equilibrium slope stability analyses were performed to evaluate the stability of the embankments for Ash Pond 2. The process involved performing two-dimensional analyses on the critical cross-section for Ash Pond 2 using Spencer's Method as coded in the computer program SLOPE/W (Version 8.15.4.11512, www.geoslope.com) which satisfies vertical and horizontal force equilibrium and moment equilibrium (Geosyntec, 2016e). For each cross section analyzed, the program searches for the sliding surface that produces the lowest factor of safety

(FS). Factor of safety is defined as the ratio of the shear forces/moments resisting movement along a sliding surface to the forces/moments driving the instability.

Subsurface stratigraphy, groundwater conditions, and engineering parameters for the embankment and foundation materials were developed based on previous subsurface investigations performed at the Site (Geosyntec, 2016b and Geosyntec, 2016e).

4.2 Slope Stability Analyses

Four cases were analyzed to satisfy the safety factor assessment requirements in §257.73(e) (Geosyntec, 2016e).

4.2.1 Static, Long-Term Maximum Storage Pool Loading – §257.73(e)(1)(i)

Pursuant to §257.73(e)(1)(i) a static, long-term condition with the maximum operating pool loading on the embankments was evaluated. For Ash Pond 2, this condition included a pool elevation at 2 feet below the top of the embankments (Geosyntec, 2016e).

4.2.2 Static, Maximum Storage Pool Loading – §257.73(e)(1)(ii)

The conditions for §257.73(e)(1)(ii) are identical to §257.73(e)(1)(i) with the exception of the pool elevation, which is set at the top of the embankment (Geosyntec, 2016e).

4.2.3 Seismic – §257.73(e)(1)(iii)

Pursuant to §257.73(e)(1)(iii), a seismic condition for Ash Pond 2 was also analyzed. Seismic stability was evaluated with a pseudostatic analysis that uses constant horizontal accelerations to represent the effects of earthquake shaking. The horizontal accelerations are represented in SLOPE/W by a horizontal seismic coefficient. The horizontal seismic coefficient used for analysis was based on a peak ground acceleration with a 2 percent probability of exceedance in 50 years (Geosyntec, 2016g).

4.2.4 Liquefaction – §257.73(e)(1)(i)

The Ash Pond 2 embankment soils are assumed to be unsaturated. Based on quarterly groundwater monitoring in the vicinity of Ash Pond 2, groundwater is approximately 8 feet below the bottom of the pond. Further, the embankments are lined with an HDPE geomembrane liner that limits infiltration into the embankments and makes saturation of the embankments unlikely. Because the embankment soils are unlikely to be saturated and therefore are not considered susceptible to liquefaction, the calculation of a factor of safety for post-liquefaction slope stability is not required.

4.3 Results

The results of the slope stability analysis for the critical cross section of the Ash Pond 2 embankments are summarized in Table 1 below and presented in Figures 4 through 6 (Geosyntec 2016e).

Table 1: Safety Factor Results

Section	Safety Factor			
	257.73(e)(1)(i)	257.73(e)(1)(ii)	257.73(e)(1)(iii)	257.73(e)(1)(iv)
1	≥1.50	≥1.40	≥1.00	N/A

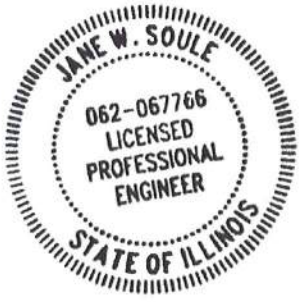
The results of the slope stability analyses meet the minimum safety factors requirements presented in §257.73(e)(1)(i) through §257.73(e)(1)(iii).

4.4 Retaining Wall Analyses

Stability of the retaining wall located on the southwest portion of the southern embankment of Ash Pond 2 was also evaluated (Geosyntec, 2016h). Construction drawings for the wall and site observations indicate that it is a reinforced concrete cantilever type wall. As-built construction documentation for the wall was not available. Inputs for the analyses were based on information provided in the construction drawings and developed from subsurface investigations at the Site (Geosyntec, 2016h and Geosyntec, 2016b). Factors of safety for bearing capacity, overturning, and sliding were calculated for the wall and results indicate that the factors of safety exceed minimum industry standard values (Geosyntec, 2016h).

