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October 11, 2021

Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Subject: USEPA CCR Rule and IEPA Part 845 Rule Applicability Cross-Reference
2021 USEPA CCR Rule Periodic Certification Report
GMF Gypsum Stack Pond, Coffeen Power Plant, Coffeen, Illinois

At the request of Illinois Power Generating Company (IPGC), Geosyntec Consultants (Geosyntec) has prepared this letter to document how the attached 2021 United States Environmental Protection Agency (USEPA) CCR Rule Periodic Certification Report (Report) was prepared in accordance with both the Federal USEPA CCR Rule[1] and the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 Rule[2]. Specific sections of the report and the applicable sections of the USEPA CCR Rule and Illinois Part 845 Rule are cross-referenced in **Table 1**. A certification from a Qualified Professional Engineer for each of the CCR Rule sections listed in **Table 1** is provided in Section 9 of the attached Report. This certification statement is also applicable to each section of the Part 845 Rule listed in **Table 1.**

Table 1 – USEPA CCR Rule and Illinois Part 845 Rule Cross-Reference

Report Section	USEPA CCR Rule		Illinois Part 845 Rule	
3	§257.73 (a)(2)	Hazard Potential Classification	845.440	Hazard Potential Classification Assessment[3]
4	§257.73 (c)(1)	History of Construction	845.220(a)	Design and Construction Plans (Construction History)
5	§257.73 (d)(1)	Structural Stability Assessment	845.450 (a) and (c)	Structural Stability Assessment
6	§257.73 (e)(1)	Safety Factor Assessment	845.460 (a-b)	Safety Factor Assessment
7	§257.82 (a)(1-3)	Adequacy of Inflow Design Control System Plan	845.510(a), (c)(1), (c)(3)	Hydrologic and Hydraulic Capacity Requirements / Inflow Design Flood Control System Plan
	§257.82 (b)	Discharge from CCR Unit	845.510(b)	Discharge from CCR Surface Impoundment

[1] United Stated Environmental Protection Agency, 2015. *40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule.*
[2] State of Illinois, Joint Committee on Administrative Rule, Administrative Code (2021). *Title 35: Environmental Protection, Subtitle G: Waste Disposal, Chapter I: Pollution Control Board, Subchapter j: Coal Combustion Waste Surface Impoundment, Part 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments.*
[3] "Significant" and "High" hazard, per the CCR Rule[1], are equivalent to Class II and Class I hazard potential, respectively, per Part 845[2].

CLOSING

This letter has been prepared to demonstrate that the content and Qualified Professional Engineer Certification of the 2021 Periodic USEPA CCR Rule Certification Report fulfills the corresponding requirements of Part 845 of Illinois Administrative Code listed in **Table 1**.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

2021 USEPA CCR RULE PERODIC CERTIFICATION REPORT §257.73(a)(2), (c), (d), (e) and §257.82 GMF GYPSUM STACK POND Coffeen Power Plant Coffeen, Illinois

Submitted to

Illinois Power Generating Company

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Submitted by

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EXECUTIVE SUMMARY

This Periodic United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule [1] certification report (Periodic Certification Report) for the Gypsum Management Facility (GMF) Gypsum Stack Pond (GMF GSP)[1] at the Coffeen Power Plant (CPP), also known as the Coffeen Power Station (COF), has been prepared in accordance with Rule 40, Code of Federal Regulations (CFR) §257. herein referred to as the "CCR Rule" [1]. The CCR Rule requires that initial certifications for existing CCR surface impoundment, completed in 2016 and subsequently posted on the Illinois Power Generating Company (IPGC) CCR Website ([2], [3], [4], [5], [6]) be updated on a five-year basis.

The initial certification reports developed in 2016 and 2017 were independently reviewed by Geosyntec ([2], [7], [3], [8], [4], [5], [6]). Additionally, field observations, interviews with plant staff, updated engineering analyses, and evaluations were performed to compare conditions in 2021 at the GMF GSP relative to the 2016 and 2017 initial certifications. These tasks determined that updates are not required for the Initial Hazard Potential Classification. However, due to changes at the site and technical review comments, updates were required and were performed for the:

- History of Construction Report,
- Structural Stability Assessment,
- Initial Safety Factor Assessment, and
- Initial Inflow Design Flood Control System Plan.

Geosyntec's evaluations of the initial certification reports and updated analyses identified that the GMF GSP meets all requirements for hazard potential classification, history of construction reporting, structural stability, safety factor assessment, and hydrologic and hydraulic control. **Table 1** provides a summary of the initial 2016 certifications and the updated 2021 periodic certifications.

[1] The GMF GSP is also referred to as ID Number W13501250004-03, GMF GSP by the Illinois Environmental Protection Agency (IEPA); CCR unit ID 103 by IPGC; and IL50579 within the National Inventory of Dams (NID) maintained by the Illinois Department of Natural Resources (IDNR). Within this document it is referred to as the GMF GSP.

Table 1 – Periodic Certification Summary

	CCR Rule Reference	Requirement Summary	2016 Initial Certification		2021 Periodic Certification	
			Requirement Met?	**Comments**	**Requirement Met?**	**Comments**
Hazard Potential Classification						
3	§257.73(a)(2)	Document hazard potential classification	Yes	Impoundment was determined to have a High hazard potential classification [2].	Yes	The Initial Hazard Potential Classification (HPC) is conservative due to the consideration of ultimate buildout conditions relative to existing conditions. An update to the Initial HPC is not required at this time but could be performed to potentially reduce the HPC to Significant.
History of Construction						
4	§257.73(c)(1)	Compile a history of construction	Yes	A History of Construction report was prepared for the GMF GSP, Ash Pond 1, Ash Pond 2, and the GMF Recycle Pond [3].	Yes	A letter listing updates to the History of Construction report is provided in **Attachment C**.
Structural Stability Assessment						
5	§257.73(d)(1)(i)	Stable foundations and abutments	Yes	Foundations were found to be stable. Abutments were not present [8].	Yes	Foundations and abutments were found to be stable after performing updated slope stability analyses.
	§257.73(d)(1)(ii)	Adequate slope protection	Yes	Slope protection was adequate [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(iii)	Sufficiency of dike compaction	Yes	Dike compaction was sufficient for expected ranges in loading conditions [8].	Yes	Dike compaction was found to be sufficient after performing updated slope stability analyses.
	§257.73(d)(1)(iv)	Presence and condition of slope vegetation	Yes	Vegetation was present on exterior slopes and was maintained. Interior slopes had alternate protection (geomembrane liner) [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(v)(A) and (B)	Adequacy of spillway design and management	Yes	Spillways were adequately designed and constructed to adequately manage flow during the probable maximum flood (PMF) [8].	Yes	Spillways were found to be adequately designed and constructed and are expected to adequately manager flow during the PMF, after performing updated hydrologic and hydraulic analyses.
	§257.73(d)(1)(vi)	Structural integrity of hydraulic structures	Not Applicable	Hydraulic structures penetrating the dikes or underlying the base of the GMF GSP were not present. This requirement was not applicable [8].	Not Applicable	No changes were identified that may affect this requirement.
	§257.73(d)(1)(vii)	Stability of downstream slopes inundated by water body.	Not Applicable	Inundation of exterior slopes were not expected. This requirement was not applicable [8].	Not Applicable	No changes were identified that may affect this requirement.
Safety Factor Assessment						
6	§257.73(e)(1)(i)	Maximum storage pool safety factor must be at least 1.50	Yes	Safety factors were calculated to be 3.45 and higher [8].	Yes	Safety factors from updated slope stability analyses were calculated to be 3.45 and higher.
	§257.73(e)(1)(ii)	Maximum surcharge pool safety factor must be at least 1.40	Yes	Safety factors were calculated to be 3.45 and higher [8].	Yes	Safety factors from updated slope stability analyses were calculated to be 3.45and higher.
	§257.73(e)(1)(iii)	Seismic safety factor must be at least 1.00	Yes	Safety factors were calculated to be 1.47 and higher [8].	Yes	Safety factors from updated slope stability analyses were calculated to be 1.45 and higher.
	§257.73(e)(1)(iv)	For dike construction of soils that have susceptible to liquefaction, safety factor must be at least 1.20	Not Applicable	Dike soils were not susceptible to liquefaction. This requirement was not applicable [8].	Not Applicable	No changes were identified that may affect this requirement.
Inflow Design Flood Control System Plan						
7	§257.82(a)(1), (2), (3)	Adequacy of inflow design control system plan.	Yes	Flood control system adequately managed inflow and peak discharge during the Probable Maximum Precipitation, 24-hr Inflow Design Flood [8].	Yes	The flood control system was found to adequately manage inflow and peak discharge during the Probable Maximum Precipitation, 24-hour Inflow Design Flood, after performing updated hydrologic and hydraulic analyses.
	§257.82(b)	Discharge from CCR Unit	Yes	Discharges into Waters of the United States were not expected to occur during normal and Probable Maximum Precipitation, 24-hr, Inflow Design Flood conditions [8].	Yes	Discharge into Waters of the United States were found to not be expected to occur during both normal and Probable Maximum Precipitation, 24-hour Inflow Design Flood conditions, after performing updated hydrologic and hydraulic analyses.

SECTION 1

INTRODUCTION AND BACKGROUND

This Periodic United States Environmental Protection Agency (USPA) Coal Combustion Residual (CCR) Rule [1] Certification Report was prepared by Geosyntec Consultants (Geosyntec) for Illinois Power Generating Company (IPGC) to document the re-certification of the GMF GSP at the Coffeen Power Plant (CPP), also known as the Coffeen Power Station (COF), located at 134 Cips Lane in Coffeen, Illinois, 62017. The location of CPP is provided in **Figure 1**, and a site plan showing the location of the GMF GSP, among other closed and active CCR units and non-CCR surface impoundments, is provided in **Figure 2**.

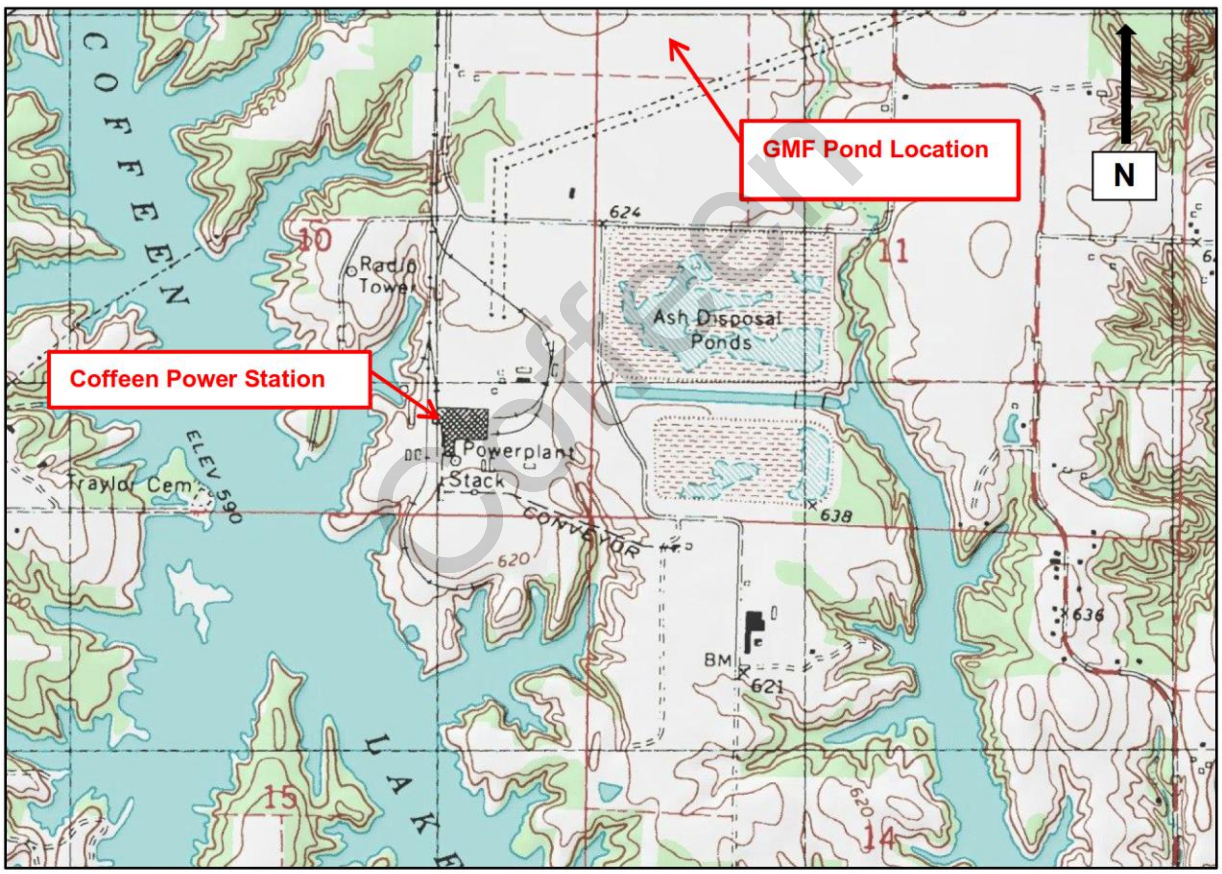


Figure 1 – Site Location Map (from AECOM, 2016)

Figure 2 – Site Plan (adapted from AECOM, 2016)

1.1 GMF GSP Description

CPP was retired in 2019. Prior to retirement, three active CCR surface impoundments – the GMF GSP, the GMF Recycle Pond, and AP1 – and one CCR landfill – were used for managing CCRs generated at CPP. This certification report only pertains to the GMF GSP. The GMF GSP has a High hazard potential, based on the initial hazard potential classification assessment performed by Stantec in 2016 in accordance with §257.73(a)(2) ([2], [7]).

The GMF GSP formerly served as the primary wet impoundment basin for gypsum produced by the wet scrubber system at CPP. The GMF GSP was constructed between 2008 and 2009 and received inflow from two pairs of high-density polyethylene (HDPE) gypsum slurry pipes. Clear water discharge from the GMF GSP flowed downstream into the GMF Recycle Pond via a lined channel (transfer channel) and a 14-in. diameter HDPE low-flow pipe buried beneath the transfer channel. The transfer channel effectively acts as the primary spillway for the GMF GSP, as the bottom elevation of the transfer channel is equal to the adjacent exterior toe elevation of the dike. The transfer channel is approximately 580 ft in length, trapezoidal in shape, lined with 60-mil HDPE, has three horizontal to one vertical (3H:1V) side slopes, and the bottom elevation[2] decreases from 624 ft at the upstream end to 622 ft at the downstream end.

The 14-in. diameter low-flow pipe has an invert elevation of 619.0 ft at the upstream end and 617.6 ft at the downstream end. A berm was constructed within the transfer channel in 2020 with a crest elevation of approximately elevation 627 ft [9] to retain additional water in the GMF GSP and reduce the pool level in the downstream GMF Recycle Pond. The GMF Recycle Pond formerly acted as a polishing pond, and outflow was pumped to the CPP to be recycled for use in the wet scrubber system [8].

The GMF GSP has a composite liner system that extends up to interior dike crests at elevation 630.5 ft and is present beneath the entire footprint of the pond. The liner system includes a 3-ft thick layer of compacted clay that is overlain by a 60-mil textured HDPE geomembrane. The geomembrane liner is exposed at the pond bottom and side slopes [8].

As formerly operated, the normal pool elevation of the GMF GSP was observed to be 621.2 ft in the 2015 Weaver Consultants survey of the site [10], as controlled by the 14-in. diameter low-level outlet pipe and recycle water inflow and outflow pumping rates [8]. The water elevation in the GMF GSP had increased to 625.2 ft by the time of the periodic survey in December of 2020 [9], due to the construction of the berm in the transfer channel and could rise as high as approximately El. 627 ft due to the berm that was constructed in the transfer channel.

The GMF GSP is approximately 36.2 acres in size and was formed with a continuous embankment, a ring dike, which has a total perimeter length of approximately 5,000 ft. The perimeter dike was constructed to include a crest width of between approximately 15 to 25 ft and a crest height of 5 ft at the north embankment and 9 ft at the east embankment. The interior of the GMF GSP extends deeper than the exterior natural grade, and the maximum interior slope height is approximately 25 ft in the southeast corner of the pond. The elevation of the embankment crest ranges from 631 to 632 ft. Both interior and exterior slopes have 3H:1V orientations [8].

Initial certifications for the GMF GSP for Hazard Potential Classification (§257.73(a)(2)), History of Construction (§257.73(c)), Structural Stability Assessment (§257.73(d)), Safety Factor Assessment (§257.73(e)(1)), and Inflow Design Flood Control System Plan (§257.82) were

[2] All elevations in the report are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

completed by Stantec and AECOM in 2016 and 2017 and subsequently posted to IPGC's CCR Website ([2], [3], [4], [5], [6]). Additional documentation for the initial certifications included detailed operating record reports containing calculations and other information prepared for the hazard potential classification by Stantec [7] and for the structural stability assessment, safety factor assessment, and inflow design flood control system plan by AECOM [8]. These operating record reports were not posted to IPGC's CCR Website.

1.2 Report Objectives

These following objectives are associated with this report:

- Compare site conditions from 2015/2016 to site conditions in 2020/2021, and evaluate if updates are required to the:
  - §257.73(a)(2) Hazard Potential Classification [2];
  - §257.73(c) History of Construction [3];
  - §257.73(d) Structural Stability Assessment [4];
  - §257.73(e) Safety Factor Assessment [5], and/or
  - §257.82 Inflow Design Flood Control System Plan [6].
- Independently review the Hazard Potential Classification ([2], [7]), Structural Stability Assessment ([4], [8]), Safety Factor Assessment ([5], [8]), and Inflow Design Flood Control System Plan ([6], [8]) to determine if updates may be required based on technical considerations.
  - The History of Construction report [3] was not independent reviewed for technical consideration, as this report contained historical information primarily developed prior to promulgation of the CCR Rule [1] for the CCR units at CPP, and did not include calculations or other information used to certify performance and/or integrity of the impoundments under §257.73(a)(2)-(3), §257.73(c)-(e), or §257.82.
- Confirm that the GMF GSP meets all of the requirements associated with §257.73(a)(2)-(3), (c), (d), (e), and §257.82, or, if the GMF GSP does not meet any of the requirements, provide recommendations for compliance with these sections of the CCR Rule [1].

SECTION 2

COMPARISION OF INITIAL AND PEROIODIC SITE CONDITIONS

2.1 Overview

This section describes the comparison of conditions at the GMF GSP between the start of the initial CCR certification program in 2015 and subsequent collection of periodic certification site data in 2020 and 2021.

2.2 Review of Annual Inspection Reports

Annual onsite inspections of the GMF GSP were performed from 2016 to 2020 ([11], [12], [13], [14], [15]) and were certified by a licensed professional engineer in accordance with §257.83(b). Each inspection report stated the following information, relative to the previous inspection:

- A statement that no changes in geometry of the impounding structure were observed since the previous inspection;
- A statement that no geotechnical instrumentation was present;
- Approximate volumes of impounded water and CCR at the time of inspection;
- A statement that no appearances of actual or potential structural weakness or other disruptive conditions were observed; and
- A statement that no other changes which may have affected the stability or operation of the impounding structure were observed.

In summary, the reports did not indicate any significant changes to the GMF GSP between 2015 and 2020. No signs of instability, structural weakness, or changes which may have affected the operation or stability of the GMF GSP were noted in the inspection reports.

2.3 Review of Instrumentation Data

Nineteen groundwater monitoring wells, (G102, G103, R104, G105, G106, G205, G206, G207, G208, G209, G210, G211, G212, G213, G214, G215, G216, G217, and G218), are present at the GMF GSP. Groundwater level readings were collected generally on a quarterly basis and provided between February 17, 2016 and January 27, 2021. Geosyntec reviewed the groundwater level data to evaluate if significant fluctuations, partially increases in phreatic levels, may have occurred after development of the initial structural stability and factor of safety certifications ([4], [5], [8]), which utilized phreatic conditions estimated from cone penetration testing (CPT) data. Available water level readings are plotted in **Attachment A** and **Figure 3** provides approximate locations of the monitoring wells.

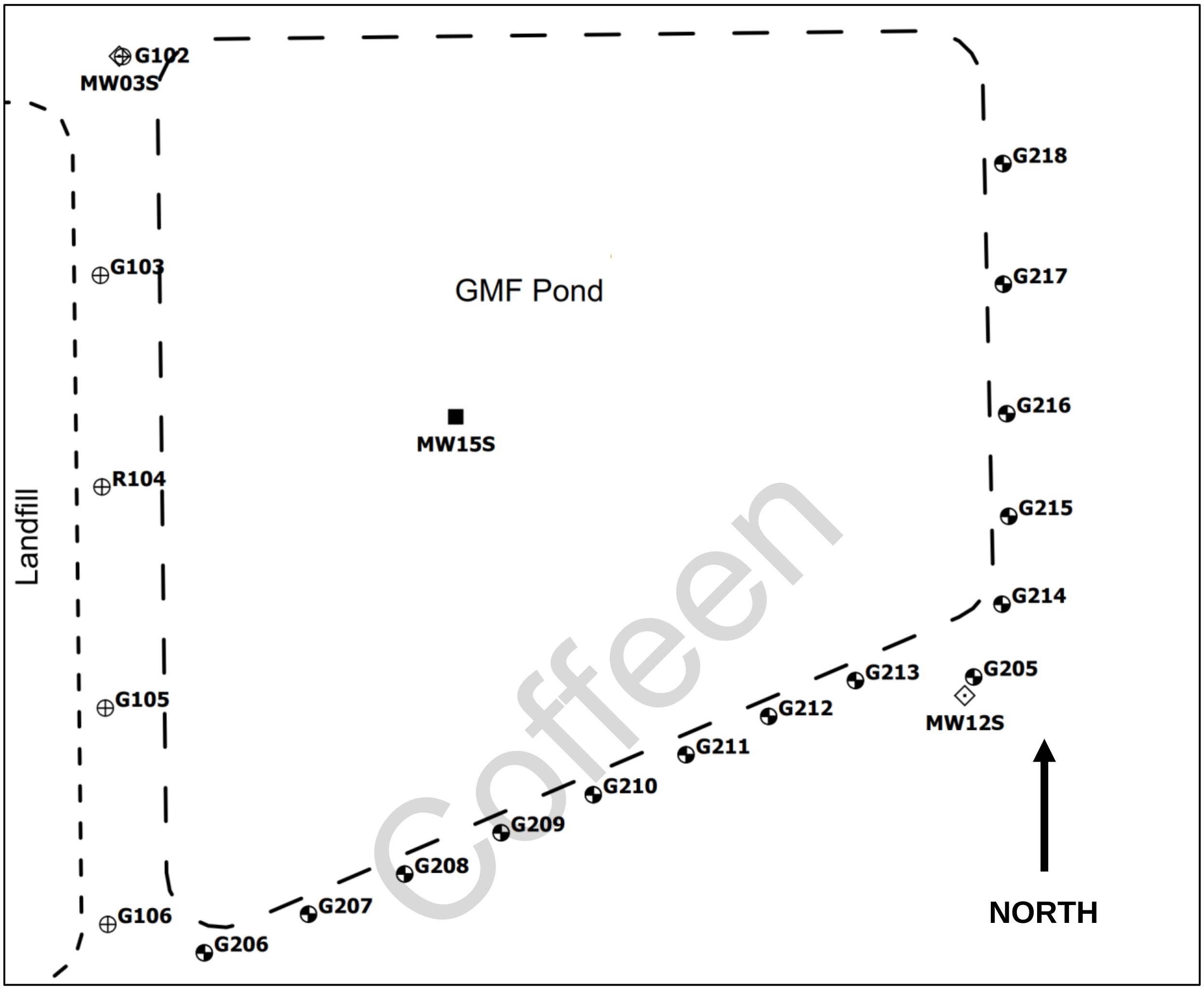


Figure 3 – GMF GSP Monitoring Well Locations
(Not to Scale, adapted from Hanson, 2021)

In summary, groundwater levels in the monitoring well network were observed to be relatively consistent between individual wells. Water levels were typically no more than 1 to 4 ft different between individual wells and seasonal fluctuations were on the order of 1 to 4 ft. Water levels ranged from a low of El. 617 ft to a high of El. 627 ft, resulting in a total fluctuation of 10 ft. These water levels are approximately 1 to 3 ft higher than water levels utilized in the slope stability analyses prepared to support the initial structural stability and safety factor assessments ([4], [5], [8]).

The water levels in the initial assessments were based on cone penetration testing (CPT) pore pressure dissipation (PPD) testing collected at a discrete point in time (August 2015) and are therefore less representative of long-term groundwater trends than the water level data collected from monitoring wells.

2.4 Comparison of Initial to Periodic Surveys

The initial survey of the GMF GSP, conducted at the site by Weaver Consultants (Weaver) in 2015 [10], was compared to the periodic survey of the GMF GSP, conducted by IngenAE, LLC (IngenAE) in 2020 [9], using AutoCAD Civil3D 2021 software. This comparison quantified changes in the volume of CCR placed within the GMF GSP and considered volumetric changes above and below the starting water surface elevation (SWSE) used for the 2016 §257.82 inflow design flood control plan hydraulic analysis [6]. Potential changes to embankment geometry were also evaluated. This comparison is presented in a side-by-side comparison of the surveys in **Drawing 1** and a plan view isopach map denoting changes in ground surface elevation in **Drawing 2**. A summary of the water elevations and changes in CCR volumes is provided in **Table 2**.

Table 2 – Initial to Periodic Survey Comparison

Initial Surveyed Pool Elevation (ft)	621.2
Periodic Surveyed Pool Elevation (ft)	625.2
Initial §257.82 Starting Water Surface Elevation (SWSE) (ft)	621.2
Total Change in CCR Volume (CY)	+74,294
Change in CCR Volume Above SWSE (CY)	+30,006
Change in CCR Volume Below SWSE (CY)	+44,288

The comparison indicated that approximately 74,000 CY of CCR was placed in the GMF GSP between 2015 and 2020, including approximately 30,000 CY above the SWSE, thereby leading to a potential for the peak water surface elevation (PWSE) to increase during the design 1,000-year flood event.

Furthermore, the surveyed pool elevation increased by approximately 4 ft, due to the construction of a berm in the transfer channel. A review of the 2020 survey data indicated the crest elevation of the new berm is approximately 628 ft; this is higher than the periodic surveyed pool level elevation of 625.2 ft. No other significant changes in embankment geometry or other features were noted in the comparison.

2.5 Comparison of Initial to Periodic Aerial Photography

Initial aerial photographs of the GMF GSP collected by Weaver 2015 [10] were compared to periodic aerial photographs collected by IngenAE in 2020 [10] to visually evaluate if potential site changes (i.e., changes to the embankment, outlet structures, limits of CCR, other appurtenances) may have occurred between. A comparison of these aerial photographs is provided in **Drawing 3**, and the following changes were identified:

- The berm in the transfer channel discussed in **Section 2.4** was identified in the channel.

- Minor changes in site conditions outside of the GMF GSP were identified, including the expansion of existing haul roads and the seeding of the GMF GSP exterior embankment near the transfer channel. However, these minor changes are not expected to significantly affect the design and/or operation of the GMF GSP.

2.6 Comparison of Initial to Periodic Site Visits

An initial site visit to the GMF GSP was conducted by AECOM in 2015 and documented with a Site Visit Summary and corresponding photographs [16]. A periodic site visit was conducted by Geosyntec on May 28, 2021, with Mr. Lucas P. Carr, P.E. conducting the site visit. The site visit was intended to evaluate potential changes at the site since 2015 (i.e., modification to the embankment, outlet structures or other appurtenances, limits of CCR, maintenance programs, and repairs), in addition to performing visual observations of the GMF GSP to evaluate if the structural stability requirements (§257.73(d)) were still met. The site visit included driving the perimeter of the GMF GSP, periodically stopping to exit the vehicle and visually observe conditions, recording filed notes, and collecting photographs. The site visit is documented in a photographic log provided in **Appendix B**. One significant finding was identified during the periodic site visit and is listed below:

- A berm was constructed in the transfer channel in 2020, as discussed in **Section 2.4**.

2.7 Interview with Power Plant Staff

An interview with Mr. John Romang of CPP was conducted by Mr. Lucas P. Carr, P.E. of Geosyntec on May 28, 2021. Mr. Romang had been, at the time of the interview, employed at CPP for approximately 20 years as the environmental and chemistry manager or supervisor and was responsible for general oversight and compliance for the GMF GSP, including weekly CCR inspections and identifying required repairs. The interview included a discussion of potential changes that may have occurred at the GMF GSP since the development of the initial certifications ([2], [7] [3], [8], [4], [5], [6]). A summary of the interview is provided below.

- Were any construction projects completed for the GMF GSP between 2015 and 2021, and, if so, are design drawings and/or details available?
    - A berm was constructed in the transfer channel between the GMF GSP and the GMF Recycle Pond in 2020 and excess water from the GMF Recycle Pond was pumped into the GMF GSP.

- Were there any changes to the purpose of the GMF GSP between 2015 and 2017?
    - No, outside of plant retirement.

- Were there any changes to the to the instrumentation program and/or physical instruments for the GMF GSP between 2015 and 2021?
    - No instruments are present at the GMF GSP.
- Were there any changes to spillways and/or diversion features for the GMF GSP completed between 2015 and 2021?
    - Yes, the berm was constructed within the GMF GSP transfer channel.
- Have any area-capacity curves been developed for the GMF GSP since 2015?
    - No known curves have been developed.
- Were there any changes to construction specifications, surveillance, maintenance, and repair procedures for the GMF GSP between 2015 and 2021?
    - No.
- Were there any instances of dike and/or structural instability for the GMF GSP between 2015 and 2021?
    - No known instances occurred.

SECTION 3

HAZARD POTENTIAL CLASSIFICATION - §257.73(A)(2)

3.1 Overview of Initial HPC

The Initial Hazard Potential Classification (Initial HPC) was prepared by Stantec Consulting Services, Inc. (Stantec) in 2016 ([2], [7]), following the requirements of §257.73(a)(2). The Initial HPC included the following information:

- Reviewing a breach analysis prepared by Hanson Professional Services (Hanson) in 2007 [17], as part of the permitting of obtaining a permit to construct the GMF GSP as a regulated dam though the Illinois Department of Natural Resources, Offices of Water Resources (IDNR-OWR).
    - The review indicated that 12 structures were located within an area where the inundation depth was estimated to be 5 ft, including:
        - Eight (8) occupied structures, including seven residential structures, for a breach at the northwest corner of the GMF GSP perimeter dike.
        - Two (2) residential structures for a breach at the east side of the GMF GSP perimeter dike.
        - The CPP plant building, which was frequently occupied, for a breach to at the south side of the GMF GSP perimeter dike.
    - The review also noted that the breach analyses considered the final buildout height of the GMF GSP as a gypsum stack extending approximately 100 ft above the surrounding grades, rather than the current configurations, where the level of CCR and water inf the GMF GSP is approximately equal to surrounding grades.
- While a breach map is not included within the Initial HPC, it included within the §257.73(a)(3) Initial Emergency Action Plan (Initial EmAP) [18].

The breach analysis concluded that a breach of the GMF GSP, at its maximum height, would result in a probable threat to human life at multiple residential and other occupied structures. The Initial HPC therefore recommended a "High" hazard potential classification for the GMF GSP [7].

3.2 Review of Initial HPC

Geosyntec performed a review of the Initial HPC ([2], [7]), in terms of technical approach, input parameters, and assessment of results. The review included the following tasks:

- Reviewing the breach assessment inputs for appropriateness;
- Reviewing the selected HPC for appropriateness based on the results of the breach analysis, including flow velocities and depths;
- Reviewing the HPC vs. applicable requirements of the CCR Rule.

The review noted that the Initial HPC considered ultimate buildout conditions for the GMF GSP, where it extends approximately 100 ft above grade using the upstream method of construction and dikes comprised of CCR, relative to existing conditions where the GMF GSP is essentially at-grade, as discussed in **Section 3.1**. The GMF GSP is unlikely to reach ultimate buildout conditions due to closure of CPP and the cessation of CCR generation. Therefore, the Initial HPC includes a conservative volume of breach material relative to the amount of material than is currently in the pond.

No other significant technical issues were noted in the technical review, although a detailed review (e.g., check) of the calculations was not performed.

3.3 Summary of Site Changes Affecting the Initial HPC

The GMF GSP is currently considered a High hazard potential CCR surface impoundment [2]; this is the highest hazard classification within §257.53 of the CCR Rule [1]. Therefore, the hazard potential classification would not increase if new structures were to be constructed within the existing mapped breach areas, and a visual assessment of these areas was not performed.

3.4 Periodic Hazard Potential Classification

The current hazard potential classification for the GMF GSP, which is "High" per §257.73(a)(2), is considered conservative as the GMF GSP has not reached and is not expected to reach ultimate buildout conditions. The "High" hazard potential classification is conservative and could maintained or could potentially be revised to "Significant" if a revised breach analysis is performed. However, Geosyntec recommends retaining the current "High" hazard potential classification, unless a revised breach analysis is performed to justify a "Significant" hazard potential classification.

SECTION 4

HISTORY OF CONSTRUCTION REPORT - §257.73(C)

4.1 Overview of Initial HoC

The Initial History of Construction report (Initial HoC) was prepared by AECOM in 2016 [3], following the requirements of §257.73(c), and included information on all CCR surface impoundments at CPP, including AP1, AP2, the GMF GSP, and the GMF Recycle Pond. The Initial HoC included the following information for each CCR surface impoundment:

- The name and address of the owner/operator,
- Location maps,
- Statements of purpose,
- The names and size of the surrounding watershed,
- A description of the foundation and abutment materials,
- A description of the dike materials,
- Approximate dates and stages of construction,
- Available design and engineering drawings,
- A summary of instrumentation,
- Area-capacity curves for the GMF GSP,
- Information on spillway structures,
- Construction specifications,
- Inspection and surveillance plans,
- Information on operational and maintenance procedures, and
- A statement that no known instability has occurred at the GMF GSP.

4.2 Summary of Site Changes Affecting the Initial HoC

Several significant changes at the site were identified since development of the Initial HOC and required updates to the HoC report. Each change is described below:

- A state identification number (ID) of W1350150004-03 was assigned to the GMF GSP by the Illinois Environmental Protection Agency (IEPA).

- Electricity generation at CPP ceased in 2019 and the GMF GSP is no longer being used to actively store CCR generated by CPP as CCR is no longer being generated. Additionally, the GMF GSP no longer received regular process water inflows our outflows.

- A berm was constructed within the transfer channel between the GMF GSP and GMF Recycle Pond in 2020, as discussed in **Section 2.4**.

- Revised area-capacity curves and spillway design calculations for the GMF GSP were prepared as part of the updated Periodic Inflow Design Flood Control System Plan, as described in **Section 6.3**.

A letter documenting changes to the HoC report is provided in **Attachment C**.

SECTION 5

STRUCTURAL STABILITY ASSESSMENT - §257.73(D)

5.1 Overview of Initial SSA

The Initial Structural Stability Assessment (Initial SSA) was prepared by AECOM in 2016 [4], following the requirements of §257.73(d)(1), and included the following evaluations:

- Stability of dike foundations, dike abutments, slope protection, dike compaction, and slope vegetation;
- Spillway stability including capacity, structural stability and integrity;
- An evaluation of the effects of liquefaction in the foundation soils using a slope stability analysis considering post-cyclic softening in the foundation soils; and
- An evaluation to determine if downstream water bodies that could induce a sudden drawdown condition to the exterior slopes were present.

The Initial SSA concluded that the GMF GSP met all structural stability requirements for §257.73(d)(1)(i)-(vii).

The Initial SSA referenced the results of the Initial Structural Factor Assessment (Initial SFA) ([5], [8]), to demonstrate stability of the stability of foundations and abutments (§257.73(d)(1)(i)) and sufficiency of dike compaction (§257.73(d)(1)(iii)) portions of the SSA criteria. This included stating that slope stability analyses for slip surfaces passing through the foundation met or exceeded the criteria listed in §257.73(e)(1), for the stability of foundations and abutments. For the sufficiency of dike compaction, this included stating that slope stability analyses for slip surfaces passing through the dike also met or exceeded the §257.73(e)(1) criteria.

5.2 Review of Initial SSA

Geosyntec performed a review of the Initial SSA ([4], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing photographs collected in 2015 and used to demonstrate compliance with §257.73(d)(1)(i)-(vii).
- Reviewing geotechnical calculations used to demonstrate the stability of foundations, per §257.73(d)(1)(i) and sufficiency of dike compaction, per §257.73(d)(1)(iii), in terms of

supporting geotechnical investigation and testing data, input parameters, analysis methodology, selection of critical cross-sections, and loading conditions.

- Review of the methodology used to demonstrate that a downstream water body that could induce a sudden drawdown condition, per §257.73(d)(1)(vii), is not present.

No significant technical issues were noted within the technical review, although a detailed review (e.g., check) of the calculations was not performed.

5.3 Summary of Site Changes Affecting Initial SSA

Several changes at the site occurred after development of the Initial SSA were identified. These changes required updates to the Initial SSA. The changes and the recommend updates to the Initial SSA and are described below.

- The Initial SSA utilized the results of the Initial Inflow Design Flood Control System Plan (IDF) to demonstrate compliance with the adequacy of spillway design and management (§257.73(d)(1)(v)(A)-(B)). The Initial IDF was subsequently updated to develop a Periodic IDF, based on site changes, as discussed in **Section 7**.
- The Initial SSA utilized the slope stability analysis results of the Initial Safety Factor Assessment (SFA) as part of the compliance demonstration for the stability of foundations and abutments (§257.73(d)(1)(i)) and sufficiency of dike compaction (§257.73(d)(1)(iii)) as discussed in **Section 5.1**. The Initial SFA slope stability analyses, including the sudden drawdown analyses, were subsequently updated to develop a Periodic SFA, based on site changes, as discussed in **Section 6**.

5.4 Periodic SSA

The Periodic SFA (**Section 6**) indicated that foundations and abutments are stable and dike compaction is sufficient for expected ranges in loading conditions, as slope stability factors of safety were found to meet or exceed the requirements of §257.73(e)(1), including for post-earthquake (i.e., liquefaction) loading conditions considering seismically induced strength loss in the foundation soils. Therefore, the requirements of §257.73(d)(1)(i) and §257.73(d)(1)(iii) are still met for the Periodic SSA.

The updated Periodic IDF (**Section 7**) indicated that spillways are adequately designed and constructed to adequately manage flow during the PMF flood, as the spillway can adequately manage flow during peak discharge from the PMP storm event without overtopping of the embankments. Therefore, the requirements of §257.73(d)(1)(v)(A)-(B) are met for the Periodic SSA.

SECTION 6

SAFETY FACTOR ASSESSMENT - §257.73(E)(1)

6.1 Overview of Initial SFA

The Initial Safety Factor Assessment (Initial SFA) was prepared by AECOM in 2016 ([5], [8]), following the requirements of §257.73(e)(1). The Initial SFA included the following information:

- A geotechnical investigation program with in-situ testing;
- An assessment of the potential for liquefaction in the dike and foundation soils;
- The development of four (4) slope stability cross-sections for limit equilibrium stability analysis utilizing GeoStudio SLOPE/W software; and
- The analysis of each cross-sections for maximum storage pool, maximum surcharge pool, and seismic loading conditions.
    - Liquefaction (i.e., post-earthquake) loading conditions were analyzed due to the presence of a soft layer in the foundation material that may be susceptible to cyclic softening and/or liquefaction. However, this assessment was utilized to support the Initial SSA rather than the Initial SFA, as liquefaction-susceptible soil layers were not identified in the embankment soils.

The Initial SFA concluded that the GMF GSP met all safety factor requirements, per §257.73(e), as all calculated safety factors were equal to or higher than the minimum required values.

6.2 Review of Initial SFA

Geosyntec performed a review of the Initial SFA ([5], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing geotechnical calculations used to demonstrate the acceptable safety factors, per §257.73(e)(1), in terms of:
    - Completeness and adequacy of supporting geotechnical investigation and testing data;
    - Completeness and approach of liquefaction triggering assessments; and
    - Input parameters, analysis methodology, selection of critical cross-sections, and loading conditions utilized for slope stability analyses.

No significant technical issues were noted within the technical review, although a detailed review (e.g., check) of the calculations was not performed.

6.3 Summary of Site Changes Affecting the Initial SFA

Several changes at the site, occurred after development of the Initial SFA ([5], [8]), were identified. These changes required updates to the Initial SFA and are described below:

- The normal pool levels within the GMF GSP increased from 621.2 ft to 625.2 ft, due to the construction of a berm in the transfer channel (**Section 7**), resulting in 4.0 ft of additional water loading on the embankment dikes for the maximum storage pool and seismic loading conditions (§257.73(e)(1)(i) and (iii)), relative to the Initial SFA.

- Peak pool levels in the GMF GSP during the PMP design flood event increased from 623.8 ft to 626.7 ft, per the updated Periodic IDF (**Section 7**), resulting in 2.9 ft of additional water loading on the embankment dikes for the maximum surcharge pool loading conditions (§257.73(e)(1)(iv)), relative to the initial SFA.

- Groundwater levels in foundation soils around the GMF GSP, as measured from the monitoring well network over a multi-year period, were observed to be approximately 1 to 3 ft higher than groundwater levels utilized in the slope stability analyses supporting the Initial SFA (see **Section 2.3**). Therefore, the groundwater levels in the slope stability analysis do not represent long-term trends at the GMF GSP.

6.4 Periodic SFA

Geosyntec revised existing slope stability analyses associated with the Initial SFA ([5], [8]), for the four cross-sections (13+50, 22+50, 46+50, and 58+00) previously evaluated to account for site changes, as described in **Section 6.3**. The following approach and input data were used to revise the analyses:

- Water levels in the GMF GSP for the maximum storage pool, and seismic slope stability analysis loading conditions were increased to El. 625.2 ft in all the cross-sections, based on the Periodic IDF (**Section 7.4)**.

- Water levels in the GMF GSP for the maximum surcharge pool slope stability analysis loading conditions were increased to El. 626.7 ft in al the cross-sections based on the Periodic IDF (**Section 7.4)**.

- According to updated groundwater level monitoring plot (**Section 2.3**), the phreatic level in the location of related piezometers increased for all the loading conditions from El. 621.8 to El. 623.3 ft in cross-section 22+50, from El. 623.3 to El. 624.0 ft in cross-section 46+50, and from El. 620.0 to El. 623.0 ft in cross-section 58+00.

- All other analysis input data and settings from the Initial SFA ([5], [8]), were utilized, including, but not limited to, subsurface stratigraphy and soil strengths, phreatic conditions, ground surface geometry, software package and version, slip surface search routines and methods, and input data for the seismic analyses.

Factors of safety from the Periodic SFA are summarized in **Table 3** and confirm that the GMF GSP meets the requirements of §257.73(e)(1). Slope stability analysis output associated with the Initial SFA is provided in **Attachment D**.

Table 3 – Factors of Safety from Periodic SFA

	Structural Stability Assessment (§257.73(d)) and Safety Factor Assessment (§257.73(e))				Structural Stability Assessment (§257.73(d))
Cross-Section	**Maximum Storage Pool §257.73(e)(1)(i) Minimum Required = 1.50**	**Maximum Surcharge Pool[1] §257.73(e)(1)(ii) Minimum Required = 1.40**	**Seismic §257.73(e)(1)(iii) Minimum Required = 1.00**	**Dike Liquefaction §257.73(e)(1)(iv) Minimum Required = 1.20**	**Foundation Liquefaction §257.73(d)(1)(i) Minimum Required = 1.20**
13+50	3.45*	3.45*	1.6	N/A	2.46
22+50	3.48	3.48	1.45*	N/A	2.39*
46+50	4.17	4.17	1.74	N/A	3.01
58+00	3.57	3.57	1.63	N/A	2.57

Notes:
*Indicates critical cross-section (i.e., lowest calculated factor of safety out of the ten cross-sections analyzed)
N/A – Loading condition is not applicable.

SECTION 7

INFLOW DESIGN FLOOD CONROL SYSTEM PLAN - §257.82

7.1 Overview of 2016 Inflow Design Flood Control System Plan

The Initial Inflow Design Flood Control System Plan (Initial IDF) was prepared by AECOM in 2016 ([6], [8]), following the requirements of §257.82. The Initial IDF included the following information:

- A hydraulic and hydrologic analysis, performed for the Probable Maximum Flood design flood event because of the hazard potential classification of "High", which corresponded to 34.25 inches of precipitation over a 24-hour period.

- The Initial IDF utilized a HydroCAD Version 10 [19] model to evaluate spillway flows and pool level increases during the design flood, with a SWSE of 621.2 ft.

The Initial IDF concluded that the GMF GSP met the requirements of §257.82, as the peak water surface estimated by the HydroCAD model was El. 623.8 ft, relative to the minimum GMF GSP dike crest elevation of 631.0 ft. Therefore, overtopping was not expected. The Initial IDF also evaluated the potential for discharge from the CCR unit and determined that discharge from the unit was not expected, as the GMF GSP does not discharge into waters of the United States and overtopping of the GMF GSP embankments was not expected during the PMF inflow design flood.

7.2 Review of Initial IDF

Geosyntec performed a review of the Initial IDF ([6], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing the return interval used vs. the hazard potential classification.

- Reviewing the rainfall depth and distribution for appropriateness.

- Performing a high-level review of the inputs to the hydrological modeling.

- Reviewing the hydrologic model parameters for spillway parameters, starting pool elevation, and storage vs. the reference data.

- Reviewing the overall IDF vs. the applicable requirements of the CCR Rule [1].

One comment was identified during review of the Initial IDF. The comment is described below:

- The Initial IDF considered the GMF GSP, but the HydroCAD analysis supporting the Initial IDF did not explicitly consider the downstream GMF Recycle Pond (GMF RP) within the model.

7.3 Summary of Site Changes Affecting the Initial IDF

Two changes at the site that occurred after development of the Initial IDF were identified. These changes required updates to the Initial IDF and are described below:

- A berm was constructed in the transfer channel between the GMF GSP and the GMF RP, with a crest elevation of approximately 626 ft, thereby increasing the SWSE in the GMF GSP relative to the Initial IDF.

- Approximately 30,000 CY was placed above the SWSE in the GMF GSP, thereby altering the stage-storage curve relative to the Initial IDF.

7.4 Periodic IDF

Geosyntec revised the Initial IDF to account for the increase in SWSE and additional CCR placement, as described in **Section 7.2** and **7.3**. The following approach and input data were used for the revised analyses: The model was expanded to include the Gypsum Management Facility Recycle Pond (GMF RP) pond and its drainage area.

- The drainage area to the GMF RP was modeled as a subcatchment and assigned an area of 18.3 ac per the 2020 site survey [9]. It was assigned a Curve number (CN) of 98 and a time of concentration of 6 min (direct inflow).

Table 4 – GMF RP Culvert Attributes in Periodic IDF

Parameter	Value
Orifice/Grate	
Invert Elevation (ft)	624.0
Discharge Coefficient	0.6
Orifice Width (in)	60
Orifice Length (in)	60
Culvert	
Inlet Elevation (ft)	615.0
Crest Breadth (ft)	1.0
Outlet Elevation (ft)	613.0
Length (ft)	92.0
Diameter (in)	45
Manning’s n	0.013
Entrance Loss Coefficient	0.5
Contraction Coefficient	0.9

- The GMFR Pond was modeled as a pond with three identical emergency spillway outlets.
  - The outlets were modeled as horizontal orifices routed to culverts, with attributed listed in **Table 4**.
- The routing method for the model was updated to account for routing between the ponds. The Reach Routing Method was updated from "Storage Indication+ Translation" to "Dynamic Storage Indication". The Pond Routing Method was updated from "Storage – Indication" to "Dynamic Storage Indication".
- The stage-storage curve was updated for both the GMF GSP and GMF RP Ponds based on the 2020 site survey [9].
  - Revised stage-volume curves for the GMF RP and GMF GSP were prepared based on measuring the storage volume of the GMF RP and GMF GSP at every one-foot increment of depth from an elevation at the bottom of the ponds (621.1 ft for GMF GSP; 604.9 ft for GMF RP) to the approximate minimum perimeter dike embankment crest elevation (632 ft for GMF GSP; 629 ft for GMF RP). This analysis identified an overall decrease of 9.67 ac-ft of storage volume at the GMF GSP from the storage used in the 2016 Initial IDF Certification.
- The subcatchment area draining to the GMF GSP was updated from 33.8 ac to 36.2 ac to reflect the 2020 site survey [9].
- The time of concentration (ToC) for drainage areas to the GMF GSP was updated from 5 minutes to 6 minutes to reflect direct run-on inflow in accordance with TR-20 [20].
- The SWSE within the GMF GSP was updated from 621.2 ft to 625.2 ft to reflect the water surface elevation from 2020 site survey [9].
- The SWSE in the GMF RP was assumed to be El. 622.1 ft, based on the Updated IDF for the GMF RP [21].
- The GMF GSP and transfer channel geometry were updated to reflect the new berm at the inlet to the transfer channel.
  - The outlet invert from the GMF Pond to the transfer channel between the GMF Pond and the GMFR Pond was raised from 625 ft to 626 ft per the 2020 site survey [9]. The geometry of the outlet was updated based on the 2020 site survey, as listed in **Table 5**.

Table 5 – GMF GSP Outlet Geometry in Periodic IDF

Head (ft)	Channel Width (ft)
0	45
2	60
4	75

- The transfer channel geometry was updated based on the 2020 site survey, as listed in **Table 6**.

Table 6 – GMF GSP Transfer Channel Geometry in Periodic IDF

Parameter	Value
Bottom Width (ft)	32.7
Channel Depth (ft)	6
Left Side Slope	3
Right Side Slope	1.6
Channel Length (ft)	450

- The three outlet structures in the GMF RP were updated from 24 ft broad-crested weirs to horizontal, rectangular orifices with dimensions of 5 ft by 5 ft to reflect the riser structures existing on site. The inlet elevation of the orifices was set to 624 ft per the initial certification reports for the GMF RP ([22], [23]).

The results of the Periodic IDF are summarized in **Table 7** and confirm that the GMF GSP meets the requirements of §257.82(a)-(b), as the peak water surface elevation does not exceed the minimum perimeter dike crest elevations, as long as the SWSE in the GMF GSP is maintained at El. 625.2 ft or lower. Additionally, all discharge from the GMF GSP is routed through the existing spillway system to the GMF RP during both normal and IDF conditions. Updated area-capacity curves and HydroCAD model output are provided in **Attachment E**.

Table 7 – Water Levels from Updated Periodic IDF

Analysis	Starting Water Surface Elevation (ft)	Peak Water Surface Elevation (ft)	Minimum Dike Crest Elevation (ft)
Initial IDF	621.2	623.8	631.0
Periodic IDF Update	625.2	626.7	632.0
Initial to Periodic Change[1]	+4.0	+2.9	

Notes:
[1]Postive change indicates increase in the WSE relative to the Initial IDF, negative change indicates decrease in the WSE, relative to the Initial IDF.

SECTION 8

CONCLUSIONS

The GMF GSP at CPP was evaluated relative to the USPEPA CCR Rule periodic assessment requirements for:

- Hazard potential classification (§257.73(a)(2)),
- History of Construction reporting (§257.73(d)),
- Structural stability assessment (§257.73(d)),
- Safety factor assessment (§257.73(e)), and
- Inflow design flood control system planning (§257.82).

Based on the evaluations presented herein, the referenced requirements are satisfied.

SECTION 9

CERTIFICATION STATEMENT

CCR Unit: Illinois Power Generating Company, Coffeen Power Plant, GMF Gypsum Stack Pond

I, Lucas P. Carr, being a Registered Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this 2021 USEPA CCR Rule Periodic Certification Report, has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the periodic assessment of the hazard potential classification, history of construction report, structural stability, safety factors, and inflow design flood control system planning, dated October 2021, were conducted in accordance with the requirements of 40 CFR §257.73(a)(2), (c), (d), (e), and §257.82.