5. Limitations and Certification

This initial periodic structural stability and safety factor assessment meets the requirements of §257.73(d) and §257.73(e) of the Code of Federal Regulations Title 40, Part 257, Subpart D, and was prepared in accordance with current practices and the standard of care exercised by scientists and engineers performing similar tasks in the field of civil engineering. The contents of this report are based solely on the observations of the conditions observed by Geosyntec personnel and information provided to Geosyntec by Midwest Generation. Consistent with applicable professional standards of care, our opinions and recommendations were based in part on data furnished by others, which was consistent with other information that we developed in the course of our performance of the scope of services. The information contained in this report is intended for use solely by Midwest Generation and their subconsultants.



Jane W. Soule, P.E.
Illinois Professional Engineer No. 062-067766
Expiration Date: 11/30/2017

6. References

Geosyntec (2016a). History of Construction Report, Ash Pond 2, Joliet 29 Station, October.

Geosyntec (2016b). Soil Properties Calculations, Joliet 29 Station, October.

Geosyntec (2016c). Annual Inspection Report, Ash Pond 2, Joliet 29 Station, 18 January 2016.

Geosyntec (2016d). Liquefaction Calculations, Ash Pond 2, Joliet 29 Station, October.

Geosyntec (2016e). Slope Stability Calculations, Joliet 29 Station, October.

Geosyntec (2016f). Inflow Design Flood Control System Plan, Ash Pond 2, Joliet 29 Generating Station, October.

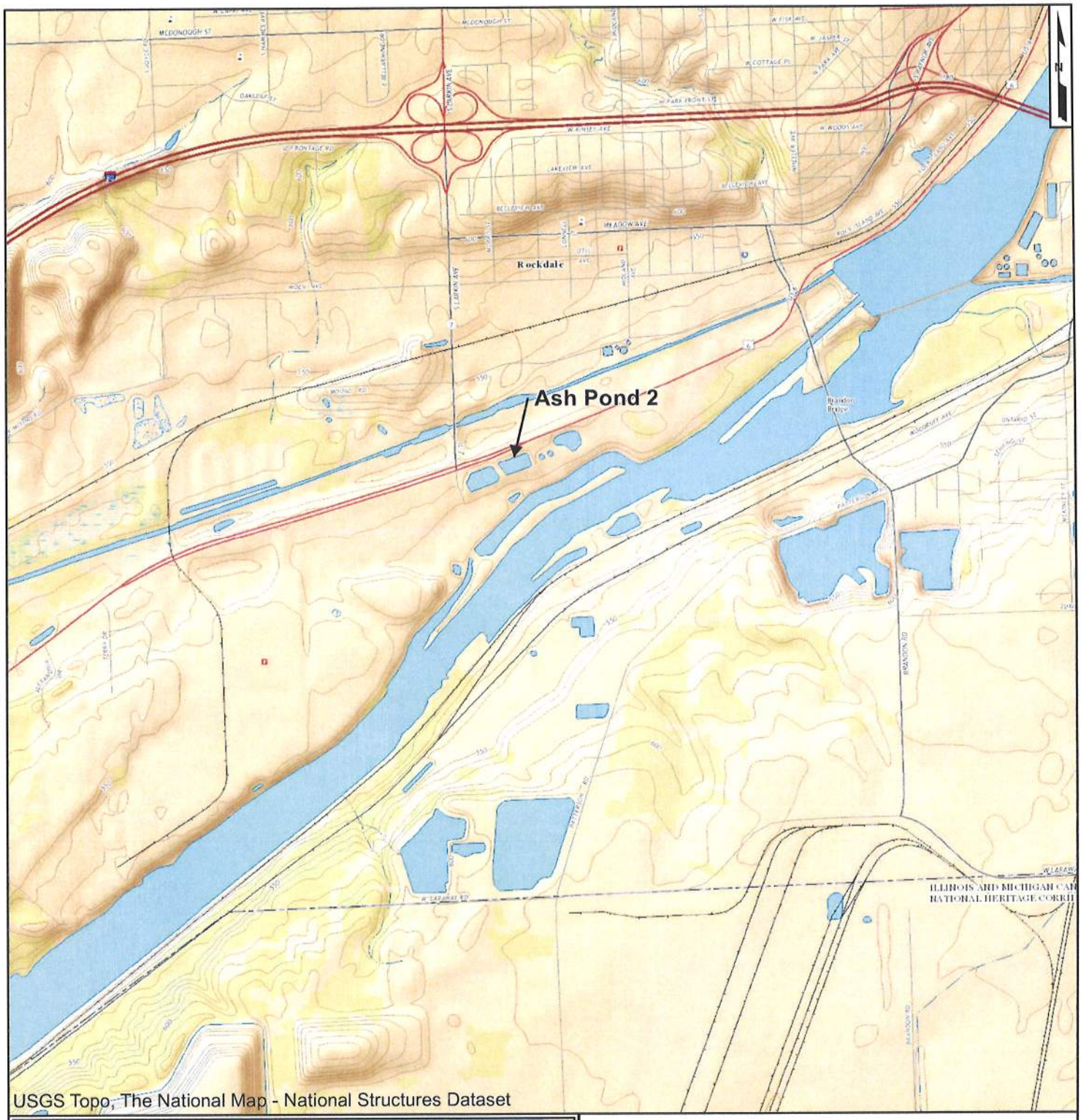
Geosyntec (2016g). Seismic Coefficient Calculations, Joliet 29 Station, October.