Lucas P. Carr

10/11/2021

Date

LICENSED PROFESSIONAL ENGINEER
LUCAS PHILIP CARR
062066694
STATE OF ILLINOIS
Exp. 11/30/2021

SECTION 10

REFERENCES

[1] United States Environmental Protection Agency, 40 CFR Parts 257 and 261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, 2015.

[2] Stantec Consulting Services, Inc., "Initial Hazard Potential Classification Assessment, EPA Final CCR Rule, GMF Pond, Coffeen Power Station, Montgomery County, Illinois," Fenton, MO, October 12, 2016.

[3] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR §257.73(c), Coffeen Power Station, Coffeen, Illinois," October 2016.

[4] AECOM, "CCR Rule Report: Initial Structural Stability Assessment for GMF Pond At Coffeeen Power Station," St. Louis, MO, October 2015.

[5] AECOM, "CCR Rule Report: Initial Safety Factor Assessment for GMF Pond at Coffeen Power Station," St. Louis, MO, October 2016.

[6] AECOM, "CCR Rule Report: Initial Inflow Design Flood Control System Plan for GMF Pond at Coffeen Power Station," St. Louis, MO, October 2016.

[7] Stantec Consulting Services, Inc., "Documentation of Initial Hazard Potential Classification Assessment, GMF Pond, Coffeen Power Station, Montgomery County, Illinois," October 12, 2016.

[8] AECOM, "CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan for GMF Pond at Coffeen Power Station," St. Louis, MO, October 2016.

[9] IngenAE, "Luminant, Illinois Power Generating Company, Coffeen Power Station, December 2020 Topography," February 26, 2021.

[10] Weaver Consultants Group, "Dynegy, Collinsville, IL, 2015 - Coffeen Topography," December 1, 2015.

[11] J. Knutelski and J. Campbell, *Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Coffeen Power Station, Gypsum Stack Pond*, January 18, 2017.

[12] J. Knutelski and J. Campbell, *Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Coffeen Power Station, Gypsum Stack Pond*, February 7, 2018.

[13] J. Knutelski, *Annual Inspection by a Qualified Professional Engineer*, *Coffeen Power Station*, *Gypsum Stack Pond*, November 30, 2019.

[14] J. Knutelski, *Annual Inspection by a Qualified Professional Engineer*, *40 CFR §257.83(b), Coffeen Power Station, Gypsum Stack Pond*, January 8, 2020.

[15] J. Knutelski, *Annual Inspection by a Qualified Professional Engineer*, *40 CFR §257.83(b), Coffeen Power Station, Gypsum Stack Pond*, January 6, 2021.

[16] AECOM, "Initial Site Visit CCR Unit Summary, Dynegy CCR Compliance Program, Coffeen Power Station - GMF Gypsum Stack Pond," September 28, 2015.

[17] Hanson Professional Services, Inc., "Breach Analysis for Coffeen Gypsum Stack Dam," 2007.

[18] Stantec Consulting Services, Inc., "Illinois Power Generating Company, Coffeen Power Station, Montgomery County, Illinois, Emergency Action Plan (EAP)," Fenton, MO, April 13, 2017.

[19] HydroCADTM Software Solutions, LLC, "HydroCADTM Stormwater Modeling System, Version 10," Chocorua, New Hampshire, 2016.

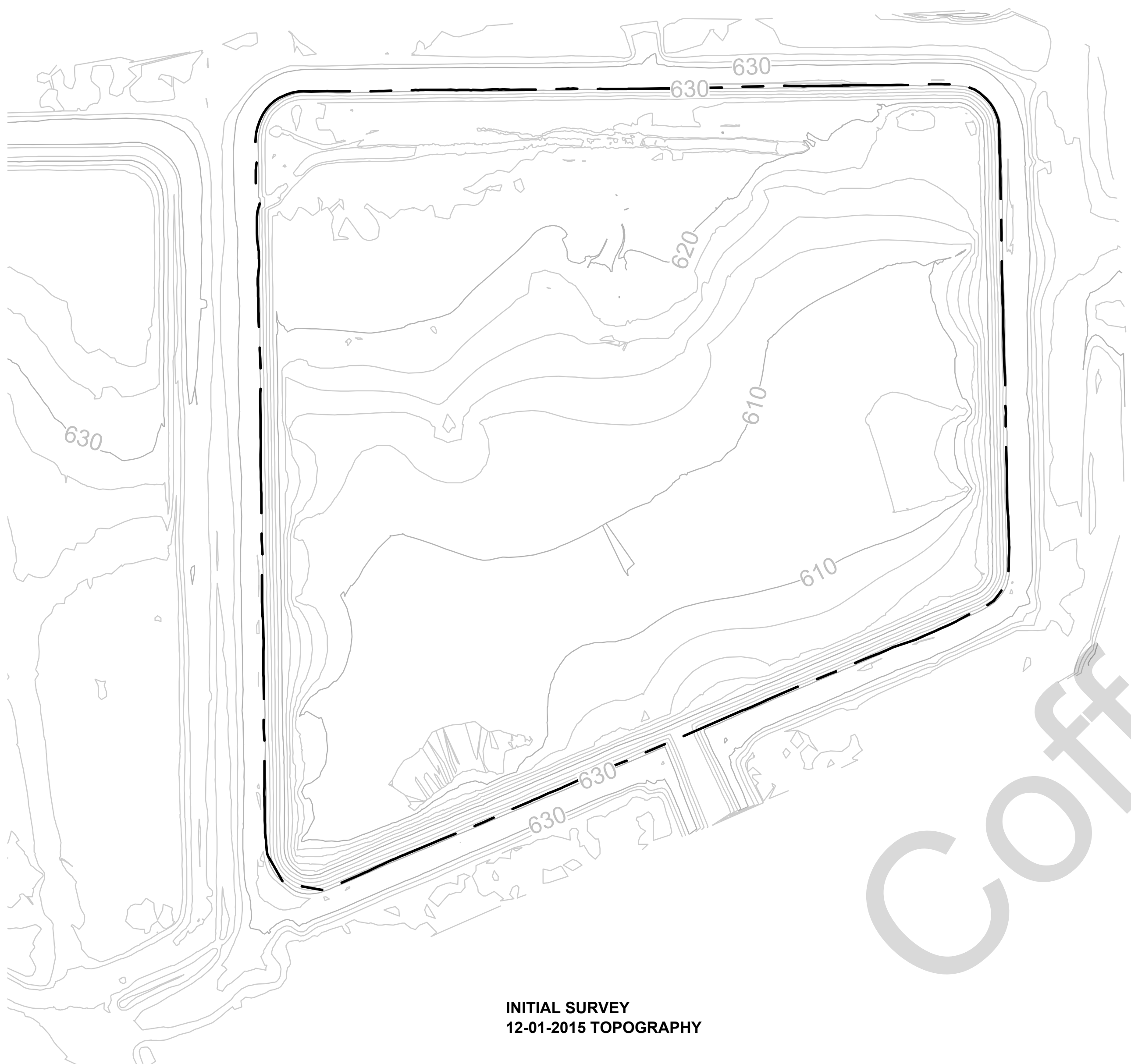
[20] National Resoruce Conservation Service, U.S. Department of Agriculture, "WinTR-20 Project Formulation Hydrology," 2021.

[21] Geosyntec Consultants, "Final Draft 2021 USEPA CCR Rule Periodic Certification Report, §257.73(a)(2), (c), (d), (e), and §257.82, Ash Pond No. 1, Coffeen Power Plant, Coffeen Illinois," Chesterfield, Missouri, September, 2021.

[22] Hanson Professional Services, Inc., "CCR Rule Report: Initial Inflow Design Flood Control System Plan, GMF Recycle Pond, Coffeen Power Station, Montgomery County, Illinois," October 2016.

[23] Hanson Professional Services, Inc., "CCR Documentation Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan, GMF Recycle Pond, Coffeen Power Station, Montgomery County, Illinois," October 2016.

DRAWINGS



INITIAL SURVEY
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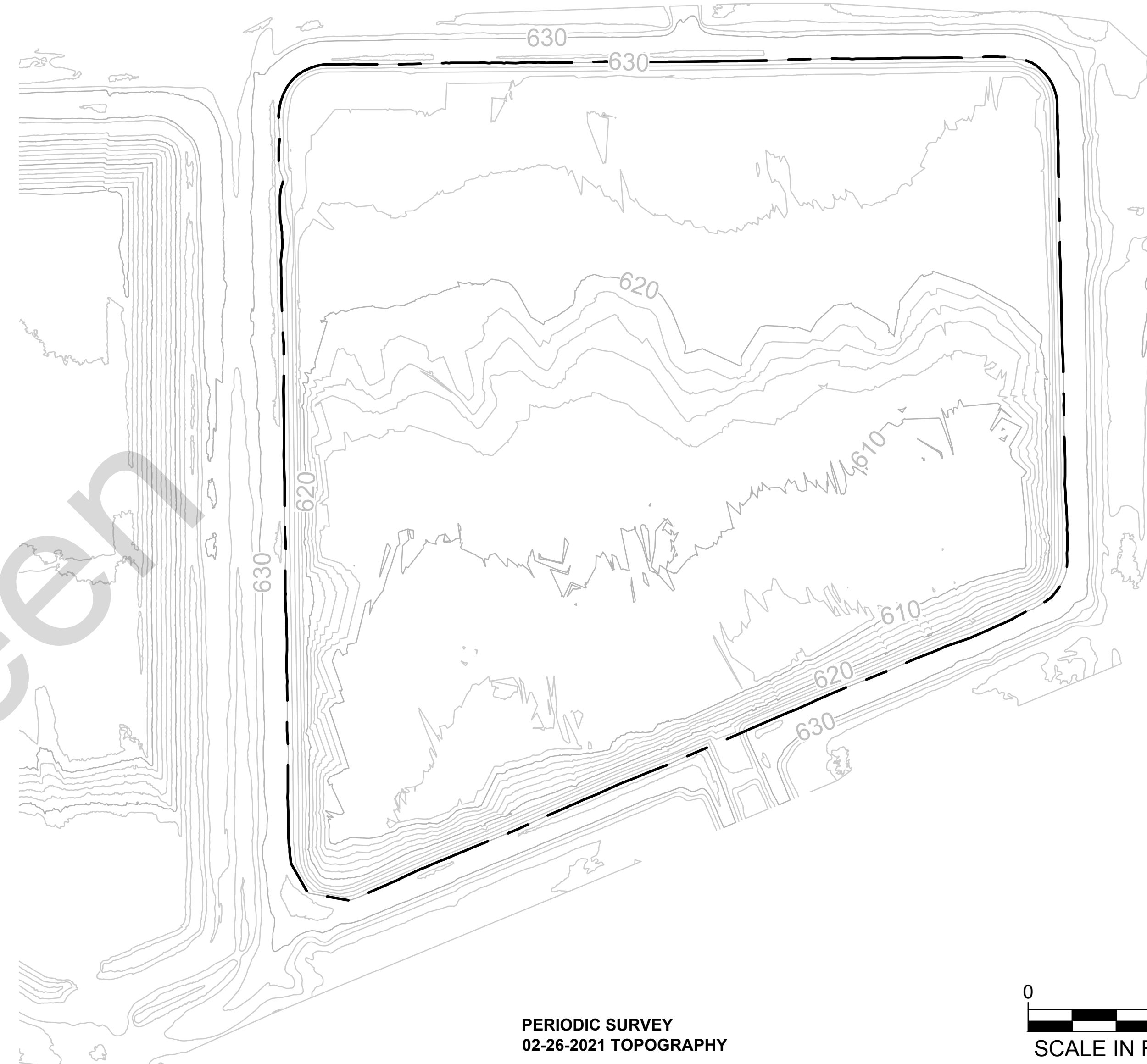

PERIODIC SURVEY
02-26-2021 TOPOGRAPHY

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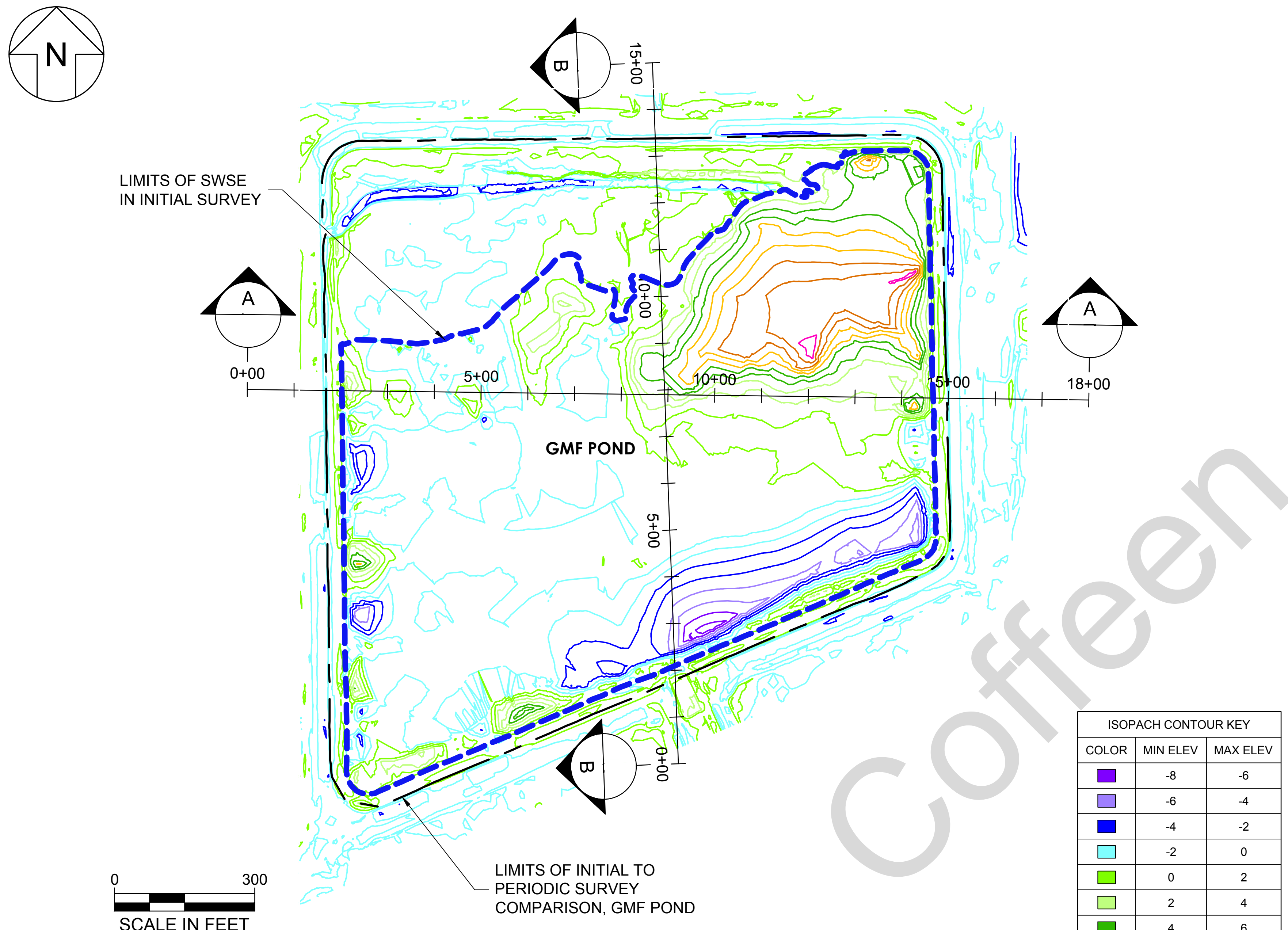
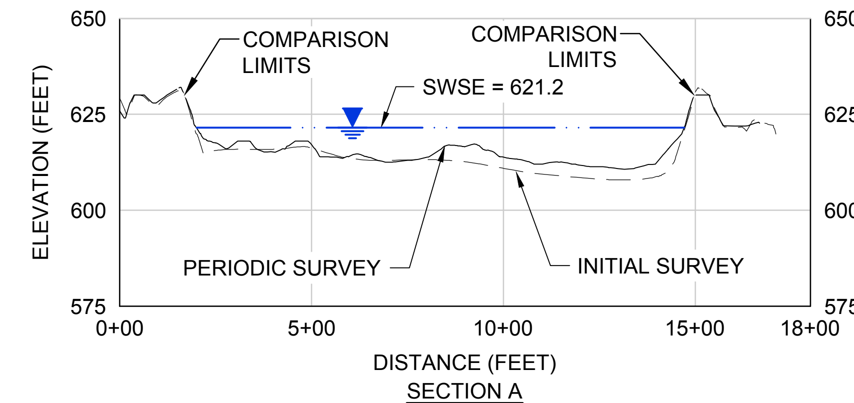
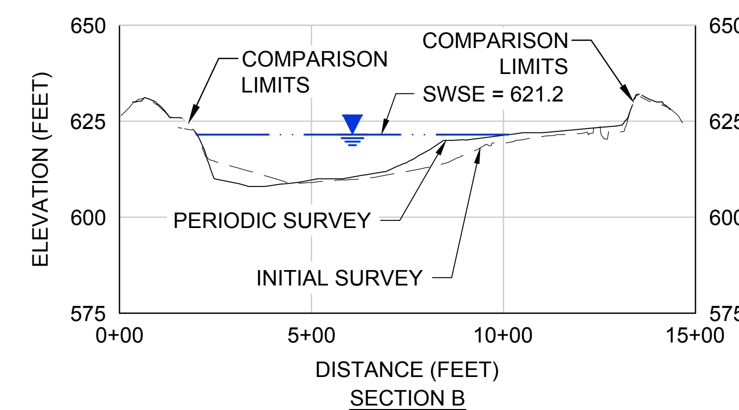
NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - COFFEEN TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ILLINOIS POWER GENERATING COMPANY, COFFEEN POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED FEBRUARY 26, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.

INITIAL TO PERIODIC SURVEY COMPARISON GMF GYPSUM STACK POND COFFEEN POWER PLANT COFFEEN, ILLINOIS		
Geosyntec consultants		DRAWING 1
GLP8027.02	MAY 2021	







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ISOPACH CONTOUR KEY

COLOR	MIN ELEV	MAX ELEV
(violet)	-8	-6
(light purple)	-6	-4
(blue)	-4	-2
(cyan)	-2	0
(green)	0	2
(light green)	2	4
(dark green)	4	6
(yellow-orange)	6	8
(orange)	8	10
(magenta)	10	11

NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED "DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - COFFEEN TOPOGRAPHY", PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED "LUMINANT, ILLINOIS POWER GENERATING COMPANY, COFFEEN POWER STATION, DECEMBER 2020 TOPOGRAPHY", PREPARED BY INGENAE, DATED FEBRUARY 26, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.
4. THE STARTING WATER SURFACE ELEVATION (SWSE) OF THE GMF POND IS EL. 621.2 FT, AS NOTED IN THE REPORT TITLED "CCR CERTIFICATION REPORT: INITIAL STRUCTURAL STABILITY ASSESSMENT, INITIAL SAFETY FACTOR ASSESSMENT, AND INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN FOR GMF POND AT COFFEEN POWER STATION", PREPARED BY AECOM, DATED OCTOBER, 2016.

INITIAL TO PERIODIC SURVEY COMPARISON SUMMARY

	CUT	FILL	NET (CU. YD.)
GMF POND	20,320	94,614	74,294 (FILL)
ABOVE SWSE	2,168	32,174	30,006 (FILL)
BELOW SWSE	18,152	62,440	44,288 (FILL)

SURVEY COMPARISION ISOPACH
GMF GYPSUM STACK POND
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

Geosyntec consultants

DRAWING 2

GLP8027.02 | MAY 2021

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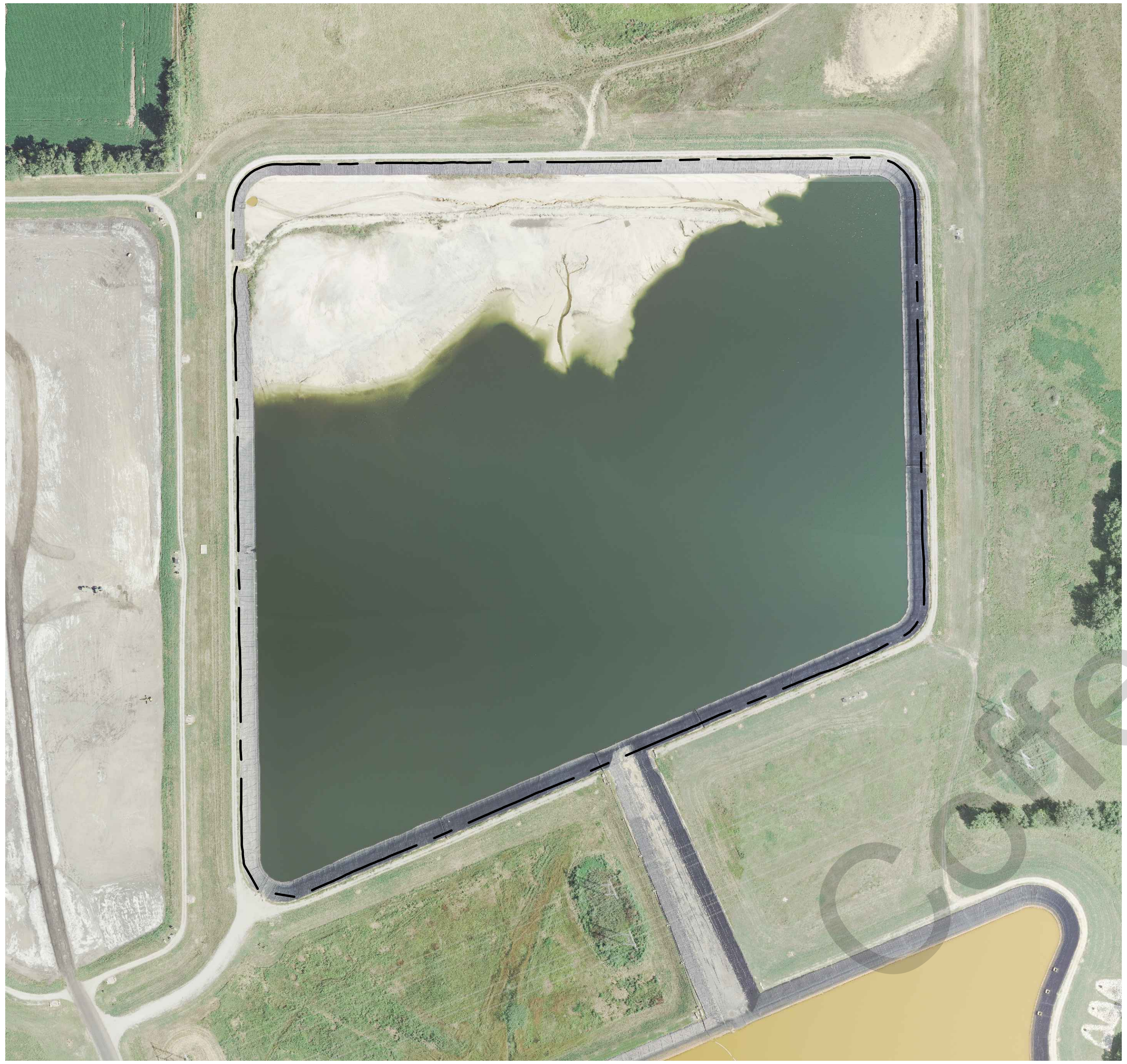

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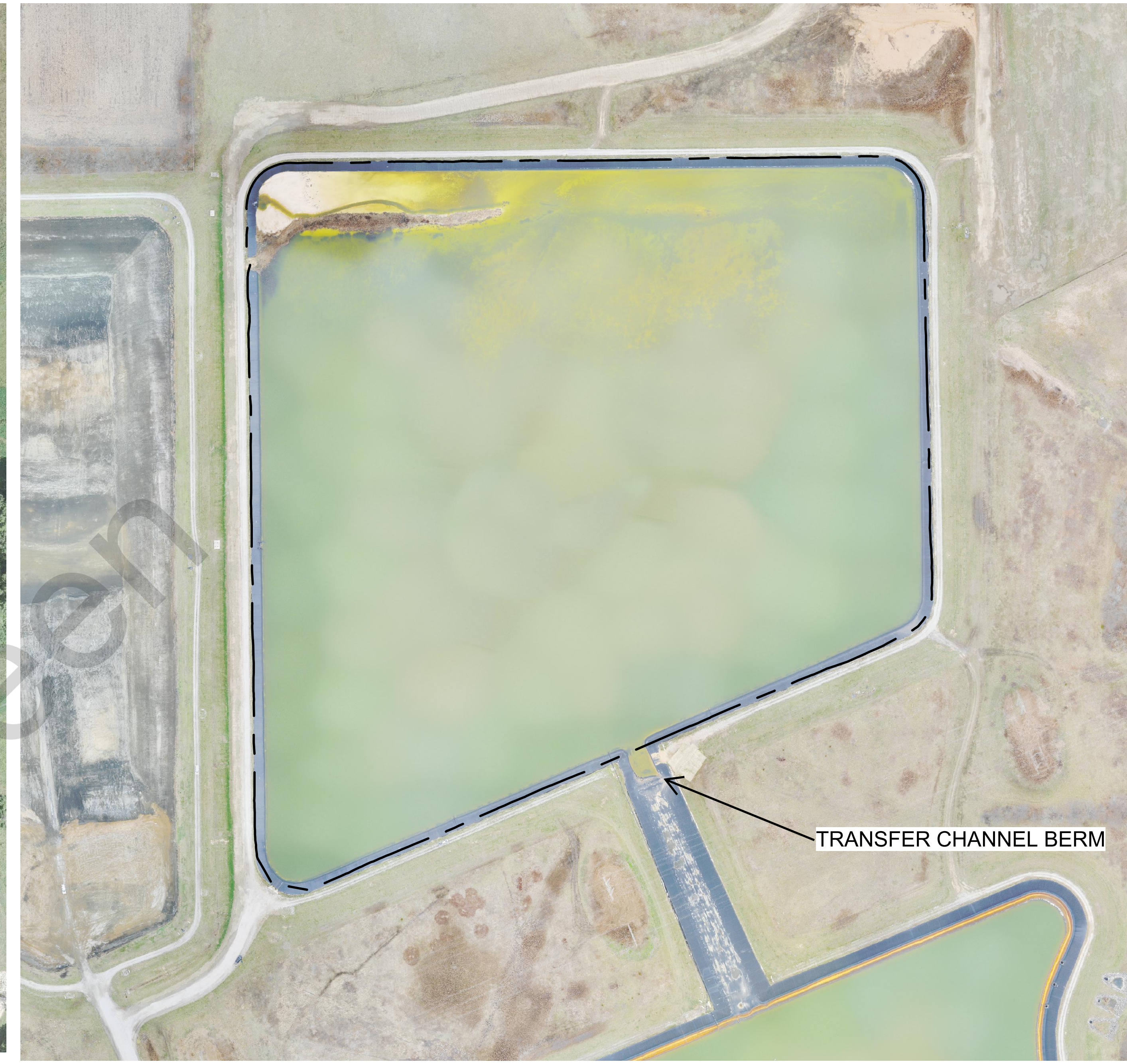

PERIODIC AERIAL
02-26-2021 IMAGERY

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NOTES:

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2. THE PERIODIC IMAGERY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ILLINOIS POWER GENERATING COMPANY, COFFEEN POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED FEBRUARY 26, 2021.

INITIAL TO PERIODIC AERIAL IMAGERY COMPARISON GMF GYPSUM STACK POND COFFEEN POWER STATION COFFEEN, ILLINOIS		
Geosyntec consultants		DRAWING 3
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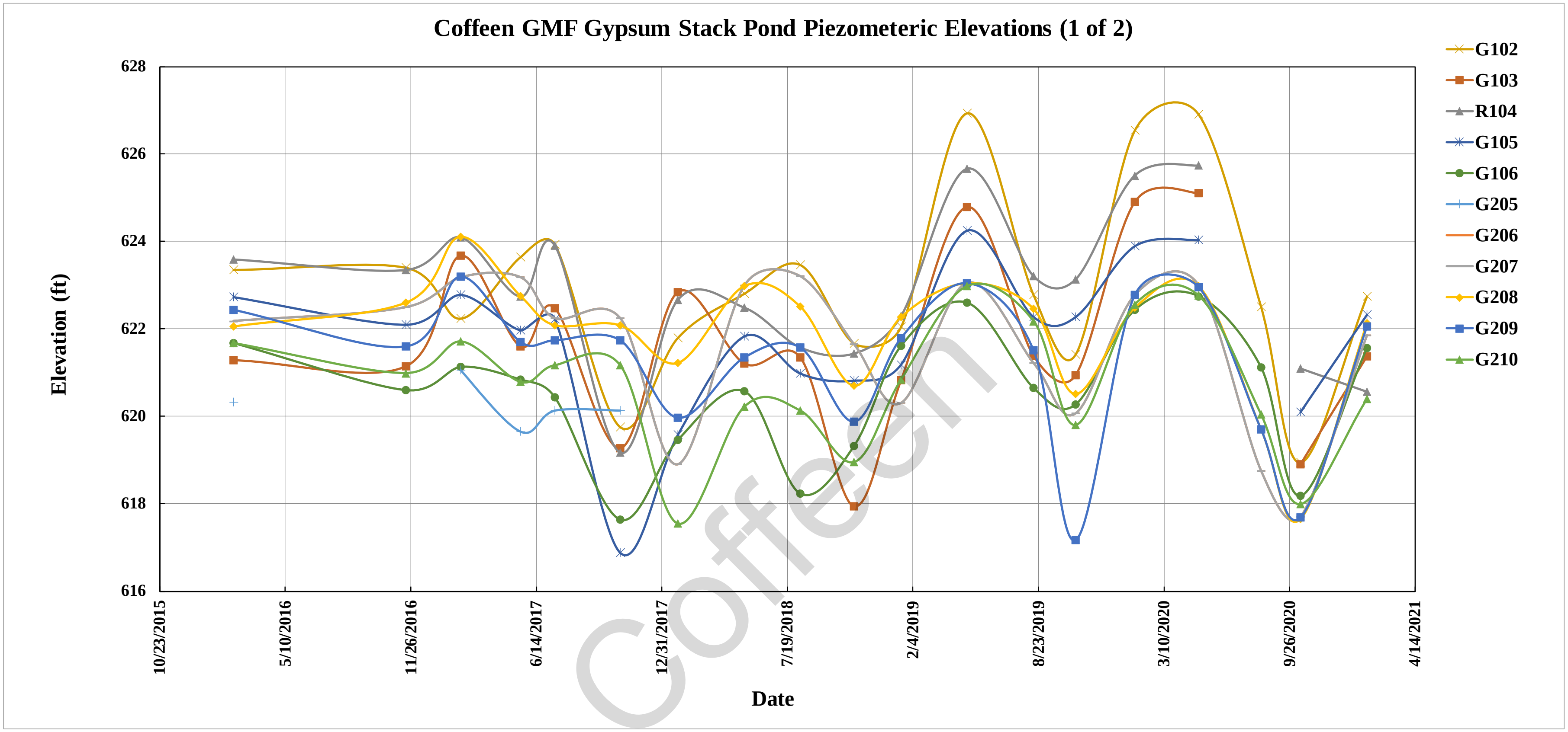
ATTACHMENTS

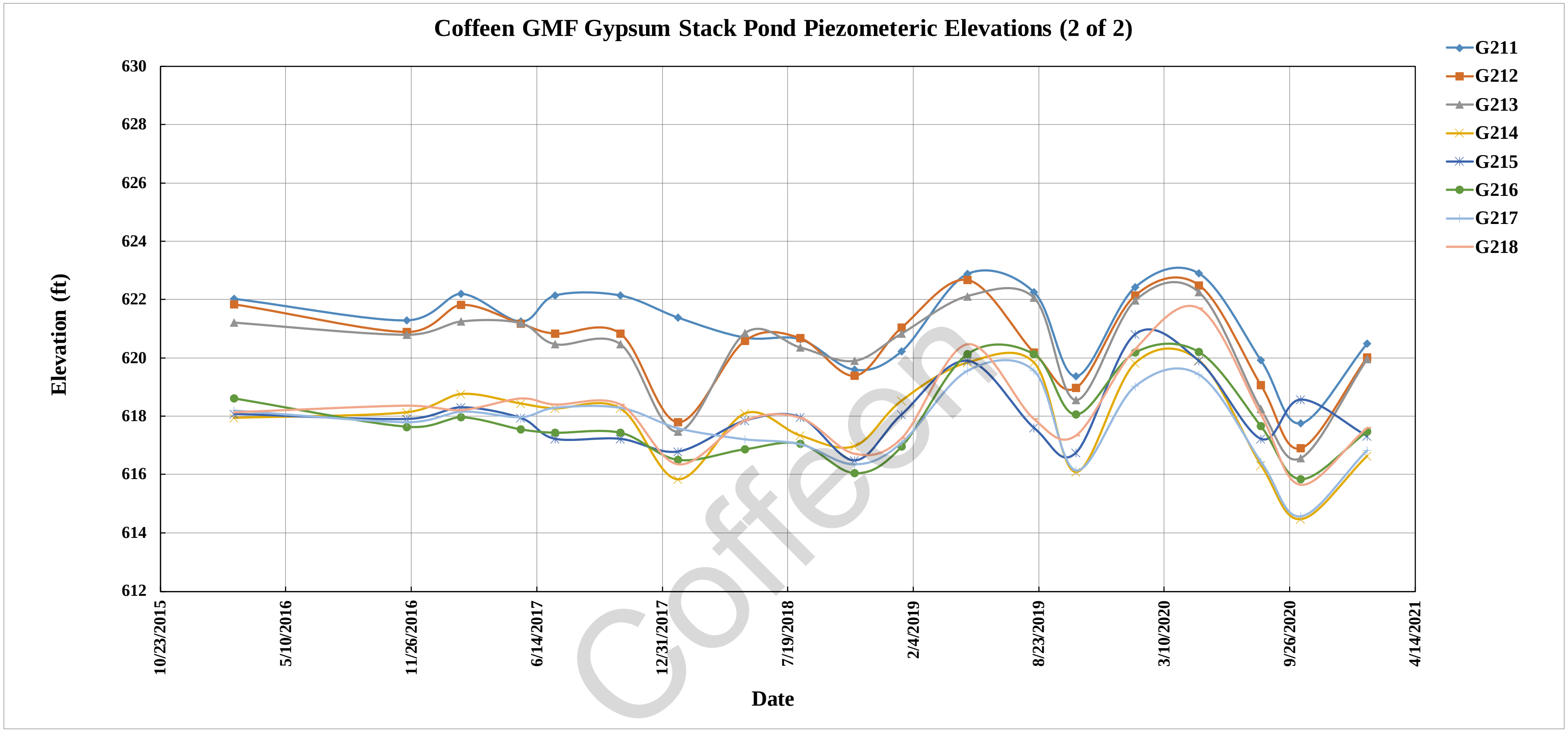
Attachment A

GMF GSP Phreatic Data Plots



NOTES:
1. Piezometer data was taken from the spreadsheets titled " Coffeen GW 1017", " Coffeen GW 1018", " Coffeen GW 1019", " Coffeen GW 1020", " Coffeen GW 1021", provided by the Coffeen Power Plant.

PIEZOMETER DATA PERIODIC CERTIFICATION, GMF GSP COFFEEN POWER PLANT COFFEEN, ILLINOIS		
Geosyntec consultants		Figure A-1
GLP8027	7/8/2021	



NOTES:

1. Piezometer data was taken from the spreadsheets titled " Coffeen GW 1017", " Coffeen GW 1018", " Coffeen GW 1019", " Coffeen GW 1020", " Coffeen GW 1021", provided by the Coffeen Power Plant.

PIEZOMETER DATA
PERIODIC CERTIFICATION, GMF GSP
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

Geosyntec consultants

Figure A-2

GLP8027 | 7/8/2021

Attachment B

GMF Gypsum Stack Pond Site Visit Photolog

Geosyntec Consultants
Photographic Record

Site Owner: Illinois Power Generating Company	**Project Number:** GLP8027
CCR Unit: GMF Gypsum Stack Pond (GMF GSP)	**Site:** Coffeen Power Plant

Photo: 01

Date: 05/28/2021

Direction Facing: SE

Comments: Berm installed in the transfer channel to reduce the water level in the downstream GMF Recycle Pond.

Photo: 02

Date: 05/28/2021

Direction Facing: W

Comments: Southwestern interior slopes.

GEOSYNTEC CONSULTANTS
Photographic Record

Site Owner: Illinois Power Generating Company	**Project Number:** GLP8027
CCR Unit: GMF Gypsum Stack Pond (GMF GSP)	**Site:** Coffeen Power Plant

Photo: 07

Date: 05/28/2021

Direction Facing: N

Comments: West dike exterior slope. Note leachate valve sump.

Photo: 08

Date: 05/28/2021

Direction Facing: NE

Comments: Gypsum discharge pipes.

GEOSYNTEC CONSULTANTS

Site Owner: Illinois Power Generating Company | **Project Number:** GLP8027

CCR Unit: GMF Gypsum Stack Pond (GMF GSP) | **Site:** Coffeen Power Plant

Photo: 09

Date: 05/28/2021

Direction Facing: E

Comments: North dike exterior overview

Photo: 10

Date: 05/28/2021

Direction Facing: E

Comments: North dike interior overview

GEOSYNTEC CONSULTANTS
Photographic Record

Site Owner: Illinois Power Generating Company **Project Number:** GLP8027

CCR Unit: GMF Gypsum Stack Pond (GMF GSP) **Site:** Coffeen Power Plant

Photo: 11

Date: 05/28/2021

Direction Facing: NE

Comments: North dike exterior overview

Photo: 12

Date: 05/28/2021

Direction Facing: S

Comments: East dike interior overview

Site Owner: Illinois Power Generating Company **Project Number:** GLP8027

CCR Unit: GMF Gypsum Stack Pond (GMF GSP) **Site:** Coffeen Power Plant

Photo: 13

Date: 05/28/2021

Direction Facing: S

Comments: East dike exterior overview.

Photo: 14

Date: 05/28/2021

Direction Facing: S

Comments: Southeast corner interior overview

GEOSYNTEC CONSULTANTS **Photographic Record**	
Site Owner: Illinois Power Generating Company	**Project Number:** GLP8027
CCR Unit: GMF Gypsum Stack Pond (GMF GSP)	**Site:** Coffeen Power Plant

Photo: 15	
Date: 05/28/2021	
Direction Facing: SE	
Comments: Southeast corner exterior overview	

Photo: 16	
Date: 05/28/2021	
Direction Facing: N	
Comments: Area where geomembrane has bulged slightly due to air.	

GEOSYNTEC CONSULTANTS

Site Owner: Illinois Power Generating Company	**Project Number:** GLP8027
CCR Unit: GMF Gypsum Stack Pond (GMF GSP)	**Site:** Coffeen Power Plant

Photo: 17

Date: 05/28/2021

Direction Facing:
E

Comments:
Southeast embankment exterior overview

Photo: 18

Date: 05/28/2021

Direction Facing:
E

Comments:
Southeast embankment interior overview

Attachment C

Periodic History of Construction Report Update Letter

Geosyntec consultants

1 McBride and Son Center Drive, Suite 202
Chesterfield, MO 63005
PH 636-812-0800
www.geosyntec.com

October 11, 2021

Illinois Power Generating Company
134 Cips Lane
Coffeen, Illinois 62017

Subject: **Periodic History of Construction Report Update Letter**
USEPA Final CCR Rule, 40 CFR §257.73(c)
Coffeen Power Plant
Coffeen Illinois

At the request of Illinois Power Resources Generation Company (IPRG), Geosyntec Consultants (Geosyntec) has prepared this Letter to documents updates to the Initial History of Construction (HoC) report for the Coffeen Power Plant (CPP), also known as the Coffeen Power Station (COF). The Initial HoC report was prepared by AECOM in October of 2016 [1] in accordance with 40 Code of Federal Regulations (CFR) §257.73(c) of the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals Rule, known as the CCR Rule [2]. This letter also includes information required by Section 845.220(a)(1)(B) (Design and Construction Plans) of the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 CCR Rule [3] that is not expressly required by §257.73(c).

BACKGROUND

The CCR Rule required that, by October 17, 2016, Initial HoC reports to be compiled for existing CCR surface impoundments with: (1) a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) a height of 20 feet or more. The Initial HoC report was required to contain, to the extent feasible, the information specified in 40 CFR §257.73(c)(1)(i)-(xii). The Initial HoC report for CPP, which included four existing CCR surface impoundments, Ash Pond No. 1 (AP1), Ash Pond No. 2 (AP2), the GMF Gypsum Stack Pond (GMF GSP, also known as the GMF Pond), and the GMF Recycle Pond (GMF RP), was prepared and subsequently posted to IPGC's CCR Website prior to October 17, 2016.

The CCR Rule requires that Initial HoC to be updated if there is a significant change to any information complied in the Initial HoC report, as listed below:

§ 257.73(c)(2): If there is a significant change to any information complied under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(9).

IPRG retained Geosyntec to review the Initial HoC report, review reasonably and readily available information for AP1, AP2, the GMF GSP, and the GMF RP generated since the Initial HoC report was prepared, and perform a site visit to CPP to evaluate if significant changes may have occurred since the Initial HoC report was prepared. This Letter contains the results of Geosyntec's evaluation and documents significant changes that have occurred at AP1, AP2, the GMF GSP, and the GMF RP, as they pertain the requirements of §257.73(c)(1)(i)-(xii).

UPDATES TO HISTORY OF CONSTRUCTION REPORT

Geosyntec's evaluation for the CPP AP1, AP2, GMF GSP, and GMF RP determined that no known significant changes requiring updates to the information in the Initial HoC report pertaining to §257.73(c)(1)(ii), (iv), (v), (vi), (vii), (xi), and (xii) of the CCR Rule had occurred since the Initial HoC report was developed.

However, Geosyntec's evaluation determined that significant changes at the CPP AP1, AP2, GMF GSP, and GMF RP, pertaining to §257.73(c)(1)(i), (iii), (viii), (ix), and (x) of the CCR Rule had occurred since the Initial HoC report had been developed. Additionally, information how long the CCR surface impoundments have been operating and the types of CCR in the surface impoundments, as required by Section 845.220(a)(1)(B) of the Part 845 Rule were not included in the Initial HoC report, as this information is not required by the CCR Rule. Each change and the subsequent updates to the Initial HoC report is described within this section.

Section 845.220(a)(1)(B): A statement of … how long the CCR surface impoundment has been in operation, and the types of CCR that have been placed in the surface impoundment.

<u>*Ash Pond No. 1*</u>

The AP1 was in operation from 1964 until CPP was retired in 2019 and received CCR for approximately 55 years. As of the date of this report, the AP1 has been present for approximately 57 years [4].

CCR placed in the AP1 included bottom ash [4].

<u>*Ash Pond No. 2*</u>

The AP2 was in operation from 1971 to 1984, for a total of approximately 13 years. The AP2 was closed in 1984-1985 by installing a clay cover and has not since been active or received CCR. As of the date of this report, AP2 has been present for approximately 50 years. [4].

CCR placed in the AP2 was used to store and dispose of fly ash and bottom ash [4].

GMF Gypsum Pond

The GMF GSP was in operation from 2010 until CPP was retired in 2019 and received CCR for approximately 9 years. As of the date of this report, the GMF GSP has been present for a total of approximately 11 years [4].

CCR placed in GMF GSP included gypsum [4].

GMF Recycle Pond

The GMF RP was in operation from 2010 until CPP was retired in 2019, for a total of 9 years [4]. As of the date of this report, the GMF RP has been present for approximately 11 years.

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

State identification numbers (IDs) for AP1, AP2, the GMF GSP, and the GMF RP have been assigned by the Illinois Environmental Protection Agency (IEPA). Each ID is listed in **Table 1**.

Table 1 – IEPA ID Numbers

CCR Surface Impoundment	State ID
Ash Pond No. 1 (AP1)	W1350150004-01
Ash Pond No. 2 (AP2)	W1350150004-02
GMF Gypsum Stack Pond (GMF GSP)	W1350150004-03
GMF Recycle Pond (GMF RP)	W1350150004-04

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

AP2 was closed in 2020, in substantial compliance with the written closure plan posted to IPRG's CCR Website [5], and as documented by a certified Notification of Completion of Closures posted to DMG's CCR Website [6].

The CPP was retired in December of 2019, with the generation of electricity ceased at that time. Therefore, AP1, the GMF GSP, and the GMF RP are no longer being used to store and dispose of new CCR that is actively generated by CPP, as CCR generation as ceased. All three impoundments still contain CCR and liquids that was present at the time of plant retirement. The GMF RP also previously received dewatering discharge from AP2; this inflow was ceased after AP2 was closed in 202.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Instrumentation monitoring at AP2 is no longer required as the CCR surface impoundment was closed in accordance with §257.102 [6], and the instrumentation network was modified at that time. Therefore, the instrumentation locations shown in Appendix C of the Initial HoC report are no longer applicable to AP2.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Updated area-capacity curves were prepared for AP1, the GMF GSP, and the GMF RP in 2021 and are provided in **Figures 1**, **2**, and **3**, respectively.

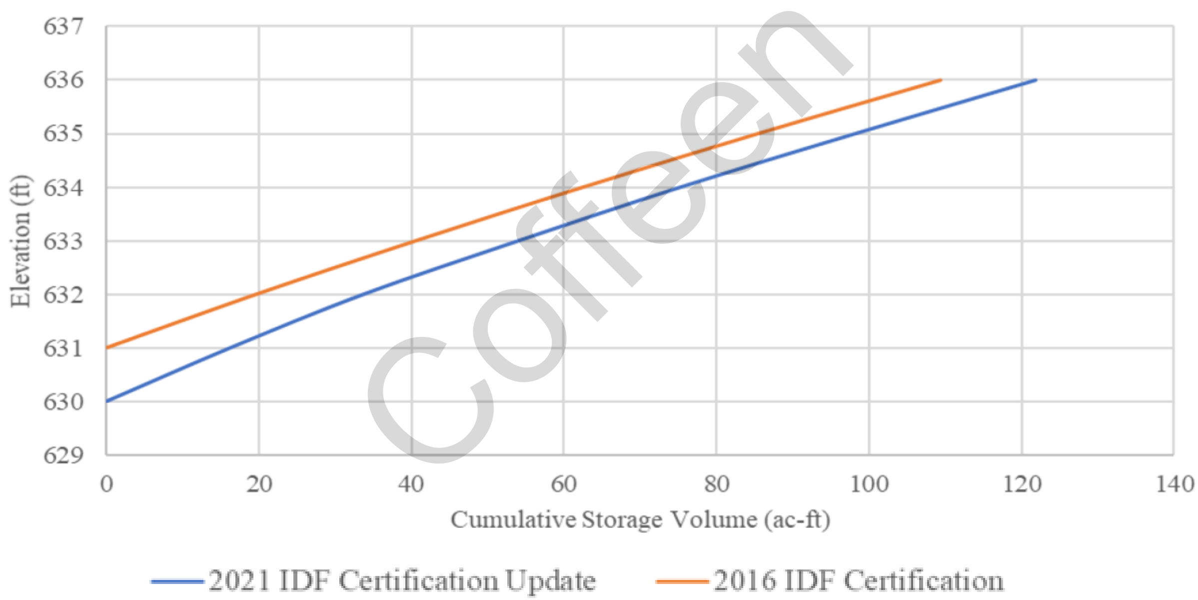


Figure 1 – Area-Capacity Curve for AP1

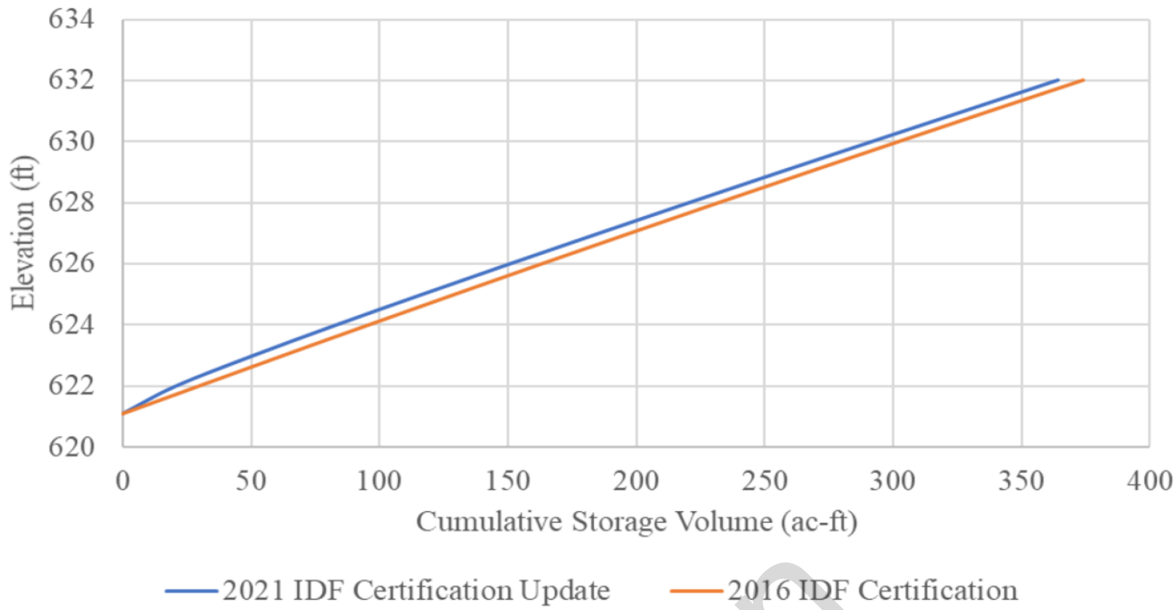


Figure 2 – Area-Capacity Curve for GMF GSP

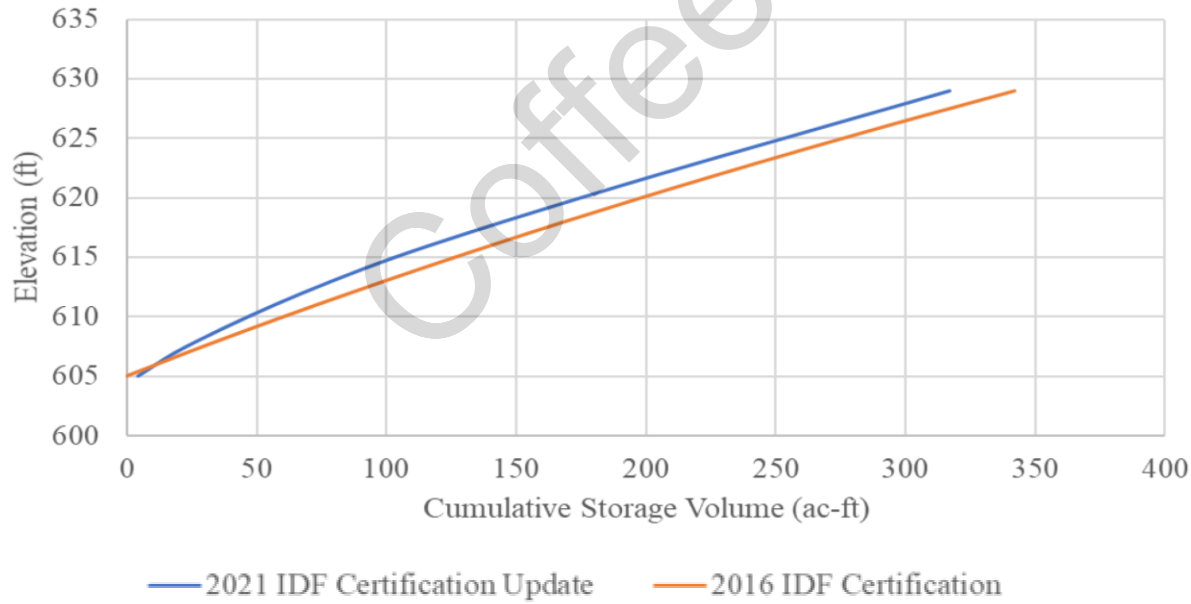


Figure 3 – Area-Capacity Curve for GMF RP

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

The primary spillway structure for AP1 was modified in 2020 by constructing a berm of bottom ash around the entrance to the spillway, to reduce the potential for freezing around the spillway during post-CPP closure conditions, with a berm crest elevation of approximately 630 ft. Design drawings for the bottom ash berm are not reasonably or readily available.