Geosyntec (2016h). Retaining Wall Calculations, Joliet 29 Station, October.

Idriss and Boulanger (2008). "Soil Liquefaction During Earthquakes". Earthquake Engineering Research Institute, MNO-12.

Attachments

Figure 1 – Site Location
Figure 2 – Hydraulic Structure Locations
Figure 3 – Critical Cross Section
Figure 4 – Slope Stability Output, Section 1 - 257.73(e)(1)(i)
Figure 5 – Slope Stability Output, Section 1 - 257.73(e)(1)(ii)
Figure 6 – Slope Stability Output, Section 1 - 257.73(e)(1)(iii)



2,000 1,000 0 2,000 Feet

Site Location

Ash Pond 2
Joliet 29 Station
Joliet, Illinois

Geosyntec consultants

San Diego | October 2016

Figure 1

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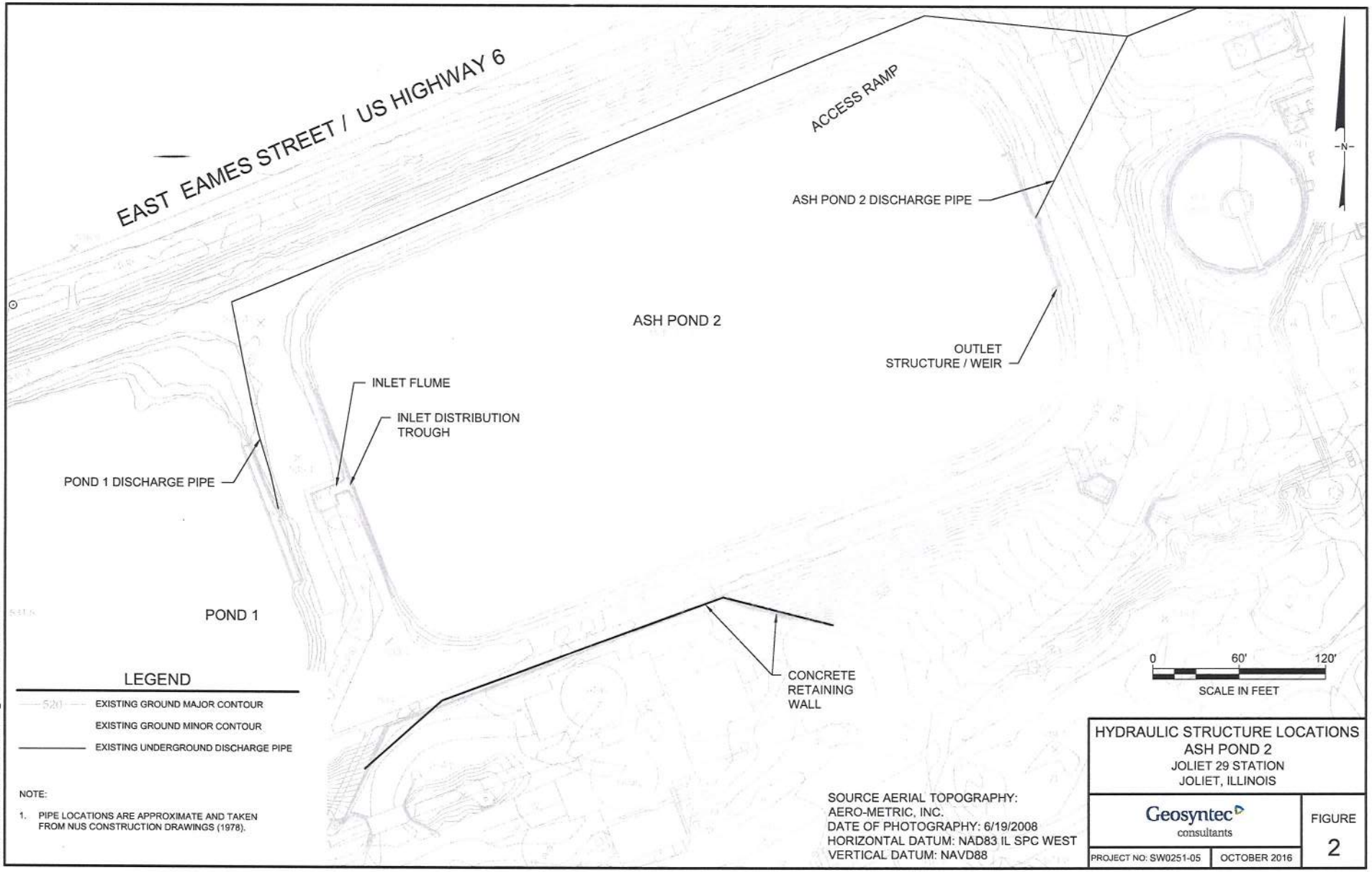


LEGEND

- EXISTING GROUND MAJOR CONTOUR
- EXISTING GROUND MINOR CONTOUR
- EXISTING UNDERGROUND DISCHARGE PIPE

NOTE:

1. PIPE LOCATIONS ARE APPROXIMATE AND TAKEN FROM NUS CONSTRUCTION DRAWINGS (1978).

SOURCE AERIAL TOPOGRAPHY:
AERO-METRIC, INC.
DATE OF PHOTOGRAPHY: 6/19/2008
HORIZONTAL DATUM: NAD83 IL SPC WEST
VERTICAL DATUM: NAVD88