The transfer channel between the GMF GSP and the GMF RP was modified in 2020 by constructing a geomembrane-lined berm, in order to allow the normal pool level of the GMF GSP to be increased. Design drawings for the berm are not reasonably or readily available. However, survey data [3] indicates the berm has an elevation of approximately 628 ft, a top width (perpendicular to the flow direction) of approximately 75 ft, a total length (parallel to the flow direction) of 25 ft, and side slopes of approximately 4 horizontal to 1 vertical.

Valves were installed on the intake pipes for the GMF RP after the CPP was closed and plant process water intake pumping was ceased. Design drawings for these valves are not reasonably or readily available.

Updated discharge capacity calculations for the existing spillways of AP1, the GMF GSP, and the GMF RP were prepared in 2021 using HydroCAD 10 modeling software. The calculations indicate that the AP1 and the GMF RP have sufficient storage capacity and will not overtop the embankments during the 1,000-year, 24-hour, storm event. The calculations also indicate that the GMF GSP has sufficient storage capacity and will not overtop the embankments during the Probable Maximum Precipitation (PMP), 24-hour storm event. The results of the calculations are provided in **Table 2**.

Table 2 – Results of Updated Discharge Capacity Calculations

	AP1	GMF GSP	GMF RP
Approximate Berm Minimum Elevation[1], ft	636.0	632.0	629.0
Approximate Emergency Spillway Elevation[1], ft	Not Present	Not Present	624.0
Starting Water Surface Elevation[1] (SWSE), ft	630.2	625.2	622.1
Peak Water Surface Elevation[1] (PWSE), ft	631.4	626.7	623.9
Time to Peak, hr	No Discharge	10.6	No Discharge
Surface Area[2], ac	18.1	34.8	16.1
Storage[3], ac-ft	19.5	52.9	29.0

Notes:
[1]Elevations are based on the NAVD88 datum
[2]Surface area is defined as the water surface area at the PWSE
[3]Storage is defined as the volume between the SWSE and PWSE

AP2 no longer retains free water as the CCR surface impoundments was closed in 2020 [6]. Therefore, the spillways are no longer present and the information regarding these structures, as presented in the Initial HoC report, is no longer applicable to AP2.

CLOSING

This letter has been prepared to document Geosyntec's evaluation of changes that have occurred at AP1, AP2, the GMF GSP, and the GMF RP since the Initial HoC was developed, based on reasonably and readily available information provided by IPRG, observed by Geosyntec during the site visit, or generated by Geosyntec as part of subsequent calculations.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

REFERENCES

[1] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Coffeen Power Station, Coffeen, Illinois," October 2016.

[2] United Stated Environmental Protection Agency, "40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 2015," 2015.

[3] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[4] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Hennepin Power Station, Hennepin, Illinois," October 2016.

[5] V. Modeer, "Closure Plan for Existing CCR Surface Impoundment, Coffeen Power Station, Illinois Power Generating Company, Ash Pond No. 2," October 17, 2016.

[6] D. Tickner, "Coffeen Power Station; Ash Pond No. 2; Notification of Completion of Closure," December 17, 2020.

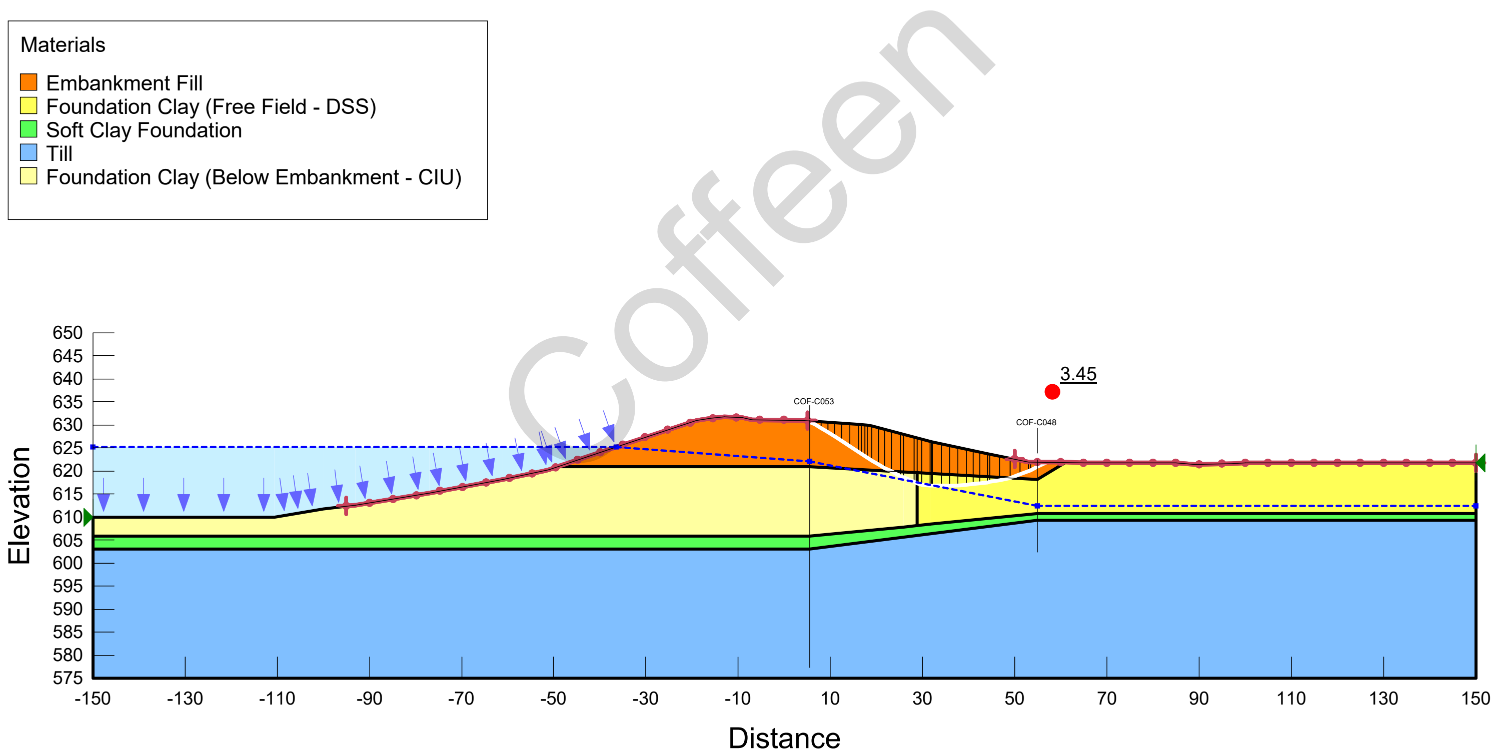
Attachment D

Periodic Structural Stability and Safety Factor Assessment Analyses

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 13+50
Slope Stability - Static Drained

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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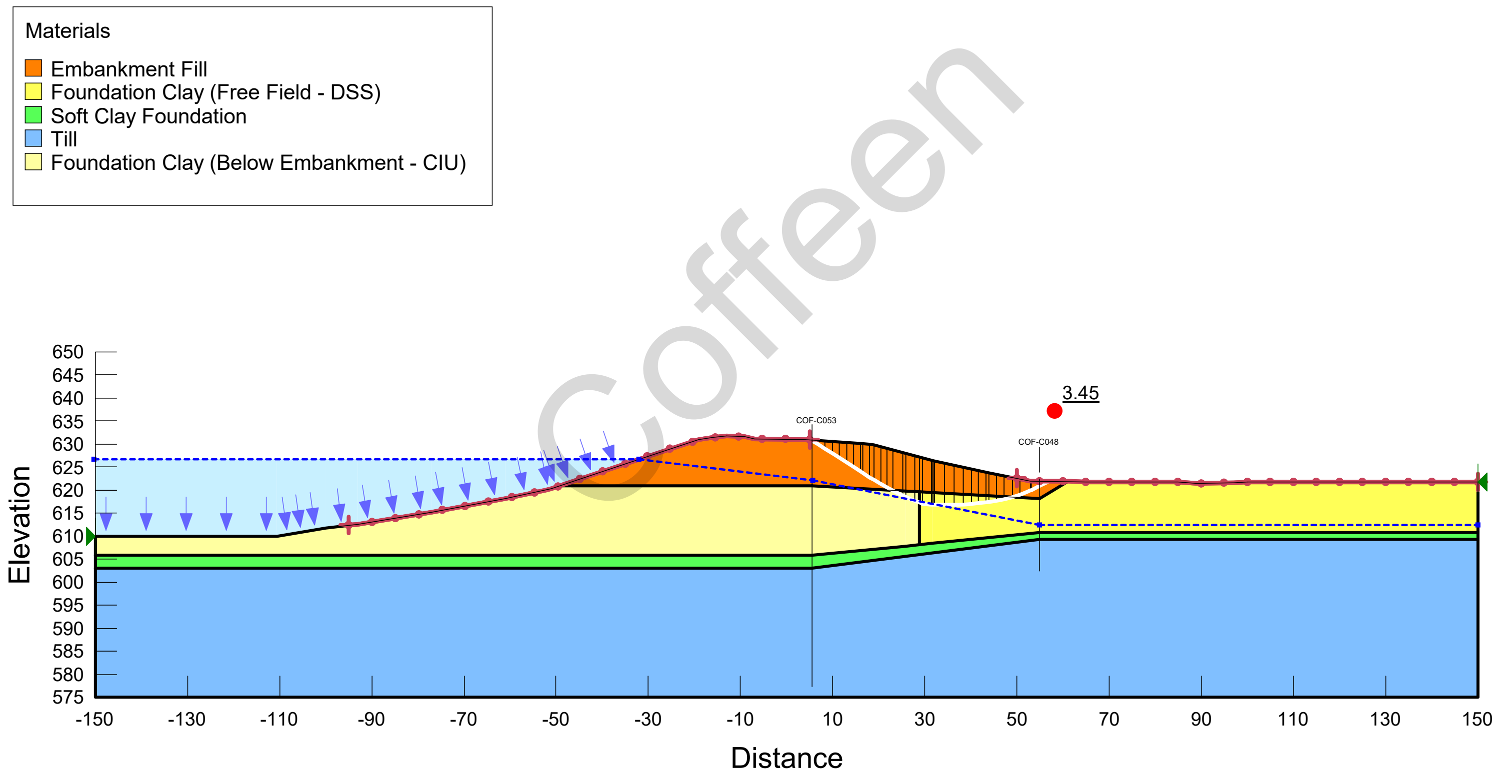
Coffeen_GMF_13+50_Static_Drained_PK_20210913.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 13+50
Slope Stability - Static Drained

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/13/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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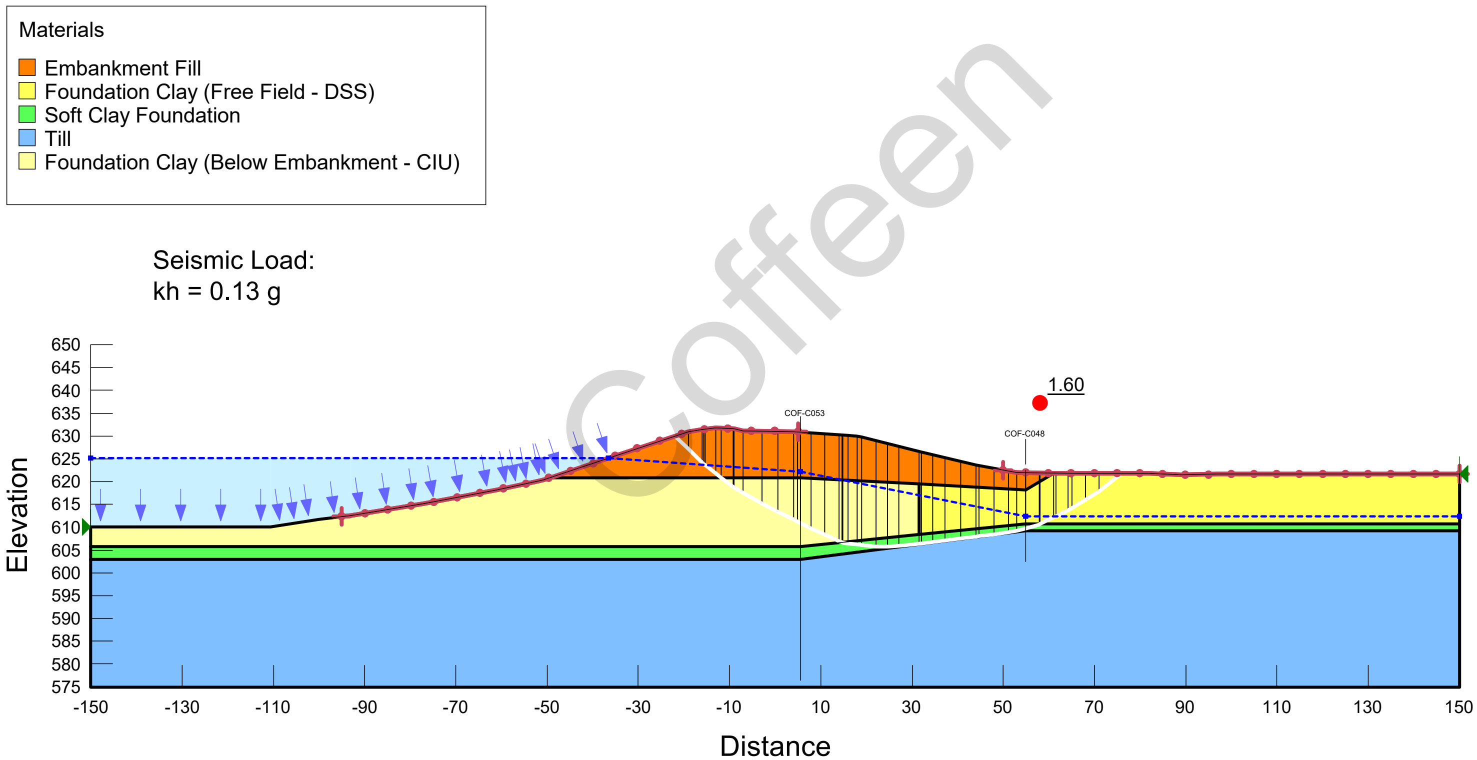
Dynegy Coffeen
GMF Gypsum Stack Pond
Station 13+50
Peak Undrained Soil Strengths
Pseudostatic - Entry-Exit

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 275 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1



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Coffeen_GMF_13+50_Peak_Undrained_LPC_PK_20210913.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 13+50
Slope Stability - Post Earthquake

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.16 Minimum Strength: 200 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
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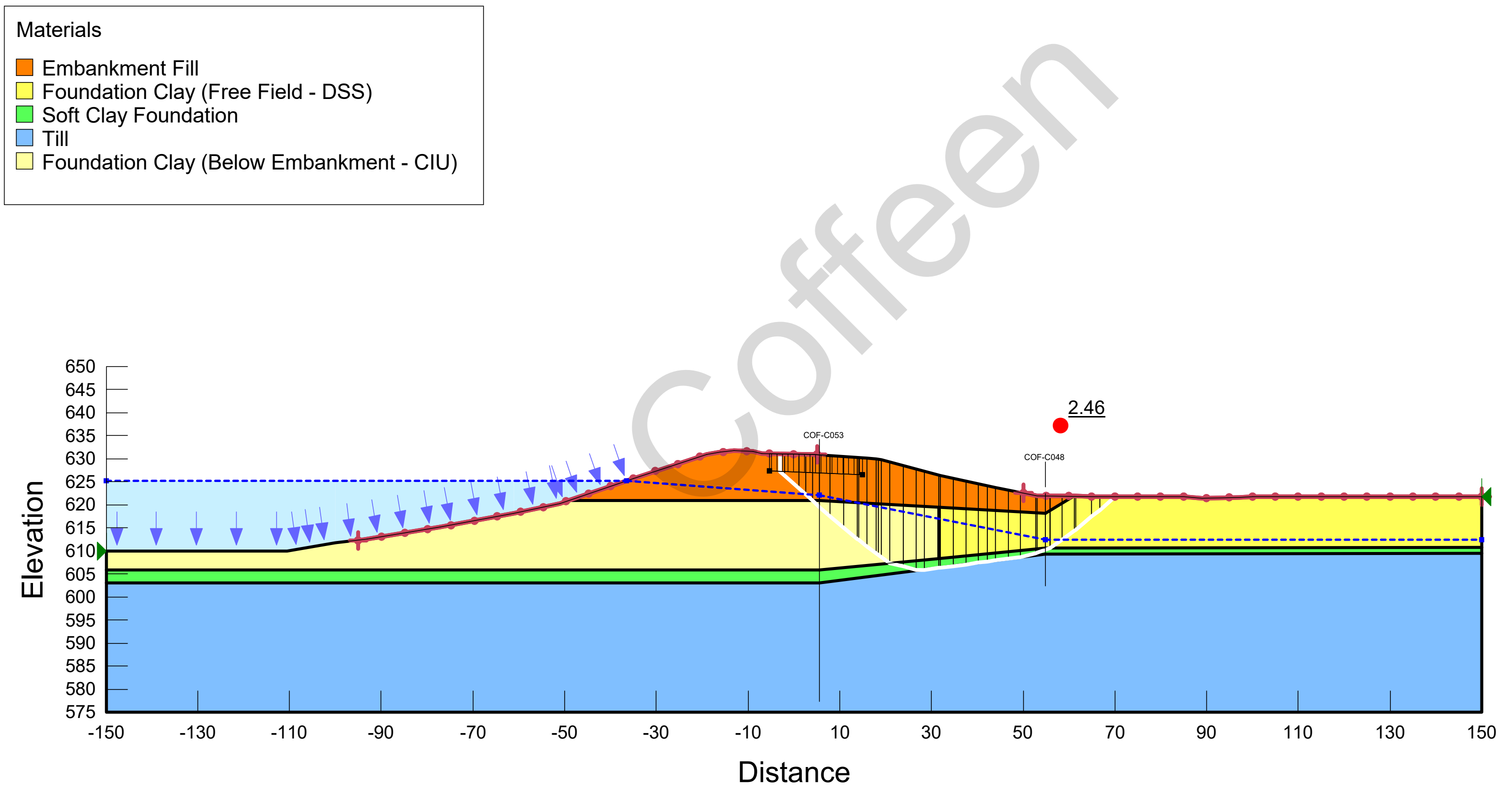

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Coffeen_GMF_13+50_PostEQ_Undrained_PK_20210913.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 22+50
Slope Stability - Static Drained

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Ash Model: Mohr-Coulomb Unit Weight: 112 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
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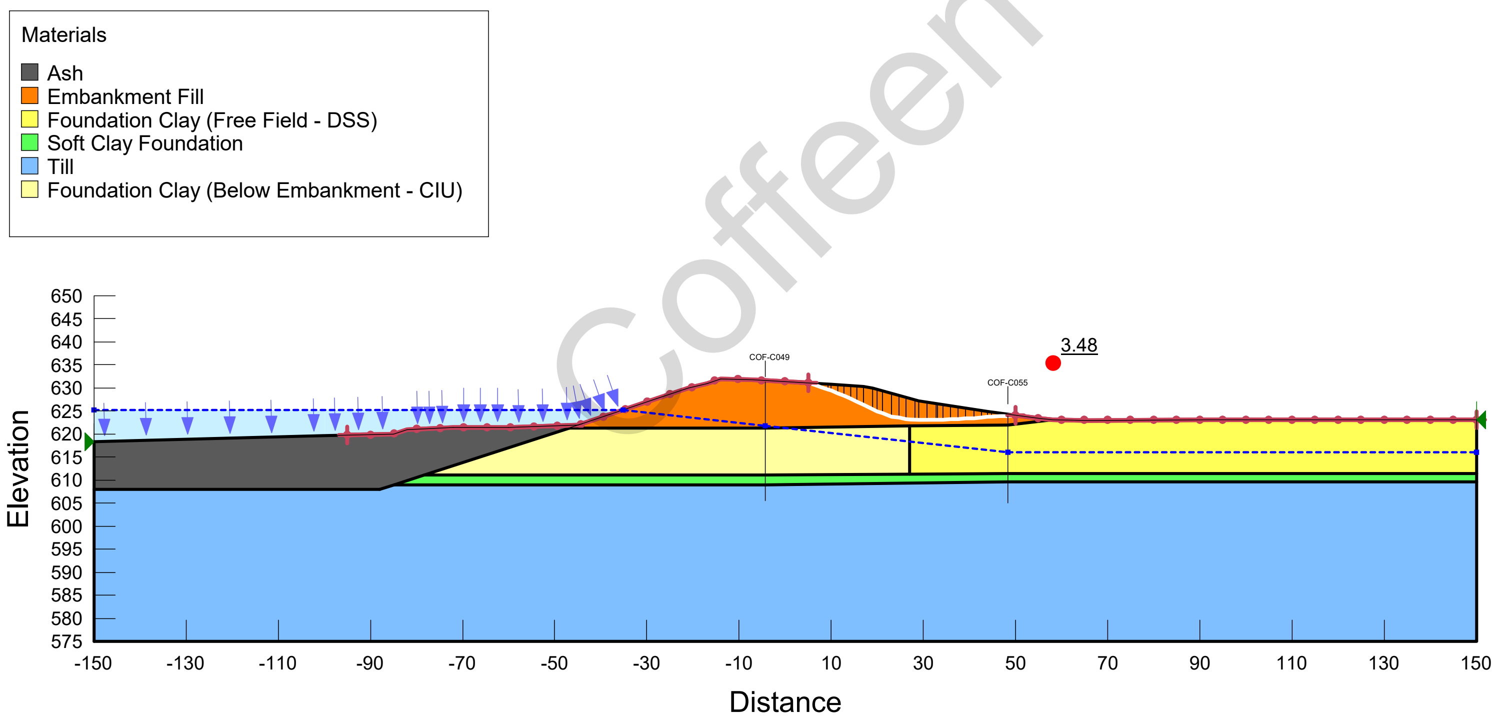

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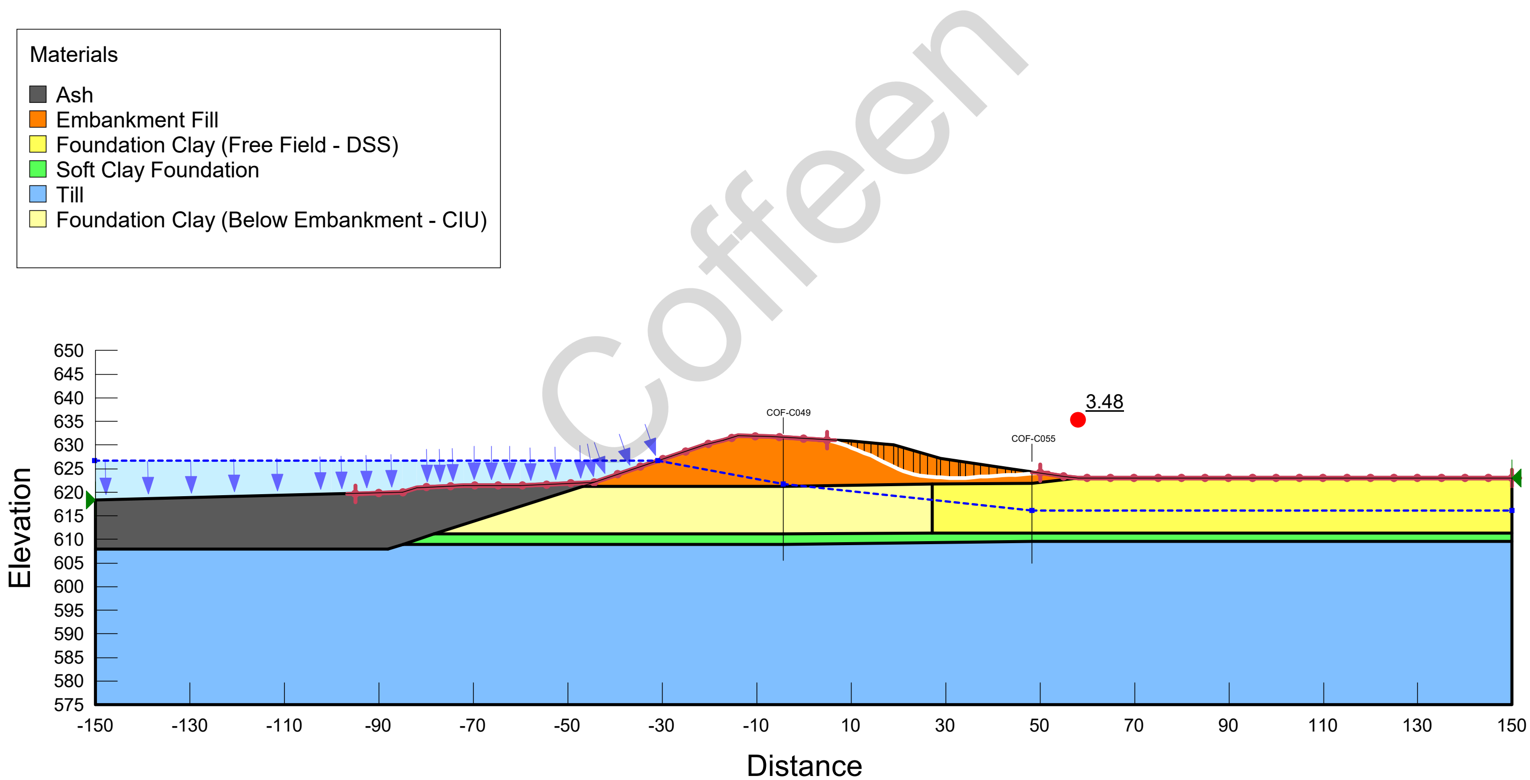
Coffeen_GMF_22+50_Static_Drained_LPC_20160113v0.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 22+50
Slope Stability - Static Drained

Design by: Lucas Carr
Modidfied by: Betty Tesfu
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/13/2021

Name: Ash Model: Mohr-Coulomb Unit Weight: 112 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1
Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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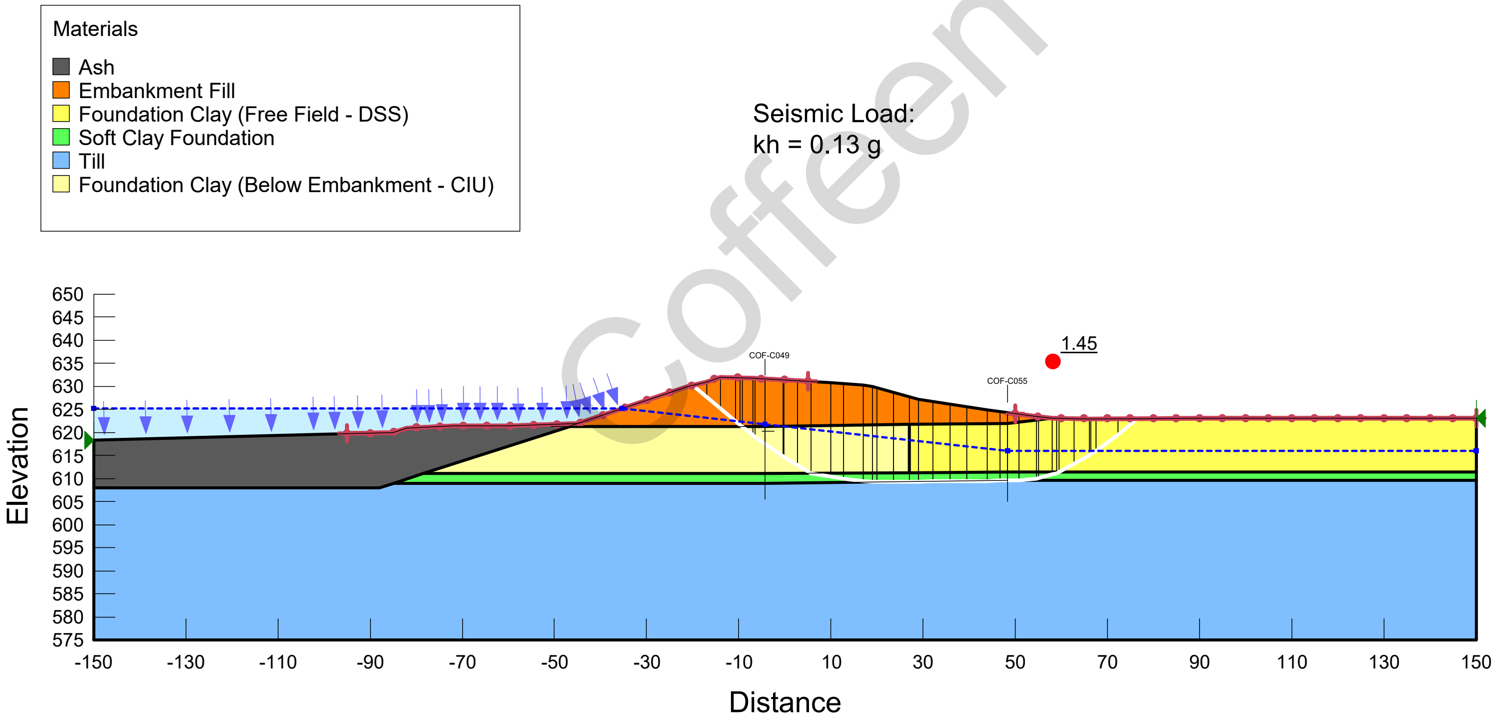
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 22+50
Peak Undrained Soil Strengths
Pseudostatic - Entry & Exit

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Ash Model: S=f(overburden) Unit Weight: 112 pcf Tau/Sigma Ratio: 0.4 Minimum Strength: 0 psf Piezometric Line: 1
Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.22 Minimum Strength: 275 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.39 Minimum Strength: 700 psf Piezometric Line: 1

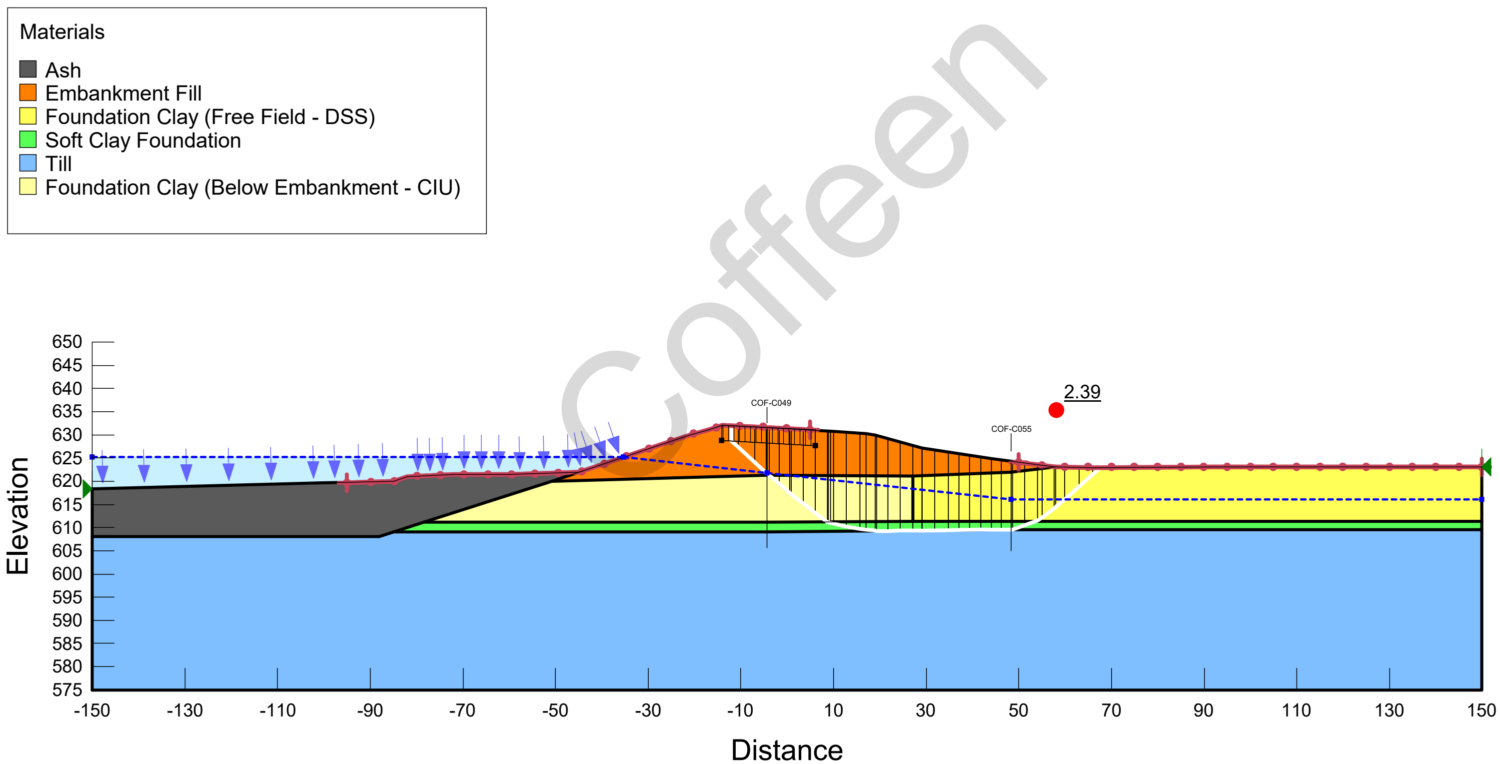


\\STLOUISMO-01\Data\Company\Projects_post_2014\GLP8027_CCR_ReCert\500_Technical\502_COF\502d_Periodic_Report\GMF\Revised SFA\22+50\
Coffeen_GMF_22+50_Peak_Undrained_LPC_20160902v1.gsz

Coffeen Power PlantGMF Gypsum Stack Pond
Station 22+50
Slope Stability - Post Earthquake

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Ash Model: S=f(overburden) Unit Weight: 112 pcf Tau/Sigma Ratio: 0.05 Minimum Strength: 0 psf Piezometric Line: 1
Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.13 Minimum Strength: 200 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.39 Minimum Strength: 700 psf Piezometric Line: 1



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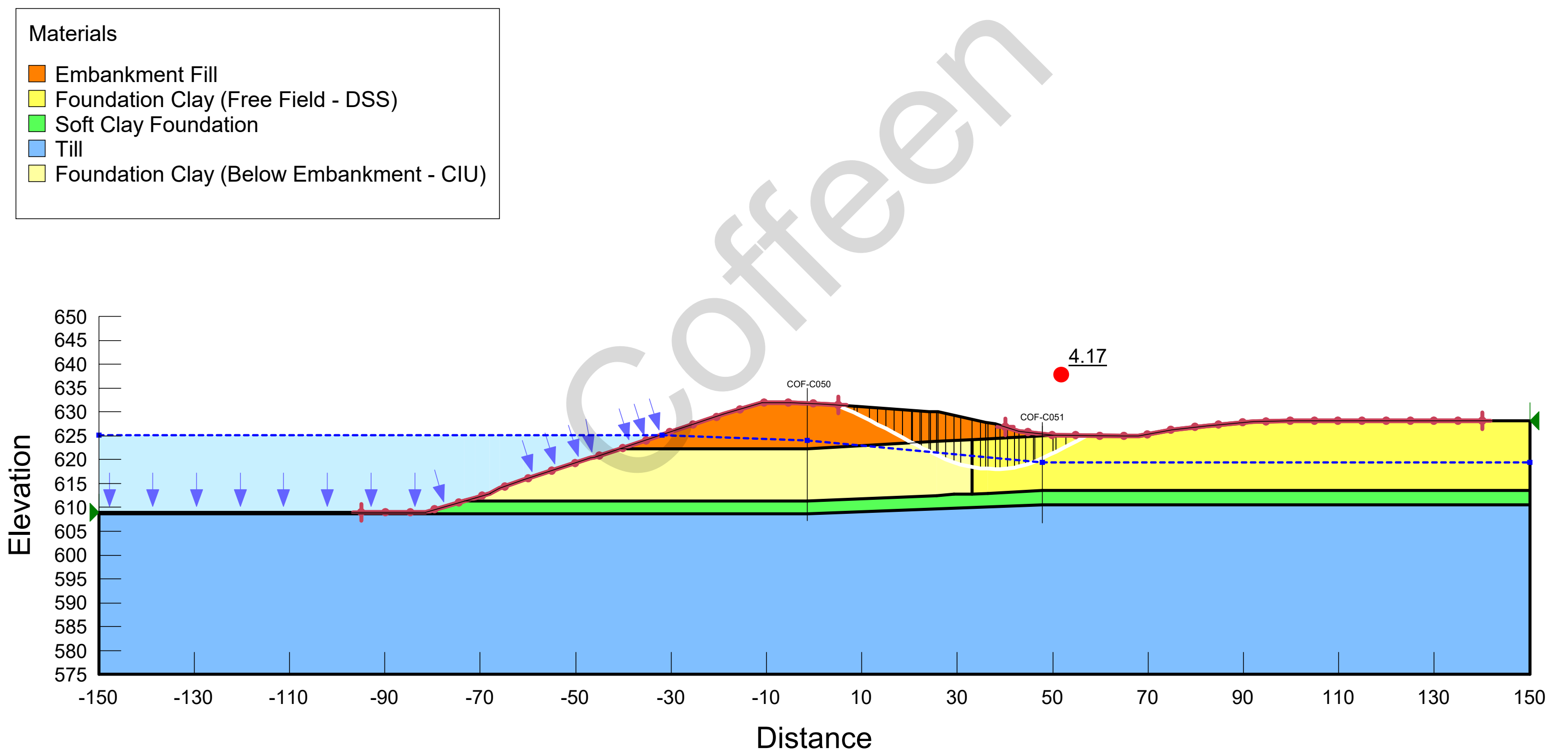
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 46+50
Static Drained - Entry & Exit

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/8/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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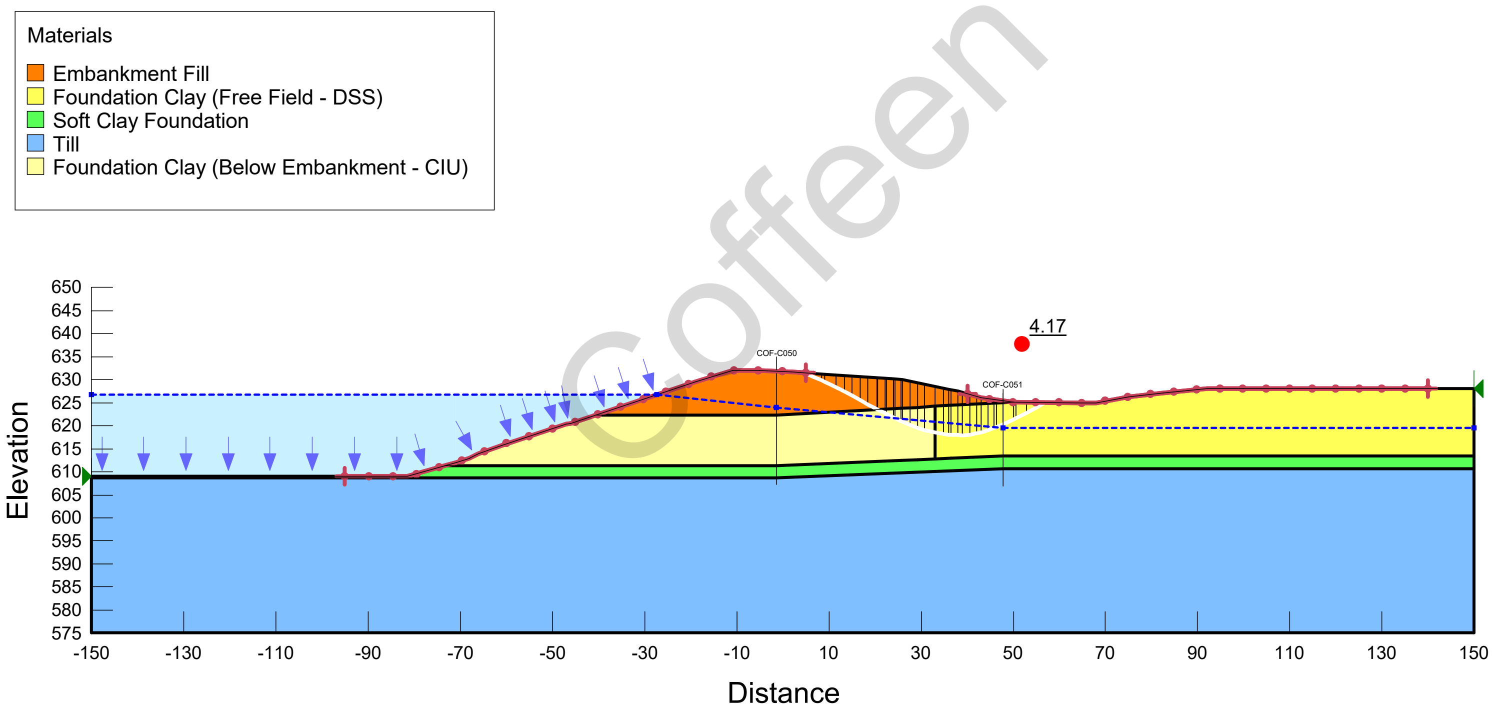
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 46+50
Surcharge Pool - Entry & Exit

Design by: Lucas Carr
Modidfied by: Betty Tesfu
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/13/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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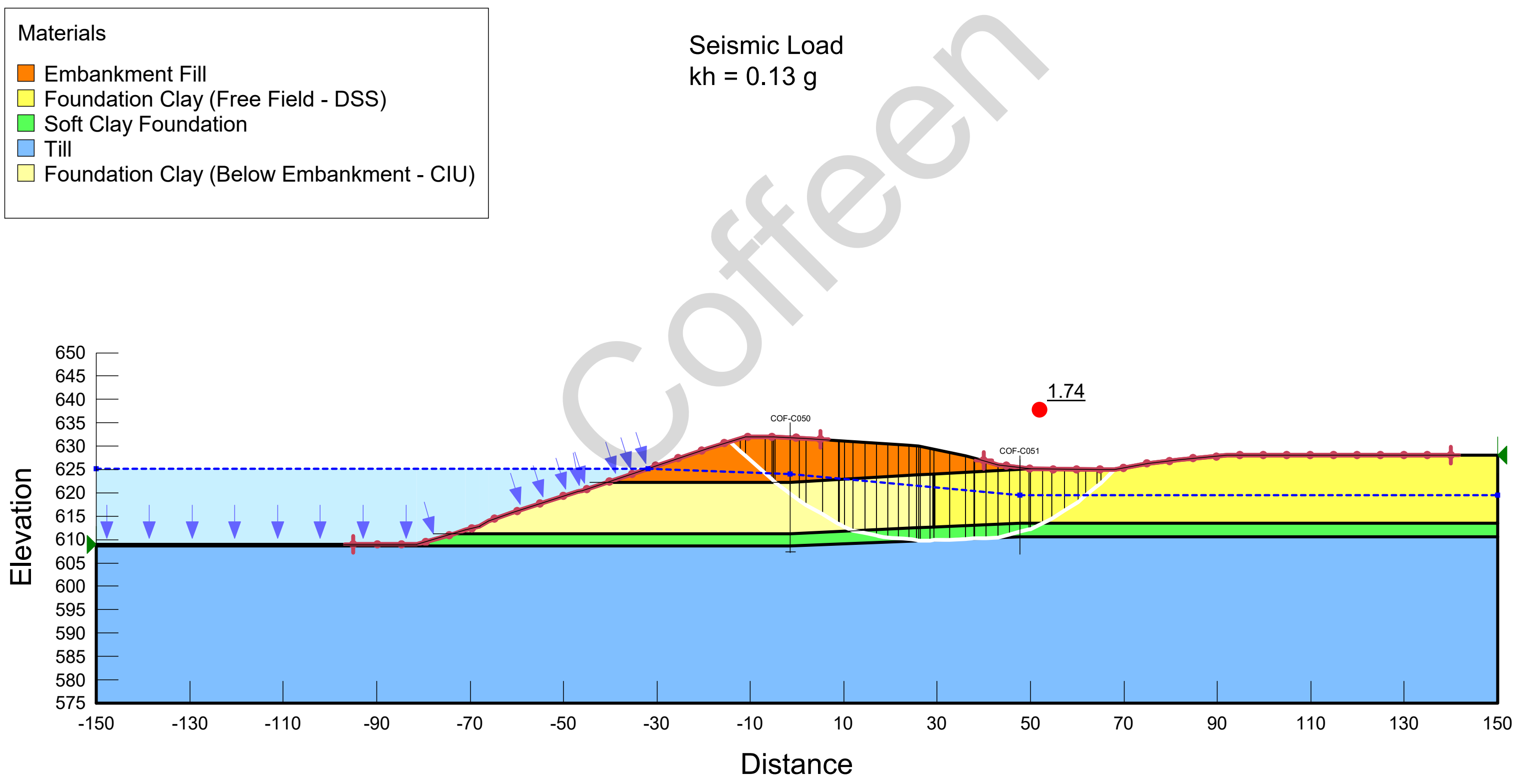
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 46+50
Peak Undrained Soil Strengths
Name: Pseudostatic - Entry & Exit

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 275 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1



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Coffeen_GMF_46+50_Peak_Undrained_LPC_20160902v1.gsz

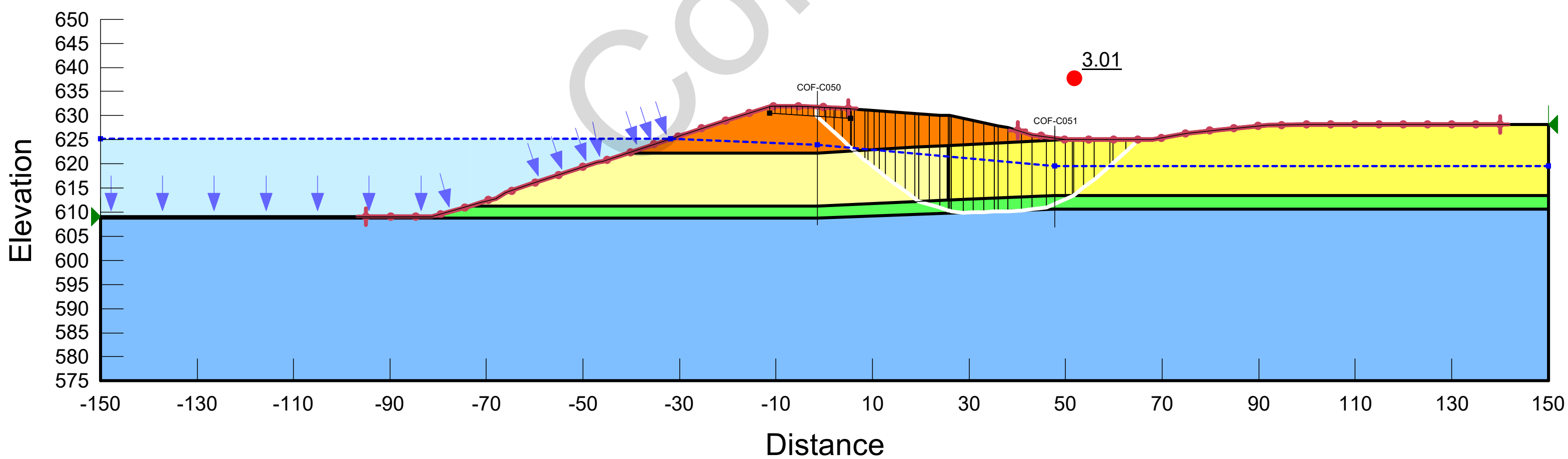
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 46+50
Slope Stability - Post Earthquake

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.28 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.16 Minimum Strength: 200 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1

Materials

- Embankment Fill
- Foundation Clay (Free Field - DSS)
- Soft Clay Foundation
- Till
- Foundation Clay (Below Embankment - CIU)



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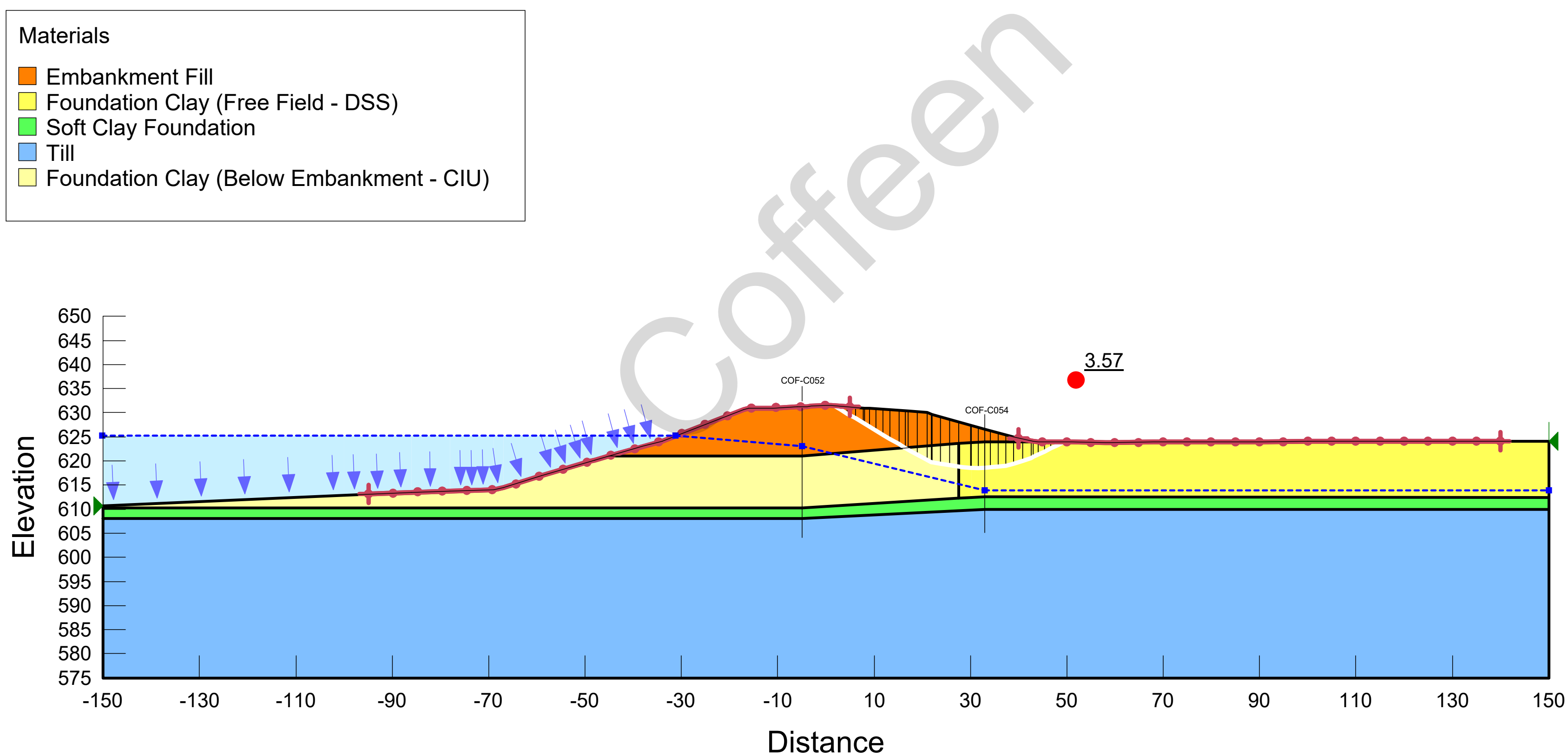
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 58+00
Slope Stability - Static Drained