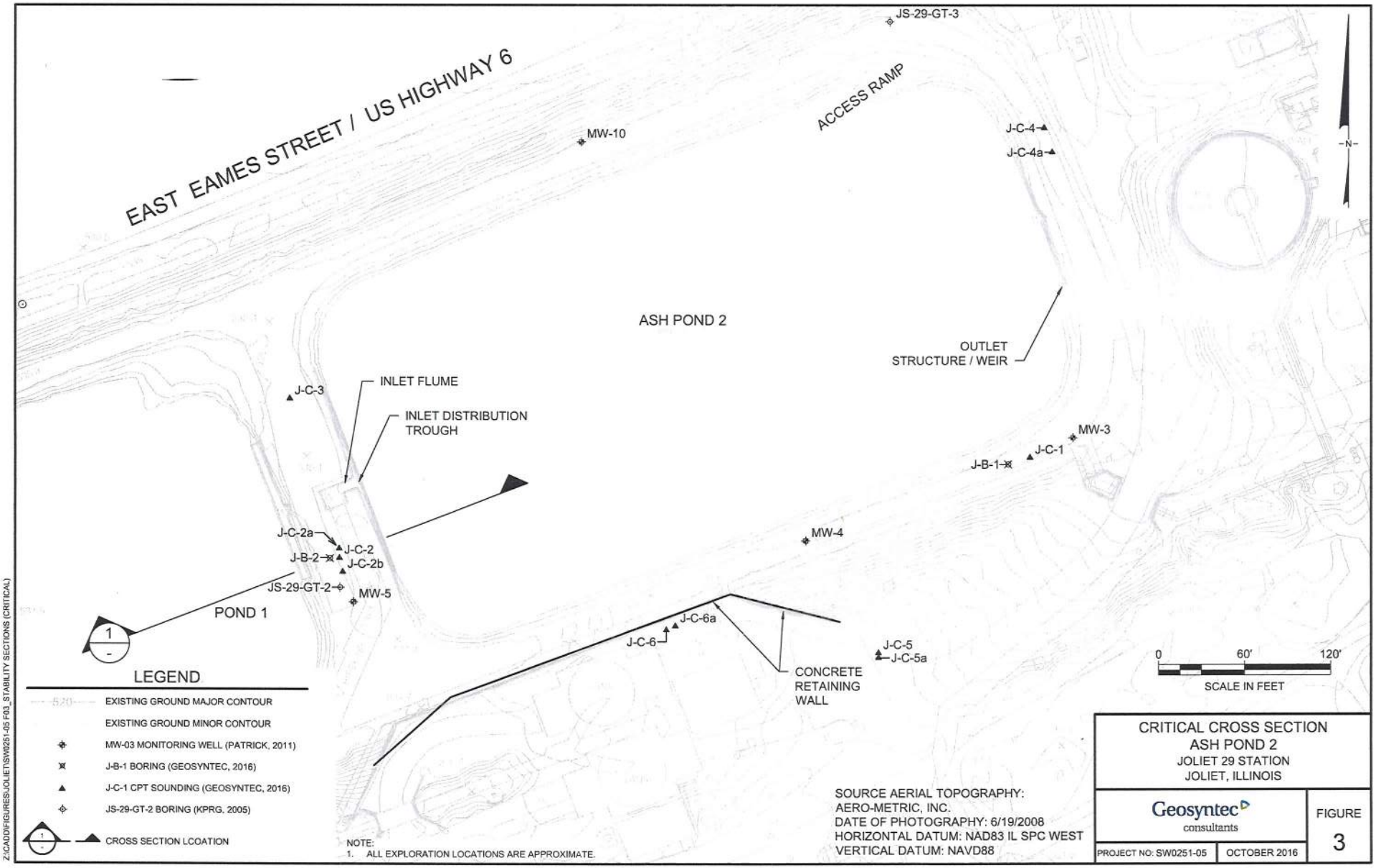
HYDRAULIC STRUCTURE LOCATIONS
ASH POND 2
JOLIET 29 STATION
JOLIET, ILLINOIS

Geosyntec consultants