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/8/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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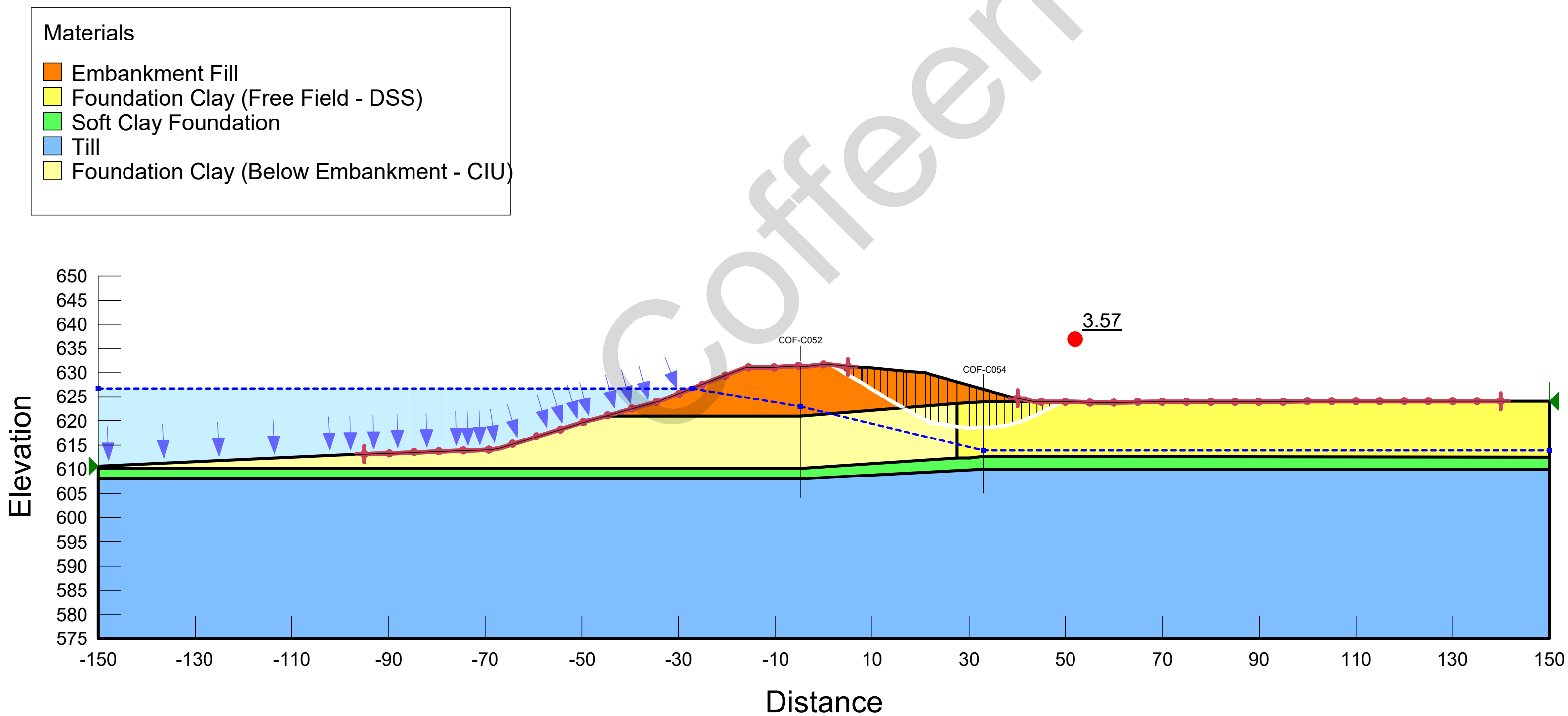
Coffeen_GMF_58+00_Static_Drained_LPC_20160113v0.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 58+00
Slope Stability - Static Drained

Design by: Lucas Carr
Modidfied by: Betty Tesfu
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/13/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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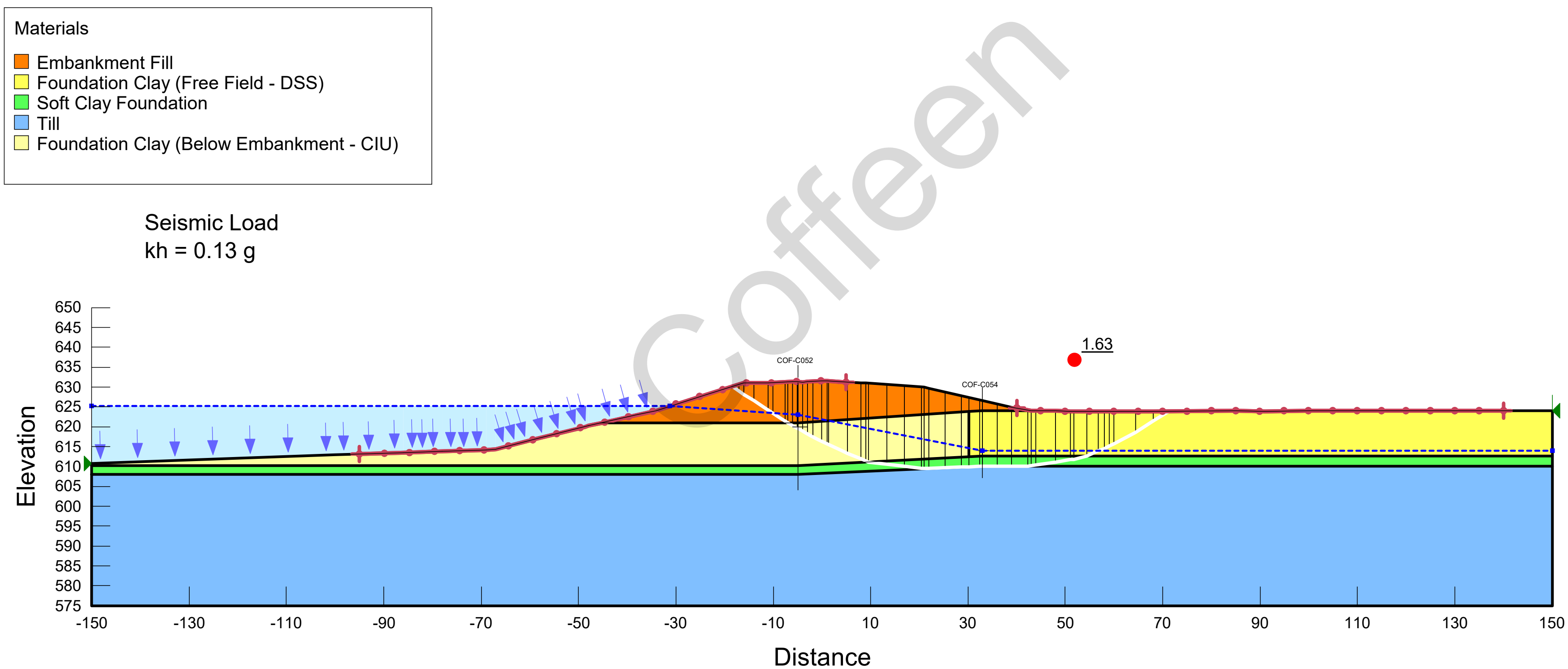
Coffeen Power Plant
GMF Gypsum Stack Pond
Station 58+00
Peak Undrained Soil Strengths
Pseudostatic - Entry-Exit

Design by: Lucas Carr
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/14/2021

Name: Embankment Fill Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.6 Minimum Strength: 450 psf Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.24 Minimum Strength: 450 psf Piezometric Line: 1
Name: Soft Clay Foundation Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.23 Minimum Strength: 275 psf Piezometric Line: 1
Name: Till Model: S=f(overburden) Unit Weight: 135 pcf Tau/Sigma Ratio: 0.45 Minimum Strength: 700 psf Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: S=f(overburden) Unit Weight: 125 pcf Tau/Sigma Ratio: 0.39 Minimum Strength: 700 psf Piezometric Line: 1



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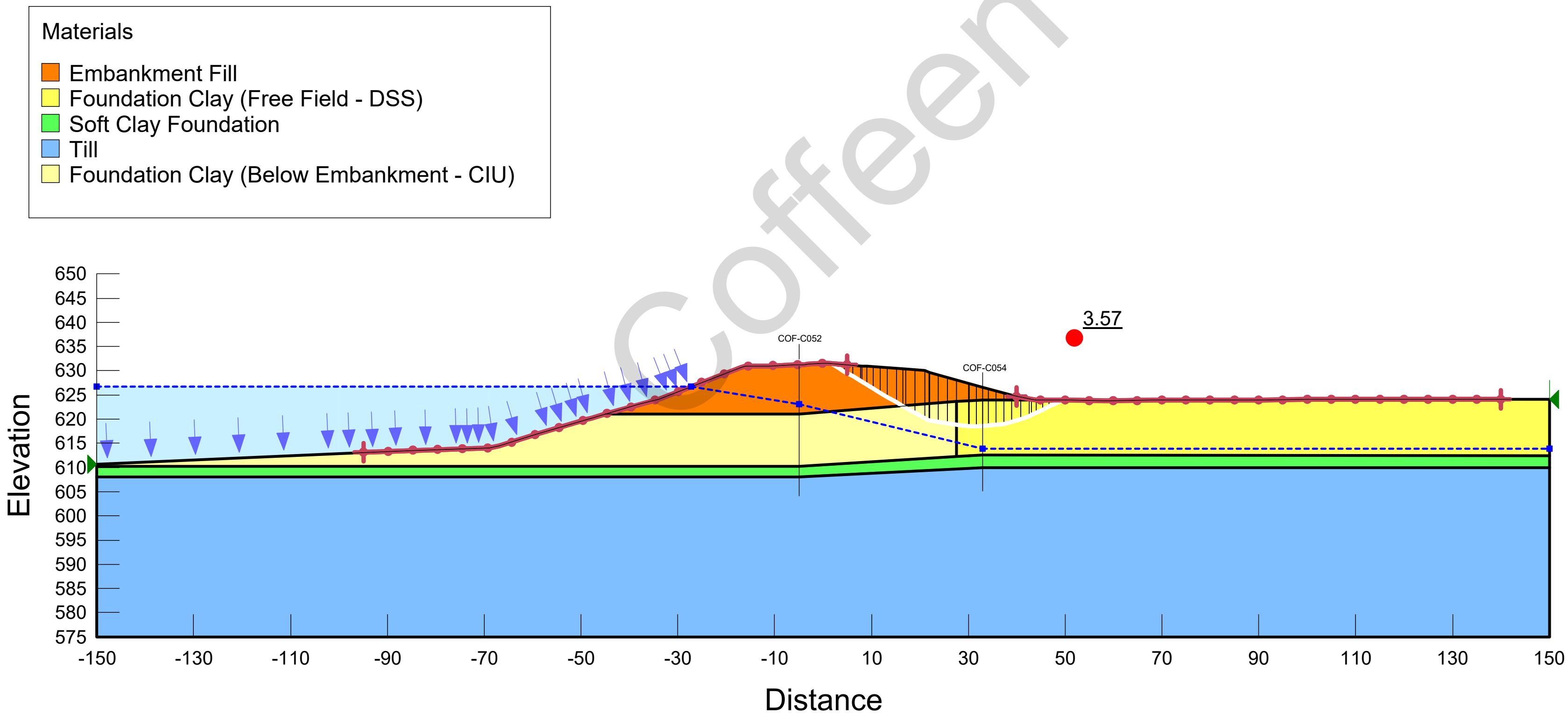
Coffeen_GMF_58+00_Peak_Undrained_LPC_20160902v1.gsz

Coffeen Power Plant
GMF Gypsum Stack Pond
Station 58+00
Slope Stability - Static Drained

Design by: Lucas Carr
Modifdied by: Betty Tesfu
Checked by: Nick Sanna
Modified by: Pourya Kargar
Checked by: Zachary Fallert
Date: 9/13/2021

Name: Embankment Fill Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 31 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Free Field - DSS) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Soft Clay Foundation Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 ° Phi-B: 0 ° Piezometric Line: 1
Name: Till Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 0 psf Phi': 40 ° Phi-B: 0 ° Piezometric Line: 1
Name: Foundation Clay (Below Embankment - CIU) Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 ° Phi-B: 0 ° Piezometric Line: 1



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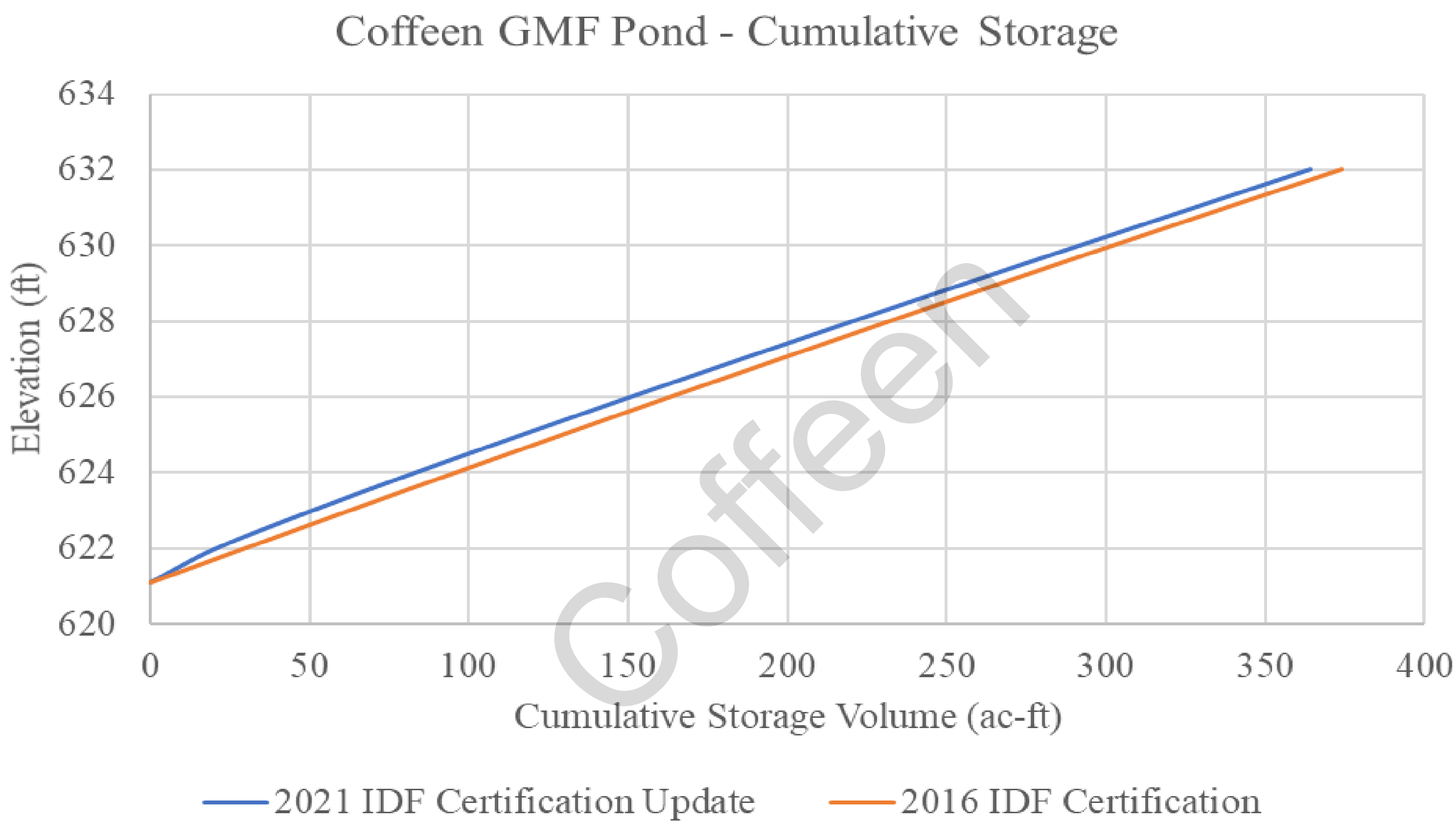
Attachment E

Periodic Inflow Design Flood Control System Plan Analyses

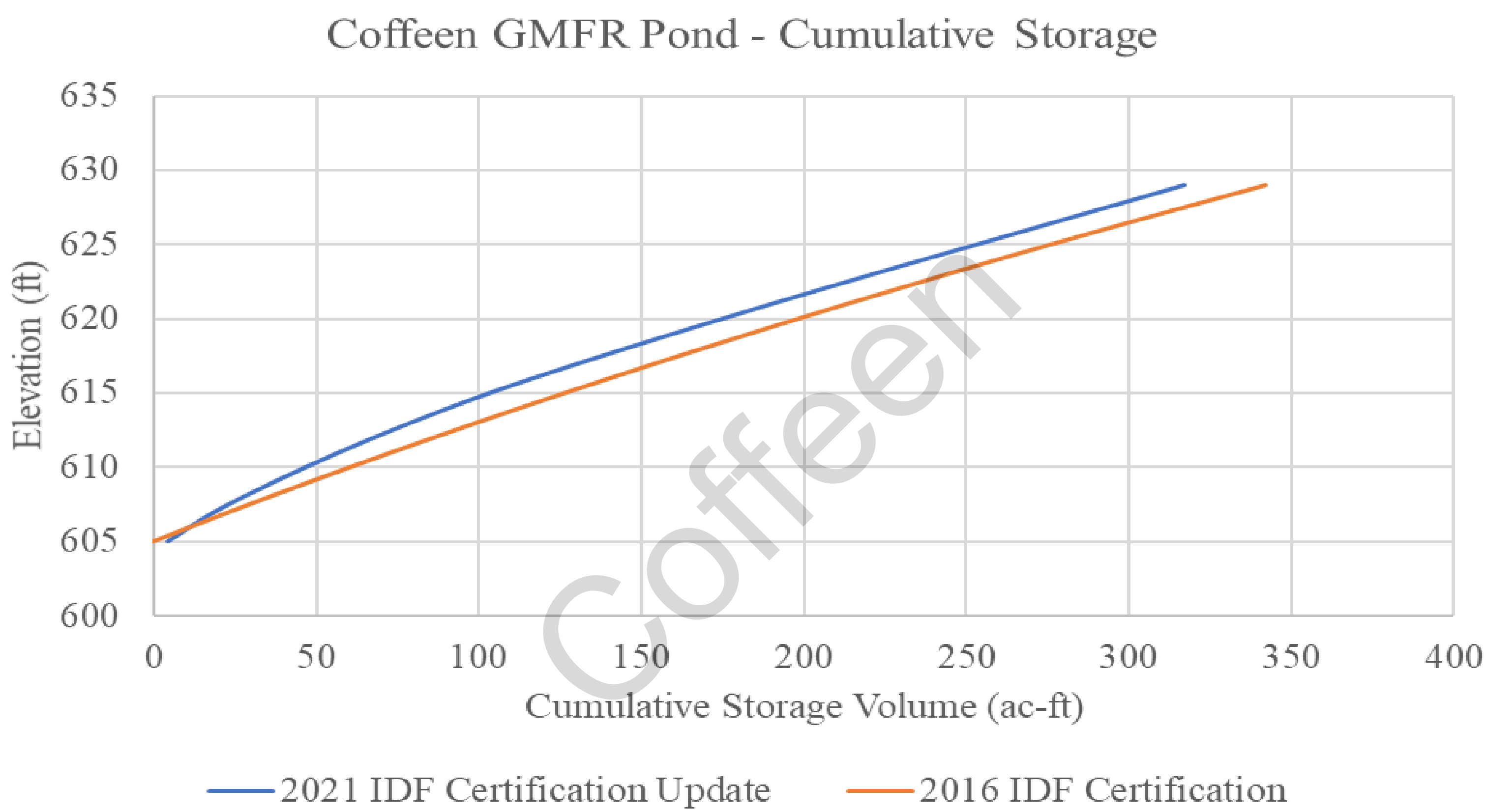


COFFEEN GMF GSP CUMULATIVE STORAGE
PERIODIC CERTIFICATION
COFFEEN POWER PLANT
COFFEEN, ILLINOIS

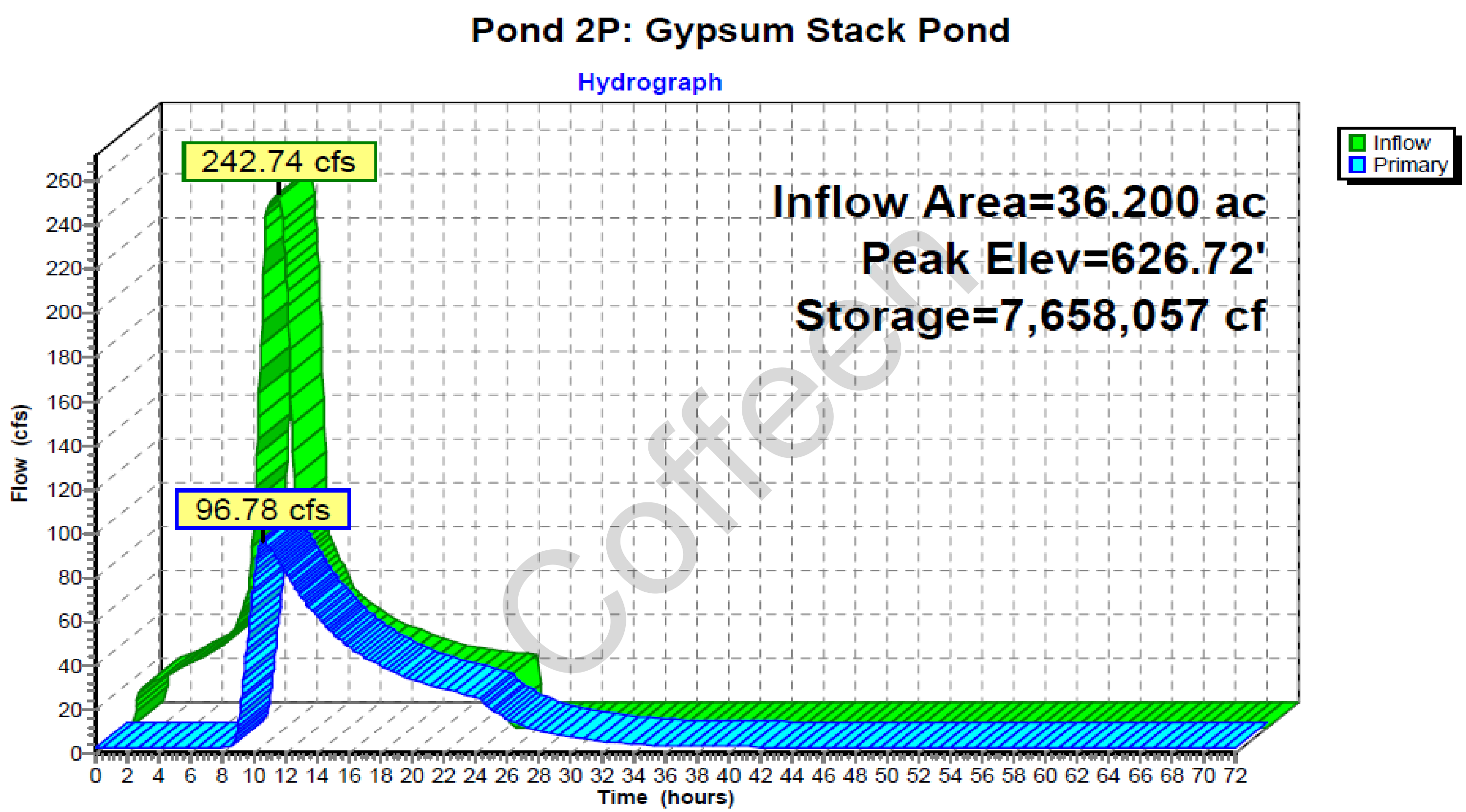
Geosyntec consultants

Figure E-1

GLP8027 | 9/14/2021



COFFEEN GMF RECYCLE POND CUMULATIVE STORAGE PERIODIC CERTIFICATION COFFEEN POWER PLANT COFFEEN, ILLINOIS		
Geosyntec consultants		Figure E-2
GLP8027	9/14/2021	



GMF GSP IDF HYDROGRAPH PERIODIC CERTIFICATION COFFEEN POWER PLANT COFFEEN, ILLINOIS		
Geosyntec consultants		Figure E-3
GLP8027	9/14/2021	

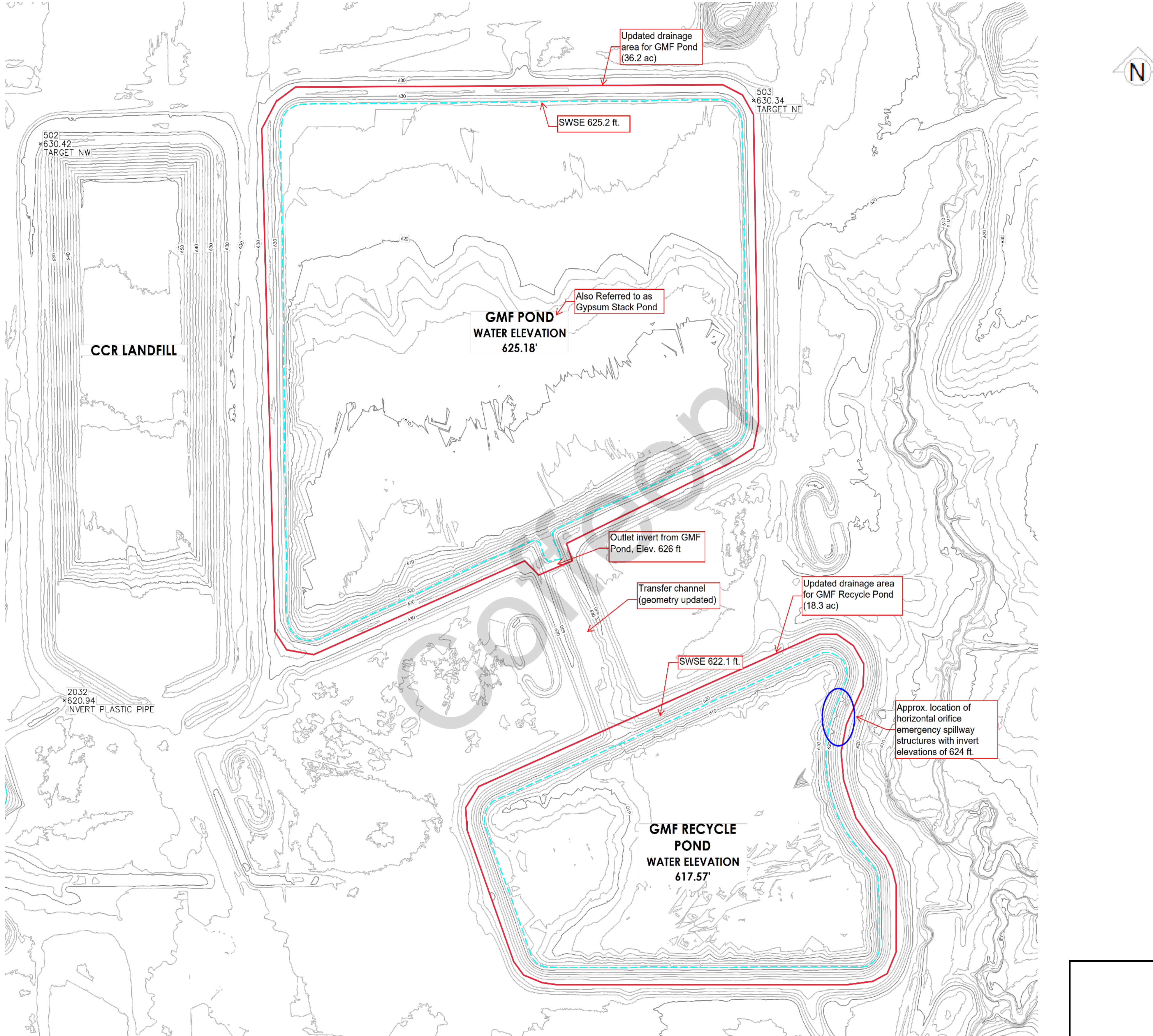
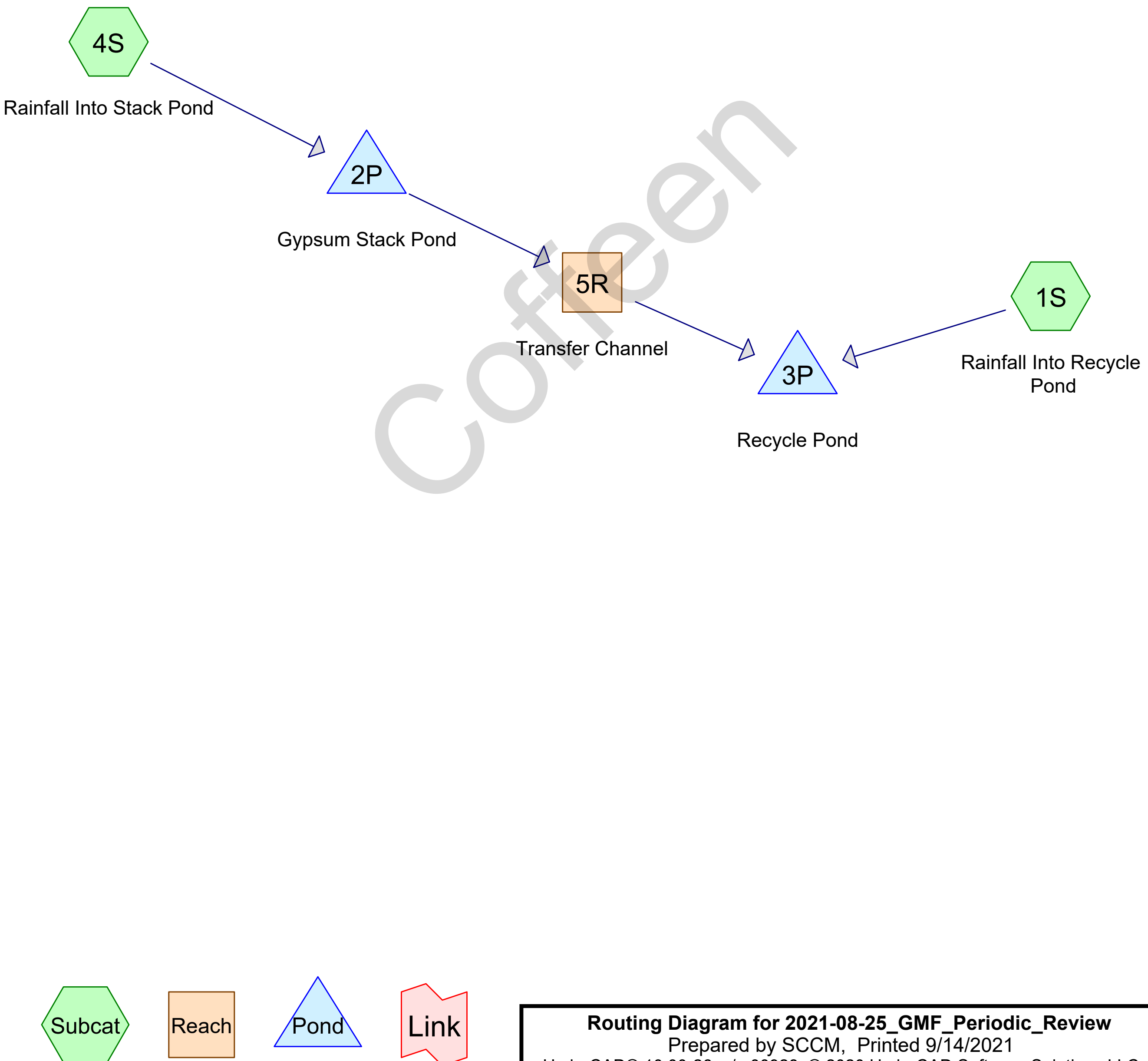


Figure based on IngenAE 2020 Site Topo

NOT TO SCALE

Coffeen Power Plant GMF and GMFR Pond Hydrologic Workmap	
Geosyntec consultants	Figure
GLP8027 / September 2021	E-4



Routing Diagram for 2021-08-25_GMF_Periodic_Review
Prepared by SCCM, Printed 9/14/2021
HydroCAD® 10.00-26 s/n 00928 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.500	98	Water Surface, HSG C (1S, 4S)
54.500	**98**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
54.500	HSG C	1S, 4S
0.000	HSG D	
0.000	Other	
54.500		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	54.500	0.000	0.000	54.500	Water Surface	1S, 4S
0.000	**0.000**	**54.500**	**0.000**	**0.000**	**54.500**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2P	619.00	617.60	580.0	0.0024	0.013	14.0	0.0	0.0
2	3P	615.00	613.00	92.0	0.0217	0.013	45.0	0.0	0.0
3	3P	615.00	613.00	92.0	0.0217	0.013	45.0	0.0	0.0
4	3P	615.00	613.00	92.0	0.0217	0.013	45.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Rainfall Into Recycle Runoff Area=18.300 ac 100.00% Impervious Runoff Depth=34.01"
Tc=6.0 min CN=98 Runoff=122.71 cfs 51.860 af

Subcatchment 4S: Rainfall Into Stack Runoff Area=36.200 ac 100.00% Impervious Runoff Depth=34.01"
Tc=6.0 min CN=98 Runoff=242.74 cfs 102.586 af

Reach 5R: Transfer Channel Avg. Flow Depth=0.48' Max Vel=5.94 fps Inflow=96.78 cfs 82.274 af
n=0.010 L=450.0' S=0.0044 '/' Capacity=7,454.18 cfs Outflow=96.77 cfs 82.255 af

Pond 2P: Gypsum Stack Pond Peak Elev=626.72' Storage=7,658,057 cf Inflow=242.74 cfs 102.586 af
Outflow=96.78 cfs 82.274 af

Pond 3P: Recycle Pond Peak Elev=624.70' Storage=10,813,783 cf Inflow=183.51 cfs 134.115 af
Primary=38.24 cfs 34.428 af Secondary=38.24 cfs 34.428 af Tertiary=38.24 cfs 34.428 af Outflow=114.71 cfs 103.284 af

Total Runoff Area = 54.500 ac Runoff Volume = 154.445 af Average Runoff Depth = 34.01"
0.00% Pervious = 0.000 ac 100.00% Impervious = 54.500 ac

Summary for Subcatchment 1S: Rainfall Into Recycle Pond

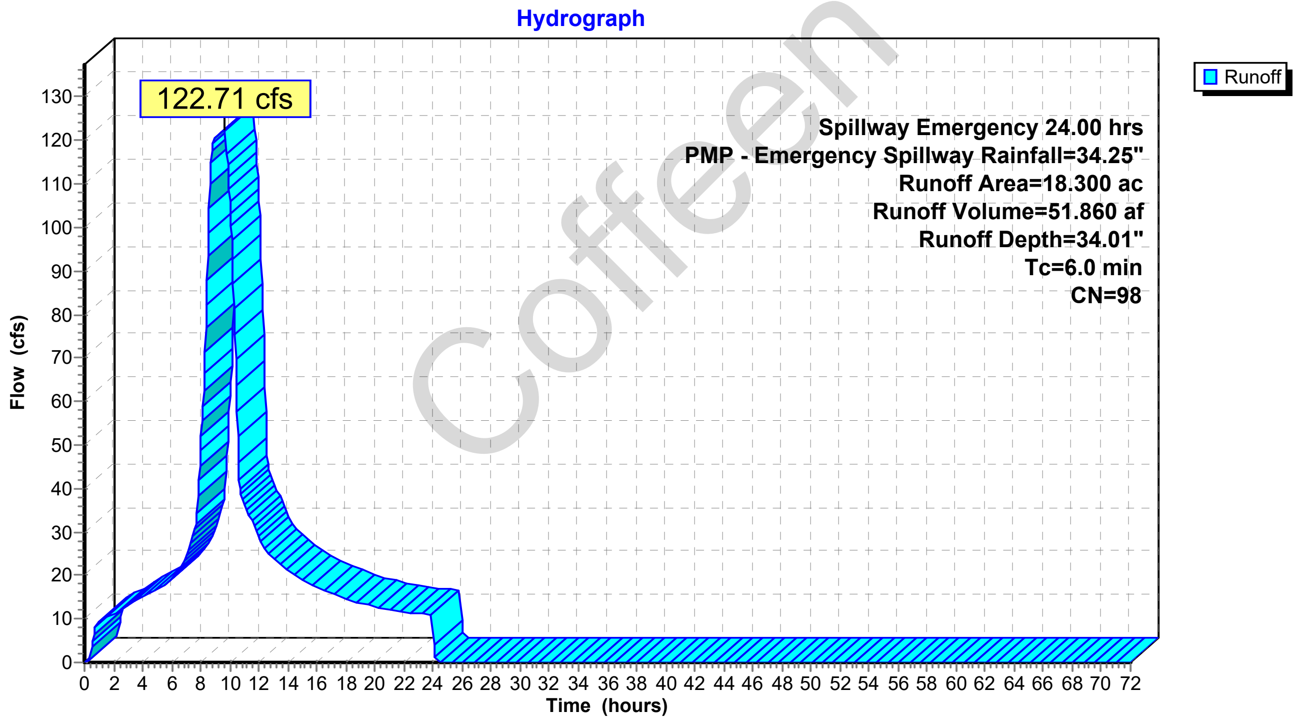
Runoff = 122.71 cfs @ 9.62 hrs, Volume= 51.860 af, Depth=34.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Spillway Emergency 24.00 hrs PMP - Emergency Spillway Rainfall=34.25"

	Area (ac)	CN	Description
*	18.300	98	Water Surface, HSG C
	18.300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Fall**

Subcatchment 1S: Rainfall Into Recycle Pond



Summary for Subcatchment 4S: Rainfall Into Stack Pond

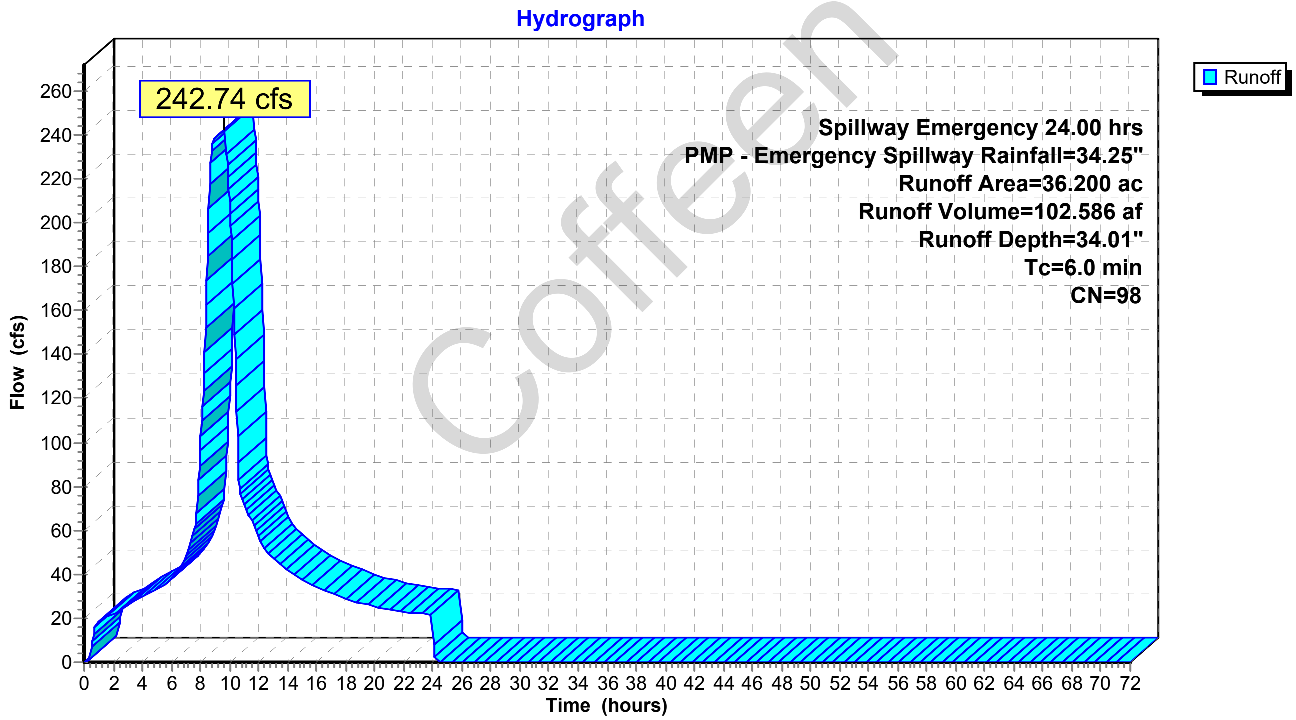
Runoff = 242.74 cfs @ 9.62 hrs, Volume= 102.586 af, Depth=34.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Spillway Emergency 24.00 hrs PMP - Emergency Spillway Rainfall=34.25"

Area (ac)	CN	Description
36.200	98	Water Surface, HSG C
36.200		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Fall**

Subcatchment 4S: Rainfall Into Stack Pond



Summary for Reach 5R: Transfer Channel

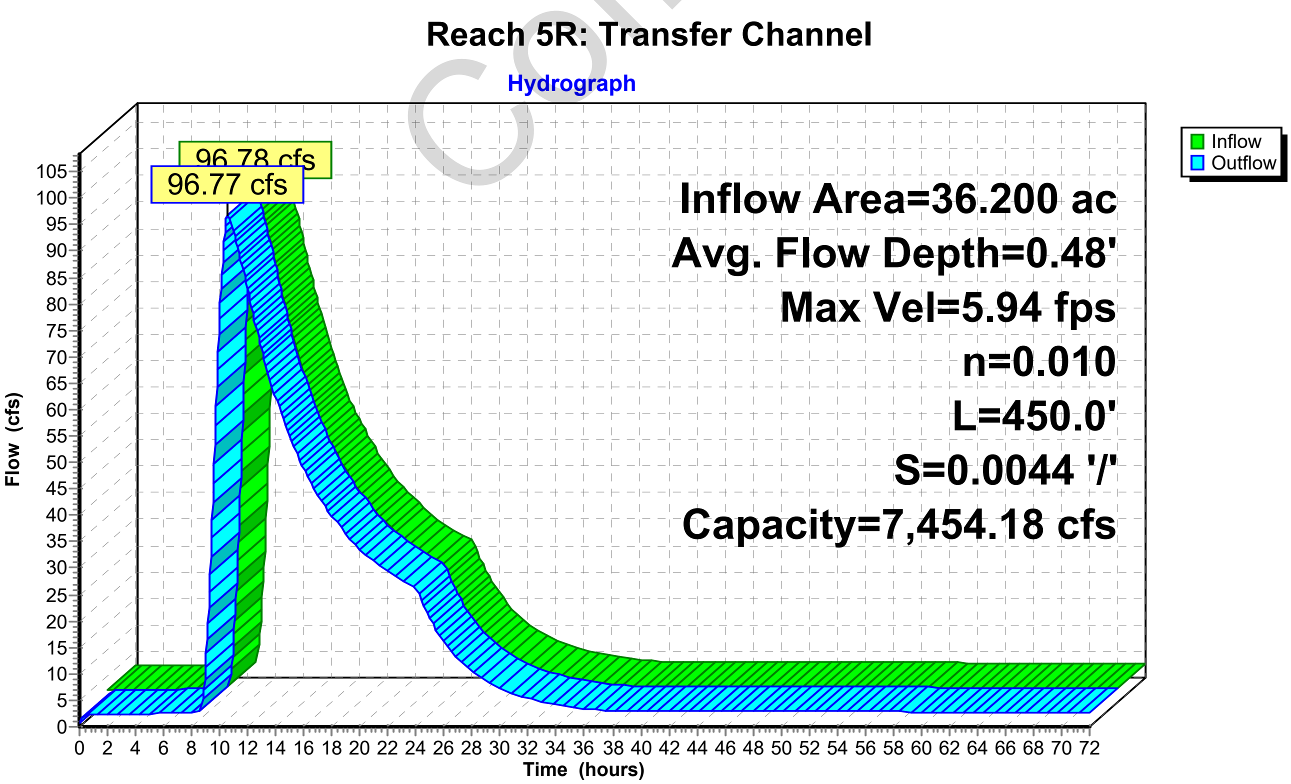
Inflow Area = 36.200 ac,100.00% Impervious, Inflow Depth > 27.27" for PMP - Emergency Spillway event
Inflow = 96.78 cfs @ 10.58 hrs, Volume= 82.274 af
Outflow = 96.77 cfs @ 10.59 hrs, Volume= 82.255 af, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.94 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 2.28 fps, Avg. Travel Time= 3.3 min

Peak Storage= 7,334 cf @ 10.59 hrs
Average Depth at Peak Storage= 0.48'
Bank-Full Depth= 6.00' Flow Area= 279.0 sf, Capacity= 7,454.18 cfs

32.70' x 6.00' deep channel, n= 0.010 PVC, smooth interior
Side Slope Z-value= 3.0 1.6 '/' Top Width= 60.30'
Length= 450.0' Slope= 0.0044 '/'
Inlet Invert= 624.00', Outlet Invert= 622.00'

‡



Summary for Pond 2P: Gypsum Stack Pond

[44] Hint: Outlet device #2 is below defined storage

Inflow Area = 36.200 ac,100.00% Impervious, Inflow Depth = 34.01" for PMP - Emergency Spillway event
Inflow = 242.74 cfs @ 9.62 hrs, Volume= 102.586 af
Outflow = 96.78 cfs @ 10.58 hrs, Volume= 82.274 af, Atten= 60%, Lag= 57.2 min
Primary = 96.78 cfs @ 10.58 hrs, Volume= 82.274 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 625.18' Surf.Area= 0 sf Storage= 5,353,910 cf
Peak Elev= 626.72' @ 10.58 hrs Surf.Area= 0 sf Storage= 7,658,057 cf (2,304,147 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 554.6 min (1,215.4 - 660.8)

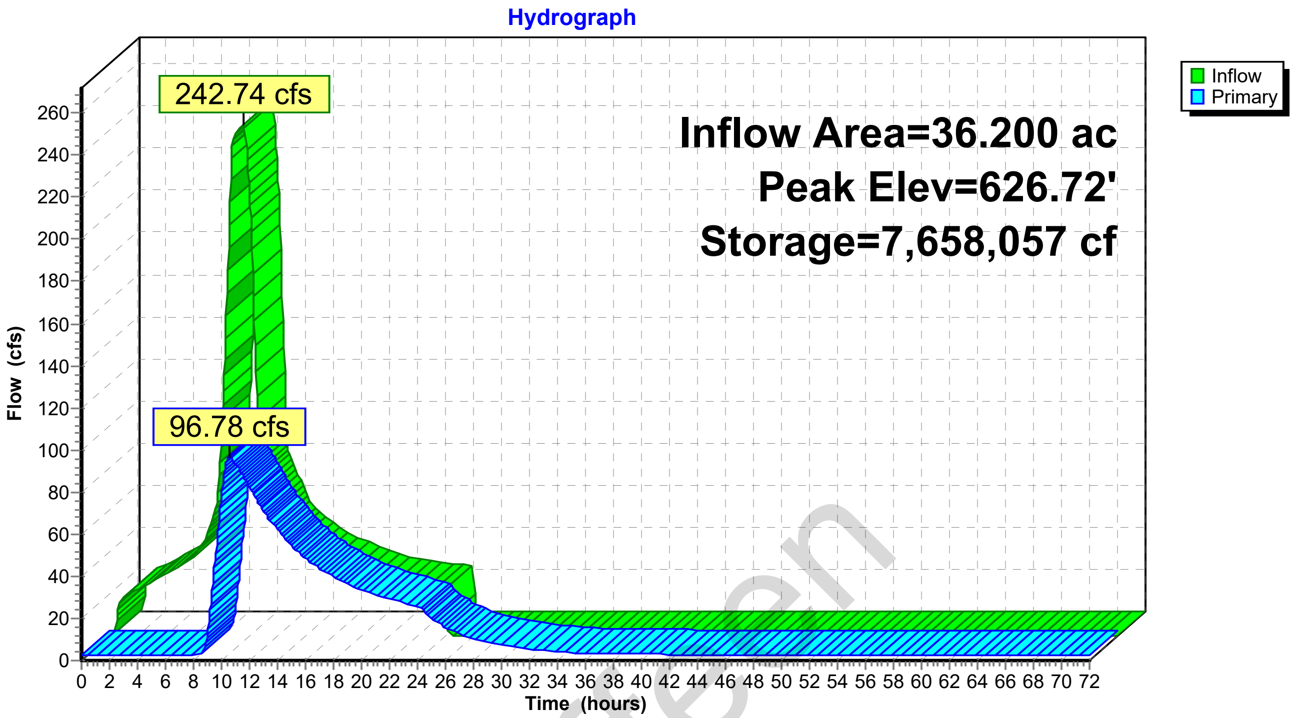
Volume	Invert	Avail.Storage	Storage Description
#1	621.10'	15,871,813 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
621.10	0
622.00	898,355
623.00	2,215,071
624.00	3,622,761
625.00	5,085,824
626.00	6,575,189
627.00	8,086,603
628.00	9,615,334
629.00	11,161,695
630.00	12,725,625
631.00	14,298,658
632.00	15,871,813

Device	Routing	Invert	Outlet Devices
#1	Primary	626.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 4.00 Width (feet) 45.00 60.00 75.00
#2	Primary	619.00'	**14.0" Round Culvert** L= 580.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 619.00' / 617.60' S= 0.0024 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.07 sf

Primary OutFlow Max=96.75 cfs @ 10.58 hrs HW=626.72' TW=624.48' (Dynamic Tailwater)
└1=**Custom Weir/Orifice** (Weir Controls 93.61 cfs @ 2.74 fps)
└2=**Culvert** (Outlet Controls 3.14 cfs @ 2.93 fps)

Pond 2P: Gypsum Stack Pond



Summary for Pond 3P: Recycle Pond

[63] Warning: Exceeded Reach 5R INLET depth by 0.26' @ 12.35 hrs

Inflow Area =	54.500 ac,100.00% Impervious,	Inflow Depth > 29.53"	for PMP - Emergency Spillway event		
Inflow =	183.51 cfs @	10.06 hrs,	Volume=	134.115 af	
Outflow =	114.71 cfs @	11.82 hrs,	Volume=	103.284 af,	Atten= 37%, Lag= 105.4 min
Primary =	38.24 cfs @	11.82 hrs,	Volume=	34.428 af	
Secondary =	38.24 cfs @	11.82 hrs,	Volume=	34.428 af	
Tertiary =	38.24 cfs @	11.82 hrs,	Volume=	34.428 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 622.10' Surf.Area= 0 sf Storage= 9,024,347 cf
Peak Elev= 624.70' @ 11.82 hrs Surf.Area= 0 sf Storage= 10,813,783 cf (1,789,436 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 234.9 min (1,236.7 - 1,001.8)

Volume	Invert	Avail.Storage	Storage Description
#1	604.90'	13,809,827 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
604.90	0
605.00	193,406
607.00	824,155
609.00	1,613,462
611.00	2,487,712
613.00	3,446,903
615.00	4,502,797
617.00	5,698,519
619.00	6,966,115
621.00	8,279,014
623.00	9,634,165
624.00	10,326,769
625.00	11,023,294
626.00	11,719,818
627.00	12,416,342
628.00	13,112,867
629.00	13,809,827

Device	Routing	Invert	Outlet Devices
#1	Primary	615.00'	**45.0" Round Culvert** L= 92.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 615.00' / 613.00' S= 0.0217 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 11.04 sf
#2	Secondary	615.00'	**45.0" Round Culvert** L= 92.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 615.00' / 613.00' S= 0.0217 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 11.04 sf
#3	Tertiary	615.00'	**45.0" Round Culvert** L= 92.0' CPP, square edge headwall, Ke= 0.500

			Inlet / Outlet Invert= 615.00' / 613.00' S= 0.0217 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 11.04 sf
#4	Device 1	624.00'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	624.00'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 3	624.00'	**60.0" x 60.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=38.23 cfs @ 11.82 hrs HW=624.70' (Free Discharge)
└**1=Culvert** (Passes 38.23 cfs of 148.75 cfs potential flow)
 └**4=Orifice/Grate** (Weir Controls 38.23 cfs @ 2.73 fps)

Secondary OutFlow Max=38.23 cfs @ 11.82 hrs HW=624.70' (Free Discharge)
└**2=Culvert** (Passes 38.23 cfs of 148.75 cfs potential flow)
 └**5=Orifice/Grate** (Weir Controls 38.23 cfs @ 2.73 fps)

Tertiary OutFlow Max=38.23 cfs @ 11.82 hrs HW=624.70' (Free Discharge)
└**3=Culvert** (Passes 38.23 cfs of 148.75 cfs potential flow)
 └**6=Orifice/Grate** (Weir Controls 38.23 cfs @ 2.73 fps)

Pond 3P: Recycle Pond