PROJECT NO: SW0251-05 | OCTOBER 2016

FIGURE 2

Z:\CADD\FIGURES\JOLIET\SW0251-05 F02_HYDRAULIC STRUCTURES



CRITICAL CROSS SECTION
ASH POND 2
JOLIET 29 STATION
JOLIET, ILLINOIS

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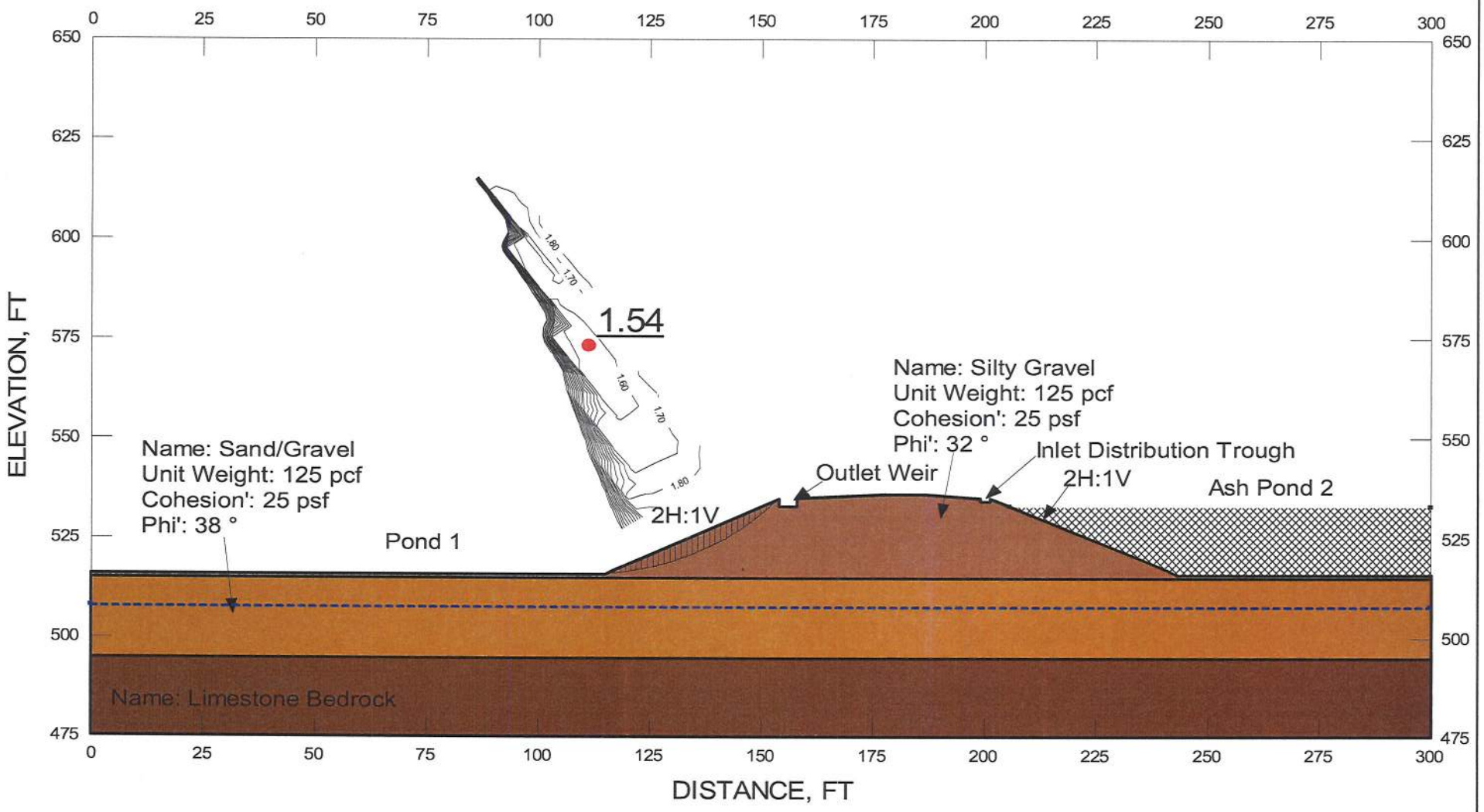
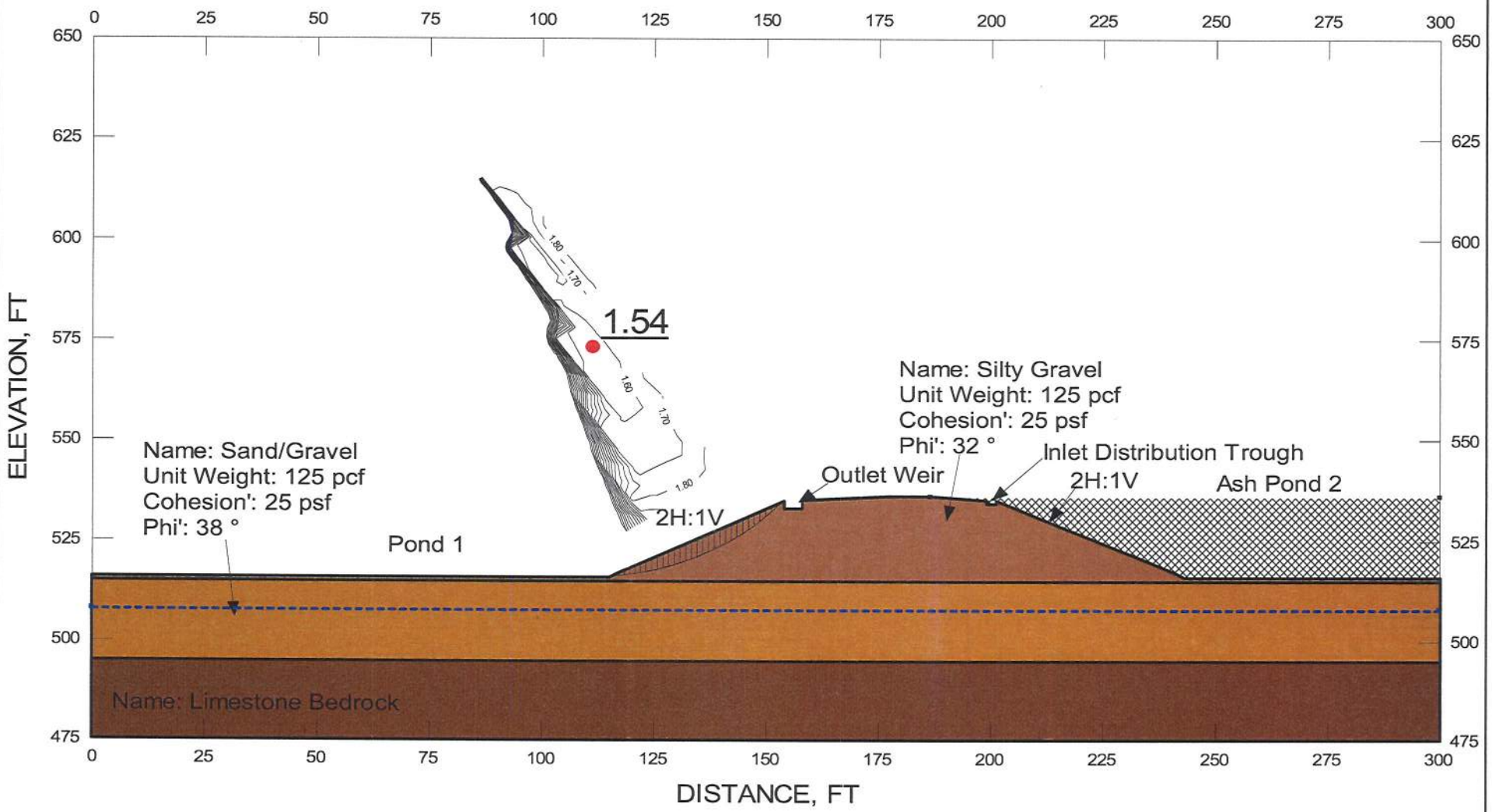
FIGURE 3

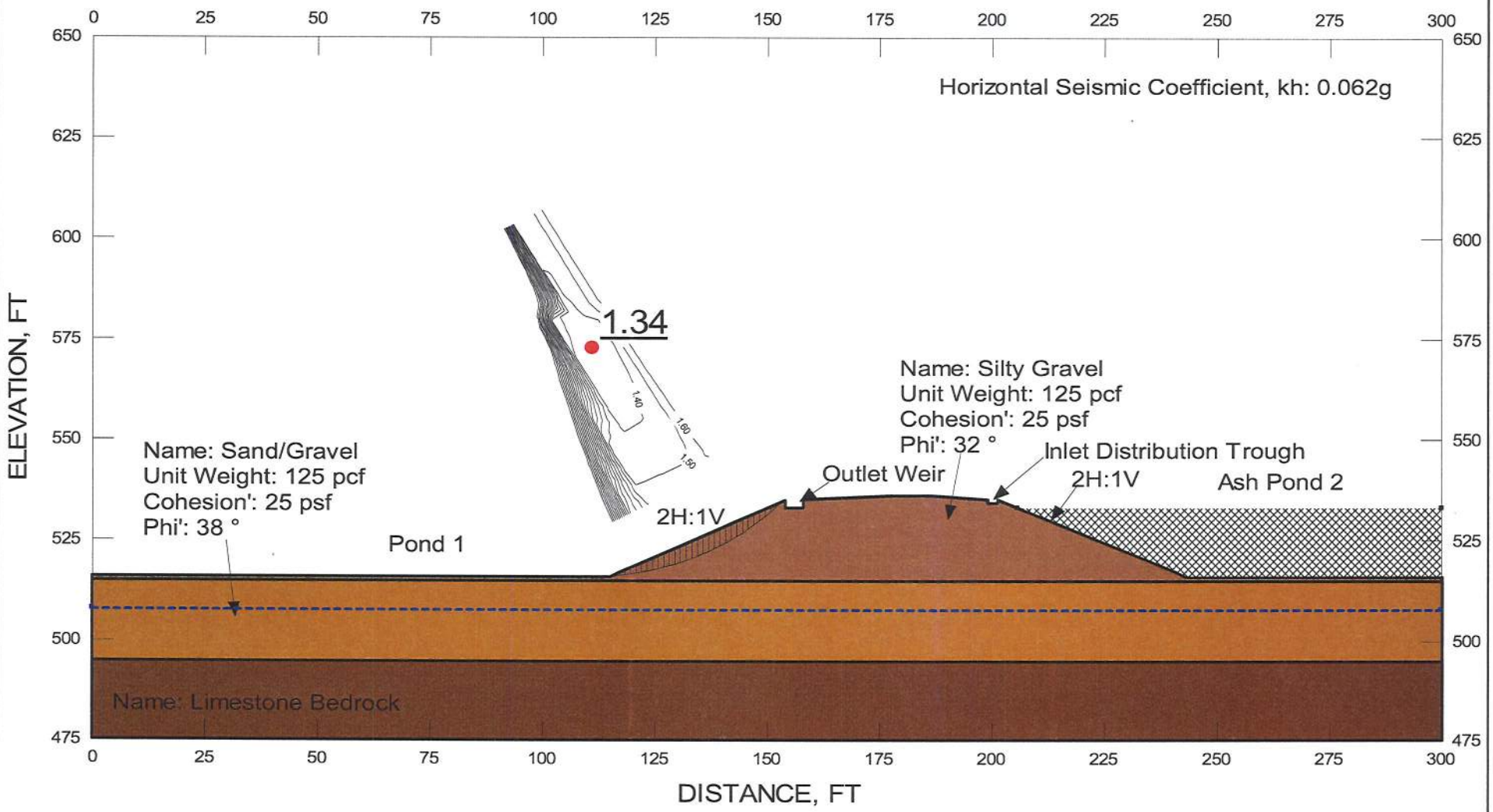
Z:\CADD\FIGURES\JOLIET\SW0251-05 F03_STABILITY SECTIONS (CRITICAL)



Geosyntec consultants	Analysis: Section 1 - §257.73(e)(1)(i): Long Term, Maximum Storage Pool Loading		FIGURE 4
	Project: Joliet Ash Pond 2	Analysis By: Cory Russell	
	File Name: Joliet Ash Pond 2.Section 1.gsz	Date: October 2016	



Geosyntec consultants	Analysis: Section 1 - §257.73(e)(1)(ii): Maximum Surcharge Pool Loading		FIGURE 5
	Project: Joliet Ash Pond 2	Analysis By: Cory Russell	
	File Name: Joliet Ash Pond 2.Section 1.gsz	Date: October 2016	



Geosyntec consultants	Analysis: Section 1 - §257.73(e)(1)(iii): Long Term, Maximum Storage Pool Loading with Seismic		FIGURE 6
	Project: Joliet Ash Pond 2	Analysis By: Cory Russell	
	File Name: Joliet Ash Pond 2.Section 1.gsz	Date: October 2016	